WEST VIRGINIA RIVERS COALITION

3501 MacCorkle Ave. SE #129 • Charleston, WV 25304 • (304) 637-7201 • www.wvrivers.org

July 30, 2015

Laura Cooper
Water Quality Standards, DWWM, DEP
601 57th St. SE
Charleston, WV 25304

Submitted electronically to dep.comments@wv.gov

RE: Comments on Proposed Revisions to 47CSR2 – Requirements Governing Water Quality Standards

Thank you for providing the public the opportunity to comment on the 2016 proposed revisions to Requirements Governing Water Quality Standards (47CSR2). West Virginia Rivers Coalition submits these comments in collaboration with the organizations listed on the signatory page of this document. Each signatory has a vested interest in the quality of West Virginia's waters, and believes that strong water quality standards are critical to the future health and safety of our water resources.

Site-specific variance for specified streams in the Cheat and Tygart watersheds

We support the comments submitted by Appalachian Mountain Advocates appended to these comments.

Selenium fish tissue-based standards

We support the comments submitted by Appalachian Mountain Advocates appended to these comments.

Aluminum hardness-based standard

We support the comments submitted by Dr. James Van Gundy to West Virginia Department of Environmental Protection's ("WVDEP's") Environmental Protection Advisory Council appended to these comments and offer the additional comments below.

We oppose WVDEP's proposed revisions to the aluminum water quality criteria.

The revisions are drastic. For high-hardness streams, the proposed chronic criterion is more than 40 times weaker for trout streams, and almost five times weaker for warm water streams. The proposed acute criterion is almost 12 times weaker. The Clean Water Act ("CWA") requires that States "adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use." 40 C.F.R. 131.11(a)(1).

Unfortunately, in a rush to provide regulatory relief to dischargers, the proposed revision fails to comply with this mandate.

There is no emergency that justifies the promulgation of this rule.

WVDEP originally proposed this change as an emergency rule in 2013.[1] WVDEP's proposed rule weakening the aluminum water quality standard does not meet the requirements for promulgation as an emergency rule. The rule is not necessary to prevent substantial harm to the public interest, but rather is intended to protect the private profits of a small number of coal mine and industrial facility operators.

In 2013, WVDEP claimed that the emergency rule was necessary to prevent "substantial harm to the public's interest in economical and meaningful expenditures of resources in environmental regulation." WVDEP claimed that the existing standards needed to be changed because they subjected certain members of the "regulated community" to "unnecessary treatment costs." In the emergency rule, and in the rule proposed now, WVDEP is thus protecting not the public's interest, but the interests of a small number of polluters who do not wish to pay to treat their waste.

The true public interest lies not in WVDEP's short-term protection of polluters, but in protecting West Virginia's waters. As explained in these comments, the proposed standards would not protect West Virginia's waterways. Thus any minimal benefit to the public that might possibly accrue from private companies avoiding the cost of treating their pollution are outweighed by the damage that will result to West Virginia's streams as a result of these changes. The weakened standards thus fail to "prevent substantial harm to the public interest," as required by the regulations governing emergency rules.

When the 2013 emergency rule was up for approval before the Legislature in 2014, the Legislature withdrew the rule after the Freedom Industries chemical leak. Legislative leaders asserted that just after the chemical leak was not an appropriate time to weaken water standards. The same holds true today.

The proposed rule change will significantly weaken the Aluminum criteria.

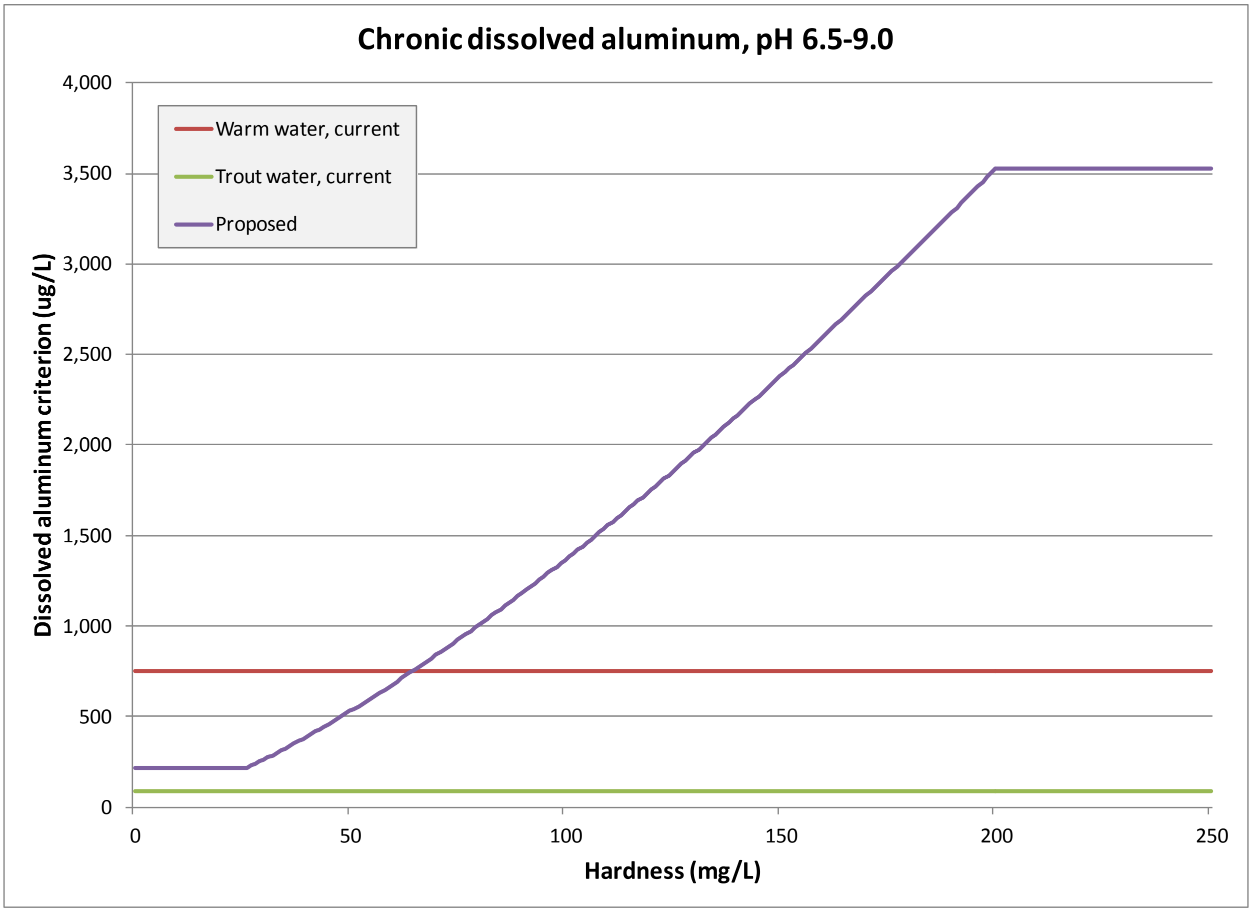
The proposed rule requires the calculation of aluminum criteria based on the hardness of the stream. The new equation in the rule would significantly weaken protections, as compared to the existing rule.

---

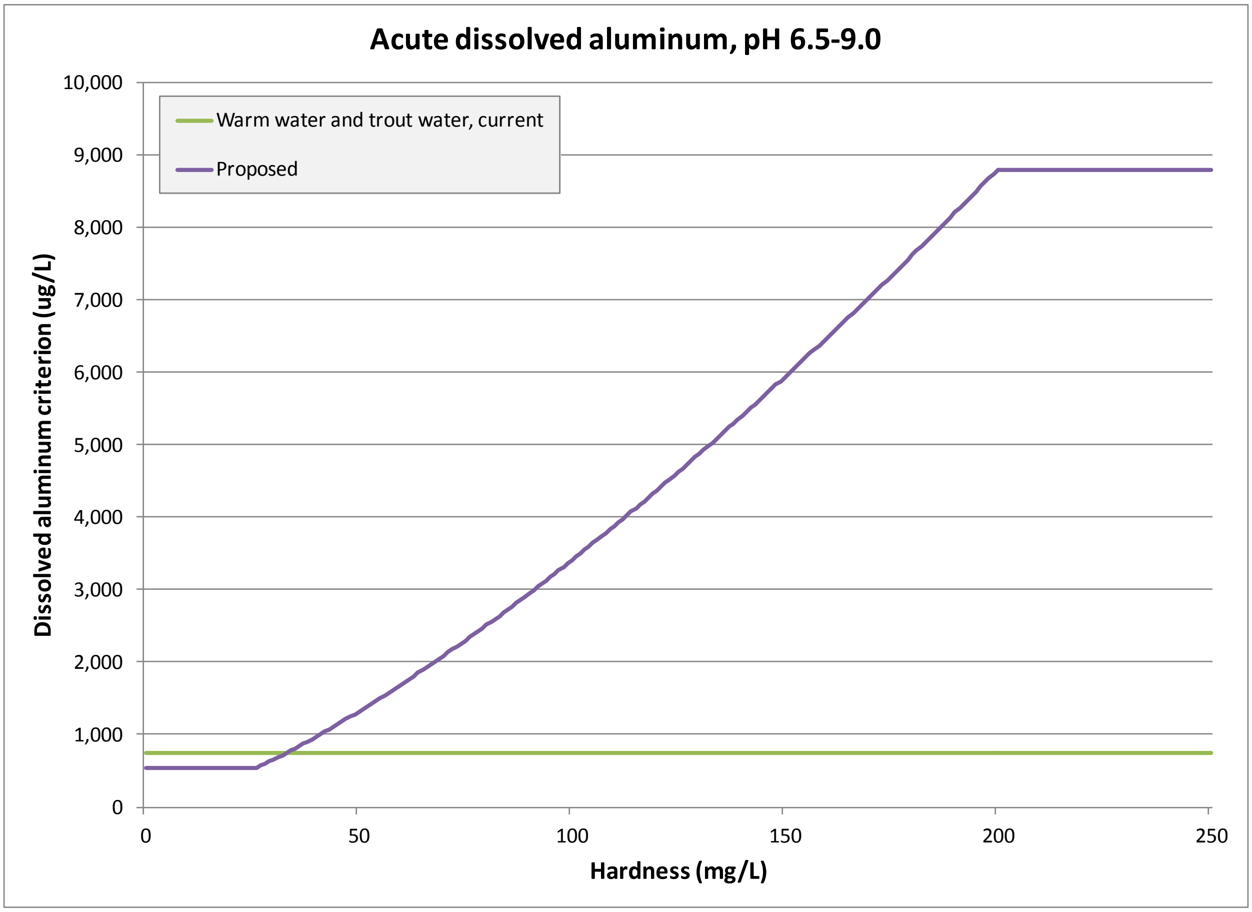
[1] The proposed change was exactly the same as what is being proposed now, except that the maximum hardness concentration was changed from 220 to 200 mg/L.

As shown in the first chart below, the emergency rule would weaken the current criterion for trout waters at all hardness values. As hardness increases, it will become increasingly less stringent. Once hardness reaches 200 mg/L, the proposed criterion is more than 40 times more permissive than the current criterion.

The first chart also compares the proposed chronic criterion to the current criterion for warm waters. In this case, the proposed criterion would provide additional protections if hardness is less than 65 mg/L—a condition that might be found in very few streams, and certainly not in streams already impacted by coal mining. However, at all other hardness values, the proposed criterion is weaker than the current criterion. Once hardness reaches 200 mg/L, the proposed criterion is nearly 5 times more permissive than the current chronic criterion.



Additionally, a single acute criterion currently applies to both trout and warm waters. As shown in the following table, the proposed criterion is slightly more protective in streams with hardness below 34 mg/L— conditions that might be found in very few streams, and certainly not in streams already impacted by coal mining. However, at all other hardness values, the proposed criterion is weaker than the current criterion. Once hardness reaches 200 mg/L, the proposed criterion is nearly 12 times more permissive than the current acute criterion.



