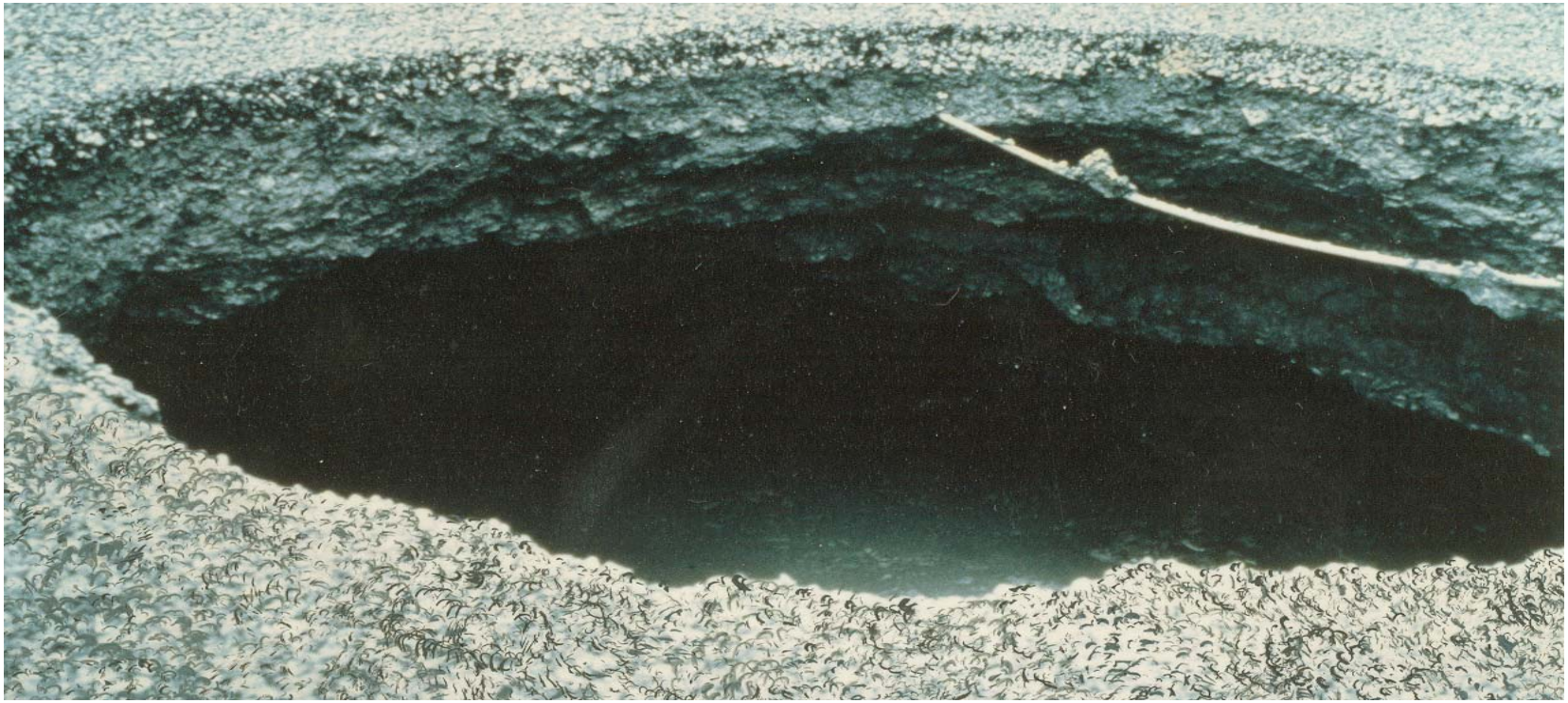
SUBSIDENCE MISCONCEPTIONS AND MYTHS



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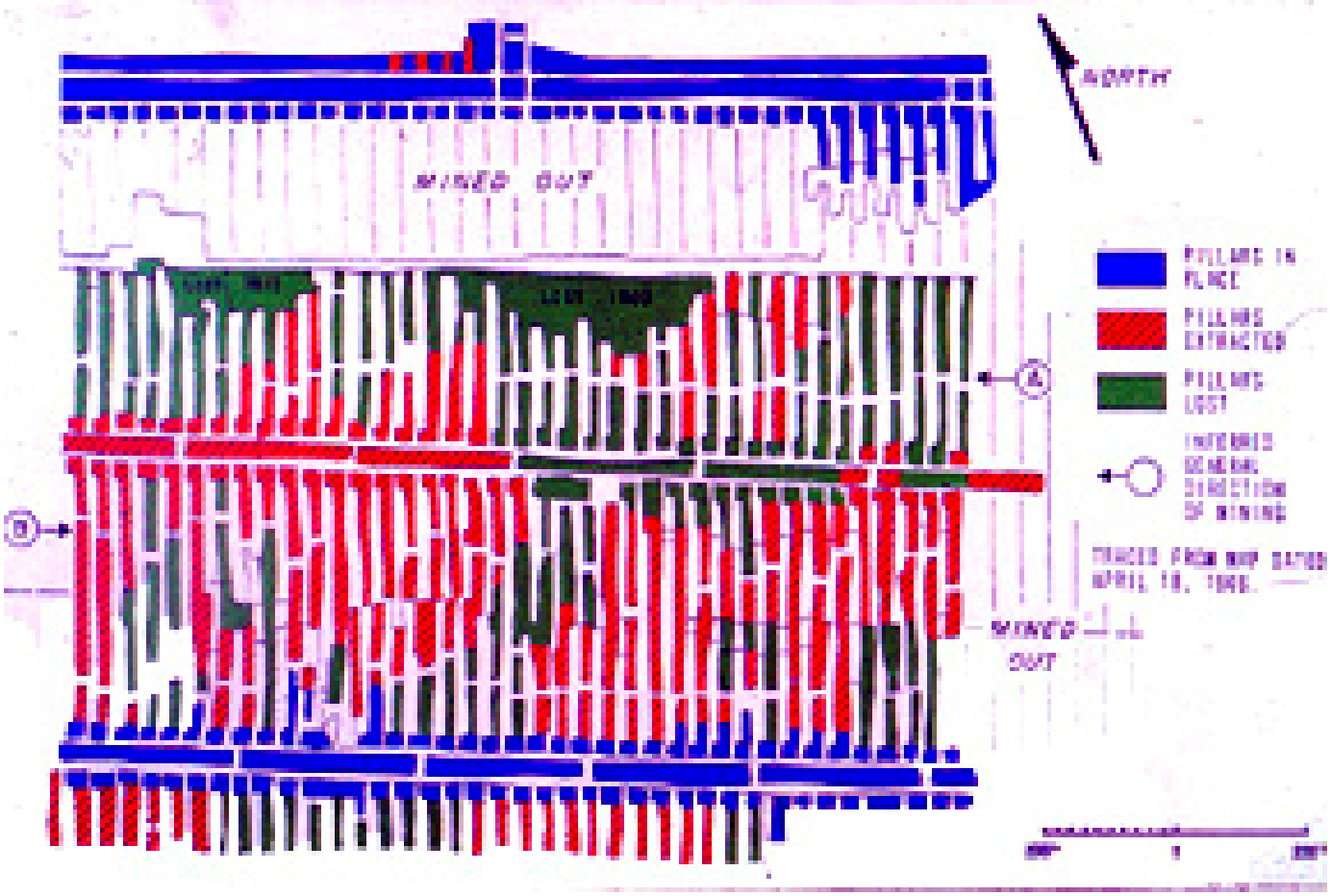
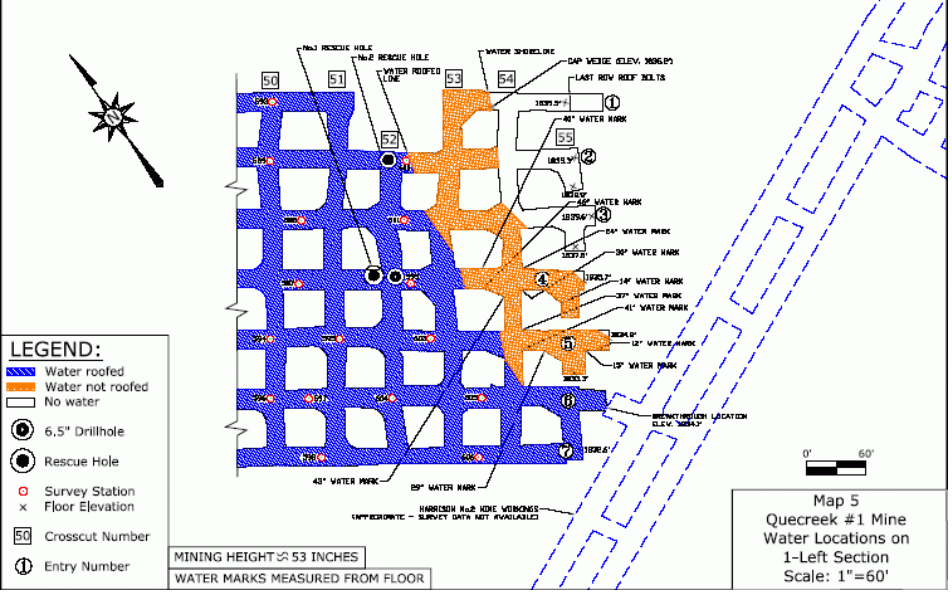
Lexington, Kentucky



