Geohazard Mapping using LiDAR in Nova Scotia[1]

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Many geohazards, such as abandoned mines and sinkholes in karst terrain, are hidden or obscured by forest cover, making them difficult to identify and locate. This creates problems for effective remediation or for land-use planning. With the advent of LiDAR bare-earth imagery, a detailed view of the earth's surface without vegetation is possible, allowing for the identification and systematic mapping of these features. At several study area in inland Nova Scotia we examine the effectiveness of using LiDAR for identifying and mapping abandoned mine openings and sinkholes.

Historic gold mining in Nova Scotia has left thousands of abandoned mine openings, ranging from shallow trenches to open mine workings or shafts potentially hundreds of feet deep. The locations and character of these features were often incompletely documented during mining activity and provide a limited guide to field identification of openings. Because the accuracy of the historic documentation is low and many of the mine openings were never documented, however, field identification can be time consuming (and hazardous). At the historical Montague Gold District in Halifax Regional Municipality, many of the openings can be readily identified on the LiDAR bare-earth hillshade model, although field visits are required to assess their level of risk. We identified openings that were previously unknown and were able to improve the accuracy of locations for documented features. We also identified subtle subsidence features (10 cm) that might be used to identify partially in-filled mine workings, although effective identification using this technique would likely require multiple surveys.

The near surface exposure of coal seams in Cape Breton has facilitated illegal surface mining ('bootleg mining'), resulting in a series of pits that poses a potential hazard in this forested area. The small (1-2 m diameter) water-filled holes and associated 1 m mounds of overburden adjacent to them have been identified on the LiDAR DEM. The occurrence of these surface pits accurately defines the strike of the coal seam in addition to bedding features that may allow for a more detailed and accurate definition of the geological boundaries in the area.

In karst terrain, sinkholes can be accurately mapped on the LiDAR bare-earth model and in Antigonish County four types of sinkholes were identified: (1) sinkholes in sub-horizontal gypsum that are overlain by thick clay-rich till, (2) dipping gypsum deposits where sinkholes can be mapped along strike, (3) fault-bounded karst terrain where the 'edge' of karst terrain can be accurately mapped, and (4) incipient sinkholes or features that appear like sinkholes in the initial stages of formation. Proposed land-use planning recommendations include creating buffer zones around sinkholes of flat-lying deposits and along strike of dipping deposits. Where sinkholes have the potential to form, based on bedrock geology or the appearance of incipient sinkholes on the LiDAR imagery, we suggest an on-site assessment prior to construction of new property or roads.

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