In short, in any but the most pristine streams, the emergency rule would weaken the existing aluminum criteria. And in high-hardness conditions witnessed in streams that are impacted by coal mining, the emergency rule represents a significant weakening of the existing criteria—more than 40 times more permissive for the chronic trout water criterion and more than 12 times more permissive for the acute criterion.

WVDEP lacks sufficient information to promulgate hardness-based aluminum criteria.

WVDEP says that "[d]issolved aluminum toxicity, like other metals, has a direct relationship to hardness, and numerous scientific studies have validated the impact of hardness as it relates to toxicity to the aquatic community."[2] WVDEP, however, has mischaracterized the state of the science. In fact, there are few peer reviewed studies on the effects of hardness on aluminum toxicity. According to Dr. Carys Mitchelmore, an aquatic toxicologist from the University of Maryland:

---

[2] See WVDEP Secretary of State filing.

> "changes to the water quality standards for aluminum in West Virginia are inappropriate given the paucity of peer-reviewed studies and definitive data sets that specifically investigate the relationship between aluminum toxicity and water hardness. Studies should include definitive LC50 or EC50 values at multiple and wide-ranging hardness levels. Unlike other metals (e.g. Cd, Cu, Zn), where we have a good understanding of the relationship between water hardness and toxicity, there are very few similar robust data sets regarding this relationship with aluminum. There are indeed hundreds of papers detailing this relationship in the aforementioned metals but very few for aluminum (with the majority of studies having been carried out in the 1970-1980's). Whereas there are studies that suggest this relationship there are others that also disprove this relationship. It is unclear whether differences are due to the specific aquatic species under study (or life-stage) or something else that confounds this relationship (i.e. other water quality parameters such as pH or dissolved organic matter) until more detailed replicate studies in numerous aquatic species are carried out. These studies are also laboratory studies that do not replicate complex field conditions.[3]
>
> Furthermore, many studies were not designed specifically to look at this aluminum/hardness relationship and hence are limited in their use of only a few concentrations of aluminum and often only two (or a small concentration range) of hardness levels were used. This is especially the case for subacute and chronic studies where very little data is available."[4]

Presumably, this is why the Environmental Protection Agency ("EPA") did not promulgate hardness-based aluminum criteria at the same time it promulgated them for other metals.

Dr. James Van Gundy, aquatic ecologist and member of WVDEP's Environmental Protection Advisory Council, also points out the limitations of the report WVDEP relies on as the basis for the revision:

> "the GEI Report upon which WVDEP bases its case for a hardness-based Aluminum WQ rule, relies upon mostly static and mostly short-term bioassays of relatively few species, only a few of which actually occur in West Virginia waters. The US EPA recommends the use of indigenous species in developing criteria intended to apply statewide (as opposed to nationwide or federal standards."[5]

Van Gundy goes further in pointing out the scarcity of available studies examining biological implications of the proposed change:

> "The specific biological activity of the various Aluminum species is almost entirely unknown as most published studies have dealt with a very limited list of test organisms under often poorly controlled or characterized experimental conditions.

---

[3] Mitchelmore at 2.

[4] Id.

[5] Van Gundy comments to EPAC.

> It would be useful if the WV DEP could produce data that shows that the currently permissible levels of Aluminum are truly protective of a range of aquatic life broader than just salmonid fishes and daphnids. Unfortunately, the requisite laboratory studies have apparently not been done and the evaluation of Aluminum toxicity from field data is difficult at best due to the presence of multiple confounding factors. We have seen no evidence that the discharge of Aluminum even at currently permissible levels is protective of all of the species of aquatic life that are important in West Virginia's aquatic ecosystems. Because there is such a paucity of relevant scientific information regarding both the effects of Aluminum on aquatic organisms and the role that water hardness plays in ameliorating such effects, it would be irresponsible to drastically increase the amount of Aluminum that can be legally discharged until such time as a better understanding of the possible effects of such a change is at hand."[6]

Aluminum toxicity is complex and further undermines WVDEP's proposal.

Aluminum toxicity depends on many factors other than water hardness. For example, major drivers include pH and the amount of dissolved organic material (DOM) in the water. The solubility, speciation and/or complexation of aluminum is highly dependent upon multiple ambient water quality characteristics that ultimately determine bioavailability and toxicity.[7] WVDEP has not appeared to fully consider the complex interactions affecting aluminum toxicity.

Dr. Van Gundy's comments go on to explain:

> "It is reasonably well understood that different chemical species of Aluminum have different levels of toxicity. As water moves through a stream system, pH, temperature, and other factors change and may affect the chemical species of Aluminum present. Such changes are especially likely to occur in zones where two streams of varied chemical and physical quality meet and mix, and there is some field evidence to support the assertion that the toxicity of aluminum may increase in such mixing zones. Also, the reliance on a single parameter, hardness, to calculate safe levels of Aluminum disregards the scientific evidence that pH (within the range of 6.5 - 9.0), temperature, and the presence of dissolved organic matter (DOM) may have equal or greater influence on Aluminum toxicity. For instance, Lydersen (1990) showed that a decrease in temperature of about 15°C has the same effect on Aluminum speciation and solubility as does a decrease in pH by one unit; thus temperature is important to consider when calculating Aluminum toxicity. The formation of complexes with fluoride, sulfate, phosphate, and silicate ions may also alter the toxic action of Aluminum."[8]

---

[6] Van Gundy comments to EPAC

[7] Mitchelmore at 3.

[8] Van Gundy comments to EPAC

The proposed rule is flawed in that it only considers dissolved Aluminum.

The proposed rule is the only hardness-based Aluminum criteria the nation that only considers dissolved Aluminum, and WVDEP has provided no scientific justification for not also considering total recoverable Aluminum in its proposed standard. Even the New Mexico and Colorado criteria, which have been touted as examples of similar hardness-based criteria, do not apply hardness-based equations to dissolved aluminum (See details later in this comment letter).

Dr. Van Gundy's comments point out:

> "The reliance on a standard that considers only dissolved Aluminum is particularly problematic. Insoluble forms of Aluminum may well have significant biological effects. For example, precipitated $Al(OH)_3$ may coat and clog respiratory structures or surfaces and interfere with the ability of aquatic organisms to exchange respiratory gasses. It is also likely that insoluble Aluminum hydroxides are converted to soluble and more toxic forms when ingested. None of the bioassay studies referenced in the GEI Report (GEI, 2011) examined routes of Aluminum exposure other than absorption across external body membranes.
>
> More significantly, the standard 96 hour short-term bioassay procedure requires that the test animals not be fed during the test period. As a consequence of this, dietary sources of Aluminum are not considered in evaluating its potential toxicity towards aquatic organisms. For some organisms in nature however, dietary exposure may be the major mode of entry of toxins (Poteat and Buchwalter, 2011). These authors state that in every study comparing dietary vs. dissolved exposure of which they are aware, diet is the predominant route of exposure of aquatic insects to toxic metals and they conclude that dietary acquisition strongly drives the bioaccumulation of metals in aquatic insects.
>
> One study (Cain *et al,* 2011) suggests that as much as 95% of the toxic metal body burden of aquatic insects may come from dietary sources. Another study (Xie and Buchwalter. 2011) suggests that diet derived metals may be more physiologically active than those acquired in dissolved form through gills or other external body surfaces.
>
> While many laboratory studies have indicated that aquatic insects are relatively insensitive to metals, a number of field studies conducted in natural aquatic systems have suggested that it is the aquatic insects that are among the first members of the aquatic community to disappear at metals contaminated sites (Brix et al, 2011). This disconnect makes sense if the primary route of exposure is via the digestive tract rather than passage of dissolved metals through respiratory or other body surfaces since only the later is generally considered in laboratory studies."[9]

---

[9] Van Gundy comments to EPAC.

Additionally, Van Gundy points to the significance of insoluble Aluminum exposure through dietary pathways:

> "Over the usual pH range of natural waters, any aluminum that enters a stream in soluble form is likely to be rapidly converted to insoluble Aluminum hydroxide, $Al(OH)_3$, which may be incorporated into bottom sediments or may coat the surfaces of submerged objects. In either location it is probable that it will be ingested by stream animals that make their living by scraping algae off of rocks, or shredding leaves, or filtering small particles of organic material out of the water, or by simply passing bottom sediment through their digestive tracts, extracting anything digestible that happens to be included in it. All of these represent feeding styles of aquatic insects or other macroinvertebrates that inhabit West Virginia's streams. Detritus is a low quality food material and therefore detritus feeders must consume large quantities of it to meet their nutritional needs. If the material is coated with Aluminum hydroxide or otherwise contains Aluminum in particulate form, detritivores will potentially ingest a great deal of Aluminum in the course of their normal feeding activities. Corbi *et al* (2010) found that Iron and Aluminum in sediments were "highly bioaccumulated" by aquatic insects and that metals levels in aquatic insect larvae varied directly with the concentration of those metals in the sediments of the streams in which they lived.
>
> In a survey of Swedish streams of different acidities and Al concentrations Herrmann and Frick,(1995) found that a predacious stonefly (*Isoperla grammatica*) consistently had aluminum tissue levels only about a third as high as the detritus-feeding organisms upon which it fed. This is consistent with Aluminum's apparently modest potential for biological magnification, but since both stonefly and prey were exposed to the same levels of dissolved Aluminum in the external medium, they would be expected to contain similar Al tissue levels if absorption via body surfaces was the only route of entry. This observation supports the notion that detritivores acquire Aluminum from other sources, presumably dietary ones, since in natural systems, that is the only other possible route of exposure.
>
> The chemical environment in an animal's digestive tract is far different from that of the external environment and would be expected to influence the uptake and perhaps the chemical speciation of ingested metals. Dow (1992) found that members of at least four Orders of Insects (Coleoptera,Diptera, Lepidoptera, and Isoptera) have midgut pHs in excess of 12 - the highest pH known in any biological system. There is some evidence that these high pH values represent an adaptation to a tannin-rich diet such as plant detritus (Berenbaum,1980). Since terrestrial plant detritus is a major food source for many members of the aquatic insect communities of forested upland stream systems, these animals might be expected to have a similar type of digestive physiology.
>
> As pH varies, changes in inorganic Aluminum speciation are nearly instantaneous (Gensemer & Playle, 1999). At the high pH of the insect midgut., ingested particulate Aluminum compounds

> would be expected to be rapidly converted from the insoluble and relatively non-toxic forms such as the $Al(OH)_3$ prevalent at normal stream pHs into more soluble (and more toxic) forms such as the Aluminate ion, $Al(OH)_4^-$. Such effects were of course not accounted for by the standard 96 hour bioassays used in support of the hardness-based Aluminum model. Detritus-feeding macroinvertebrates are keystone species in woodland stream ecosystems, and as such, a water quality rule that is not protective of them is not protective of aquatic life in general."[10]

The Colorado and New Mexico criteria are less permissive than WVDEP's proposal because they apply to total aluminum, not dissolved aluminum.

WVDEP says that new studies (i.e., the GEI report noted above) were used to update and support new hardness-based approaches to dissolved aluminum criteria in Colorado and New Mexico. WVDEP mischaracterizes those criteria.

In Colorado, the aluminum criteria are for total aluminum and not dissolved.[11] This means that the Colorado criteria are much more stringent than what is proposed by the WVDEP. For example, monitoring required for two coal mining NPDES permits in West Virginia showed the relationship between dissolved and total aluminum over time for three separate outfalls. On average, 42% of total aluminum was dissolved.[12] In other words, on average the Colorado criteria are nearly 2 ½ times more stringent than WVDEP's proposed criteria.