Subsidence due to coal mining is poorly understood by non-specialists. This has led to numerous misconceptions and myths based on limited observations and lack of knowledge. The three most common are:

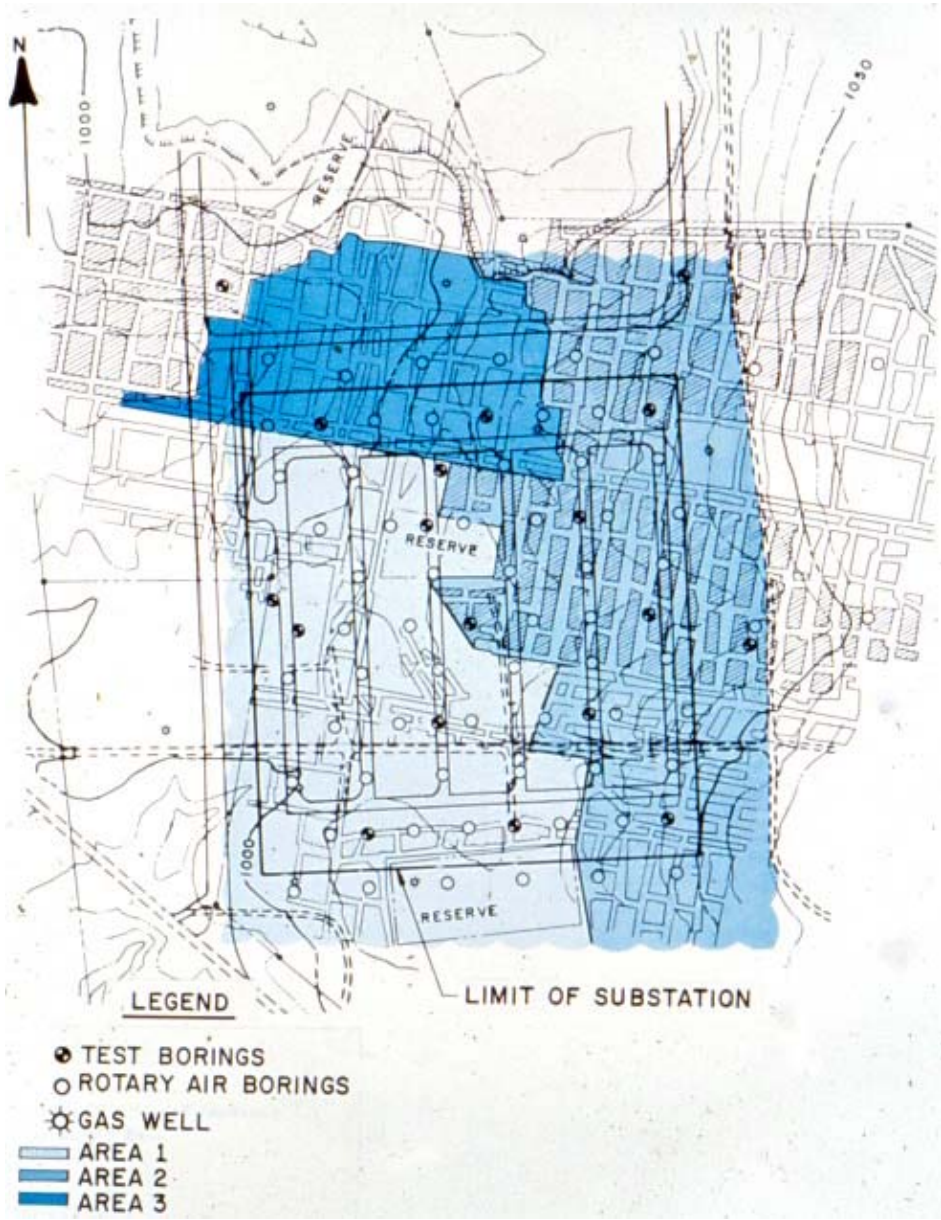
1. Mine maps are inaccurate.
2. Deep mines are not a problem.
3. If no subsidence has occurred for many years after mining, there is no risk of future subsidence.



Maps are important during mining and most are carefully prepared. Future use to evaluate conditions at mine level often includes drilling to confirm what the map shows.

Usually, little or no effort is made to tie the surface survey of the property to the mine survey, to conduct a well designed drilling program to confirm the mine map, or to drill test borings vertically.

When a mine entry is encountered rather than a coal pillar, or vice versa, and conditions at mine level appear different than anticipated, the first reaction is the mine map is inaccurate.



A map of the abandoned mine workings was available but an extensive drilling and borehole camera investigation did not encounter conditions (pillars and mined areas) as indicated by the map.

Careful review by the project geologist and perhaps a bit of luck indicated a shift of 15 feet in boring locations produced excellent agreement with the mine map.

