AIARE Operational Avalanche Risk Management Plan

Version 1

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Limitations

This plan is valid as long as the operational conditions described here remain constant. Changes in operational conditions that may warrant a review of the plan include but are not limited to: changes in terrain; conditions of tenure; changes in Occupational Health and Safety Regulations affecting this plan; and other factors that may diminish the ability of this avalanche safety plan to protect from danger any person entering the workplace described in this document.

Date	Version	Author	Comments	Publication Notes
2022-07-13	1.0	SC	Final draft completed and reviewed	Published

Plan Summary

This Operational Avalanche Risk Management Plan (OARMP) outlines the practices to provide for safety relative to snow avalanche hazard in the workplace. This includes providing a learning environment relevant to snow avalanche hazards during field activities and, in a broader sense, managing other environmental and course delivery hazards. Identification and mitigation of these other hazards are not covered in the same detail attributed to snow avalanche hazard. However, the processes described (e.g. daily planning and record keeping) can be followed for field activities without avalanche hazard. Additional course non-field activity risk management practices are described in human resource documents that describe staff qualifications and expectations.

Plans such as this should be reviewed whenever regulations change, near-misses occur, or, at minimum, every two years.

The emergency response component must be reviewed and revised annually prior to the operational season.

Who is this Document For?

This document is procedure and policy for AIARE staff. All staff who work or supervise those who work in areas of avalanche hazard are to be knowledgeable, trained, and comply relative to their roles in the organization.

Additionally, the OARMP was written with the intention of providing a model for AIARE Providers which they may use for their own organization. To meet this purpose, it includes more background information than one would typically find in such a plan.

1. Context

This plan's structure and the guidance it provides follow best practices as outlined in *The Technical Aspects of Snow Avalanche Risk Management* (TASARM) (CAA 2016) and its description of how snow avalanche risk management aligns with ISO31000 risk management fundamentals. Under the TASARM, the ISO31000 basics (Figure 1) are expanded in a logical manner (Figure 2) separating out terrain identification, hazard, forecasting, and risk.

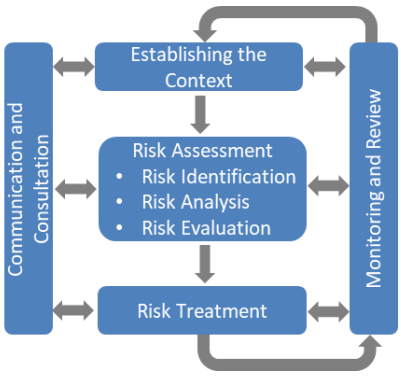

Figure 1. ISO31000 risk management process

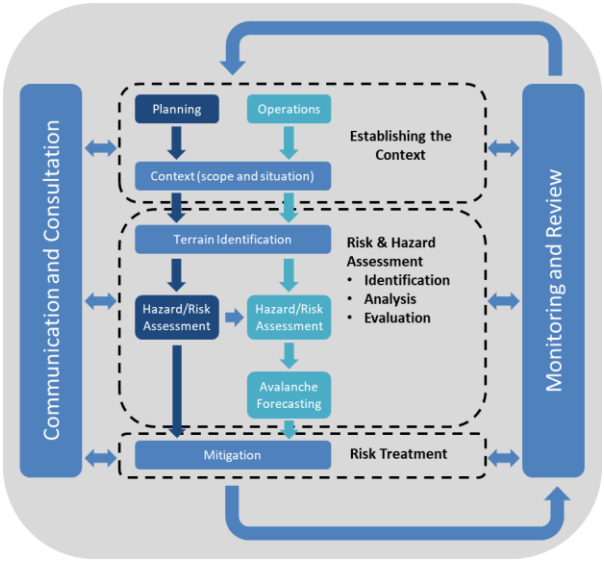

Figure 2. Snow avalanche risk management process.

Operational context includes determining the scope and situation. Scope, including the objectives and risk criteria, is the first component of a risk management plan.

The American Institute for Avalanche Research and Education (AIARE) provides high-quality avalanche education in the form of instructor, course leader, professional avalanche worker, and avalanche search & rescue training (see Appendix 7.3). Field work by AIARE staff (employees or contractors who work or supervise those who work in areas of avalanche hazard during AIARE provided training) includes avalanche education, student assessments, and staff training of individuals and groups within avalanche terrain, field location reconnaissance, and survey.

Field-based activities by staff, by nature, are typically undertaken in locations that have an annual occurrence of avalanche hazard with potential consequences to individuals. These annual occurrences are at a frequency and magnitude above the minimum practice thresholds set in Chapter 9 of TASARM, and therefore an avalanche risk management plan is appropriate.

1.1 Scope

The primary objectives of AIARE field work are learning and assessment objectives where students are either aspirant avalanche education instructors, aspirant avalanche workers, current avalanche workers continuing their training, or AIARE staff.

The health and safety criteria of AIARE is to operate without placing staff, contractors, or students in harm's way of likely consequential avalanche hazard. Consequential avalanche hazard is where real-time snowpack and terrain conditions at the path scale support a destructive size 2 or larger avalanche, and in specific cases, where

the position of exposure due to terrain features means that a destructive size 1 can cause injury or death. This criterion informs the operational risk band (ORB). There are upper and lower bounds of the ORB where risk is considered too great or too conservative to accomplish the organizational objectives (McClung & Schaerer, 2006).

1.2 Situation

Situation is the 3-way intersection of the element(s) at risk, scale, and the hypothetical sequence of events where exposure to the avalanche hazard occurs (avalanche risk scenarios). In AIARE's case, it is when staff and students are on field trips, engaged in avalanche education, under whatever conditions exist.

1.1.1 Elements at Risk

The elements at risk are unprotected people, i.e. they are not behind or inside anything that provides protection from avalanches. Their potential for loss is injury (mental or physical) or worse. They may be moving or stationary. Moving speed (and therefore potential exposure period) varies between travel modes (i.e. walking versus motorized).

1.2.1 Scale & Geographical Limits

AIARE operates internationally. Course locations are typically drainage-scale or smaller. This plan does not address any specific areas. Each instance or venue of application will include terrain identification as part of the avalanche hazard and risk assessment process and venue documentation.

1.2.2 Avalanche Risk Scenarios

Avalanche hazard exposure occurs when staff or groups travel through or pause in avalanche paths. In order to outline mitigation strategies in this document, the length of time exposed is categorized as either brief or stationary.

- **Brief** means an individual's or total group transit time (sledding, sliding, skinning, etc.) in the path is less than 15 minutes.
- **Stationary** means occupying the same general location (an area based on group size) for more than 15 minutes.

In an effort to capture typical scenarios and align avalanche educational objectives (desires) with optimal terrain selection, four terms are used to categorize the situations that occur in the field: Instructional, Dry-run, Validation, and Practicum (*The Avalanche Review*, 40.2. December 2021). The "Misstep Opportunities" column illustrates a hypothetical sequence of events where the element at risk might become exposed to avalanche hazard.

Table 1: Educational Mindsets

Education Situation	Explanation	Misstep Opportunities
Instructional	The learning objective requires skill or knowledge typically with adherence to a set of guidelines or standards. Demonstration, practice, and repetition occur while semi-stationary (including extended breaks while traveling).	Here an opportunity for misstep would be in skill practice, such as poor craftsmanship or misreading a compass.
Dry-run	The learning objective is met through coaching of a students' practice or and feedback on demonstration of intellectual or physical skill.	Opportunities are limited or restricted to minor consequence outcome potential through robust terrain margins.

Validation	Intellectual or physical skills are confirmed or assessed through monitoring in a simulated situation or scenario.	Real or simulated opportunity for misstep without the immediate threat of hazard.
Practicum	A student has the mentored opportunity to practice skills in real-world environments and conditions.	Same opportunity for misstep and same consequence as real-life situations.

