Local Cave & Mine Leader Award Water Safety

British Caving Association

Supporting document for the LCMLA Award Scheme: Water Safety

Disclaimer

Neither the authors nor British Caving Association assume any responsibility for the improper application of the techniques or principles outlined in this document. Use of these techniques are at the user's risk. The techniques illustrated in this document provide supporting information for the Local Cave & Mine Leader Award syllabus and should be read with the remit of that award in mind. This document is not a substitute for attending certified training courses.

Introduction

This document has been produced on behalf of the Qualification Management Committee (QMC) of the British Caving Association. Its purpose is to support candidates preparing for the Local Cave and Mine Leader Award.

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Contents

Cave and mine exploration can include being in or near shallow, deep, slow or fast moving water. A leader should be able to assess and manage risks associated with water underground.

The LCMLA Syllabus and Water

Candidates must demonstrate competence in the following aspects of the syllabus regarding water. What follows is additional information to guide responsible risk awareness when managing groups underground in and near water.

- Weather forecast and sources
- Water levels and fluctuations – recent rainfall / catchment areas
- Effects of bad weather – on the surface
- Clothing – suitability for wet / dry venues
- Deep / fast water hazards
- Awareness of flooding – speed, likely effects
- Evidence of a cave or mine's reaction of flooding
- Emergency action in the event of accidental immersion

Typical caving water hazard, surprisingly deep water!

Drowning

Considerable work has been undertaken in recent years by the National Water Safety Forum (UK Drowning Prevention Strategy, 2016) to reduce the number of drownings in the UK, the annual figure being around 450. The key areas of concern in relation to primary drowning mechanisms are:

- Submersion - submerged airway leading to drowning. With the airway under water, water enters the lungs, blocks oxygen transfer, and leads to cardiac arrest
- Immersion Effects – which can result in airway submersion and drowning on varying timelines:
    - Cold Water Shock (0-3 minutes)
    - Swim or Buoyancy Failure (3 - 30 minutes)
    - Hypothermia (greater than 30 minutes)

Submerged airway and cold water shock are probably the most important for cavers. Swim failure is often about muscles beginning to become cold and unable to function effectively in cold water: a consideration for extended swims underground. Rafferty (2000) investigated buoyancy failure and demonstrated that a caver can sink in 65 seconds wearing "fibre pile undersuit, cordura or TSA, wellingtons, and full SRT rig", and only becoming "very buoyant" wearing "a full 5mm wetsuit with full SRT rig". Tipton et al (2017) in their useful review of cold water immersion note that "55% of annual open water deaths in the UK occurred within 3m of safe refuge".

Cold water shock possible from falling into deep water

Cold Water Shock is caused by sudden immersion and is a potentially lethal physiological reaction. Some people are more susceptible to cold shock than others; cold water immersion is a significant cause of death internationally.

Cold Water Shock only happens with sudden and total immersion, resulting in:

- gasping
- breathing rate becomes uncontrolled at 60-80 breaths per minute
- inability to hold breath
- potential instant Cardiac Arrest

Average UK water temperatures are 11ºC. Cold-Water Shock can occur in water at 25ºC, though hazardous responses peak between 10 and 15ºC. Water flowing into caves can be close to 0ºC, to above 11ºC depending on the time of year and weather conditions. Autogenic water (water from within a limestone area) or water deep underground is likely to be within the range of 8-12ºC.

