



National
Operational
Guidance

Hazard

Below ground structures



NFCC
National Fire
Chiefs Council

Developed and maintained by the NFCC



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Hazard - Below ground structures

Hazard Knowledge

A below ground structure is either partially or fully under the ground, or under another type of covering, such as concrete. Incidents in these types of structures may present significant hazards for emergency responders and the public.

Below ground structures vary greatly in depth, surface area and design, often presenting hazards such as:

- Restricted access and egress
- Reduced visibility
- Extreme temperatures
- Complex and extensive layouts

Some structures are modern and well-documented. However, older buildings may be lacking in plans; they may also, either due to their design or adaptation, not conform to current building standards. Some may come under heritage designation or be tourist attractions, while others may have no official public access.

Below ground structures include:

- Pedestrian areas
- Waterways
- Road, rail or pedestrian tunnels
- Utility provision
- Car parks
- Mines
- Bunkers and underground storage facilities
- Military installations
- Basements
- Cellars
- Catacombs
- Vaults
- Cold stores

Such environments can be under construction, operational, disused or abandoned. Various types of incidents, either accidental or deliberate, may occur in below ground structures, including:



- Fire in structure
- Fire in vehicles
- Vehicle collisions, including road or rail vehicles
- Derailments
- People trapped by or in vehicles or machinery
- People lost or fallen into below ground structure
- Flooding or inundation
- Hazardous materials
- Explosions
- Collapse

Tunnels

Tunnels include those used for road, rail, waterway and pedestrian travel or for transporting goods and services, and will be of varying size and complexity.

Tunnels used for pedestrian access do not present many incidents for fire and rescue services. However, tunnels that form part of the transport infrastructure systems, including road and rail, more frequently require the assistance of the fire and rescue service. Incidents include vehicle collisions and fires in road tunnels, rail vehicle derailments and fires in rail tunnels, and fires on board vessels in waterway tunnels.

Hazards of working in tunnels include:

- Disorientation, due to:
 - Repetition of features
 - Lack of wayfinder indicators, such as signage or landmarks
- Reduced visibility
- Restricted communication
- Extended access, egress and evacuation distances
- High temperatures

For further information on rail tunnel incidents refer to [Transport – Rail-related incidents in tunnels](#).

Operational mines

Mines present various hazards, including:

- [Security features](#)
- [Moving vehicles: Industry](#)
- [On-site machinery](#)
- [Combustible dust](#)
- [Irrespirable atmosphere](#)

- [Reduced visibility](#)
- [Noise](#)
- [Explosives](#)
- Complex layouts
- Lengthy travel distances
- Vertical shafts, some hundreds of metres deep
- Traverses and climbs
- Constricted and restricted passages and squeezes
- Static or running water (sometimes completely submerging the passageways)

The incident may also be affected by the impact of adverse weather conditions on the environment below ground.

For further information refer to [Industry supplementary information: Mines and quarries](#)

Fire and rescue services may be called to mining-related incidents, such as partial collapse of a building or a person or animal falling into old mine workings. There may be oxygen-deficient atmospheres or gases that are toxic or explosive. Areas around the original collapse may be unstable and subject to collapse.

Caves

The UK has an extensive system of natural caves, coastal and inland, with new caves or extensions to caves always being discovered. Caving, also known as potholing, is the recreational exploration of caves and potholes. Depending on the ability and experience of people participating in this activity, the caves may be well-known to them or previously unexplored. Caves may also be explored for scientific or historical research.

There are also incidents when people accidentally fall into caves, for example due to unstable ground or the cave entrance being obscured.

The incident may also be affected by the impact of the weather on the environment below ground; cave systems may flood rapidly and with little warning.

Abandoned mines

Some parts of the UK have extensive disused mining systems, some of which are accessible to the public. The exploration of abandoned mines is sometimes arranged as an activity through caving clubs. Although people may have some knowledge and experience of these environments, it is an uncontrolled, unregulated and dangerous activity.

