My name is Dr. Conrad D. Volz, and my testimony is in support of amending 58 Pa. Code Chapter 75 by adding the salamander mussel, the rabbitsfoot mussel and the snuffbox mussel to the list of endangered species and adding the sheepnose mussel and the rayed bean mussel to the list of threatened species. I am the Director of the Center for Healthy Environments and Communities (CHEC) and the Environmental Health Risk Assessment Certificate Program at the Graduate School of Public Health and an Assistant Professor in the Department of Environmental and Occupational Health.

The Center for Healthy Environments and Communities (CHEC) as part of the Allegheny River Stewardship Project (ARSP) conducted an experiment on the water quality outcomes of river mining for aggregate (Murry et al., 2008) in July of 2008. We found:

- Significantly higher levels of Arsenic (1.68X, p< .0001), Selenium (1.56X, p= .027) and Zinc (1.20X, p= .018) in river water after mining operations had been active for at least two hours compared to samples taken at 3AM before operation had begun. Further there was no rain or other weather events to change water indicators during this period.

- Turbidity (TSS) levels at all sampling stations at all depths were higher after at least 2 hours of mining operations than before mining turbidity samples (p, .0001).

- Turbidity (TSS) was found to be significantly different if the data are stratified by depth at all 3 depths (1 meter below surface, 3 meters depth and 1 meter above bottom). This indicates the TSS plume made by the mining operation was found to extend essentially from bank to bank and from the surface to the bottom of the river in the study area.

- Kriged concentration gradients of total dissolved solids (TDS), at 6 meters depth, were changed markedly after mining as compared to prior to mining operations (See Figure 1, Total Dissolved Solids Kriged Concentration Gradients in ppm (mg/L) Before Mining Operations and Figure 2, Total Dissolved Solids Kriged Concentration Gradients in ppm (mg/L) After Mining Operations Have Begun). The after mining Kriged concentration gradient shows a much larger area of higher TDS than before mining Kriged concentration gradients with some apparent funneling from the clamshell dredge area. (Murry et al., 2008)

These Se, TSS, and TDS data along with evidence of significantly elevated Selenium (Se) bioaccumulation in Pools 5 and 6 in channel catfish over levels found in Pittsburgh Pool channel catfish are suggestive of ecotoxicological stress to mussels and the general aquatic ecosystem;
hypothesized due to Se runoff from agriculture and water discharges from coal-fired electrical
generation plants as well as non-anthropogenic sources (Volz et al., 2007). River mining causes
significant levels of river sediments to rise throughout the water column, with subsequent
suspended solid deposition downstream, particularly where river velocity decreases, and causes
increases in ionic metal and element species, made soluble by water. These three variables (Se,
TSS and TDS) can impact mussels directly or through general ecosystem effects via the
following mechanisms.

There are several concepts concerning the ecotoxicology of Se that can be stated. Elevated
concentrations have degraded many freshwater ecosystems throughout the United States, and
additional systems are expected to be affected as anthropogenic activities increasingly mobilize
Se into aquatic systems. Se is a very toxic essential trace element. Toxic threshold concentrations
in water, dietary items, and tissues are only 2-5 times normal background concentrations.
Toxicity in freshwater ecosystems is the result of bioaccumulation, biotransformation, and
cycling of Se in aquatic food chains (Maier and Knight, 1994). Organic selenium
bioaccumulation and toxicity patterns in the freshwater bivalve sentinel species *Corbicula
fluminea* have recently been demonstrated. Waterborne selenomethionine (SeMet) exposure was
used to mimic dietary organo-Se uptake. Results of this study demonstrate that SeMet is
accumulated to a relatively high extent with a concentration factor of 770 (wet weight basis). The
higher uptake than depuration rates suggest that bivalves deal with high Se amounts using a
strategy of detoxification based on Se sequestration that could involve granules, as shown by a
strong increase of Se in the particulate subcellular fraction. Selenium is persistent in the cytosol
of bivalves exposed to SeMet where it is found in proteins of a wide range of molecular mass,
indicating a possible replacement of methionine by selenomethionine. A subsequent alteration of
protein function might be one of the mechanisms of Se toxicity that could explain the
histopathological effects observed in gills by using transmission electronic microscopy. Those
analyses showed changes in gill filament ultrastructure and suggested mitochondria as the first
target for SeMet cytotoxicity, with alterations of the outer membrane and of cristae morphology.
Organo-Se would thus not only be toxic via indirect mechanisms of maternal transfer as it is
suggested for fish but also directly (Adam-Guillermin et al., 2009).

Total dissolved solids cause toxicity through increases in salinity, changes in the ionic
composition of the water and toxicity of individual ions. Increases in salinity have been shown to
cause shifts in biotic communities, limit biodiversity, exclude less-tolerant species and cause
acute or chronic effects at specific life stages (Weber-Scannell, PK., and Duffy, LK., 2007). A
significant and negative correlation between concentrations of chlorophyll-a (an estimate of
primary production) and concentrations of Na⁺, Mg²⁺, SO₄²⁻, HCO₃⁻ and CO₃²⁻ have been
observed in aquatic environments (Bierhuize, J.F.H. and E.E. Prepas, 1985). Dissolved solids
also adversely impact aquatic life by altering the osmotic pressure of the external environment,
which interferes with the organisms' osmoregulatory functions (Title 25 – ENVIRONMENTAL
Excessive fine sediment impacts the benthic organisms that characterize a healthy stream. Sediment abrades aquatic organism gills during high water events and smothers them upon deposition. The embedding nature of fine sediment also causes the loss of microhabitat in the spaces between larger substrate particles (Reylea, 2000).
Figure 1, Total Dissolved Solids Kriged Concentration Gradients in ppm (mg/L) Before Mining Operations

Total Dissolved Solids (TDS) in ppm Before Riving Mining Event
Allegheny River, Freeport Pennsylvania, Allegheny County
Using Ordinary Kriging Interpolation

- Before River Mining
- After River Mining

TDS Before (ppm)
- 115.03 - 117.90
- 117.90 - 120.78
- 120.78 - 123.66
- 123.66 - 126.54
- 126.54 - 129.42
- 129.42 - 132.30
- 132.30 - 135.18
- 135.18 - 138.05
- 138.05 - 140.93

- World Imagery from ESRI ArcGIS Online Standard Services, 2008
Figure 2, Total Dissolved Solids Kriged Concentration Gradients in ppm (mg/L) After Mining Operations Begin

Total Dissolved Solids (TDS) in ppm After Riving Mining Event
Allegheny River, Freeport Pennsylvania, Allegheny County
Using Ordinary Kriging Interpolation

- World Imagery from ESRI ArcGIS Online Standard Services, 2008
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