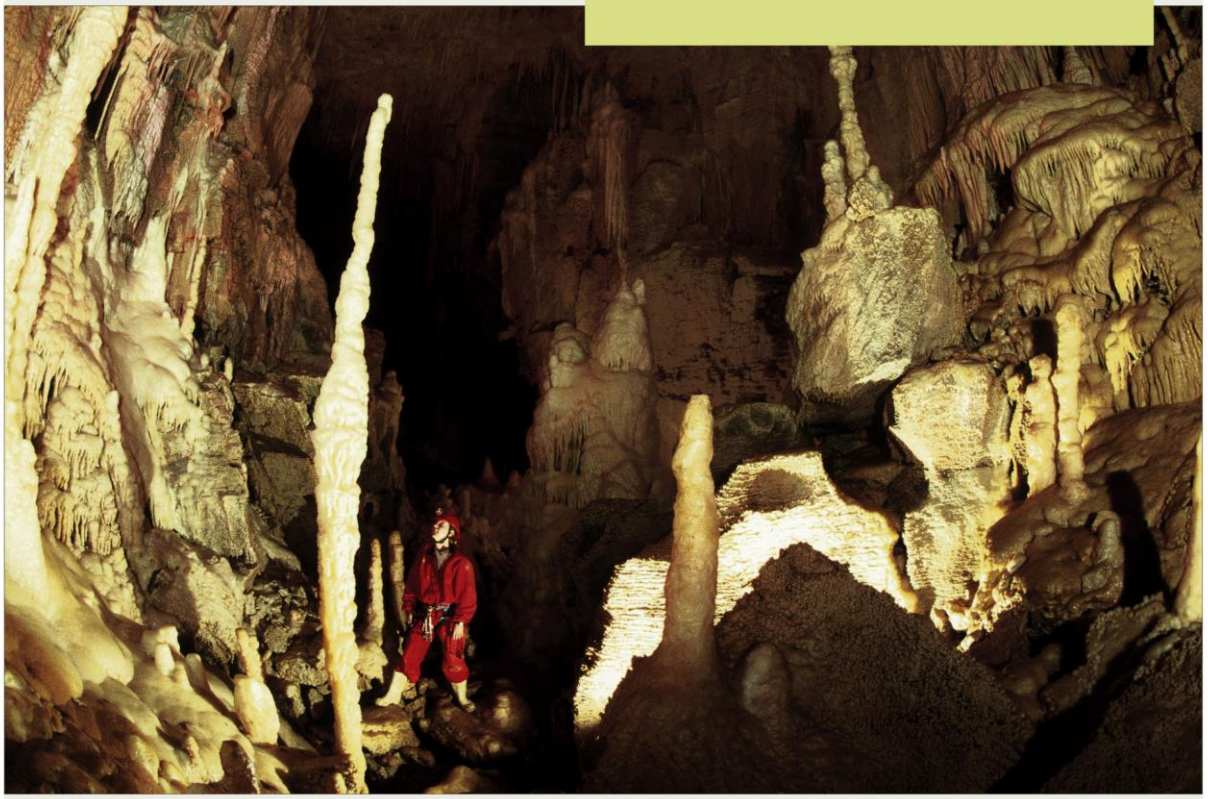
ASG

Activity Safety Guideline

Caving



September 2019 Version 2

SupportAdventure.co.nz

SAFETY SYSTEMS DRIVEN BY SAFETY CULTURE

Preface

This activity safety guideline (ASG) for caving was developed and published by Tourism Industry Aotearoa (TIA) with support from WorkSafe New Zealand. TIA involved experts from the caving sector and other relevant technical experts. More information about the development process can be found here.

Activity safety guidelines are a recommendation from the report of the 2009/10 government review of risk management and safety in the adventure and outdoor commercial sector in New Zealand. The variety of activities provided by these sectors is referred to broadly as adventure activities, and include activities provided by adventure tourism operators and outdoor education centres. More information about the government review can be found here.

The guideline is a web-based document and will be reviewed and updated as required. The current version is available at www.supportadventure.co.nz. This website also has information that is generic to all activities, and should be read in conjunction with this activity safety guideline. Users should periodically check the date and version number of the current online document to ensure that any printed copies are up to date.

TIA, WorkSafe, and the caving community have made every effort to ensure that the information contained in this guideline is reliable. We make no guarantee of its accuracy or completeness and do not accept any liability for any errors. We may change, add to, delete from, or otherwise amend the contents of this publication at any time without notice.

Document control

Version 2

Significant changes from version 1.3	**Where**
Deleted generic information	Generic information to all ASGs is now at: www. supportadventure.co.nz – see the **Risk Management** and **Good Practice** sections, and the **Mountain Biking ASG – Core Principles**
Updated health and safety terminology	Throughout the document
Added a *technical advisor* definition and revised some definitions, eg *risk*	Definitions
Expanded the swimming and wading section	Section 3.1
Broadened the lanyards concept to personal anchor systems (PAS)	Section 3.3
Expanded delivering safety information	Section 6.2

As well as these significant changes, there are small changes throughout the document.

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Cover photo: Saint Benedict's Cave. Photo: Waitomo Adventures.

Acknowledgements

Other publications

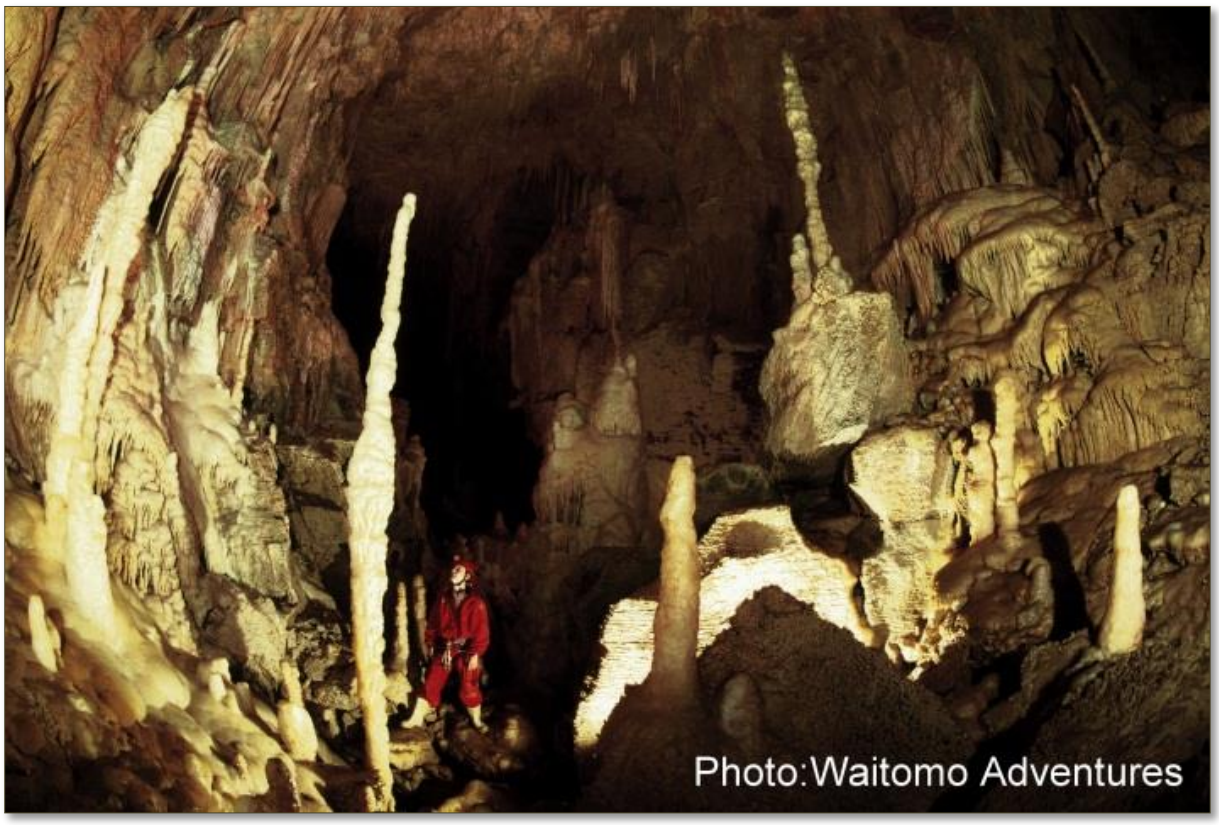
This guideline contains adventure tourism and outdoor commercial sector information published on the SupportAdventure website and public sector information published by WorkSafe New Zealand.