In New Mexico, the aluminum criteria are based on a modified method for generating dissolved aluminum. Generally in order to analyze a sample for a dissolved parameter, the test water is filtered to remove particles. The standard filter size for a dissolved analysis0.45 µm.[13] New Mexico aluminum criteria, however, are "...based on analysis of total recoverable aluminum in a sample that is filtered to minimize mineral phases as specified by the department" (NMED 2011).[14] A study done by the New Mexico Environment Department concluded that a 10 µm pore size minimized mineral-phase aluminum without restricting amorphous or colloidal phases and that if turbidity was less than 30 NTU, no filtration was needed.[15]

Thirty NTU equates to approximately 46 mg/L total suspended solids ("TSS").[16] In reviewing the TSS associated with the example NPDES monitoring reports noted in the paragraph above, the TSS associated with those discharges are all substantially less than 46 mg/L and thus would not require

---

[10] Van Gundy comments to EPAC.
[11] Colorado Regulation #31 at 56.
[12] See attached spreadsheet Aluminum_pH analysis. Data obtained through FOIA request.
[13] See http://testamericalabs.blogspot.com/2011/01/what-is-difference-between-toal-metals.html
[14] New Mexico Aluminum Filtration Study. August 24, 2012 at 2.
[15] Id.
[16] A log-linear model showed strong positive correlation between TSS and turbidity (R2 = 0.96) with a regression equation of ln(TSS) = 1.32 ln(NTU) + C, with C not significantly different than zero for eight of the nine sampled streams. See www.depts.washington.edu/cuwrm/research/tssturb.pdf.

filtering under the New Mexico criteria. More generally NPDES discharges are usually restricted to an average monthly TSS of 35 mg/L. Thus, in effect, the New Mexico criteria are based on total aluminum and are also nearly 2 ½ times more stringent that what WVDEP is proposing.

Conclusion

There is not enough scientific data at this time to support the proposed hardness-based criteria. We need to know a lot more about how Aluminum behaves in varying stream chemistry and its biological effects. We support the summary points listed in Dr. Van Gundy's comments in finalizing a revised Aluminum standard:[17]

1. The scientific support for the assertion that increased levels of hardness are protective against Aluminum toxicity is considerably weaker than it is for the protective effects of hardness against divalent metals.

2. Only a few of the scientific studies that were used to support this assertion were specifically designed to examine the relationship between hardness and Aluminum's toxicity towards aquatic organisms.

3. In many of the published studies cited by the GEI Report, the experimental conditions were poorly controlled or poorly characterized.

4. There is some evidence that the toxicity of Aluminum increases at the higher end of the pH range 6.5 to 9.0.

5. The organisms used to derive the slope of the aluminum-hardness relationship: *Ceriodaphnia dubia, Daphnia magna,* and *Pimephales promelas* are either not found or are uncommon in the vast majority of the West Virginia streams to which this rule would apply. In addition, these organisms are relatively tolerant of a wide range of polluted conditions.

6. WVDEP's stated belief that only the Aluminum that is dissolved in a stream is bioavailable is almost certainly not true for many species of stream benthic macro-invertebrates.

7. The assumption that insoluble Aluminum will stay insoluble as it moves through the chemically and physically variable stream environment is probably not valid in many cases.

8. While the equations used to derive allowable levels of discharged Aluminum under this rule are similar to those used by the states of Colorado and New Mexico, they are not identical and no scientific rationale has been provided for these differences.

---

[17] Van Gundy comments to EPAC.

9. There is no scientific rationale offered for the use of an Aluminum-hardness relationship (the equation) that was developed for total recoverable Aluminum to be applied to a rule based only upon dissolved Aluminum values. Such rationale needs to be made explicit to the interested public.

10. Any hardness-based rule that is adopted by the state of West Virginia should employ total recoverable aluminum as a basis of calculation rather than dissolved Aluminum alone.

11. USEPA recommends the use of indigenous species in developing criteria intended to apply statewide (as opposed to nationwide or federal standards.) As far as we can determine, this was not the case inmate scientific studies that are cited to support the proposed Aluminum rule.

Thank you for your consideration of these comments.

Signed,

Angie Rosser, Executive Director
West Virginia Rivers Coalition

Dianne Bady
Ohio Valley Environmental Coalition

Conni Gratop Lewis, Legislative Coordinator
West Virginia Environmental Council

Gary Zuckett
West Virginia Citizen Action Group

Cynthia Ellis, President
West Virginia Highlands Conservancy

Julie Archer
West Virginia Surface Owners Rights Organization

Appendices:
1. Dr. Carys Mitchelmore Opinion Report
2. Dr. James Van Gundy EPAC Comments
3. Aluminum pH analysis spreadsheet
4. AppalMAD Comments

Opinion Report on the West Virginia DEP's Emergency Rule For Changes to the Water Quality Standard For Aluminum (January, 2013).

By

Dr. Carys L. Mitchelmore
Associate Professor,

University of Maryland Center for Environmental Science,
Chesapeake Biological Laboratory,
Solomons, MD 20688.

March 18th, 2013

In Summary:

I believe West Virginia's proposed change for aluminum water quality standards from a fixed threshold to hardness-based criteria to be inappropriate given that;

(1) There are very limited peer reviewed studies and definitive toxicity data available regarding this relationship, especially in the pH range of 7-9.
(2) Aluminum toxicity is complex and dependent upon many other water quality parameters (e.g. dissolved organic material, pH), species and life-stages.
(3) Aluminum toxicity in laboratory tests may not represent the array of toxicity mechanisms (i.e. especially physical toxicity) for aluminum in field situations.
(4) West Virginia's proposal is to use dissolved aluminum levels. This differs from the EPA's guideline that total recoverable aluminum be used. The use of total recoverable is the most conservative and consistent approach.

Detailed report:

In West Virginia the current water quality standard for aquatic life for aluminum is based on fixed values i.e. set at 750 μg/L for acute toxicity and 87 μg/L or 750 μg/L for chronic toxicity for warm and trout waters respectively. These values are based on the current USEPA water quality guidelines for aluminum with an acute toxicity level of 750 µg/L and a chronic level of 87 µg/L (USEPA, 1988).

West Virginia proposes to change the water quality standard for aluminum (see WVDEP, 2013) from its current fixed toxicity thresholds to one based upon a relationship with water quality hardness. The proposed changes state that in waters with pH values in the range of > 6.5 to < 9.0 toxicity threshold levels would be calculated on a scale based on one water quality parameter, that of hardness. For example, at hardness levels of 220 mg/L or greater this would set the acute and chronic toxicity levels to be 10,030 and 4,019 µg/L respectively. These would represent a > 13-fold and > 46-fold increase over the current water quality standards for aluminum for acute and chronic toxicity to aquatic life respectively.

It is my opinion that the changes to the water quality standards for aluminum in West Virginia are inappropriate given the paucity of peer-reviewed studies and definitive data sets that specifically investigate the relationship between aluminum toxicity and water hardness. Studies should include definitive LC50 or EC50 values at multiple and wide-ranging hardness levels. Unlike other metals (e.g. Cd, Cu, Zn), where we have a good understanding of the relationship between water hardness and toxicity, there are very few similar robust data sets regarding this relationship with aluminum. There are indeed hundreds of papers detailing this relationship in the afore mentioned metals but very few for aluminum (with the majority of studies having been carried out in the 1970-1980's). Whereas there are studies that suggest this relationship there are others that also disprove this relationship. It is unclear whether differences are due to the specific aquatic species under study (or life-stage) or something else that confounds this relationship (i.e. other water quality parameters such as pH or dissolved organic matter) until more detailed replicate studies in numerous aquatic species are carried out. These studies are also laboratory studies that do not replicate complex field conditions.

Furthermore, many studies were not designed specifically to look at this aluminum/ hardness relationship and hence are limited in their use of only a few concentrations of aluminum and often only two (or a small concentration range) of hardness levels were used. This is especially the case for subacute and chronic studies where very little data is available. Studies are often treated the same and compared together yet they represent differing pH ranges (although they are all in the pH 6.5-9 range required for these new West Virginia guidelines) and there are very few that are in the pH 8-9 range. In addition, some of the mechanisms driving aluminum toxicity in field situations may be missed in traditional laboratory tests. For example, aluminum can physically alter the habitat by clogging interstitial spaces.

The West Virginia emergency rule states that there is a direct relationship between water hardness and aluminum toxicity in waters of pH 6.5-9, although no references are provided to support this statement (WVDEP, 2013). It is also unclear how the equations used to set the new West Virginia toxicity thresholds for aluminum (i.e. see 8.1.1 and 8.1.2 in Table 1, Appendix E; WVDEP, 2013) were derived. The equations are similar to those used by Colorado (e.g. see GEI, 2010) but they differ slightly resulting in different toxicity threshold values. It is unclear why these equations for the same hardness based criteria exist.

A further issue with the proposed new standards for West Virginia is that they state the use of dissolved aluminum concentrations, rather than total recoverable aluminum as detailed in the USEPA guidelines (USEPA, 1988). As stated earlier Colorado uses a similar hardness based criteria for Aluminum, however, it should be noted that these criteria are based on total recoverable aluminum levels (as in the 1988 EPA guidelines) and thus are much more stringent than those proposed for the West Virginia guidelines that use dissolved aluminum concentrations.

Aluminum toxicity depends on many factors other than water hardness, for example major drivers include pH and also the amount of dissolved organic material (DOM) in the water (see review by Gensemer and Playle, 1999). The solubility, speciation and/or complexation of aluminum is highly dependent upon multiple ambient water quality characteristics that ultimately determine bioavailability and toxicity. There are many peer-reviewed papers that focus on the toxicity of aluminum at lower pH, some at neutral pH, but very few in higher alkalinity waters (or above pH 8). The new proposed guidelines do address this elevated toxicity at lower pH as the standard EPA limits are used in waters of pH < 6.5 or pH >9.0 (USEPA, 1988). However, as mentioned earlier there are very few publications addressing toxicity at pH > 8.0. The increased solubility of aluminum in pH <6 and >8 is known and the toxicity of aluminum to aquatic life in lower pH waters is very well documented. Indeed Gensemer and Playle stated in their future recommendation section that "...predicting Al toxicity as pH values increase above 7 may not be a simple matter and is restricted by our limited understanding of Al bioavailability under such conditions. In particular, the toxicity of $Al(OH)_4^-$, which predominates at pH 7, is very poorly understood" (Gensermer and Playle, 1999).

Furthermore, the toxicity of aluminum can be greatly altered by organism microenvironments. For example, the chemical condition of fish gill surfaces can modify aluminum speciation, sorption and precipitation resulting in chemical or physical toxicity. There is evidence that calcium (i.e. hardness) can compete with monomeric aluminum (and other soluble hydroxide forms) and prevent its binding to fish gills and impacts on ionic regulation but this is just one of the proposed toxicity mechanisms of action for aluminum (Gensemer and Playle, 1999; Gunderson et al., 1994). For example, particulate aluminum can cause physical suffocation and/or irritation especially if it precipitates out in the fish gill microenvironment and polymeric and colloidal forms may be important in fish growth inhibition (Gunderson et al., 1994).

As mentioned earlier, the lack of definitive LC50 (acute) and EC50 (chronic) data and studies using multiple hardness levels at pH levels 6.5 and above (and especially in the range of pH 8-9 and with the pH standardized for each study) is why I believe these new guidelines to be inappropriate. For the new hardness based criteria for Colorado new data (since 1988 and those not included in the USEPA (1988) guidelines) were presented (GEI, 2013). However, this data is also limited in scope (number of aquatic species, replicated studies, definitive LC50 levels, pH levels differing between studies and often a small range of hardness or only two hardness data points used). Indeed, the GEI report (2010) notes that there are very few LC50 data available in the pH range of 6.5 to 9. Furthermore, in the GEI report (2010) used to derive the chronic aluminum/hardness equation for Colorado it was noted that only a few studies were available and that the hardness values used in the literature only represented a small range (i.e. 7.5-45 mg/L). Furthermore, they present data from a study by Cleveland (see Table 2; Cleveland manuscript reference in GEI, 2010) where the toxicity (using pH 6.5) of aluminum increased with increasing hardness.

