Water Quality of the West Branch Susquehanna Watershed

Historical Water Quality

Photo: R. Dunlap

AMD in Clearfield County.

The first qualitative assessment of the pollutant load in and delivered to the West Branch Susquehanna River occurred as part of Operation Scarlift in the early 1970s. As part of this assessment, a thorough investigation of the stream water quality data was compiled for the 40-mile reach of the West Branch from its headwaters to Bower and cursory data were also collected between Bower and Renovo. The river, according to this report, was either predominantly acidic or intermittently acidic along its entire length (Commonwealth of Pennsylvania 1972). The river at Germantown, between Bakerton and Bower was documented to have a pH of 4.1, an acidity of 17,820 lbs/day, and an iron loading of more than 1,000 lbs/day (Commonwealth of Pennsylvania 1972). The conditions of the headwaters were so deteriorated that one conclusion of this study stated "The overall acid loading conditions to the West Branch are such that no significant length of stream above Bower Station can be permanently recovered for recreational use even with abatement expenditures of the order of $20 to $30 million" (Commonwealth of Pennsylvania 1972).

The next assessment that quantified a large portion of the river was in 1984 when the USGS completed an evaluation of water quality and flow in the West Branch Susquehanna River and all its tributaries between Curwensville and Renovo. This investigation documented that the river was still polluted throughout much of its length. In fact, the pH of the river at Renovo was measured to be 4.6 in the spring and 3.8 in the summer and concentrations of acidity were measured to be 9.9 mg/L as $CaCO_3$ in the spring and 15 mg/L as $CaCO_3$ in the summer. Additionally, this study identified Moshannon Creek, Sinnemahoning Creek, Clearfield Creek, and Kettle Creek as the major sources of acidity and iron to the river. Moshannon Creek, Sinnemahoning Creek, and Clearfield Creek accounted for 63% (231 tons/day) of acidity measured in the river in spring conditions while Moshannon Creek, Kettle Creek, and Clearfield Creek accounted for 60% (78 tons/day) of the acidity measured in the river during summer conditions (Hainley and Baker 1993). With respect to iron, Clearfield Creek and Moshannon Creek alone accounted for 76% (34 tons/day) of the total iron measured in the river in spring conditions and Kettle Creek and Moshannon Creek accounted for 51% (3 tons/day) of the total iron measured in the river in summer conditions (Hainley and Baker 1993).

