Assessing How Hydrologic Isolation of Coal Mine Spoils Affects Streamflow Mechanisms and Water Chemistry Using Open Source Wireless Technology[1]

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Abstract: High freshwater salinity (usually measured as total dissolved solids, TDS) is toxic for many fish and macroinvertebrates, particularly species in fresh water (highly dilute) streams. Salinity levels are often the strongest indicators of stream degradation below surface coal mining and valley fill (SCM/VF) operations throughout central Appalachia. The negative environmental effects of elevated stream salinity appear to be cumulative and long-term. Unfortunately, there are no standard technologies to cost-effectively control TDS loadings to streams at remote mine sites. However, a promising experimental technology to remedy this called "hydrologic isolation" (HI) was implemented at a SCM/VF site in Magoffin County, KY. The HI method was designed to maintain water quality and quantity downstream from SCM/VF operations by minimizing groundwater contact with high TDS-producing overburden. Our project goal is to evaluate the effectiveness of this HI methodology. We will identify and characterize the source water contributions to streamflow using salinity measurements (conductivity, a proxy for TDS) to determine how HI affects surface water-groundwater interactions and identify the dominant hydrologic flowpaths contributing to streamflow in mined watersheds. We have developed an inexpensive open source wireless sensor network to continuously monitor and live-stream weather, streamflow, and groundwater and surface water physical and chemical data. We pair continuous rainfall data with continuous discharge and flow-weighted conductivity to evaluate the seasonal relationship between rainfall-runoff and streamflow and conductivity levels. Our sensor data will be compared to surface water and groundwater grab samples and *in situ* data collected monthly and analyzed in the laboratory. End-member mixing analyses will be used to quantify contributions to stormflow from different streamflow generation mechanisms. The wireless sensor technology will be described and preliminary results will be presented.

Additional Key Words: salinity, total dissolved solids, conductivity, source water identification, end-member mixing analysis.

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