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Assessment of Pre-Reclamation Water and Sediment Quality at an Abandoned Mine Land Site: Hurricane Creek Watershed, Alabama.

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The research area, situated in the upper Hurricane Creek watershed in eastern Tuscaloosa County, Alabama, encompasses a 67-acre abandoned coal strip mine site slated for reclamation in Fall 2024 as part of the USDOI/DOL Abandoned Mine Land Economic Revitalization (AMLER) Program. The AMLER initiative seeks to properly reclaim legacy mining sites, thereby promoting economic development in the community. This study focuses on the pre-reclamation assessment to inform future remediation efforts. Surface water samples are collected monthly and sediment samples are obtained quarterly from ten locations (SW1–SW10) from June 2021 to the present.

Stream water pH remained circum-neutral (7–8) throughout the study period, but elevated conductivity (600–1800 µS/cm) and sulfate levels (100–1200 ppm) were observed, except during winter months. In contrast, retention pond (SW9, SW10) and pond outlet (SW8) samples consistently displayed strongly acidic pH (3–3.5), while one stream site exhibited lower conductivity and higher pH values throughout the sampling period.

ICP-OES analysis of surface water samples revealed elevated concentrations of major, minor, and trace elements. Retention pond and pond outflow sites (SW8-SW10) consistently showed the highest minor and trace element concentrations, surpassing USEPA drinking water MCLs or SMCLs across all seasons. Aluminum (SMCL=0.05-0.2 mg/l), Mn (MCL=0.05 mg/l), and Ni (MCL=0.1 mg/l) concentrations exceeded drinking water standards with values > 4, 29, and 0.2 mg/l respectively in October 2023. Iron (MCL=0.3 mg/l) dominated with values > 2 mg/l in November. Except site SW7, Mn consistently surpassed the MCL.

Particle size analysis categorized sediment samples at SW1-SW6 and SW8 as sand and those at SW7, SW9, and SW10 as silt. Sediment extractible element concentrations obtained using USEPA Method 3051A showed consistently high extractable Fe concentrations at pond outflow site, SW10. Across all sites and sampling seasons, Al exhibited the lowest percent extractability while Fe and Mn showed 70-90% extractability.

These findings underscore the need for remediation to reduce potential environmental and health impacts associated with abandoned mine lands, particularly at sites SW8-SW10. Moreover, the sediment analysis sheds light on the distribution and availability of key elements in the aquatic ecosystem, providing valuable insights for future remediation strategies.