Consultation

The guideline was developed in consultation with the commercial guiding and instructing caving sector and other relevant experts. The following experts comprised the Caving ASG working group and are acknowledged for their advice and support: Kyle Barnes, Wayne Darlington, Simon Hall, Paul Hunt, Kieran McKay, and Angus Stubbs.

The following groups are also acknowledged for their input and support: Aviation, Tourism and Travel Training Organisation; Maritime New Zealand; Mountain Safety Council; New Zealand Outdoor Instructors Association; Outdoors New Zealand; outdoor safety auditors; Qualmark; Skills Active Aotearoa Industry Training Organisation; Tourism Industry Aotearoa; Water Safety New Zealand.

The 2019 review invited 29 stakeholders to provide input, many being operators registered with WorkSafe to provide adventure activities.



Contents

Definitions

This guideline assumes the reader has technical knowledge of this activity. It defines only those terms that may be unique to this guideline, are used in a specific way, or that would otherwise be open to interpretation.

For the purposes of this document, the following definitions apply.

Competent person (at a specific task)
A person who can correctly perform the task. They have usually acquired the knowledge and skills to do this through a combination of training, qualification and experience.

Client (participant)
A person who takes an active role in an adventure activity but is not in a leadership or supervisory role.

Direct supervision
Is when the person supervising is in a position to be able to physically intervene and manage anticipated hazards.

Edge
The place over which a person could fall if they are not attached to a safety system.

Fixed anchors
Anchors that are not placed protection anchors nor part of a building or structure, eg bolts or natural features such as strong trees or boulders.

Good practice
The range of actions currently accepted within the adventure and outdoor sector to manage the risk of harm to staff, participants, and visitors.

Incident
An event that caused or could have caused harm to any person, that is, both accidents and near misses.

Indirect supervision
Is when the person supervising is able to communicate with the person being supervised, but may not be able to physically intervene to manage risks should they develop. There are two types of indirect supervision – proactive and reactive:

- **Proactive** is where the supervising staff member is actively monitoring the client and is in a position to provide verbal assistance to intervene and manage risks should they develop.
- **Reactive** is where the supervising staff member is in a position to communicate verbally and provide assistance to a participant when sought, but may not be actively monitoring the client or provide pre-emptive assistance.

Operator
Person or other legal entity (whether an employer, principal, or self-employed person) that provides an adventure activity to a client.

Personal Anchor System (PAS)
A piece of equipment that secures you directly to the anchor or rope. It includes cow's tails, lanyards, adjustable tethers, and anchor chains (but not traditional daisy chains).

Placed protection anchors
Temporary anchors such as camming devices, wires, and nuts that are constructed at a site and removed on departure.

Qualified
A person who holds a current, nationally recognised qualification.

Risk
A chance of harm – a potential failure to ensure the health and safety of clients, staff, and others involved in an activity.

Risk assessment
A process undertaken by a competent person to identify hazards and their associated risks, and to assess the risks according to their significance – potential severity of impact and probability of occurrence.

Safety management plan (SMP)
The written plan outlining the systems an operator will use to manage safety.

Safety management system (SMS)
The overarching management system for controlling safety, that is, the SMP, SOPs, and all other documents that are part of an operator's safety planning, eg staff records and equipment checks.

Sector

New Zealand adventure tourism and outdoor education operators, support organisations, and associations. A specific part of the sector may be referenced, eg the caving sector.

Staff
Employees, contractors or volunteers who work for an operator and are responsible for the safety of clients undertaking caving activities.

Standard operating procedures (SOPs)
Written guidance that provides health and safety information about a particular activity or task – such as how it should be conducted.

Technical advisor
A person with a high level of competence who usually holds a high-level qualification in the activity. They understand current good practice and have extensive knowledge, skills, and experience sufficient to advise an operator, including reviewing the activity policies, procedures and practices. They can be internal (a staff member) or external.

Technical expert
A person who has professional credentials such as a high level, nationally recognised qualification or, if a qualification is not available, extensive knowledge, skills, and experience. They advise auditors on whether safety plans are consistent with good practice and whether operators are working to them.

Section 1: Introduction

1.1 The caving sector

Commercial caving in New Zealand occurs both in outdoor education centres and adventure tourism operations. The majority of commercial caving, and certainly the more technically difficult trips, occur with adventure tourism operations.

New Zealand cave tourism began with the Waitomo glow worm cave in the 1800s. The modern adventure tourism caving sector started in the late 1980s, corresponding with the broader New Zealand adventure tourism boom.

There are strong links within the adventure tourism caving sector. The majority of adventure tourism caving occurs in the Waitomo area, with a number of smaller operations spread throughout the rest of the country.

The outdoor education centres providing caving are spread throughout New Zealand and are not particularly connected with each other or the adventure tourism caving community.

There is a small but knowledgeable recreational caving community in New Zealand and there are a number of recreational cavers who work in the caving adventure tourism and outdoor education sector.

The recreational cavers developed caving-specific qualifications with the New Zealand Outdoor Instructors Association (NZOIA) in the late 1980s. A complementary set of qualifications was developed in the mid-2000s by the recreational and commercial cavers in association with Skills Active Aotearoa.

1.2 Legislation

Commercial caving operations are subject to the health and safety legislation as are all workplaces.

Health and safety legislation that applies to commercial caving operations includes the Health and Safety at Work Act 2015 – *the Act* – and the Health and Safety at Work (Adventure Activities) Regulations 2016 – *the Adventure Activities Regulations*.

The health and safety legislation uses both *operators* and *providers* to refer to people or organisations who provide activities such as caving. This guideline uses *operators* throughout.

The Adventure Activities Regulations

Caving activities expose the participant to risks of the kind defined in the Adventure Activities Regulations. The Adventure Activities Regulations cover activities where:

- the recreational or educational experience the participant has is the main purpose
- the participant is guided, taught or otherwise assisted to participate in the activities
- the design of the activities deliberately exposes the participant to a serious risk to their health and safety that must be managed by the operator
- failure of the operator's management systems is likely to result in a serious risk to the participant's health and safety.

The regulations require operations providing these activities to undergo an external safety audit and be registered with WorkSafe.

1.3 Purpose of this ASG & the SupportAdventure website

This ASG aims to provide guidance for commercial caving operators in New Zealand to actively manage the safety of the caving activities they provide.

The SupportAdventure website provides practical advice for adventure activity operators on developing good practice safety management systems, including information and examples for developing a safety management plan.

This guideline and the SupportAdventure website act as companions to the health and safety legislation. They are not part of the health and safety legislation, but following their recommendations will help operators meet legal requirements to take all practicable steps to identify hazards and manage risks.

An investigation into an accident may look at how well an operator followed this guideline. However, risks may be managed in ways other than those recommended in this guideline and achieve the same level of safety or better.

The responsibility for making safe decisions remains with the operator.

1.4 Using this guideline

This guideline defines caving as:

> An activity that involves movement through a natural underground environment requiring the use of technical safety equipment and techniques – as indicated by the Grade 1 to 6 cave environments described in section 3.1.

This guideline covers activities that meet this definition, whether or not they are advertised specifically as caving.

The guideline describes what caving operators and technical experts consider to be good practice for actively managing safety in providing commercial caving activities in New Zealand.

> This guideline is written for commercial abseiling operators (the primary audience) and also for safety auditors and technical experts (the secondary audience) as a benchmark for current good practice.

It will also be useful for:

- Other people involved in caving, such as trainers and people involved with providing non-commercial caving activities.
- Activities other than caving that involve similar hazards, risks, and techniques.

This guideline focuses on preventing serious injury and death. It identifies common significant hazards that clients, and the guides or instructors who lead them, may be exposed to during caving trips. It makes recommendations for managing the risks.

Activities associated with taking clients to and from caving activities are outside the scope of this guideline. Operators who provide these activities need to manage the associated hazards.

