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A management plan for the caves of Lathkill Dale, Monyash, Derbyshire

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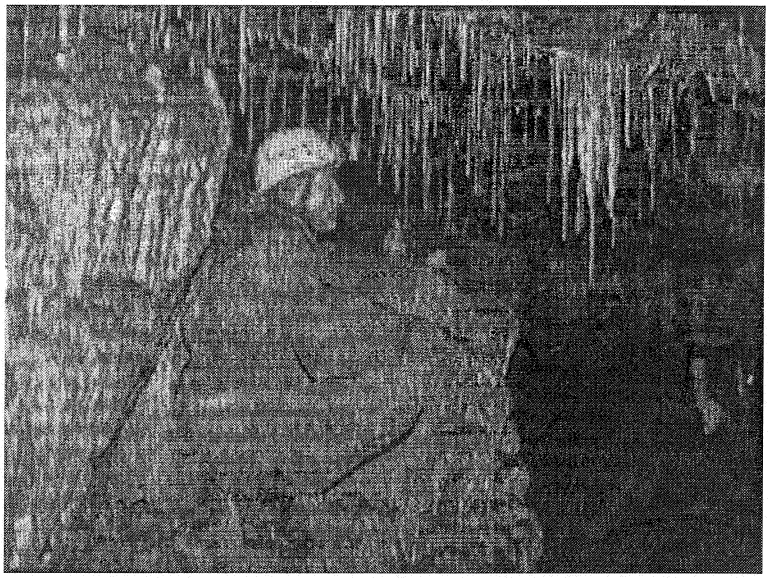

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Number 223

A management plan for the caves of Lathkill Dale, Monyash, Derbyshire

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1. Introduction: Lathkill Dale SSSI and Upper Lathkill SSSI

Lathkill Dale in the Peak District was first designated as a Site of Special Scientific Interest in 1951 under the National Parks and Access to the Countryside Act (1949). The SSSI was revised in 1981 under the Wildlife and Countryside Act (1981) incorporating both geological and biological features. Stretching from the B5055 (Bakewell - Monyash road) in the west to the unclassified road between Alport and Youlgreave, the site covers an area of 272.1 hectares (Figure 1). The geological importance of the site includes not only karst and speleological features, but also stratigraphical and sedimentological aspects of the exposure limestone sequence. The great significance of the area with its associated biological interests (including botanical) is recognised by the designation of a substantial proportion of the site as a National Nature Reserve in 1972 (Derbyshire Dales NNR).

An additional outlier of the same SSSI in the area around Water Icicle Close Cavern (Grid reference SK 1610 6460), is also included as a related part of the speleological system. A further area around Knotlow Cavern (SK 1438 6739) and Hillocks Mine (SK 145 672) to the North West of Monyash village was designated as a separate Upper Lathkill SSSI, for speleological reasons in 1989, and covers 26.2 hectares (Figure 2). These three distinct geographical areas are part of a single connected cave system and are therefore considered together.

Derbyshire Dales NNR is extremely popular as a recreational walking area and as an educational resource. The caves and mines in the area show important interrelationships with the associated wildlife, and conservation of the site as a whole requires appropriate integration.

Many of the caves have been at least partially investigated by lead miners in the past, and some may therefore have been "open" from at least around 1700. Mining modified a number of the passages and consequently the caves and mines of the Lathkill Dale System can be classified in two distinct categories:

1. Those predominantly natural and unaltered.

2. Those significantly altered by mining activities, or predominantly artificial (see section 2).

Investigation of the Lathkill Dale system was initially archaeologically driven, with J. Puttrel, a Victorian "cave hunter" and amateur archaeologist, being at the forefront of exploration in the late 19th century and early 20th century. Although sporadic interest was shown over the next forty years it was only after World War II that more systematic exploration commenced.

Over the past 50 years the known extent of the caves of Lathkill Dale has slowly increased, with major successes being regularly made in some parts and sporadically in others. In recent years this collection of parts has been linked together to form a single interconnected system. Further details concerning these discoveries is incorporated into section 2. The major components of this system (Figure 3) are now known to be connected at least hydrologically, and in places navigably by cave explorers.

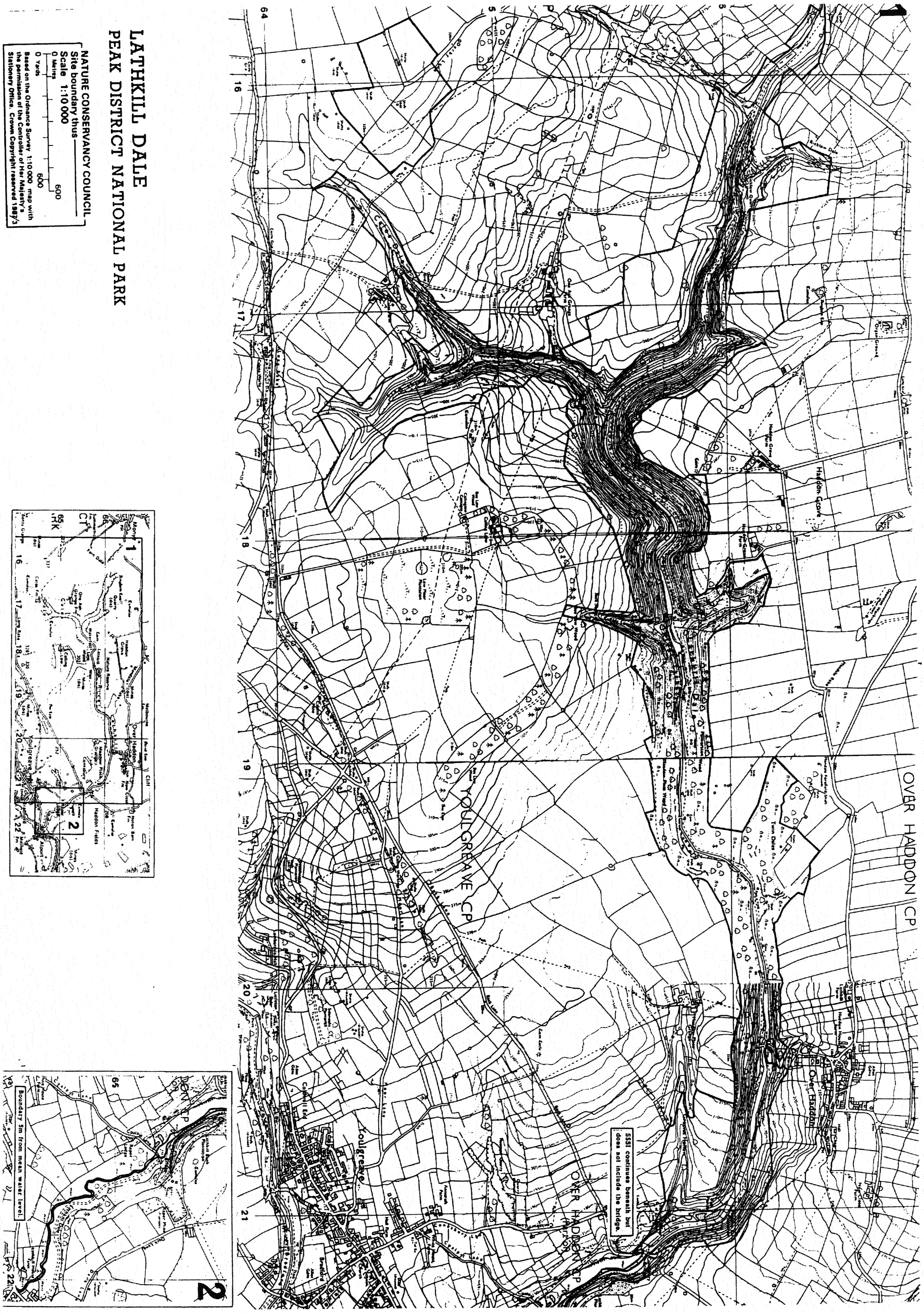


Figure 1. Site boundary map for Lathkill Dale SSSI

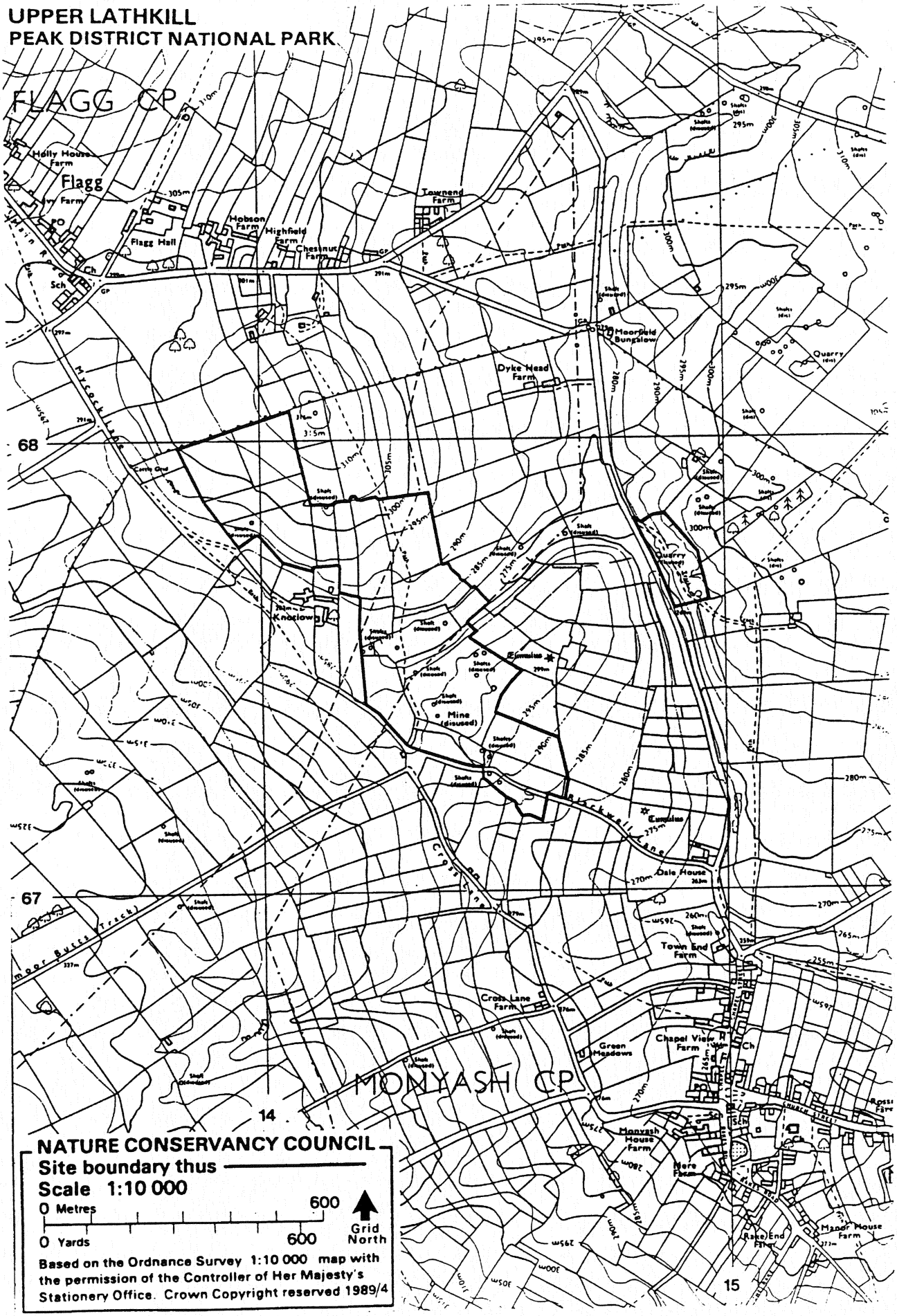


Figure 2. Site boundary map for Upper Lathkill SSSI

2. The Lathkill Dale Cave System

2.1 Geographical Context and Relationships

Through the early 1990's a programme of accurate surveying, both on surface and underground, has presented an overall picture of the relationships of the Lathkill Dale caves to each other. This study has indicated that, far from being isolated, the various named caves appear to be part of a single major system.

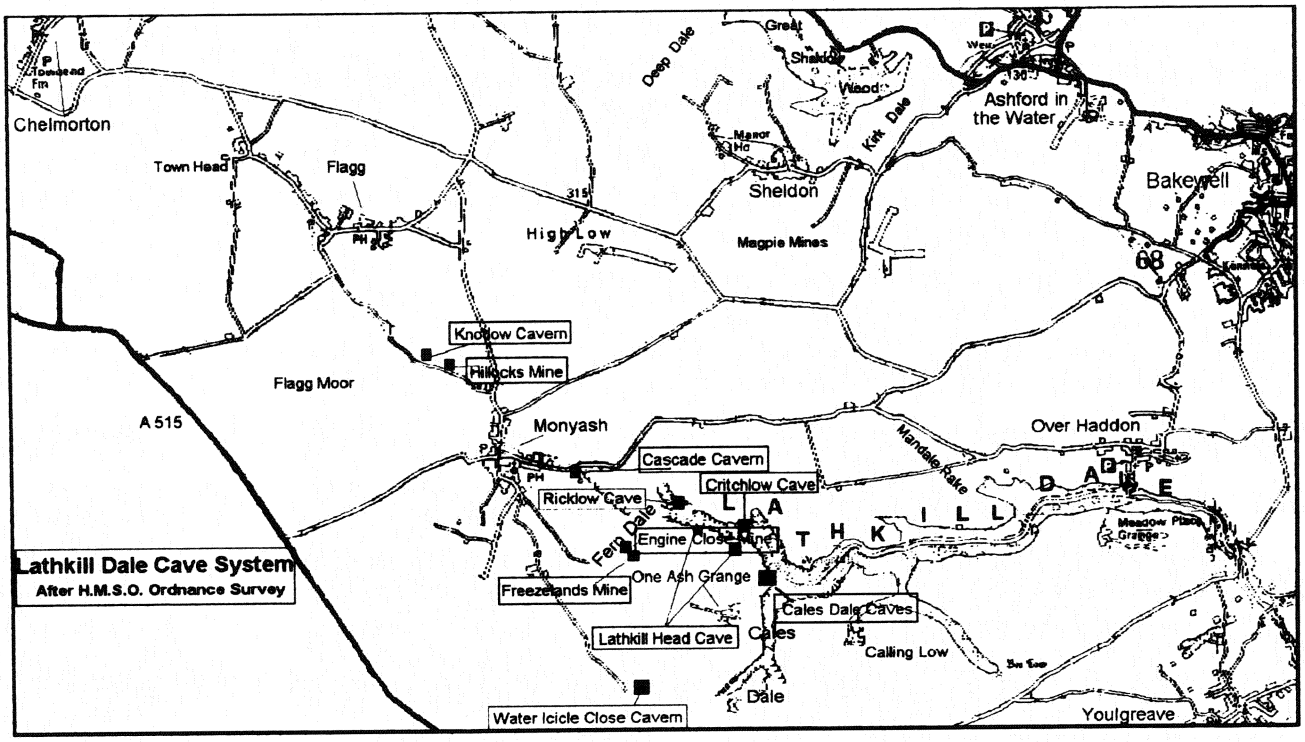


Figure 3. The major components of the Lathkill Dale Cave System

Figure 3 shows the entrances of all major caves and mines in the area and the major links in the chain appear to be as follows:

1. Knotlow Cavern has shown a positive dye test (hydrological) link to Lathkill Head Cave. There is also a navigable connection with Hillocks Mine.

2. Cascade Cavern has shown a positive dye test link to Lathkiller Hall in Lathkill Head Cave and to Lower Cales Dale Cave.

3. Ricklow Cave has a navigable connection to Lathkill Head Cave.

4. Lower Cales Dale Cave has a hydrological connection with Lathkill Head Cave. This may be navigable in the very near future.

5. Water Icicle Close Cavern is thought to have a link with the Lathkill Dale system.

6. Critchlow Cave has a hydrological link to the River Lathkill.

7. Raven Mine is thought to have a hydrological link to Lathkill Head Cave, but this is untested.

8. Engine Close Mine may soon have a navigable connection with Lathkill Head Cave.

9. Magpie Mine, though having no proven connection to any of the caves, may have been partially responsible for a lowering of the water table and may therefore capture water otherwise destined for the cave system.

