Geotechnical
Environmental
Water Resources
Ecological

Memo

To: Karen Bennett, NMA

From: Steve Canton, Grant De Jong, and Carrie Claytor

Date: July 12, 2010

Re: Review of Relevant Sections of EPA MTM Report

As requested, GEI has reviewed the EPA report on effects of mountaintop mining and valley-fill techniques. Specifically, we are providing our evaluation of key portions relevant to their conclusions on ecological effects.

1.0 Introductory Review and Description of Document

The EPA (2009) report provides their view of the state of the science on the environmental impacts of mountaintop mining and valley fills (MTM/VF) on streams in the central Appalachian coalfields, covering over 48,000 km^2 in West Virginia, Kentucky, Virginia, and Tennessee. MTM/VF techniques were briefly reviewed, and six potential consequences of MTM/VF were cited, including: loss of headwaters and forest resources, impacts on water quality, impacts from aquatic toxicity, impacts on aquatic ecosystems, cumulative impacts from multiple mining operations, and ineffectiveness of mining reclamation and mitigation.

The conclusions of the report suggest that MTM/VF techniques include the following environmental consequences: 1) springs, intermittent streams, and small perennial streams are permanently lost after burial under fill, 2) water quality (particularly ionic and selenium concentrations) is degraded to toxic levels and this change persists downstream, and 3) the macroinvertebrate and fish communities are consistently and significantly degraded.

EPA (2009) was written very broadly, such that the statements made are generally applicable to nearly any headwater system in the eastern United States, not just limited to the headwater streams considered to be at risk from MTM/VF operations. Where specific information on central Appalachian headwaters streams is provided, there is little to indicate that these streams are unique – either in terms of other streams in the eastern United States or from downstream reaches of the same streams.

2.0 Definition of Headwaters and Measure of Loss of Headwaters

There are some significant inconsistencies in how EPA summarizes impacts to headwaters, based on conflicting definitions. EPA (2009) initially defines "headwaters" as the point at which groundwater breaks through to the surface and below which surface erosional processes have formed a channel (p. 12, ll. 15-17). We believe this definition is valid and would add that for intermittent and ephemeral streams, this would also constitute that point where the water from seasonally high groundwater levels or precipitation runoff begins to flow in a defined channel. Using this definition, the surface water downgradient of that point, which is flowing in a defined channel to the confluence with another stream, is therefore the classic interpretation of a "headwater stream."

The EPA initially provides a measure of the impacts to headwaters that is linear; i.e., apparently referring to miles of stream downstream of when a defined channel is formed, with cumulative impacts reported in number of miles (as in the data in the third paragraph, p. 12, ll. 27ff). However, EPA then notes that there is a possibility that isolated springs, seeps, and wet areas may also occur upgradient of that point where headwaters are formed. They do not specify whether they believe this is always the case or if it is simply a possibility. Because of this possibility of isolated, upgradient springs, seeps, and wet areas, EPA (2009) subsequently replaces the linear notion of headwaters with that of a watershed area by measuring the entire catchment upgradient of the point where a defined channel is formed that was used to define "headwaters" (p. 13, ll. 3ff). Therefore, even though isolated springs, seeps, and wet areas do not exist in every valley, and even though EPA specifically defined "headwaters" as where a defined channel is formed, they believe the entire watershed area upstream of that point should be included in the estimates of "headwater loss." EPA (2009) did not cite instances where this has occurred in MTM/VF streams – they just say it could be possible.

However, since most, if not all, of the area of the watershed upgradient of the origin of flow is dry, it really cannot constitute a "headwater stream" or even a "water of the United States" as defined by EPA. Even if isolated upgradient wet areas exist in a given valley, the rest would be dry land. Therefore, the discussion in EPA (2009) about the area of watersheds covered by valley-fills as a surrogate for headwater stream loss is misleading.

In fact, not only is this misleading, it appears to be factually inaccurate. Paybins (2003), which was cited by EPA (2009), used 36 permitted sites in 2000 - 2001 and estimated that the median watershed area "upstream of the origin of intermittent flows" was 14.5 acres (range: 6.3 – 45.3 acres), and median watershed area "upstream of the origin of permanent flows" was 40.8 acres (range: 10.4 – 150.1 acres). Paybins (2003) also reported that the median size of a valley fill in southern West Virginia was 12.0 acres, according to WVDEP GIS data. The WVDEP GIS data also reported that VFs in West Virginia ranged in size from <1 acre to 480 acres, though it is important to remember that Paybins (2003) was a survey of only 36 sites, and the referenced watershed area upstream of the 480-acre VF may not have been included in that study. The median values discussed above would suggest that many valley fills are located upstream of the point at which intermittent flows originate. In these areas,few, if any, defined stream channels below the point of origin defined by EPA as the "headwaters" are actually being "buried" under waste rock.

While EPA relies on other data sources to suggest the contrary, those data are inadequate to make that finding. In particular, Table 1 in EPA (2009) said that the average size of the watershed above the approved valley fill toe was 71 acres, ranging up to 3,774 acres. However, again, key information is missing. Specifically, the watershed area upstream of the point of intermittent flow was not reported in EPA (2009), so it really does not "suggest that intermittent and perennial streams are being buried by valley fills," as claimed in EPA (2009 - p. 13, ll. 13-14).