> *'Safety management systems are made of a safety management plan underpinned and driven by a positive safety culture'.* www.supportadventure.co.nz
>
> For information on building a safety management system, see: www.supportadventure.co.nz

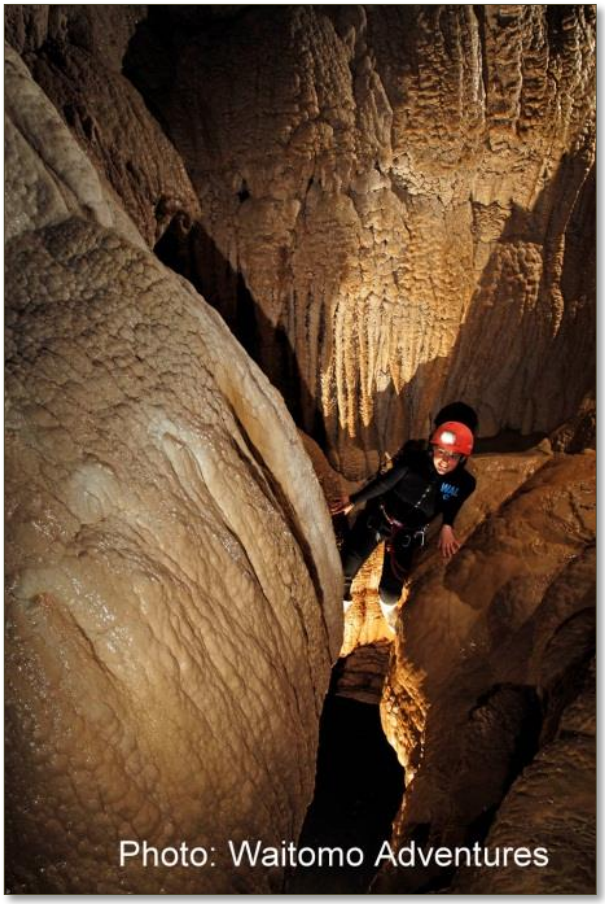
Building safety into your SOPs

As an operator, you should have an overall safety management plan that you use to manage health and safety in everything you do. Your plan should contain standard operating procedures (SOPs) for each activity you provide.

This guideline outlines good practice safety recommendations that are specific to caving. Conduct a site-specific hazard identification and risk management process, consider the recommendations in this guideline, and add the relevant procedures to your SOPs.

Before departing from the recommendations given here, seek advice from a caving technical advisor. Variations must be at least as good as the guidelines, and an operator will need to be able to justify why they use a different procedure from the guideline.

It is essential that, alongside site specific assessments and the use of this guideline, guides and instructors conduct dynamic hazard identification and risk management.



This guideline gives examples which are not exhaustive – think of other examples that could apply to your specific activity. The responsibility for making safe decisions remains with the operator.

This guideline gives examples to explain hazards and other concepts. The examples are not exhaustive – think of other examples that could apply to your specific activity.

It is essential that, alongside site specific assessments and the use of this guideline, guides and instructors conduct ongoing dynamic hazard assessment and management.

Passing safety audits

The Adventure Activities Regulations require a caving operator to pass safety audits by an audit provider recognised by WorkSafe. Following this guideline will help operators to do this.

The Safety Audit Standard for Adventure Activities outlines the standards or requirements that adventure activity operators must comply with to reduce risks when providing adventure activities.

This ASG sets out recommended technical standards for commercial caving activities. It will help safety auditors assess whether an operator is complying with good practice.

Section 2: The Caving Environment

The most likely sources of serious injury while caving are an unexpected rise in water levels, and impact and entrapment from cave roof collapse or from falling objects. Focus safety management strategies on preventing these from occurring.

Note: The other most likely serious injuries are impact injuries due to people falling from height. For more information on this and other activity-based risks see section 3.

2.1 Grading difficulty

A grading system is a tool for communicating the level of difficulty of a cave. The New Zealand commercial caving sector does not currently use a consistent national grading system.

For the purposes of this guideline six grades have been identified. The grades are based on:

- whether the cave is horizontal or vertical
- the type of technical safety system used to prevent falls
- whether or not the technical safety system is pre-rigged.

Horizontal caves: grades 1 and 2

Horizontal caves that may require the use of technical safety systems such as handlines, fixed ropes, or ladders, but do not include navigation of vertical sections requiring belaying. Horizontal caves are divided into two grades based on whether rope or ladder systems are in place before the trip begins.

Grade 1: pre-rigged horizontal
Handlines, fixed ropes, or ladders are set up before the trip begins.

Grade 2: non pre-rigged horizontal
The guide or instructor is required to rig ladders, and fix ropes or handlines as they go.

Vertical caves: grades 3 to 6

Vertical caves involve navigating one or more vertical sections that requiring belaying. Vertical caves are divided into four grades based on whether rope systems are in place before the trip begins, and on the required rope-safety techniques.

Grade 3: pre-rigged vertical top rope

Top ropes are the most technically difficult belay system used, and are set up before the trip begins.

Grade 4: non pre-rigged vertical top rope

The guide or instructor rigs them as they go.

Grade 5: pre-rigged vertical single rope

Single rope techniques (SRT) are used, and the rope systems are set up before the trip begins.

Grade 6: non-pre-rigged vertical single rope

The guide or instructor rigs them as they go.

2.2 Rising water level

The potential for rising water level is a very serious risk. Water levels can rise for several reasons, including heavy or persistent rain or snow melt in the water catchment, dam collapse and/or release, or landslides or avalanches into the water catchment.

Ensure that guides and instructors are well aware of the causes of rising water for the caves they work, and that they know how to monitor, plan for, and react to rising water levels. To do this they should know:

- local catchment areas and any associated dangerous weather patterns or dam and slide hazards
- likely water rising rates for particular weather patterns and catchment surface conditions
- the best weather forecasting service available (most up to date and most accurate) and how to use it
- how and when to cancel a trip due to water level concerns
- methods for monitoring water rising rates, water level indicators, and maximum safe water levels
- procedures for dealing with rising water levels in a cave, such as safe waiting areas, escape routes, and evacuation procedures
- landslide or avalanche hazards that could affect the catchment – how to monitor these and any associated activity cancellation parameters.

2.3 Getting assistance

Many caves have very limited access and often involve constricted space, which can make emergency evacuation difficult and lead to lengthy waits for external emergency support.

Strategies for managing difficult cave access should be based on the associated risk. Options include:

- mapping options for access and escape
- pre-rigging emergency access ropes or ladders
- caching emergency evacuation equipment
- induction training and ongoing practice for guides or instructors on access and escape routes
- training or informing local emergency services about your access systems and their limitations
- considering accessibility when determining guide or instructor to client ratios, screening clients, and setting competence requirements for guides or instructors
- ensuring that sufficient equipment is available to ensure group safety during a delay leaving the cave, such as warm clothing and high-energy food.

2.4 Cold temperatures

Cold air or water temperatures can lead to clients becoming hypothermic or struggling to safely participate in activities.

Strategies for managing cold temperatures should be based on the associated risk. Options include:

- ensuring that clients are equipped for the expected temperatures
- managing the start times and duration of trips to suit the temperature

- minimising time in cold water
- carrying and using extra thermal clothing, food, and heat sources
- training guides and instructors to manage cold temperature hazards.

2.5 Lack of natural light

The lack of natural light has the potential to lead to people falling off edges or hitting objects. It can also lead to people becoming lost or separated from the group – this can happen particularly quickly in a moving-water environment. Managing safety during technical activities can also be seriously compromised if sufficient light is not available.

Operators should ensure there are sufficient and suitable sources of artificial light to manage safety on the trip, including identified emergency scenarios. For information on light sources, see section 7.1.

2.6 Falling objects

Falling objects can be a significant hazard of caving and have the potential to injure large numbers of people without warning. This hazard is often present at cave entrances and in areas with unstable cave roofs and formations. Serious injuries may include those resulting from entrapment due to cave roof collapse.

Operators should assess and monitor the cave for the likelihood of falling objects. This should be based on the type and quality of the cave roof and its formations, and the environment around cave entrance points, including their proximity to people and animals.

Strategies for managing risks involved with falling objects should be based on the associated risk. Options include:

- avoiding the area by choosing a different route through the cave or cordoning off the area
- moving quickly through the area.