Additional relationships between the caves and the mines in the area are not presently believed to be significant. The exact impact of the lead mine soughs on the water table is an unknown quantity, with no definitive data available on water levels prior to the driving of the Mandale, Magpie, Lathkill Dale and Hillcar soughs. Future research into both the hydrology and the caves of Lathkill Dale may well add to this picture, but at present there is insufficient data to quantify any such affects.

The scientific importance of the Lathkill Dale Cave System lies not only in its extensive development of interconnected passages, but also in their method of formation and the contained clastic deposits. The vast majority of cave systems in Britain are allogenic in nature, (ie reliant upon water from sink holes or swallets for their formation, Figure 4) but the Lathkill Dale System relies on autogenic feed (ie supply directly from percolation of rainwater from the surrounding area, Figure 5). Further interest lies in the clastic deposits within the system, which can be used to date stages of cave formation and also gain information on climatic conditions prevalent in the district over the last 350, 000 + years.

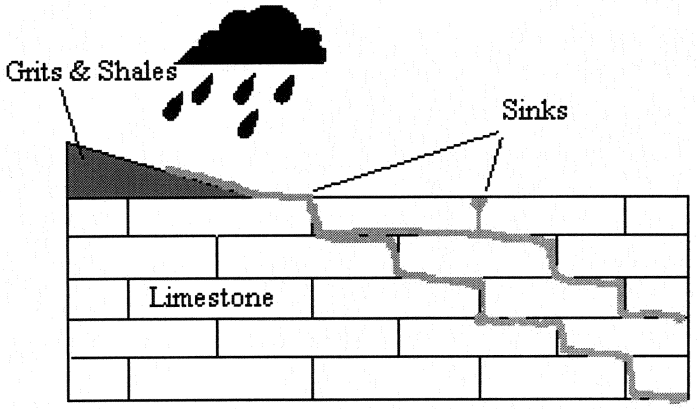


Figure 4. Cave formation by water for allogenic source (water input from sinkhole)

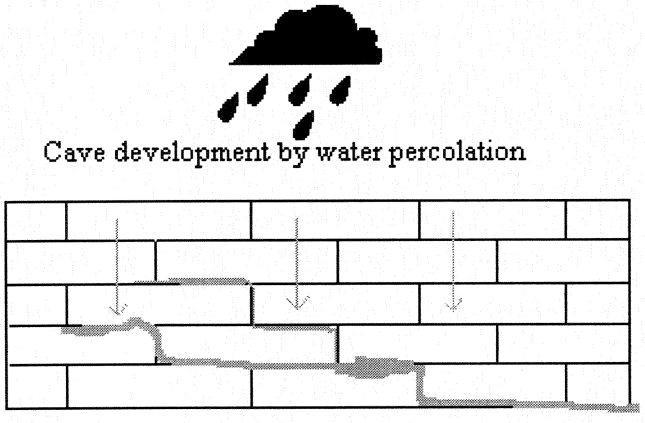


Figure 5. Cave formation by water from autogenic sources (water input by percolation)

2.2 Geology

Lathkill Dale itself is a dry valley gorge over much of its length, with steep rocky sides descending to a depth of 75m below the surrounding limestone plateau. The upper part of the presumed catchment area is broadly oval in shape with a number of shallow dry valleys to the east. Most of the dry valleys do not hang above the valley floor (Warwick 1964), although low down the valley this phenomenon does occur to a limited degree. Here the only significant hanging valley connected with Lathkill Dale lies east of Lathkill Head Cave and is probably related to the primary limestone geology, a possible consequence of internal differences, such as solubility (Ford & Beck 1977).

The main development of Lathkill Dale lies further eastwards along the axis of a gentle syncline in the Monsal Dale Limestone of Lower Carboniferous age (*c.*360 million years old). Darker facies in the lower part of the sequence are rich in shale partings and less permeable than the Monsal Dale beds (Figure 6). Ford and Beck (1977) suggest that the dale itself developed primarily under periglacial conditions during the Pleistocene. During cold phases (ie 'ice ages') the flow of surface water over the frozen ground allowed valley incision. The hypothesis suggested that initial incision was during the last Interglacial (*c.*130,000 - 110,000 years ago) at the downstream end of the gorge, with a greatest effect in the area of the now truncated dry valley at Greaves Hollow. The incision followed the axis of the syncline upstream, with the river eventually being offset to the north by some form of river capture (Ford & Beck 1977).

Below Lathkill Head Cave, faults bring a lava flow to the surface at Bubble Springs, the permanent resurgence of the River Lathkill. Downstream of Bubble Springs an extensive bed of tufa covers the valley floor, and there are two tufa phytothem barrages upstream of Alport. The upper part of the tufa development has undergone erosion by both agricultural activities and the stream itself, whilst at Pudding Springs there has been modification as a result of quarrying.

All the caves of Lathkill Dale lie in the bedded, lagoonal facies of the Monsal Dale Limestones, and display evidence of phased development. Ford *et al* (1983) have proposed a tentative chronology for the development of these caves, with speleothems in Water Icicle Close Cavern a Uranium - Uranium and Uranium-Thorium date, indicating the caverns abandonment by at least 350,000 years B.P.. Isolated fragments of large phreatic cave passages are visible at Water Icicle Close along with a significant amount of fluvioglacial infill.

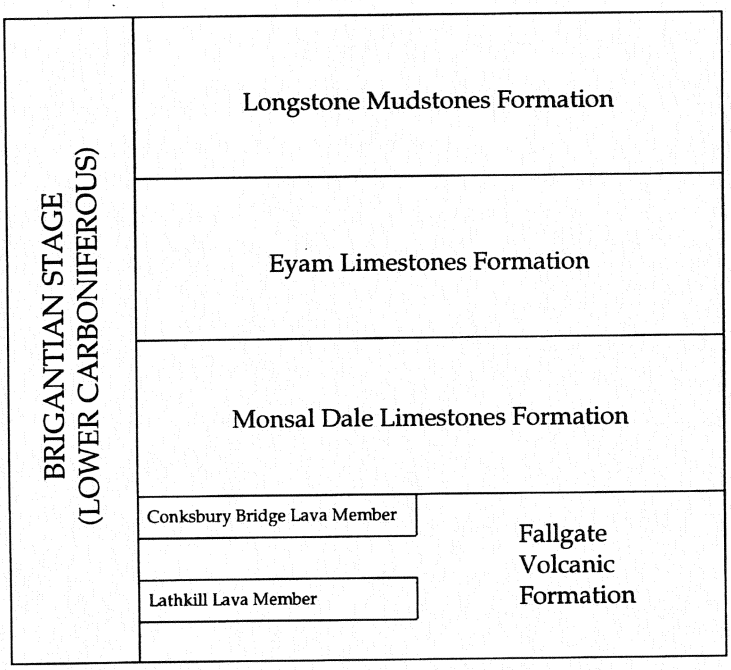


Figure 6. Generalised sequence in the Lower Carboniferous Limestones of the district

2.3 Hydrology

The hydrology of Lathkill Dale is extremely complex, and not fully understood. Bamber (1951) and Ford & Beck (1977) have discussed the effect that mine drainage has had on Lathkill Dale, and consequently the caves. Nevertheless the actual effects that mine drainage systems have had on the River Lathkill are undetermined as there is a lack of documentation prior to draining.

The River Lathkill presently flows from one of the Peak District's largest "dry" areas, with no identifiable sinks within its catchment. The total lack of apparent allogenic sources gives the underlying cave system a unique nature. It is widely believed that the whole of the system relies on autogenic input from an undetermined surface catchment, as a result of downward percolation of rainwater. The only potential for allogenic input is via seepage from a few isolated lava outcrops. The system between Knotlow Cavern and Lathkill Head Cave also represents the finest example of a river flowing on or beneath a limestone valley in the Peak National Park. Under flood conditions the river resurges at the entrance to Lathkill Head Cave, with water levels measured underground to at least the 220m O.D. mark. As water levels decrease the river outlet migrates to Lathkill Resurgence, then down as far as Bubble Springs, under dry weather (Figure 7).

The water in Knotlow Cavern has been dye tested downstream to Lathkill Head Cave and Lower Cales Dale Cave (Wheeldon 1992), but has no positively identified source to date. Given the lack of allogenic sources and the volume of water present, autogenic input is again suggested. These caves are primarily mining-modified phreatic passages, with minimal vadose invasion and occasional fracture guided breakdown chambers. The large deposits of fluvioglacial infill within Hillocks Mine provide evidence of Interglacial invasion. Wheeldon also includes details of a positive dye test between Cascade Cavern, the next known cave downstream, and both Lathkill Head Cave and Lower Cales Dale Cave (Wheeldon 1992). These tests again confirm that the basic subterranean drainage pattern is along the line of the Monyash Syncline. Ricklow Cave was also dye tested during the floods of late 1991, with positive results at Lathkill Head Cave and Lower Cales Dale Cave. Critchlow Cave was also monitored for responses, as it was acting as a resurgence in the high water conditions, but proved negative (Bentham & Sutton 1993).

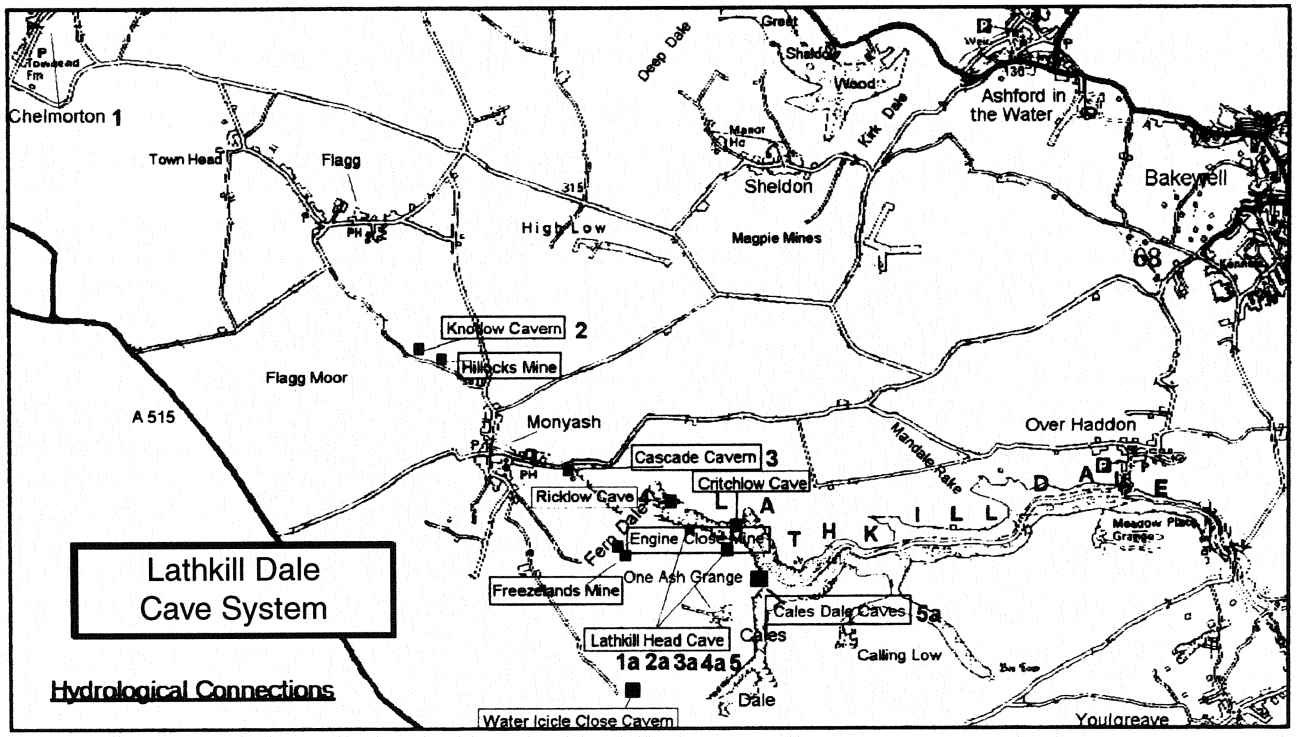


Figure 7. Hydrological connections (1 links to 1a, 2 to 2a, etc)

The present hydrology of the area is consistent with a multi-phase formation system for the caves of Lathkill Dale. Water Icicle Close Cavern was formed in excess of 350,00 years BP, and was followed by the creation of Lower Cales Dale Cave. During the Devensian (the last Ice Age, 110,000-10,000 years ago) the present gorge was incised by meltwater and Lathkill Head Cave was formed (Ford *et al* 1983). Critchlow Cave is inactive during hydrological testing suggesting the bifurcation of a single master stream which also feeds Lathkill Head Cave. This bifurcation, on the evidence of Wheeldon's results (1992), must be upstream of Ricklow Cave.

While the fluvioglacial deposits in Hillocks Mine may initially indicate a similar stage of development to Water Icicle Close Cavern there is, as yet, no data regarding the age of either these deposits or any speleothems within the Knotlow - Hillocks system. Equally no data is available for any of the clastic deposits found within upper Lathkill Head Cave, and the variable nature of the underground River Lathkill prevents effective measurement of the rate of erosion of any deposits. It is interesting to note that the nearest contemporary surface outcrops of the Upper Carboniferous Millstone Grit which has contributed to a large part of the fluvioglacial deposits is some 7 km distant to the west, although material now present within the caves could have been derived from more local fluvio glacial sources.

In historical times the River Lathkill has been reported to have been in evidence on the surface as far up the dale as Monyash village (Bamber 1951; Oakman 1979). In living memory residents of Monyash have reported minor springs upstream of Ricklow Cave being active. While the creation of Hillcar Sough, Lathkill Dale Sough, Magpie Sough and Mandale Sough during mining operations may account for the historical lowering of the water table, the apparent disappearance of active springs within the last 90 years is more difficult to account for.

The present knowledge of the hydrology of the River Lathkill catchment, however, indicates that much uncertainty still remains. Recent dye tests (1996) have indicated a positive connection from Chelmorton to Lathkill Head Cave (J. Gunn , Huddersfield University, *per.comm.*) and may suggest that autogenic supply could be adequate to create the volume of water present in the lower reaches of the Lathkill Dale Cave system. A comprehensive hydrological survey of the complete area is ideally required, and would enable a more complete picture of the cave development to be made. At present the words of Bamber (1951) and Ford & Beck (1977) still hold true - the hydrology of Lathkill Dale is complex and far from being fully understood.

2.4 The Caves

The following descriptions are not intended for the purpose of route finding, but as a guide to the known extent and key formation processes of the caves . For a more definitive guide, Gill & Beck (1991 - *Caves of the Peak District*) or one of the references in the appendices should be consulted.

2.4.1 Predominantly natural caves

Lathkill Head Cave - Ricklow Cave

The main, downstream, and comparatively large, entrance to Lathkill Head Cave has probably been open for many centuries. Speleological study commenced post World War II, with investigation of the entrance series by the British Speleological Association (BSA) (Bamber 1948).

Ricklow Cave has been open for at least two hundred years, and was definitely entered by lead miners. A date, 1797, by the entrance may or may not be relevant, but what is known is that the Fourways Club were working on Ricklow Cave in the 1960's (Anon, 1962).

The known section of Lathkill Head Cave is formed primarily on two distinct bedding planes.

Dawke's Crawl, Tiger 1, Tiger 2, Tiger 3, Gloop Canal and Gasson Passage are on the lower surface. Approximately 10m above this is the bed controlling the Lathkiller Passage, Tigers 4, 5, 6 and 7, The Northern Lights and The Hope Show. It has not as yet been determined which of these beds the lower (valley) entrance series is on, if either.

Figure 8. Lathkill Head Cave. Photo © D Arveschough

The route followed by explorers does not necessarily represent the total extent of cave passage in any area, rather the passage that has been discovered to date (Bentham 1996). The main route through any section occasionally deviates from the dominant bedding surface, but only, for example to negotiate a roof collapse. The single important exception lies at Oval Pot where solution of a higher bed has occurred, and a higher chamber is present. The higher bed is only occupied by the River Lathkill during high water conditions.