2. Terrain Identification

Analysis of topography, vegetation, avalanche activity records, and snow climate characteristics during planning to identify the location and extent of avalanche terrain provides a valuable reference that supports operational decision making and streamline actions to mitigate risk.

Each venue has a terrain catalog, where the terrain to which the AIARE Avalanche Risk Management Plan is applied is described. The terrain catalog includes maps and details on the intended course type and terrain complexity with runs, routes, or zones identified (see template in Appendix 7.1). The details include and outline the geographical, topographical, logistical, and historical characteristics at the scale of the mapping (i.e. zone, route, or run).

Avalanche paths that are used for instruction should also be included in the terrain catalog for the associated course venue.

At a minimum, terrain is identified by operational zone and exposure severity. Exposure severity is described using one of two categorizations: avalanche terrain exposure scale (ATES) or severity class.

ATES is a system that classifies terrain according to its exposure to avalanches by analyzing variables such as slope, forest density, frequency and size of avalanches, and the presence of terrain traps (Statham et al, 2006). The ATES categorizes terrain into one of three levels:

- **Simple**: Exposure to low-angle or primarily forested terrain. Some forest openings may involve the runout zones of infrequent avalanches. Many options to reduce or eliminate exposure.
- **Challenging**: Exposure to well defined avalanche paths, starting zones or terrain traps; options exist to reduce or eliminate exposure with careful route-finding.
- **Complex**: Exposure to multiple overlapping avalanche paths or large expanses of steep, open terrain; multiple avalanche starting zones and terrain traps below; minimal options to reduce exposure.

If the terrain has not been formally ATES rated, a severity class specific to this plan is used to categorize avalanche terrain by potential concentration of avalanche hazard, feature size, topography scale and difficulty. Table 2 describes the classification schema used.

Table 2. AIARE terrain categorization severity classes (after CAA ITP L2 Robert Frost Terrain Exercise version 2015).

Severity Class	Description (Concentration of potential avalanche hazard)
O	Non-avalanche terrain.
A	**Avoidable** hazards, typically smaller features (may become class M during seasons with climatologically anomalous weather patterns).
M	**Mixed** level of hazards, size, scale and complexity of features. Some overhead threat.
U	**Unavoidable** hazards, large scale features, notable overhead threat.

3. Operational Avalanche Hazard & Risk Assessment

Operational avalanche risk assessment is an ongoing process that undergoes continual updates in near-real time. Operational decisions are made as close as possible to the exposure time as possible. The process follows an established protocol for documentation and to ensure steps are not overlooked.

The AIARE operational process follows a monitor-plan-act-review cycle, which includes:

- Monitoring field and weather conditions as early as is practical prior to planned courses or field trips.
- A team meeting and appropriate reconnaissance field trips occur prior to arrival of students. This supports venue terrain familiarization, and knowledge of local baseline snowpack, weather, and avalanche conditions. This is important since each course occurrence typically transpires with a new team in a new location (i.e. a team that has not worked together or at the location in the weeks prior).
- All operational days adhere to a structured daily process:
    - Begin with a collaborative pre-field trip team meeting to assess the hazard, align locations with objectives, and determine mitigation measures to follow in the field. This meeting is also a time to identify information gaps so targeted observations can be made during the field trip.
    - Conduct classroom and field learning opportunities.
    - Conclude with a review and summary meeting to complete the monitor, update, and forecast cycle.

3.1 Avalanche Hazard Assessment

The Conceptual Model of Avalanche Hazard (CMAH) (Statham, et al., 2018) is applied utilizing the operational context outlined in Section 1 to undertake the avalanche hazard assessment and subsequent forecast. The operational avalanche hazard forecast objective (see section 4.1.1 in CMAH) is to keep individuals safe while providing a high-quality learning environment.

Avalanche hazard assessment includes systematic observation, monitoring, and investigation of avalanche activity, and snowpack and weather conditions (the hazard identification and analysis component of the hazard assessment) on the assessment scale that corresponds to the area to be traveled. The recording of avalanche activity, snowpack and weather conditions will follow *Observation Guidelines for Avalanche Programs in the United States*. (American Avalanche Association, 2016)

1. The hazard assessment component is summarized in these questions:
1. What scale are we taking into account, considering?
2. Are there structural weaknesses or instabilities in the snowpack?
3. Is there a pattern of characteristics associated with an avalanche problem type(s)?
4. Where in the terrain are these problems located?
5. How likely is it that an avalanche will occur?
6. How destructive will the avalanche be?
7. What uncertainties can be reduced, communicated, and accommodated?

The outcome of this assessment is articulated and recorded in the operational record (example worksheet in Appendix 7.3). The key information maintained in the operational record is outlined as follows:

- Snowpack Synopsis: Generalized description of the surface, upper, mid-, and lower snowpack. May include slab properties, weak layer attributes, temperature gradients, etc. Additional comments may include notes on signs of instability, settlement, and the effects of wind, air temperature, relative humidity, and solar radiation.

- Patterns & Evidence: Portrayal of avalanche activity, test results, and organizational trends (organize and reduce data).
- Avalanche Problems: Type, elevation band, aspect, spatial distribution, sensitivity to triggering, destructive size, relevant features where triggering is likely, expected partial release or full width of the start zone (relative size), anticipated runout, natural or artificial triggering main concern, and hazard trend.
- Uncertainty: Primary source of uncertainty (e.g. weather, people, terrain, snowpack) and plan for reduction.

3.2 Avalanche Risk Assessment

The avalanche risk is assessed given the vulnerability associated with the operational element at risk, the educational situation or field trip objectives, and exposure to the avalanche hazard as determined in the previous steps. Other hazards relative to the accomplishment of objectives are also considered.

Risk assessment is a series of actions undertaken to acknowledge the uncertainties associated with the anticipated scenarios. Answers to the following questions in consideration of the current avalanche hazard are the core of any decision:

1. How likely is it that a specific scenario will happen?
2. If it does happen, are the likely consequences acceptable?
3. How do we reduce, communicate, and accommodate any uncertainties?
4. What needs to be done to achieve acceptability?

These questions are covered formally as part of the pre-field trip meeting.

The evaluation step within the assessment uses criteria to interpret the risk. The upper boundary of the Operational Risk Band (risk criteria) is set in AIARE's organizational objectives to operate without placing individuals or groups in harm's way of likely consequential avalanche hazard (consequence is a function of avalanche magnitude and the vulnerability of the element at risk). The lower boundary highlights over-conservatism that prevents the learning objectives from being attained.

The box below contains a description of how likelihood, size, and exposure are captured in the ORB.

Outside Upper ORB

- *Any exposure to Almost Certain, Very Likely, or Likely Artificial or Natural Triggering AND larger than destructive size 1.*
- *Any exposure to Possible or Unlikely Artificial or Natural Triggering AND destructive size 2 or larger.*

Within ORB

- *Brief exposure in scenarios where artificial or natural triggering is Possible or Unlikely of a destructive size 1.5 or smaller.*
- *Brief exposure in scenarios where artificial or natural triggering is Almost Certain, Very Likely, or Likely of a destructive size 1.*
- *Stationary exposure in avalanche terrain where and when there is no threat of a destructive size 1 or larger.*

Outside Lower ORB

- *Students are not in or adjacent to identifiable avalanche terrain. An entirely classroom-based or virtual course would not meet the learning outcomes of any course from a Rec 1 through a PRO 2.*

The terms Almost Certain, Very Likely, Likely, Possible, and Unlikely relate to their use in describing the likelihood of avalanches. Likelihood of avalanches is a function of the anticipated sensitivity to triggering and spatial distribution of clues (Table 3). In terms of the ORB, this means that where the suspected avalanche problems or problems' sensitivity to triggering, spatial distribution, or size fall in the red areas of the tables below, the condition does not meet organizational objectives. Areas of orange represent conditions where the specific avalanche problem type or maximum destructive size potential is assessed on-site and plays a key role when considering whether the slope's potential consequences are within the ORB.

