Modeling Water Balance of Geomorphic Evapotranspiration Covers for Reclamation of Mine Land[1]

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Abstract: Surface mining imposes severe ecological effects on the land because it not only alters the vegetation, soils, bedrock, and landforms, but also changes the surface hydrology, groundwater, and flow paths that ultimately result in degraded ecology and water quality. The combination of two relatively new methodologies, fluvial geomorphic landform design and evapotranspiration (ET) covers, as the geomorphic ET (GET) covers, offer solutions to reclaim abandoned mine land for long term. The GET cover can be evaluated for optimized design, e.g., by predicting the water and contaminant balance using a numerical simulator. An ET module is being developed for the existing eSTOMP simulator. Soil water stress is quantified with a water stress function, which is the product of plant wilting factor and the fraction of roots. The plant-wilting factor is a function of soil water matric head. When the plant is not stressed (water stress function = 1), actual transpiration (T_a) is the same as the potential evapotranspiration (PET). When the plant is stressed (water stress function < 1), T_a is the reduced PET by a factor of the water stress function. The ET module provides an additional capability to the eSTOMP simulator to predict actual ET for different plant types. Different types of vegetation can be mixed. Different micro-climate condition (as indicated by the PET) can be applied to as desired (e.g., in the north and south slopes of a hill). This simulation capability is demonstrated for different GET cover designs.

Additional Key Words: Abandoned Mine Waste; Water Management; Contaminants; Vegetation.

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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.

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