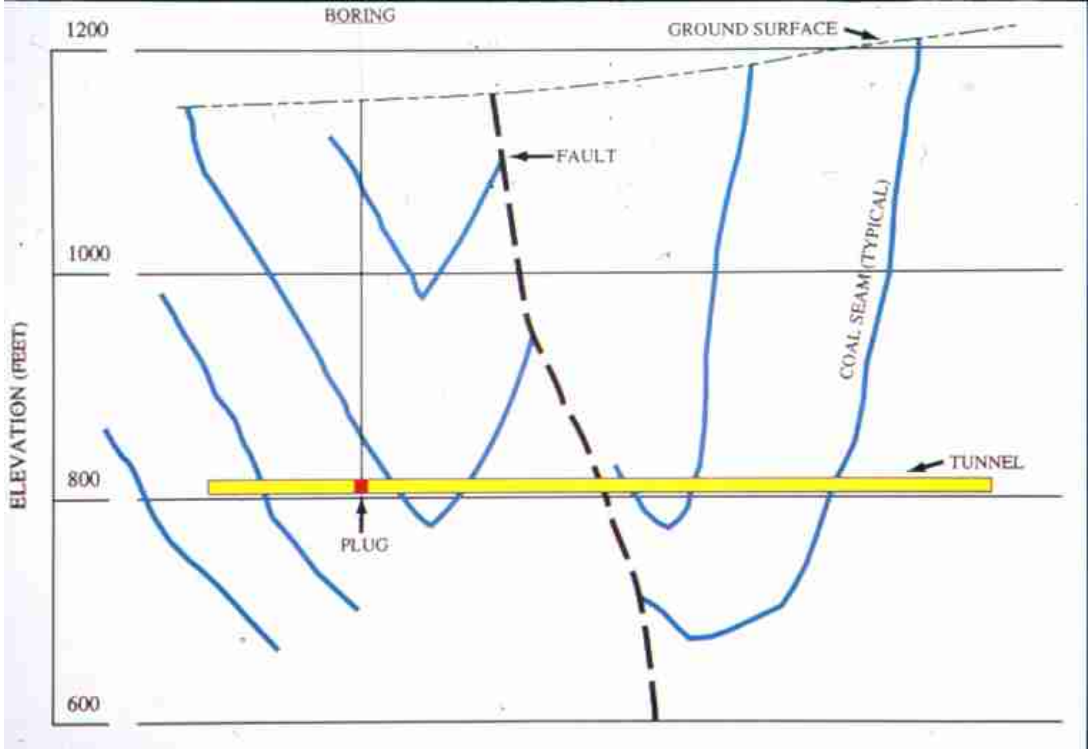
In this case, differences in survey control between the surface property map and the mine map wrongly implied the mine map was inaccurate.

Carelessness also produces myths. In an evaluation of alleged subsidence damage to a house in southwestern Pennsylvania, an engineer using the plan of the housing development located the damaged house on the mine map. He then located a boring by pacing from the corner of the house. When the boring encountered a coal pillar rather than a mine void the engineer claimed this showed the mine map was not accurate. You be the judge on this example.

In another case near Pittsburgh, Pennsylvania, an old mine map showed several large blocks of coal. The drilling investigation for a large suburban mall encountered mined areas rather than solid coal. When shown this example of yet another inaccurate mine map, the senior author pointed out notes on the map which showed the large blocks of coal had been leased to others in the 1920's. Why would you lease coal unless you planned to mine it?

During a trial on alleged subsidence damage, an engineer from a major coal company was testifying to the accuracy of his company's maps.

A foolish attorney asked, "How do you know the mine maps are accurate?" He answered, "To place materials from the surface down a hole into a mine car I use the mine map to locate a hole in the center of the mine rails or when I need to extend electricity from the surface to the mine, I locate a hole at the side of the entry so I can place the electric switch box on the side of the pillar. Then I pay the driller to drill slowly with minimum pressure on the drill bit so the hole remains vertical."



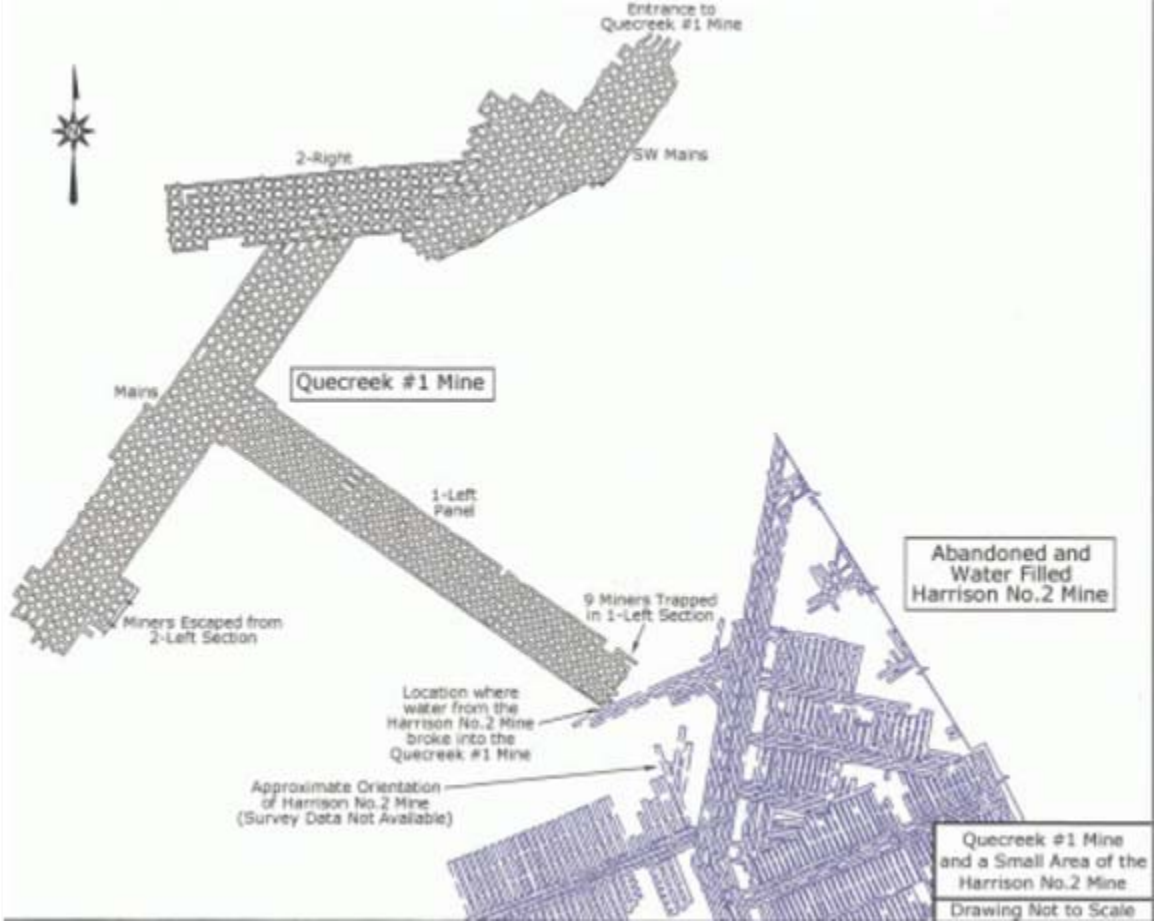
Control of an underground fire in Pennsylvania's Anthracite region required construction of concrete plugs in four rock tunnels that connected underground mine workings in adjacent coal seams.