3.0 Biodiversity of Central and Southern Appalachian Headwaters

EPA (2009) stated that the Central and Southern Appalachians are a biodiversity hotspot, as identified by NatureServe and Figure 8 in EPA (2009). However, most of the coal-mining region of southern West Virginia is not located within that hotspot area. This demonstrates that much of the discussion on "biodiversity loss" is irrelevant to streams with MTM/VF operations in West Virginia.

In Section 3.2, Loss of Headwater Ecosystem Biota, EPA (2009) further indicated that the loss of headwater biota on regional biodiversity would be expected to be most severe for taxa that occur only in headwater ecosystems. There are two issues here. First – as noted above, EPA's own calculations indicate that valley fills are, in fact, not burying headwater streams, but rather generally are located upgradient of the point where headwater streams are formed. Second, EPA (2009) failed to identify any specific invertebrate taxa that are *restricted* to such headwater habitats. Instead, even EPA's analysis shows that many invertebrate taxa are found in both intermittent and perennial streams, as described in EPA (2009) – p. 14, ll. 5-6, 12, 14-15. This indicates that there is very little difference between the communities of intermittent streams and perennial streams in these systems, and the biotic communities found in intermittent streams are not unique in nature. As such, neither EPA (2009), nor the other papers cited therein can identify a unique assemblage in the headwaters of these streams. Rather, it appears they only assume that these headwater streams provide a sink population for the benthic invertebrates. What is not recognized in EPA (2009) is that these headwaters stream systems may actually serve only as a “facultative” or “opportunistic” habitat for these invertebrates and are not critical for their life histories in any way. Furthermore, the hyporheic zone of streams in West Virginia, suggested to be a sink or refuge for invertebrates by EPA, apparently does not harbor a unique invertebrate assemblage (Angradi et al. 2001).

Finally, it was noted by EPA that other organisms also utilize headwater streams, including diatoms, fungi, salamanders, and fish. For example, it was noted that 30 species of diatoms and 40 species of beneficial fungi were reported from two Appalachian headwater streams, but the report did not indicate if those taxa were restricted to those headwaters to identify the uniqueness of that habitat. Furthermore, one paragraph (p. 16, ll. 14ff) discussed the role of headwater streams as critical habitat for brook trout, even though many of the valleys subjected to MTM/VF in West Virginia are probably fishless due to small size, limited depths, possibly intermittent flows, and lower elevations with average temperatures too high to support reproducing brook trout populations. Although fish were observed in lower stream reaches, we did not observe any fish in the headwaters at the origin of surface flow in our own studies. These results also do not identify any unique attributes of the aquatic biological communities of the headwater streams in West Virginia.

4.0 Water Quality

Similar to the section on headwaters, the statements made by EPA on water quality issues are generally applicable to nearly any headwater system in the eastern United States and are not just limited to the headwaters streams considered to be at risk from MTM/VF operations.

Section 4, Impacts on Water Quality, summarizes results from a variety of studies that have evaluated differences in water quality downstream of MTM/VF. The impacts discussed include: alteration of flow, changes in sedimentation, changes in chemical transport and basic water quality parameters, and changes in sediment chemistry. Results and corresponding original studies are generally presented in the context of mined versus unmined areas. This section does not attempt to correlate reported changes in water quality with effects on biota or aquatic ecosystems. Rather, results were generally reported in a factual, straightforward way as they would be in the results section of a scientific paper. Results are presented for findings implicating both negative and positive effects of MTM/VF on water quality, as were results where no significant differences between mined and unmined areas were observed.

In addition to the water quality impacts addressed individually in this section, a discussion of “cumulative impacts” is also included. However, as it relates to the concepts discussed herein, “cumulative impacts” is somewhat a misnomer. One of the main points asserted is that conductivity is often elevated in MTM/VF streams and since conductivity, by definition, is a parameter that integrates the concentrations of many ions into one metric, this is a cumulative impact. Similarly, the “cumulative impact” of depressed iron, manganese, and aluminum concentrations in MTM/VF streams as a consequence of elevated pH (from increased sources of alkaline waters) is discussed in this section. This trend appears to be more of a water chemistry association rather than a cumulative impact. As cumulative impacts were discussed in each of the other sections of the report, it seems a similar evaluation was included in the water quality section only for the sake of convention, especially considering all of the concepts discussed therein were previously mentioned in the 4.3.1 subsection: Changes in chemical transport and basic water quality parameters - pH, matrix ions, metals.

References

Angradi, T., R. Hood, and D. Tarter. 2001. Vertical, longitudinal, and temporal variation in the macrobenthos of an Appalachian headwater stream system. *American Midland Naturalist* 146: 223-242.

Paybins, K. S. 2003. *Flow origin, drainage area, and hydrologic characteristics for headwater streams in the mountaintop coal-mining region of southern West Virginia, 2000-01.* Water Resources Investigations Report 02-4300, U.S. Geological Survey, Charleston, WV.

U.S. Environmental Protection Agency. 2009. *The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields*. Draft EPA/600/R-09/138A. U. S. Environmental Protection Agency, Washington, DC.