The study by Gunderson et al (1994) investigated the effect of pH, hardness and humic acid on aluminum toxicity to rainbow trout in acute (96 hour mortality) and sub acute (16 day growth, cumulative mortality). Aluminum induced mortality was different at pH's that are within the range used to apply the new proposed West Virginia guidelines. A higher aluminum-induced mortality was observed at weakly alkaline pH (7.95-8.58) than near-neutral pH (7.14-7.64). The study also found pH (pH range 7.14-8.58) to be the most important independent variable affecting mortality. Furthermore the study found no significant relationship ("negligible hardness effects"; Gunderson et al, 1994) between 96-hour LC50s and hardness (i.e. at 83.6 $CaCO_3$ mg/L LC50 was 7670 µg/L aluminum but at the higher 115.8 $CaCO_3$ mg/L the LC50 was lower at 6930 µg/L). However, in the subacute tests growth rates were higher at the weakly alkaline compared to the near-neutral pH and hardness did not significantly protect against aluminum-induced growth inhibition although the addition of humic acid did (Gundersen et al., 1994).

In summary given the paucity (and often conflicting) data regarding the relationship of hardness with acute and (especially) chronic toxicity of aluminum particularly at alkaline pH levels (pH 7-9) it is inappropriate to change the current threshold toxicity values for aluminum.

References:

GEI Consultants, Inc. 2010. Ambient Water Quality Standards for Aluminum – review and Update. March 2010, 36 pp.

Gensemer, R.W. and Playle, R.C. 1999. The Bioavailability and Toxicity of Aluminum in Aquatic Environments. Critical Reviews in Environmental Science and Technology, 29, 4, 315-450.

Gundersen, D.T., Bustaman, S., Seim, W.K. and Curtis, L.R. 1994. pH, Hardness, and Humic Acid Influence Aluminum Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) in weakly alkaline waters. Can. J. Fish. Aquat. Sci, 51, 1345-1355.

United States Environmental Protection Agency (USEPA). 1988. Ambient water quality criteria for aluminum. EPA/440/5-86-008.

WVDEP. Emergency Briefing Document. 2013. "Requirements Governing Water Quality Standards", 47CSR2. January 30, 2013, 60pp.

Comments regarding the proposed Emergency Aluminum rule (J. Van Gundy)

I ask the WVDEP to proceed with caution in employing a hardness-based approach to setting a new and significantly more permissive Aluminum water quality standard. The few studies that are available do not make nearly as strong a case for the protective effects of hardness against Aluminum toxicity as has been made for divalent metals such as Cadmium, Copper, and Zinc. In addition, very little is known about the fate and biological effects of Aluminum in natural aquatic systems.

It is reasonably well understood that different chemical species of Aluminum have different levels of toxicity. As water moves through a stream system, pH, temperature, and other factors change and may affect the chemical species of Aluminum present. Such changes are especially likely to occur in zones where two streams of varied chemical and physical quality meet and mix, and there is some field evidence to support the assertion that the toxicity of aluminum may increase in such mixing zones. Also, the reliance on a single parameter, hardness, to calculate safe levels of Aluminum disregards the scientific evidence that pH (<u>within</u> the range of 6.5 - 9.0), temperature, and the presence of other dissolved constituents may have equal or greater influence on Aluminum toxicity. For instance, Lydersen (1990) showed that a decrease in temperature of about 15^{o}C has the same effect on Aluminum speciation and solubility as does a decrease in pH by one unit; thus temperature is important to consider when calculating Aluminum toxicity.

The specific biological activity of the various Aluminum species is almost entirely unknown as most published studies have dealt with a very limited list of test organisms under often poorly controlled or poorly characterized experimental conditions.

The reliance on a standard that considers only dissolved Aluminum is particularly problematic. Insoluble forms of Aluminum may well have significant biological effects. For example, precipitated $Al(OH)_3$ may coat and clog respiratory structures or surfaces and interfere with the ability of aquatic organisms to exchange respiratory gasses. It is also likely that insoluble Aluminum hydroxides are converted to soluble and therefore more toxic forms when ingested. None of the bioassay studies referenced in the GEI Report (GEI, 2011) examined routes of Aluminum exposure other than absorption across external body surfaces.

The GEI Report upon which WV DEP bases its case for a hardness-based Aluminum WQ rule, relies upon mostly static and mostly short-term bioassays involving relatively few species, and only a few of which actually occur in West Virginia waters. The US EPA recommends the use of indigenous species in developing criteria intended to apply <u>statewide</u> (as opposed to <u>nationwide</u> or federal standards.)

More significantly, the standard 96 hour short-term bioassay procedure requires that the test animals not be fed during the test period. As a consequence of this, dietary sources of Aluminum are not considered in evaluating its potential toxicity towards aquatic organisms. For some organisms in nature however, dietary exposure may be the major mode of entry of toxins (Poteat and Buchwalter, 2011). These authors state that in every study comparing dietary vs. dissolved exposure of which they are aware, diet is the predominant route of exposure of aquatic insects to toxic metals and they conclude that dietary acquisition strongly drives the bioaccumulation of metals in aquatic insects. One study (Cain *et al,* 2011) suggests that as much as 95% of the toxic metal body burden of aquatic insects may come from dietary sources. Another study (Xie and Buchwalter. 2011) suggests that diet-derived metals may be more physiologically active than those acquired in dissolved form through gills or other external body surfaces.

While many laboratory studies have indicated that aquatic insects are relatively insensitive to metals, a number of field studies conducted in natural aquatic systems have suggested that it is the aquatic insects that are among the first members of the aquatic community to disappear at metals-contaminated sites (Brix et al, 2011). This disconnect makes sense if the primary route of exposure is via the digestive tract rather than passage of dissolved metals through respiratory or other body surfaces since only the later is generally considered in laboratory studies.

Many of the stream insects of West Virginia feed upon detritus, i.e. dead particulate organic material transported by streamflow. In fact, such materials often represent the base of the food webs of forested upland stream systems. Much of this material originates in the terrestrial ecosystem that surrounds the stream rather than in the stream itself. Seasonally-shed tree leaves and flowers constitute the bulk of this detrital material which may consist of particles as large as a whole leaf or as small as a grain of pollen. The bulk of a leaf's dry weight consists of cellulose which cannot be digested by stream insects. What detritus-feeding insects actually feed upon is a thin surface layer of aquatic bacteria and fungi that are actually digesting the cellulose of the leaf. For the aquatic macro-invertebrate there is relatively little nutritional value in the detritus itself.

Over the usual pH range of natural waters, any aluminum that enters a stream in soluble form is likely to be rapidly converted to insoluble Aluminum hydroxide, $Al(OH)_3$, which may be incorporated into bottom sediments or may coat the surfaces of submerged objects. In either location it is probable that it will be ingested by stream animals that make their living by scraping algae off of rocks, or shredding leaves, or filtering small particles of organic material out of the water, or by simply passing bottom sediment through their digestive tracts, extracting anything digestible that happens to be included in it. All of these represent feeding styles of aquatic insects or other macro-invertebrates that inhabit West Virginia's streams. Detritus is a low quality food material and therefore detritus feeders must consume large quantities of it to meet their nutritional needs. If the material is coated with Aluminum hydroxide or otherwise contains Aluminum in particulate form, detritivores will potentially ingest a great deal of Aluminum in the course of their normal feeding activities. Corbi *et al* (2010) found that Iron and Aluminum in sediments were "highly bioaccumulated" by aquatic insects and that metals levels in aquatic insect larvae varied directly with the concentration of those metals in the sediments of the streams in which they lived.

In a survey of Swedish streams of different acidities and Aluminum concentrations Herrmann and Frick, (1995) found that a predacious stonefly (*Isoperla grammatica*) consistently had aluminum tissue levels only about a third as high as the detritus-feeding organisms upon which it fed. This is consistent with Aluminum's apparently modest potential for biological magnification, but since both stonefly and prey were exposed to the same levels of dissolved Aluminum in the external medium, they would be expected to contain similar Al tissue levels if absorption via body surfaces was the only route of entry. This observation supports the notion that detritivores acquire Aluminum from other sources, presumably dietary ones, since in natural systems, that is the only other possible route of exposure.

The chemical environment in an animal's digestive tract is far different from that of the external environment and would be expected to influence the uptake and perhaps the chemical speciation of ingested metals. Dow (1992) found that members of at least four Orders of Insects (Coleoptera, Diptera, Lepidoptera, and Isoptera) have midgut pHs in excess of 12 - the highest pH known in any biological system. There is some evidence that these high pH values represent an adaptation to a tannin-rich diet such as plant detritus (Berenbaum,1980). Since terrestrial plant detritus is a major food source for many members of the aquatic insect communities of forested upland stream systems, these animals might be expected to have a similar type of digestive physiology.

As pH varies, changes in inorganic Aluminum speciation are nearly instantaneous (Gensemer & Playle, 1999). At the high pH of the insect midgut., ingested particulate Aluminum compounds would be expected to be rapidly converted from the insoluble and relatively non-toxic forms such as the $Al(OH)_3$ prevalent at normal stream pHs into more soluble (and more toxic) forms such as the Aluminate ion, $Al(OH)_4^-$. Such effects are of course not accounted for by the standard 96 hour bioassays used in support of the hardness-based Aluminum model. Detritus-feeding macroinvertebrates are keystone species in woodland stream ecosystems, and as such, a water quality rule that is not protective of them is not protective of aquatic life in general.

It would be useful if the WV DEP could produce data that shows that the currently permissible levels of Aluminum are truly protective of a range of aquatic life broader than just salmonid fishes and daphnids. Unfortunately, the requisite laboratory studies have apparently not been done and the evaluation of Aluminum toxicity from field data is difficult at best due to the presence of multiple confounding factors. We have seen no evidence that the discharge of Aluminum even at currently permissible levels is protective of all of the species of aquatic life that are important in West Virginia's aquatic ecosystems. Because there is such a paucity of relevant scientific information regarding both the effects of Aluminum on aquatic organisms and the role that water hardness plays in ameliorating such effects, I feel that it is irresponsible to drastically increase the amount of Aluminum that can be legally discharged until such time as a better understanding of the possible effects of such a change is at hand. It may well be that discharging Aluminum at the levels that this proposed rule would permit will still be protective of West Virginia's aquatic life, but right now no one can say with any authority that this is the case.

Much, if not most of the data relied upon by the GEI report was generated by studies that were not designed to demonstrate that a hardness-based Aluminum standard such as the one proposed by the WV DEP will be protective of aquatic life. The studies cited in the GEI Report show a good deal of scatter of LC50 figures for similar values of hardness and pH. Such scatter of values for the same organism, and the same investigator(s), and for similar hardness and pH values suggest that factors other than hardness were likely important in determining the Aluminum toxicity in the test situations. In addition, because of the sensitivity of Aluminum chemistry to pH (and other factors), it is not at all clear in these data which species of Aluminum were actually being evaluated.

According to the GEI Report, at the pHs employed in the cited toxicity studies, the dosed Aluminum should rapidly be converted to poorly soluble polymeric hydroxides. In the study of McCauley et al. (1986) there is considerable variation in LC50 values while pH varies somewhat and hardness is constant. There is also some evidence in these data (see data from Gundersen et al. 1994) that flow-through bioassays yield lower LC50 (i.e. higher toxicity) values than do static tests under otherwise comparable conditions. This possibility was also mentioned in EPA's 1988 Aluminum Water Quality Criteria document. It is possible that the high LC50 values produced by some of the static testing is due to conversion of Aluminum to less soluble and therefore less toxic forms over the duration of the bioassay. Although still within the pH 6.5 to pH 9 range, the pH values employed in the Gundersen studies were higher than those of most of the other studies used in this data set. This may have resulted in more toxic forms of Aluminum [eg. $Al(OH)_4^-$] being produced. Gensemer and Playle (1999) point out that the prediction of Aluminum toxicity at pH > 7 is not a simple matter and is limited by a poor understanding of the bioavailability of Aluminum under alkaline conditions.

