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SUBMITTED ELECTRONICALLY
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Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul MN 55155-4194

RE: Planned Amendments to Water Quality Sulfate Standard to Protect Wild Rice and Identification of Wild Rice Waters. Minnesota Rules Chapters 7001, 7050, 7052, 7053

Dear Ms. Nankivel:

These comments are submitted in response to the above-captioned Planned Amendments to Minnesota's Water Quality Sulfate Standard to Protect Wild Rice, on behalf of WaterLegacy. WaterLegacy is a Minnesota non-profit organization with approximately 10,000 members and supporters, formed to protect Minnesota water resources and the communities that depend on them.

On October 26, 2015, the Minnesota Pollution Control Agency (MPCA) provided notice in the State Register of the Agency's planned amendments to rules governing water quality standards that protect wild rice from excessive sulfate pollution. These proposed amendments were based on the cited reference Minnesota Pollution Control Agency, *Proposed Approach for Minnesota's Sulfate Standard to Protect Wild Rice*, March 24, 2015. (hereinafter "*MPCA Proposal"*). The MPCA proposed the following amendments to rules that protect wild rice:

- Eliminate Minnesota's existing water quality standard limiting sulfate in wild rice waters to 10 milligrams per liter (mg/L) of sulfate and replace this standard with an equation that would calculate a sulfate concentration for each water body based on an asserted relationship between sulfate, sediment iron, sediment organic carbon and sulfide in sediment.

- Provide a new definition of "wild rice waters" (formerly referred to as "water used for production of wild rice") using a minimum threshold based on the number of wild rice stems in a given water body. The MPCA has proposed a minimum wild rice stem count threshold for lakes and wetlands of 8,000 stems, and 800 stems per river mile for streams and rivers.

- Provide a list of wild rice waters where a sulfate standard is to be applied. MPCA has compiled a draft list of approximately 1,300 lakes, wetlands, streams, and rivers that appear to meet the minimum stem count thresholds proposed.

Introduction

In these comments, WaterLegacy first objects to the elimination of Minnesota's wild rice sulfate standard in favor of the equation in the *MPCA Proposal* on the grounds that this equation has very poor predictive power even within the data set from which it is derived, is unreliable to predict actual porewater sulfide concentrations in new water bodies, and would fail to protect wild rice as a result of underprediction of sulfide levels. The equation also lacks scientific validity since it assumes that iron would have an ameliorative effect on porewater sulfide, when there is no experimental evidence supporting this theory. The *MPCA Proposal* equation also fails to consider other ecological implications of increased sulfate in water bodies, including increased mercury methylation and eutrophication. The equation would fail to protect the designated use of waters for wild rice in violation of the Clean Water Act and would also impair designated uses of Minnesota waters for aquatic life and for the human consumption of fish.

Technical and scientific data confirms that retaining Minnesota's sulfate standard of 10 mg/L in wild rice waters is needed and reasonable to protect wild rice.

Next, WaterLegacy addresses the suggestion in the *MPCA Proposal* that a new definition be provided for "wild rice waters." WaterLegacy supports the MPCA proposed rule change defining wild rice waters as an aquatic life and wildlife use, as distinct from an agricultural use classification, which may be appropriate for paddy rice. We have no objections to the Agency's compilation of a preliminary list of wild rice waters in rule to provide additional certainty to dischargers and regulators. However, WaterLegacy objects both to the proposed threshold for designation of wild rice waters and the effective de-listing of wild rice waters previously identified by the Minnesota Department of Natural Resources in collaboration with the 1854 Treaty Authority. The MPCA's current proposal would fail to protect existing beneficial uses of water for wild rice and improperly remove designated uses for wild rice in violation of the Clean Water Act.

Finally, WaterLegacy objects to the omission from the *MPCA Proposal* of any proposed amendment to existing rule provisions designating a specific time of the year during which the wild rice sulfate standard should apply. State-supported research identifying sulfide in sediments as the chemical agent causing impairment of wild rice and assessing conversion of sulfate to sulfide in sediments at various temperatures demonstrates that limiting the sulfate discharge standard to any particular season is inconsistent with scientific data and analyses as well as inconsistent with the 2011 Session Law providing funding for wild rice research.

