



Emergency
ManagementBC

Volunteer Public Safety Lifeline Interim Avalanche Safety Plan

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List of Acronyms

ACMG	Association of Canadian Mountain Guides
ASE	Air Service Emergency
AST	Avalanche Skills Training
ATES	Avalanche Terrain Exposure Scale
BCAS	British Columbia Ambulance Service
BCERMS	British Columbia Emergency Response Management System
CAA	Canadian Avalanche Association
CAC	Canadian Avalanche Center
CARDA	Canadian Avalanche Rescue Dog Association
CDFL	Helicopter Class D Fixed Line – External Human Cargo Transportation
ECC	Emergency Coordination Center
EMBC	Emergency Management British Columbia
GSAR	Ground Search and Rescue
GSTL	Ground Search team Leader
IAP	Incident Action Plan
ICP	Incident Command Post
ICS	Incident Command System
IRT	Initial Response Team
JRCC	Joint Rescue Coordination Center
MR	Mountain Rescue
OAR	Organized Avalanche Response
PAB	Public Avalanche Bulletin
PEP	Provincial Emergency Program
WCB	WorkSafeBC
QAP	Qualified Avalanche Planner



Introduction

British Columbia has a land and freshwater area of over 95 million hectares. As Canada's third largest province BC comprises 9.5 per cent of the country's total land area and is characterized by forests and mountainous topography with approximately 48 million hectares of forested land, 0.4 million hectares alpine and sub-alpine range and 20.3 million hectares of rock and alpine barren ice fields and glaciers. An estimated 80% of the province is classified as mountainous terrain, this fact, combined with a climate that produces average annual snowpack of 70-200 cm, is ideal for the production of snow avalanches. There are three distinct snowpack climates in BC; Maritime, Transitional and Continental.

"Snow Avalanches are a common natural Hazard in most mountain ranges in British Columbia. It is estimated that more than 300,000 large snow avalanches occur in the province each winter, primarily in forested zones (Stitzing et al. 2000), but only a very minor proportion of these actually damage property or injure people. Many snow avalanches occur naturally in remote areas where there are few people and little developed property." (Wier, 2002)

In British Columbia avalanches are responsible for, on average, approximately fourteen fatalities per year. The majority of avalanche fatalities result from people triggering the same avalanche that kills them (McClung & Schaerer, 1993). Emergency Management British Columbia (EMBC) volunteer Search and Rescue (SAR) groups in British Columbia respond to hundreds of incidents per year that result in significant exposure to avalanche hazard.

The majority of SAR responses take place in areas that are transitory and low impact in nature and as such it is unlikely that a comprehensive or detailed avalanche risk assessment of the terrain has been conducted. SAR Training and Exercises' offer similar risk exposure and should be treated as the same as the scenarios outlined below. SAR personnel may be asked to perform any one or more of three different types of response activities that expose them to avalanche hazard. These types of assignments are characterized below. In each of the three situations an Avalanche Safety Officer must be identified, consulted and lead the development and implementation of the Active Avalanche Safety Program. This is to ensure that an adequate avalanche risk assessment is conducted and that suitable active avalanche safety measures are established prior to the initiation of on-site operations in avalanche risk zones.

Typical SAR assignments, in addition to training, in Avalanche Risk Areas:

1. Search and/or Rescue Activities (except Avalanche Rescue) in avalanche risk zones:

The location of a subject is not known. The subject may be in an area that may or may not pose significant risk of avalanches. However, the SAR personnel may be required to pass through avalanche a risk zone in order to conduct their search and/or rescue assignment. This necessitates a general awareness and recognition of avalanche hazards and an analysis of the hazards for that time and location to determine the avalanche danger level. The danger level may be such that an area is not searched until later, some other route or mode of transport is used to reach the assignment area or to conduct the search, or that a higher degree of competency is required on behalf of field personnel.

2. Rescue of injured, buried or stranded persons after an avalanche:

The exact spot, or approximate location, of the incident is known and people are thought to be alive but trapped (buried by snow), injured or in further danger. Responders are able to reach the location but must be aware of further avalanche risk at the incident site or during the travel into or out of the area. This scenario may present the greatest danger, as responders are eager to provide assistance and may do so with minimal thought for their own safety. Thoughtful assessment is required to determine, as best as possible, the exact circumstances and conditions related to the incident. Is the person still buried? Was the person buried and has been extricated? What exactly is the urgency of the situation and the resource needs at the incident site?

3. Recovery of a human remains after an avalanche:

The chance for the live recovery of a person buried after an avalanche diminishes rapidly over a short period of time. The literature suggests that in the first 30 minutes the likelihood of survivability diminishes substantially and beyond 30 minutes to the point of little to no reasonable expectation of survivability after 150 minutes (Brugger et al. 2001). Additionally specific considerations need to be made in determining the likelihood of survivability for those



persons who are or may be buried in a vehicle or building as the likelihood of survival rate may be increased due to the nature of the burial. "However, their chances of extricating victims alive from buildings or vehicles are undoubtedly higher over a protracted time than in the case of persons buried in open areas." (Brugger et al. 2001). Responders must carefully consider their response where all the information suggests the time between burial and their arrival is excessive (>2.5 hours). The recovery response may be much slower and allow for more careful consideration of the process and associated hazards.

