Identification of Areas Susceptible to Ground Subsidence Due to Mine Drift or Shaft Collapse in Butte, Montana

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• History of mining in Butte
• Explanation of underground mine workings
• Post underground mining challenges/events
• Long term monitoring of subsidence
• Utilization of old mine maps with new technology
Overview of Butte, Montana Mining

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Overview of Butte, Montana Mining

• Placer mining started in Butte around the 1860s

• Underground hard rock mining resurged in the 1870s

• Historic Anaconda Copper Mining Company (ACMC) maps show approximately 5600 miles of workings (Example on next slide)

• Mine workings extend from just below the surface to about a mile below the surface

• Ground subsidence and sink holes have appeared

https://www.mininghistoryassociation.org/ButteHistory.htm
http://www.co.silverbow.mt.us/481/History-Culture
Example: Level 31 Map
People want answers

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Individuals Seeking Answers

- “Is there any mine working below my property that would cause X, Y, or Z”
- “I’m interested in purchasing a property. Are there any mine workings below it?”
- My house/building has a big crack in the floor or foundation. Is it from a mine?
Solution Ideas

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Solution Ideas

• Development of a georeferenced 3-D model
  - Could be overlaid with property boundaries and ownership information
  - Allow for the input of a GPS location

• Benefits sought
  - Quicker processing time
  - Ability to export an image to provide visual aid to individual
Development Problems

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Development Problems

• Anaconda Copper Mining Company established a local coordinate system for use in their mapping

  - Elevation datum used is unknown since it predates National Geodetic Vertical Datum of 1929 (NGVD 29)

• Elevations to each mining level were measured from the Alice shaft collar

  - Currently the Alice shaft and headframe are gone.

  - The previous location of the Alice shaft and headframe is now a pit – Alice Pit
Development Problems
633 West Broadway Street, Lincoln Elementary School

08/08/2005
Old Glory Incline Shaft

08/06/2007
Development Problems

- Unable to directly calculate correction needed to convert local elevation to North American Vertical Datum of 1988 (NAVD 88) due to the Alice shaft headframe being removed and a pit being developed.

**Ideal – Collar present**

**Not Ideal – No collar and area is a pit**
Development Solutions

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Development Solutions

• Interpolation of ground points to determine an approximate Alice Shaft ground elevation

• All levels of drifts were intersected with the Digital Elevation Model (DEM) cell boundaries to allow for individual calculations of depth below surface

• Determination of average vertical correction based on still standing headframes and DEM

  - Approximate error:
    - ~ +/- 5 m from average correction to still standing headframes
    - error from DEM is dynamic. A steeper ground area may incur a larger error
Results

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Results

• Developed a 3D model of all 51 levels of mining drift and shaft locations

• Developed a general map showing areas that may be susceptible to ground subsidence due to mine drift or shaft collapse
3D Model
Areas Susceptible to Ground Subsidence in Butte, Montana due to Mine Shaft or Drift Collapse
I JUST HATE IT WHEN BUTTE PEOPLE DROP IN UNANNOUNCED!
Questions?

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