1. Eliminating Minnesota's existing wild rice sulfate standard and replacing it with the MPCA's proposed equation is statistically unsound, scientifically indefensible and would fail to protect wild rice in violation of the Clean Water Act.

Minnesota's existing 10 mg/L wild rice sulfate standard was enacted by the State in 1973 and approved by the United States Environmental Protection Agency (EPA). Minnesota's discretion to revise this wild rice sulfate standard is constrained by the Clean Water Act and its implementing regulations.

The Clean Water Act, §303(c)(2)(A) provides:

> Whenever the State revises or adopts a new standard, such revised or new standard shall be submitted to the Administrator [of the EPA]. Such revised or new water quality standard shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses. Such standards shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act. Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and also taking into consideration their use and value for navigation. 33 U.S.C. §1313(c)(2)(A).

Recent cases have underscored that states do not have the discretion to adopt a standard that is inconsistent with the Clean Water Act in response to the advocacy of an industrial polluter. In *El Dorado Chem. Co. (El Dorado) v. U.S. EPA*, 763 F. 3d 950 (8th Cir. 2014), the Court of Appeals affirmed the EPA's disapproval of an Arkansas state standard weakening limits for chloride, sulfate and total dissolved standards that could affect downstream waters. The Court explained,

> [S]tates do not have unfettered discretion under the CWA. States may establish and revise water quality standards, yet all new and revised water quality standards must be submitted to the EPA. 33 U.S.C. § 1313(c)(2)(A). The EPA has the power to reject a state's proposed water quality standard, and even promulgate its own standards in some circumstances. *Id*. § 1313(c)(3).

El Dorado Chem. Co. (El Dorado) v. U.S. EPA, *supra*, 763 F. 3d at 956. The Court explained that the state, "not the EPA bears the burden of adducing evidence the proposed water quality criteria meet the requirements of the CWA." *Id*. at 959. Despite industry studies, the court affirmed that the EPA had a rational basis to conclude that there was "insufficient evidence that these bodies of water would remain protected given the proposed" increases in pollutant concentrations. *Id*., at 960.

The EPA has a mandatory duty to review and either approve or disapprove of a state's proposal to change water quality standards. *Miccosukee Tribe of Indians of Fla. v. United States, 105 F.3d 599, 602 (11th Cir. 1997)*; *Florida Public Interest Research Group (FPIRG) v. EPA,* 386 F. 3d 1070, 1080 (11th Cir. 2004). *See also Friends of Merrymeeting Bay v. Olsen,* 839 F. Supp. 2d 366, 370-372 (D. Maine 2012); *Miccosukee Tribe v. U.S.A.,* 2008 U.S. Dist. LEXIS 57809; 38 ELR 20205 (S. D. Fla., July 29, 2008); *Ohio Valley Envtl. Coalition v. Horinko*, 279 F. Supp. 2d 732, 751 (W. D. Va. 2003).

Pursuant to Chapter 40 of the Code of Federal Regulations, section §131.5(a), that review by EPA requires the following determinations:

> (1) Whether the State has adopted water uses that are consistent with the requirements of the Clean Water Act;
> (2) Whether the State has adopted criteria that protect the designated water uses based on a sound scientific rationale consistent with §131.11. .
> (7) Whether the State standards which do not include the uses specified in section

> 101(a)(2) of the Act are based upon appropriate technical and scientific data and analyses, and;
> (8) Whether the State submission meets the requirements included in § 131.6 of this part.

Section 131.6 of Chapter 40 sets the minimum requirements for water quality standards submitted to the EPA. These minimum requirements include:

> (a) Use designations consistent with the provisions of sections 101(a)(2) and 303(c)(2) of the Act;
> (b) Methods used and analyses conducted to support water quality standards revisions;
> (c) Water quality criteria sufficient to protect the designated uses.