2.7 Changes to hazards

Significant environmental events such as floods, rock falls, cave roof or formation collapse may affect known existing hazards on a caving trip or create new hazards.

Check caves and relevant specific activities within caves after environmental events that could have changed or created hazards. Record any changes and notify relevant staff and other cave users.

2.8 Protecting caves

Cave environments are very easily damaged. Protecting the cave itself is an important part of running a caving adventure activity.

When establishing permanent equipment in contact with the cave walls, consider using stainless steel bolts rather than those that will corrode and stain cave walls, and avoid the use of metal cable and anchor systems. For more information on safe management of cave environments, see: www.ackma.org.

Section 3: Caving Activities

The information in this section should not be considered all-inclusive. It is essential to carry out site-specific and activity-specific risk management processes, and for guides and instructors to conduct ongoing dynamic hazard identification and risk management.

3.1 Swimming and wading

Caving often involves swimming and wading, and therefore exposes people to the risk of drowning.

Identifying the hazards

Hazards to consider when swimming or wading include:

- clients with limited or no swimming ability
- water that is fast flowing
- water that is too shallow or too deep
- unstable or slippery streamway bottom
- aerated water with reduced buoyancy
- features that could trap people.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

The SMS should establish maximum safe water levels for swimming, wading, and other water-related activities.

Guides and instructors should:

- Operate within the SMS's safe water levels.
- Choose swim or wade activities that match client abilities.
- Manage client equipment to eliminate or minimise entrapment risks to acceptable levels.
- Use additional buoyancy devices as in the recommendations in section 7.1.
- Check clients' swimming competence before activities that demand strong swimming ability.
- Assess swims and wades to ensure they can supervise and intervene as needed to manage safety.
- Directly manage difficult swim or wade exit points where exiting at that point is integral to safety.
- Only allow clients to swim over drops when the landing area is deep and obstacle free.
- Receive swift water rescue training if operating in large river caves where the water is the main element of a trip.
- Receive training on high-water levels in the event that they are caught by unexpected rises.

Client management

Guides and instructors should understand the characteristics of the group and manage the safety of each member. For example:

- identify and supervise weak swimmers – consider avoiding the swim or wade, swimming with the guide or instructor, or using extra buoyancy as in section 7.1.
- ensure that supervision levels and strategies are in line with the group's needs.

Client briefing

Ask clients to inform the guides or instructors if they have limited or no swimming ability.

Include information on suitable hazard avoidance techniques in safety briefings for swimming or wading, eg:

- wading and/or swimming techniques suited to route to be negotiated
- ways to recognise hazards where appropriate, such as logs or undercut walls
- actively swimming away from hazards
- entrapment avoidance techniques such as white-water float position and active swimming.

Note: See also section 2.2 and section 2.4 for recommendations on managing the hazard of rising water levels and the effects of cold temperatures on people.

3.2 Negotiating sumps and ducks

Negotiating sumps and ducks is one of the most psychologically challenging caving activities. It also exposes people to the risk of drowning.

Identifying the hazards

One of the primary hazards is the limited options for supervising clients as they negotiate the sump or duck.

Other factors to consider when identifying hazards for negotiating sumps or ducks include:

- client panic
- high water levels
- low water clarity
- long or curved sumps or ducks.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

Standard operating procedures should include strategies as in section 2.2, and include water level indicators for specific sumps and ducks, as well as maximum safe water levels.

Use a directional aid to control the client's journey through the sump or duck, such as a handline or holding the guide or instructor's hand.

Establish water clarity parameters for sump and duck activities if integral aspects to managing client safety include the guide or instructor seeing the client, or the client seeing their way.

Client management

Ensure that each person is safely through before allowing another to enter the sump or duck – this may involve using a signal such as a torch flash or line tug.

Pay particular attention before and during the trip to assessing each client's likelihood to participate safely in negotiating a sump or duck – consider factors such as swimming ability and confidence underwater.

Client briefing

Guides and instructors should:

- Include sump and duck activities in the pre-trip risk disclosure information.
- Inform clients of how long they can expect to spend underwater negotiating the sump or duck.
- Instruct clients to enter the sump or duck only after the previous person is safely through.
- Instruct clients to use the directional aid to guide their journey.

3.3 Being exposed to edges

Negotiating caves often involves exposing clients and guides or instructors to edges and the risk of falls. Specific techniques for moving near edges also bring their own hazards. This section looks at reducing the risk of falling, using personal anchor systems, deep-water belaying, and using clients to belay.

Reducing the risk of falling

Manage general exposure to the risk of falling by ensuring that people stay far enough away from edges to minimise the risk. This will often include establishing safe zones back from an edge and communicating these clearly to clients.

Sometimes exposure to edges cannot be avoided. Belay client and instructors or guides, or attach them to a safety point, when in the opinion of a technical expert or suitably qualified person:

- they are likely to fall and the fall is likely to cause a serious injury, or
- a guide or instructor needs to be attached in order to protect the client safely.

Assess the likelihood to fall by looking at factors such as:

- how close people are to the edge
- how much the surface slopes down
- how unstable or slippery the surface is
- the ability of the client and guide or instructor.

Guides and instructors should use other safety techniques to protect clients from lesser falls that may still cause a serious injury, eg use spotting techniques when clients move in technically difficult terrain.

Operators should conduct regular in-house mock evacuations, particularly with regards to vertical extraction.

Using personal anchor systems (PAS)

A PAS is commonly used in conjunction with safety lines and anchors as a fall restraint.

Identifying the hazards

Hazards to consider when using personal anchor systems include:

- clients totally unclipping personal anchor systems in a hazard zone (a full unclip)
- clients being unable to reach clip and unclip points

- carabiner gates opening accidentally
- high peak forces impacting on people and equipment in the event of a fall.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

Operators should:

- Ensure unclip and clipping points are within safe reach of clients – *easy-on, easy-off*.
- Rig safety lines high so that they stay above waist height.
- Avoid using a PAS to protect vertical travel in conjunction with safety lines.
- Consider peak forces on people and equipment when establishing safety line angles and anchors, and when choosing safety line and PAS material.

Client management

Check clients' ability to use a PAS correctly, particularly around avoiding a full unclip.

Practise first in a low-consequence environment.

Ensure that individual client's supervision levels and strategies are in line with their needs.

Client briefing

Brief clients on:

- the possible consequences of double unclipping in the hazard zone
- strategies for staying attached, such as *add before you subtract*
- carabiner use and orientation, such as *the squeeze test*
- the importance of keeping the safety line above waist height.

Note: The High Wire and Swings and the Abseiling Activity Safety Guidelines may give different good practice guidance for the horizontal use of a PAS. The High Wire and Swings ASG gives good practice guidance for the vertical use of personal anchor systems.

Using clients to belay

Clients on caving trips are sometimes used to bottom-brake belay, and very occasionally to top-rope belay.

Identifying the hazards

Factors to consider when identifying hazards for using clients to belay include the belayer:

- using incorrect belay technique
- using safety equipment incorrectly, such as harnesses and rope attachment systems
- being distracted or not focusing on the task
- being unable to catch a fall due to mismatched size between the belayer and the person being belayed
- getting loose items or hair jammed in the belay device.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

When clients are top-rope belaying, if there is a mismatch in size between the belayer and the person being belayed, consider securing the belayer or adding friction to the system.

Client management

Pay particular attention to assessing clients and allocating belaying tasks to a suitable person.

Directly supervise client belayers if they are under 14 years old.

Either directly supervise client belayers 14 years old and over, or use an adequately trained and supervised client as a back-up belayer. Indirect supervision may be acceptable if all the following conditions are met:

- the client belayer has been approved for indirect supervision by an experienced guide or instructor verified as competent in the skills of the Level 1 NZOIA Caving qualification, or a guide or instructor verified as competent in the skills of the Level 2 NZOIA Caving qualification or the Skills Active NZ Certificate in Outdoor Leadership award.
- the guide or instructor has previously taught or observed the client belayer performing the task required and has absolute confidence that, in their opinion, the client will perform the skills correctly in normal and adverse conditions.

Ensure the client belayer and the guide or instructors are able to communicate throughout the belay process. Ideally, they would be able to see each other.

Client briefing

Instruct clients on the belay techniques for the system and equipment in use. Stress the importance of correct and diligent belaying techniques and the consequences of belay failure.