A variety of factors can contribute to the decision to not provide immediate rescue services including but not limited to the following:

- The risk to rescue personnel.
- Insufficiently trained or experienced rescue personnel.
- High to Extreme avalanche danger rating.
- Greater than 2.5 hours has elapsed from the time of burial of the subject.
- The known or estimated burial depth.
- The type of avalanche that has occurred (dry snow vs. wet snow avalanche)
- The estimated destructive potential of the avalanche.
- Avalanches into large catchment areas or terrain traps (E.g. bodies of water or glacial hazards such as crevasses).



Organization of Search and Rescue Activities

Emergency Management British Columbia

Emergency Management BC (EMBC) provides support and assistance to recognized SAR volunteers. When requested by a requesting agency, through the issuance of a task number, EMBC supports the activation of local SAR groups. SAR Groups are community-based volunteer organizations that have various levels of skills, training and equipment in ground and inland water search and rescue and in some cases other special disciplines such as road rescue. A number of these groups are trained and equipped to respond to various aspects of rope rescue, swift water rescue, and organized avalanche response in response to identified needs in their operational areas.

EMBC provides WorkSafeBC (WCB) coverage, reimbursement of operational expenses and repair and/or replacement of equipment during tasks and liability coverage for responders. EMBC will replace equipment essential to the task, which is lost or damaged during a task but not on training tasks. EMBC will also reimburse SAR groups and their members for expenses incurred during tasks and sometimes for training as per established rates in EMBC policy. EMBC provides training task numbers in order to provide WorkSafeBC coverage and liability coverage to SAR groups for regular training and pre-approved special training tasks.

EMBC maintains a database of volunteers involved in recognised SAR groups in British Columbia and issues photo identification cards. Registration is done through the SAR groups. It is the responsibility of each SAR volunteer to maintain valid registration with EMBC. To be eligible for expense reimbursement, members are required to be registered with EMBC.

In regard to SAR Operations in Avalanche Risk Zones SAR Commanders (government agency or department representatives with jurisdictional authority) in conjunction with EMBC Regional Managers are responsible for the ongoing monitoring / evaluation of the overall search and rescue effort.

Incident Commander

This individual is the representative from the agency with responsibility for the type of search and/or rescue and/or recovery that is occurring. They are responsible for the management of all



incident operations at the incident site. During the majority of SAR operations in British Columbia the role of Incident Commander is filled by a representative of the Royal Canadian Mounted Police (RCMP).

Requesting agencies with authority to function in role of Incident Commander:

- Police force of Jurisdiction
- British Columbia Ambulance Service
- Department of National Defense / Canadian forces
- Transport Canada, Canadian Coast Guard (unlikely for avalanche rescue and/or recovery)
- Parks Canada Agency
- The BC Coroner Service
- Local Authorities, including Fire / Rescue services providers.

Specifically each of these departments and agencies can request the assistance of EMBC SAR volunteers for SAR related activities under the conditions outlined in EMBC Policy Bulletin 2.17¹.

The Volunteer SAR Manager role is:

The SAR Manager is a volunteer within an EMBC recognised Search and Rescue Group who is certified by the Justice Institute of BC in SAR Management and is recognised by their SAR Group to perform the SAR Manager role. While the requesting agency retains ultimate responsibility for the task the SAR Manager(s) is given the authority by EMBC and the requesting agency to functionally organize the task from start to finish with a primary responsibility being to ensure that the task is carried out safely. In addition, the SAR Manager is responsible for ensuring that the response is planned, organized and managed and does this in consultation with the SAR Commander in a Unified Command structure. They do this in conjunction with other SAR Managers and in consultation with the other agencies involved.

Typical SAR management activities include:

- Manage the functional aspects of the SAR task
- Develop overall incident and operational period objectives
- Work in conjunction with planning section to develop team assignments

¹ http://EMBC.bc.ca/policy/2.17_Search_and_Rescue.pdf



- Assign ICS functions
- Determine Operational Periods
- Development of the Incident Action Plan (IAP)
- Communicate to EMBC ECC on a regular basis
- Update SAR Commander and brief Media & Family Liaison Officer
- Review team assignment debriefings & modify overall objectives accordingly
- Adequately brief incoming SAR Management team at shift changes

Avalanche Safety Officer

The Avalanche Safety Officer is a highly skilled and experienced command staff member responsible for assessing and monitoring avalanche hazards and for developing the Active Avalanche Safety program which indicates the required measures for ensuring personnel safety. Avalanche Safety Officers frequently coordinate onsite operations as the rescue leader however this function can be delegate by the Avalanche Safety Officer to the Avalanche Site Safety Officer. When possible, the Avalanche Safety Officer operates independently of any other duties.

Common duties of the Safety Officer include:

- Identification of Avalanche Risk Areas
- Conduct preliminary and/or detailed avalanche risk assessments
- Asses site specific safety and identify winter related hazards
- Contribute to the development of the Incident action Plan (IAP)
- Monitor rescuers progress and level of exposure to hazards
- Change, postpone or terminate rescue or recovery activities that may pose imminent safety or health danger to the rescuers,
- Develop hazard and travel advisories.
- Use authority to take appropriate action to mitigate or eliminate unsafe conditions, operations or hazards.
- Document safe and unsafe acts, corrective actions taken on scene, accidents or injuries, and ways to improve safety on future incidents.
- Investigate accidents that may have occurred within the incident area.
- Coordinate with various teams.
- Maintain an activity log.



Through agreements with both the Ministry of Transportation and Infrastructure (MOTI) and Parks Canada, EMBC is able access to CAA trained avalanche workers to assist in responding to avalanche incidents. MOTI and Parks Canada staff are primarily responsible for the safety and operation of avalanche affected highways and parks. If their workload allows, they may be able to assist in a SAR response and/or recovery operation at the request of EMBC, the RCMP and BCAS.