So little is known of the fate and biological effects of Aluminum in natural aquatic systems that it seems prudent to take a conservative approach to revising the Aluminum standard at this time. A great deal more sound science is needed before it can confidently be determined what levels of Aluminum are protective of the aquatic life of West Virginia's waters. Until that science is available, it is irresponsible to permit the significantly greater aquatic loading of Aluminum that this emergency rule would allow. I therefore respectfully ask that the WV DEP take the following points into consideration as it finalizes a revised Aluminum standard.

1. The scientific support for the assertion that increased levels of hardness are protective against Aluminum toxicity is considerably weaker than it is for the protective effects of hardness against divalent metals such as Copper or Cadmium..

2. Only a few of the scientific studies that were used to support this assertion were specifically designed to examine the relationship between hardness and Aluminum's toxicity towards aquatic organisms.

3. In many of the published studies cited by the GEI Report, the experimental conditions were poorly controlled or poorly characterized.

4. There is some evidence that the toxicity of Aluminum increases at the higher end of the pH range 6.5 to 9.0.

5. The organisms used to derive the slope of the aluminum-hardness relationship: *Ceriodaphnia dubia, Daphnia magna,* and *Pimephales promelas* are either not found or are uncommon in the vast majority of the West Virginia streams to which this rule would apply. In addition, these organisms are relatively tolerant of a wide range of polluted conditions.

6. USEPA recommends the use of indigenous species in developing criteria intended to apply statewide (as opposed to nationwide or federal standards.) As far as I can determine, this was not the case in the scientific studies that are cited to support the proposed Aluminum rule.

7. The assumption that insoluble Aluminum will remain insoluble as it moves through chemically and physically variable stream environments, and through the digestive tracts of organisms themselves, will almost certainly not be valid in many cases.

8. While the equations used to derive allowable levels of discharged Aluminum under this rule are similar to those used by the states of Colorado and New Mexico, they are not identical and the WV DEP should provide a scientific rationale for these differences.

9. WV DEP should provide scientific justification for the use of an Aluminum-hardness relationship (the equation) that was developed for total recoverable Aluminum to be applied to a rule based upon dissolved Aluminum alone.

10. Any hardness-based rule that is adopted by the state of West Virginia should employ total recoverable aluminum as a basis of calculation rather than dissolved Aluminum alone.

Submitted by:

James J. Van Gundy, Ph.D.
Member, Environmental Protection Advisory Council

References:

Berenbaum, M. 1980. Adaptive Significance of Midgut pH in Larval Lepidoptera Amer Nat, vol. 115, no. 1, 1980

Brix, Kevin V., David K. DeForest, and William J. Adams. 2011. The sensitivity of aquatic insects to divalent metals: A comparative analysis of laboratory and field data. Science of the Total Environment 409 (2011) 4187–4197

Cain, D. 2011.M.N. Croteau, and S. Luoma, . Bioaccumulation dynamics and exposure routes of Cd and Cu among species of aquatic mayflies. Environ. Toxicol. Chem. 2011, 30 (11), 2532−2541, DOI: 10.1002/etc.663.

Corbi, Juliano Jose (2010) and Claudio Gilberto Froehlich, Susana Trivinho Strixino, Ademir dos Santos. Bioaccumulation of metals in aquatic insects of streams located in areas with sugar cane cultivation. Quim.Nova vol 33 no.3 Sao Paulo.

Dow , J.A.T. 1992. pH Gradients in Lepidopteran Midgut. J.Exp Biol. 172, 355-375

EPA. 1988. Ambient Water Quality Criteria for Aluminum. EPA 440/5-86-008

GEI Consultants, Inc. 2011. Updated Freshwater Aquatic Life Criteria for Aluminum. Report to Henthorn Environmental Services, LLC, St. Albans, WV.

Gensemer, Robert W. & Richard C. Playle. 1999. The Bioavailability and Toxicity of Aluminum in Aquatic Environments, Critical Reviews in Environmental Science and Technology, 29:4, 315-450

Hem, J.D. and C.E. Roberson. 1967. Form and Stability of Aluminum Hydroxide Complexes in Dilute Solution. USGS Water Supply Paper 1827-A

Herrmann, J. and Frick, K. 1995. Do stream invertebrates accumulate aluminium at low pH conditions? Water, Air and Soil Pollution 85, 407412.

Lydersen, E. 1990. The solubility and hydrolysis of aqueous aluminium hydroxides in dilute fresh waters at different temperatures. Nordic Hydrol. 21, 195–204.

Poteat, Monica D. and David R.Buchwalter. 2011. Four reasons why traditional metal toxicity testing with aquatic insects is irrelevant. Environ. Sci. Technol. 2014, 48, 887−888.

Wilson, Rod W. 2011. in Wood, Farrell, and Brauner (Eds.) Homeostasis and Toxicity of Non-Essential Metals.

Xie, L. and Buchwalter, D. B. 2011. Cadmium exposure affects antioxidant responses in the mayfly *Centroptilum triangulifer*. Aquat. Toxicol. 2011,105, 199−205, DOI: 10.1016/j.aquatox.2011.06.009.

Aluminum pH_Analysis

Footnote 12

date	tss	tot	dis	fd	pH	Dataset	Permit
1/30/07	2	0.22	0.104	0.473	6.89	1	WV1014597(1)
2/6/07	4	0.3	0.115	0.383	6.88	1	WV1014597(1)
2/18/07	1	0.21	0.155	0.738	7.2	1	WV1014597(1)
3/6/07	10	0.31	0.148	0.477	7.02	1	WV1014597(1)
3/22/07	1	0.21	0.11	0.524	6.83	1	WV1014597(1)
4/10/07	1	0.13	0.064	0.492	7.09	1	WV1014597(1)
4/23/07	1	0.21	0.091	0.433	6.9	1	WV1014597(1)
5/8/07	1	0.16	0.099	0.619	6.97	1	WV1014597(1)
5/24/07	1	0.19	0.121	0.637	6.97	1	WV1014597(1)
6/13/07	1	0.15	0.114	0.76	6.91	1	WV1014597(1)
6/23/07	1	0.13	0.096	0.738	6.95	1	WV1014597(1)
7/10/07	1	0.1	0.098	0.98	7.09	1	WV1014597(1)
7/17/07	13	0.12	0.0015	0.013	7.02	1	WV1014597(1)
1/8/08	1	0.22	0.111	0.505	7.1	1	WV1014597(1)
1/16/08	1	0.2	0.085	0.425	6.93	1	WV1014597(1)
1/24/08	1	0.3	0.075	0.25	7.05	1	WV1014597(1)
2/1/08	32	0.98	0.136	0.139	6.68	1	WV1014597(1)
2/9/08	1	0.28	0.116	0.414	7.57	1	WV1014597(1)
2/25/08	2	0.31	0.122	0.394	7.31	1	WV1014597(1)
3/4/08	6	0.34	0.1	0.294	7.02	1	WV1014597(1)
3/12/08	1	0.41	0.096	0.234	7.26	1	WV1014597(1)
3/20/08	2	0.01	0.0015	0.15	7.25	1	WV1014597(1)
5/7/08	1	0.07	0.008	0.114	6.83	1	WV1014597(1)
5/15/08	4	0.45	0.135	0.3	6.83	1	WV1014597(1)
5/23/08	1	0.37	0.079	0.214	7.83	1	WV1014597(1)
5/31/08	1	0.27	0.126	0.467	7.04	1	WV1014597(1)
6/8/08	1	0.16	0.117	0.731	7.28	1	WV1014597(1)
6/16/08	2	0.15	0.118	0.787	7.64	1	WV1014597(1)
1/8/08	1	0.08	0.02	0.25	6.25	2	WV1014597(2)
1/16/08	1	0.05	0.0015	0.03	6.56	2	WV1014597(2)
1/29/08	33	0.81	0.063	0.078	7.01	2	WV1014597(2)
2/1/08	16	0.71	0.06	0.085	5.12	2	WV1014597(2)
2/9/08	1	0.05	0.018	0.36	6.12	2	WV1014597(2)
2/18/08	1	0.06	0.031	0.517	5.14	2	WV1014597(2)
2/25/08	1	0.03	0.005	0.167	6.54	2	WV1014597(2)
3/4/08	1	0.02	0.004	0.2	6.85	2	WV1014597(2)
3/12/08	1	0.01	0.0015	0.15	6.19	2	WV1014597(2)
3/20/08	1	0.08	0.022	0.275	6.31	2	WV1014597(2)
3/28/08	7	0.14	0.028	0.2	6.85	2	WV1014597(2)
4/9/08	1	0.07	0.009	0.129	6.5	2	WV1014597(2)
4/13/08	1	0.06	0.017	0.283	6.48	2	WV1014597(2)
4/21/08	1	0.08	0.01	0.125	6.28	2	WV1014597(2)
4/29/08	12	0.09	0.02	0.222	6.77	2	WV1014597(2)
5/7/08	9	0.06	0.029	0.483	6.22	2	WV1014597(2)
5/15/08	4	0.05	0.018	0.36	7.49	2	WV1014597(2)
5/31/08	1	0.04	0.014	0.35	7.52	2	WV1014597(2)
2/13/2007	0.01	0.04	0.03	0.75	6.42	3	WV1002040
2/22/2007	0.01	0.05	0.02	0.4	5.6	3	WV1002040

Aluminum pH_Analysis

Footnote 12

3/7/2007	0.01	0.03	0.02	0.6667	6.74	3	WV1002040
3/21/2007	0.01	0.04	0.03	0.75	6.93	3	WV1002040
4/3/2007	0.01	0.03	0.02	0.6667	6.59	3	WV1002040
4/18/2007	0.01	0.11	0.04	0.3636	5.9	3	WV1002040
5/20/2007	0.01	0.07	0.03	0.4286	5.43	3	WV1002040
5/29/2007	0.01	0.02	0.01	0.5	5.52	3	WV1002040
6/14/2007	0.01	0.06	0.02	0.3333	5.63	3	WV1002040
6/21/2007	0.01	0.07	0.02	0.2857	5.17	3	WV1002040
7/16/2007	0.01	0.04	0.03	0.75	5.2	3	WV1002040
7/24/2007	0.01	0.03	0.02	0.6667	5.43	3	WV1002040
8/8/2007	0.01	0.04	0.01	0.25	5.32	3	WV1002040
8/16/2007	0.01	0.05	0.03	0.6	5.48	3	WV1002040
9/18/2007	0.01	0.09	0.05	0.5556	5.58	3	WV1002040
9/26/2007	0.01	0.1	0.08	0.8	5.26	3	WV1002040
10/11 /2007	0.01	0.1	0.09	0.9	4.79	3	WV1002040
10/31/2007	0.01	0.08	0.02	0.25	5.9	3	WV1002040

APPALACHIAN
MOUNTAIN
ADVOCATES

P.O. Box 507
Lewisburg, WV 24901
ph: 304-645-9006
fax: 304-645-9008
email: info@appalmad.org
www.appalmad.org

Scott Mandirola
WVDEP
601 57th Street S.E.
Charleston WV 25403
dep.comments@wv.gov

Dear Mr. Mandirola,

Please accept these comments on behalf of Appalachian Mountain Advocates, West Virginia Highlands Conservancy, and the West Virginia Rivers Coalition. We are greatly concerned about West Virginia's triennial review of water quality standards and revisions to the water quality criteria for the toxic pollutant selenium proposed by the West Virginia Department of Environmental Quality ("DEP"). DEP's proposed fish tissue-based criteria would allow total extirpation of sensitive fish species from West Virginia's waters and should be rejected as scientifically indefensible and practically unenforceable. Additionally, the criteria fail to protect threatened and endangered species and cannot be approved in compliance with the Endangered Species Act.

1. The proposed chronic fish tissue criteria will not protect sensitive and recreationally important species in West Virginia's waters.