Four rock tunnels10 feet wide and 330 to 470 feet below ground in rock dipping at 70° were intercepted at the locations indicated by the 80-year old maps and the concrete plugs were successfully constructed.

QueCreek Mine Accident

On July 24, 2002 nine miners were trapped when they dug into a flooded abandoned mine. Their map did not show the full extent of the flooded mine workings.

Shortly after two state legislators wrote, “historic mine maps are notoriously inaccurate”.



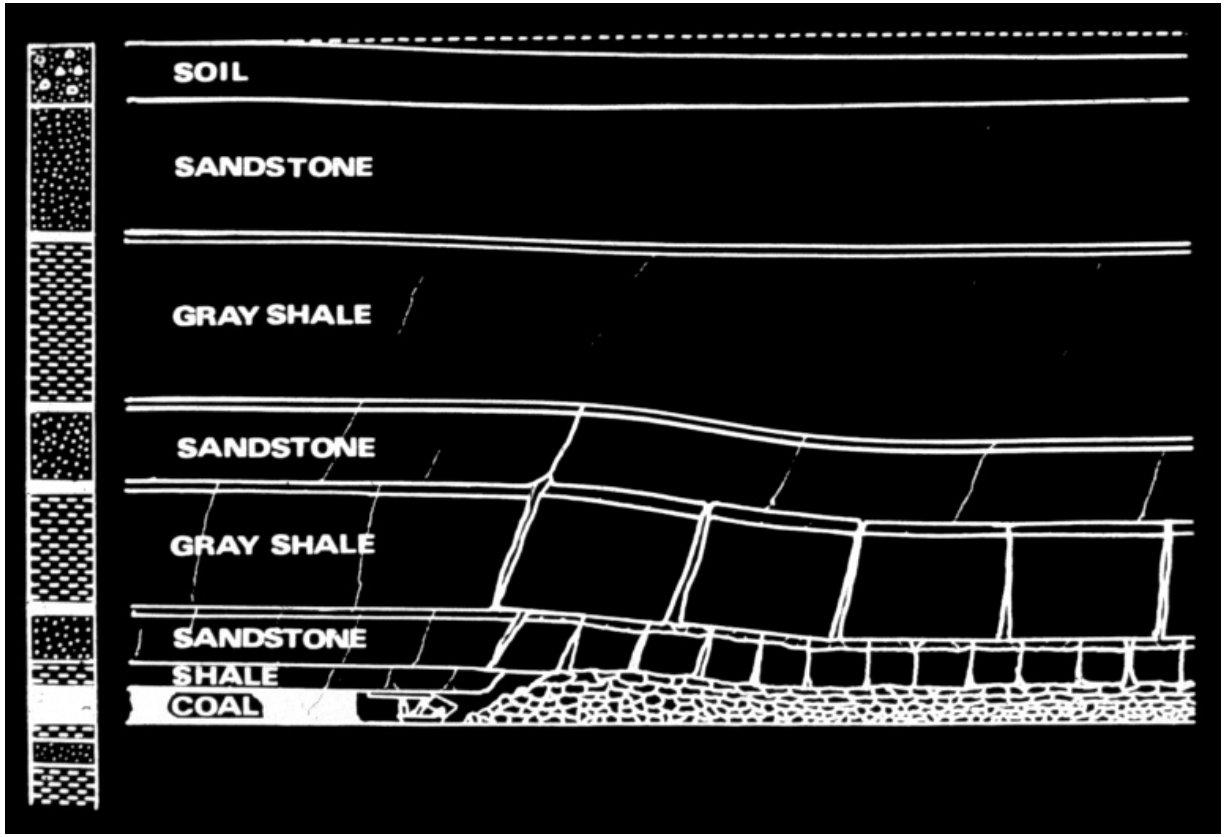
A Pittsburgh paper said the flooding, “showed a mapping mistake can leave miners isolated ……”. Eventually a 1964 map was found that clearly showed the full extent of the abandoned mine.

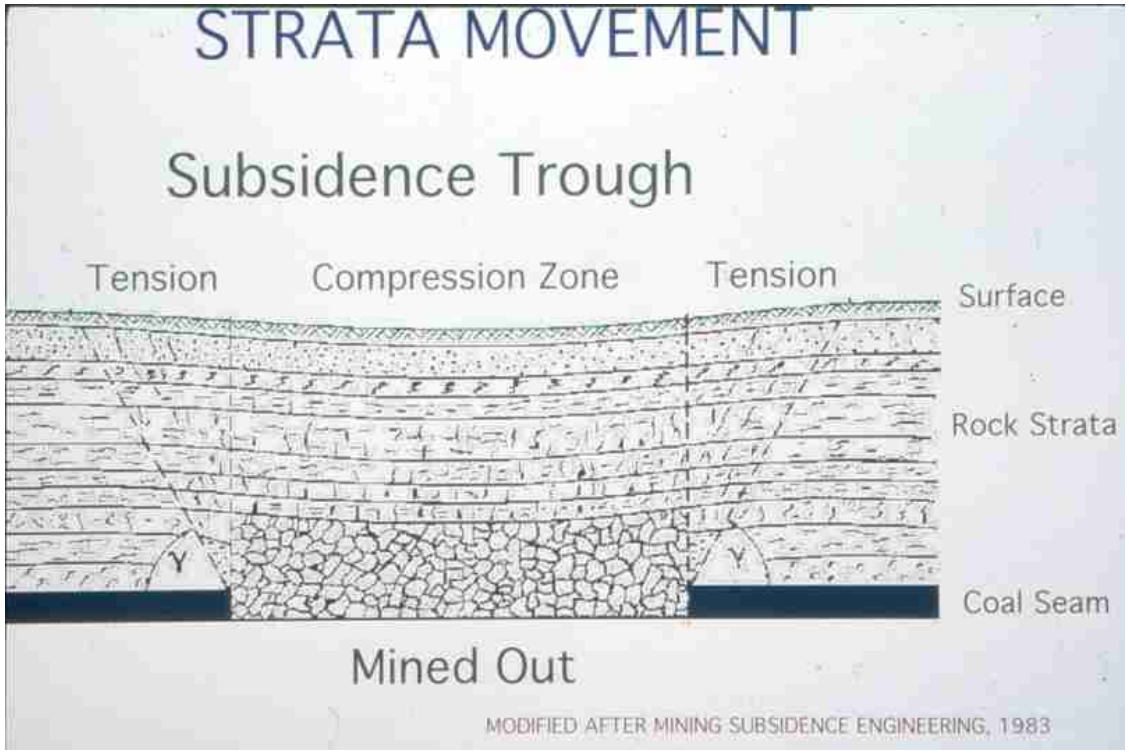
On July 28, 2002 all nine miners were brought to the surface through a vertical drilled shaft. Had QueCreek maps and surveys been wrong, rescue workers would not have been able to pinpoint the location of the trapped miners.

Deep Mines are not a Problem!

