Long-term Stability of Designed Ephemeral Channels at Reclaimed Coal Mines, Wyoming

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1.0 INTRODUCTION

Surface coal mining continues to be an important cornerstone of fossil fuel extraction in Wyoming. Associated with the extraction of coal is the disturbance of surface drainage networks. Natural channels may become blocked by spoils, rerouted, or unearthed during the surface mining process, thus, an important aspect of mined land reclamation is the restoration of surface drainage systems.

Reclamation seeks to reestablish long-term channel stability by efficiently routing surface water and sediment, while minimizing erosional processes. The goal of attaining long-term stability of ephemeral channels in semi-arid environments is particularly challenging because natural sediment yields are normally high, and ephemeral streams may, by nature, undergo cycles of cutting and filling (Schumm and Hadley, 1957).

Evaluating the long-term performance of designed ephemeral channels at reclaimed coal mines in Wyoming is difficult because major channel adjustments in semi-arid regions typically occur in response to infrequent, large floods. Complete certification and bond release issues are management and regulatory decisions that involve evaluating long-term performance of reclaimed channels, but the rarity of the channel-changing discharges and the short time since reclamation construction completion poses a great challenge to Abandoned Mine Land (AML) and Department of Environmental Quality/Land Quality Division (DEQ/LQD) personnel. At

present, many of these decisions are based on the short-term observations provided by post-construction monitoring or annual permit application information. There is a need to derive a means of evaluating long-term channel stability that is not limited by short-term monitoring. The specific objectives of this research are:

- To understand previous channel design practices at reclaimed abandoned coal mine sites in Wyoming through an inventory of engineering design reports and plans;
- To determine characteristics that contribute to ephemeral channel stability by conducting field investigations of natural, unmined channels and drainage basins, and;
- To derive a risk-based stability evaluation for reclaimed channels using statistical comparisons of channel design criteria from reclaimed AML coal sites with adjacent, natural surface drainage systems.

1.1 Definition of Channel Stability

A major premise of this research is that natural alluvial channels represent long-term stability because their deformable boundaries allow channel geometry adjustments to accommodate water and sediment discharges, a self-regulating process known as dynamic equilibrium (Hack, 1960). In addition, natural channels have evolved over long periods of time with channel cross section parameters of width, depth, and slope reflecting prevailing climatic and hydrologic conditions. By this definition natural channels are stable, whether aggrading or degrading, a temporally independent definition that evaluates reclaimed channel stability solely on how closely reclaimed channels resemble unmined, natural drainages. Reclaimed channels that are properly integrated into the surrounding landscape, specifically the drainage basin, will respond to large flows in a manner that is similar to channels upstream or downstream of the mined areas. Degradation and\or aggradation that occurs on a basin-wide scale and migrates