The dominance of these two major beds on passage development is as yet unexplained, but in the exploration of the system as a whole it gives a reference to the likely position of further passages. As a consequence of these preferred horizons for cave development a more pronounced horizontal dimension to the primary cave passages, rather than the more usual phreatic elliptical shape, is evident. This broad horizontal development, at times up to 20m in width can present problems for route finding underground.

From the valley entrance to the cave, the passage soon lowers to a slab covered crawl along a typical bedding plane as far as the Rift Chamber A descent then leads via another bedding crawl to a sump (in all but dry weather), and then Puttrell's Chamber and the hydrological link to Lower Cales Dale Cave, Dawke's Crawl. From Puttrell's Chamber (originally passed by the Eldon Hill Pothole Club in 1965), the passage continues along the (lower main) bedding plane, interrupted at intervals by first Bridge Chamber then Fan Chamber, until Handshake Chamber is reached (Westlake 1966; Lord 1969; Gasson 1970, 1974; Drakeley 1974; Gill 1976). In this region the two other passages dominated by this bed are found, Gasson's Passage and Gloop Canal.

At Handshake Chamber, a large scale collapse, "The Lathkiller", gives access to Lathkiller Hall (figure 10) and The Waiting Room (Bentham & Sutton 1993). Each of these features are chambers caused by the collapse of the roof in blocks (figure 9). They are also each important for their speleothem and flowstone contents, which are numerous on the walls and in silted phreatic passages at higher levels.

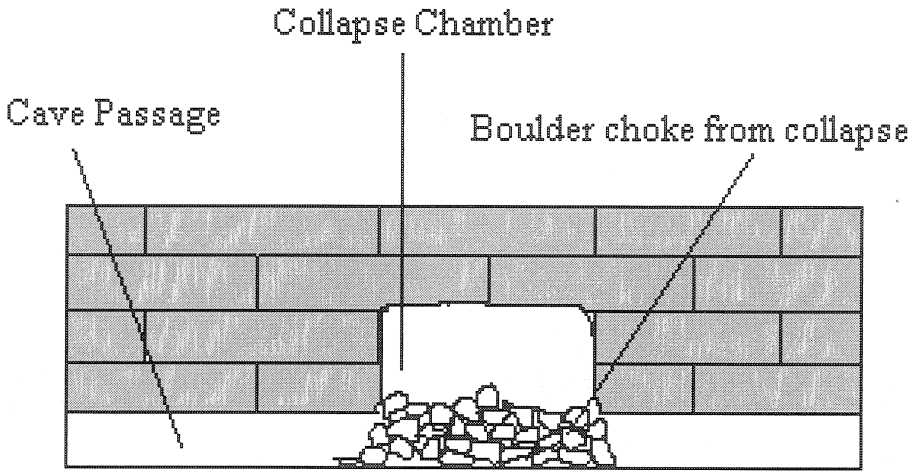


Figure 9. The formation of chamber by roof collapse

Figure 10. Lathkiller Hall. Photo © D Arveschough

The Waiting Room (figures 11,12) is a large chamber containing stalactites, stalagmites and flowstone in abundance, and remnants of a significant crystal floor (Bentham & Sutton 1993). At least three avens are present within The Waiting Room containing further speleothems. None of the avens, or blocked bedding plane passage presently appears to have much potential for further significant exploration.

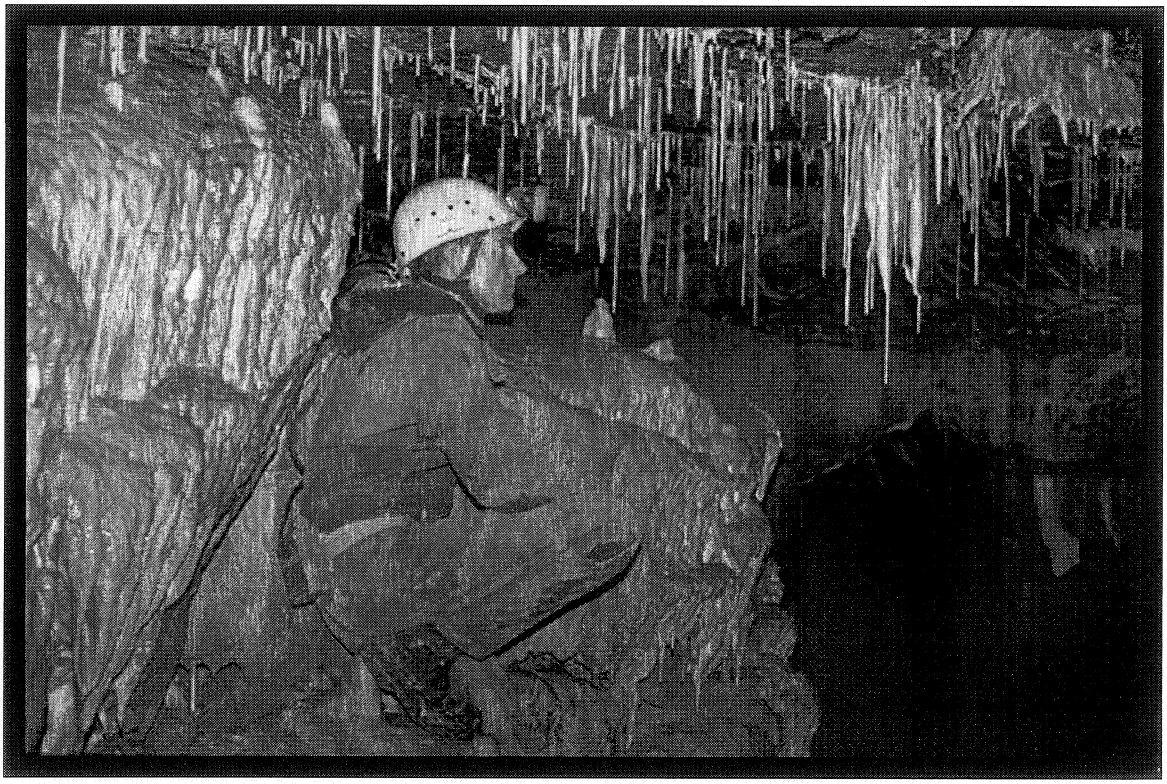


Figure 11. The Waiting Room. Photo © D Arveschough

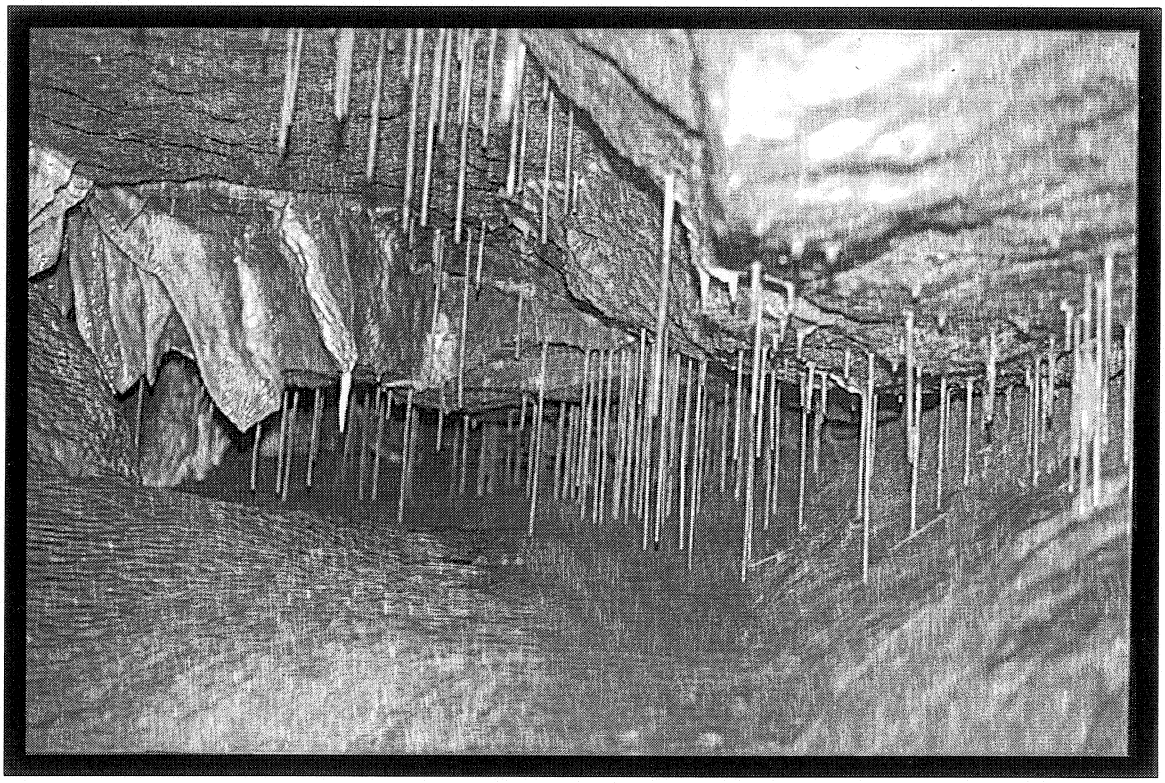


Figure 12. The Waiting Room. Photo © D Arveschough

From this point onwards to the present upstream limit of the cave the higher bed dominates in the cave's formation. Lathkiller Passage trends south-west before changing to north west and bypassing a further major collapse. At this point The Emporium is reached. The Emporium is another well decorated chamber, accessed by negotiating a large, loose, boulder choke from Tiger 4 (Bentham & Sutton 1993). The exact nature of The Emporium's formation is as yet not fully understood, but its aesthetic and scientific value is beyond doubt. Numerous phreatic tubes exist within the walls, each of which contains further speleothems, as does the large aven above. As with The Waiting Room there is some potential here for extensions to the system as a whole but the effect on remaining speleothems will need consideration.

Tiger 4 continues past The Emporium as a wide bedding passage, passing the connection to The Hope Show before reaching The Northern Lights (Bentham 1995) and swinging back south west. The Hope Show and The Northern Lights are still dominated by the upper dominant bedding surface governing Tigers 4 and 5 (figure 13). The Northern Lights connection with Ricklow Cave has distinctly more clastic fill and sediment filled passages alternate with enlarged rifts, leading to a series of right angled rift - bedding junctions, and ultimately to the connection with the lead miners' entrance level of Ricklow Cave.

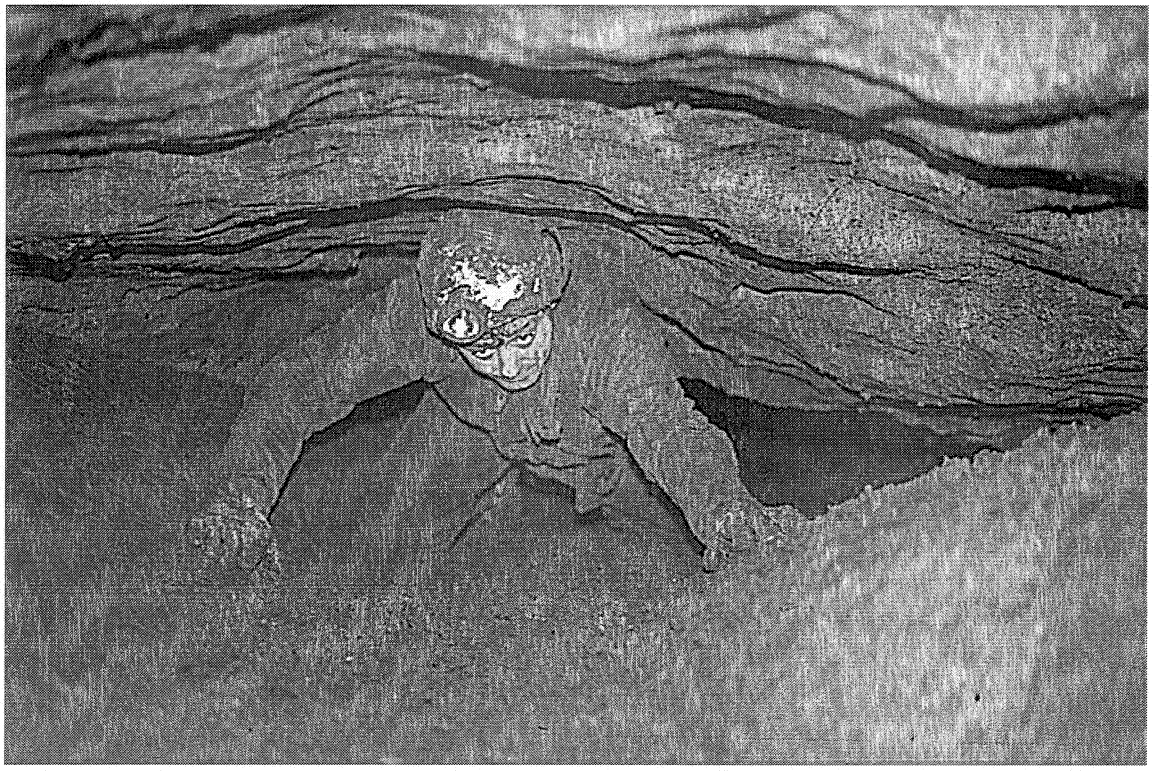


Figure 13. The Northern Lights. Photo © D Arveschough

Beyond the Ricklow Cave connection (established by excavation of the Beresford Link in 1995) the bedding plane passage returns to a south west direction, arriving after a short distance at Black Rock Sands and Dream Time. This area is similar to The Lathkiller and The Waiting Room, with a collapse chamber directly above a major boulder choke. As with The Waiting Room, the walls here are festooned with speleothems, and boulders are flowstone covered (figures 15, 16). The boulders display various amounts of flowstone, partially dependent on their position within the collapse. Dream Time continues upwards as a tapering aven approaching the surface, with the top almost completely boulder choked and only around 7m from daylight.