Avalanche Site Safety Officers

An Avalanche Site Safety Officer is located at the site of an avalanche and is responsible for evaluating the risk of further avalanches, identifying safety hazards or unsafe situations, monitoring on-site rescue operations, conducting field assessments and gathering observations, and for implementing and supervising measures for ensuring personnel safety indicated in the Active Avalanche Safety Program.

The member of the search and rescue team tasked with fulfilling the role of Avalanche Site Safety Officer and with implementing and supervising the measures specified in the Active Avalanche Safety program will normally have completed, at a minimum, a CAA level 1 certificate or JIBC Organized Avalanche Response Team Leader course.

Ground Search and Rescue Team Member(s) and Team Leader(s), and Organized Avalanche Rescue Team Member(s) and Team Leader(s)

GSAR Team Members and OAR Team members are trained in avalanche risk awareness, specialized search and/or rescue techniques, navigation and survival. They are able to participate as part of a multi-disciplinary team operating in Avalanche Risk Zones once they have completed Avalanche Skills Level 1 Training (AST), Recreational Avalanche Training (RAC) or Organized Avalanche Response (OAR). The OAR Team Leader is responsible for organizing, leading, and supervising teams during on-site operations.

Avalanche trained Dog Team(s)

Avalanche Rescue Dog teams who are members of the Canadian Avalanche Rescue Dog Association and trained and validated in conjunction with the RCMP. These Dog Teams are trained and capable of searching snow avalanches with dogs, probes and with electronic transceivers. Dog Handlers are trained in ski mountaineering, snowpack structure data gathering and analysis, identifying avalanche



terrain, safe route selection and performing various rescue functions. In the interest of both public and responder safety it is the policy of EMBC, where reasonably practical, to call upon the assistance of these resources during operations in avalanche risk zones.

Staffing Criteria

During SAR operations in Avalanche Risk Zones, each of the above noted position functions are required to be fulfilled by one or more individuals (EMBC Interim Avalanche Risk Zone Operation Policy, 2010). Frequently and because of the complexity of SAR operations and the nature of avalanches, key functions are staffed by a single individual. Functions can be fulfilled by Volunteer personnel (EMBC registered volunteers), agency personnel, industry representatives (trained convergent volunteers), and contractors.

For more specific information in regard to staffing criteria please refer to the EMBC Interim Avalanche Safety Policy.

Communication Expectations

Onsite Operations

SAR Command Staff are responsible for ensuring adequate communications with field teams.

Typically this is accomplished through VHF radio communications or satellite telephone communication devices. Check in procedures for field teams should include a well being check every 30 minutes or as directed by the Avalanche Safety Officer

Emergency Coordination Centre (ECC)

EMBC maintains a 365/24/7 operations centre to support search and rescue activities. SAR Managers are responsible to communicate with the ECC on a frequent basis

- At the start and end of each operational period
- Two hour updates for rescue activities
- Four hour updates for search activities.
- Whenever the status of the subject(s) of a search changes (located, deceased, etc)



The Canadian Avalanche Centre

Avalanche incident details should be submitted at the earliest opportunity to the Canadian Avalanche Centre via their online avalanche incident reporting tool.

The BC Coroners Service

Avalanche-related information that is collected or observed in the field while conducting site safety assessments, or during other stages of body recovery operations, is of value to the BC Coroners Service and this information should be provided to the coroner as soon as it is practical. However, while the greatest amount of relevant avalanche-related detail is requested for the purpose of supporting the coronial investigation, the immediate safety of SAR team members must always take precedence over data-collection and over any other tasks associated with the recovery of human remains.



Operational Objectives and Procedures

Search and rescue incidents contain varying levels of risk because the risk associated with them varies both by activity and by conditions at the time an activity is carried out. The British Columbia Emergency Response Management System (BCERMS) establishes response objectives set out in priority as follows to:

- 1) provide for the safety and health of all responders,
- 2) save lives,
- 3) reduce suffering,
- 4) protect public health,
- 5) protect government infrastructure,
- 6) protect property,
- 7) protect the environment,
- 8) reduce economic and social losses.

In British Columbia, the Incident Command System (ICS) has been adopted and is utilized during incidents response. ICS provides for a standardized incident management system, which is organized around major functional units. Components include: common terminology, modular organization, integrated communications, unified command structure, incident action plan, manageable span of control, designated facilities and comprehensive resource management.

For search and rescue personnel, working in the field, a SAR Safety Maxim establishing safety priorities has been created to aid in decision making:

1. Self
2. Team
3. By-standers
4. Subject

Search and Rescue operational phases are characterized below. This list specifies, for program managers and SAR supervisors, what type of activities are taking place and are not taking place during a specific phase of a SAR response. Levels of risk are controlled by both the diligence of program managers, who must attend to administrative details required by good risk management, and the



knowledge, skills, and abilities of SAR responders, who deliver the services in sometimes harsh environments and difficult circumstances.

SAR Operational Phases

Advisory

The notice of an Ongoing or impending incident that may require SAR resources. This can be characterized as the early dialogue or information exchange pertaining to an incident before it is determined that a SAR resource will be deployed. Advisories may be issued to SAR resources for operations occurring adjacent to their response areas or to inform of potentially dangerous conditions which could increase the likelihood of a response (E.g. Flood, Fire, Weather Bulletins/Warnings and Avalanche Bulletins and/or Special Advisories).