The MPCA's proposed elimination of the wild rice sulfate standard in favor of an equation is not consistent with the Clean Water Act, is not based on a sound scientific rationale, and would not protect the designated use of water to protect wild rice, which is a wildlife use protected under Section 101(a)(2) of the Clean Water Act. This proposal must thus be rejected.

A. The MPCA Proposal is a poor predictor of sulfide in wild rice waters and would fail to protect wild rice as a result of underprediction of sulfide.

Variability in the use of the proposed equation to calculate porewater sulfide is evident in review of the *MPCA Proposal* itself, as reflected in Figure 9 on page 14 of the *Proposal*. WaterLegacy consulted with experts to understand the significance of this variability.

We contacted John William Shipley, Full Professor in the University of Sherbrooke Department of Biology and the author of two scientific textbooks and 16 peer-reviewed publications regarding the development and ecological application of structural equations modeling. Dr. Shipley agreed to review the March 24, 2015 Proposal (described in his opinion as the "MPCA report") and evaluate its predictive efficacy.

Dr. Shipley's opinion (hereinafter Shipley 2015), attached with WaterLegacy's comments, explained that the MPCA equation provided a poor level of within-sample predictive ability.

> The authors report a "model R^2" value of 0.44 on page 13 and so the proportion of the total variance in the observed porewater sulfide concentration that is not captured by the model is 1-0.44=0.66. This is a first indication that the within-sample predictive ability of the model is poor since more variance in the actual values of porewater sulfide concentration is left unexplained than the proportion that the model succeeds in capturing. Actually, although not explicitly stated in the MCPA report, the authors must have first transformed all of their original variables to logarithms and so the reported model R^2 of 0.44 actually refers to the logarithm of porewater sulfide; this means that the R^2 using the original units would be even lower. This is a rather poor level of "within-sample" predictive ability. (Shipley 2015, p. 3).

Dr. Shipley suggested that the authors of the MPCA report should have reported the 95% confidence intervals of the observations. Since the authors did not provide this information, Dr.

Shipley used Figure 9 on page 14 of the MPCA report to approximate this range. Judging visually, it appeared that the actual observed concentrations of porewater sulfide in samples where the model predicted the critical value of 165 micrograms per liter (µg/L) ranged from about 24 µg/L to 3,020 µg/L, covering almost the entire range of observed values. "In other words," Dr. Shipley explained, "when the model predicts that a lake will have a porewater sulfide concentration at the target value of 165 (and therefore would be judged in an acceptable range), about half the time the actual concentration will be more than this (i.e. has a porewater sulfide concentration that puts Wild Rice at risk) and can even reach concentrations that are over 18 times higher than predicted." (*Id*., p. 4).

Dr. Shipley also identified model bias within the data:

> There are other problems in the "within-sample" predictive ability of this model that are clear from Figure 9 of the MCPA report. An unbiased model will have (i) the points distributed equally above and below the solid blue diagonal line (this is the line along which the observed and predicted values are equal) and (ii) the scatter above and below this line will be of the same magnitude all along this line. In fact, we see that above about 250 micrograms/L, there is no longer any relationship between the observed values (x axis) and the model predicted values (y axis); the observed values go up to over 3000 but the model predictions never go over about 414. Even when the actual observed values are as low as 20 micrograms/L the model predictions go up to almost the maximum values of around 414, and certainly above the target value of 165 micrograms/L. There is therefore clear model bias in these data. (*Id*., p. 4).

Dr. Shipley's bottom line is emphasized in his report:

> **My conclusion, based on the regression fit of the MCPA's Equation 3, their (almost) equivalent SEM-derived equation 2, and their Figure 9, is that this prediction equation has quite poor "within-sample" predictive ability and could not reliably distinguish between lakes whose porewater sulfide concentration is below or above the critical value.**

Dr. Shipley noted that there are additional concerns in applying the prediction equation to predict actual porewater sulfide concentrations in the sediment of some new lakes or the same lakes at a new time. He explained that to answer this question, it is critical to understand the underlying causal processes. Dr. Shipley emphasized that, even if the "within-sample" predictive ability had been high, "If some of the predictor variables in the equation do not actually cause changes in porewater sulfide concentrations then the predictor equation might not correctly predict porewater sulfide concentrations when used in new observations." (*Id*., p. 5).