The idea of a safe depth from subsidence is usually based on the false premise that mining results in sufficient "breakup of the overlying rock strata that bulking compensates for the volume of coal extracted and prevents subsidence.

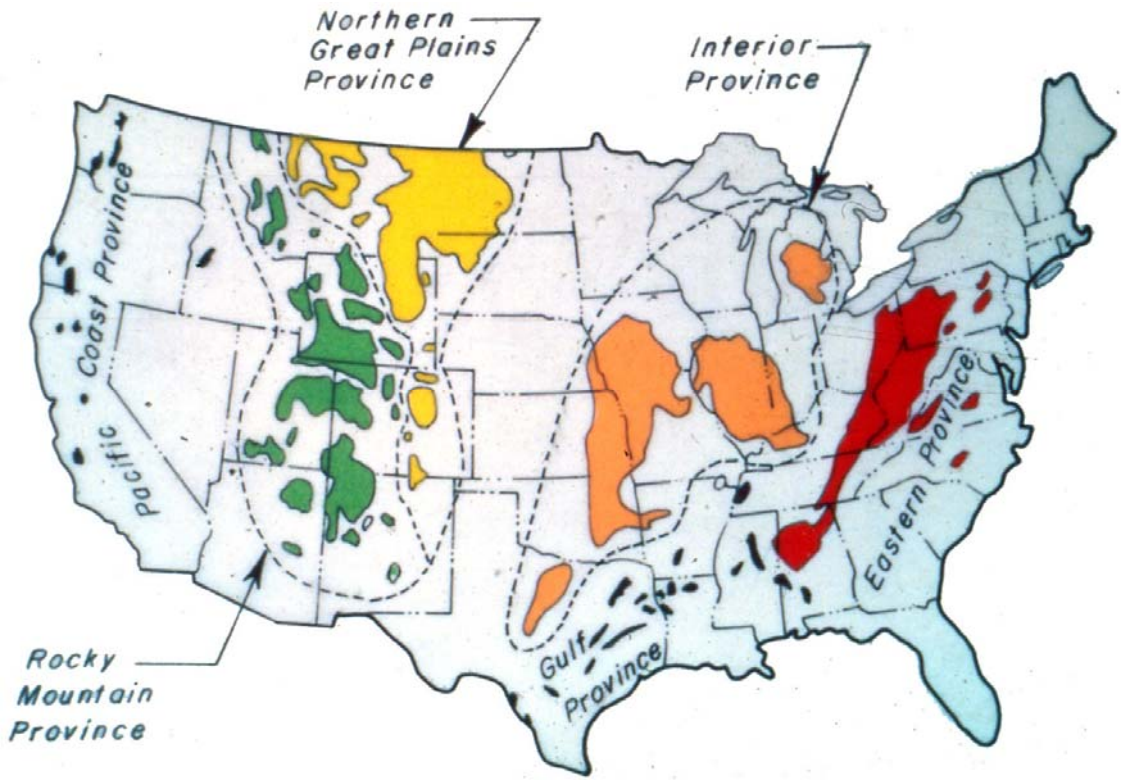
An early expression of a safe depth resulted from an 1825 study of mine subsidence in the city of Liege, Belgium. A commission concluded that an interval of 300 feet between the mine workings and the ground surface was more than sufficient to prevent subsidence (Young and Stoek, 1916).



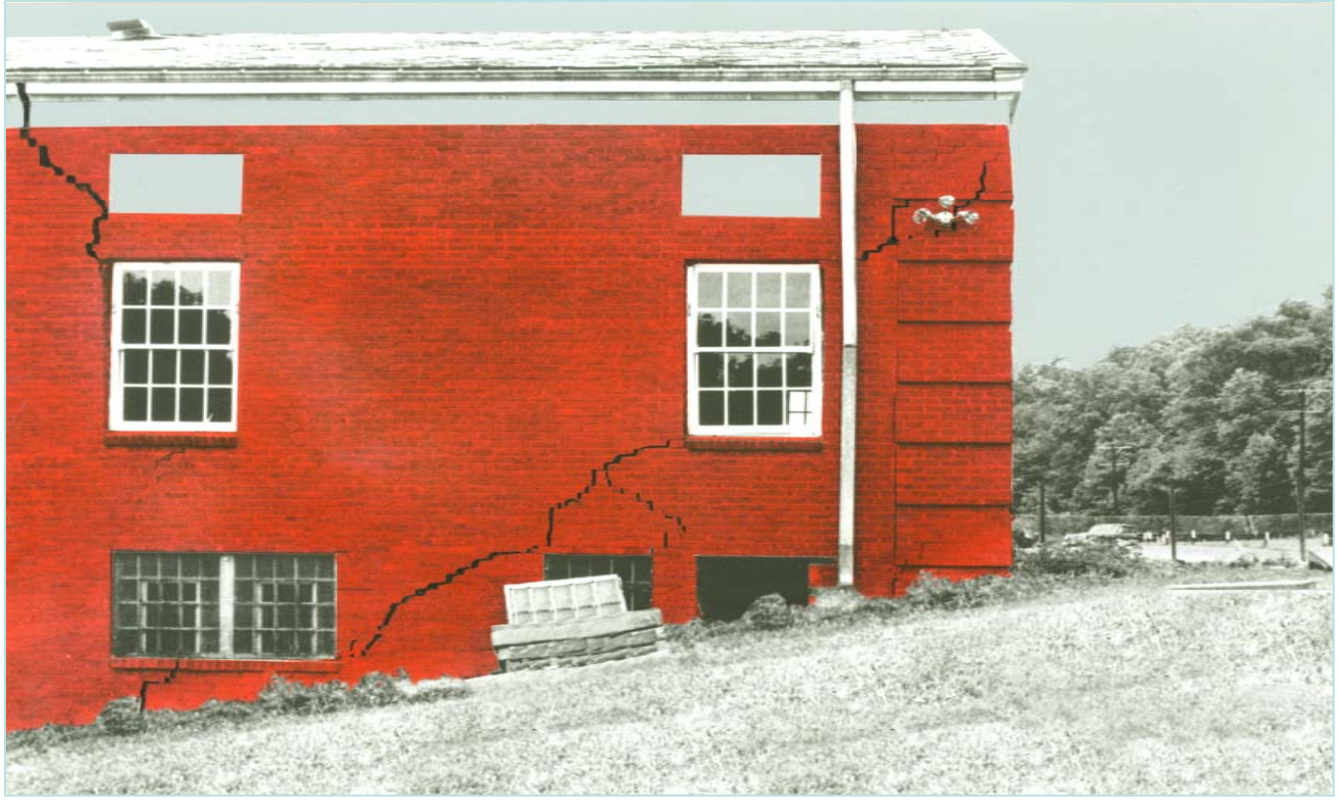


The Prussian government appointed a commission in 1868 to collect information from other countries on the influence that mine workings may have on surface buildings. They found that the majority of Belgian engineers believed that when the coal is entirely removed, the most careful packing gives no guarantee against damage to surface buildings.