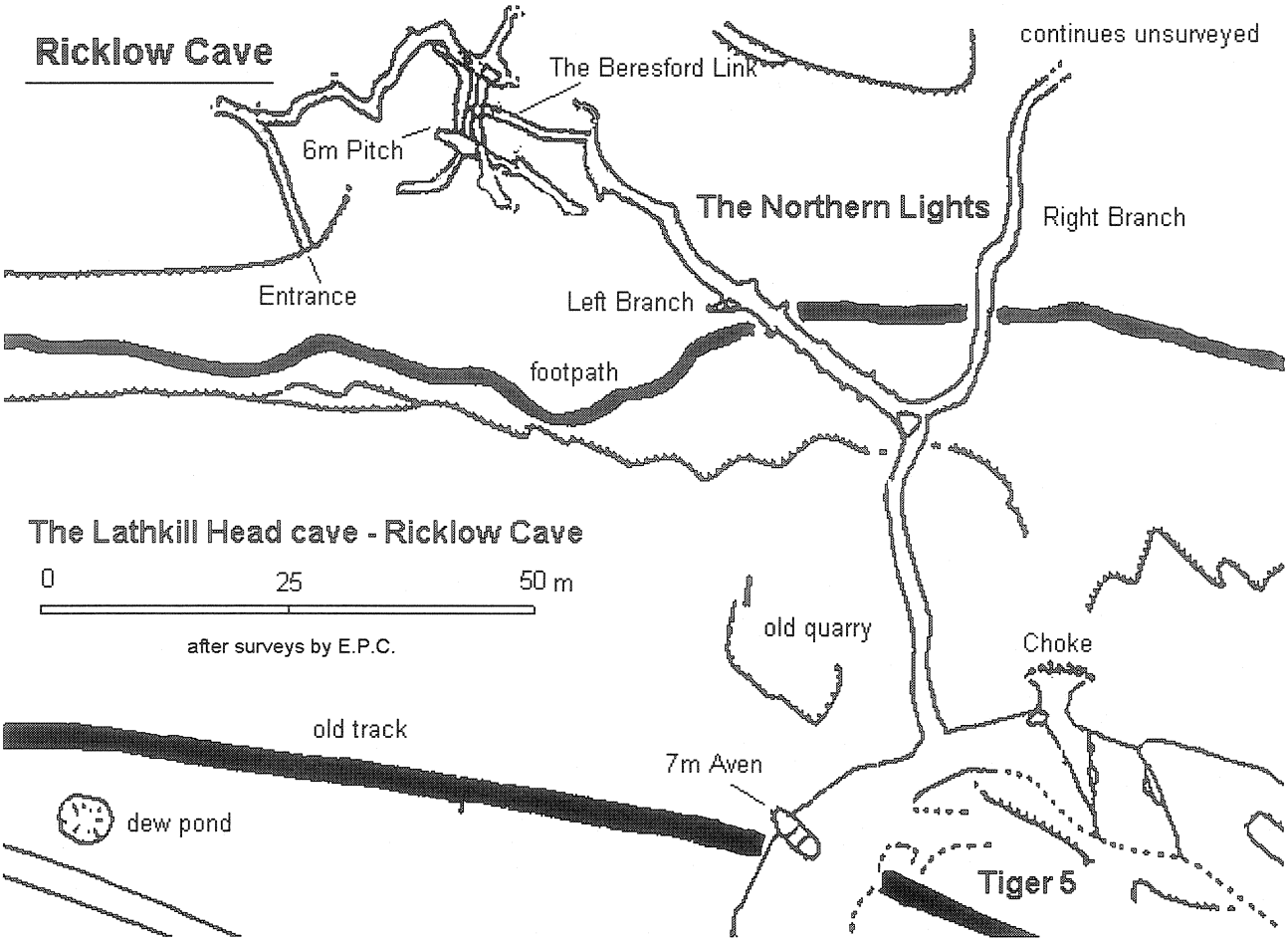


Figure 14. Lathkill Head Cave-Ricklow Cave

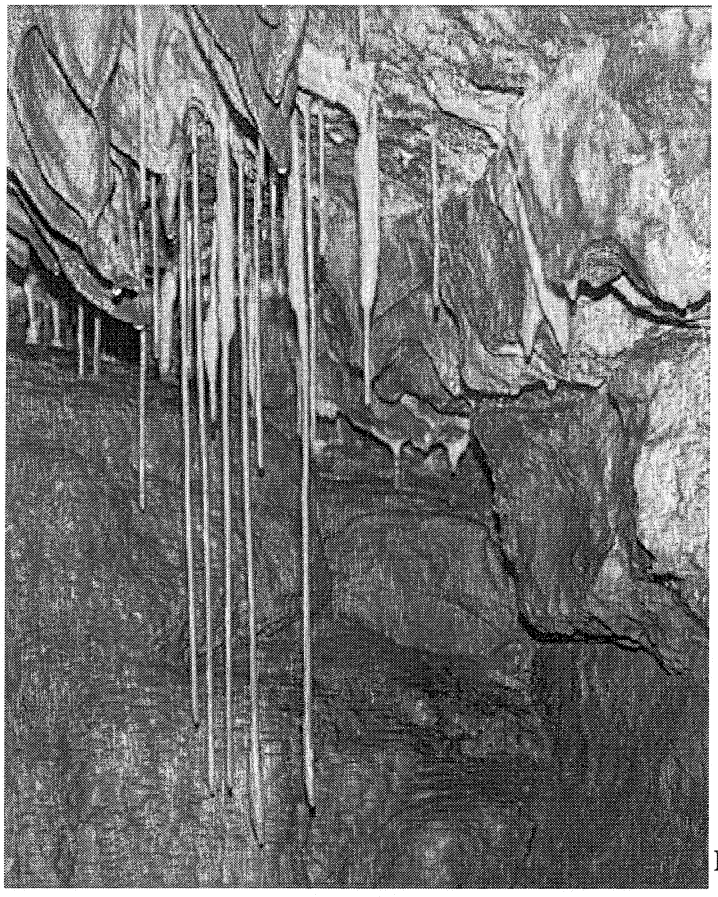


Figure 15
Dream Time. Photo © D Arveschough

Figure 16. Dream Time. Photo © D Arveschough

From Dream Time to the present known upstream limit of Lathkill Head Cave the Tiger 6 and Tiger 7 passage continues in a meandering course as a wide, low bedding plan passage. There is a section of stratified sediment deposit in Tiger 6 of potential scientific importance. Tiger 7 commences after Rolling Thunder, another very low section of the bedding, with clean washed rock showing the effect of the River Lathkill's regular progress through the cave. The present limit of exploration is the far end of Tiger 7, where a further small area of collapse and infill has temporarily halted progress.

Lower Cales Dale Cave

There are four known caves in Cales Dale, with Lower Cales Dale Cave being the dominant and largest.

Lower Cales Dale Cave has been investigated in a similar manner to Lathkill Head Cave, with the height of the River Lathkill being the main controlling factor for exploration. Until 1976 the initial sump was the main factor preventing major discovery, but this was passed first in 1971 then again to greater effect during the long summer of 1976.

The majority of this cave is dominated by a single bedding plane, probably the same one which dominates the Tiger 1 to Tiger 3 sections of Lathkill Head Cave (ie the lower surface). There are two major passages, one trending south west the other heading north west. The south west passage is a low, bedding dominated passage punctuated by two boulder chokes, the latter of which is the limit of present exploration in this direction. Shortly after the entrance lies the joint controlled chamber called The Dog House, which is above the dominant bed of the rest of the cave although still connected. The north west passage is by far the most extensive in the cave, and consists entirely of a horizontal development along a single bed (Friday the Thirteenth and Thursday the Thirteenth passages; Bentham & Sutton 1993). Part way along this passage is a branch leading north to the hydrological, though not yet navigable, connection with Dawke's Crawl in Lathkill Head Cave. The main passage continues, as before, until it reaches a junction. At this point one section continues north west though decreasing in size through The Fallopian Tube, while the other, much larger, section heads west to the limit of exploration.

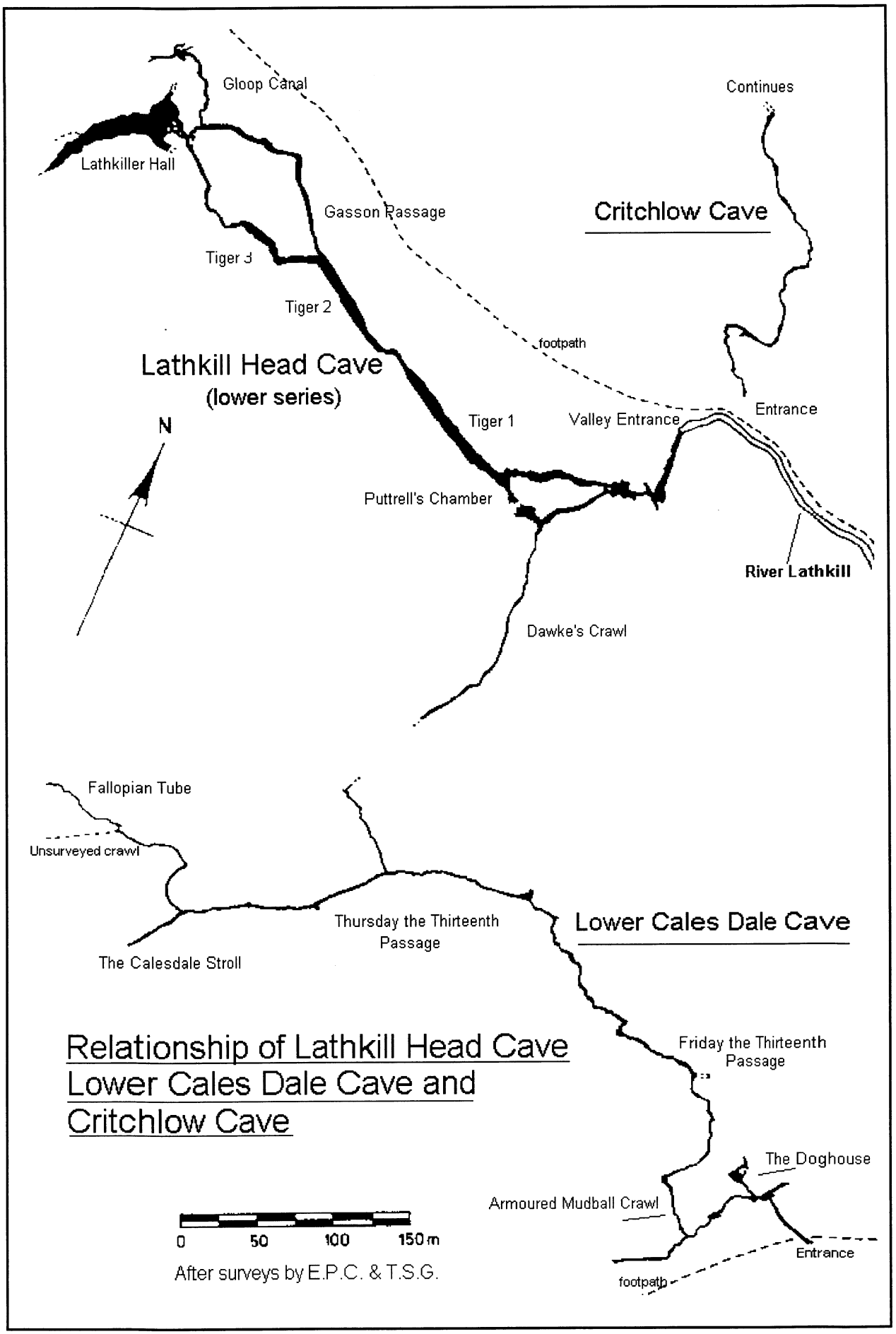


Figure 17. Relationship of Lathkill Head Cave, Lower Cales Dale Cave and Critchlow Cave

Critchlow Cave

Speleological investigation commenced here in 1947 when the British Speleological Association excavated the entrance crawl.

The whole cave is dominated by one bed. In the section between the entrance and The Critch the cave generally follows the direction of the joints, which are only slightly enlarged by natural solution (The Choke). The latter half of this section has numerous speleothems, a feature which comes to an end shortly before The Critch is reached (Bentham & Sutton 1993). This restricted area of speleothem development requires further investigation, but is probably related to the amount of time each section regularly spends totally submerged. Beyond The Critch the cave intersects joints at right angles, as opposed to following their line. The joints here are also dramatically enlarged, producing relatively sizeable chambers. As with the far downstream section of the cave there are no stalactitic deposits in the upstream section beyond The Critch.

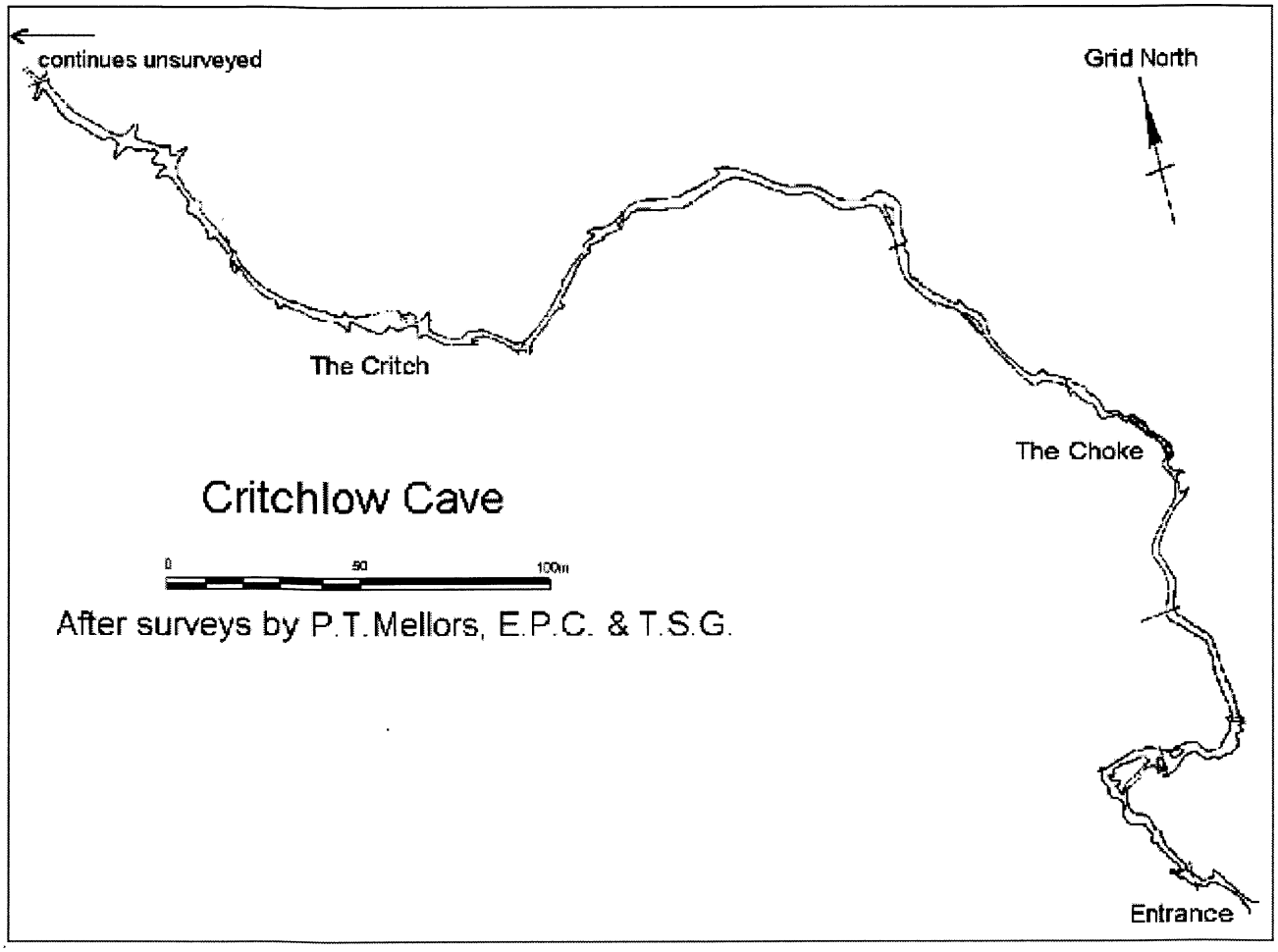


Figure 18. Critchlow Cave

Water Icicle Close Cavern

This shaft is one of the many remnants of mining in the area of which there appear to be no dated records. No dates are available either for the discovery of the large natural sections of this site. The cave has been under almost constant speleological investigation from the 1960's (Westlake 1970) to the present day, but without major success in terms of navigable passage.

Water Icicle Close Cavern, though predominantly natural, is accessed by means of a 32m mineshaft and three passages radiate from the base of the shaft. The three passages are phreatic tubes partially filled with fluvioglacial deposits. Flowstone and the rare speleothem are evident, particularly in the Northwest Passage. Throughout the cave is evidence of mining operations.