Ensure that clients secure loose items such as hair, jewellery, and clothes so they do not interfere with belay devices.

3.4 Ziplines

Caving sometimes involve ziplines, exposing people to the risks associated with falling from height and moving at high speed.

Additional sources of information and technical expert advice on managing zipline activities or constructing ziplines include commercial zipline operators, the High Wire and Swing ASG, and

technical rescue training associations such as the Search and Rescue Institute of New Zealand and Rescue 3 New Zealand.

Identifying the hazards

Factors to consider when identifying hazards for ziplines include:

- incorrect attachment to the zipline
- exposure of people to edges and falling
- impact of peak forces on people and equipment
- lack of ground clearance in take-off areas
- clients hitting obstacles in the path of travel or stopping zones
- clients not stopping in time or stopping too abruptly due to inadequate braking systems
- clients suspended in a harness for an extended period of time
- clients' hands, hair, or equipment being in positions where they could be caught in pulleys.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques and client briefings.

Technical systems

The operator should ensure that:

- zipline routes and landing zones are free of obstacles that could cause injury
- zipline angles and client retrieval systems enable efficient client travel and rescue
- launching and stopping systems do not cause impact likely to cause harm
- ropes, wires, anchors, and other system components are able to manage the likely forces of normal zipline use and emergency procedures[1].

Good practice alert for using ziplines

There have been two near miss incidents involving clients connected to ziplines by one point of attachment. This has resulted in both WorkSafe and the ASG working group recommending:

Use two points of attachment between the client's harness and the safety line.

Note: Ensure that attachments do not cause an entanglement hazard or otherwise interfere.

Client management

Instructors and guides should:

- Check the connection of the client's zipping device to the zipline before they launch.
- Ensure clients are protected from unsafe exposure to edges as in section 3.3.

[1] Strength requirements for load-bearing ropes in zipline systems will almost certainly exceed the recommendations made for general use ropes in section 7.1. Examples of ways to manage the additional forces include using double ropes or metal cables for low angle, horizontal, or highly tensioned ziplines.

Client briefing

Instructors and guides should:

- Instruct clients on safe hand positions to ensure that hands will not become entrapped in pulleys or braking systems.
- Ensure clients know what to do to assist with stopping themselves sliding back along the zipline once they have reached the end point.

3.5 Abseiling

This section covers guided abseiling and abseiling in waterfalls or into water. These activities all involve the risk of falling and have their own unique hazards.

Also see section 3.3 which describes strategies for managing the risks of clients belaying and the Abseiling ASG.

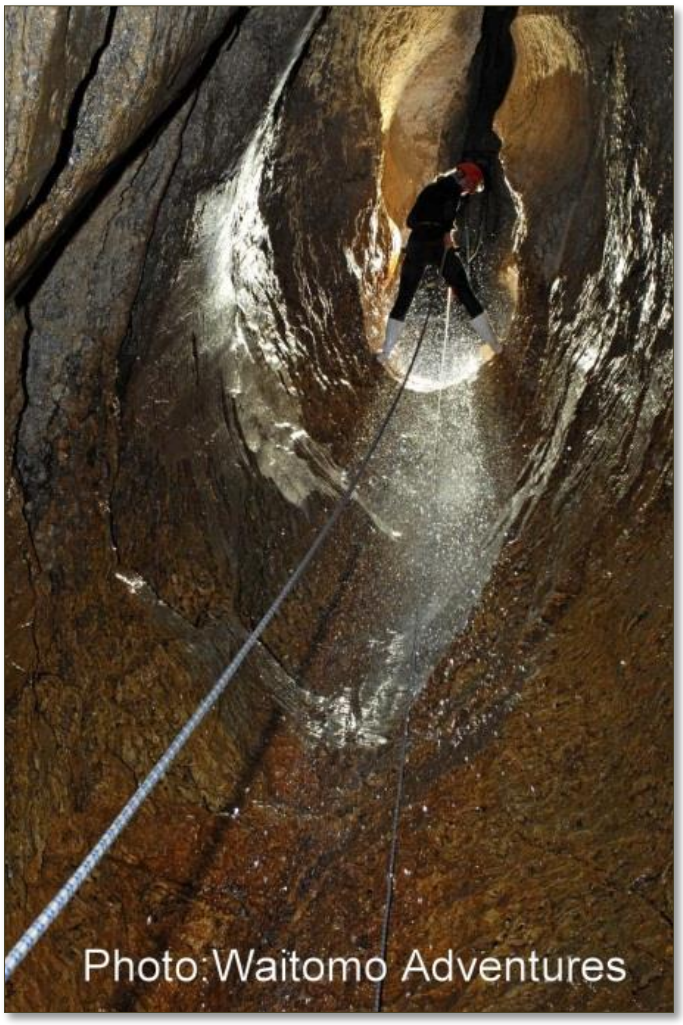
Guided abseiling

Caving often involves clients abseiling and occasionally includes guided abseils.

Identifying the hazards

Factors to consider when identifying hazards for abseiling include:

- exposure of people to edges and falling
- incorrect client abseiling technique or equipment use
- a difficult abseil starting area affecting the ease of weighting the rope and options to practise abseil technique
- abseiler suspended in harness for an extended period of time
- top heavy clients creating the possibility of inverting while abseiling
- objects falling on the abseiler
- long abseils – compromised ability of guide or instructor to communicate with the client
- guided abseils – increased load on equipment and anchors and not avoiding the hazard as intended.



Managing the risks

Include strategies for managing these factors in technical systems, client management techniques, and client briefings.

Technical systems

Technical systems need to take into account equipment loadings, the time a client spends hanging in a harness, and the abseiler's ability.

- Ensure abseiling systems are releasable or include another option for recovering the abseiler in stuck abseiler scenarios, eg hauling systems or lowering using another rope.
- Choose abseil sites and starting point set ups to enable clients to safely weight the abseil rope.
- Choose abseil sites and instructor or guide supervision positions to enable suitable supervision of the abseiler's descent, such as being able to see and talk with a nervous abseiler during difficult sections.
- Provide clients with equipment to maintain them in an upright position if the instructor or guide thinks they may invert while abseiling.
- Guided abseils – ensure anchors and equipment is suitable for the extra load on the system and line tension and angle is sufficient to avoid the relevant hazard.
- Keep the edge at the top of the abseil site clear of loose equipment and objects such as rocks.
- Protect ropes and webbing from sharp or abrasive surfaces – use edge protection such as padding or re-directing ropes.

Client management

Ensure clients have a safety backup system while abseiling. This will usually involve being belayed by another person. Clients using self-managed backup systems such as prusiks will generally only occur in an instructional rather than a guided environment.

The decision to allow a client to use a self-managed backup system, or to check their own abseil device connection, should be made by a guide or instructor verified as competent in the skills of the NZOIA Cave 2 qualification, or the Skills Active NZ Certificate in Outdoor Leadership award. For information on guide and instructor competence and qualifications, see section 5.1.

Check the connection of each client's abseil device to the rope before they abseil unless **all** the following conditions are met:

- the guide or instructor has previously taught or observed the client performing the skills required and has absolute confidence that in both normal and adverse conditions the client will perform the skills correctly
- buddy checks are used
- the initial weighting of the client's abseil setup is backed up by another form of safety, eg the client being attached by a personal anchor system.

Client briefing

Instructors and guides should:

- Instruct clients on correct body position, and on techniques for speed control and braking.
- Instruct clients to secure loose items, such as hair and clothing that could catch in the belay device.

Abseiling in waterfalls or into water

Abseiling in waterfalls or into water adds the risk of drowning to that of falling. The significance of the hazards involved will usually increase with the amount of water, the number of entrapment features, and the length of the abseil.

Identifying the hazards

Factors that should be considered when abseiling in waterfalls include:

- features in the rock behind the waterfall trapping the abseiler – cracks, chockstones, hanging pools
- water hitting the abseiler or belayer, affecting their ability to abseil or belay
- surface slipperiness leading to foot entrapments or inability to maintain abseil stance
- difficult communication between client and the instructor or guide
- client bottom belayers needing to assist with complex rescue scenarios
- the abseiler becoming entangled in rope when abseiling into water.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

Instructors and guides should:

- If abseiling into water, ensure the abseil line finishes at or above water level and the abseil device allows easy rope release.