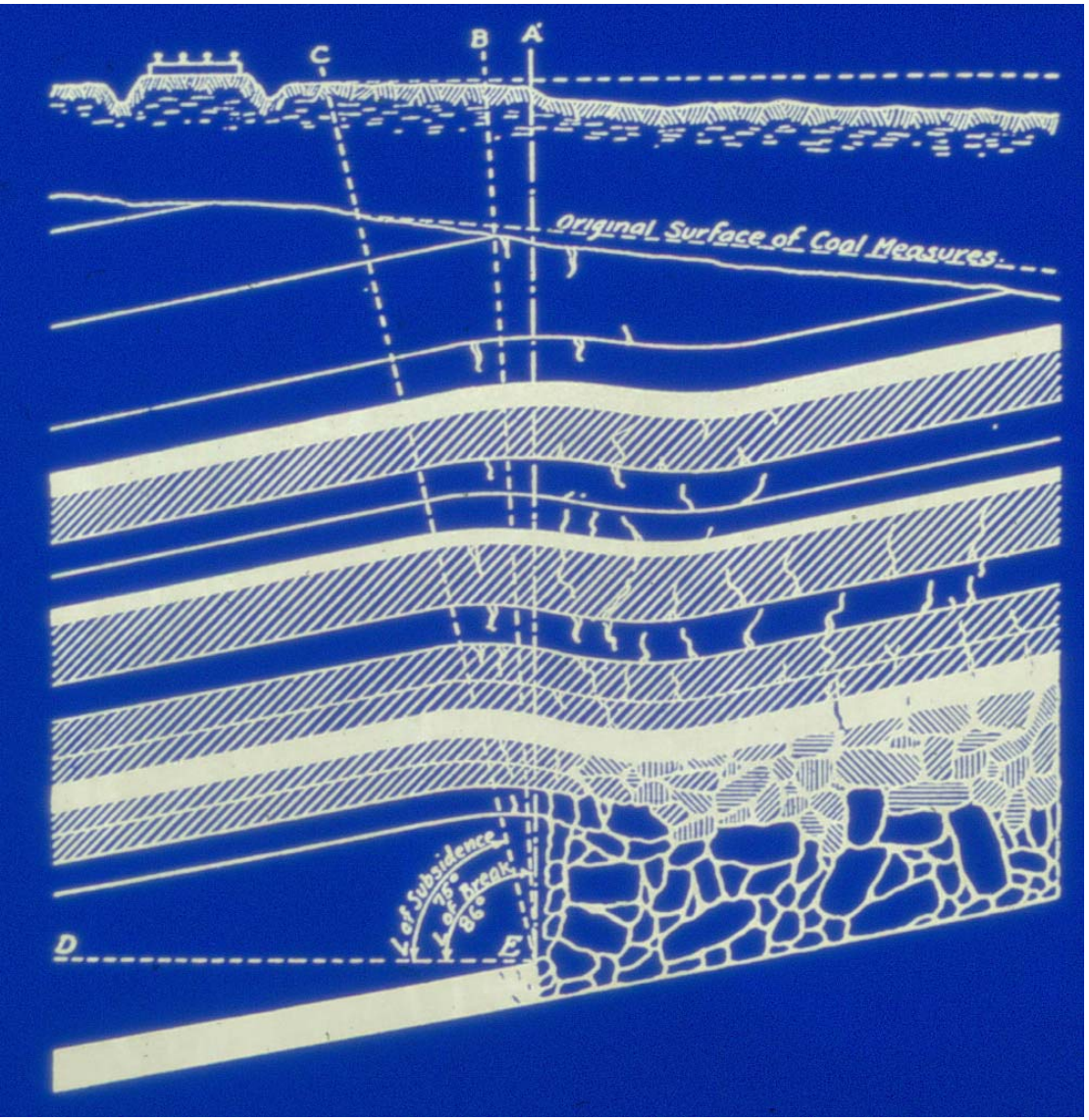
Fayol's Findings (1885)



- Subsidence movements reach the surface irrespective of the depth of mining.
- Subsidence movements do not reach the surface when the workings exceed a certain depth.
- Subsidence extends to the surface without diminution.
- Subsidence decreases upward.



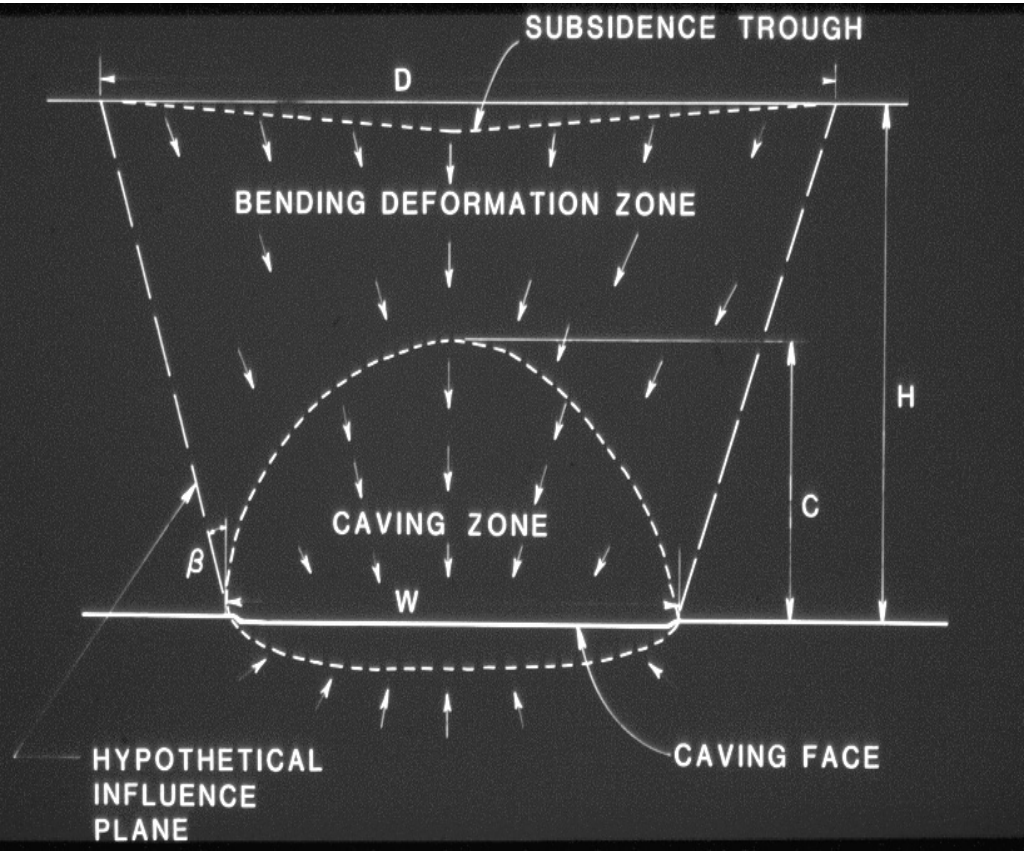
Fayol's investigation, backed by model studies, led him to propose that subsidence is limited to a dome over the mined area and that surface subsidence diminishes in proportion to the depth of the workings (Young and Stoek, 1916). Fayol's work on dome theory and the safe depth postulate had great influence for many years after.