Present Day Water Quality

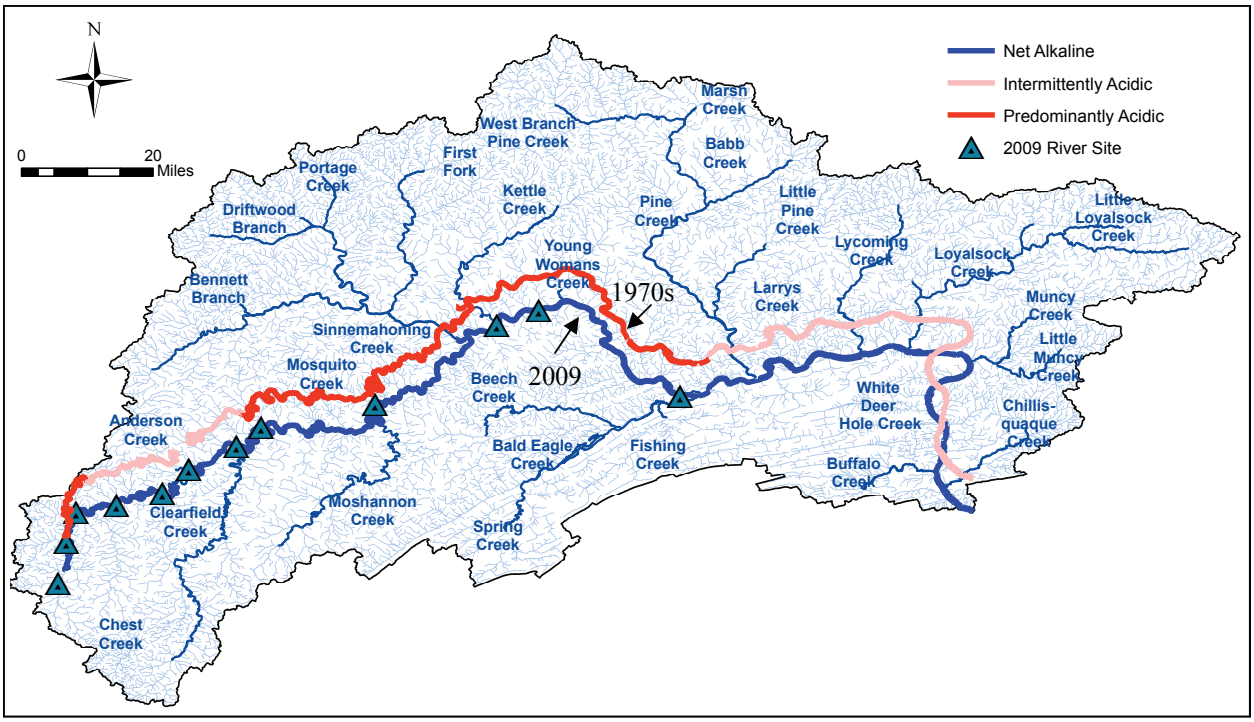

Figure 2— *Acidity of the West Branch Susquehanna River as documented in the 1972 Scarlift report and net acidity (as calculated by pH, metals, and alkalinity) (mg/L) as documented by the twelve river sites included in the Project.*

Data collected in 2009 as part of the Project indicate markedly improved conditions in the river compared to conditions reported in both of the aforementioned studies. As an example, instead of predominantly or intermittently acidic conditions along the entire length of the river as was found in the early 1970s, data collected in 2009 reveal that the river is now in a net alkaline state according to its calculated net acidity based on pH, metals, and acidity (Figure 2). Even though there was a notable decreasing trend in alkalinity concentrations from the headwaters downstream from the addition of AMD impacted tributaries, the river remained in a net alkaline state (Figure 3). Additionally, the pH of the river at Renovo was measured to be 6.6 and 6.3, 2.0 and 2.5 units higher in spring and summer 2009 conditions respectively compared to measurements in 1984. Lastly, concentrations of acidity, iron, and aluminum in 2009 were each reduced compared to concentrations found in 1984 (Figure 4).

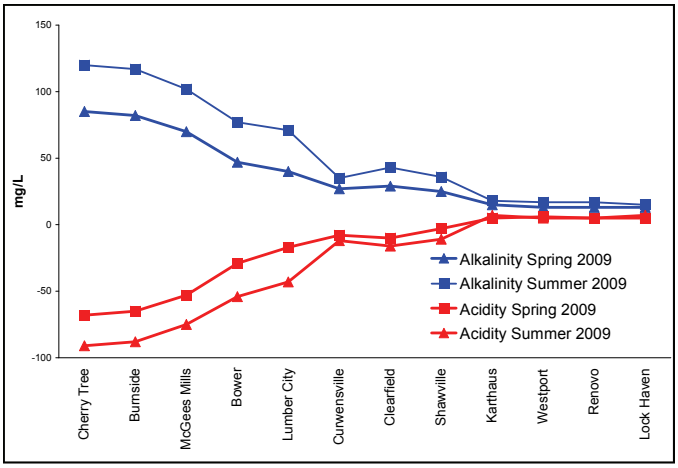

Figure 3— *Alkalinity (mg/L) and acidity (represented as hot peroxide acidity) (mg/L) of the West Branch Susquehanna River as documented by the twelve river sites included in the Project.*

Water quality conditions in the tributaries were also markedly improved. At those sites sampled in both 1984 and 2009, 85% percent of the tributary pH measurements in 2009 were higher than what was measured in 1984, 79% of the acidity concentrations were lower, 68% of the iron concentrations were lower, and 92% of the aluminum concentrations were lower. In addition, while a considerable amount of the acidity measured in the river can still be attributed to three tributaries, the total amount of acidity measured and those tributaries delivering the load has changed (Figures 4 and 5). For instance, Clearfield Creek, a once net acidic tributary delivering 45 tons/day of acidity in the spring and 15.5 tons/day of acidity in the summer was measured to be net alkaline (according to acidities reported by the lab and also by calculating net acidity with pH, metals, and alkalinity) at its mouth in 2009. Although Moshannon Creek in both 1984 and 2009 and in both spring and summer conditions delivered the most acidity loading to the river, 2009 data indicate that this tributary had 109 tons/day less acidity in the spring and 26.5 tons/day less acidity in the summer compared to 25 years ago. Additionally, although Sinnemahoning Creek and Kettle Creek still contributed marked loadings to the river in 2009, those loadings were much less and the season during which their impact was most noted changed when compared to 1984 (Figures 4 and 5). Finally, although Alder Run did not contribute significantly to the acid load delivered to the river in 1984 it was found to be responsible for 10% and 11% of the acidity entering the river in spring and summer conditions respectively as measured in 2009.