Dr. Shipley explained that one way to determine the underlying causal processes would be to perform controlled experiments and directly manipulate each of the predictor variables – surface water sulfate, sediment iron, and sediment organic content. (*Id.*). He cautioned, "Since we have no experimental evidence showing a causal effect from each of the other two predictor variables and porewater sulfide concentration, we cannot simply assume that the causal relationships

between these two variables and porewater sulfide concentration would remain the same in new observations." (*Id*., pp. 5-6).

Dr. Shipley then analyzed the SEM methodology used by the MPCA to assert causation in the absence of experimental evidence. He concluded that problems with the SEM analysis created doubt that the analysis was done correctly. These included the lack of information establishing that alternative structural models can be rejected based on statistical criteria *(Id*., p. 7), the incorrect modeling of the degrees of freedom to determine the statistical significance of the fit between the model and the data, and the inconsistency between reported values of coefficients used to represent effects of variables on porewater sulfide. (*Id*. pp. 7-8). Dr. Shipley emphasized, "**even if the prediction equation had good 'within-sample' predictive ability (it doesn't), we could not know if we could apply this equation to new observations**." (*Id.*, p. 9).

Dr. Shipley was not informed that members of the Scientific Peer Review Panel convened by the MPCA in the summer of 2014 had expressed similar concerns about the MPCA's June 2014 conceptual synthesis proposing the use of an equation based on surface water sulfate and iron to predict the sulfide level that would protect wild rice. Conclusions, Recommendations and Discussions summarized in the Final Report from this Panel[1] cautioned:

> Although the conceptual model described in the Synthesis is qualitatively correct, the current Synthesis goes too far in implying that sulfide concentrations in sediment can be predicted accurately by the multiple quantile regression model based on sulfate concentrations in the overlying water and acid-extractable iron in sediments. (*Peer Review Report*, Conclusions and Recommendations, p. 9).
>
> It would be useful to have an experiment that examines whether iron would mitigate the ecological effects on wild rice of added sulfide levels. Additionally, current models do not account for the effects from oxygenated rhizospheres and iron plaques on root systems. MPCA needs to understand the mechanism of toxicity better before claiming to understand how iron mitigates sulfide stress. (*Id*., Summary of Discussions, p. 28).
>
> The conceptual model seems qualitatively correct, but it presents an overly optimistic impression about our ability to predict whether toxic sulfide levels will occur in a given wild rice stand from the sulfate concentrations in surface water and acid-extractable iron in sediment. (*Id*., Summary of Discussions, p. 33).

The chair of the Scientific Peer Review Panel criticized the MPCA's approach as going too far in implying that the model can accurately predict concentrations in sediment porewaters:

> If for no other reason than the uncertainties in the kinetics of solid-phase FeS formation, the statement at the beginning of the paragraph is not realistic. . . In my view, the section and especially its last paragraph presents an overly optimistic picture of our state of knowledge regarding: (a) the quantitative effects of sulfate and sulfide on wild rice and

[1] Eastern Research Group, *Summary Report of the Meeting to Peer Review MPCA's Draft Analysis of the Wild Rice Sulfate Standard Study*, Final Report Sept. 25, 2014 ("*Peer Review Report*") available at https://www.pca.state.mn.us/sites/default/files/wq-s6-43i.pdf

> (b) our ability to predict accurately whether toxic sulfide levels will occur in a wild rice stand from knowledge of sulfate levels in the surface water and the acid-extractable iron content of the sediment. I think the Synthesis needs substantial rethinking and rewriting. (*Peer Review Report,* Comments of Dr. Patrick L. Brezonik, p. F-27).

One individual peer reviewer explicitly proposed that the correlations developed in the MPCA's synthesis be tested in an experimental mesocosm setting. (*Peer Review Report,* Comments of Dr. Gertie H.P. Arts, pp. F-5, F-9).