There are also incidents when people accidentally fall into abandoned mines or mineshafts, due to unstable ground or where the mine entrance or mineshaft are obscured.

Armed forces and civil protection below ground structures

The use of structures that are under military control is wide-ranging; they are not usually accessible by the general public or emergency services, as they are subject to security protocols.

Below ground armed forces or civilian protection structures have various uses including munition storage, command and control, equipment testing or accommodation. They may have several below ground levels or be on one level with a single entrance and exit. They may have ventilation and heating systems, be fully self-contained, and have pedestrian or vehicle access.

Decommissioned below ground structures may either be sealed up, or ownership transferred to another organisation to maintain and run for other purposes. One use may be that of historical education, in the form of a museum or historical society, such as the underground tunnels and command facilities at Dover. Others may be sold to private companies for a variety of purposes, such as document storage or housing of remote electronic equipment.

Critical national infrastructure

Some below ground environments may be used as a conduit for critical national infrastructure. An incident adjacent to these systems could have a potentially significant effect on the maintenance of essential services. Consideration should be given to the impact on:

- National transport networks, with local, national and international dependencies, principally involving road and rail use
- Telecommunications and power systems
- Water treatment systems
- Storage of significant items and use by industries
- Potential for widespread flooding resulting from the inundation of tunnels
- Tunnels being put to more than one use, for example a transport tunnel used to carry telecommunications cables, thereby compounding the community impact of a significant incident

For further information refer to the [Centre for the Protection of the National Infrastructure: Critical National Infrastructure](#).



Control measure - Situational awareness: Below ground structures

Control measure knowledge

Incidents in below ground structures may present significant challenges in gathering information and establishing accurate situational awareness. Therefore, it may be beneficial for fire and rescue services to liaise with local organisations or groups to maintain knowledge of below ground structures in their area.

The seriousness of the incident in a tunnel or below ground structure may not be immediately apparent and there is potential for the incident to rapidly escalate. Responding to below ground incidents may present personnel with a range of complex and unfamiliar hazards that may include:

- Long travel distances
- Complex workings and uncharted layouts
- No through access
- Compressed air workings
- Complex and unfamiliar machinery
- Highly restricted working areas

Consideration should be given to the likely resource and time requirements to establish, initiate and maintain an effective intervention and the likely development of the incident during that time. Initial considerations should include:

- Identifying any fixed installations and their status
- Identifying appropriate bridgeheads or equipment staging areas
- The position of any ventilation outlets if the products of the incident may affect people on the surface or remote from the incident
- Direction of any mechanical forced ventilation, so that safe areas for members of the public and operational bridgeheads can be provided
- Gradient of any passageway allowing run-off, liquid contamination or flowing fuel fire to spread, or the potential for inclined surface 'trench effect'
- Method of containing run-off or contaminated liquids, and their environmental impact
- Stability of the structure and its effect on the surface
- Risk of inundation of the infrastructure
- Identifying the possible spread of flood water and its predicted effects on the wider community

Tunnels

Where tunnels have public access, fire and rescue services will normally have prior knowledge and understanding of the hazards presented. There may be pre-planned arrangements for attendance and the actions to be taken in the event of an incident.

Sewers and associated below ground assets

Sewage or wastewater undertakers should have emergency procedures for their employees and subcontracted staff working in those environments. The assistance that fire and rescue services can provide will depend on the knowledge, training, skills and equipment of the individual services. It may be necessary to seek specialist assistance, such as urban search and rescue (USAR). For further information refer to [Utilities and fuel: Isolate utility or fuel supply to the premises](#).

Operational mines

The [British Geological Survey \(BGS\)](#) continually monitors the location and nature of active onshore mineral workings in the UK and publishes this information in its [Directory of Mines and Quarries](#). A number of mines are used for other purposes such as tourism and storage of documents, computer records, wine and cheese.