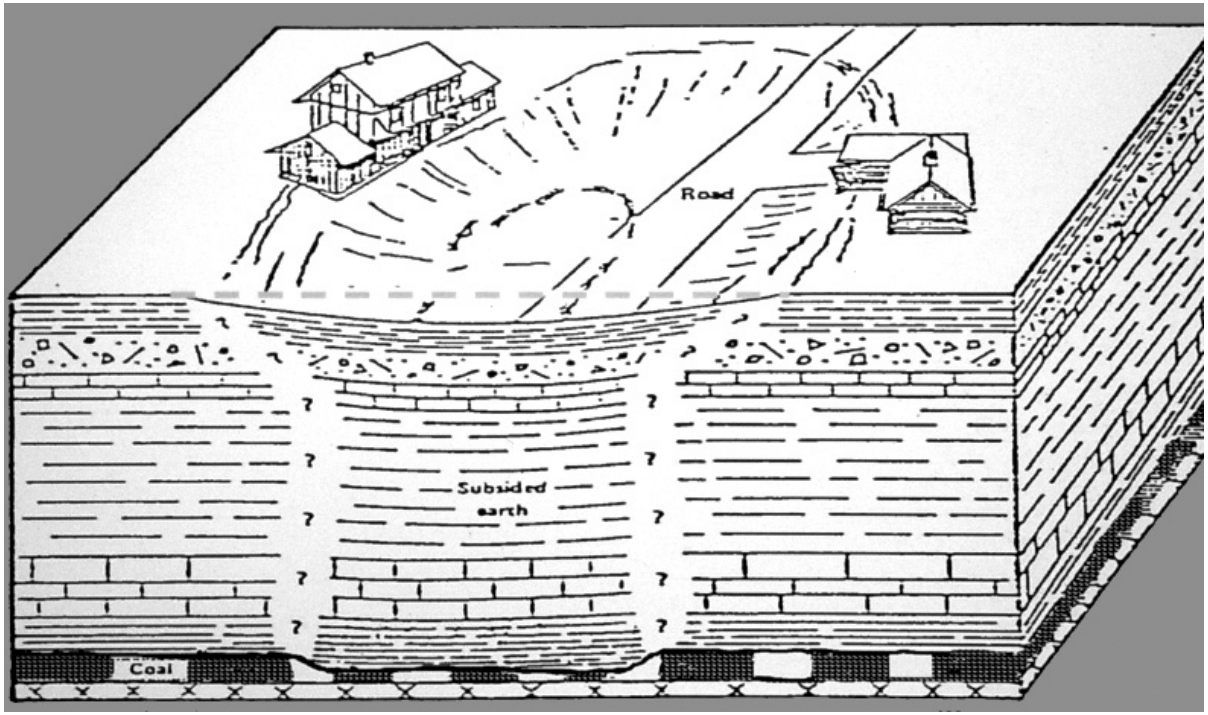


Sadly, safe depth based on the bulking concept is still encountered. The modern understanding of fragmentation of the immediate mine roof with the overlying beds sagging down on the broken roof rock was first described in 1900 by Wachsmann (Young and Stoek 1916).

- Unless total extraction has been achieved, there is no interval above an abandoned mine that is necessarily safe from subsidence, or that reduces severity of damage.
- Increased intervals above mine level, however, exhibit a reduced frequency of subsidence.

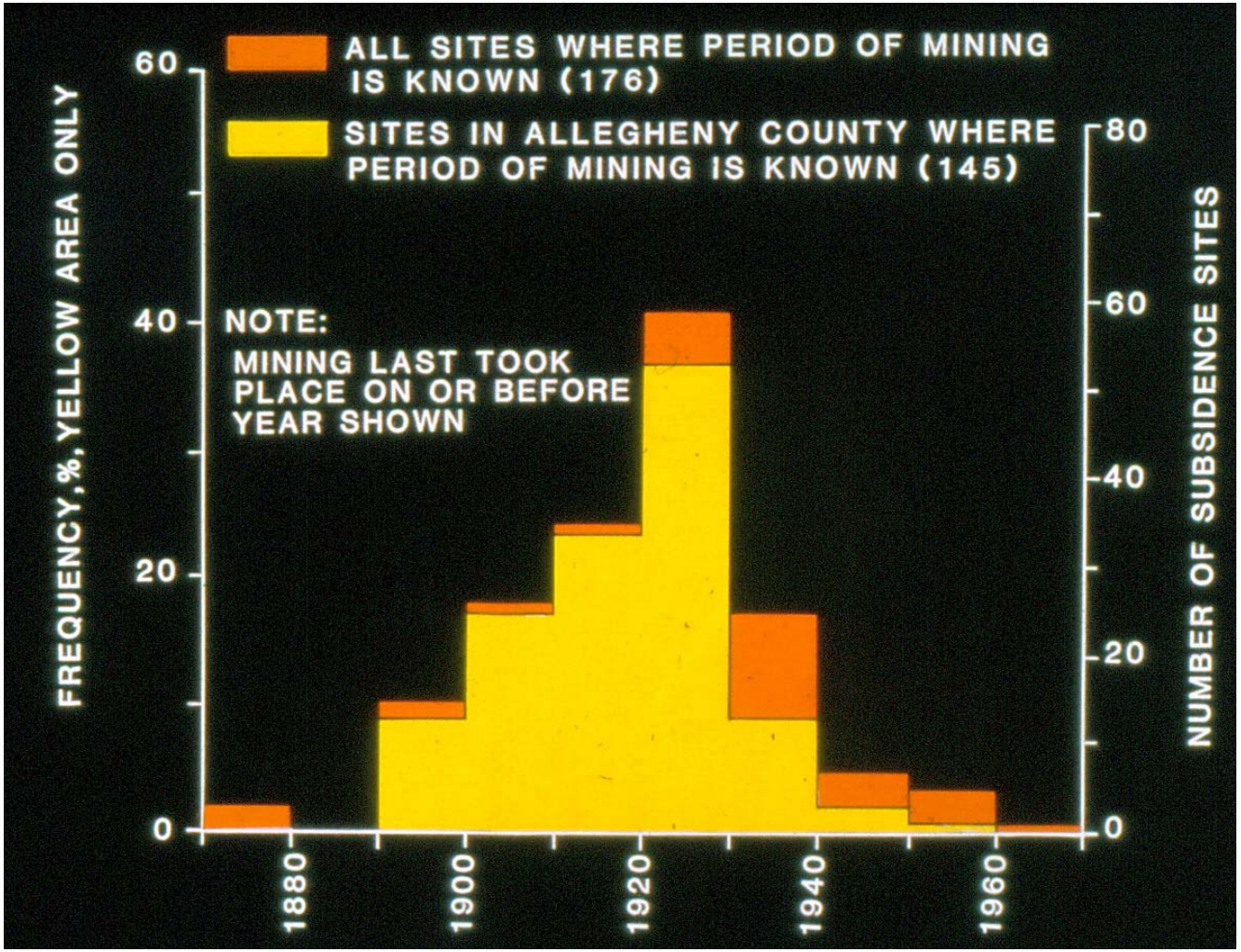
Numerous studies of undermined sites conclude there is no risk of future movement since mining occurred many years ago and no subsidence has occurred.