Table 3. Likelihood guidance table from CMAH highlighting how they relate to the ORB.

		Sensitivity to Triggers			
		Unreactive *No natural or artificially triggered avalanches.*	**Stubborn** *Few natural (large triggers) or difficult to artificially trigger avalanches*	**Reactive** *Several natural (medium triggers) or easy to artificially triggered avalanches*	**Touchy** *Numerous natural or almost certain artificially triggered avalanches*
Spatial Distribution	**Widespread** *Problem found in many terrain features. Evidence is everywhere and easy to find.*	**Unlikely**	**Possible**	**Very Likely**	**Almost Certain**
	Specific *Problem exists in terrain features with common characteristics. Evidence exists but is not always obvious.*	**Unlikely**	**Possible**	**Likely**	**Very Likely**
	Isolated *Problem is spotty and found in only a few terrain features. Evidence is rare and hard to find.*	**Unlikely**	**Unlikely**	**Possible**	**Likely**

Table 4. Destructive size table highlighting the relationship to the ORB.

D Size	Destructive potential [a]	Typical mass [a] (tonnes)	Typical deposit volume [b] (m^3)	Typical path length [a] (m)	Typical slab height [c] (m)
1	Relatively harmless to people	<10	40-100	10	0.2-0.25
2	Could bury, injure or kill a person	100	300-700	100	0.4-0.5
3	Could bury a car, destroy a small building, or break a few trees	1,000	2,500-5,000	1000	0.75-1.0
4	Could destroy a railway car, large truck, several buildings, or a forest with an area up to 4 ha.	10,000	20,000-35,000	2000	1.7-2.2
5	Largest snow avalanches known; could destroy a village or a forest of 40 ha.	100,000	150,000-250,000	3000	3.3-4.4

a. McClung and Schaerer 1981, 2006, p. 322
b. Proposed by Jamieson et al. (2014)
c. After McClung (2009) and converted to slab height (measured vertically)

Exposure specific to the spatial scale is the overriding concept. The CMAH guidance that describes spatial scale is in Table 5 below. There can be notable differences between a drainage or larger forecast of avalanche danger and the localized danger conditions of a slope. Conditions like this provide opportunities for appropriate terrain choice during elevated avalanche danger. Example: A zone may be rated with a problem that is likely or greater and travel in the zone possible if specific exposure (at the slope, path, or run scale) is not to destructive size 2 or larger. In this case, the terrain coding and trip plan must specify and record plans at a spatial scale that is identifiable in the field and ensures no exposure to hazard exceeding the operational risk band.

Table 5: Spatial Scale Guidance from CMAH used to describe amount of terrain that each scale covers.

Spatial Scale (extent)	Description	Examples	Typical Area*
Terrain feature	Individual geographic features contained within a larger slope	Convex roll gully or terrain trap	< 100 m^2 (120 sq yards)*
Slope	Large open inclined areas with homogeneous characteristics bounded by natural features such as ridges gullies or trees	Typical avalanche starting zone or wide open area on a ski run	<1 km^2 (0.38 sq mi or 247 acre)
Path or run	Multiple interconnected slopes and terrain features running from near ridge crest to valley bottom	Full length avalanche paths with a start zone track and runout zone or typical long backcountry ski run	
Mountain	An area rising considerably above the surrounding country with numerous aspects and vertical relief running from summit to valley bottom	Ski resort area or typical single operating zone in a snow cat skiing area	< 100 km^2 (38 sq mi)
Drainage	An area with a perimeter defined by the divide of a watershed	Typical single operating zone in a helicopter skiing area	
Region	A large area of multiple watersheds defined by mapped boundaries	Typical public forecasting area or public land jurisdiction	> 1000 km^2 (386 sq mi)
Range	A geographic area containing a chain of geologically related mountains	Mountain ranges or sub-ranges	

*This column includes additional interpretation for this document.

Representing this on a hazard chart at purely the slope or path scale is illustrated in Figure 3.

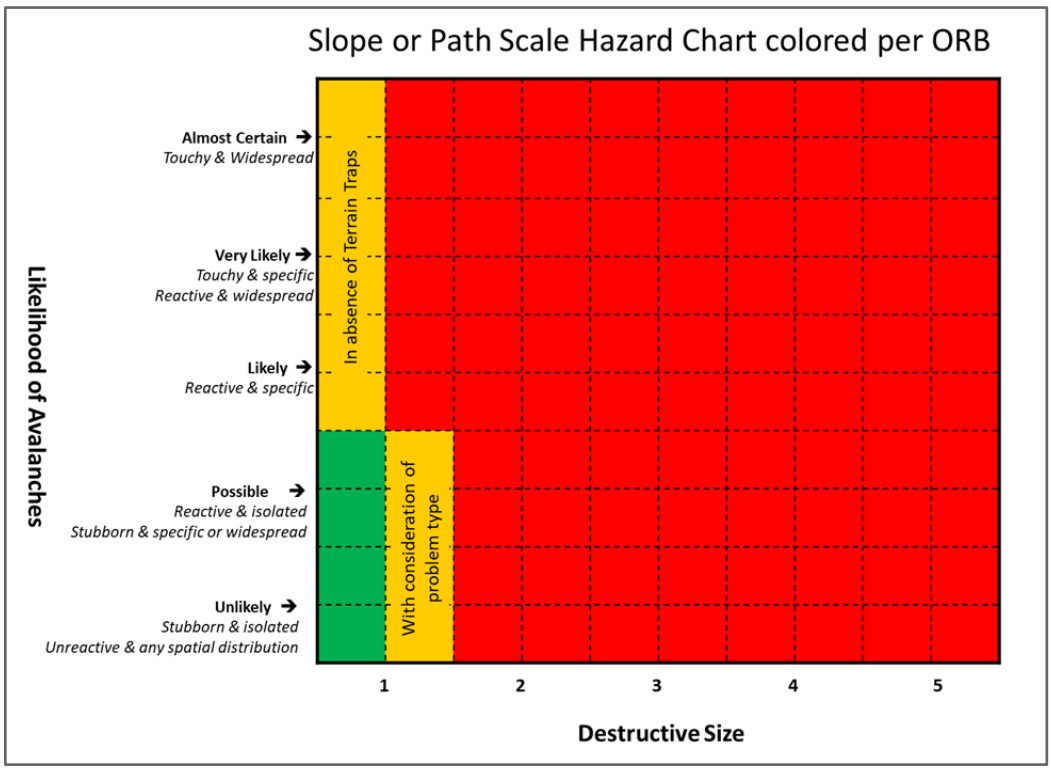

Figure 3. Interpretation of the ORB on a path or slope scale hazard chart.

3.3 Additional Risk Factors

An important part of the daily operational risk analysis in preparation for field work is addressing non-avalanche hazards and other factors influencing team performance.

- Identify what other field-related issues there are to contend with (Examples: Radio repeater down; cold; early-season hazards).
- Collaborate with team members about goals, ambitions, health, and gear issues that could affect education objectives or field decision-making.
- When items are identified in this step that require a shared plan to address them, this is captured and recorded in the operational record.

4. Risk Treatment and Mitigation Consensus

The section header acknowledges that participatory risk management is a team activity where responsibility for recognition and mitigation are shared between the institution, the instructors, and the students with the goal of a safe educational experience.