Hypothermia

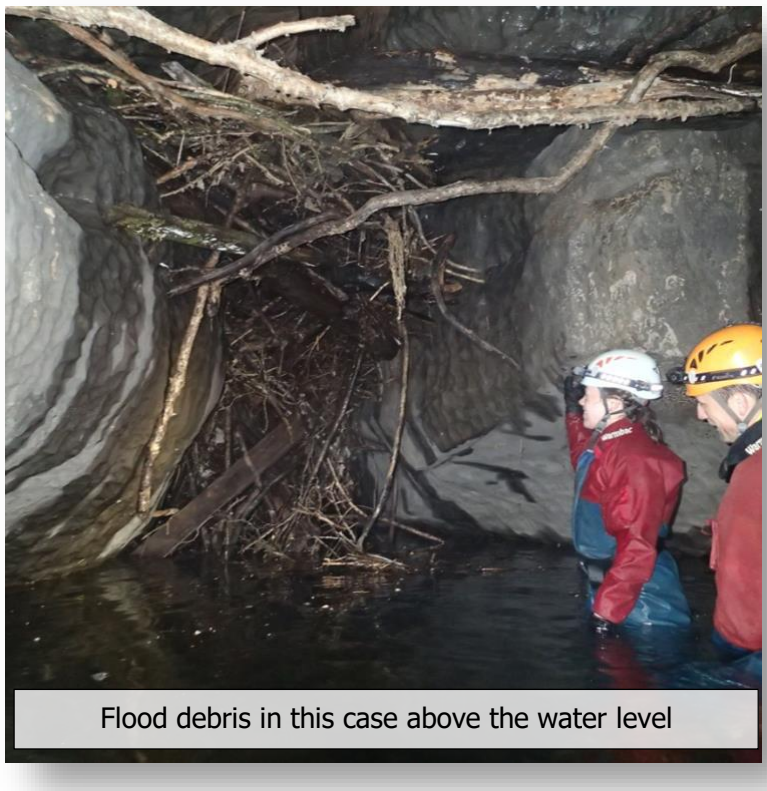
Hypothermia is a medical emergency that occurs when the body loses heat faster than it can produce it. Hypothermia can be serious if not treated.

Research has shown that survival times within the water are measured in hours rather than minutes, however once a group member is out of the water insufficient clothing or lack of movement can result in the onset, often gradual, of Hypothermia.

The ability to rewarm a person once removed from water is critical and in this regard effective shelter, warm dry clothing, and facility to provide a hot drink should be at hand. Recognition and effective treatment for hypothermia is an important aspect of first aid and rescue training.

Entrapment & Entanglement

If negotiating deep or swift moving water leaders need to consider the risk of entanglement in underwater debris, or becoming otherwise stuck, for anyone who submerges. Struggling against the flow of water can be exhausting leading to an inability to exit a cave/mine in rising water and becoming stuck. The forces experienced in swift water are considerable irrespective of the debris in the water or rolling rocks on the stream bed.



Flood debris in this case above the water level

Water or Fluid Material Inrush into Abandoned Mine Workings

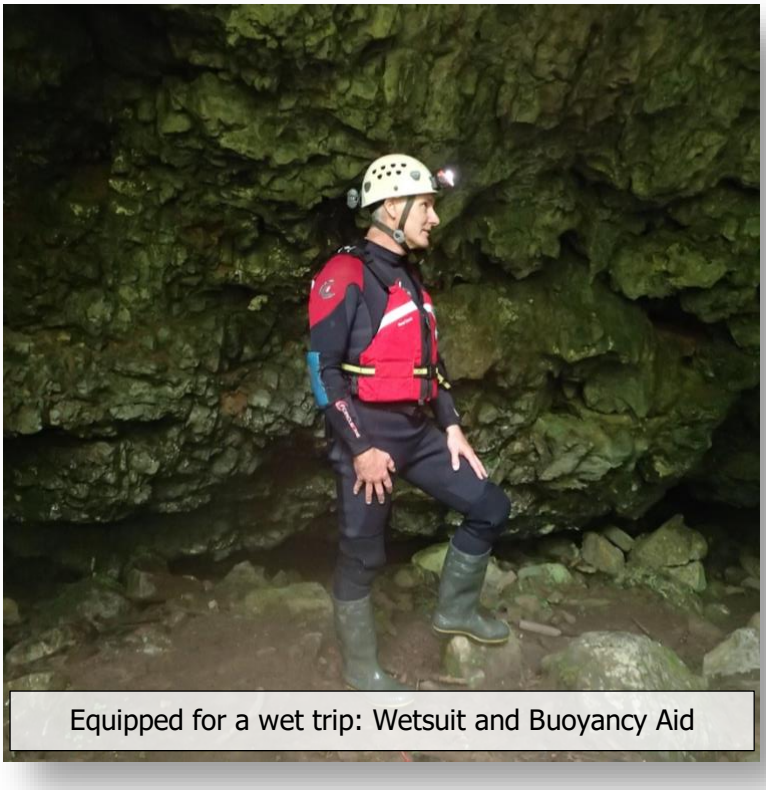
When planning leading groups in mines The Mine Regulations (2014) Regulation 33, 34, 35, require that a thorough risk assessment includes the chances of harm from sudden inundation by water, gas or any material that flows when wet. Inrush could be from adjacent workings or from surface water via a borehole, shaft, or other inlet. It must be assumed that inrush is possible unless there is evidence to the contrary.