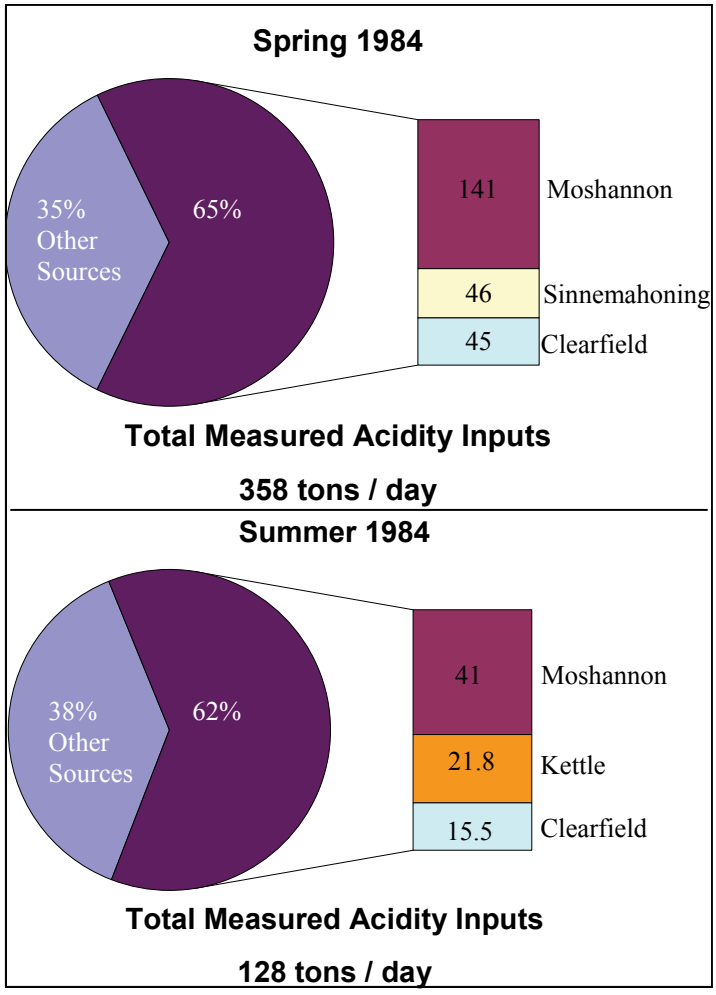

Figure 4 *— Total acidity loading (tons/day) and major sources of acidity to the West Branch Susquehanna River in 1984 as measured by the tributaries included in both the Project and 1984 USGS study (Hainley and Barker 1993).*

Despite the overwhelming improvements in water quality over the last quarter century, many of the tributaries entering the river are still degraded with AMD. Fifty-five percent of the tributaries sampled as part of the Project in the spring and 63% sampled in the summer had concentrations of aluminum higher than DEP Chapter 93 water quality criteria of 0.75 mg/L, while 41% and 50% in the spring and summer respectively had concentrations of iron higher than the Chapter 93 water quality criteria of 1.5 mg/L. Furthermore, 61% of the tributaries sampled as part of the Project in the spring and 60% of the tributaries in the summer had a pH of less than 6. Figures 6 and 7 depict how many Chapter 93 water quality criteria

concentrations (considering the criteria for aluminum, iron, pH, manganese, sulfate, and total dissolved solids) were exceeded at each sampling location. Only 10 of the 68 tributaries sampled were found to have water quality that met all Chapter 93 water quality criteria concentrations in the spring and only 11 were found to meet all criteria in the summer (see Appendix).

Additionally, the water quality of a few tributaries to the West Branch Susquehanna showed little change or was worse in 2009 than was documented in 1984. For example, while Sandy Creek, a tributary that enters the river in Clearfield County, exhibited slight improvements in pH, acidity, and aluminum, concentrations of iron in 2009 were 1.5 mg/L and 2.2 mg/L higher than what were found in the spring and summer of 1984. Also, Alder Run, another tributary that enters the river in Clearfield County had 15 mg/L more of iron in the spring of 2009 than it did in the spring of 1984 and 26 mg/L more in the summer and has shown no improvement in pH since 1984.