Risk treatment happens through mitigation measures that result in changes of the likelihood or size of avalanches, exposure, and/or consequence. This plan uses short-term measures (policy and procedure) that do not physically intervene (e.g. through artificial triggering or defenses) with the avalanche hazard. Five primary components are described to reduce avalanche risk operationally: personnel qualifications, safety practices, group size, exposure control, and emergency response.

The plan for the day's field trip is outlined, agreed upon, and recorded as part of the daily risk management collaboration. The key information maintained in the operational record is:

- Strategic Mindset (staff).
- Education Situation (for class days).
- Exposure controls (terrain coding by zone or routes and destinations).
- Plan for reducing uncertainties.
- Mitigations for identified additional risk factors.
- Adjustments to ERP.

4.1 Personnel Qualifications

An essential component in the application of the framework outlined in this plan is the qualifications of the personnel accomplishing the tasks. Qualifications include both training and experience, which are described in the "AIARE Recreational Avalanche Instructor and Course Leader Qualifications and Continuing Education Requirements" document.

At least one staff member per field group will possess current 80-hour first aid certification with wilderness experience or better (not applicable to lone workers).

4.2 Safety Practices

Standard safety practices in avalanche terrain include:

- Every individual is equipped for avalanche rescue with avalanche transceiver (current per manufacturer), shovel, and probe (UIAA standard).
- Every group has adequate and appropriate communication (intra- and extra-course), first-aid, and prolonged environmental exposure equipment.
- Trailhead or tailgate departure check that includes: gear check, plan confirmation, communications check, and a transceiver function check.
- Travel choices that minimize exposure to and potential consequence of avalanche hazard by maintaining self-rescue capability (ensuring entire group not exposed) when travel necessitates.
- Ensuring observation location locations are suitable for stationary exposure.

4.3 Group Size

Group size and instructor-to-student ratio are important in managing risk. Field instructional groups are limited to 1 instructor and 6 students with 1 ancillary staff (e.g. apprentice instructor).

4.4 Exposure Control

Control of the timing and position of exposure to avalanche hazard is the principal mitigation measure employed under this plan. Strategies for terrain choice (Educational Situation), the operational day (Strategic Mindset), special situations (Lone worker protocol) and determining access for the planned extent of travel (Terrain Coding) are the measures.

4.4.1 Terrain Use

Terrain selection supports reducing risk through the adoption of strategies directly aligning objectives with desires and conditions in a manner that proactively filters (narrows or broadens choices) locations available in the terrain catalog. Identifying the Education Situation aligning with learning objectives is the step necessary for course field trip planning.

Table 6: Terrain Choice Strategies for Various Educational Situations.

Education Situation	Terrain Choice Strategy
Instructional	Destination and route are chosen for semi-stationary or extended exposure period. Route is chosen to minimize learning roadblocks and maximize available field lesson time.
Dry-run	Destination and route are chosen pre-trip to meet specific learning objectives and to inherently provide restriction to exposure (brief). Objectives may require locations chosen or opportunities for semi-stationary or extended exposure periods. Avalanche terrain where the class might be exposed is observable and verifiable prior to exposure regardless of conditions. Terrain assessment exercises can occur without the need to be exposed. Appropriateness of extended exposure is determined as part of the pre field trip hazard assessment workflow.
Validation	Destination and route provide appropriate scenarios or simulated situations that vary based on the curriculum and course objectives. Opportunities for misstep are identified by instructors as part of their planning to ensure the group is managed such that the instructor can step in at any time. Appropriateness of extended exposure is determined as part of the pre-field trip hazard assessment workflow.
Practicum	Under Practicum, a student applies skills under direct supervision of an appropriately competent mentor in a highly structured relationship using established protocols and skill expectations. Established protocols might be organization or sector standards, desired learning outcomes described in a curriculum, or specific skill expectations.

Strategic Mindsets (Atkins, 2014) are an adopted communication and debiasing method for connecting hazard conditions to an **operational** terrain choice strategy and an information collection plan. They are applied at the operational level by staff but may also be a topic being covered with students, where a difference between the staff operational plan (e.g., stepping out cautiously since they have been on site in the field prior to the course) and student's practice (assessment since it is their first day) may be evident.

Table 7: Strategic Mindsets

Strategic Mindset	Typical Conditions	Typical Operating Strategy
Assessment	There is a high degree of uncertainty about conditions, such as when first encountering the terrain for the season, entering new terrain, following a lengthy period with limited observations, or after substantial weather events.	Select conservative terrain in which to operate confidently while more information is gathered to gain confidence in the hazard assessment.
Stepping Out	Conditions are improving and/or we are gaining confidence in our assessment. The 'stepping out' mind-set covers a range from stepping out very cautiously to stepping out confidently. Stepping out cautiously occurs when there is limited confidence in extrapolation from the available observations, for example when persistent slab instabilities are becoming less easily triggered and for large storm instabilities in the early stages of recovery. Stepping out confidently occurs when one is confident to extrapolate from the available observations.	When stepping out cautiously, it is common to seek specific information about each piece of terrain under consideration before opening that terrain. When stepping out confidently, it is common to open a broader set of terrain with particular characteristics based on extrapolation of evidence from other sites.
Status Quo	There is no substantial change in conditions, the evidence continues to support the current hazard assessment, and the comfort level for exposure under these conditions has been reached.	Change nothing and continue operating as before.
Stepping Back	Weather changes increase the hazard or when events or observations cause uncertainty about the validity of the existing assessment. A small step back may result from minor or subtle weather changes while substantial weather events or observations of unexpected avalanches may result in a large step back.	The typical strategy when stepping back is to close terrain that has become suspect based on weather changes or evidence that creates uncertainty.
Maintenance*	A potentially persistent weak layer is just buried or soon to be buried.	The focus of the program is to disturb the weak layer to reduce future avalanche hazard in specific terrain.

Entrenchment	Dealing with a well-established persistent instability. Entrenchment is not a preferred operating mode and requires discipline to sustain it for the necessary time; this is the last resort short of closing operations completely.	Limit skiing to a small terrain selection assessed as having acceptable risk until the situation has clearly changed. New evidence continues to be gathered and monitored for changing conditions, but new terrain is only opened if there is compelling evidence that it is advisable to do so (e.g. an avalanche was observed that definitely removed the layer of concern from that terrain).
Open Season	The hazard assessment suggests that only small avalanches are possible in very isolated terrain features, and there is a high degree of confidence in the hazard assessment.	Any skiable terrain may be considered with due attention to the possibility of small surface avalanches.
Spring Diurnal	The hazard assessment suggests that the only substantial hazard is from wet avalanches during the afternoon thaw phase of the diurnal freeze-thaw cycle.	Watch closely for adequate overnight freeze and avoid avalanche terrain during the thaw phase of the cycle.

4.4.2 Lone Worker Protocol

A lone worker is someone who is in the field and remote without a partner. Under conditions where the pre-field trip assessment concludes avalanche likelihood is “unlikely” AND D-size 1 the maximum for the planned location, route, assessment scale; lone field work is allowed under following protocol:

- A monitoring and check-in plan appropriate to the local response time, conditions, and hazards is determined in conjunction with qualified AIARE staff who are responsible to receive the check in and initiate any response.
- Direct communication is required, typically via radio, cell phone, or satellite phone. PLB use may be appropriate with consideration of potential hazards and what response time is deemed effective.

4.4.3 Terrain Coding

Access is based on the most current and recent hazard and risk assessment, optimally done the morning or night before course groups or staff enter the terrain. The guidance is per the terrain code categories and detailed below in Table 7.

Table 7 Access per Terrain Coding as Determined During Pre-trip Hazard and Risk Assessment.