DEP proposed the use of 8.3 µg/g dw as a final chronic value (FCV) for whole body fish tissue and 20.0 µg/g dw as a FCV for egg/ovary tissue. Both criteria are less protective than those recommended by US EPA in its 2014 "External Peer Review Draft Aquatic Life Ambient Water Quality Criterion for Selenium" ("2014 Draft Criterion"). DEP's calculation of the FCVs for both whole body and egg/ovary is inappropriately lax because it is not derived to protect the most sensitive recreationally-important species in West Virginia's waterways. To calculate FCVs, DEP included the GMCVs from fourteen separate genera. Even if the GMCVs derived for each of these taxa were accurate (and they are not), the consideration of fourteen genera, rather than the most sensitive species, is inappropriate.

EPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (1985) explain that water quality criteria should fully protect sensitive species that are "commercially or recreationally important." Although DEP's Scientific Justification provides very little detail on the methods used to its egg/ovary element, which forms the basis for its whole tissue element, it appears DEP averaged the genus mean chronic values for fourteen different genera. The resulting fish tissue elements are not adequate to protect certain sensitive species that are commercially and recreationally important, such as species of bluegill and catfish.

In a letter to EPA expressing concern over the egg/ovary criterion in EPA's 2010 draft proposal, selenium expert Dr. Dennis Lemly of the USDA Forest Service concluded that EPA's inclusion of more tolerant species in the criterion evaluation and development resulted in a proposed criterion that would have allowed mortality to exceed allowable limits in more sensitive species. Dr. Lemly stated that scientific studies show:

> quite clearly that a criterion of 17.07 mg/kg for fish eggs/ovaries will jeopardize two of the most important freshwater fish families in North America: Centrarchidae and Ictaluridae. For example, (1) An EPA field study published in the peer reviewed journal *Environmental Toxicology and Chemistry* (Hermanutz et al 1992) found that ovary selenium concentrations of 9 mg/kg dw or greater resulted in 40% higher mortality and 80% more edema in larval bluegill

> sunfish that controls for an EC40-80 (converted from wet weight using 80% moisture, based on mean wet weight +- one standard deviation).[1] The results of this study are not included in EPA's draft criterion calculation, and (2) A laboratory study at the University of California (Doroshov et al. 1992) found that the EC50 for larval mortality of channel catfish and bluegill sunfish occurred at egg selenium concentrations of 7.2 and 15.0 mg/kg dw respectively (lower limit of 95% confidence intervals). These mortality data were not included in the data used to derive the FCV.
> . . .
> Extensive field data from the Belews Lake case example, which includes reproductive analysis from young-of-the-year stock assessment, clearly show that catfish are very sensitive selenium poisoning in a real-world setting. . .equal to or greater than sunfish (Cumbie 1978, Cumbie and Van Haron 1978, Holland 1979, Garrett and Inman 1984, Lemly 1985). . . .
> The FCV needs to be lower than 10 mg/kg dw in order to protect sunfish and catfish at an EC10 level, which is the level of protection afforded to trout by the 17.07 draft criterion value.

Letter to Mr. Joseph Beaman, Chief, USEPA, Office of Water, Ecological Risk Assessment Branch, Washington, DC from A. Dennis Lemly, Ph.D., Research Fish Biologist, USDA Forest Service, Southern Research Station, Piedmont Aquatic Research Laboratory, July 6, 2010 at 1-3 (emphasis added). Clearly, DEP's proposed egg/ovary element of 20.0 mg/kg would not protect those species at the EC10 level.

In addition to improperly averaging values across genera, DEP failed to adequately account for "winter stress" in sensitive bluegill species. As EPA recognized in its Draft Criterion document, a study by Dr. Lemly found the protective chronic selenium whole body concentration for juvenile bluegill to be 5.85 mg/kg prior to winter stress. Instead of using this protective value for the bluegill's genus mean chronic value, DEP apparently adopted EPA's approach in its 2014 criterion and averaged that value with the values from McIntyre et al.'s 2008 study, which also purported to account for winter stress, but arrived at a much less protective concentration of over 9 mg/kg. See EPA Draft Criterion at 122–23. Reliance on the McIntyre study to account for selenium is misplaced, however, because that study failed to actually induce winter stress, in part, because it did not control photoperiod or discuss the impacts that the lack of photoperiod controls may have on the interpretation of study results. EPA must fully account for winter stress, using studies that actually induce such stress by recreating realistic winter conditions including reduced photoperiod, when revising its fish tissue concentrations to ensure protection of sensitive aquatic species.

Protection of sensitive species could be further undermined as a result of implementation issues. If DEP allows "species composite" sampling to suffice for enforcement and assessment purposes, impacts to sensitive species could go unnoticed. Thus, if DEP adopts fish-tissue criteria, it must require compliance with those criteria are determined on a species-by-species basis. Evan that approach is flawed, however, because it fails to account for variation among individuals and various life stages.

Finally, reliance on fish tissue criteria fails to protect sensitive species that have already been extirpated from a site due to selenium or other mining related pollution. Nor will it allow sensitive fish to recolonize those streams. If sensitive species are missing, for whatever reason, that will greatly distort evaluation of whether discharges are complying with water quality standards including protection of stream uses. It will mean that high selenium inputs could be authorized despite pollution that has already led to the elimination of sensitive species. If a stream contains only species that process selenium from the environment into their tissue at much slower rates, serious impairment as a result of depletion of species-richness would be missed by the proposed tissue criteria. The U.S. Fish and Wildlife Service critiqued this same "survivor bias" in its comments on EPA's 2014 Draft Criterion:

---

[1] DEP wrongly omits the results of this study based on "unexplained irregularities" while relying on studies with equal or greater flaws that resulted in higher, less-protective tissue values. Especially given the general paucity of selenium toxicity data, the 1992 Hermanutz studies provides valuable information that DEP should have considered.

> For water bodies that are substantively over the water-based chronic criteria, how would we know that results of tissue sampling weren't biased low due to the susceptibility of nearly all fish sampling techniques to survivor bias? The changes in fish assemblages following selenium pollution from mountaintop removal-valley fill mining in Appalachia reported by Hitt and Chambers (In Press), and the differential extirpations of select species of fish at Belews Lake, in the San Luis Drain, California, and in the Swedish Lakes study (all these examples summarized in Skorupa 1998) suggest that implementation of tissue-based criteria for fish could face impediments related to sampling designs that don't have a means for detecting and protecting against the invalidating effects of survivor bias.

July 28, 2014 Comments of US FWS to Gina McCarthy, Administrator US EPA at 21–22. DEP's criteria thus do not protect streams already impaired by selenium or where other pollutants have already eliminated sensitive fish species. If a species such as bluegill were present in a stream at the time the Clean Water Act was passed, protecting the use of that stream as a bluegill fishery is mandated now. DOW criteria thus impermissibly fails to guarantee protection of stream uses.

2. The proposed chronic fish tissue criteria are effectively unenforceable and are not compatible with meaningful development of effluent limitations in WV/NPDES permits.

Because fish tissue criteria are not compatible with clear and efficient implementation, DEP should express its criteria as practically enforceable water column elements. In passing the CWA, Congress recognized the fact that water quality standards – which existed prior to 1972 – would not, of themselves, protect and improve water quality. Accordingly, Congress established the National Pollutant Discharge Elimination System (NPDES), providing a mechanism for clear application and enforcement of water quality standards. Further frustrated with a lack of progress in realizing the promise of narrative water quality goals, Congress again amended the Act in 1987, at that time requiring the development and application of numeric criteria for waterways affected by toxic pollutants. These revisions clearly illustrate Congress' intent to assure that water quality standards and goals are specific and translated into enforceable limitations on pollution sources.

Water quality criteria thus not only measure whether water bodies are meeting the uses mandated by the CWA, but also form the basis for establishing effective controls on water pollution to further the CWA's goal of "restor[ing] and maintain[ing] the chemical, physical and biological integrity of the nation's waters." *See* 33 U.S.C. § 1251(a). As EPA has recognized, water quality criteria must "serve the dual function of establishing water quality goals for a specific waterbody <u>and providing the basis for regulatory controls</u>." *EPA Water Quality Standards Handbook* at 4.6 (emphasis added). <u>See also</u> 40 C.F.R. § 130.3 (noting that water quality standards "serve the dual purposes of establishing the water quality goals for a specific water body and serving as the regulatory basis for establishment of water quality-based treatment controls and strategies"). Although a fish tissue-based criterion may be an accurate way to measure the threat posed by selenium in a waterbody (if the criterion is set at the appropriate level), it fails to provide the basis for effective regulatory action.

Indeed, in 2005, the USEPA/U.S. Department of Interior Tissue-based Criteria Subcommittee issued a draft report summarizing its opinions on aquatic life water quality standard guidelines. The report cautioned that fish tissue criteria alone would be insufficient to address "both scientific and regulatory needs concerning the relationship between chemical loadings and accumulated chemical residues in the tissues (i.e. bioaccumulation)." Science Advisory Board Consultation Document, Proposed Revisions to Aquatic Life Guidelines, Tissue-Based Criteria for "Bioaccumulative" Chemicals at 10.[2] In the Subcommittee's opinion, there was a "need to develop guidelines for translating tissue-based aquatic life…criteria into corresponding concentrations in environmental media (e.g. water)…" <u>Id.</u> at 13. The Subcommittee subsequently listed "implementability" as a reason to develop fish-tissue-to-water-column translations, noting that "monitoring and

---

[2] <u>Available at</u> http://www.epa.gov/scipoly/sap/meetings/2008/october/aquatic_life_criteria_guidelines_tissue_08_26_05.pdf

enforcing pollutant discharge limits on the basis of measured chemical concentrations in tissues of organisms may not be practical or desirable…" Id.

DEP has not explained how it will incorporate the proposed fish-tissue elements into enforceable measures needed for NPDES permit limits, TMDLs, and other pollution control decisions required by the Clean Water Act. DEP's proposal leaves unanswered fundamental questions about how the fish-tissue elements are to be used when issuing NPDES permits. For instance, how are regulators to determine the "reasonable potential" for a proposed new discharge to cause or contribute to violations of the fish tissue elements? How will appropriate "end of pipe" effluent limits be determined? If there is a "reasonable potential," when must treatment start? Without clear guidance from DEP, we fear that the agency will not be practically able to set necessary water quality-based permit limits. A recommended criterion that does not explicitly establish when permit limits must be imposed but instead injects considerable uncertainty into the reasonable potential analysis invites acquiescence to industry pressure to impose no limits or limits that are effectively meaningless.

Likewise, DEP's proposal lacks necessary information regarding how compliance with the fish-tissue elements should be determined for the purpose of enforcing WV/NPDES permit limits, evaluating waters for impairment, and developing and enforcing TMDLs. For instance, if a permittee receives a fish tissue-based NPDES permit limit, where must sampling of fish occur in relation to the discharge? How many fish must be collected to provide a representative sample? How often and at what stages of life must sampling take place? What fish taxa will be used to determine compliance? How will regulators account for variation and individual differences and toxicity within taxa depending on, among other things, age, individual diet, areas of forage, and duration of stay in polluted waters? If adequate numbers of fish are indeed collected, what impact will this have on fish populations that may already be pressured by selenium and other pollution? How will regulators ensure that endangered species are protected by sampling protocols such that illegal "take" of threatened or endangered species is avoided? How will impairment be detected in waters where sensitive species that rapidly accumulate selenium have already been extirpated?

DEP has not shown that compliance with the fish tissue elements can accurately be determined in most circumstances. This is particularly problematic in small headwater streams that directly receive much of the selenium pollution from coal mines in Appalachia. These streams often lack sufficient fish populations for a truly representative sample to be collected, and downstream reaches with larger fish populations often receive discharges from many different sources such that responsibility for violations of the standard will be extremely difficult to assign. Moreover, if a "species-composite" method is used to determine compliance with a fish-tissue element, wherein the tissue of all fish collected is combined for analysis, it is likely to miss impairment of sensitive species that accumulate selenium more rapidly.