WaterLegacy understands that such an experimental study has been conducted for the past two years at the University of Minnesota in Duluth and that MPCA staff has been informed of preliminary study results. The mesocosm manipulation of the variables in the *MPCA Proposal* equation has demonstrated that addition of iron does *not* ameliorate adverse effects of surface water sulfate on wild rice. As cautioned by both Dr. Shipley and the Scientific Peer Review Panel, the primary hypothesis on which the *MPCA Proposal* was based was an untested hypothesis about the ability of iron to protect wild rice from the effects of sulfide in sediments resulting from loading of sulfate to surface water. When added to the weakness of within-sample predictive power, the equation proposed by the MPCA is not supported by a sound scientific rationale as required under the Clean Water Act.

In addition to the expert analysis by Dr. Shipley, retired University of Minnesota mathematician Joel Roberts, Ph.D., undertook an analysis of the underlying data on which the *MPCA Proposal* is based, allowing the weakness of the equation's predictive power to be understood as applied to individual water bodies. Dr. Roberts obtained from the MPCA the wild rice, sulfate and sulfide field data used to generate the *MPCA Proposal* and replicated the MPCA's calculations of predicted sulfide to compare them with observed sulfide. His opinion and the spreadsheets reflecting his analysis are provided with WaterLegacy's comments. Dr. Roberts reached the following conclusion based on his analysis:

> Comparing observed sulfide concentrations in the MPCA field data with predicted sulfide concentrations obtained by applying the MPCA's equation demonstrated to me the poor predictive power of the proposed equation. The lack of consistency in the ratios of predicted and observed sulfide provides no confidence that the MPCA's Proposal will provide a reliable prediction of sulfide levels. Thus, even setting aside questions about the ecology that these predictions represent (a set of issues that are outside my expertise) the MPCA Proposal seems like an unreliable method to protect wild rice from excess sulfide. (Roberts 2015, p. 1).

Dr. Roberts expressed concern that the linear scale used for Figure 9 on page 14 of the MPCA Proposal created a visual impression of a greater closeness of fit than warranted by the data. (*Id.*) He explained that the chi-square test of the goodness of fit presented "an inconclusive result" that "does not make a compelling case for goodness of fit of the model." He stated, "Even though it is possible to draw a line through the data points that indicates a potential relationship between the data points, as the MPCA has done, this single line does not provide a powerful predictor of results for specific water bodies/data points." (*Id*., p. 2).

After analyzing the MPCA data on which the equation was based and calculating the ratio of predicted or expected sulfide levels to actual observed sulfide levels in individual lakes and streams (Roberts 2015, Attachment A), Dr. Roberts concluded, "Few of the Expected/Observed ratios cluster around the central value of 1, which would be the indicator of a perfect positive correlation." (*Id*., p. 6). Dr. Roberts was particularly concerned about the potential that application of the equation in the MPCA Proposal would lead to underprediction of sulfide levels. He identified a cluster of data points where the MPCA equation significantly under-predicts sulfide in waters with high observed sulfide concentrations. (*Id*., p. 4-5).

After sorting the MPCA field data by the Expected/Observed sulfide ratio (Roberts 2015, Attachment B), Dr. Roberts reviewed a number of specific water bodies where the MPCA equation substantially under-predicted sulfide. He found that in nearly every site with an Expected/Observed sulfide ratio below 0.4, no wild rice or very sparse wild rice was present. He highlighted the examples of Mahnomen Lake and Sandy Lake to demonstrate his concern that application of the MPCA's proposed Calculated Protective Sulfide Concentration (CPSC) would fail to protect wild rice. (*Id.*, pp. 6-7).

Dr. Roberts explained that applying the MPCA's equation to Mahnomen Lake (FS-133, line 33 of Attachment A) would yield a CPSC of 174.4 mg/L, suggesting that a limit of 174.4 mg/L of sulfate would be sufficient to protect wild rice in Mahnomen Lake from excess sulfide (levels exceeding 165 µg/L). However, with observed sulfate levels of 16.9 mg/L, porewater sulfide in Mahnomen Lake was measured at 308 µg/L. Dr. Roberts noted that the lake's name suggests this water body once grew wild rice, but MPCA field study data showed no wild rice still present. (*Id*., p. 7).