Deployment

The actual relocation of SAR resource to incident site, staging area or other point of departure. Deployment is the initiation of on-site SAR operations.

On-site Operations

The SAR resources at the incident site and/or staging area are undertaking assignments. For SAR Activities in Avalanche Risk Zone the Avalanche Safety Officer, or their delegate, is responsible for initiating on-site operations.

Demobilization

The notice of release of SAR resource from assignments and preparation to return to point of departure / point of origin.

Return to Readiness

The process to return SAR resource to pre-advisory state of readiness. Personnel and equipment are ready for response to future incident. Debriefing processes.

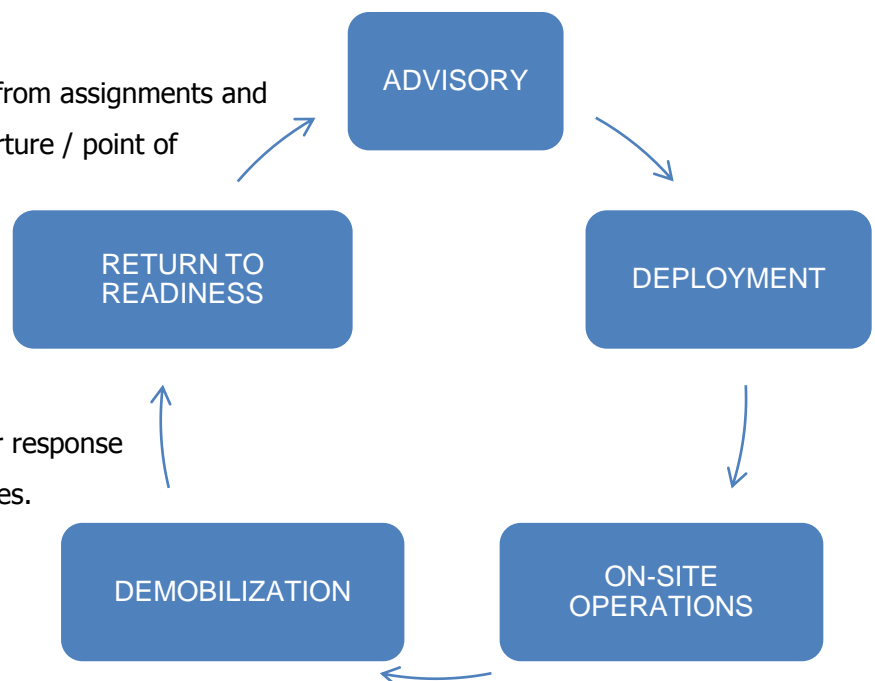


Figure 1 SAR Operational Phases



Avalanche Hazard Identification

Before on-site SAR operations commence, where there is or may be a risk from an avalanche to a responder, an avalanche risk assessment must be prepared in accordance with established guidelines of the Canadian Avalanche Association (Canadian Avalanche Association, 2010). In respect to the urgent nature of SAR operations and specifically avalanche rescue, the Avalanche Safety Officer may conduct a preliminary risk assessment, completed off-site, and based on empirical, topographical, and other information. This plan, combined with other sources of information such as Public Avalanche Bulletins, CAA InfoEx™ Data, Avalanche Terrain Exposure Scale ratings, local knowledge of terrain and conditions, response planning tools (ICS 305 –Safety Plan), and responder training can be used to document and assist in the process of creating an Active Avalanche Safety Program.

“To avoid avalanche risk areas you must first be able to recognize them.”
(Us Department of Agriculture, 1974)

Increasingly stringent safety measures are applied as avalanche danger levels and terrain complexity increases. When avalanche danger conditions indicate that the threshold for safety may be surpassed, a recommendation is made to the SAR Commander that on-site ground based SAR operations be discontinued until conditions improve, avalanche risk is mitigated and/or suitably trained personnel are available to respond. Active avalanche control measures (i.e. use of explosives) may be applied to rapidly improve conditions and reduce the risk to rescuers. Given the vast array of avalanche related variables and the complex ways that they interact with one another, it is understood that avalanche hazard assessments cannot be precise in every instance and largely relies on hazard identification, avoidance and expert judgement.

To view a flowchart for outlining the steps for identifying potential avalanche hazard see Figure 2.

This flowchart, an excerpt from the Canadian Land managers Guide to Snow Avalanche Hazards in Canada is provided for the purposes of outlining the steps for recognizing potential avalanche hazard.