Terrain Code	Signal Color	Access Description
Open	Green	Access permitted. Mandatory standard safe travel techniques adherence, avalanche survival equipped. Groups are companion rescue ready. Lone worker acceptable following protocol.
Conditional	Orange	Access only by team under direct supervision of senior staff for observations and assessment. Egress terrain must be coded open. Exposure must meet ORB. Mandatory standard safe travel techniques adherence, avalanche survival equipped, and companion rescue ready.
Closed	Red	No access.

4.5 Emergency Avalanche Search-and-Rescue Response

Two scenarios are possible:

1. Staff in the field are involved in, witness or come upon an avalanche accident, or
2. Base station staff receive notification that there has been an avalanche accident

A weather-proof rescue card and avalanche response plan should be carried by every staff member.

An avalanche response plan is provided in the appendix that functions both as part of this plan and as a stand-alone document that is annually updated.

Documenting and reporting accidents or near-miss events is an important part of risk management. A notable course event reporting process is outlined in an ancillary document.

5. Professional Practice

Keeping an operational record is essential to supporting avalanche hazard risk management. This is the documentation of observations, basic analyses, and/or decisions. Records kept should include field observations, snow profile summaries, assessment and review meeting notes typically captured in the Pre-Field Trip Assessment and Post-Field Trip Summary.

Additionally, staff are expected to keep personal logs of their snow travel, observations, and operational comments.

6. Reference Documents

American Avalanche Association. (2016). *Snow, Weather and Avalanches: Observation Guidelines for Avalanche Programs in the United States (3rd Edition).* Victor, Idaho: American Avalanche Association.

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7. Appendix

1.2 Terrain Catalog Template

Terrain cataloging is done at a geographic granularity that supports hazard assessment, forecasting, and terrain coding with high confidence in an effective and efficient manner. It provides an opportunity for cultivation of organizational and operational memory.

Venue Summary Sheet

Venue Name	
Mountain Range & Sub-range	
Link to digital collection	
Elevation Range	
Area (sq mile)	
Snow Climate & Latitude	
List of Operating Zones	
List of Trailheads or Access	
List of Routes or Runs	
List of Avalanche Paths	
Course History (updated annually)	

Venue Map

Minimum content:

- Entire operational area.
- Trailhead(s) or access points
- Medevac Locations
- Operational zones (routes and runs are optional depending on applicability and map scale).
- Locations or zones for semi-stationary and extended activities.
- Scale, north, date, contour interval, and legend if annotated.

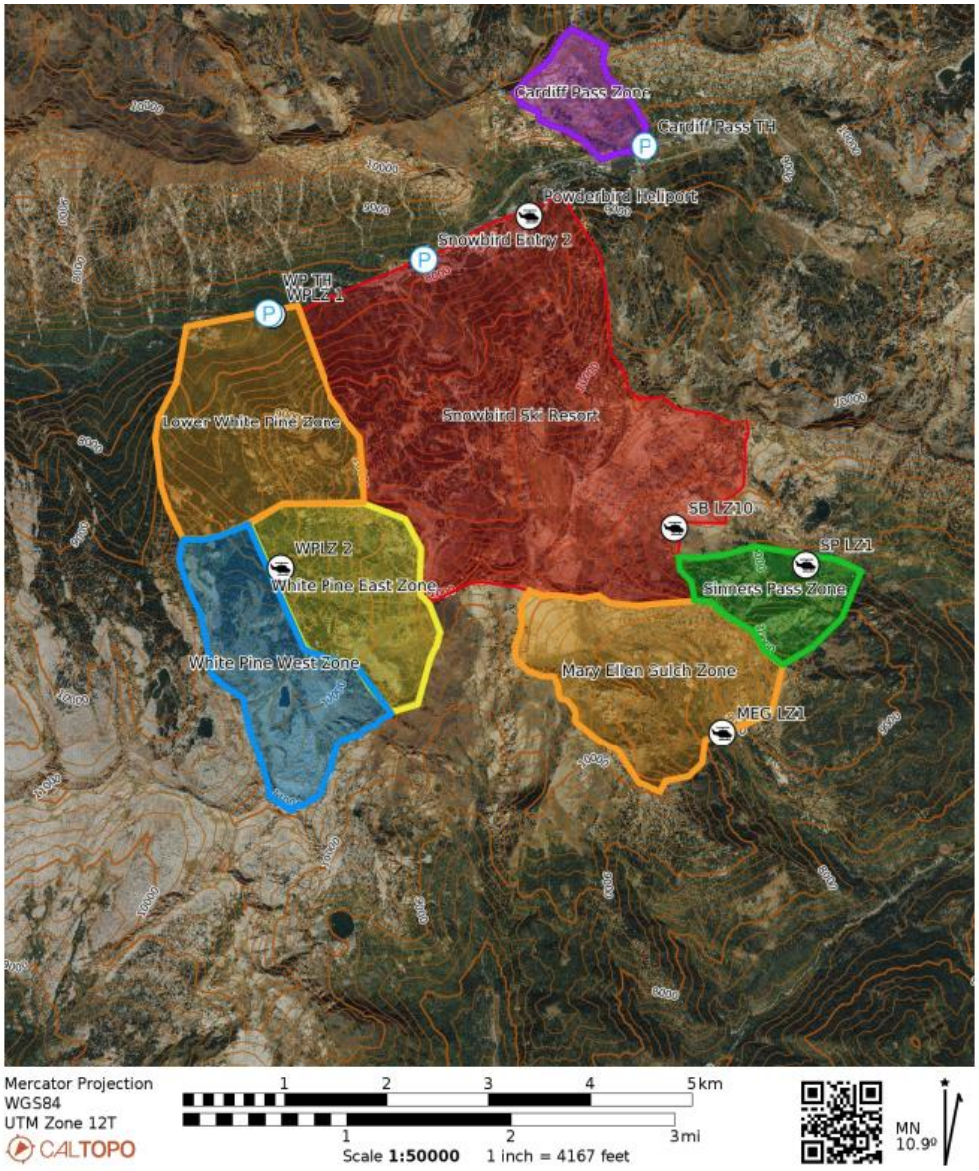
Individual zone, route, run, or path locations

- Required when venue map does not support the geographic granularity required for operational decisions.
- Adequate scale map to identify avalanche paths.
- Includes any operational notes or comments (e.g. “creeks typically open year-round”; “adequate for 10 or fewer full snow profiles”).

- Includes notable avalanche observations.