Dr. Roberts also analyzed the application of the CPSC equation to Sandy Lake in St. Louis County (FS-320, FS-305, FS-348 on Attachment B), which he noted was historically a major and abundant ricing site for the Bois Forte Band. At Sandy Lake, a lake with very high sediment iron levels, sulfide was significantly underpredicted by the CPSC equation and wild rice was not protected by the presence of high sediment iron. Sulfide levels were observed at 3,080 ug/L (FS-320) and at 1,080 ug/L (FS-305). No wild rice was observed at either location. (*Id*., p. 7).

Dr. Roberts reviewed the data as a whole and concluded, "These two examples of underprediction of sulfide using the MPCA equation do not seem to be anomalies. If one uses a threshold of variability of 20%, for example, the MPCA field data contains at least 77 of the 242 sites for which data was available where the MPCA's CPSC underpredicted sulfide levels or 32% of the sampled sites." He cautioned that neither the graphic representation of the field study data, the chi-square analysis or the analysis of underlying field study data in individual water bodies "provides any basis for confidence in the use of MPCA's proposed CPSC equation to predict sulfide levels and protect wild rice from excessive levels of sulfide." (*Id*., p. 7).

Professor David Schimpf, a retired professor in biology and plant ecologist from the University of Minnesota, whose comments were provided to the MPCA on December 14, 2015 and were just received by WaterLegacy, summarizes the flaws of the MPCA Proposal from the perspective of resource protection and adequacy for regulation. Dr. Schimpf expressed concerns about the inadequacy of the statistical model for the purpose of regulation and the failure to test its

predictive power with data other than that used to generate the equation in the first place. (Schimpf 2015, pp. 2, 10).

Dr. Schimpf also questioned the assumption that reactive iron remains stable in sediments and that sulfate loading would not exhaust all reactive iron in longer-term experience, a concern similar to that raised by Dr. Brezonik on the Peer Review Panel. (*Id*., p. 10).

Perhaps most significant, Dr. Schimpf explained that by basing its formula and the definition of a protective level of sulfide on the presence or absence of wild rice, the *MPCA Proposal* would allow any non-zero-density stands of wild rice to be potentially reduced in abundance through elevated sulfate release. (*Id*., pp. 3, 11). He emphasized that the MPCA draft proposal "does not call attention to its major change in the abundance level of wild rice that is to be protected. This is probably the most crucial aspect of the draft proposal." (*Id*., p. 3).

It is evident from the above expert analysis, as well as the comments of the Scientific Peer Review Panel convened by the MPCA, that the *MPCA Proposal* to eliminate Minnesota's wild rice sulfate standard and replace it with an equation does not meet the minimum requirements for approval under the Clean Water Act and applicable regulations. Rigorous analysis demonstrates that the *Proposal* is scientifically unsound. Such analysis demonstrates that the proposed equation has poor within-sample predictive ability, has not been tested for predictive capacity outside the data set from which it was derived, and makes unfounded assumptions both about causation and about the stability of sampling results over time and distance.

Examination of the data demonstrates that the MPCA Proposal would underestimate sulfide and insufficiently protect wild rice. Recent mesocosm research testing calls into question the hypothesis assumed for the equation – that adding increased iron to high sulfate mesocosm experiments does not protect wild rice from decline and extirpation. The equation proposed by the MPCA to supplant the existing wild rice sulfate standard must be rejected as inconsistent with the Clean Water Act and inadequate to protect the designated use of water for the growth of wild rice as well as scientifically unsound.

WaterLegacy also believes that the elimination of Minnesota's limit on sulfate pollution and its proposed replacement with an equation based on the assumption that high levels of iron would allow additional anthropogenic discharge of sulfate is a short-sighted approach that neither recognizes the ecology of aquatic systems nor the importance of preserving other beneficial uses of water.