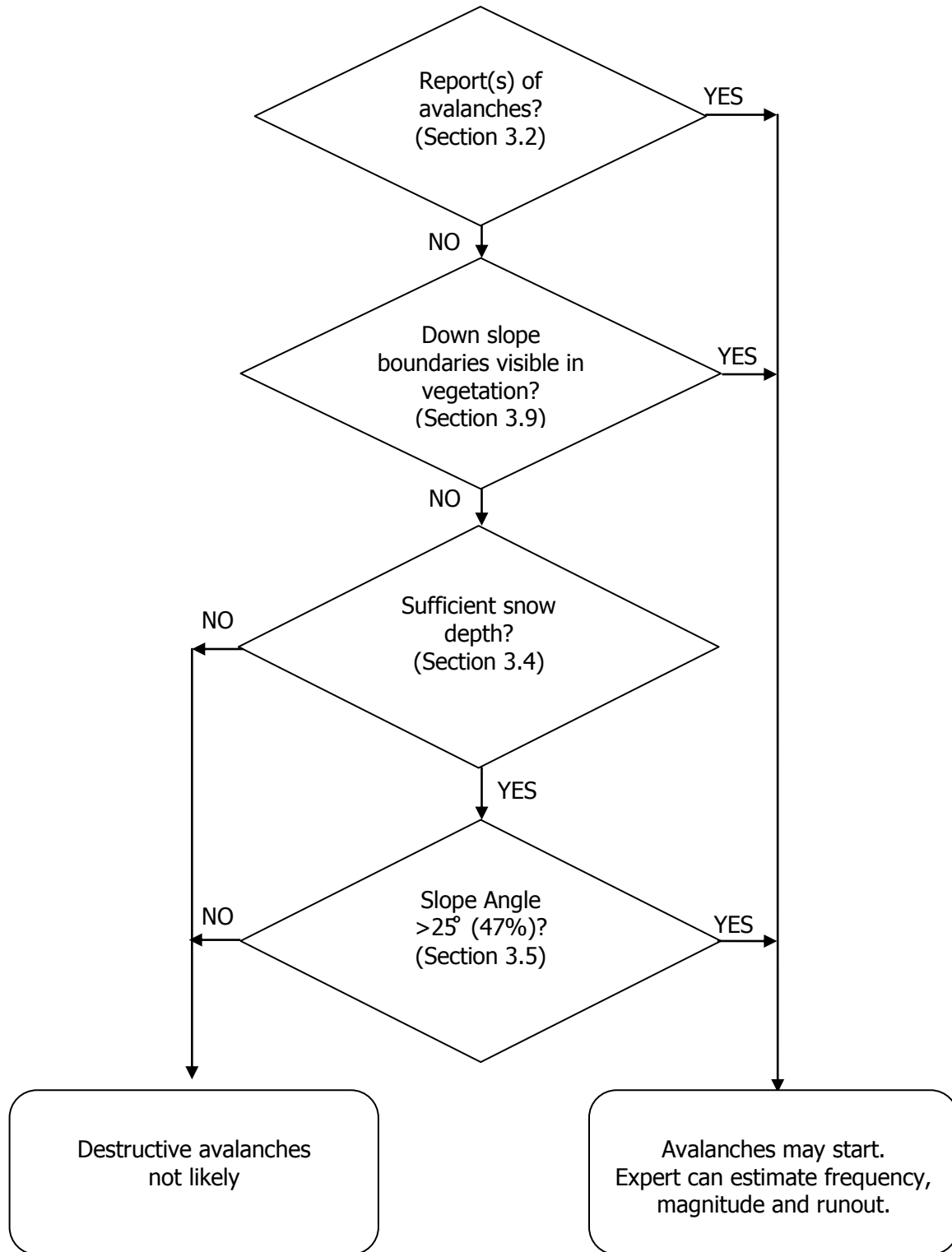


Figure 2 - (Canadian Avalanche Association, 2002).

Avalanche Risk Assessment

For SAR operations (non-avalanche rescue) in the wilderness where any person working in the workplace undertakes short-duration, low impact activities in undeveloped terrain, a preliminary avalanche risk assessment should be prepared by a suitably trained Avalanche Safety Officer or delegate, as soon as reasonably practical.

When is an Avalanche Risk Assessment required?

When both of the following factors are present:

- Slopes with an angle of greater than 25 degrees.
- Consistent snow-cover of more than 50cm in depth.

If avalanche hazard is identified, no On-site SAR operations may be initiated in the avalanche risk zone, when snow conditions have the potential to create an avalanche, until an avalanche risk assessment is complete and an Active Avalanche Safety Program has been implemented. The avalanche risk assessment and Active Avalanche Safety Program will provide guidance as to the appropriate level of supervision required to proceed with on-site operations. The risk management objectives of the Avalanche Safety Plan provide only guidance for the Avalanche Safety Officer in determining acceptable levels of risk for On-site Operations.

Preliminary / Urgent Avalanche Risk Assessment Guidelines

The preliminary or urgent avalanche risk assessment provides for an early warning system for the Safety Officer and Initial Response Teams. Not all potential avalanche risk zones may be identified through this process, specifically avalanche risk zones that are covered by dense forest and micro terrain features such as gullies and short slopes. Regional trends in avalanche & weather hazards combined with the identification of major avalanche risk zones are incorporated into the Active Avalanche Safety Program. Typically, preliminary risk assessments are conducted with informational material such as:

- Oral history of terrain use patterns and avalanche frequency
- CAC Public Avalanche Danger Bulletin
- Avalanche Terrain Exposure Scale Classifications
- Maps - Contour (1:50000 or 1:20000), Google Earth, and others
- Stereo air photos, Oblique photos (summer or winter), 3D Satellite imagery
- Canadian Avalanche Association InfoEx™ data and information



In many avalanche accident areas the Canadian Avalanche Centre provides a Public Avalanche Bulletin that will provide the current Avalanche Danger Level, travel advice and hazard exposure information that must be considered by rescuers. These bulletins provide the Avalanche Safety Officer with an avalanche hazard forecast related to specific areas over a number of days. The bulletin provides additional information in the form of written synopsis of avalanche observations and specific conditions while also providing a visual representation of hazardous conditions and their location through a series of icons.