A thorough examination of abandonment plans should be part of your written risk assessment along with advice from a certified mine engineer and other relevant authorities. Information should be documented and recorded so that it is readily available.

Considerations for a safe trip involving water

A thoroughly considered risk assessment drawing on local knowledge, experience and training helps avoid 'trouble', helps ensure that the correct equipment is carried, and that appropriate procedures around safety and rescue are in place.

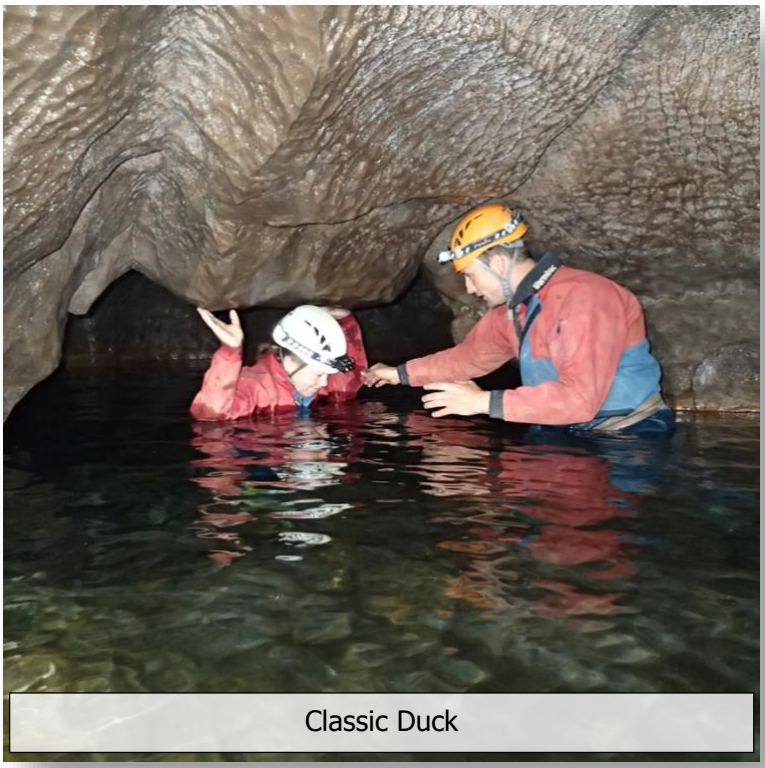
- **Weather Forecast** –always obtain a current and appropriate weather forecast for the catchment area in which you plan to cave/mine, as well as having an overview of the weather for several days leading up to the trip.
- Have a thorough understanding of how water levels, ground conditions and geology effect the suitability of your trip, taking into consideration the forecast, prior rainfall, and the hydrology of your venue. If in any doubt select a dry alternative venue
- **Good to excellent local knowledge** of the cave/mine system with regard to hydrology, flooding patterns, time to flood and drain, and in an emergency safe places to wait for rescue.
- **Equipment** – participants' clothing must be appropriate for the planned trip, a wetsuit or similar that provides protection from cold water is essential when planning to enter deep water, as is a buoyancy aid.
- **Route Choice** – routes that avoid deep, or fast water must be considered.
- **Traverse Lines** – and use of 'cows-tails' ensure cavers cannot slip, slide, or fall into deep or fast water.
- **Keeping away from edges** – Use good and timely briefing, create safe zones, or safely get between participants and drops to keep people away from deep water.
- **Ducks & Sumps** – A duck has a small airspace: breathing is not problematic and communication is easy. **A sump is a completely flooded passage and is beyond the remit of the LCMLA**, leaders wishing to negotiate sumps with groups should consider further site-specific training and risk assessment. When managing a duck leaders should consider:



Equipped for a wet trip: Wetsuit and Buoyancy Aid

    - Is the duck appropriate for the group, what if one member of the group refuses to continue?