Instead of relying on fish tissue standards that present critical implementation problems, DEP should adopt clearly enforceable water column criteria. EPA's 2014 Draft Criterion document recognizes that the dietary pathway of selenium accumulation can still be accounted for in water column criteria. Using the methods developed by the EPA and the United States Geological Survey, protective fish tissue concentrations can be translated to practically enforceable water column criteria. Draft Criterion at 62. The model developed by USGS recognizes that diet is the primary pathway of exposure for selenium and creates a simple, direct linkage between dissolved selenium in the water column and selenium toxicity to aquatic life. EPA's Draft Criterion document explains that the expected and measured relationships between egg-ovary concentrations and water column concentrations are "highly correlated."[3] Draft Criterion at 134. An inviolable water column

---

[3] DEP could create an even more robust water column criterion by collecting additional data correlating fish-tissue concentrations to water column concentrations. See 2014 Draft Criterion at 135 (explaining that minor variability in correlation could be due in part to small sample size). Regardless, the uncertainty in translating protective fish tissue values to water column numbers is likely far outweighed by the uncertainty in determining compliance with the fish tissue elements in the absence of robust tissue sampling protocols.

criterion that is based on fish tissue concentrations is therefore scientifically defensible because it recognizes and accounts for the fact that diet is the primary pathway for selenium uptake.

DEP's retention of its previous water column criterion in no way corrects this fundamental flaw. DEP's proposal explicitly states that the fish tissue elements should be given primacy over the water column elements. That statement largely eliminates any implementation benefits of including water column elements. The better approach would be to adopt only a translated water column criterion and to eliminate the fish tissue elements.

Not only is a translated water column criterion scientifically defensible, it is also vastly more useful as a regulatory tool. West Virginia has specific, federally-approved procedures for how to convert water column criteria to enforceable restrictions on wastewater discharges, in addition to the technical guidance, training and other materials on scientifically valid models, necessary background data, sampling protocols, and acceptable laboratory techniques for the implementation of traditional water column criteria that EPA has provided. Water column criteria also can be more easily enforced by citizens with limited resources. Enforcing the proposed fish-tissue elements, in contrast, will require a case-by-case analysis of the local ecosystem, including collection, processing, and testing of fish tissue, all of which will require significant resources and inject considerable uncertainty. Thus, in order to achieve the dual purposes of water quality criteria, DEP should adopt a set of water column criteria that are translated from protective fish-tissue concentrations.[4]

3. The proposed water column criteria is inadequate because instream selenium levels of 5 µg/l can lead to significant impacts on aquatic life.

DEP proposes to retain its existing water column criteria of 5 µg/L as one element of its tiered criteria, but does not provide a scientific justification for maintain that value. Commenters believe that a water column value must be an element of any approvable standard and that a stand-alone water column value translated from a fish tissue threshold represents the best, most easily implementable selenium criterion. However, as DEP revises its selenium criteria, it should revisit using the 5 µg/L value in light of data not available or considered when that criterion was developed. A number of leading experts promote reducing the existing national water column criterion to a level lower than 5 µg/l. Swift recommends a criterion of 2µg/l. Lemly and Skorupa criticized the existing 5 µg/l, stating that:

> The USEPA last promulgated an updated national chronic criterion for selenium in 1987, some 20 years ago, setting the criterion at 5 µg Se/L on an acid-soluble basis (USEPA 1987). Since that time, serious weaknesses in the national criterion have been revealed. For example, several reviewers of more recent selenium literature suggested that the criterion should be 2 µg/L or less (DuBowy 1989; Peterson and Nebeker 1992; Swift 2002).

United States Environmental Protection Agency ("EPA") researchers found significant effects in bluegill progeny with instream selenium concentrations of 2.5 µg/l. "Mean ranks of % edema, % lordosis, and % hemorrhaging in egg cup samples were significantly affected by selenium streams from which they came ($p<0.01$, $p<0.01$, $p<O.OS$). Mean ranks were significantly higher for the 2.5 and 10 ug/L treatments than for the control ($p<O.OS$)."[5] They concluded that the EPA criterion of 5 µg/l might be too high considering their findings.[6] EPA recently recognized the inadequacy of the 5 µg/L standard in their 2014 Draft Criterion, where the agency proposed water column elements of 4.8 µg/L in lotic systems and 1.3 µg/L in lentic systems. DEP's proposed retention of the 5 µg/l does not, therefore, appear to be protective and does not comply with the Clean Water Act.

---

[4] As explained above, the fish tissue elements of EPA's Draft Criterion are too high to protect sensitive aquatic life and should be revised downward significantly. The water column criteria should be based on fish tissue concentrations that are revised to ensure protection of such species.

[5] Hermanutz, R.O., K.N. Allen, N.E. Detenbeck, and C.E. Stephan. 1996. Exposure of bluegill (*Lepomis macrochirus*) to selenium in outdoor experimental streams. U.S. EPA Report. Mid-Continent Ecology Division. Duluth, MN at 17.

[6] Hermanutz 1996 at 19, 20, 23

4. The proposed criteria will not protect wildlife dependent on aquatic habitat for survival

The Clean Water Act mandates that water quality standards protect not only fish, but all aquatic organisms and other wildlife that depend on healthy streams. Section 303(c) governs state revisions to water quality standards and requires that such standards “shall be established taking into consideration their use and value for . . . propagation of fish *and wildlife*,” among other things. 33 U.S.C. § 1313(c)(2)(A) (emphasis added); *see also* 33 U.S.C. § 1252(a) (directing states to develop comprehensive programs for controlling water pollution giving due regard to improvements necessary to “conserve such waters for the protection and propagation of fish and aquatic life and wildlife”). EPA’s regulations require states to develop standards that will “[s]erve the purposes of the Act,” meaning that they will “provide water quality for the protection and propagation of fish, shellfish *and wildlife*,” among other things. 40 C.F.R. § 130.3 (emphasis added). West Virginia does not have a wildlife-specific selenium water quality standard. In the absence of any standards that address wildlife, an approach that focusses solely on aquatic life does not satisfy the requirements of the CWA because it leaves such wildlife without any protection under the Act from selenium pollution.

Although DEP did not analyze the impacts of its criteria on aquatic-dependent wildlife, existing evidence makes clear that the concentrations of the proposed fish tissue elements are not protective of aquatic dependent wildlife. As US FWS explained in its comments on EPA’s 2014 Draft Criterion:

> As the ecosystem-scale modelling approach makes clear, when EPA sets its primary criterion, which is the chronic criterion for fish E/O tissue, the effects will cascade throughout the aquatic ecosystem and therefore indirectly set the limits for selenium concentrations that can be expected to be observed in every compartment of the ecosystem. So, for example, if translation of the E/O chronic criterion leads EPA to set a fish whole body criterion of 8.1 mg Se/kg, then using EPA's median TTF of 1.27 for transfer of selenium from aquatic invertebrates to fish (from Table 10, p. 77), we can expect that the median limit for aquatic invertebrates has now been set at about 6.4 mg Se/kg (Le., 8.1/1.27). Ovulating female water birds rely almost exclUSively on an animal diet due to the high protein demands of egg formation, and like the species of fish studied by Conley et al. (2014) and Penglase et al. (2014), water birds move selenium into their eggs directly from their diets, not from internal tissue stores of selenium (Chapman et al. 2010). Thus, using the dietary exposure-response curve developed for mallards and reported in Ohlendorf (2003) we can directly estimate the toxic risk to mallards posed by a whole body fish tissue criterion of 8.1 mg Se/kg. Based on a table of exposure-response values provided by Dr. Ohlendorf for his 2003 publication, a mallard dietary exposure to 6.4 mg Se/kg would correspond to 27% reduction in egg hatchability (EC-27) and the 10th percentile rTF of 0.901 calculated from the data presented in Table 10 (p. 77. The corresponding value of 8.99 mg Se/kg in aquatic invertebrates would lead to a 62% reduction in mallard egg hatchability.
>
> At the median TTF of 1.27, a whole body fish tissue criterion of about 4 mg Se/kg would be required to have a safe dietary exposure of about 3 mg Se/kg for mallards. The Service notes that this is similar to the conclusion we presented in our comment package on EPA's 2004 proposed selenium criteria (that a fish whole body tissue criterion in the range of 4-5 mg Se/kg would be required to adequately protect both fish and aquatic-dependent wildlife), which we incorporate here by reference and which is still available for viewing in the current Docket (EPA-HQ-OW-2004-0019). Furthermore, a value of 4 mg Se/kg in whole body fish tissue is the guideline value recently published by the British Columbia Ministry of Environment, in part, explicitly to provide sufficient protection for aquatic-dependent wildlife (BC MoE 2014).

FWS 2014 Comments at 20.

US FWS’s comments are very similar to criticism levied at EPA’s 2004 recommended whole-body fish tissue criterion of 7.91 µg/l that was proposed but not adopted. See Notice of Draft Aquatic Life Criteria for Selenium and Request for Scientific Information, Data, and Views, 69 Fed. Reg. 75, 541 (December 17, 2004).

A group of the nation's leading selenium scientists wrote a white paper vigorously criticizing that criterion as not protective and too high. The authors explained the history of the EPA's flawed number:

> During the past 17 years numerous researchers including those funded by EPA have estimated that the toxicity threshold for selenium lies below the current chronic aquatic life criterion of 5 µg/L. Recently, corporate interests have claimed that 5 µg/L is overly restrictive. Because of an endangered species issue in California, EPA agreed to re-evaluate their CWA criteria guidance for selenium by 2002. This was problematic because:
>
> - EPA's normal procedure for setting Aquatic Life Criteria does not directly consider toxicity data for aquatic-dependent wildlife.
> - EPA has promulgated no separate wildlife criteria for selenium.
> - EPA's normal procedure for setting criteria is better suited to non-bioaccumulative pollutants – selenium is bioaccumulative.
> - ESA-listed species every individual of a population "counts" and therefore criteria guidance would need to be fully protective at an individual-effects level.
>
> EPA contracted with the Great Lakes Environmental Center (GLEC) to derive the new selenium criteria. GLEC was instructed to derive the chronic criterion on a fish-tissue basis rather than on a water concentration basis. The GLEC derived criterion was released in March 2002. The draft tissue-based chronic criterion, of 7.9 µg/g, dry weight basis, assumed 20% of the target population would die. The USFWS asked EPA to not promulgate the criterion because it wasn't protective of endangered species.

Joseph P. Skorupa, USFWS, Theresa S. Presser, USGS, Steven J. Hamilton, USGS, A. Dennis Lemly, USFS, Brad E. Sample, CH2M HILL, EPA's Draft Tissue-Based Selenium Criterion: A Technical Review. Spring 2004. at 2-3.

The authors noted significant additional flaws in EPA's proposed criterion that would lead to harm to wildlife, including threatened and endangered species:

> GLEC's assessment of risk to aquatic-dependent wildlife was based on an erroneous draft wildlife toxicology report. The draft tissue-based chronic criterion for selenium of 7.9 µg/g would leave a substantive proportion of aquatic-dependent wildlife species unprotected; on the order of half the species. Aquatic life criteria are considered by EPA to be separate and distinct from wildlife criteria. Nonetheless, in the absence of promulgated wildlife criteria (as is the case for selenium), if the aquatic life criteria do not protect wildlife the purposes of the CWA are not being met. More critically, for waters of the United States supporting ESA-listed aquatic-dependent wildlife, the criteria would not be approvable for incorporation into state or tribal water quality standards.

Id. Those experts estimated that EPA's previously proposed criterion would have caused reproductive impairment in, conservatively, 40% and possibly as high as 95% of exposed mallard ducks. See Lemly, A. Dennis, Assessing the toxic threat of selenium to fish and aquatic birds, Environmental Monitoring and Assessment 43: 19-35 (1996). Reproductive impairment occurs if ducks are exposed through a contaminated diet during the development of their chicks. Mallard ducks are ubiquitous, breeding near and relying on aquatic resources throughout the US. They are primarily vegetarians eating seeds of grasses and sedges and the leaves, stems and seeds of aquatic plants. They occasionally eat insects, crustaceans and mollusks, especially when they are young. See http://www.nhptv.org/natureworks/mallard.htm. While the ducks do not eat fish, "allowing fish tissue to reach 7.9 ug/g would allow a level of contamination in the other parts of the aquatic ecosystem sufficient to cause nearly total reproductive failure among mallard ducks." Skorupa et al. at 22.