Terrain Catalog Example

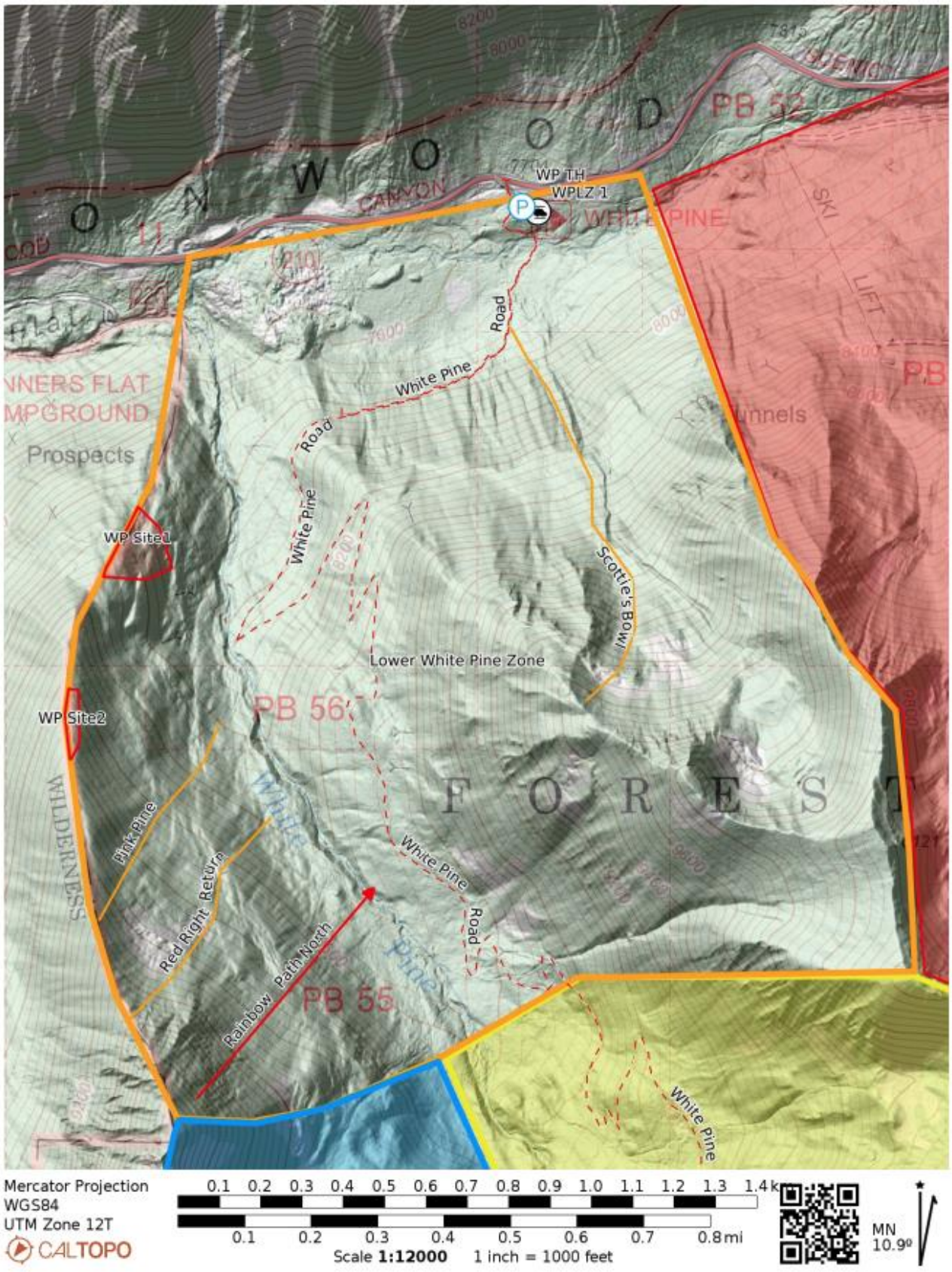
7.1.1 Venue



Venue Name	Snowbird, UT
Mountain Range & Sub-range	Wasatch Mountains/ Little Cottonwood Canyon
Link to digital collection	https://caltopo.com/m/F87A
Elevation Range	7,450-11,450
Area (sq mile)	9 sq mile/ 5,700 acres
Snow Climate & Latitude	Transitional, 40.5 deg N
List of Operating Zones	White Pine (Lower, East, West); Snowbird Resort, Sinner's Pass, Mary Ellen, Cardiff Pass

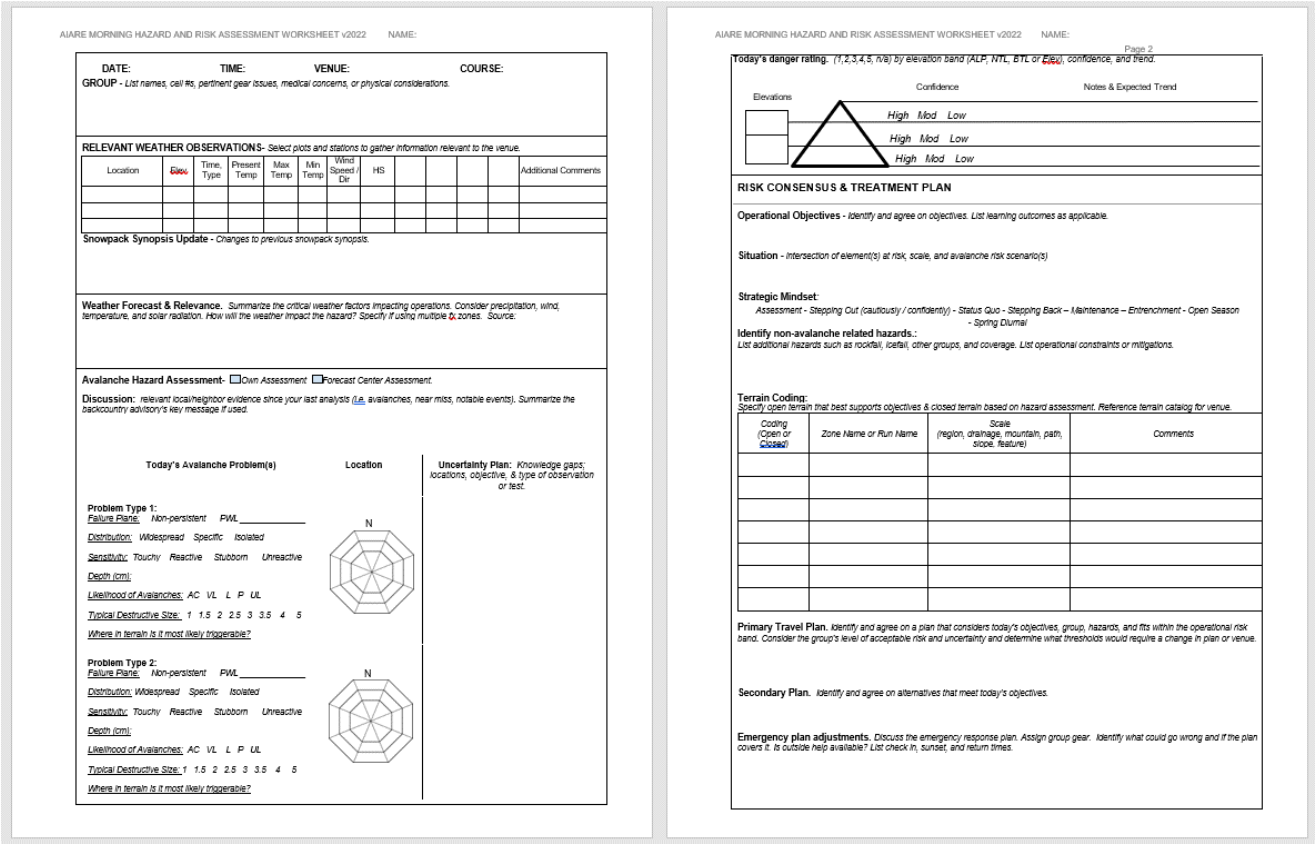
List of Trailheads or Access	White Pine Trailhead 7,600'; Snowbird Resort Entry 1, 2, and 4 8,100'; Cardiff Pass-Town of Alta-8,600'
List of Routes or Runs	See Run List
List of Avalanche Paths	See Path List
Course History	ITC 2: 2013. Level 3:2015-2017. PRO 1: 2018-2021. PRO 2: 2019.