- Are group members suitably equipped to continue the trip once wet?
- Could water levels within the duck back up as group members negotiate the challenge?
- If water levels rise will the duck still be passable, is there an alternative route?
- Can the leader position themselves to assist group members when negotiating the most challenging section of the duck?
- Are there any entrapment hazards, or the possibility of a group member going the wrong way?
- Can an assistant be positioned to assist group members through and gather group members at a safe collecting area on completing the duck
- What provision have you made to avoid hypothermia for cold, wet group members walking back from a wet trip in cold, and/or windy weather?

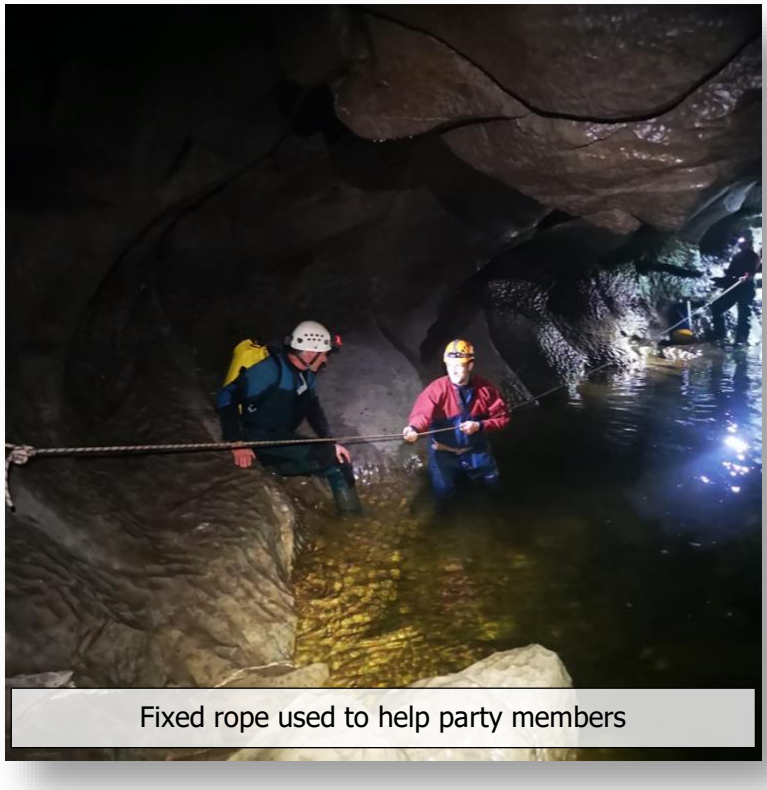


Classic Duck

- **Fast moving water** – assess the water flow prior to negotiating it. Water levels above the knees of the smallest group member are likely to be too challenging, and too risky, to negotiate.
- **Static water** – consider avoiding very slow moving or static water above the waist on the shortest member of the group.
- **A defined cut off level** – both outside and underground for high water should be identified and agreed with responsible, knowledgeable others. Once water levels and conditions are indicated as unsafe a trip should be abandoned, and a dry alternative sought.
- **Downstream hazards** – does the water become shallower, faster, deeper downstream or is there a waterfall, syphon or sump?

Deep Water

- Consider avoidance if possible such as rigging a tyrolean (Vertical Leader or CIC only) or make use of a boat.
- Wear an appropriately sized and correctly fitted buoyancy aid.
- Wear a wetsuit if swimming is necessary.
- Check the deep water area for avoidable hazards – high water, fast flowing water, strong currents, and entrapping debris (sweepers and strainers), such as trees and abandoned machinery.
- Ensure parties have a suitable leader and if an instructed group, ensure the leader is a BCA LCMLA or CIC holder, and with appropriate swift water training and experience.
- Consider a fixed rope through a deep water area and carry a floating throw-line.
- Ensure party members are confident swimmers and in good health.
- No pressure should be put on any party member to undertake any wet section of a trip.