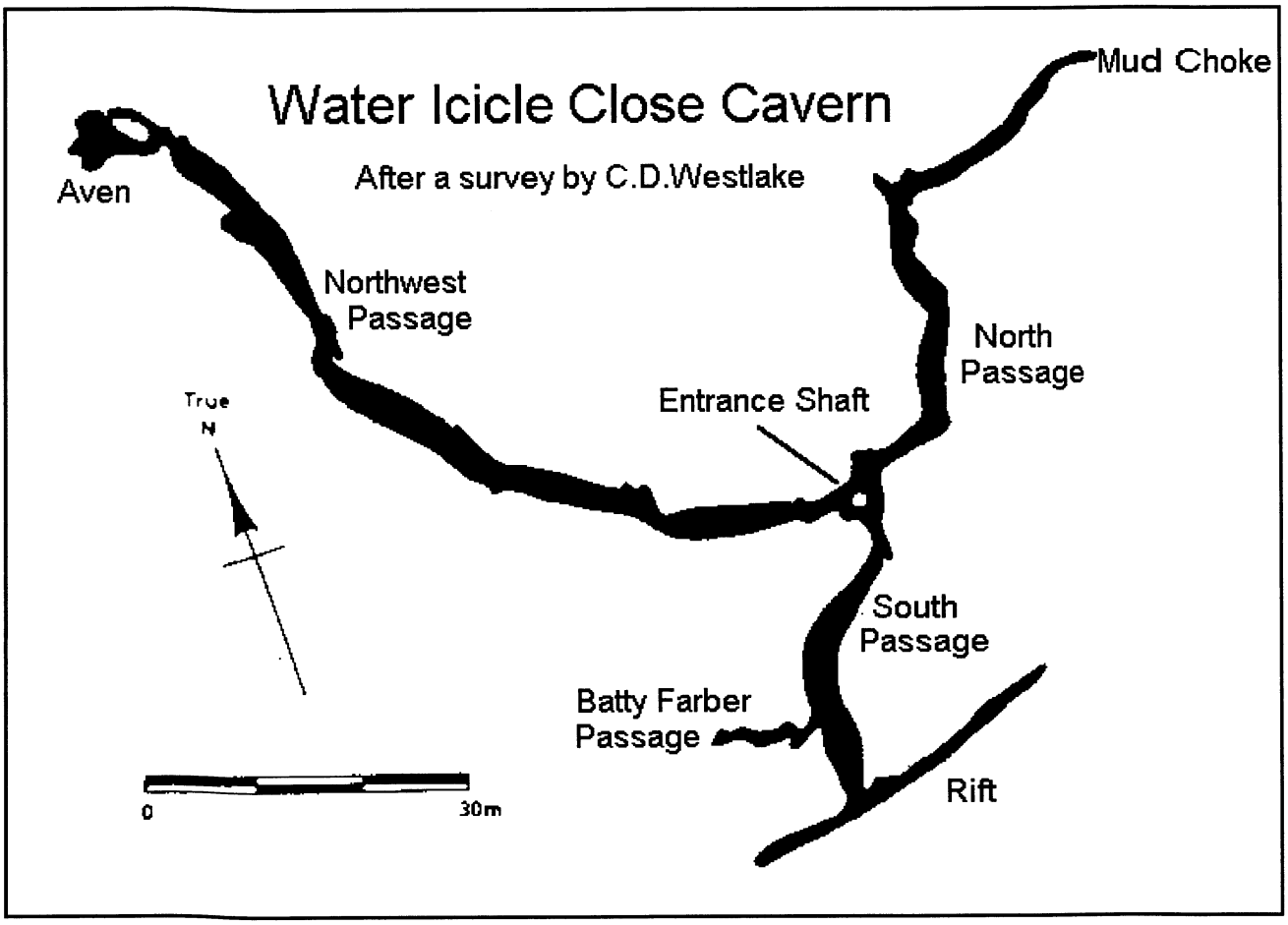


Figure 19. Water Icicle Close Cavern

Cascade Cavern

Cascade Cavern is similar to Water Icicle Close Cavern, as its initial discovery by lead miners is not recorded. From the 1950s it has received sporadic attention (Gee, 1957) but later investigation has not produced major extensions.

A 12m artificial mineshaft, now somewhat deteriorated, is followed by a further drop of 6m. The passage at the base is a measurably enlarged natural joint, which lies on the mineral vein. A small stream, dye tested to Lathkill Head Cave, disappears into a choke near the lowest point. Although the entrance is a remnant of the miners' activities this site is predominantly composed of natural features.

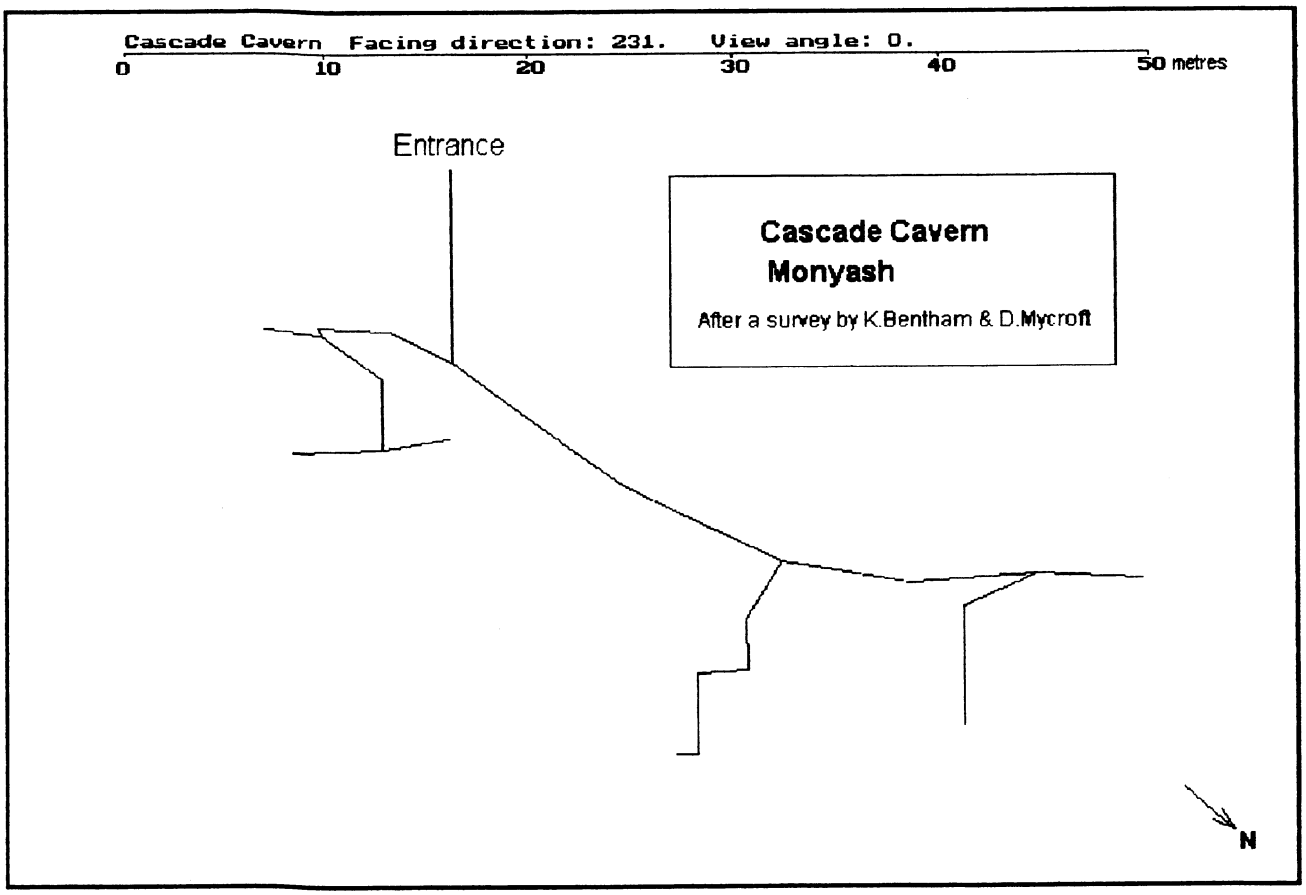


Figure 20. Cascade Cavern, Monyash

2.4.2 Caves and passages significantly altered by mining activities or predominantly artificial

Raven Mine

Interest in Raven Mine has developed since the late 1980s with initial work by the Orpheus Caving Club and then the Darfar Pothole Club in clearing minor blockages in the entrance shaft and the reopening of major horizontal connections by Bentham in 1993.

The mine lies directly on a lead rich section of a mineral vein. The majority of the mine is the result of the artificial enlargement of phreatic, joint controlled passages. The entrance pitch leads to a natural horizon with little in the way of accessible workings. 7m lower is a larger natural horizon which has been extensively worked and modified by mining operations. A further 15m lower is another major natural horizon which has also been enlarged by the mining. Below this latter horizon is an anomalous, unexpectedly large diameter, artificial shaft. This shaft appears to be out of proportion to the rest of the workings, but extensive investigation is prevented by the presence of standing water some 24m down the shaft (Bentham 1993a, b).

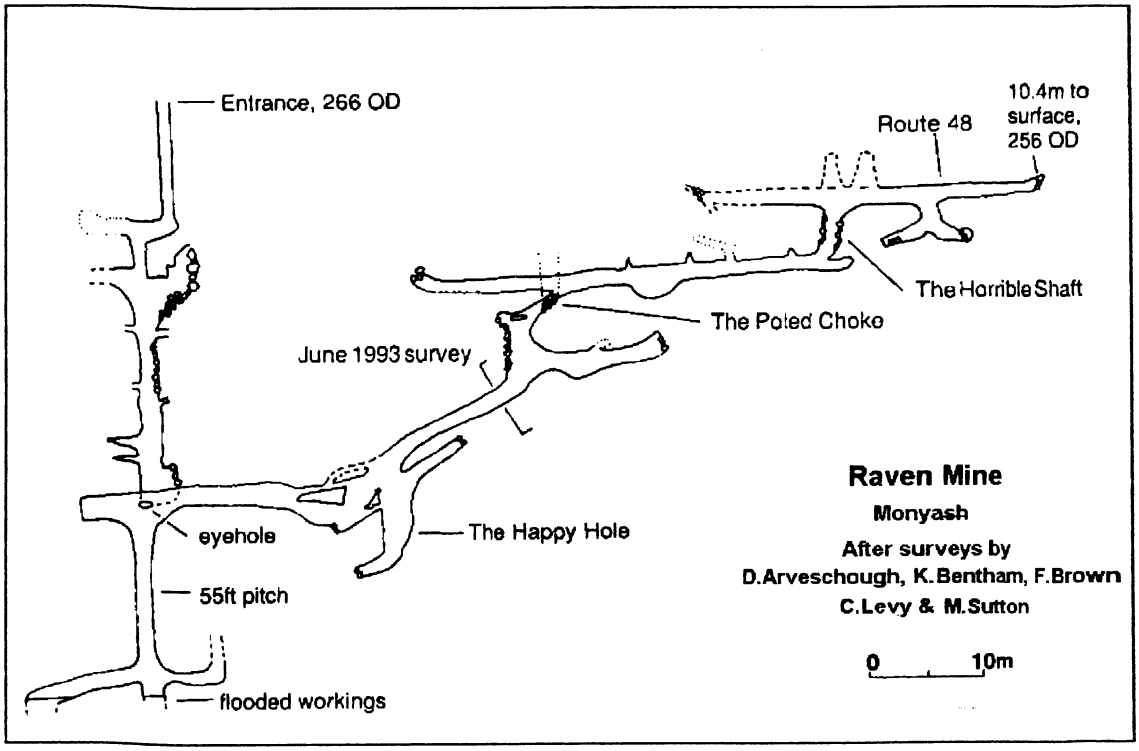


Figure 21. Raven Mine

Engine Close Mine

Engine Close Mine has been known to cavers for many years, but there has been little systematic investigation.

This mine consists of a single enlarged natural joint containing a shaft leading to a short natural horizon exhibiting signs of artificial enlargement in places.

One Ash Cave

A single short phreatic tube leads to a corroded flowstone blockage. One Ash Cave was investigated in the 1960s but no significant passages have been found (Mellors 1969).

Lynx Cave

A single phreatic tube, containing a roof entrance, which again halts at a corroded flowstone blockage. Unlike One Ash Cave, which is on the same limestone buttress, this site has been archaeologically excavated (Pennington 1875; Storrs-Fox 1906; Jackson & Storrs-Fox 1913).

Upper Cales Dale Cave

A phreatic tube which divides after some 23m, with both branches blocked after a short distance. As with Lynx Cave, this site has been archaeologically excavated (Pennington 1875; Storrs-Fox 1906; Jackson & Storrs-Fox 1913).

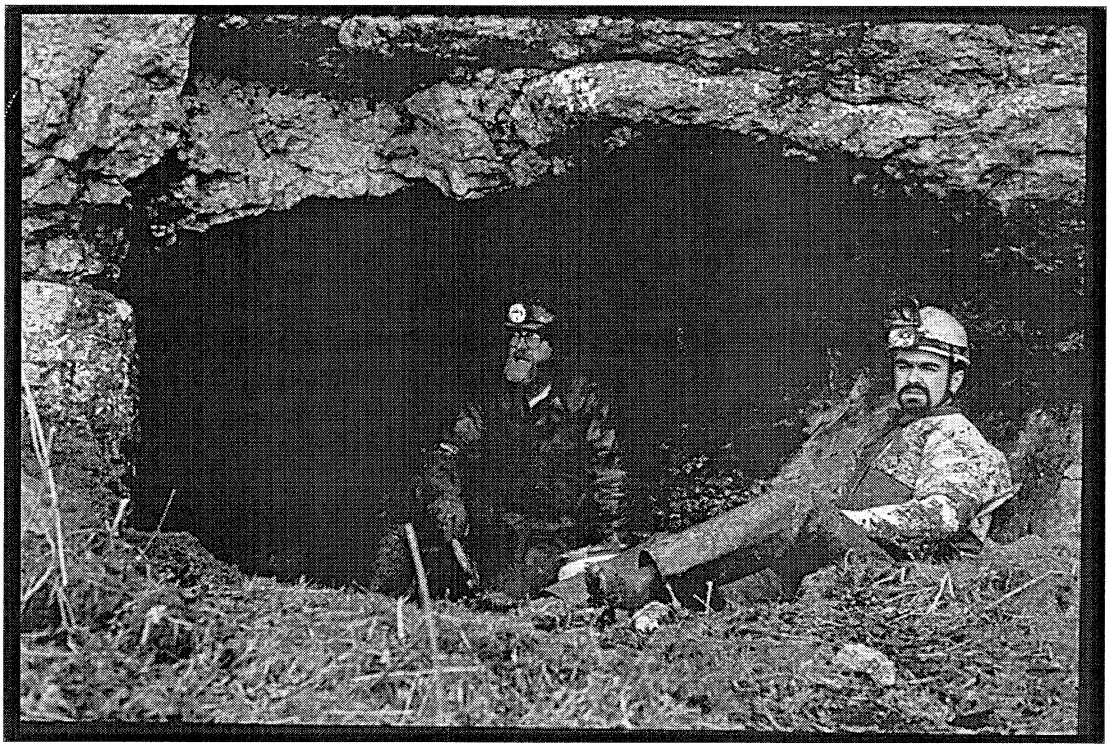


Figure 22. The entrance to Upper Cales Dale Cave. Photo © D Arveschough

Knotlow Cavern - Hillocks Mine

The exploration of this now navigable system commenced from the Hillocks Mine entrance in the 1950's (Gilbert 1952); and in 1959 Eccles Caving Club discovered Knotlow Caverns, which are only accessible *via* artificial miners entrances.

This part of the Lathkill Dale system consists of a series of natural, constricted, phreatic tubes and joint controlled chambers. Mining has been responsible for a great deal of alteration, though the basic morphology is still readily detectable. Of the four primary mining entrances into Knotlow Cavern, three are presently accessible, Chapel Dale Shaft, Crimbo Hollow (or Fourways Engine) Shaft and the "climbing shaft". The climbing shaft leads via a low arch and further shaft to Pearl Chamber. From here the passage descends to the Bung Series or via an opening in the wall of Chapel Dale Shaft to the main miners' routes through the joint controlled Waterfall Chamber.

Waterfall Chamber may also be accessed by following a route from the climbing shaft pitch down a series of collapses and a further 9m pitch. From Waterfall Chamber a climb up the east wall leads to the connection with Hillocks Mine via Meccano Passage. The Chapel Dale Shaft enters from directly above, with the ground surface 64m above. A further shaft is present in the floor and is permanently flooded. Pumping here has given access to a small complex of further miners' levels. Artificial levels, containing a stream, lead from Waterfall Chamber to Crimbo Hollow (Fourways Engine) Shaft and the Chapel Dale Level. Downstream from Crimbo Hollow Shaft is a further chamber, Rift Chamber.

Rift Chamber gives access to a series of partly enlarged phreatic tubes which take the majority of the Knotlow Cavern water. This section, including Crimbo Pipe and Crimbo Swallow is characterised by a series of low phreatic tubes, almost completely filled with fast flowing water. A number of avens and joint controlled pitches give access to various parts of this complex section, including a return route to both Waterfall Chamber and The Bung Series.