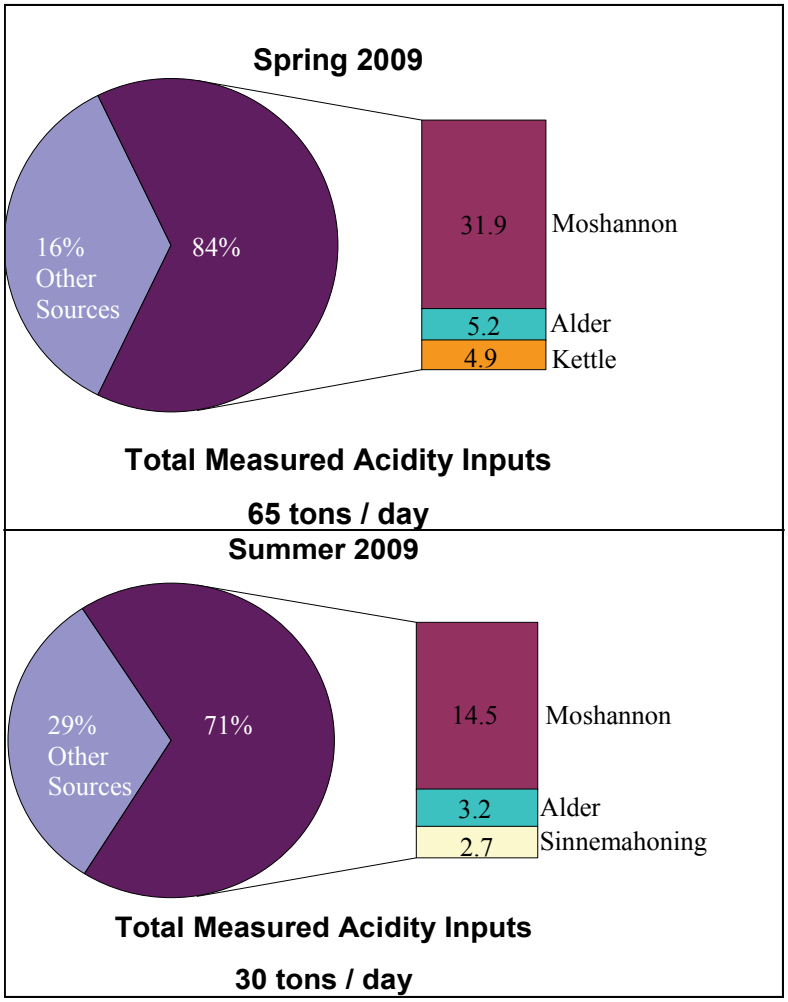

Figure 5— *Total acidity loading (tons/day) and major sources of acidity to the West Branch Susquehanna River in 2009 as measured by the tributaries included in both the Project and 1984 USGS study (Hainley and Barker 1993). Acidity represented as hot peroxide acidity (mg/L). Sites with a negative hot acidity value were not included.*

In addition to reductions in acidity, the West Branch Susquehanna River has experienced significant, albeit less dramatic, reductions in sulfate and total dissolved solids concentrations and specific conductance. At Karthaus, for example, sulfate concentrations have declined by 12% to 29% from 1984 to 2009. Total dissolved solids and specific conductance levels have similarly declined between 16% and 26%.