Two well-recognized effects of increasing sulfate pollution are the risk of increased methylmercury in downstream sediments, particularly those that are currently sulfate-limited, and the risk of eutrophication as a result of phosphorus availability. These risks have been recognized by the MPCA since at least 2006, when the MPCA developed a Strategy to Address Indirect Effects of Elevated Sulfate on Methylmercury Production and Phosphorous Availability.[2]

[2] MPCA, *Strategy to Address Indirect Effects of Elevated Sulfate on Methylmercury Production and Phosphorus Availability*, Oct. 19, 2006, attached as Exhibit 1 to these comments.

Although the MPCA's *Analysis of the Wild Rice Sulfate Standard Study: Draft for Scientific Peer Review*[3] mentioned neither of these issues, members of the Scientific Peer Review Panel raised concerns that sulfate-reducing bacteria could increase methylmercury and that sulfide preferentially binding to iron could release phosphate and drive eutrophication:

> A third reviewer agreed with the focus of sulfide in porewater, but noted that the complexity of the system should be addressed more fully, especially regarding the sediment system. For example, sulfate plays a role in driving eutrophication through increased rates of decomposition of organic matter and the liberation of nutrients. Also, sulfide binding iron can lead to phosphate release by iron which becomes bio-available in the system. She also suggested examining the mercury cycle. The methylation activity of sulfate-reducing bacteria generates methylmercury, which may be important. (*Peer Review Report*, Summary of Discussions, p. 29).
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> [T]he focus on sulfide and iron to the exclusion of other sediment compounds oversimplifies the chemistry of these systems. For example, some critical plant nutrients as well as the fate of mercury in aquatic ecosystems are also tied to the biogeochemistry of sulfur and iron. . . The role of sulfate in eutrophication may also be a factor in some systems. As sulfate levels increase, its availability as an electron acceptor increases, leading to faster rates of organic matter decomposition and the mineralization of nutrients such as nitrogen and phosphorus (Smolders and Roelofs 1993, Lamers et al., 1998, 2013b). Increased nutrient availability may alter the competitive ability of aquatic macrophytes within plant communities (including wild rice), leading to changes in species composition. Pester et al. (2012) reports that as much as 50% of the anaerobic decomposition of organic matter in freshwater wetlands is due to sulfate reduction to sulfide. (*Id*., Comments of Dr. M. Siobhan Fennessy, p. F-38).

The potential that replacing the wild rice sulfate standard with a site specific standard based on iron availability would increase mercury methylation was also emphasized by citizen experts. Leonard Anderson, professional biologist and wild rice hand harvester stressed, "We must not protect wild rice and then harm our children with mercury in the food web. In Minnesota wild rice waters, down in the anoxic sediments, these biochemical processes are inextricably bound together. The dynamics of mercury, iron and sulfide and the impacts on wild rice and fish tissue mercury must be understood before we can safely use any site specific standard." (*Peer Review Report,* Observer Comments, p. E-20).

Eliminating Minnesota's wild rice sulfate standard in favor of site-specific limits set by allowing increased sulfate in the presence of high levels would threaten beneficial uses of waters for aquatic life, and for human consumption of fish as well as failing to protect their designated use for growth of wild rice.

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[3] MPCA, *Analysis of the Wild Rice Sulfate Standard Study: Draft for Scientific Peer Review,* June 9, 2014, available at https://www.pca.state.mn.us/sites/default/files/wq-s6-42z.pdf (hereinafter "*MPCA Draft for Peer Review*")

B. Technical and scientific data as well as law requires retaining Minnesota's 10 mg/L wild rice sulfate standard, approved by the EPA pursuant to the Clean Water Act.

By law, there is a presumption in favor of retaining an existing water quality standard, such as the Minnesota wild rice sulfate standard, that has been duly enacted and approved by the EPA. "Any existing water quality standard "remains the applicable standard until [the] EPA approves a change, deletion, or addition to that water quality standard, or until [the] EPA promulgates a more stringent water quality standard." 40 C.F.R. §131.21(e)." *Florida Public Interest Research Group v. EPA, supra,* 386 F. 3d at 1074.