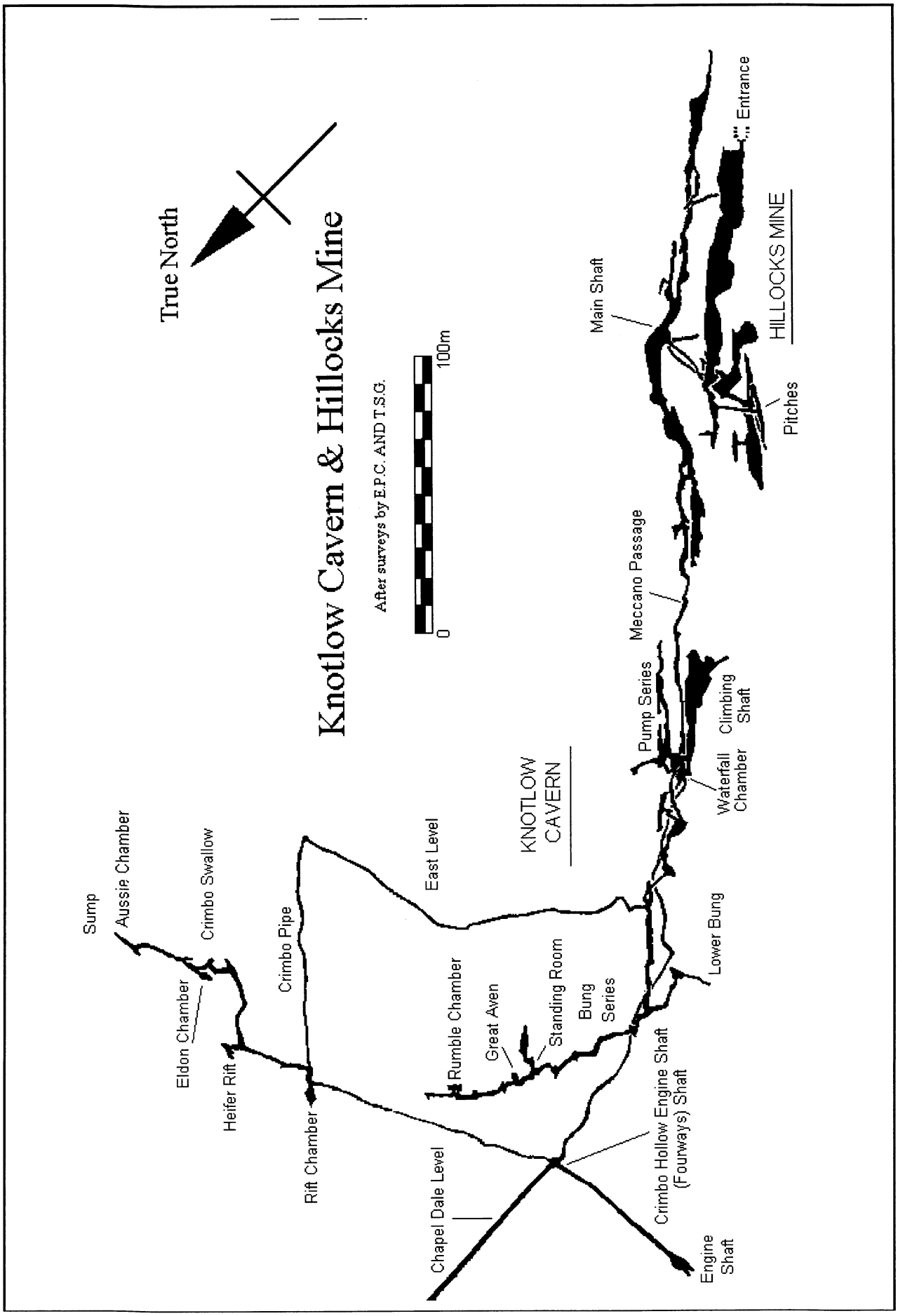


Figure 23. Knotlow Cavern and Hillocks Mine

The Bung Series is another watercourse leading towards the Crimbo Pipe section. Flat out crawls along phreatic tubes are interspersed with rifts and avens to give access to The Lower Bung Series. The Lower Bung Series carries water down a bedding plane towards Crimbo Pipe from Rumble Chamber and is the limit of present exploration in this area.

Hillocks Mine is generally accessed via a lined entrance directly into the entrance chamber, which contains large banks of fluvioglacial deposits and an open shaft in the roof. From the entrance chamber the passage descends steeply to a low mined level. This ancient hand picked "coffin level" leads directly to an artificial 7m shaft and a further descent through an enlarged section. From this second descent a low arch gives access to the main workings

The areas accessible from here on have been extensively altered by mining operations, and in general consist of large levels, hand picked "coffin levels" and collapses. The Main Chamber is 9m in diameter, with the Engine Shaft entering through the roof from surface (58m above). A passage heading north west from Main Chamber passes through a smaller chamber (Pool Chamber) before giving access to an altered section of low mud filled crawls and Meccano Passage. This passage is the connection to Knotlow Caverns.

3. Conservation

Caves are Integrity Sites, that is locaties "whose scientific or educational value lies in the fact that they contain finite and limited deposits or landforms that are irreplaceable if destroyed" (Nature Conservancy Council 1991). Deposits and/or landforms are therefore retained in original condition unless it can be shown to be scientifically constructive to remove or modify them.

3.1 Threats

The sensitivity of an integrity site such as Lathkill Dale's cave system necessitates a thorough investigation of the threats to the system, whether internal, or external. Although the identification of potential threats to the cave system may be straightforward the evaluation of precise effects may be more problematic, particularly given the present level of knowledge of the River Lathkill's catchment.

3.1.1 External

Principal external threats come from the interaction between people and the environment surrounding the cave system and its catchment. These could include effluent disposal and dumping, and the threats of cave entrance closure, three out of four of the categories classified by the Nature Conservancy Council as being "usually highly damaging if unmodified" (1991). Some activities, such as changes in agricultural practice (eg drainage works) and entrance controls, can cause damage but this can usually be avoided if the work is sensitively planned and implemented. Minor developments above cave passages are only damaging in exceptional circumstances.

Agricultural practices

The autogenic nature of this cave system means that the water content of the caves is not the result of the more usual allogenic sinks, but a consequence of the percolation of rainwater over a large ground surface area. Changes in the chemical composition of this percolation water have been shown to have a potential to damage speleothems (Hardwick & Gunn, 1993). Such changes in the chemical composition of the percolation water can be attributed to a number of factors ranging from acid rain to changes in land use. While the production of acid rain in surrounding cities is beyond the control of site management influencing the level of the use of chemicals (eg fertilisers) in surrounding areas may be possible.

The land immediately above and adjacent to presently navigable passages is largely within the existing SSSI boundaries and there is a requirement by land owners and operators under the 1981 Wildlife and Countryside Act to discuss their activities with English Nature. Wher these are considered to be damaging to the special interests of the caves, English Nature can enter into discussions to seek resolution. In addition factors affecting the water quality in one part of the system can, and probably will, impact on the downstream parts of the system. For example a change of land use in the area surrounding Knotlow Cavern which affects its water quality will also impact on Ricklow Cave, Lathkill Head Cave and Lower Cales Dale Cave, with impact also likely on both Cascade Cavern and Critchlow Cave.

Effluent disposal and dumping

While there is no definitive evidence to date of deliberate effluent disposal directly into the cave system there have been numerous reports of organic based pollution within parts of Knotlow Cavern (Mellors, 1994, 1995 & 1996). It is essential in an autogenic feed cave system that such sources of organic pollution as may exist are identified. The likelihood of the source having an autogenic input is small in comparison with the possibility of the source being by direct feed into the system. The potential for such a direct feed is immense, given the number of mine shafts in the region around Monyash which reach to or below the water table. If any pollution is introduced in this way it could remain in a high, and potentially hazardous, concentration close to its input source until diluted and dispersed by percolation. If the presence of organic pollution is proved, the source should be traced and, preferably, eliminated. Likely sources of pollution could be refuse and waste dumping in mine shafts or leakage from septic tanks and other waste disposal systems.

Entrance Closure

As the overall system is complex, there are multiple entrances throughout the Lathkill Dale area. At present the majority of these entrances are covered, in line with Nature Conservancy Council guidelines (NCC, Appendix 2, 1991). There are, however, certain cases where the seals are of a permanent nature and such closures may be incompatible with conservation as they alter airflow and ventilation, in addition to preventing access to potentially scientifically important passages. A system of lockable gates or grills is consistent with most conservation aims but will restrict recreational caving. Consultation with the regional representative body for caving, in this case the Derbyshire Caving Association (DCA), on the design, positioning and date of installation of such closure mechanisms is therefore essential and careful assessment should be made of the use of such entrances, with allowance for access as is appropriate at each point. Managed/controlled use of the cave system as determined by conservation aims and constraints is appropriate, but regular monitoring is required to ensure that the integrity of the site is not compromised.

3.1.2 Internal

The principal internal threats within the Lathkill Dale caves undoubtedly comes from cavers and their activities. Certain sections of the system are particularly popular for recreational caving, while others are under threat from the possibility of indiscriminate digging in search of passages. As caves are important as both a recreational facility and a scientific resource there is the potential here for a conflict of interests. As caves are "Integrity" sites the priority is obvious "the approach to their conservation.....is therefore weighted heavily in favour of preservation and restricting man made changes" (Nature Conservancy Council 1991). Under such guidelines the priority is therefore maintaining any scientific interest. This principle, however, does not necessarily exclude all recreational activities within the cave system as a whole, and future research and exploration is dependent upon the technical abilities learned through recreational caving. An ideal solution would be to determine particular areas of the system where recreational use is acceptable, and areas where access should be primarily for the purposes of research. This approach would require cooperation between cavers and the regional body for caving (DCA) and English Nature, but given the diverse nature of the system as a whole, satisfying both requirements is achievable.

Recreational use

Hardwick *et al* (1993) state that the major internal threats to the Upper Series of Lathkill Head Cave come from carelessness, deliberate vandalism and ill considered digging. Of these three activities two are primarily related to active recreational use. Since the completion of their report, a further entrance, Ricklow Cave, has been joined to Lathkill Head Cave and the potential for damage has dramatically increased. To adequately assess the potential for damage throughout the whole system it is useful to assess the aims of a sporting caver, along with the differences between novice and experienced recreational cavers:

"What the sporting caver likes"

Sporting, or purely recreational, cavers account for the vast majority of users of this system. Their basic aim is to descend to the lowest accessible point of a cave and then return to surface. To achieve this aim they will use whatever route is available to them, provisional on having the equipment and ability to use such a route. The absolute ideal is for a trip which is demanding on their personal abilities, but not over demanding, and involves entering and exiting using different cave entrances. A desire to explore " new caves", is very apparent but not necessarily the work required to find them.

Within this group there are obvious differences between novice and experienced cavers. For example the novice cavers prefer vertical sections to be relatively short (ie < 15m) and straightforward, whereas the experienced sporting caver will frequently consider such sections as "not worth the effort", and prefers long, complex, vertical descents. Other than the vertical sections the physical attributes of passages are generally immaterial. The primary exception here is where water is met, a novice being unlikely to welcome sections of restricted airspace whereas an experienced caver regards it is a standard feature.

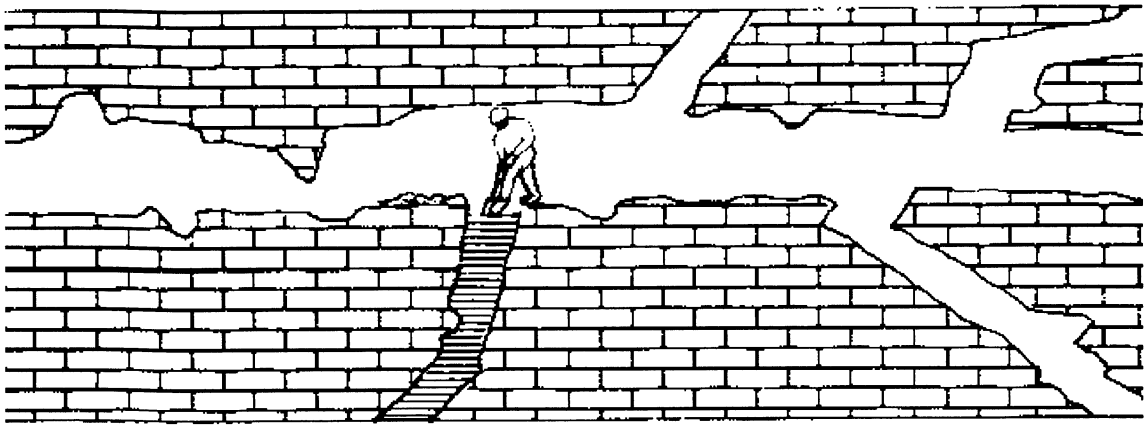
An important further difference between certain novices and responsible, experienced sporting cavers is apparent in their degree of respect for the underground environment. Some cavers will exhibit a degree of disregard for features underground, such as clastic deposits and speleothems, although such potentially damaging traits do, fortunately, tend to disappear with education and experience. The experienced caver will tend to have a greater understanding of the processes involved in cave formation, and more respect for their surroundings. Their aesthetic interest in certain underground features, however, may not lead to a respect for the scientific importance of other features, such as sediments.

Digging

Experienced sporting cavers frequently have an almost insatiable appetite for new caves to explore. Given the finite nature of cave systems, the only solution is to find new caves or extensions to existing ones. Fortunately the majority of new cave passages are found not by chance, or even quickly, but by research and long term work. They are also usually discovered as a result of an initial survey, before being used for recreation. There does still remain, however, the distinct possibility that irresponsible or inexperienced cavers can destroy a site or part of a site by digging away sediments or removing rock falls or other features.

Weighing up the benefits of a proposed cave dig in terms of its ability to produce new extensions and data against the damage to scientifically valuable sediment deposits and formations is therefore essential. Expert knowledge on the potential for a dig to succeed is often available and should be used wherever possible. Careful consideration must also be given as to the disposal of excavated material. Deposition in the cave may block or restrict existing passages or lead to removal by water systems only to be deposited elsewhere, potential in "clean areas". In addition material, must not be dumped indiscrimately around cave entrances as this can damage or destroy surface feastures including biological interests. Site owner/occupier and/or EN consultations are therefore required.

Indiscriminate digging can cause damage to important sediments !



after N.C.C., 1991

Figure 24. Cave digging

3.1.3 Threats to specific sites

Knotlow Cavern - Hillocks Mine

This section of the system represents the upstream limit of navigable passage within the Lathkill Dale system, and as such any threats here have the potential to affect the whole system. At present there are two major threats already apparent:

External threat:

- *Pollution*: Over several years there have been numerous reports within the caving community of organic pollution within Knotlow Cavern. The pollution appears to be both water and air based, and exhibits seasonal fluctuations. Reports vary from a slight smell to such an overpowering stench that progress into the cave becomes impossible. Such pollution that does make its way into the water course here will inevitably reach sections of the system downstream and this has been evident.

  The National Rivers Authority (now part of the Environment Agency) has investigated these reports but the unknown nature of the catchment prevents accurate assessment of likely sources, and the seasonal nature of its appearance makes monitoring difficult. A detailed hydrological survey of the complete catchment would increase the chance of identifying the source, and some form of remote detectors could be used to monitor it. In addition, visitors to the cave, when detecting contamination, could be encouraged to take water samples for future analysis and assessment. Once the source is detected the pollution could be rapidly prevented.

Internal threat:

- *Recreational use*: The Knotlow Cavern - Hillocks Mine system is one of the "classic" sporting trips in Derbyshire, or was until the pollution problem. The system is particularly suitable for "through trips" involving entering and exiting at different locations. Due to this feature caver "traffic" is relatively high throughout the year, using three major entrances. Given that the site has been modified by miners and has been speleologically studied for at

least twenty years, the potential for damage to the scientific interest of the site is now limited. The most significant scientific resource so far identified are the fluvioglacial deposits within Hillocks Mine. These deposits are extensive, but also readily accessible by even complete novices.

Given the relatively large extent of the fluvioglacial deposits within Hillocks Mine Entrance Chamber risk of their complete removal is not great although their extent is still finite. To date no scientific research has been carried out on these deposits in order to relate them to the deposits within other caves in the system. Research on these deposits is therefore needed in order to give a more distinct view of the place of Hillocks Mine in the chronology of the Lathkill Dale system. It would be advisable to either signpost or tape part of the deposit to prevent total destruction in the long term.