Under the [Mines Regulations 2014](#), the mine operator needs to make suitable arrangements for the escape and rescue of people from the mine; this may include using safe havens in the mine.

Arrangements for rescue may include using companies that provide specialist rescue training, trained rescue staff at mines, cave rescue teams in locations such as tourist mines and, in some instances, fire and rescue services.

If fire and rescue services are requested to assist, and depending on the type of incident at a mine, first responders may be limited in their ability to deal with the situation. It may be necessary to seek specialist assistance from teams skilled in rope rescue, confined space rescue, urban search and rescue, cave or mine rescue.

Although large-scale coal mining operations have ceased in the UK, there may be hazards to people, livestock, property and the environment from:

- Collapse of mine entries and shallow coal mine workings (subsidence)
- Emissions of mine gases
- Incidents of spontaneous combustion
- Discharge of water from abandoned coal mines

The [Coal Authority](#) manages the effects of past coal mining, including subsidence damage claims that are not the responsibility of licensed coal mine operators. It deals with mine water pollution and other mining legacy issues.

At all mine and mine surface incidents, it is important to consider the need to preserve the scene for investigation purposes. Fire and rescue services need to be aware that other organisations may have to carry out their own investigations. For further information refer to Operations: Compromised investigations: [Poor scene preservation](#).

As large-scale incidents involving mine or mine surface hazards are infrequent, fire and rescue services should carry out joint exercises with the mine operator to understand what skills and techniques may be required.

Caves and recreational below ground environments

Depending on the type of incident at caves or recreational below ground environments, first responders may be limited in their ability to deal with the situation. It may be necessary to seek specialist assistance from teams skilled in rope rescue, confined space rescue, cave rescue or urban search and rescue.

Attendance and intervention will often be led by attending cave rescue specialists, but there may be occasions when fire and rescue services have the ability and resources to assist. For example, if a person has fallen into a vertical entry point at the start of a cave system, personnel may have the rope rescue capability to immediately access and recover the casualty.

Abandoned mines

Depending on the type of incident involving abandoned mines, first responders may be limited in their ability to deal with the situation. It may be necessary to seek specialist assistance from teams skilled in rope rescue, mine rescue, confined space rescue, cave rescue or urban search and rescue.

Attendance and intervention will often be led by attending rescue specialists, but there may be occasions when fire and rescue services have the ability and resources to assist. For example, if a person has fallen into a mineshaft, personnel may have the rope rescue capability to immediately access and recover the casualty.

Armed forces and civil protection below ground structures

Some structures in use are fully occupied, while others are remote stations that are only visited occasionally. Some are only visited by staff to check or maintain equipment or to assess the security of the site. Other sites provide resilience and have only occasional use, but there are usually procedures in place to ensure the safety of those who visit.

The Defence Fire and Rescue Service may provide normal emergency response activities for all operational military establishments.

Structures in private or commercial use will be required to maintain a safe system of work for any working staff or visiting public and, depending on the use and levels of commercial security and sensitivity, will include notification and collaboration with local fire and rescue services.

Fire and rescue services should work with the establishment's management to provide additional assistance if required, to establish a structured response plan and arrange regular joint exercises

and familiarisation of sites to ensure all partners have a clear understanding of the extent and limitations of their role and responsibilities.

Evacuation and rescue

Some infrastructures will contain large numbers of people, unfamiliar with their surroundings or emergency procedures. The responsibility for their evacuation in an emergency rests with the infrastructure managers; however, fire and rescue services will undertake rescues of staff or members of the public if they are in imminent danger.

Incident commanders should attempt to identify the progress and success of a managed evacuation. If it appears that people are, or may be, imminently exposed to harm personnel will need to take appropriate action. For further information refer to Operations: [Evacuation and shelter](#).