Detailed Avalanche Risk Assessment

The detailed risk assessment provides for avalanche path specific information for the Avalanche Safety Officer. Not all potential avalanche risk zones may be identified through this process (avalanche risk zones that are covered by dense forest and micro terrain features such as gullies and short slopes). In addition to the various element identified in the Preliminary / Urgent risk assessment model, the detailed risk assessment may include the following activities and/or processes; a review of oral and written history of area, inventory of vegetation, historical snowpack depth analysis, terrain inventory including avalanche terrain classification utilizing (ATES), establishment of avalanche occurrence records and weather observations, snow profile worksheets, snow stability evaluation worksheets, snow stability forecast worksheets, avalanche path summaries.

In the context of the urgency of an avalanche rescue response, and with respect to the nature of the remote wilderness environments these incidents typically occur in, it is unlikely that a detailed avalanche risk assessment of the terrain will have previously been conducted.

Situations where there is an increased likelihood of this information being available to the Avalanche Safety Officer include responses where backcountry winter recreation operations are active, ski areas, provincial highways and / or National Parks. In these circumstances it is highly likely that a detailed avalanche risk assessment has been completed and an Active Avalanche Safety Program is already operating. Where practical Avalanche Safety Officers should consult with the local expertise of the Avalanche workers and Avalanche professionals associated with established programs and these local experts should be encouraged to participate in the avalanche risk assessment process.



Active Avalanche Safety Program

When a wilderness emergency occurs in a location where there is snow cover on the ground an assessment of avalanche risk is required. If it is unknown whether a substantial avalanche risk is present or it is obvious that avalanche risk exists in the operational area then an Avalanche Safety Officer must be assigned to the incident. The Avalanche Safety Officer will implement safety measures and establish closures or use other methods to reduce avalanche risk that has not been mitigated through passive measures².

Where SAR personnel are interacting with an established and Active Avalanche Safety Program, the avalanche workers associated with that program can provide invaluable information on local conditions. When practical, any local avalanche worker or avalanche professional should be encouraged to participate in SAR operations as an Avalanche Safety Officer.

When SAR personnel are responding to an incident at an industrial operation with an established Active Avalanche Safety Program , the avalanche worker in charge of that program should, at a minimum, participate as a Liaison to the Avalanche Safety Officer and ideally contribute to the development of the Active Avalanche Safety Program.

When an Active Avalanche Safety Program is established a copy of the Active Avalanche Safety Program must be readily available to each person who administers (EMBC) or implements (Volunteers and other SAR Responders) the Active Avalanche Safety Program for the worksite. To assist in the documentation of the Active Avalanche Safety Program EMBC has created the ICS 305A – Active Avalanche Safety Program form³. The Active Avalanche Safety Program must be reviewed to ensure it is appropriate and relevant to the conditions and activities for the workplace as follows:

1. Whenever there is a significant change to the workplace activities or contemplated change;
2. Whenever there is a significant change to snowpack, weather or avalanche conditions;
3. Whenever there is a change in Avalanche Safety Officer;
4. At the end of each operational period.

² WorkSafeBC, Occupational Health and Safety Regulation, 4.1.1, Passive Measures,

³ Appendix C

Principles for Applying Risk Management

The risk of avalanche to personnel should be reduced as much as reasonably practicable. Where risk avoidance is impossible additional risk mitigation measures are necessary such as the use of personal protective equipment.

1. No unnecessary risk should ever be taken
2. Risk decisions must be made at the appropriate level of command
3. Risk is acceptable if potential benefits outweigh potential risk
4. Integrate risk management into planning, preparation, and execution at all levels.

On-Site SAR Operations Active Avalanche Risk Reduction Measures

The purpose of these measures is to reduce the exposure of humans to avalanches.

1. Avalanche risk zone identification and avoidance
2. Avalanche danger travel advisories
3. Implementation of terrain limitations for personnel
4. Use personal protective equipment
 - a. Essential avalanche equipment - Transceiver, Shovel, Probe.
 - b. Recommended avalanche equipment – Avalanche Flotation Devices (SnoPulse™, ABS™ & others)
 - c. Personal Gear – SAR Ready Pack, Outdoor Clothing, Helmet (as / when required)
5. Field Team Decision Aids
 - a. Avaluator v2.0™ (CAA 2010)
 - b. Decision Making in Avalanche Terrain (CAA 2010)

Tactical Risk Reduction Measures

1. Explosive Avalanche Control
2. Specialized Search and Rescue Techniques
 - a. Barryvox VS Pro Ext. avalanche transceiver signal receiver
 - b. Class D Fixed Line – Human External Cargo transportation
3. Avalanche trained Dog Teams

Avalanche Risk Management Guidelines

Evaluating the potential consequences of anticipated avalanche activity in specific situations is critical to determining the avalanche risk. Correctly making such an evaluation relies on training, the knowledge, and above all, the expert judgement of the Avalanche Safety Officer. Avalanche risk management guidelines frequently go beyond 'rules based' safety program objectives commonly applied in industrial risk management programs and move into the realm of expert judgement based decisions.

Avalanche risk management involves a complex process of hazard analysis that ultimately leads to a decision to:

1. Identify Avalanche Hazard
2. Classify avalanche terrain exposure (Parks Canada, 2004); and
3. Assess weather, snowpack and avalanche information
4. Apply one of five avalanche hazard forecast danger levels to the avalanche risk zone(s), (Low, Moderate, Considerable, High, Extreme)⁴; and
5. Identify, establish, implement and maintain specific operational procedures as part of the Incident Action Plan (IAP) and specific safety measures associated with danger level and planned on-site operations, the Active Avalanche Safety Program; and
6. Provide recommendations to the SAR Command staff (Incident Commander, SAR Manager and/or Avalanche Site Safety Officer) to commence or cease Ground SAR Operations; and
7. Provide recommendations to the SAR Commander staff to implement additional active avalanche risk mitigation measures (E.g. the use of explosives) due to avalanche hazard conditions.