Both of the fish tissue values that leading scientists determined would have unacceptable impacts on aquatic-dependent wildlife are more protective than the criteria proposed by DEP. DEP thus must either revise its fish tissue criteria to ensure that they protect aquatic-dependent wildlife or else adopt a concurrent wildlife criterion along with the aquatic life criteria.

5. The Criterion Must Protect All Threatened or Endangered Species

Although, DEP does not have obligations under the Endangered Species Act related to its revision of water quality standards, EPA's approval of those standards, required by 40 C.F.R § 131.21, does trigger the requirements of the ESA. USEPA, USFWS, and the National Marine Fisheries Service have a Memorandum of Agreement (MOA) that governs protection of endangered and threatened species under Section 7 of the Endangered Species Act, 16 U.S.C. § 1536, in regard to, among other things, revisions to water quality standards.[7] EPA has stated that "where approval of new or revised standards may have an effect on a listed species or designated critical habitat, consultation under section 7(a)(2) [of the ESA] is required. . . . [W]ater-dependent endangered and threatened species are an important component of the aquatic environment that the CWA is designed to protect, and steps to ensure the protection of those species are well within the scope of the CWA."[8]

Water quality standards must protect all existing uses in a waterbody, which uses often include supporting species that are listed as threatened or endangered pursuant to the Endangered Species Act. See 33 U.S.C. § 1313. Additionally, Section 7 of the Endangered Species Act and its implementing regulations require each federal agency, in consultation with the appropriate wildlife agency, to insure that any action authorized, funded, or carried out by the agency is not likely to (1) jeopardize the continued existence of any threatened or endangered species or (2) result in the destruction or adverse modification of the critical habitat of such species. 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a). EPA thus must ensure that any criteria that it approves will be fully protective of listed species.

USFWS records show that West Virginia waters support numerous species that have been listed as threatened or endangered pursuant to the Endangered Species Act, including 10 species of freshwater mussels and one crustacean. See WV DNR, Federally Threatened and Endangered Species in West Virginia.[9] Additionally, both the Diamond Darter and the Big Sandy Crayfish are proposed for listing. Id. In the absence of specific toxicity data for those species, DEP cannot safely assume that the species it considered in setting its fish tissue criteria are good proxies. Indeed, EPA recognizes in its 2014 Draft Criterion document that "because other threatened or endangered species might be more sensitive, if relevant new information becomes available in the future, it should be considered in state- or site-specific criteria calculations." Draft Criterion at 139–40. Instead of putting off protection of sensitive endangered species to later state or site-specific standard setting, DEP must revise its criterion to ensure protection of all endangered species. It is not sufficient to say that the agency lacks information. Rather, in the absence of additional data regarding selenium-sensitive listed species, DEP must apply a substantial safety factor to its criterion to ensure protection of such species.

Moreover, as USFWS has noted to EPA, use of the EC10 effect is inappropriate for water quality criteria that apply to listed species. When dealing with listed species, every individual is important. An EC10 effects level assumes that one out of every ten individuals will suffer adverse effects. That is unacceptable for listed species. As the USFWS stated to EPA in comments on its 2014 Draft Criterion:

> [I]t is still unclear how an EC-10 standard for fish-tissue criteria relates to threatened and endangered species conservation. A large majority (>90%) of all species of freshwater fish listed under the Endangered Species Act (ESA) have not been tested for sensitivity to selenium

---

[7] 66 Fed. Reg. 11,202 (Feb. 22, 2001).

[8] *Id.* at 11,206.

[9] Available at http://www.wvdnr.gov/Wildlife/RareSpecList.shtm.

> toxicity. Assuming that ESA-listed species exhibit a distribution of sensitivities comparable to non-listed species (as several EPA-funded studies have indicated), it can be expected that in waters achieving EPA's newly proposed fish-tissue criteria about 5% of ESA-listed species would experience a 10% or greater level of reproductive toxicity. Also, it can be expected that some unknown additional percentage of ESA-listed species would experience a level of reproductive toxicity greater than 0% but less than 10%.

FWS Comments at 3. It is thus clear that DEP's proposed criteria will not adequately protect federally-listed species and this will not be approvable as a result of the required consultation with US FWS pursuant to Section 7 of the ESA.

CONCLUSION

For the foregoing reasons, DEP must significantly reduce the concentrations allowed under its fish tissue elements to ensure they are protective of sensitive species, aquatic-dependent wildlife, and threatened and endangered species. DEP must then translate those revised tissue concentrations to enforceable water column criteria that can be practically implemented to achieve the regulatory requirements of the Clean Water Act.

Respectfully submitted,

/s/ J. Michael Becher
J. Michael Becher
Appalachian Mountain Advocates
P.O. Box 507
Lewisburg, WV 24901
304-382-4798
mbecher@appalmad.org

/s/ Cynthia Rank
Cynthia "Cindy" Rank
West Virginia Highlands Conservancy
HC 78 Box 227
Rock Cave, WV 26234
304-924-5802
clrank2@gmail.com

/s/ Angie Rosser
Angie Rosser
West Virginia Rivers Coalition
3501 MacCorkle Ave SE #129
Charleston, WV 25304
arosser@wvrivers.org

APPALACHIAN
MOUNTAIN
ADVOCATES

P.O. Box 507
Lewisburg, WV 24901
ph: 304-645-9006
fax: 304-645-9008
email: info@appalmad.org
www.appalmad.org

July 31, 2015

Scott Mandirola
WVDEP
601 57th Street S.E.
Charleston WV 25403
dep.comments@wv.gov

Dear Mr. Mandirola,

Please accept these comments on behalf of Appalachian Mountain Advocates, the West Virginia Highlands Conservancy, and the West Virginia Rivers Coalition, in regards to the proposed site specific water quality variances on Martin Creek of Preston County and its tributaries, including Glade Run, Fickey Run, and their unnamed tributaries, as well as Maple Run, Left Fork of Little Sandy Creek, Left Fork Sandy Creek and their unnamed tributaries. WVDEP is moving too fast, answering too few questions, in proposing the variances for these streams in the Cheat and Tygart watersheds. The background work and legal justification has not been provided to support the variances and too many questions remain for WVDEP to move forward at this point.

1. There has been No Showing the Designated Uses Cannot Be Achieved

A variance from numeric water quality criteria may only be granted if certain conditions, outlined in 47 CSR 2-6.1.b, limit the attainment of specific water quality criteria. 47 CSR 2-8.4. The Office of Special Reclamation is applying for both variances under the provision, "Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place." 47 CSR 2-6.1.b.4; 46 CSR 6-4.1.d. The regulations require that "it can be demonstrated that attaining the designated use is not feasible because" of such a condition. OSR has not made such a showing.

2. The Office of Special reclamation has Not Shown that Pollution Entering the Streams from its Facilities Cannot Be Remedied or that a Remedy Would Cause More Environmental Damage

There has been no demonstration that either the discharges from OSR's facilities or the AML pollution entering the streams "cannot be remedied or would cause more environmental damage to correct than to leave in place." The variance applications do not even identify the locations, flows, and chemical compositions of the OSR or AML sources. The maps attached to the applications do little to substitute for the missing information. They simply indicate that OSR has more information than it is making available to the public. The applications include no description of possible treatment options for the OSR or AML sources and their limitations. While a seven-year remediation effort is referenced in the application for a variance on Martin Creek, it does not describe what treatment methodologies were used.

3. The Office of Special Reclamation has Not Demonstrated the Discharger Will Be Unable to Meet Water Quality Criteria.

In addition, OSR has conflated the OSR discharges and the instream water quality. An application for a variance must include, "Identification of the specific circumstances which render the discharger unable to meet the existing water quality criteria which apply to the stream." 46 CSR 6-5.3.d (emphasis added). In the each application, to meet that requirement OSR describes the AMD problem from abandoned mine lands. Pre-law mining pollution has no impact on OSR's ability to meet existing numeric water quality criteria. In fact, OSR does not require a variance for its own discharges. At no point has OSR indicated that it cannot meet water quality standards at the "end-of-pipe." OSR has not made the showing required under the law for a complete application for a variance. A variance only applies to the discharger requesting the variance, 46 CSR 6-5.2; 47 CSR 2-8.4, yet the discharger in this case does not require a variance. In addition, the variances are phrased as if they apply to waterbodies, rather than OSR's discharges in those waterbodies, as required by the regulations. The use of instream dosers cannot be covered by this variance, but also should not require a variance.

4. The Proposed Variance Does Not Describe Alternative Restoration Measures.

The proposed variances reference, "Alternative restoration measures, as described in the variance application." The variance applications do not describe alternative restoration measures. The closest they come is the vague statement, "OSR is proposing the strategic placement of in-stream lime doser's in order to enhance overall stream quality," which appears in the introduction to each application. The maps attached to the applications include locations for the dosers. The applications lacks any description of what the dosers will do, what chemicals and concentrations will be used, how they will be monitored, or what impact they will have downstream.

5. The Proposed Variance Will Result in Sections of Martin Creek and Sandy Creek Being Used Only for Waste Transport

The proposed variances will result in the suspension or removal of all designated uses in certain sections of Martin Creek and its tributaries and Sandy Creek and its tributaries. These sections of stream will, in effect, be used only for waste transport, a use strictly prohibited by federal regulations. 40 C.F.R. § 131.10(a) ("In no caser shall a State adopt waste transport or waste assimilation as a designated use for any waters of the United States.")

6. The Office of Special Reclamation has not Conducted the Necessary Use Attainability Analysis to Remove Fishable/Swimmable Uses

The removal of designated uses will necessarily include the removal of aquatic life and human contact recreation uses described in 47 C.S.R. § 2-6. In other words these waterways will no longer be designated to attain the "fishable/swimmable" uses that are at the heart of the Clean Water Act. *See* 33 U.S.C. § 1251(a)(2) (establishing the national goal of fishable/swimmable waters). The fishable/swimmable designated uses have special protection under the Clean Water Act. 40 C.F.R. § 131.10(j). To remove them a state must conduct a use attainability analysis pursuant to 40 C.F.R. § 131.3(g). This is a "structured scientific assessment of the factors affecting the attainment of the use. . ." 40 C.F.R. § 131.3(g). According to EPA, "the most significant misperception about designated uses and UAAs is that UAAs need only address the current condition of a waterbody: that a designated use may be removed simply by documenting that protective criteria are exceeded. However, it is the prospective analysis of future attainability of designated uses that provides the demonstration necessary to support a use change."
See http://water.epa.gov/scitech/swguidance/standards/uses/uaa/info.cfm. While the Office of Special Reclamation has shown that the waters to be subject to the proposed variance are not currently meeting designated uses, the OSR has performed no analysis to demonstrate the impossibility of achieving those uses in the future. Importantly,the proposed variances are not an incremental step to achieve the current designated uses of the Martin Creek and Sandy Creek watersheds. Rather, they will allow OSR to avoid treating sources to current water quality standards—even though the office has both the financial ability and legal obligation to do so.

Respectfully submitted,

/s/ J. Michael Becher
J. Michael Becher
Appalachian Mountain Advocates
P.O. Box 507
Lewisburg, WV 24901
304-382-4798
mbecher@appalmad.org

/s/ Cynthia Rank
Cynthia “Cindy” Rank
West Virginia Highlands Conservancy
HC 78 Box 227
Rock Cave, WV 26234
304-924-5802
clrank2@gmail.com

/s/ Angie Rosser
Angie Rosser
West Virginia Rivers Coalition
3501 MacCorkle Ave SE #129
Charleston, WV 25304
arosser@wvrivers.org