**Evaluation of TDS Concentrations from Valley Fills[[1]](#footnote-1)**

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**Extended Abstract**

The coal industry faces concerns about effects of total dissolved solids (TDS) in waters discharged by surface mining operations. Specific conductance (SC) is often monitored as proxy for TDS. Several studies have demonstrated degraded aquatic resources in streams influenced by mine waters with elevated SC. Regulators are sensitive to such impacts, and mine permitting has become more difficult. Hence, development and implementation of practices for reducing TDS concentrations of discharged water is of direct interest to the Appalachian coal industry. The mining industry has opportunity to develop practices that will reduce SC/TDS in discharge water while achieving other beneficial outcomes.

We are working with mining firms to develop, demonstrate, and assess the effectiveness of improved practices for construction of mine spoil fills. The practices are intended to:

* Reduce TDS concentrations in water discharge, relative to fills constructed using conventional techniques.
* Produce surface-water flows that more closely approximate pre-mining hydrology compared to those produced by conventional fills.
* Establish soils and vegetative cover that will develop into forested ecosystems resembling those which occur on nearby non-mined areas.
* Control costs to the extent possible while achieving improved environmental outcomes.

We have developed a set of “best practices” that can be employed by mining firms for the purpose of achieving those goals (Table 1).

We are working with two firms that are conducting mining and reclamation operations using the practices described by Table 1. Methods for TDS management include characterization of rock strata for TDS generation potentials, targeted handling and placement of high-TDS spoils, and construction of post-mining landforms intended to minimize interactions of high-TDS spoils with environmental waters. At both mining operations, we are monitoring SC, water chemistry, and water discharge. We are also monitoring waters discharged by somewhat older and completed valley fills constructed using conventional techniques at these same mine sites. Waters discharged from one of the experimental sites have SC levels comparable to those measured prior to current mining and well below SC’s of conventional valley-fill discharges but above natural background. On this mine site, discharge water quality is influenced by a combination of current operations and prior mining effects. Construction of the second experimental fill has been initiated.

**Table 1.** Summary of spoil management and placement methods (recommended, planned, and employed) for construction of experimental mine spoil fills.

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| Design Factor | Practice |
| Landform Design | Minimize flat and near-level areas with potential to enable rainfall infiltration to bulk fill †; and/or construct compact subsurface spoils beneath such areas as needed to channelize or direct infiltrating waters so as to minimize hydrologic interactions with TDS-generating spoils. |
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| Spoil Characterization | Drill cores are obtained prior to mining and analyzed to discriminate rock strata by TDS generation potentials. . |
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| Water Drainage | Construct drains using durable low-TDS rock materials. Provide a rock filter or geotextile to protect the drain. Intercept major groundwater flows that enter the mining excavation and valley fill area; direct these flows into constructed drains, ensuring gravity-directed flow to spoil exits. This practice is intended to (a) minimize interactions of groundwater flows with TDS-generating spoil materials, and (b) provide source waters for dilution any higher-TDS waters that may be produced by the fill via rainfall infiltration. |
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| Mine Spoil Selection for Bulk Fill | Select low to medium-TDS spoil materials for placement in valley fills. Identify high-TDS spoil materials for “high and dry” placement and isolation away from hydrologic flows. |
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| Mine Spoil Placement for Bulk Fill | Ideally, place spoils in 25-foot lifts with compacted and crowned surfaces. If adequate low-TDS material is available to construct the entire valley fill, loose dump selected spoils to construct bulk fill. |
|  |  |
| Bulk Fill Surface | Compact surface (crown) of bulk fill materials, to the extent that is practical and feasible to achieve a low-permeable barrier prior to application of surface-soil materials. |
|  |  |
| Mine Soil Construction | Cover compacted zone with salvaged soil (to include rooting materials and seed bank) where possible, with low-TDS weathered spoils where soil salvage is not possible, or with a mixture of weathered spoils and salvaged soils. |
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| Contributing Area Management | Minimize open spoil areas by mining and reclaiming in rapid sequence. Ensure that groundwater flows are captured and channelized in low-TDS drainage structures; and that rainwater infiltration into bulk fill is minimized throughout the mining area. |
|  |  |
| Reclamation / Revegetation | Use the Forestry Reclamation Approach (FRA) where compatible with post-mining land use goals. |
|  |  |
| Surface Water Management | Ensure that all surface-water drains are pitched, lined, or underlain by compacted spoils as needed to ensure minimal infiltration. Minimize impoundments on mine spoil fills; if above-fill impoundments are necessary, install lining or compact underlying spoils as needed to ensure against water loss from pond bottoms into bulk fill. |

† The term “bulk fill” is refers to the mass of spoils placed within the valley fill. The bulk fill does not include surface materials intended to provide plant rooting, water infiltration, and near-surface flow.

Assessment of the experimental fill construction techniques’ effectiveness is, of necessity, a long-term endeavor as their potential to achieve low-TDS water discharges cannot be evaluated until the mine-spoil fills have been completed and reclaimed for at least several years. Full assessment of these mine spoil fill construction techniques will require even longer (perhaps decades) as development of surface vegetation will influence surface hydrology and rainwater infiltration into the mine spoil fill.

The current research emphasizes valley fills. We see this as a practical necessity, as valley fills channel waters from defined mining areas through a single discharge point that can be readily monitored. We expect that methods are also applicable to other types of mine spoil fills, such as bench fills and backfills. The work is intended to aid development of improved environmental remediation techniques by the Appalachian coal industry.

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