Avalanche Safety Officers should not hesitate to make recommendations to the SAR Command Staff when they believe on-site ground search and rescue activities need to be suspended due to the level and/or nature of the avalanche hazard and/or availability of suitably trained personnel.

SAR Commanders, EMBC Regional Managers, and EMBC SAR responders are collectively responsible for ensuring that response activities are planned and conducted according to provincial and federal standards, industry practices and procedures and meet all regulatory requirements, where reasonably practicable.

⁴ North American Avalanche Danger scale (CAC, 2010)



Identification of Avalanche Risk Zones

Potential avalanche risk zones identified through the avalanche risk assessment process should be clearly marked on a map. There are four main types of avalanche map including; a locator map, avalanche atlas maps and a avalanche risk map (Canadian Avalanche Association, 2002). In accordance with the Terrain Classification System of British Columbia (BC Ministry of Environment, 1997) and CAA guidelines (Canadian Avalanche Association, 2002) a line locator map, can be used, where practicable, during SAR operations to identify major avalanche paths. This map may be topographical in nature and well defined avalanche paths are marked with an arrow showing the direction of flow down the approximate centre line of the avalanche path.

Naming Convention for Identified Avalanche Risk Zones

If required Avalanche paths can be named and indicated on a map. Paths are usually identified using a sequential number in the observation area (e.g. Path 2a), a road or trail kilometre distance originating from an identified point or drainage reference (E.g. Path 2.7km). For extended multi-day SAR operations, field marking of paths with flagging tape may be appropriate to provide a clear indication of the location of the path to field teams and to facilitate clear communication about specific locations of SAR teams in relation to these risk zones. To accomplish this, flagging tape and/or another marking device can be placed in conspicuous locations where search and rescue teams can easily identify them.



Appendix A – Glossary

Incident Commander

The individual responsible for the management of all incident operations at the incident site. The term 'Incident Commander' includes Unified Command. During SAR operations in British Columbia the role of the Incident Commander is filled by a representative of the police, BC Ambulance Service, Fire Services, Coroner or Parks Canada.

Search and Rescue Manager

Under the general direction of the Incident Commander, the SAR Manager will manage the volunteer SAR response during a SAR response.

Avalanche Safety Officer

A member of the Command Staff responsible for assessing the avalanche hazard, monitoring weather and avalanche conditions, and for developing and implementing the Active Avalanche Safety Program.

Typically CAA qualified avalanche workers (with a CAA level 2 or 3 certificate) will fulfill the role of Avalanche Safety Officer and oversee and implement the program.

Avalanche Site Safety Officer

A Site Safety Officer is located at the site of an avalanche and is responsible for evaluating the risk of further avalanches, identifying safety hazards or unsafe situations, monitoring on-site rescue operations, conducting field assessments and gathering observations, and for implementing and supervising measures for ensuring personnel safety.

The member of the search and rescue team tasked with fulfilling the role of Avalanche Site Safety Officer and with implementing and supervising the measures specified in the Active Avalanche Safety program will normally have completed, at a minimum, a CAA level 1 certificate or JIBC Organized Avalanche Response Team Leader course.

Avalanche Safety Plan

Means a documented plan meeting CAA guidelines, specifying passive measures to mitigate or reduce the avalanche risk to any person working at the workplace and any active avalanche safety program necessary to monitor and manage any avalanche risk that has not been mitigated through use of passive measures.

Active Avalanche Safety Program

Means a program for monitoring daily, or more frequently if conditions warrant, the weather, snow and avalanche conditions, determining temporal fluctuations of avalanche hazards and implementing safety measures, closures or other methods specified in the program to reduce avalanche risk that has not been mitigated through use of passive measures.



Avalanche Risk Assessment

The determination of the characteristics of the terrain in and around a geographic area based on an analysis of topographic variables, the snow climate, the estimated return periods and magnitudes of avalanches, and the type of activity that is to be done in that area.

Avalanche Risk Zone




A workplace or part of a workplace where an avalanche risk assessment determines that avalanches pose a risk to any person working at the workplace and risk control measures are required to make the area safe for work to be conducted.

Rescue Response Plan

The response plan is a set of guidelines developed by the SAR group that specifies a series of steps that a SAR manager would take to respond to a particular type of incident.

Appendix A – Parks Canada Avalanche Terrain Scale

The Avalanche Terrain Exposure Scale (ATES) (Parks Canada, 2004), identifies three different classes to describe the exposure to avalanche hazard: SIMPLE, CHALLENGING and COMPLEX. The table below describes the basic characteristics of the three different classes. This avalanche classification system is based on terrain analysis, not snowpack analysis. The technical model below has been designed for users trained and skilled in the subtle nuances of avalanche terrain. The ATES can be applied at whatever scale is appropriate.