  Note: This assumes the abseiler is not being bottom-brake belayed.
- Packs should not be worn when abseiling in waterfalls with significant water flows.
- Client bottom brake belayers should stand back from the waterfall, have stable footing and good visibility of the abseiler.

Client management

Client screening and progressions should be used to ensure clients are suited to managing their role when abseiling in waterfalls.

Abseilers should be within sight of the guide or instructor in the parts of their descent involving significant water flows, ledges containing pools of water which present a drowning risk, or rock features which present an entrapment risk.

If bottom-brake belayers need to assist in complex rescues, such as those requiring them to assist with moving the abseiler out of the main flow, observe them competently performing the tasks required before they belay.

Client briefing

Briefing information will vary greatly depending on the actual hazards of a particular waterfall. Points to consider include instruction on managing slippery surfaces, avoiding entrapment features, and ways to maintain an airway, such as body and head positions.

If abseiling into water, instruct clients on how to get clear of the rope.

If using clients to bottom-brake belay an abseil where they may need to assist in a rescue and move the abseiler out of the main flow, ensure they have been previously trained and observed competently performing their part of the required rescue techniques.

3.6 Jumping into water

Commercial caving sometimes includes jumping into water. This involves risks associated with height, speed, water, and the inability to directly manage the client throughout the activity.

Identifying the hazards

Hazards that should be considered when jumping from height include:

- exposure of people to edges and falling
- difficult and exposed access routes
- unstable take-off areas
- lack of confidence or ability of client
- long horizontal distance of landing zones from the take-off position
- obstacles in route of travel
- the landing zone too shallow or containing obstacles
- non-aerated water in the landing zone for high jumps, causing hard landings
- high speed of client on landing
- equipment impacting the jumper on landing, particularly packs when jumping
- fast-flowing water in the landing zone flowing into hazards.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

Technical systems need to consider access and take-off areas, landing zones and run-out.

Instructors and guides should:

- Directly control client take-off positions if it is integral to safety, eg the guide or instructor being attached to a safety point at the top of a jump to enable the hands-on guidance of the client.
- Protect clients from falling as they access take-off areas, eg use fixed lines and personal anchor systems or direct guide or instructor assistance.
- Assess landing zones to ensure they have sufficient depth and no dangerous obstacles.
- Assess landing zones to ensure any impact on the client is acceptable – consider both water aeration and likely client speed.
- Position a guide or instructor to stop clients from being washed downstream in landing zones with exits that actively flush clients towards hazards. For lesser flows, this may be substituted by techniques such as a rope across the exit from the pool.
- Clients should not wear packs when jumping, and guides or instructors should consider forces resulting from landing wearing a pack before jumping themselves.

- Actively manage difficult landing zones, eg position a guide or instructor at the bottom to indicate the safe landing area and/or mark a hazard.
- Consider using buoyancy aids for high jumps into non-aerated water.

Client management

Client screening should be more stringent for jumps that have difficult access, take-offs, or landings.

Manage clients so that they do not interfere with each other's stability in access and take-off areas, nor land on each other in landing zones.

Client briefing

Instruct clients in take-off and landing positions, including body, head, and limb positions.

Inform clients that they can do a less risky activity where relevant, such as a lower jump.

Note: clients should be informed before a trip commences if a trip contains high-risk activities with no alternative options.

3.7 Negotiating confined spaces

Negotiating confined space is an integral activity on many caving trips. It involves the risk of entrapment and, when the confined space includes water, a risk of drowning.

Identifying the hazards

Factors to consider when identifying hazards for negotiating confined space include:

- client panic
- incorrect client movement techniques
- equipment becoming snagged
- high water levels blocking access to air
- obstacles blocking the passage
- guide or instructor inability to assist due to their size.

Managing the risks

Include strategies for managing risks in technical systems, client management techniques, and client briefings.

Technical systems

Instructors and guides should:

- Choose confined space activities that suit the abilities and size of clients.
- Ensure at least one guide or instructor on the trip is able to negotiate the confined space to access a client in an emergency.
- For confined space activities involving water, include safety strategies as in section 3.2, and include specific water level indicators for the confined space and maximum safe water levels.
- Ensure that trips with challenging confined space activities at the end of a trip include alternative options for exiting the cave.

Client management

Ensure that guide or instructor intervention is possible at all times during confined space activities. This could include using voice or physical contact.

Ensure that clients' equipment is unlikely to snag.

Client briefing

Include confined space activities in the pre-trip risk disclosure information.

Instruct clients on managing their equipment to avoid snags.

3.8 Using ladders

Ladders are used for gaining vertical height and as bridges for crossing open spaces. When height or exposure to edges is involved, the associated risk from falling should be managed as in section 3.3.

Wire ladder activities also involve the risk of entrapping fingers. Brief clients on how to avoid this.

Section 4: Trip Management

Trip management includes ensuring that each trip is staffed and monitored effectively and that the most practicable communications systems are in place.

4.1 Knowledge of the trip

Ensure that guides or instructors are familiar with the hazards of the cave they are working and with the operator's standard operating procedures. The number of trips and amount of training this requires will vary. Factors to consider include:

- the grade of the cave and the specific hazards associated with the trip
- the competence of the guide or instructor
- the familiarity of other guides or instructors with the trip.

4.2 Trip monitoring

Monitor trip safety with a suitable backup person who is not on the trip, and with a suitable person on the trip itself.

Backup monitoring

The person providing backup monitoring is responsible for initiating emergency response as per the procedures in the operator's safety management plan. They should not be in the cave and should be as contactable as is practicable while the trip is underway.

On-trip monitoring

Ensure every trip has a guide or instructor who is responsible for monitoring general trip safety and ensuring the trip follows the operator's standard operating procedures.

This person should be an experienced guide or instructor who the operator is confident will exercise good judgement under pressure.

Note: This does not remove the responsibility for each individual guide or instructor to manage the safety of clients within their supervision ratio.

4.3 Communication systems

Communication systems need to cover communication between:

- Guides or instructors within the cave.
- People in the cave and the backup monitor outside the cave, plus other emergency support.

Communicating with external support

Communicating from inside the cave with those outside is often very difficult.

Caving trips should have a primary communication system, and a backup system if the primary system is likely to be compromised. Compromising factors could include getting wet or suffering from impact damage.

The primary system should be the most effective option practicable, and ideally be two-way. Examples of communication systems include:

- access to nearby landlines
- scheduled meetings with other operators or backup personnel
- two-way devices, eg cellphone, satellite phone, or satellite texting device
- a one-way device, eg a personal locator beacon.

Exiting the cave will likely be required for use of devices that rely on coverage. Ensure that guides or instructors and personnel monitoring the trip are aware of coverage areas and blind spots.

Difficulty in communicating with external support is a significant hazard associated with many caves. Limited communication options can affect access to emergency support.

Communicating between guides or instructors within the cave

Communicating within a cave is often difficult due to lack of light, confined space, or water noise.

Ensure that guides or instructors are trained in the use of an agreed set of signals. These will often include light, rope, and whistle signals.

Section 5: Staff

Using competent staff is one of the mainstays of ensuring safety. It is the responsibility of the operator to ensure that staff are competent.

5.1 Qualifications

The caving qualifications are:

Skills Active

- **NZ Certificate in Outdoor Leadership (Leader):** for people in introductory, low-technical caves.
- **NZ Certificate in Outdoor Leadership (Guide):** for people who operate in a specific cave within the operator's safety management system.
- **NZ Certificate in Outdoor Leadership (Instructor)** – in development.
- **NZ Certificate in Outdoor Leadership (Senior Leader)** – in development.

NZOIA

- **Cave 1:** for people who deal with clients in easier caves with short pitches that can be negotiated using ladders.
- **Cave 2:** for people who deal with clients in all aspects of caving, including SRT, and for those who organise and supervise caving programmes.

For more information on these qualifications, including more detailed skill breakdowns, experience prerequisites, and minimum recommended first aid certification, go to: www.nzoia.org.nz and www.skillsactive.org.nz.