Strategic actions

Fire and rescue services should:

- Consider liaising with local organisations or groups to maintain knowledge of below ground structures in their area

Tactical actions

Incident commanders should:

- Establish the type of below ground structure to identify additional hazards
- Identify the presence and status of any fixed installations that are present within the below ground structure
- Liaise with on-site staff when developing the tactical plan for incidents at below ground structures
- Confirm the current status of any managed evacuations for below ground structures and take action if required



Control measure - Specialist resources: Below ground structures

Control measure knowledge

Fire and rescue services may need to provide equipment and personnel to assist specialist organisations, rather than directly use fire and rescue personnel to enter and operate as the primary rescuers. It may be beneficial to use joint on-site training to identify and plan for potential incidents involving below ground structures.

Responders such as urban search and rescue (USAR), hazardous area response teams (HART) or special operations response teams (SORT) have specialist equipment to provide support at this type of incident.

The [British Cave Rescue Council \(BCRC\)](#) is the body recognised by the UK government as providing the underground search and rescue service in caves and abandoned mines. It has a seat on the UK Search and Rescue (UKSAR) operators group, where it meets regularly with other national search and rescue operators.

The responsibility for inland rescue usually rests with the police under their general public order powers and responsibilities. However, if the police are unable to conduct searches or rescues in caves and abandoned mines, they will rely on the members of the BCRC.

BCRC members are also called on by the police to assist in animal rescues and occasionally to carry out other types of search to assist investigations.

The range of below ground environments that may be accessed for recreational purposes is wide; some will have been formed by erosion within natural geological formations and others will have been created by mining or tunnelling operations. Many of the entry points to these sites will be in locations that are difficult to find and access and that may require approach by specialist vehicles or on foot over significant distances.

Strategic actions

Fire and rescue services should:

- Consider using joint on-site training to identify and plan for below ground structures where their assistance may be requested

- Request specialist resources for assistance at below ground structure incidents

Tactical actions

There are no tactical actions associated with this control measure.



Control measure - Specialist advice: Below ground structures

Control measure knowledge

Many aspects of below ground structure construction are likely to fall outside the scope of fire and rescue service personnel knowledge and skills. It is the responsibility of experts to ensure that proposals meet statutory duties, legal requirements and standards set out for construction, and that the services required to support fire and rescue service intervention are put in place.

In the event of an incident in a below ground structure, the fire and rescue service should seek specialist advice from sources such as:

- Tunnel safety officers
- The contractor
- The appropriate regulator
- The Health and Safety Executive (HSE)
- Regulatory bodies, such as the [Office of Rail and Road](#)

Strategic actions

Fire and rescue services should:

- Develop arrangements for dealing with below ground structure incidents with identified sources of specialist advice or assistance
- Maintain the details of any specialist adviser for below ground structure incidents and know how to request their advice or attendance

Tactical actions

Incident commanders should:

- Request specialist advice or assistance based on the extent and urgency of the below ground structure incident
- Consider the specialist advice received when developing the tactical plan for below ground structure incidents



Control measure - Monitoring systems: Below ground structures

Control measure knowledge

Often below ground structures will be monitored for safety and security reasons. Widespread or complex structures often have control rooms with a range of features and information readily available to an incident commander. An understanding of the information available from those control rooms and how it can be accessed, will help to determine its usefulness when managing an incident.

In some instances, there are protected on-site control rooms, providing facilities to assist in managing an incident. These may include facilities for fire and rescue service personnel to monitor progress of personnel and the safe evacuation of the public. Alternatively, for widespread or complex infrastructure, there may be a central or off-site control room. Features provided by these control room, which may benefit fire and rescue service operations, include:

- Details of alternative access or egress routes
- Close circuit television (CCTV)
- Public address systems
- Ventilation systems and controls
- Fire and rescue service telecommunications
- Site plans
- Traffic management controls
- Refuge communications
- Water inundation protection facilities, including tunnel portal door closers



Strategic actions

Fire and rescue services should:

- Ensure that personnel are aware of the information available from and capabilities of below ground structure control rooms

Tactical actions

Incident commanders should:

- Consider using the facilities available in the below ground structure control room to manage and monitor the incident