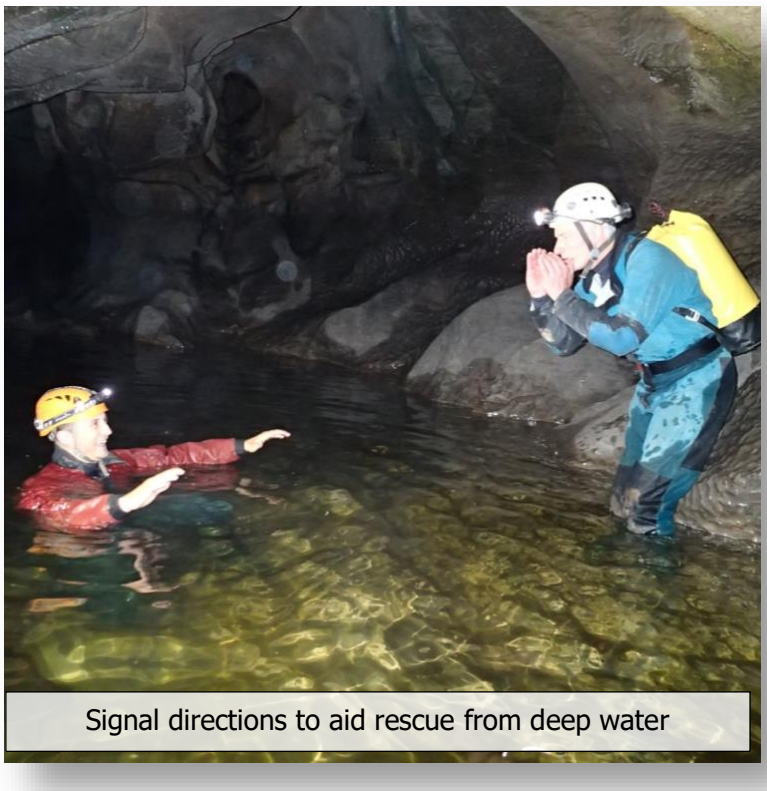
Fixed rope used to help party members

Always consider staying away from deep water areas - come back another time when conditions are better, you are more prepared, and with an appropriate group.

A journey through deep water underground is a serious undertaking and **people have lost their lives** attempting to go through deep, narrow, smooth and severely undercut sections of cave passage.

Rescue from Water

1. Shout & Signal
2. Throw
3. Reach
4. Wade
5. Tow



Signal directions to aid rescue from deep water

Conscious Casualty in the Water

For a conscious casualty provide a swift rescue without having to enter the water.

- Shout and signal to encourage a swimmer to get to a safe place
- Throw a buoyant bag or float to aid a person in the water.
- Carry a floating sling, length of tape or short floating rope to reach, perhaps combined with wading in, to get closer to the person in the water. Caving belts could also be used in this situation.

Floating tackle bag on cord used to aid a rescue

- Getting into out-of-depth water should be avoided by leaders unless there is no alternative. Consider your own buoyancy and the risk of cold water shock, wading in gradually rather than jumping in.

Further considerations

- A person in the water underground might not realise where a rescuer's voice is coming from. Give clear and firm instructions.
- Use your light to illuminate your hand signals

and illuminate the area you want the person to move to. Avoid dazzling a swimmer.

- Attempts at in-water rescue in ordinary caving clothing are at a high risk to both the casualty and rescuer. Controlled testing of in-water rescue in caving clothing has shown that buoyancy is minimal, it is hard to stay afloat, and the possibility of an effective in-water rescue is minimal.

Tape or Rope (ideally floating) used to aid a rescue

Unconscious Casualty in the Water

An in-water contact tow is both essential and extremely urgent. Get into the water gradually and, if possible, remain connected to others on land via rope, a bag, reaching, belts, etc, whilst ensuring that whatever is used is always immediately releasable to avoid entrapment.

Water Pollution

Any contact with water could expose both the instructor and group to water born diseases such as Leptospirosis (in particular Weil's disease), or other sources of pollution such as spilt fuel, run off from farms, or rubbish.

The risk of contamination can be reduced if still or slow-moving water or know contaminated areas are avoided, cuts covered, protective clothing worn and all exposed to cave or mine water thoroughly wash themselves following a trip. Particular care should be taken to ensure hands are thoroughly washed before eating.

Weil's disease is of particular concern to cavers. It is spread by animals and can find its way into water courses. Cavers can be infected through cuts, eyes, nose or if contaminated water is swallowed. **If infected, swift recognition of the symptoms and highlighting your previous caving activities to a GP could save your life!** Symptoms include a severe headache, chills, muscle aches and vomiting, usually develop 7 to 21 days after infection. Further details are available on the BCA website: https://tinyurl.com/BCAWeils.

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