Description	Class	Terrain Criteria
 <p>Simple</p>	1	Exposure to low angle or primarily forested terrain. Some forest openings may involve the run-out zones of infrequent avalanches. Many options to reduce or eliminate exposure. No glacier travel. (Photo: Grant Statham)
 <p>Challenging</p>	2	Exposure to well defined avalanche paths, starting zones or terrain traps; options exist to reduce or eliminate exposure with careful route finding. Glacier travel is straightforward but crevasse hazard may exist. (Photo: Grant Statham)
 <p>Complex</p>	3	Exposure to multiple overlapping avalanche paths or large expanses of steep, open terrain; multiple avalanche starting zones or terrain traps below; minimal options to reduce exposure. Complicated glacier travel with extensive crevasse bands or icefalls. (Photo: Bill Mark)

“Any given piece of mountain terrain may have elements that will fit into multiple classes. Applying a terrain exposure rating involves considering all of the variables described above, with some default priorities.” (Parks Canada, 2004)



Appendix A – Parks Canada Avalanche Terrain Scale, Technical Model

Technical Model (v.1-04)			
	<u>1 - Simple</u>	<u>2 - Challenging</u>	<u>3 - Complex</u>
Slope angle	Angles generally < 30°	<i>Mostly low angle, isolated slopes >35°</i>	<i>Variable with large % >35°</i>
Slope shape	Uniform	Some convexities	Convoluted
Forest density	Primarily treed with some forest openings	Mixed trees and open terrain	Large expanses of open terrain. Isolated tree bands
Terrain traps	Minimal, some creek slopes or cutbanks	Some depressions, gullies and/or overhead avalanche terrain	<i>Many depressions, gullies, cliffs, hidden slopes above gullies, cornices</i>
Avalanche frequency (events:years)	1:30 ≥ size 2	1:1 for < size 2 <i>1:3 for ≥ size 2</i>	1:1 < size 3 <i>1:1 ≥ size 3</i>
Start zone density	Limited open terrain	Some open terrain. Isolated avalanche paths leading to valley bottom	Large expanses of open terrain. Multiple avalanche paths leading to valley bottom
Runout zone characteristics	Solitary, well defined areas, smooth transitions, spread deposits	Abrupt transitions or depressions with deep deposits	Multiple converging runout zones, confined deposition area, steep tracks overhead
Interaction with avalanche paths	Runout zones only	Single path or paths with separation	<i>Numerous and overlapping paths</i>
Route options	Numerous, terrain allows multiple choices	A selection of choices of varying exposure, options to avoid avalanche paths	<i>Limited chances to reduce exposure, avoidance not possible</i>
Exposure time	None, or limited exposure crossing runouts only	<i>Isolated exposure to start zones and tracks</i>	<i>Frequent exposure to start zones and tracks</i>
Glaciation	None	<i>Generally smooth with isolated bands of crevasses</i>	<i>Broken or steep sections of crevasses, icefalls or serac exposure</i>

Terrain that qualifies under an **italicized** descriptor automatically defaults into that or a higher terrain class. Non-italicized descriptors carry less weight and will not trigger a default, but must be considered in combination with the other factors.

“Credible local professional advice may be an adequate replacement for published terrain rating and avalanche bulletins.” (Haegeli, 2010)



Appendix B – ICS 305A – Active Avalanche Safety Program

ACTIVE AVALANCHE SAFETY PROGRAM		TASK #	DATE & TIME PREPARED:
FOR OP. PERIOD #	TASK NAME:	PREPARED BY:	
IDENTIFIED HAZARD #	HAZARD NAME: AVALANCHE	SAFETY OFFICER:	
LOCATION:		DESCRIPTION:	
CURRENT DANGER RATING: (Check Highest Level for BTL, TL and/or ALP)		AVALANCHE TERRAIN EXPOSURE SCALE CLASSIFICATION:	
		<input type="checkbox"/> SIMPLE <input type="checkbox"/> CHALLENGING <input type="checkbox"/> COMPLEX <input type="checkbox"/> UNKNOWN	
		AVALANCHE INCIDENT DETAILS <input type="checkbox"/> Avalanche Incident Involvement Form Attached	
ON-SITE OPERATIONS ACCESS / EGRESS, WEATHER AND AVALANCHE CONDITIONS ADVISORY:			
ACTIVE AVALANCHE SAFETY PROGRAM MEASURES:			
SPECIAL INSTRUCTIONS:			
AVALANCHE DANGER IDENTIFICATION / MITIGATION AND RISK CONTROL CHECKLISTS			
<input checked="" type="checkbox"/>	REFERENCE DESCRIPTION	<input checked="" type="checkbox"/>	ASSIGNMENT CHECKLIST
<input type="checkbox"/>	PUBLIC AVALANCHE BULLETIN	<input type="checkbox"/>	TEAM ASSIGNMENT
<input type="checkbox"/>	WEATHER FORECAST	<input type="checkbox"/>	TEAM ASSIGNMENT BRIEFING
<input type="checkbox"/>	CAA InfoEx™	<input checked="" type="checkbox"/>	SUPPLEMENTARY REFERENCES
<input type="checkbox"/>	SNOW STABILITY EVALUATION WORKSHEET	<input type="checkbox"/>	AVAILABLE AVALANCHE ATLAS'S
<input type="checkbox"/>	SNOW STABILITY FORECAST WORKSHEET	<input type="checkbox"/>	LOCAL AVALANCHE PROFESSIONAL
<input type="checkbox"/>	AVALANCHE PATH SUMMARY	<input type="checkbox"/>	Name: _____
<input checked="" type="checkbox"/>		<input type="checkbox"/>	Safety Measures
		<input type="checkbox"/>	Personnel Protective Equipment (Transceiver, Shovel, Probe)
		<input type="checkbox"/>	Explosive Strike Team
		<input type="checkbox"/>	Helicopter Based Signal Search - Barryvox External Transceiver
		<input type="checkbox"/>	Helicopter Based Rescue Effort - Class D Fixed Line Helicopter Support
		<input type="checkbox"/>	Rapid Intervention Team
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