Water Icicle Close Cavern

Water Icicle Close Cavern is recognised as being an isolated remnant of the first phase of cave development within the Lathkill Dale system, dating back to over 350,000 years B.P. As such it is in a unique position within a unique system. Fortunately this position has already resulted in a greater degree of academic research than at any other site within the system. There are presently two potential threats to the cave:

Internal threats:

- *Recreational caving*: Water Icicle Close Cavern is a popular cave for novice training, particularly for teaching the skills of Single Rope Technique (SRT). Recent repairs to the entrance shaft cover have helped make the system more accessible, but have also improved the safety aspect of exploration here, but may encourage greater use and greater risks for the cave.

- *Digging*: For many years this site has been of interest to cave diggers, usually in a search for further high level passages. While this digging has some potential to further scientific information through the discovery of further passage the chances of success should be carefully weighed against the damage to the fluvioglacial deposits which fill many of the passages. Complete loss of these deposits is unacceptable and any requests to excavate here must be very carefully assessed.

Lathkill Head Cave -Ricklow Cave

Lathkill Head Cave is the primary navigable section of the Lathkill Dale system, and provides the main water course for the River Lathkill throughout most of the year. As such it is open to influences from not only the land above and around it, but also from any actions upstream. This means that agricultural land changes, pollution and effluent disposal throughout a wide area may have a potential impact on this site. In addition the cave is becoming increasingly popular with experienced recreational cavers and, consequently, associated pressures. With the recent massive increase in the known length of navigable passage within Lathkill Head Cave there is also a great potential for damage, through indiscriminate digging in certain areas. Of all the parts of the overall Lathkill Dale system, this section is the most at risk and requires the most protection.

External threats:

- *Agricultural practices*: The water within Lathkill Head Cave is primarily autogenic in its origin, relying on rainfall throughout the catchment percolating through the overlying soil and bedrock (Hardwick *et al*, 1993). This input includes autogenic supply from upstream sections of the system, with proven links to both the Knotlow Cavern - Hillocks Mine site

and Cascade Cavern. Any alteration of the chemical properties of this water may result in damage within the confines of Lathkill Head Cave - a primary cause of change being from changes of agricultural land use in the surrounding area. Within the SSSI there is opportunity to restrict potentially damaging agricultural change but of activities outside the confines of the site may also have a direct impact on the water. In particular extensive use of chemical fertilizers and pesticides can have an effect on speleothems (Hardwick & Gunn 1993).

- *Urban influence*: Monyash village lies within the central section of the River Lathkill's catchment. As such it has enormous potential to effect the percolated groundwater upstream of Lathkill Head Cave. The primary risk here lies in the potential for organic pollution to feed through soakaways or leakage into the groundwater. It is therefore essential that any planning application involving increased use of sewage disposal systems is carefully assessed. The requirement of applicants to demonstrate their plans for such disposal on planning applications allows for such investigation, and to assess whether "existing facilities" for example are adequate for any increased needs.

Internal threats:

- *Recreational caving*: Hardwick *et al* (1993), indicate that caver activity is the most significant threat to the system. The discovery of a further entrance into the upper series of the cave, with the connection to Ricklow Cave has led to an influx of inexperienced cavers as there is further potential for "through trips" via Ricklow Cave. This new influx places further pressure on particular sections of the cave - in addition to introducing new pressures.

The particular parts of the system at risk from the recreational cavers are as follows:

1. The Emporium. This is a large chamber above Tiger 4, containing numerous speleothems of aesthetic and scientific value. Access to the chamber is via a very dangerous climb up a boulder collapse (choke) to a steeply angled, heavily calcited floor. Several phreatic tubes are apparent within the chamber, all of which contain speleothems, as does the aven directly above the access point to the chamber. The exact nature of The Emporium's speleogenesis is undetermined and there is also an unidentified rodent skeleton within The Emporium, which is partially calcited.

   To an inexperienced cave digger the phreatic tubes within The Emporium may seem to present an ideal opportunity for extension, as there is a suitable sized area to dispose of waste from such a dig. After evaluation by the original exploration team, however, it has been concluded that there is extremely limited scope for discovering significant passage, particularly as any attempt to dig would necessitate an unacceptable level of damage to the speleothems.

   Taping of the entrance to The Emporium, or possibly the fitting of a lockable grill would help limit the risk here - either option allowing for photography of what is undoubtedly a key scientific and aesthetic resource, but discouraging any direct access.

2. Lathkiller Hall. Access to Lathkiller Hall is either via the dangerous boulder choke called "The Lathkiller" or via another site at risk "The Waiting Room". Lathkiller Hall is a large collapse chamber containing numerous speleothems and a potentially important sediment deposit. In addition, flowstone is widely evident, covering several slopes within the chamber. The standard practice of taping sensitive areas is applicable to all these features (speleothems, flowstone and clastic deposits). An alternative, or additional solution, could include creating an alternative route by completely bypassing this section of cave.

3. The Waiting Room. The Waiting Room is a large chamber accessible either via the lower (valley) entrance of Lathkill Head Cave and Lathkiller Hall, or via the Upper Entrance directly above, or via Ricklow Cave The chamber is one of the most aesthetically pleasing sights in Derbyshire caving, with large amounts of both flowstone and speleothems. Almost every wall, aven, and bedding passage contains some feature of value.

As with The Emporium and Lathkiller Hall there is potential for opening up unexplored passage, but such work would damage the speleothems and flowstone, and as the potential for the discovery of significant passage is minimal, excavation is scientifically unacceptable.

A further threat to The Waiting Room lies in the potential of damage from above. All the walls of the Upper Entrance pitches are unstable, and could easily fall into The Waiting Room causing extensive damage. This is a particular threat given the accessibility of the entrance to both novice and experienced recreational cavers.

Possible solutions are available for the protection of The Waiting Room ranging from standard taping of all sensitive sections to directing traffic away from this area and locking or permanently closing the Upper Entrance.

4. Dream Time and Tiger 6. Dream Time is a large aven above Black Rock Sands (a large boulder choke at the upstream end Tiger 5), containing many speleothems on the walls and roof. Tiger 6 has large sections of stratified clastic deposit, which is of scientific value. As Ricklow Cave is the closest entrance point to Dream Time, and the further reaches, it has already started to become the main through route creating problems in Tiger 4 and Tiger 5. Unfortunately the lower parts of Ricklow Cave contain large amounts of mud, which is slowly spreading to the previously pristine sections of cave around Dream Time and beyond.

There are two main solutions to the problem of mud transportation from Ricklow Cave, each involving a change of route. Ricklow Cave has now been gated limiting through route use via mud-rich areas, and the only open access is now via the Tiger series which are regularly cleared by the actions of the River Lathkill. An alternative solution, linking the upper reaches of the Dream Time aven directly to the surface, a distance of around 7m would allow direct access to Dream Time and the further reaches also without the need to pass through Ricklow Cave. Work on this access is in progress.

Ricklow Cave

Ricklow Cave has only had significant conservation-related issues from 1995, when it was connected to Lathkill Head Cave. The two main problems are the potential for chemical change of the groundwater and the through traffic into Lathkill Head Cave. Ricklow Cave has a direct navigable link to The Northern Lights, which is also a hydrological link, so any changes within Ricklow Cave will automatically be transferred downstream. Through traffic into Lathkill Head Cave also involves the transfer of mud from the lower sections into the more pristine parts of Dream Time, Tiger 5 and Tiger 6 (see above).

An additional potential problem is the nature of the connection with Lathkill Head Cave. The present link was opened as a temporary measure in 1995, and in its present condition may collapse within a matter of two to three years. If the connection is to remain permanent further important maintenance will be required.

Lower Cales Dale Cave

Lower Cales Dale Cave is an important link in the Lathkill Dale system, providing a resurgence for the river in times of flood. In all but drought conditions the majority of this site is inaccessible as there is a flooded sump 100m into the cave entrance. The water

provides both dangers and safeguards. The inaccessibility prevents, to a large degree, typical threats of recreational caving, but it does, however, increase the potential for damage through chemical contamination of groundwater.

The present situation may change, however, as a sump bypass, from the Dog House, is being developed during 1996-1997 This would result in the further reaches of Lower Cales Dale Cave becoming accessible for a greater portion of each year. Should the connection be made between Thursday the Thirteenth passage and Dawkes Crawl, in Lathkill Head Cave, the situation may change yet further.

Internal threat:

- *Recreational caving*: The site is of minor importance for recreational caving, with the "rewards" not presently being considered as being worth the effort. Careful monitoring would be essential should the connection with Lathkill Head Cave be made. Such a connection could be valuable in scientific terms due to the increase in knowledge it would give on the hydrology of the system, but if the connection were to drastically increase caving traffic it may either give a relief to other sections of the overall system, or may lead to unacceptable pressure.

External threat:

- *Pollution:* The threat from polluted groundwater is similar to that assessed at sites further upstream, but it should be noted that any pollution detected at this point would have no chance of dilution prior to reaching the surface flowing section of the River Lathkill.

Cascade Cavern

Cascade Cavern has until recently been largely ignored by speleologists and sporting cavers. This situation has changed over recent months with realisation of its importance in the content of the complete Lathkill Dale system. At present it has only two identified problems water pollution and collapse.

External threat:

- *Pollution*: The threat is from typical agricultural sources, plus increased potential from other sources. As the nearest accessible site to Monyash village, there is a risk of increased input of domestic waste via accidental runoff, as there is a nearby water treatment plant, especially at times of high flow. The rainwater runoff from the adjacent road leads directly onto the grass above Cascade Cavern, and consequently any pollution flowing downhill along this road from Monyash will be deposited above important hydrological link.

At present the entrance to Cascade Cavern is in an unstable state, and in danger of collapse. Should this take place it would allow unrestricted ingress of unsuitable material, and as it is in a road-side location there is a risk of fly tipping or dumping of refuse. There is some evidence to indicate that this site was used for dumping of farm-related materials prior to the present cap being installed.

Cascade Cavern would therefore be an important site to regularly monitor in order to assess the impact of both the free water runoff and the capability of the water treatment plant to cope with any increased demands or exceptional high flow. The instability of the cave entrance is a more immediate problem, however and some work may be required.

Critchlow Cave

Critchlow Cave is at risk from changes in the chemical properties of the groundwater, including pollution. Dye tests have so far been unable to identify a source for water issuing from Critchlow Cave, and this necessitates further caution when assessing proposed operations and activities in surrounding potential source areas.

As the only significant independent cave on the north side of Lathkill Dale it is important that the site is regularly monitored for pollution. Other operations acan be regulated through the SSSI designation.

Raven Mine: & Engine Close Mine

Raven Mine is relatively clean at present, though Engine Close Mine contains a large amount of dumped material. This material was probably introduced prior to capping of the site. Neither of these two sites presently show any significant conservation problems, beyond those mentioned in relation to chemical changes and pollution of groundwater. The only potential threat would come from closure of either site, with a direct effect on air circulation elsewhere in the system.

One Ash Cave

At present this site is of minor importance in the overall system. It is advisable, however, that regular monitoring is in place in order to identify any activity which may alter the present state. If no significant extension is made to the length of the cave, there would appear to be limited threat to the cave.

Lynx Cave and Upper Cales Dale Cave

These two sites are presently more important in terms of their archaeology than their speleology, and as no deposits present should be disturbed. Should any works be proposed it is essential that relevant archaeological authorities are contacted.

3.2 Key themes for future research

The Lathkill Dale System is widely accepted as being the best example in the Peak District of a river flowing on or beneath the limestone plateau. The system also contains examples of sediments no longer found on the surface in this area. In addition, the unique autogenic nature and size of the system give a great potential for scientific research and discovery. The chronology of Ford *et al* (1983) suggests three distinct phases of development, but remains provisional as more work is required to produce a more definitive chronology. Both the Knotlow Cavern - Hillocks Mine link and Lathkill Head Cave present valuable resources in terms of their clastic deposits and speleothems, and may also reveal valuable information on interglacial conditions in the Peak District.

To develop an overall picture of the systems development a programme of scientific based research, linked with further exploration should be considered with the following items being of primary importance.

- *Hydrology*: Little is known of the nature of the water supply to the caves, other than its autogenic nature. While hydrological connections have been established involving separate links between the Knotlow Cavern - Hillocks Mine section, Cascade Cavern and the resurgence caves of Lathkill Head, and Lower Cales Dale there is no available information on the upstream supply. At present the exact boundaries of the River Lathkill's catchment remain unknown. To properly monitor the chemical input into the water of this system, further research is needed to identify the complete catchment, and its underground course.

- *Chronology*: The chronology proposed by Ford *et al* (1983) is widely accepted but does rely to an extent on inference as only Water Icicle Close Cavern has provided specific dates. The fluvioglacial deposits in Hillocks Mine are easily accessible and could be tested, as could the deposits found throughout Lathkill Head Cave. Further valuable information could be gained by dating speleothems within parts of Lathkill Head. Speleothems within both Dream Time and The Waiting Room could also give valuable information not only on the age of the cave, but also on the rate of collapse of such large voids. With formations being in evidence on fallen blocks in these locations the dates of their detachment could be assessed.

- *The Lathkill Head Cave limestone bedding controlled passages*: The majority of the development within Lathkill Head Cave is along two distinct horizons, and exhibits a distinct preference for a single bed within the limestone sequence. At present there is no information to assess exactly why this single bed controls development but this could be tested, for instance, by assessing relative solubilities of successive levels in the limestone sequence. Further exploration at the end of Lathkill Head Cave will also assist in providing data for such investigation. The results of such investigation will also assist in the continued exploration of the system, indicating whether this one bed is likely to continue to dominate cave development further upstream.

- *Water levels*: Although the driving of mine soughs in the area has had a direct effect on the level of the River Lathkill throughout the cave system there is still a lack of knowledge on previous levels. Research into the historical levels of the river using mining and other records would facilitate comparison with present day levels. Further research could be assisted by the dating of speleothems, clastic deposits and surface features.

3.3 Conservation guidelines for the Lathkill Dale Cave System

The individual components of the Lathkill Dale System have historically been considered as separate sites. One section in particular has already had a Cave Conservation Plan compiled (Hardwick *et al* 1993). With the extensions and information gained between 1990 and 1996 the system can now meaningfully be considered as a whole rather than as a collection of separate parts. Each of these individual sections has an input into the whole, and actions in one section will have an impact on other sections. Any programme of conservation covering the whole system must therefore take certain factors into account including:

- The scientific value of the caves as a source of geological knowledge, and demonstration of natural formations (speleothems, sediments etc.).

- The present lack of knowledge of the chronology of cave system development .

- The lack of knowledge of the water catchment area.

- The unique nature of the systems water input.

- The demands placed on the system by recreational caving.

- A constantly changing knowledge of the hydrology, morphology and accessibility.

To develop a coherent and consistent strategy for conservation of the area, the relative importance of each factor needs to be assessed. Of particular importance is achieving a balance between recreational use and protection of the scientific resource. Educating recreational cavers will be an important element in successfully achieving conservation aims, especially as this group dominates cave users.

Management of the system as a whole is essential, in order to assess the potential effects of any actions in any part of the caves on other, adjacent, or even distant parts of the system.

General site-specific guidelines are as follows:

Knotlow Cavern - Hillocks Mine

This section is particularly suited to recreational caving, giving a choice of underground features suitable for novice and experienced cavers. There is limited risk of destruction of scientifically important information other than the fluvioglacial deposits within Hillocks Mine Entrance Chamber. The results of a hydrological research programme would assist in the elimination of the present pollution problem. Once the pollution problem is resolved the sites recreational value could be promoted providing that the remaining fluvioglacial deposits are protected.

Cascade Cavern

This is an important link between the Knotlow Cavern - Hillocks Mine section and the downstream caves. For recreational caving there is little of significant interest at present. The potential to connect this section with either those upstream or downstream is also limited, and will rely on specific data from surveys as known limits of the other sections get closer. The entrance requires stabilisation after which restrictions on access could be limited. Excavation of new sections would be of limited threat but could be controlled if necessary. Monitoring of illegal tipping at the site is also necessary.

