



OLR RESEARCH REPORT

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CAUSES OF LAND SUBSIDENCE

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You asked about the causes of land subsidence and sinkholes. You also asked why land near barite mines in Cheshire subsided and for the cause of damage to properties on Beverly Road in New Haven.

SUMMARY

Land subsidence is the gradual settling or sudden sinking of land. Its primary causes are the removal of underground water, compaction, drainage of organic soils, underground mining, and thawing permafrost. In Connecticut, the main causes are subsurface soil loss after heavy rains and abandoned mine collapse. Historic land use also affects land stability.

Improperly filled-in abandoned mines are susceptible to water destabilizing wooden support beams and causing tunnels to collapse. In recent years there have been several collapsed areas in Cheshire where abandoned barite mines are located.

A number of properties located on Beverly Road in New Haven have experienced structural damage, such as foundation cracks, from the land shifting or sinking. An engineering report prepared for the city explained that the area is over a filled-in "ice pond" (i.e., old water body). It concluded that the probable cause of settlement is due to the differing densities of the fill materials and the consolidation of the organic matter and peat over time, with groundwater a contributing factor to the biodegradation of the organic material.

LAND SUBSIDENCE

Land subsidence is the gradual settling or sudden sinking of land from subsurface movement of materials. According to a U.S. Geological Survey Circular entitled "[Land Subsidence in the United States](#)," over 17,000 square miles in the United States have been directly affected by subsidence, with over 80% of identified subsidence the result of groundwater removal from human activity. The other primary causes of land subsidence are: aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction (i.e., shallow soil subsidence from adding water), natural compaction, and thawing permafrost.

According to Connecticut's state geologist, Margaret Thomas, the primary causes of subsidence and sinkholes in Connecticut are subsurface soil loss after heavy rains and abandoned mine collapse. Less common causes include soil swelling and collapsing, groundwater withdrawal, and the dissolution of rock underground. Often several factors contribute to the unstable ground conditions causing sinkholes.

There are approximately 23 historic mining sites with underground tunnels identified in the state, according to Thomas. The locations involve both public and private property and the safety status of many is unknown or undocumented. Abandoned mine subsidence is of particular concern in Cheshire because of barite mining that occurred in the 1800s (see below).

Historic land use also affects land stability. Of particular concern are areas with artificial fill (i.e., buried construction or land clearing debris), displaced soil, filled wetlands, property drainage projects, or reclaimed building sites. Failure of underground infrastructure such as water mains, sewers, and tunnels, can cause roadway damage and collapses.

EXAMPLES IN CONNECTICUT

Cheshire's Barite Mines

For about 40 years in the 1800s, barite, then used in paint manufacturing, was mined in Cheshire. According to a [report](#) by Crawford E. Fritts that provides a detailed history of Cheshire's barite mining industry, the town was home to the country's first barite mine.

In a 2004 *New York Times* [article](#) describing the concern over Cheshire's mines, Connecticut's state archaeologist, Nicholas Bellantoni, stated that many of the state's subsurface mines were not properly filled in. Over time, water rots wood beams supporting tunnel walls, causing the tunnels to collapse.

According to Thomas, some suburban housing in the town overlies abandoned mine shafts and tunnels that are several miles long and as deep as 1,000 feet. In recent years several areas have collapsed, including two backyards and one portion of a street.

New Haven – Beverly Road

A July 9, 2013 [article](#) in the *New Haven Independent* described a number of homes along Beverly Road in New Haven as having experienced shifting and sinking from the ground changing shape, causing tilting walls and cracks in foundations.

In 2005, the city requested a preliminary geotechnical engineering study to assess the likely cause of residential structure settlement in this area by performing subsurface exploration under the roads. According to the study's report, the area generally sits over an "ice pond" that was filled in during the late 1930s. The subsurface sample tests showed presence of fill material with organic matter and peat (i.e., partially decomposed vegetable matter). The organic matter was found to range from very soft to medium soft and up to six feet thick. Groundwater was also found in the samples.

Based on the subsurface conditions, the report concluded that the probable cause of settlement in the area is due to the differing densities of the fill materials and the consolidation over time of the organic matter and peat. The report cited groundwater in the area as a contributing factor because water below or within the organic material adds to biodegradation of the materials, thus increasing long term settlement.

The legislature subsequently asked The Connecticut Academy of Science and Engineering (CASE) to evaluate the engineering report and assess its accuracy and completeness and verify its findings. CASE's [report](#), completed in 2006, found that the engineering report was helpful but not sufficiently conclusive to allow it to determine the cause of the damage to all homes in the area (about half of the homes reporting damage are located in the ice pond footprint). CASE suggested additional investigations of the properties where structural damage has occurred were needed. It also suggested an analysis of historical data of the site.

HYPERLINKS

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