7.1.2 Operating Zone



7.2 Example Operational Worksheets for Record Keeping

7.2.1 Pre-Field Trip Hazard & Risk Assessment



AIARE MORNING HAZARD AND RISK ASSESSMENT WORKSHEET v2022 NAME:

DATE: TIME: VENUE: COURSE:

GROUP - *List names, cell #s, pertinent gear issues, medical concerns, or physical considerations.*

RELEVANT WEATHER OBSERVATIONS- *Select plots and stations to gather information relevant to the venue.*

Location	Elev.	Time, Type	Present Temp	Max Temp	Min Temp	Wind Speed / Dir	HS				Additional Comments

Snowpack Synopsis Update - *Changes to previous snowpack synopsis.*

Weather Forecast & Relevance. *Summarize the critical weather factors impacting operations. Consider precipitation, wind, temperature, and solar radiation. How will the weather impact the hazard? Specify if using multiple dx zones. Source:*

Avalanche Hazard Assessment- ☐Own Assessment ☐Forecast Center Assessment.

Discussion: *relevant local/neighbor evidence since your last analysis (i.e. avalanches, near miss, notable events). Summarize the backcountry advisory's key message if used.*

Today's Avalanche Problem(s) | **Location** | **Uncertainty Plan:** *Knowledge gaps; locations, objective, & type of observation or test.*

Problem Type 1:
Failure Plane: Non-persistent PWL_____
Distribution: Widespread Specific Isolated
Sensitivity: Touchy Reactive Stubborn Unreactive
Depth (cm):
Likelihood of Avalanches: AC VL L P UL
Typical Destructive Size: 1 1.5 2 2.5 3 3.5 4 5
Where in terrain is it most likely triggerable?

Problem Type 2:
Failure Plane: Non-persistent PWL_____
Distribution: Widespread Specific Isolated
Sensitivity: Touchy Reactive Stubborn Unreactive
Depth (cm):
Likelihood of Avalanches: AC VL L P UL
Typical Destructive Size: 1 1.5 2 2.5 3 3.5 4 5
Where in terrain is it most likely triggerable?

AIARE MORNING HAZARD AND RISK ASSESSMENT WORKSHEET v2022 NAME:

Page 2

Today's danger rating: *(1,2,3,4,5, n/a) by elevation band (ALP, NTL, BTL or Elev), confidence, and trend.*

Elevations	Confidence	Notes & Expected Trend
	High Mod Low	
	High Mod Low	
	High Mod Low	

RISK CONSENSUS & TREATMENT PLAN

Operational Objectives - *Identify and agree on objectives. List learning outcomes as applicable.*

Situation - *Intersection of element(s) at risk, scale, and avalanche risk scenario(s)*

Strategic Mindset:
Assessment - Stepping Out (cautiously / confidently) - Status Quo - Stepping Back – Maintenance – Entrenchment - Open Season - Spring Diurnal

Identify non-avalanche related hazards.:
List additional hazards such as rockfall, icefall, other groups, and coverage. List operational constraints or mitigations.

Terrain Coding:
Specify open terrain that best supports objectives & closed terrain based on hazard assessment. Reference terrain catalog for venue.

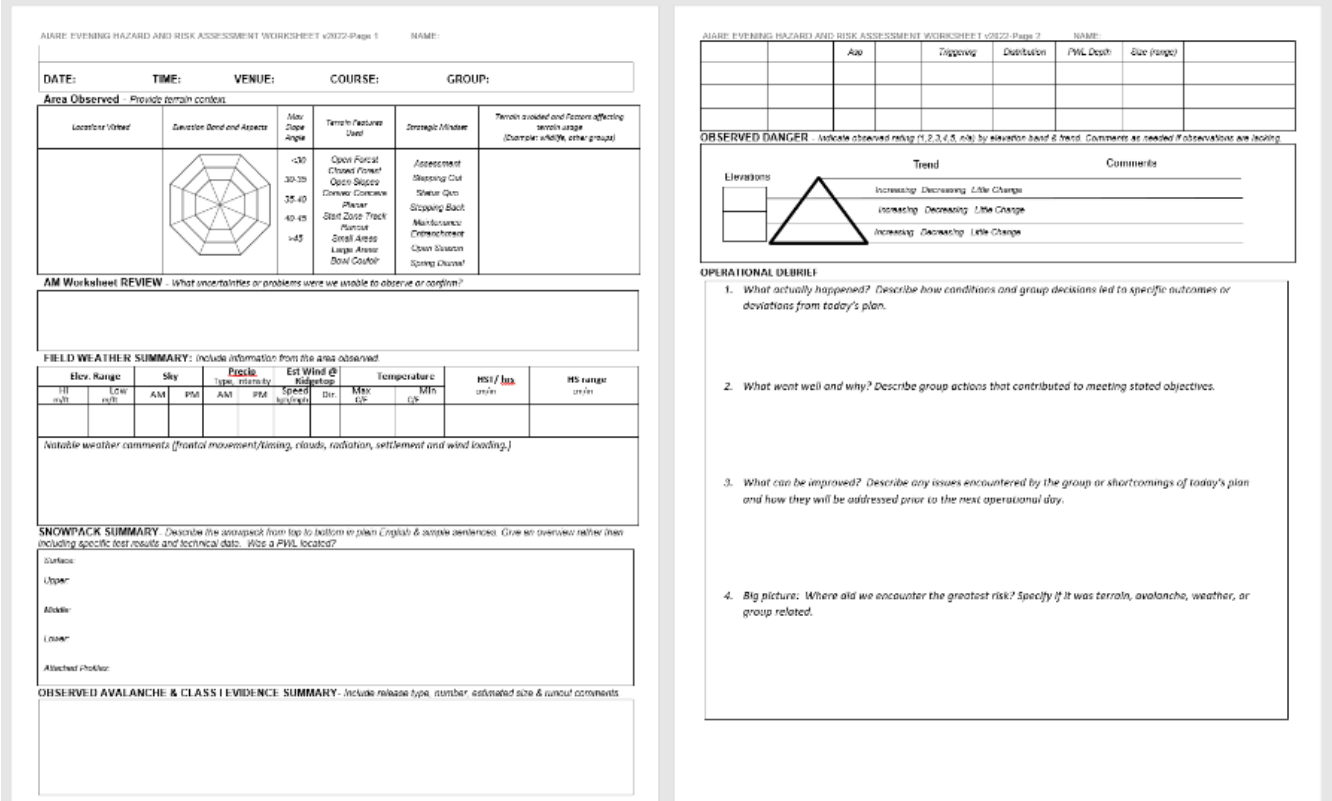
Coding (Open or Closed)	Zone Name or Run Name	Scale (region, drainage, mountain, path, slope, feature)	Comments

Primary Travel Plan. *Identify and agree on a plan that considers today's objectives, group, hazards, and fits within the operational risk band. Consider the group's level of acceptable risk and uncertainty and determine what thresholds would require a change in plan or venue.*

Secondary Plan. *Identify and agree on alternatives that meet today's objectives.*

Emergency plan adjustments. *Discuss the emergency response plan. Assign group gear. Identify what could go wrong and if the plan covers it. Is outside help available? List check in, sunset, and return times.*

7.2.2 Post-Field Trip Summary & Debrief



AIARE EVENING HAZARD AND RISK ASSESSMENT WORKSHEET v2022-Page 1 NAME:

DATE: TIME: VENUE: COURSE: GROUP:

Area Observed - *Provide terrain context.*

Location Visited	Elevation Band and Aspects	Max Slope Angle	Terrain Features Used	Strategic Mindset	Terrain avoided and Factors affecting terrain usage (Example: wildlife, other groups)
		<30 30-35 35-40 40-45 >45	Open Forest Closed Forest Open Slopes Convex Concave Planar Start Zone Track Runout Small Areas Large Areas Bowl Couloir	Assessment Stepping Out Status Quo Stepping Back Maintenance Entrenchment Open Season Spring Diurnal	

AM Worksheet REVIEW - *What uncertainties or problems were we unable to observe or confirm?*

FIELD WEATHER SUMMARY: *Include information from the area observed.*

Elev. Range		Sky		Precip Type, Intensity		Est Wind @ Ridgetop		Temperature		HST / hs	HS range
Hi m/ft	Low m/ft	AM	PM	AM	PM	Speed km/h/mph	Dir.	Max °C/°F	Min °C/°F	cm/in	cm/in

Notable weather comments (frontal movement/timing, clouds, radiation, settlement and wind loading.)

