

BULLETIN

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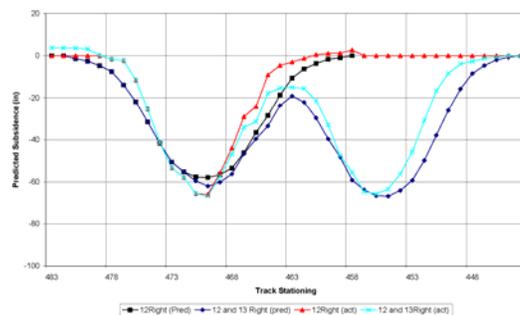
Subsidence Analysis and Impact Evaluation for Alluvial Valley Floors Steamboat, Colorado

SubTerra, Inc has provided Subsidence Engineering services to the Twentymile Mine for almost two decades. The project covered by this Bulletin involved characterization and analysis of mining impacts to the alluvial valley floors overlying the mining area and three major creeks that support them. Thousand feet wide longwall panels in the southwest, southern and northern mining districts sequentially undermined Foidel and Fish Creeks in a predictable fashion and without any significant impacts.

SubTerra's scope of work included:

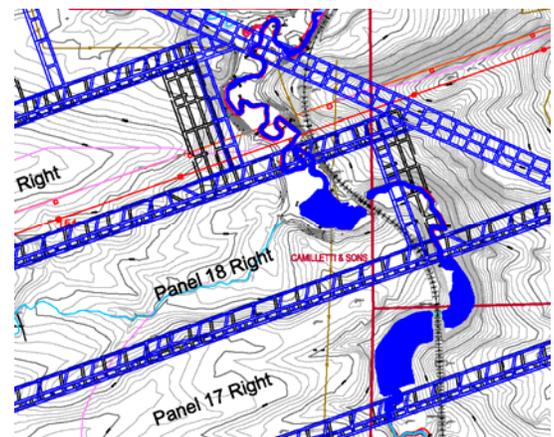
1. Predicting subsidence, strain, and tilt from initial and subsequent panels in each mining district.
2. Determining the potential for stream pirating (i.e., diversion of flow to the underground workings).
3. Estimating the increased surface area of each stream and surface water body.

The first step in this process was to compile detailed topography and profile each stream collecting stream bottom elevation data using conventional survey methods.



Subsidence, tilt, and strain predictions were made to simulate sequential undermining of each AVF and each creek using a grid of points on 50-ft centers outside the immediate AVF area. Inside the area, a grid of points on 10-ft centers was subsided along with points representing each stream's bottom, low and high bank. Sequential subsided surfaces were compared to the original topography and the un-subsided stream surface to predict increases following the extraction of each longwall panel.

The figure below shows the predicted impacts for Panels 17 and 18 Right.



The potential for stream pirating was evaluated for areas where each creek crossed the Twentymile Sandstone outcrop. This potential was predicted to be negligible and to date there has been no evidence of stream pirating at the mine site.

In addition, impacts were generally judged to be beneficial to AVF functionality.