Recommendations for guides and instructors

Ensure that caving guides and instructors operating within the scope of the above qualifications:

- hold the current NZOIA or Skills Active qualification corresponding to their job requirements, or
- hold an equivalent qualification, or
- are verified as competent in equivalent skills.
- the assistant guide or instructor only manages the tasks for which they are verified as competent
- the competence of the assistant guide or instructor is considered when establishing client supervision levels.

Section 6: Clients

6.1 Ensuring clients are suited to the trip

Assess clients to check that they are suited to participate in the caving trip and its particular activities. This should happen before the trip begins and be ongoing during the trip.

Assessing clients

Use information gathered while assessing clients to inform trip options, client supervision levels, and activity choice within the trip.

Clearly identify what to assess in the operator's safety management plan. Staff other than guides or instructors, such as front-of-house staff or drivers, may be involved in assessing clients. Client assessment should be consistent across staff, and should reflect the requirements of each trip.

Factors to assess include:

- fitness and physical ability, including client size for caves involving size-dependent activities such as manoeuvring through a squeeze
- psychological factors such as the ability and likelihood to follow instructions, confidence in the environments of the caving trip, and phobias or fears, eg of darkness, heights, and water
- medical issues, particularly pre-existing injuries
- the technical skills required for the trip or a particular activity, such as swimming.

Information on managing clients with mixed abilities can be found at www.supportadventure.co.nz and in the Mountain Safety Council Outdoor Safety Manual – Risk Management for Outdoor Leaders

Age restrictions

Establish minimum age guidance for each caving trip. Factors to consider include:

- the grade of the cave
- activities within the cave and their specific hazards
- whether the client fits the safety equipment
- the ease of cave access and escape
- the ability to access external emergency support
- supervision levels
- experience and skill of guides and instructors.

There are no overarching age recommendations for caving in New Zealand. However, there are recommendations on the minimum age of client belayers. It is common practice for operators to require children aged under 18 to have guardian consent to participate in adventure activities.

6.2 Informing clients about safety

Managing safety is more effective if clients are well informed, particularly on the risks and requirements of the caving trip.

Pre-trip risk disclosure

Before setting off on a trip inform every client of the following information:

- Caving is an adventure activity involving risk of serious injury or death. Clients should be aware that the commercial caving operator cannot guarantee the client's safety.
- The trip is mentally and physically demanding and requires the client to be comfortable and confident with being in the dark, moving over uneven and possibly slippery terrain, being in the water, and dealing with confined spaces. These points should be emphasised to suit the particular trip.
- The client should follow guide or instructor instructions at all times and understand that this is critical to their safety and that of the group.

Mention specific hazards and emphasise on whether or not they can be avoided and any extra responsibility they place on the client. These include sole-guided trips and activities such as swimming or wading in moving water, sumps or ducks, abseils, jumping from height, and slides.

Inform clients of any difficulties of escaping the cave and communicating with external emergency support.

General safety information

Instruct clients in caving awareness and general techniques. This may occur before and during the trip. Factors to cover include:

- awareness of and warnings about the hazards of the cave
- the importance of listening to the guide or instructor
- the importance of staying together and using techniques such as a buddy system and a tail-end charlie
- procedures for routine movement through the cave, eg how to move on slippery and uneven terrain, staying back from edges, and avoiding protruding cave formations
- any in-cave communication systems such as the *OK* signal
- methods for maintaining body temperature
- emergency procedures such as staying put and waiting for instructions from the guide or instructor.

Safety information for specific activities or hazards

For parts of the cave involving a significant hazard, or requiring technical manoeuvring to negotiate, inform clients of:

- the hazard and warn of its dangers
- options for avoiding the hazard such as alternative routes or techniques
- the location of safe zones, such as waiting areas back from edges

- the techniques required to negotiate the hazard or participate in the activity, such as procedures for use of technical equipment and performing technical actions.

  Note: For guidance on points to cover for specific activities, see section 3.

- applicable emergency procedures or self-rescue techniques.

Using demonstrations and activity progressions

Use demonstrations and activity progressions where practicable, particularly for more difficult activities, to help ensure clients are prepared and fully understand what they are required to do.

6.3 Supervising clients

Supervision levels are an important tool for managing risk.

Minimum supervision levels

These supervision levels do not take into account the use of assistant guides or instructors. Consider which risk management tasks an assistant guide or instructor is verified to perform unsupervised before factoring them into supervision levels. For more information on assistant guides or instructors see section 5.

Minimum supervision levels

No. of guides or instructors	Guide or instructor skill level	Cave grades 1–5	Cave grade 6
Sole guide or instructor	As recommended for the grade of cave[2]	1:6[3]	1:3
2+ guides or instructors		1:6[4]	1:4

Parameters for sole guiding or instructing

Sole guided or instructed trips involve an increased risk of clients being inadequately supervised or spending extended periods of time in the cave in an emergency scenario.

The increased risk of clients spending longer in the cave in an emergency scenario is also present in trips with limited access to external emergency support. Sole guiding these trips may not be suitable.

Only sole guide trips where clients, guides or instructors, and the cave rigging all enable a safe trip.

Assessing and informing clients

When establishing parameters for assessing clients for participating in a sole guided or instructed trip, factors to consider include:

- increasing minimum age requirements
- increasing technical ability or training requirements

[2] Guides and instructors are assumed to have the skills recommended for the trip based on the qualifications in section 5.1. A guide or instructor without these skills is considered an assistant guide or instructor.
[3] This may extend to 1:10 in caves where there are no drops, belaying, or rigging.
[4] This may extend to 1:8 in caves where clients are not exposed to moving water.

- increasing psychological suitability requirements, eg high confidence in the cave environment and likelihood to follow instructions
- excluding some medical conditions.

Inform clients of the risk that they may be inadequately supervised and spend extended periods of time in the cave in an emergency scenario. Inform clients how they can assist with managing these risks. This should include:

- emphasising the heightened responsibility sole guiding places on them
- emphasising the importance of following instructions
- training them in signals as required to assist with communication within the cave
- training them how to maintain body temperature and how to use and access warmth sources
- training them in what to do if the guide or instructor becomes unable to assist them, eg instructing them to stay where they are, training them in how to call for outside help, instructing them on how to escape the cave and supplying a map showing escape routes.

Requirements for sole guides or instructors

Ensure that guides or instructors working sole guided trips are experienced and verified as competent to manage the trip alone. Factors to consider include:

- their level of experience and ability in the skills required for leading the trip, including managing emergency scenarios
- their degree of familiarity with the environmental particulars of that cave trip
- their degree of familiarity with the operator's standard operating and emergency procedures.

Rigging caves for sole guided or instructed trips

Ensure that cave rigging allows clients to be supervised or contained in a safe place, eg:

- stacked or tethered abseils
- clearly identified safe areas
- additional safety attachments such as personal anchor systems and handlines.

Section 7: Equipment

Ensure that equipment is suitable and in good condition. Equipment choices should be based on:

- the caving activities on the trip
- identified hazards and associated management strategies
- emergency scenarios and response plans
- factors on the day such as guide or instructor skills, client ability, and environmental conditions.

7.1 General use equipment

Use equipment according to manufacturers' recommendations and current industry use.

Use equipment that complies with relevant internationally or nationally recognised standards such as the International Mountaineering and Climbing Federation (UIAA), the European Conformity (CE), and the New Zealand and Australian standard (AS/NZS). Equipment should be manufactured specifically for rock climbing, abseiling, caving, or whitewater.

Client equipment

Correctly fit equipment as per the manufacturers' instructions. Check equipment for fit as suitable throughout the trip, such as before using harnesses.

This section looks at client equipment for all trips, including trips requiring buoyancy and trips requiring technical equipment for vertical environments.

All trips

Staff and clients should have:

- Thermal clothing or wetsuits that is sufficient to protect clients from hypothermia, impact, and abrasion.
- A helmet designed for the most relevant significant hazard presented by the cave, eg hitting head on cave surfaces or obstacles in whitewater.
- Footwear with low slip soles, such as pvc-nitrol boots or wetsuit booties.
- A light source with sufficient battery power to last the expected duration of the trip, and mounted on the helmet if two hands are required for safety or the trip involves swimming.

Trips requiring buoyancy

On trips that expose clients to the risk of drowning, and where the risk is not isolated by techniques such as clipping clients to fixed lines, ensure there is sufficient buoyancy for them to float, eg neoprene, inner tubes, or a personal flotation device (PFD).

