Development of a GIS Tool for Estimating Post-Mining Water Levels in Underground Coal Mines of Ohio[1]

R. Steinberg[*], Z. Matthews, N.A. Kruse Daniels, D.L. Lopez, J.R. Bowman, and N. Sullivan[2]

Abstract: A need for estimating post-mining water level for underground coal mine permitting has been addressed through development of an algorithm relating pre-mining to post-mining water level based upon data from wells and boreholes used in underground coal mine permits in Ohio. Using Model Builder in ArcGIS Pro, a tool was built that applies the algorithm and estimates post-mining water level at well locations in a permit application. The input layers to the tool include a digital elevation model (DEM), a raster layer of coal elevation, a raster layer of coal thickness, a point layer with well locations including details of the overburden encountered in that well and static water level measurements, and a layer of pre- and post-SMCRA underground mines. These data layers are projected over the permit area and used to calculate variables in the algorithm. Variables used in the algorithm to estimate post-mining water level include: surface elevation, elevation of coal, thickness of coal, thickness of clay and shale in the overburden, thickness of sandstone in the overburden, thickness of limestone in the overburden, accumulated volume of coal mined, area of underground mines within a 4-mile buffer, and average annual precipitation. The algorithm calculates estimated post-mining water level by using the maximum coal volume proposed in the permit as accumulative volume of coal mined and setting the elevation of the bottom of each well location to the elevation of coal. The estimation points are then compared with the DEM to identify areas at risk for surface discharge. The points were transformed into a spatially interpolated layer representing water level. With low enough error, this surface was also compared to the DEM to determine areas at risk for discharge. This methodology can be undertaken for other regions to relate hydrologic, geologic, and mining parameters to post-mining water level.

Additional Keywords: groundwater, potentiometric surface, mapping.

---

1. Oral paper presented at the 2019 National Meeting of the American Society of Mining and Reclamation, Big Sky, MT. Welcome Back to Montana: The Land of Reclamation Pioneers, June 3–7, 2019. Published by ASMR, 1305 Weathervane Dr., Champaign, IL 61821.

2. Rebecca Steinberg (* presenter) and Zachary Matthews, students; Natalie Kruse Daniels, associate professor, Environmental Studies, Ohio University, Athens, OH 45701; Dina L. Lopez, professor, Geological Sciences, Ohio University, Athens, OH 45701; Jen R. Bowman, environmental program manager and Nora Sullivan, environmental specialist, Voinovich School of Leadership and Public Affairs, Ohio University, Athens, OH 45701.