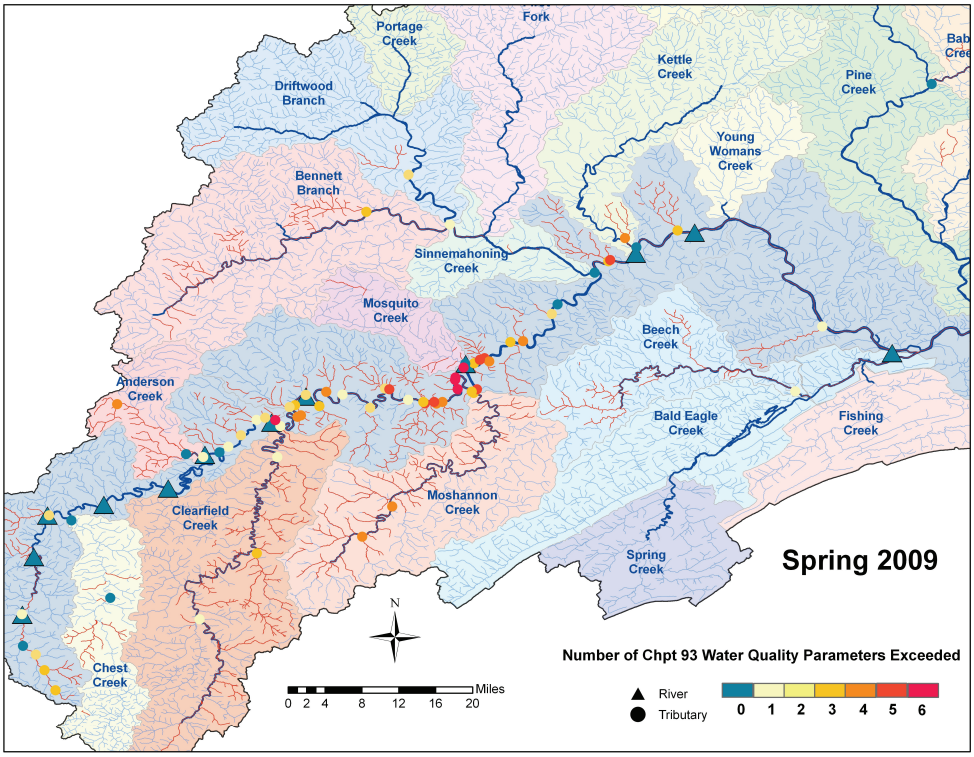

Figure 6 *— Number of chapter 93 water quality criteria (aluminum, iron, pH, manganese, sulfates, and total dissolved solids) exceeded in the spring of 2009.*

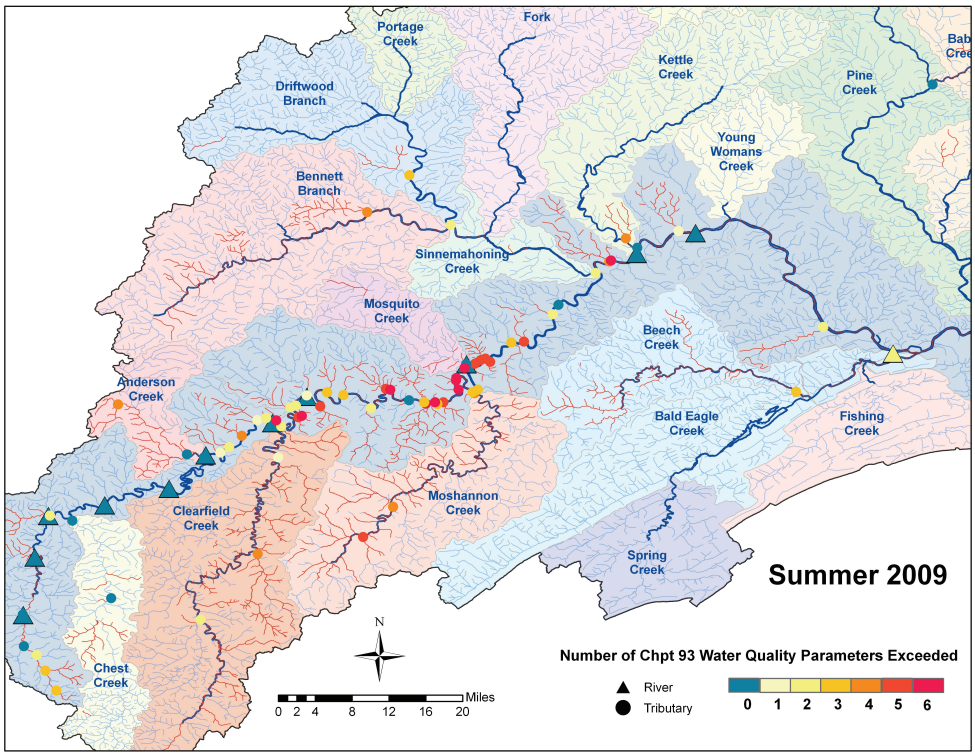

Figure 7 *— Number of chapter 93 water quality criteria (aluminum, iron, pH, manganese, sulfates, and total dissolved solids) exceeded in the summer of 2009.*