Lower Cales Dale

Given the short amount of time each year that this section is accessible there are few specific threats and the connection of this section with Lathkill Head Cave would increase the available knowledge of the systems hydrology. As with Cascade Cavern the excavation of new sections may presently not be a significant risk to the site.

Lynx Cave and Upper Cales Dale Cave

These sections are of minor speleological importance at present, but of greater archaeological importance. Access should be restricted to archaeologists, and excavation prohibited unless part of a controlled archaeological investigation and appropriately consented.

Water Icicle Close Cavern

At present this section is an isolated remnant of the first phase of cave development in this area. Valuable scientific data has already been recovered in the form of speleothem dating. Further excavation of passages may be acceptable, as any successful extension would increase the available knowledge on this little known phase of development. As at other sites such operations must only be carried out in consultation with English Nature and relevant landowners. The opening of a

second entrance, as indicated in Section 2, would be seen as having an essentially neutral effect. While air circulation would undoubtedly alter there is evidence that this has happened in the historical past. A second entrance would be of limited speleological value but as a recreational resource, could relieve pressure on more sensitive sites.

Critchlow Cave

The demanding nature of this section has successfully restricted its exploitation as a recreational resource since the 1980s and there is little evidence to any alteration of this state. Exploration at the far end of the cave would undoubtedly increase the available knowledge on the hydrology of the north side of Lathkill Dale and as such would be acceptable if appropriately carried out .

Lathkill Head Cave

This is the most extensive section of cave passage within the confines of Lathkill Dale. As it is unique both in terms of its water input and the availability of scientific information serious consideration should be given to restricting access to certain sensitive sections. In its present state there is the potential for irreparable damage at various points throughout the cave. The existence of three separate, uncontrolled entrances is likely to encourage use by recreational cavers in search of demanding but rewarding through trips. As the interaction between cavers and Lathkill Head Cave has been identified as the primary threat to the cave it is proposed that access is monitored or restricted at the Upper Entrance. Access via the lower (valley) entrance is not generally a problem due to both the technical nature of such an undertaking and the limited access period allowed by water levels.

Ricklow Cave entrance presents problems that are somewhat different from the other two main entrances to this part of the system. This entrance is relatively easy for even novices to gain access. The newly fitted gate on the Ricklow Cave entrance works as a deterrent to passers-by but will not prevent the problem of mud transfer from the lower levels into Tiger 5. The connection of the aven in Dream Time to the surface, however, will present an alternative route to the far, upstream, end of the system without the need for passing through Ricklow Cave. In addition it will eliminate the need for passing through the unstable and sensitive areas around Lathkiller Hall and Black Rock Sands (Mycroft & Bentham, 1995). Such an entrance into Dream Time will also alleviate some of the pressure on The Emporium and The Waiting Room by directing traffic towards the far end without the need for passing these sensitive areas. The only potential dangers of opening up this new entrance will be increased pressure on the Dream Time speleothems and the possibility for further recreational trips from this entrance to others. Use of this new entrance would therefore be initially restricted for the research and exploration.

The speleothems in areas such as The Emporium, The Waiting Room and Dream Time all require some form of protection. It is proposed that these formations should be preserved by a combination of education, taping and directing traffic away from them. The provision of the proposed new Dream Time entrance would direct exploration traffic away from both The Emporium and The Waiting Room. Any access restrictions to the Upper Entrance would allow leaders of groups permitted access to be educated concerning sensitive areas, as would restrictions on access to the Dream Time Entrance.

The clastic deposits throughout the cave and particularly those in Tiger 6 create a slightly different problem. While the speleothems remain above the level of the River Lathkill even during flood, the clastic deposits are frequently under water. While the educational and access restriction policies mentioned above may assist elsewhere in the cave, taping would be impractical at this level as annual replacement would be necessary and the River Lathkill would resurge complete with brightly coloured tape during flood conditions. It is necessary, therefore, that the clastic deposits are scientifically assessed to determine their significance and subsequently a route is waymarked through the Tiger Series using small cairns (a process already commenced).This may be the only

practicable means of protecting the clastic deposits, and is a valuable aid in route-finding through a complex area (although periodic replacement after times of flood may be necessary).

The importance of the system as a scientific resource is paramount to any future access agreements for the cave. It would be necessary to ensure that visitors to the cave understand the need for caution in sensitive areas and demonstrate their ability to take this into account where appropriate. The unique nature of this cave means that conservation has a clear priority over recreation.

3.3.1 General conservation remarks and recommendations

The general principles of conserving speleothems are widely accepted within the caving community and are generally achieved by the implementation of common sense and the National Caving Association Cave Conservation Policy (See appendices). The protection of clastic deposits is not so widely accepted and requires further education. Until such time as the awareness reaches an adequate level these deposits remain at risk. To assist the protection of these and other features a key for cave conservation is included in Appendix 1. This key will also allow for the instant classification and protection of features found in any sections of the system discovered after publication of this plan.

Given the sensitive nature of particular parts of the system, and the unique nature of the system as a whole, a management committee is appropriate. The committee would have to take account of both the scientific importance of the cave and its features, and the demands on the system as a recreational resource. In addition it needs to respond to the future developments through exploration of the cave, in a manner acceptable with the sites integrity status (*sensu* Nature Conservancy Council, 1991).

The committee should consist of representatives of such organisations and individuals as are likely to have a direct influence on the use of the cave. These organisations and individuals would include English Nature, those undertaking exploration and the regional representative body for recreational caving (Derbyshire Caving Association). Appropriate consultation with other relevant land owners and occupiers and also the Environment Agency would also be essential.

3.4 Safety Issues

The Lathkill Head Cave, Critchlow Cave and Lower Cales Dale Cave sections of this system are subject to the fluctuations of the River Lathkill. All three caves, along with the lower sections of Ricklow Cave are subject to extreme flooding up to roof level. The majority of these caves are inaccessible in all but very dry weather, with some sections only accessible under drought conditions. Any recreational activity within these caves is therefore potentially hazardous, with rescue from the far sections being extremely difficult and protracted. Advice should always be sought before entering the system and permission obtained.

Cavers are allowed access to the caves of Lathkill Dale National Nature Reserve under the terms of an access agreement between English Nature and the Derbyshire Caving Association. A copy of the terms of this agreement is included in Appendix 3. **Access is only available to those who are members of, or members of a member club of the National Caving Association or one of its constituent bodies.**

The environment of caves is entirely different from that normally encountered on the surface; care and respect is required. What would be a minor mishap on the surface may become a major incident underground. Certain rules apply to all caving trips, not only those sites within this plan:

- All parties should be supervised by a responsible and experienced leader with appropriate local knowledge (National Caving Association membership is required for access to caves within the National Nature Reserve).

- All parties should be correctly dressed and equipped.
- Ensure that all members of a party are capable of navigating the selected cave; caves are dangerous and hazards include water (both standing and flowing) and loose rock.
- Always let someone else know where you are going and what time you are due to return (and what action to take should you not return by a given time).
- Always take note of weather forecasts, the caves in this system are liable to complete flooding.
- Each person must have a helmet and a caving lamp.
- Always take emergency lights, food and first aid equipment in a waterproof container.
- Ensure that all ropes, knots and aids are safe before trusting your life on them.
- Be fully conversant with call out procedures for the Derbyshire Cave Rescue Organisation (DGRO, see below).
- Insurance is essential for organised groups and available through regional caving councils or via the British Cave Research Association.
- Be aware of high radon levels in the caves.

Please remember that much of the land you are crossing is privately owned, and in many areas has been designated as a Site of Special Scientific Interest not only for geological features but also for plant and animal life. Most of the area is also designated as a National Nature Reserve and directly managed by English Nature. Respect the land and the rights of land owners.

Permission to visit all caves in the area must therefore be obtained from the owner/occupiers of the land they are within. For Lathkill Head Cave, Ricklow Cave and Critchlow Cave, the access agreement with English Nature applies. All other caves are privately owned. Appendix 3 lists the standard conditions governing access to the caves of Lathkill Dale National Nature Reserve.

IN CASE OF EMERGENCY / ACCIDENT
TELEPHONE 999
ASK FOR CAVE RESCUE

The call will be answered by the Police, who will need the following information to pass on to DCRO (Derbyshire Cave Rescue Organisation).

1. Your identity.
2. Where you are calling from
3. Name of Cave or Mine (Give National Grid Reference also if possible).
4. Where in the cave, or mine, the accident occurred.
5. Time of accident
6. Number of persons injured
7. Nature of injury/accident where possible.
8. Number and location of persons still underground.

For further details of Lathkill Dale SSSI, NNR and information on access, please contact:

English Nature
Peak District and Derbyshire Team
Manor Barn
Over Haddon
Bakewell
Derbyshire
DE45 1JE

For further information on caving in the district or on the caves of Lathkill Dale please contact:

Mrs. J Potts
Hon. Secretary/Treasurer
Derbyshire Caving Association
3 Greenway
Hulland Ward
Ashbourne
Derbyshire
DE6 3FE

D Mycroft
Hon. Secretary
Buxton Underground Group
12 Chatsworth Lodge
Carlisle Road
Buxton
Derbyshire
SK17 6XX

K Bentham
11a George Mansions
Buxton
Derbyshire
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Appendices

Appendix 1. Glossary of caving related terms

Allogenic A system whereby caves receive their input of water primarily from sinks.

Autogenic A system whereby caves receive their input of water primarily via percolation of rain and groundwater.

Aven A vertical extension upwards from a passage, not meeting the surface.

Bedding plane A passage formed at the junction of two distinct layers of the prevalent strata.

Boulder choke An area of collapsed boulders, sometimes with a navigable route.

Boulder collapse An area of collapsed boulders.

Chamber An area of considerably greater dimensions than the surrounding passage.

Clastic Deposit formed of fragments ('clasts') of pre-existing rocks. Includes clay, silt, sand and gravel.

Coffin level An artificial passage created by miners, with an cross section resembling the shape of a coffin placed vertically.

Collapse chamber A chamber created primarily by the natural detachment of blocks from the cave, or passage roof.

Crawl A section of passage requiring an almost horizontal posture to navigate.

Dye testing A method of testing the water course between a source and its resurgence, involving the placement of a form of chemical dye at the source and detecting it at an outlet.

Flat out A section of passage requiring a horizontal posture to pass.

Flowstone A calcium carbonate deposit, similar to that in speleothems, formed directly on walls, roof, floor or boulders.

Gours A pool rimmed by deposited calcium carbonate (usually), associated with stalagmites.

Helictite An irregularly shaped or twisted speleothem formed where seepage water is supplied independant of gravity flow (eg by capillary action).

Joint A natural fracture of the rock usually of a vertical nature.

Level An artificially enlarged or created passage commonly associated with lead mines.

Navigable Capable of being passed by humans without further enlargement.

Phreatic A cave or passage created by solution below the water table.

Pitch A vertical section of cave passage.

Rake A vertical or near vertical deposit of minerals - usually lead in this area.

Resurgence The exit point for the water of a known cave.

Sink The point at which water disappears underground.

Speleology The scientific study of caves and their features.

Speleothem A calcium carbonate deposit within a cave, usually hanging from the roof including stalactites and similar features such as helictites.

Squeeze A section of passage requiring a horizontal posture and with restricted space.

Stalactite A calcium carbonate deposit (usually) hanging from the roof of a cave.

Stalagmite A calcium carbonate deposit (usually) building upwards from the cave floor.

Sump A section of cave or passage completely filled with water. These may be seasonal.

Syncline A downfolded structure of rocks with the beds dipping downwards on each side towards the axis.

Tube An almost circular passage.

Uranium dating A method of dating rock by calculating the percentage of decay of Uranium 235 and associated daughter isotopes.

Vadose A cave or passage created by free flowing water above the water table.

Abbreviations of Organisations

BSA	British Speleological Association
BUG	Buxton Underground Group
DCA	Derbyshire Caving Association
EA	Environment Agency
EN	English Nature
EPC	Eldon Pothole Club
NCA	Nation Caving Association
NCC	Nature Conservancy Council
OCC	Orpheus Caving Club
SUSS	Sheffield University Speleological Society
TSG	Technical Speleological Group

Appendix 2 A key to aid cave conservation

1. Is the cave or passage a new discovery?	If Yes If No	Go to Section 3 Go to Section 2
2. Is the cave within a Site of Special Scientific Interest or are there any known conservation issues?	If Yes If No	**Contact English Nature (if SSSI) and/or NCA regional conservation & access officer and management committee (if established)** Go to Section 3
3. Is the cave registered on your local cave registry?	If Yes If No	Go to Section 4 Register, Go to 4
4. Are any of the following present? Stream Stalactites Stalagmites or gours? Clastic deposits Archaeological remains	 If Yes If Yes If Yes If Yes If Yes If none present	 Refer to Section 5 Refer to Section 6 Refer to Section 12 Refer to Section 15 Refer to Section 18 Go to Section 19
5. **Streams** Streams are an important resource, having impacts upon speleothem generation rates, aesthetics and potentially drinking water. No foreign material should be allowed to enter the stream, testing for hydrological patterns must be appropriately authorised. Of particular significance chemicals such as pesticides, fertilisers and calcium carbide.		Go to Section 20
6. **Stalactites** (ie speleothems attached to roof) Are all stalactites intact and *in situ*?	 If Yes If No	 Go to Section 9 Go to Section 7

7. Have speleothems from this site been date tested?	If Yes If No	Go to Section 8 **Specimens must not be removed unless authorised by EN (if site is an SSSI) or an appropriate management committee or NCA regional conservation & access officer** Go to Section 20.
8. Are the broken speleothems in a through route?	If Yes If No	**Contact EN (if SSSI) and/or Management Committee** Go to Section 20 **Leave in place, contact EN (if SSSI) and/or Management Committee or NCA regional conservation & access officer** Go to Section 20
9. Are stalactites in a vulnerable place from physical damage?	If Yes If No	Go to Section 10 **Tape area around stalactites** Go to Section 20
10.Does the position of the stalactites restrict further exploration?	If Yes If No	Go to Section 11 **Tape area around stalactites** Go to Section 20

11. Are there alternative routes available without damaging stalactites?	If Yes If No	**Take alternative route** **Contact EN (if SSSI) and/or Management Committee or NCA regional conservation & access officer immediately for advice. Tape area around stalactites.** Go to Section 20
12. **Stalagmites and gours (ie speleothems attached/present on cave floor)** Are stalagmites or gours in a vulnerable place from physical damage?	If Yes If No	Go to Section 13 **Tape area around stalagmites** Go to Section 20
13. Does the position of the stalagmites or gours restrict further exploration?	If Yes If No	Go to Section 14 **Tape area around stalactites** Go to Section 20
14. Are there alternative routes available without damaging stalagmites or gours?	If Yes If No	Go to Section 20 **Take alternative route** Go to Section 20 **Stop immediately. Tape area around stalactites. Contact Management Committee or EN (if SSSI) or NCA regional conservation & access officer for assessment of value**
15.**Clastic deposits** Are deposits present?	If Yes If No	Go to Section 16 Go to Section 17

16. Have the deposits been scientifically examined?	If Yes	Go to Section 17
	If No	**Tape an area of deposits for examination** Go to Section 20
17. Do the deposits prevent further exploration?	If Yes	If the site is in an SSSI no removal of deposits is allowed unless consent has been obtained from English Nature. Before any excavation takes place consult NCA regional conservation and access officer and/or Management Committee. Go to Section 20
	If No	**Leave intact** Go to Section 20
18. Are any archaeologically important features present?	If Yes	Go to Section 20 **Contact EN (if SSSI), English Heritage (if appropriate), Management Committee or NCA regional conservation & access officer**
	If No	Go to Section 20
19. Are you altering the air circulation?	If Yes	**Consider lids, gates, etc to prevent damage due to major airflow alteration** Go to Section 20
	If No	Go to Section 20

20. **Remember caves are vulnerable, always try to minimise your impact on the cave. Keep to acknowledged routes, avoid contact with speleothems, take nothing but photographs, leave nothing but footprints (avoid even these if possible). Other geological features, skeletal remains and unusual features should always be left *in situ* for expert evaluation, after notifying to a Management Committee or NCA regional conservation & access officer and EN (if the cave is within an SSSI).**		