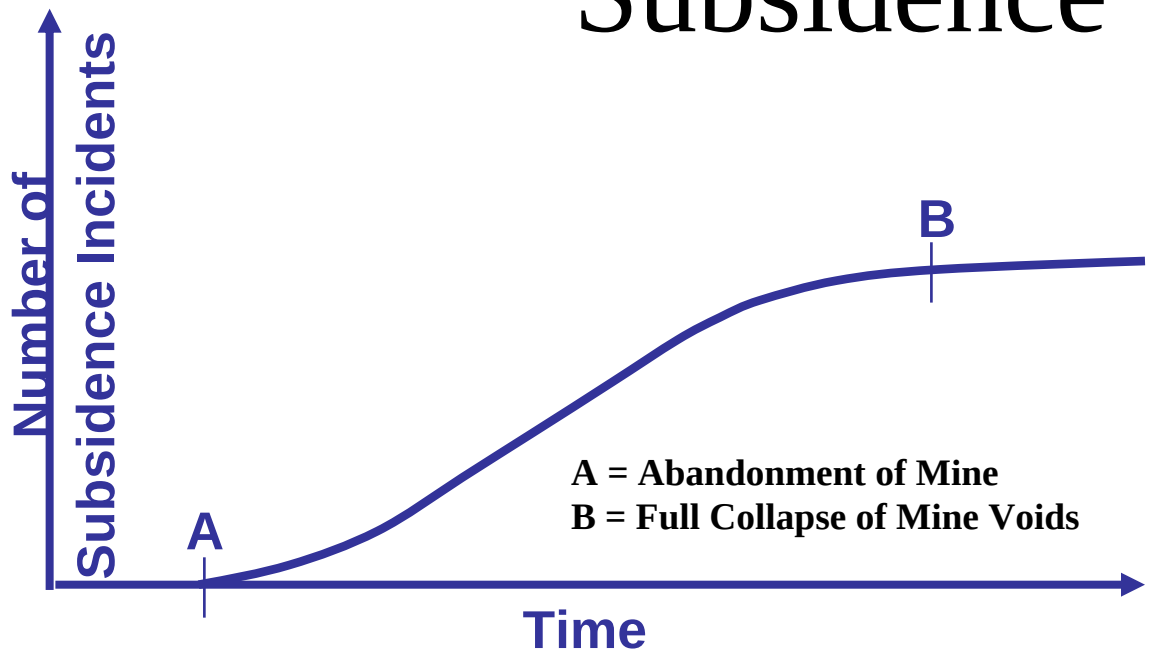
The previous slide is true if sufficient coal pillars have been left to support the overlying strata. However, each year subsidence occurs over mines that have been closed for 100 years or more.

Subsidence cannot be ruled out merely because it has not been recognized in the first 50 or 100 years after mining.

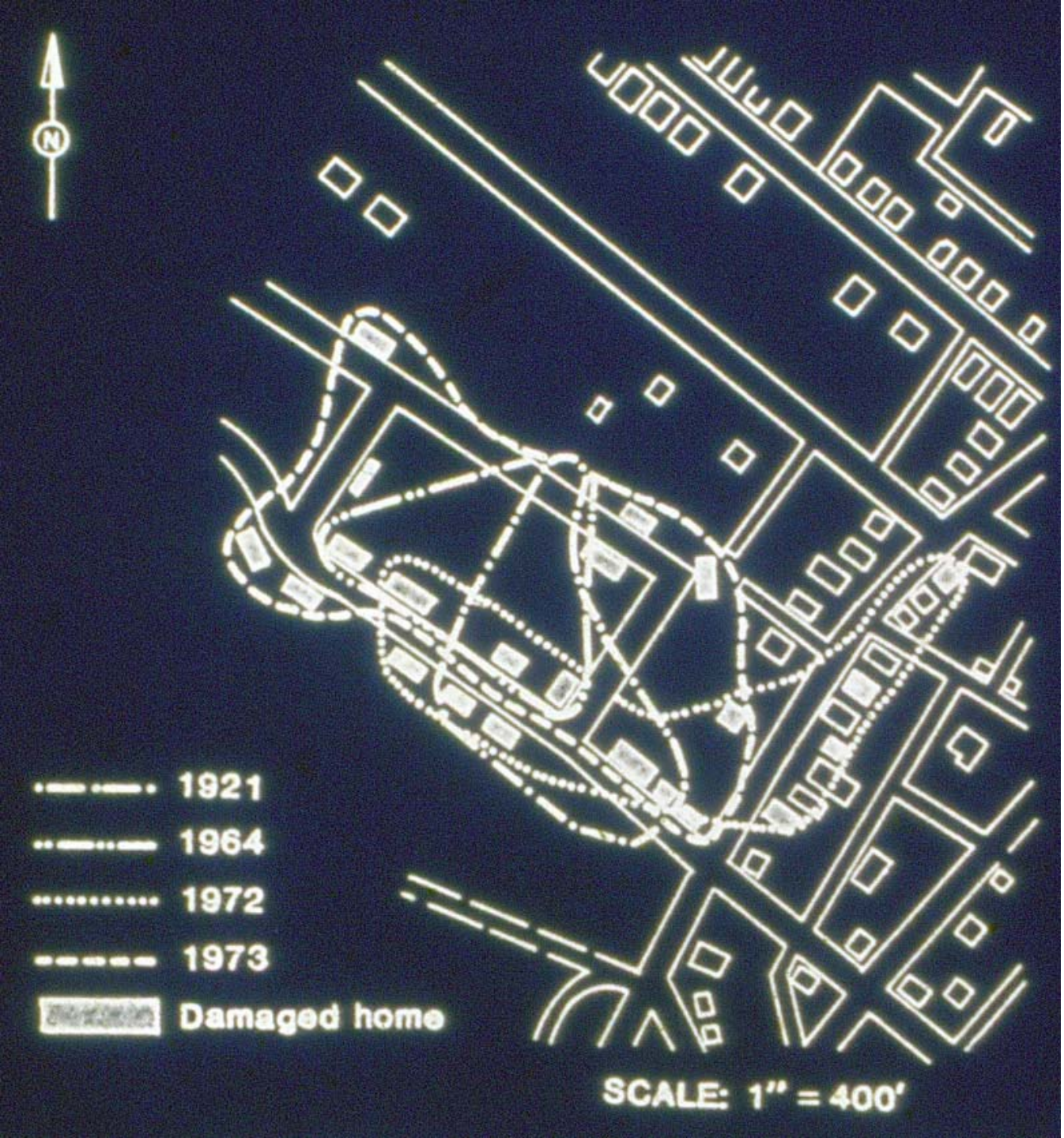


Unless total extraction has been achieved, subsidence may occur long after mining, and subsidence may not be limited to a single episode.

Conceptual Representation of Subsidence



Where full extraction mining has not occurred, subsidence can be a discontinuous process with movements separated by years. Subsidence above an abandoned mine can occur as a single event or it can be discontinuous over many years.



This western Pennsylvania community has experienced subsidence on at least four occasions over the past 50 years. Subsidence appears first to have taken place in the 1920's while mining was in progress.