Use a PFD to provide buoyancy if moving water and features within it are assessed as significant hazards. Factors to consider include:

- the swimming ability of the client
- the likelihood of a client to be trapped by hazards such as the river bottom, hydraulics, recirculation, siphons, strainers, and hanging pools in waterfalls
- the likelihood of a client becoming separated from a buoyancy device such as an inner tube
- the aeration of the water and the buoyancy it can provide
- the likelihood of a client being flushed downstream or being in moving water for a long time.

Note: Use of a PFD should be considered to assist with managing shallow water landings and managing the ability to hold on to a person, such as when catching a client and redirecting them away from a hazard.

Trips in the vertical environment

Technical equipment for the vertical environment will depend on the activities of the trip. It needs to enable risk management and emergency response strategies to be carried out, and will often include a harness, descent device, carabiner/s, and a PAS.

Guide and instructor equipment

Guides or instructors' equipment recommendations are the same as those for clients, with the addition of:

- clothing sufficient to enable participation in emergency response, eg additional thermal layers
- a knife of a type suited to, and rigged in accordance with, the trip's emergency scenarios
- a light source that is helmet mounted, sufficient in light emission to manage safety on the trip, and of sufficient power to last the expected length of the trip.

Note: Carbide lights are not recommended because they can damage the cave environment.

Life-bearing ropes, excluding ziplines

Choose ropes based on the expected use of the rope and the information in this section. Life-bearing caving ropes (excluding ziplines) are usually:

- in the 18–22kN range for rope breaking strength
- static, low stretch, or semi-static
- kernmantle or braid-on-braid design
- compliant with one of the following standards: EN 1891, AS4142.3, AS4142.2, ANSI Z133, CI1801.

Anchors, bolts, and rigging

Ensure anchor construction, rigging, and bolting is carried out by a person competent to do so and follows these recommendations:

- One anchor should only be used if it has been judged that it is so strong that it will not fail.

- Rigging of multipoint anchors should result in load sharing.
- Bolt anchors should have at least two bolts where they are expected to hold a fall or a two-person load.
- Bolt diameters and types should be suited to the rock and be able to support normal operational and emergency use, eg bolts and hangers rated to 22KN for life-bearing loads.
- Anchors should be placed where they can be protected from expected flooding and rocks falling from the cave roof. If this protected placement is not possible, the anchor should be identified as a hazard and monitored within the operator's safety management system.
- Rigging and rope systems should be protected from sharp edges or particularly abrasive surfaces.

Additional information and expert advice on bolting in the natural environment is available through the NZ Mountain Guide Association, the NZ Alpine Club, and the NZ Canyoning Association. Information on bolts and fall arrests can also be found in AS/NZS 4488 and AS 1891.4.

Information on constructing good anchors can be found in the book *Climbing Anchors* by John Long.

7.2 Emergency equipment

Accessibility of emergency equipment

Ensure that trip emergency equipment is suitably available and accessible. The nature of the cave trip and environment will determine whether equipment is attached to the guide or instructor's harness, carried in a backpack, and/or cached in the cave.

Note: Packs used to carry gear in caves where water is a significant factor should have flotation.

General emergency equipment and first aid supplies

Ensure that emergency equipment is sufficient and suitable for managing group safety and chosen for identified emergency scenarios. Ensure there is sufficient light source to manage identified emergency scenarios and exit the cave safely in the event of a light failure. The following items should also be considered:

- throwbags
- shelter and heat sources such as space blankets, heat packs, bothy bags, ground insulation, high energy food, and additional thermal clothing
- pliers
- a backboard or stretcher stationed strategically within the cave – consider including rated attachment points for hauling and helicopter strop use.

First aid supplies

Ensure that first aid supplies are suitable for the identified first aid scenarios of the trip. Suggestions for first aid kit contents can be found at www.supportadventure.co.nz.

Emergency equipment for vertical environments

Ensure that there is equipment available to manage emergencies on the most technical or longest vertical pitch. Equipment to consider includes:

- a static rope of twice the length of the longest non-avoidable abseil, with an additional length considered in caves with committing abseils without escape
- some webbing
- hardware, eg carabiners, descent devices such as abseil racks, ascent devices, and a hauling or progress-capture device.

When choosing hardware consider rope types and whether they are likely to be wet or dry, particularly when considering mechanical rope grabs versus prusik cord.

7.3 Equipment maintenance

Maintain, inspect and test equipment regularly and thoroughly enough to ensure its reliability. This section makes recommendations on:

- establishing maintenance, inspection, and testing schedules
- proof testing of bolts and other fixed anchor points.

Pay particular attention to safety equipment that is permanently installed, or that is left set up for extended periods of time, eg anchors, bolts, ropes, webbing, and cables.

Where a site has multiple users, it is recommended to share information and responsibilities on shared equipment maintenance, inspection, and testing. Keep records of equipment information as in the recommendations at www.supportadventure.co.nz.

Additional information on equipment inspection can be found at www.aspiring.co.nz. Although it is designed for situations outside the scope of this guideline, useful information on equipment, maintenance, testing, and inspection can be found in the Industrial Rope Access in New Zealand; Best Practice Guidelines.

Establishing maintenance, inspection, and testing schedules

Inspect equipment before it is used. Focus on identifying any major issues that could affect the performance of the equipment and any other issues that require testing or maintenance.

Ensure ongoing maintenance, inspection, and testing techniques and schedules are consistent with manufacturers' recommendations and reflect factors such as:

- normal operational wear and tear
- operational incidents such as exposure of ropes to sharp edges or emergency loads
- anticipated emergency loadings
- environmental factors such as the nature of the rock supporting a bolt or anchor
- time elapsed since the last check
- exposure to environmental factors that could have damaged the equipment, eg sea spray, rockfall, freeze-thaw, avalanche, and flooding.

Ensure inspection includes concealed components such as those in protective sleeves; examples include anchors around trees that are wrapped in protective material.

Proof testing of bolts and other fixed anchor points

These recommendations are based on engineering advice.

Through-bolted engineered anchors do not require testing and, in fact, should not be tested. They do, however, require maintenance and periodic inspection by a competent person in accordance with the designer's specifications. This competent person will usually be a professional engineer.

Proof test bolts and other non through-bolted engineered anchors such as posts, or obtain evidence that they have already been tested. Proof testing techniques include the use of load cells.

Conduct a risk assessment to determine when proof testing should occur, if sampling is suitable and, if so, what sampling schedule should be used. The risk assessment should consider factors such as:

- anchorage type, such as chemical or friction
- frequency of use
- exposure to environmental factors
- years in service
- expected wear and tear.

If sampling is used, ensure that it is sufficient to give assurance of overall anchor reliability and does not extend beyond six years between tests for any particular anchor. This maximum timeframe aligns with the Department of Conservation's backcountry structure proof-testing regime.

Ensure that anchors are able to support a 22KN load. When proof testing anchors, use test loads 50% of the strength limit state capacity of the anchors, eg to check an anchor is sufficient for a 22KN load, test to 12KN and, if the anchor has multiple legs, test each leg to 6KN.

Note: Do not test legs to less than 6KNs due to the difficulties of accurately predicting load sharing between linked anchor legs.

When proof testing anchors ensure that:

- Testing is done with certified and calibrated equipment and by a competent person – testing equipment, eg load cells, can be hired from industrial tools and equipment companies and some general hire companies.
- Proof test loads are applied gradually and held for at least two minutes – a positive test will show no signs of the anchor yielding or reduction of the load applied.

Using load cells to apply an axial pull is a practicable test for bolts. However, it may not be for other fixed anchors such as pickets or posts. Other testing options include loading anchors in shear. If testing anchors in shear, ensure that:

- loads are applied in the direction the anchor will be used
- loads are sufficient (friction will decrease the load) – options include using a load cell in between the anchor and the load
- anchor movement is measured against a fixed point – use a measuring device such as a dial gauge that indicates movement in at least millimetres increments; a positive test will show no deformation of the anchor and no movement at ground level. [5]

Industrial rope access companies and engineers are additional sources of information on bolt testing and load cell use.

[5] It is acknowledged that some anchors may show marginal movement at ground level and still be able to safely support a 22KN load. If an anchor shows movement at ground level, seek expert advice or treat the test as a fail.