SNOWPACK SUMMARY - *Describe the snowpack from top to bottom in plain English & sample sentences. Give an overview rather than including specific test results and technical data. Was a PWL located?*

Surface:
Upper
Middle
Lower
Attached Profile:

OBSERVED AVALANCHE & CLASS I EVIDENCE SUMMARY- *Include release type, number, estimated size & runout comments*

AIARE EVENING HAZARD AND RISK ASSESSMENT WORKSHEET v2022-Page 2 NAME:

		Asp		Triggering	Distribution	PWL Depth	Size (range)	

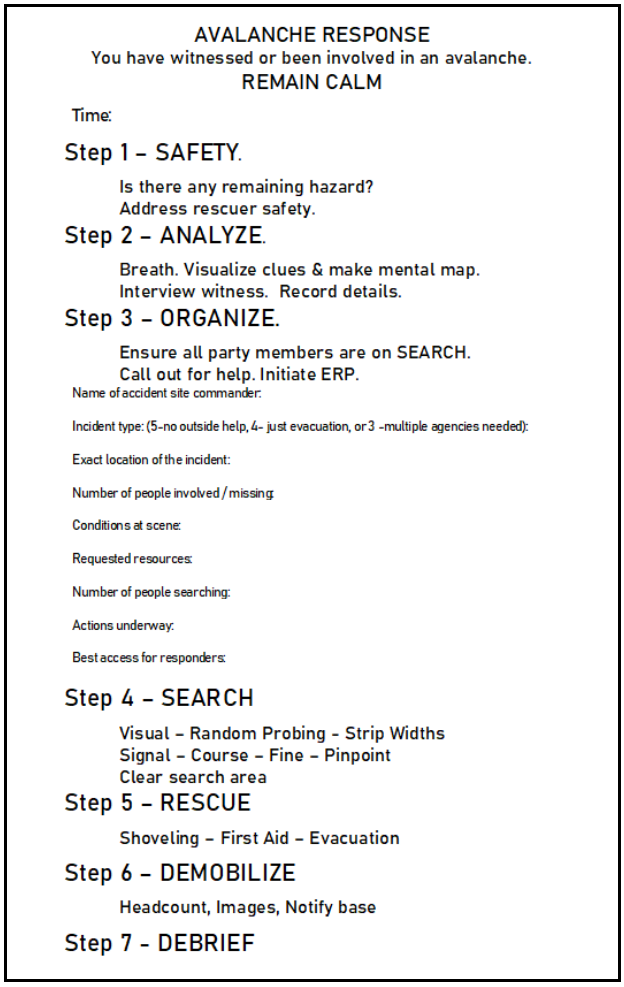
OBSERVED DANGER - *Indicate observed rating (1,2,3,4,5, n/a) by elevation band & trend. Comments as needed if observations are lacking.*

Elevations	Trend	Comments
	Increasing Decreasing Little Change	
	Increasing Decreasing Little Change	
	Increasing Decreasing Little Change	

OPERATIONAL DEBRIEF

1. *What actually happened? Describe how conditions and group decisions led to specific outcomes or deviations from today's plan.*
2. *What went well and why? Describe group actions that contributed to meeting stated objectives.*
3. *What can be improved? Describe any issues encountered by the group or shortcomings of today's plan and how they will be addressed prior to the next operational day.*
4. *Big picture: Where did we encounter the greatest risk? Specify if it was terrain, avalanche, weather, or group related.*

7.2.3 Example Avalanche Rescue Card



AVALANCHE RESPONSE
You have witnessed or been involved in an avalanche.
REMAIN CALM

Time:

Step 1 – SAFETY.

Is there any remaining hazard?
Address rescuer safety.

Step 2 – ANALYZE.

Breath. Visualize clues & make mental map.
Interview witness. Record details.

Step 3 – ORGANIZE.

Ensure all party members are on SEARCH.
Call out for help. Initiate ERP.

Name of accident site commander:

Incident type: (5-no outside help, 4- just evacuation, or 3 -multiple agencies needed):

Exact location of the incident:

Number of people involved / missing:

Conditions at scene:

Requested resources:

Number of people searching:

Actions underway:

Best access for responders:

Step 4 – SEARCH

Visual – Random Probing - Strip Widths
Signal – Course – Fine – Pinpoint
Clear search area

Step 5 – RESCUE

Shoveling – First Aid – Evacuation

Step 6 – DEMOBILIZE

Headcount, Images, Notify base

Step 7 - DEBRIEF

7.3 Course Descriptions

PRO 1

The PRO 1 is, at minimum, a five-day course. It is designed to cover topics essential to the workplace, including identifying and characterizing avalanche terrain, understanding how avalanches form and release, collecting and analyzing weather, snow, and avalanche data, and communicating hazard and risk factors. PRO 1 students conduct daily operational forecast meetings, apply effective communication strategies, and debrief field observations and decisions. The course includes pre-course reading, class presentations and field exercises, daily travel near or in avalanche terrain, and exams.

PRO 2

The PRO 2 is, at minimum, a six-day course. It is designed for those who are (or will become) operational leaders. Examples include the lead in avalanche forecasting operations, guides and ski patrol leaders who operate alone and/or will be responsible for risk management of a group or a team, as well as avalanche education course instructors and course directors. The course reviews best practices in avalanche risk management, including data management and reporting, long term observation and documentation, risk reduction procedures, worker safety, and the development of strategies to limit the effect of bias and uncertainty on individual and team decisions.

Instructor Training Course

The AIARE Instructor Training Course (ITC) is a five-day course that trains experienced backcountry travelers and avalanche professionals how to work with a team to meet the learning outcomes of AIARE's recreational avalanche education curriculum, Decision Making in Avalanche Terrain. Course participants practice teaching components of the AIARE curriculum and receive feedback on their instructional skills as well as adapting their skills as an avalanche professional to manage risk for an educational context. Upon successful completion of the course, participants will be qualified to instruct AIARE 1, Avalanche Rescue, and AIARE 2 courses. AIARE Providers, who use the AIARE curriculum to independently offer high quality avalanche education, often require additional training and certifications such as first aid, as well as demonstrated skills in guiding and movement.

Course Leader Training

This AIARE Course Leader Training is a five-day course that trains experienced AIARE Instructors to lead an instructional team in delivering Avalanche Rescue, AIARE 1, and AIARE 2 courses. Participants will apply their operational risk management skills in practicing building a teaching venue, managing and coaching an instructional team, as well as demonstrating their proficiency as instructors and fluency with the AIARE curriculum.

8. List of ancillary documents

These are related documents that have cross-effect or interaction with activities covered in the avalanche risk management plan.

Document	Relevance

9. Annually Updated Documents Attached to Plan

9.1 Example Venue-Specific Avalanche Rescue Response Plan Format

Avalanche Rescue Response Plan for [venue name]	
You have received a call that there has been an avalanche accident. Remain calm and follow the steps below to gather information and initiate a rescue.	
Date:	
Time:	
Reporting Person:	
Exact Location of the Accident:	
Conditions at Scene of Avalanche:	
Number of people missing:	
Number of people searching:	
Location of mustering point for rescuers:	
Emergency Contact Numbers:	
Search & Rescue:	
Emergency Medical:	
Police:	
AIARE Staff:	
Avalanche dog:	
Local helicopter company:	
Key Location Coordinates	

Rescue equipment is maintained at these locations:

Description	List	Location