The MPCA's current and peculiar posture was remarked upon in the recent comments of plant ecologist, Dr. Schimpf. He observed that the MPCA's primary website page on the "Sulfate Standard to Protect Wild Rice" reads, "For the past several years, the MPCA, researchers, and many varied individuals and organizations have been engaged in gathering data and developing a basis for revising this standard."[4] Dr. Schimpf cautioned, "This could lead many readers at this public comment stage to believe that the whole process was supposed to come up with a revised (i.e., new) sulfate standard. I believe that a new standard is not the default position, but that the existing standard is the default position." (Schimpf 2015, p. 1).

WaterLegacy was appointed to the MPCA's Wild Rice Standards Advisory Committee in October 2011. We have attended every meeting of the Wild Rice Advisory Committee and participated in nearly every phone conference related to this project. We and many other stakeholders were emphatically ***not*** engaged in a process to gather data and develop a basis for revising the wild rice sulfate standard. In fact, on the basis of my review of the scientific literature, the historic rulemaking record, and consultation with nearly a dozen scientists, we were convinced that an unbiased scientific analysis would confirm both that sulfide, rather than sulfate, was the chemical toxic to wild rice and that Minnesota's existing sulfate limit of 10 m/L in wild rice waters was needed and reasonable to protect natural stands of wild rice.

For more than two years, it was our perception that MPCA technical staff did a conscientious and professional job contracting with top-notch researchers and ensuring that the scientists were able to do their work without undue outside pressure.

As the state-funded study research process came to a close at the end of 2013, we read all of the scientific reports produced in this process – hydroponic, mesocosm and field studies - and conferred with the scientists involved. WaterLegacy and the scientists with whom we conferred were impressed with the consistency of the results from the various investigations. It was clear to us and to every scientist with whom we consulted that the research confirmed that sulfide, not sulfate per se, was the toxicant for wild rice, that the relationship between sulfate loading and sulfide had been established, that the data supported retaining the existing wild rice sulfate standard, but removing the seasonal limit, and that the field data showed that a discharger might be able establish the basis for a site-specific variance. In the field study, certain conditions, like oxygenation in river waters, seemed to allow wild rice to survive in concentrations between 10

[4] MPCA, *Sulfate standard to protect wild rice*, https://www.pca.state.mn.us/water/sulfate-standard-protect-wild-rice.

mg/L and about 30 mg/L, while certain lakes seemed to require a more stringent limit on sulfate than that provided in the rule, perhaps as low as 6 mg/L.

WaterLegacy looked forward to the MPCA's release of its summary of the research scheduled for February 2014 and the ability to work collaboratively with regulators to reflect the conclusions of the scientific research in rule amendments. We first realized that something had gone awry when the scheduled release of the MPCA's preliminary findings and recommendations in February 2014 was cancelled. We obtained information through Minnesota's Data Practices Act. The documents that we received confirmed that the MPCA's Findings and Preliminary Recommendations Regarding the Wild Rice Sulfate Standard were much as we expected, although the Agency seemed more optimistic about the effects of iron in protecting wild rice than our consultants advised. The MPCA's February 2014 Findings and Preliminary Recommendations (pp.1-2 in Exhibit 2) are reprinted below:

> **Findings and Preliminary Recommendations Regarding the Wild Rice Sulfate Standard**
> **Key Findings**:
> 1. **Sulfate is not directly toxic to wild rice**. Both the MPCA Study and the research commissioned by the Minnesota Chamber of Commerce support this conclusion. However, sulfate in the surface water can be converted by bacteria to sulfide in the rooting zone of wild rice (see Figure 1).
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> 2. **Sulfide is toxic to wild rice.** The MPCA Study demonstrated that elevated sulfide concentrations were toxic to wild rice seedlings. Hydroponic experiment data showed deleterious effects of sulfide on seedling plant growth when sulfide exceeded the range of 150 to 300 µg/L.
>
> 3. **Sulfide in the sediment is affected by the amount of sulfate in the water column, and the amount of iron in the sediment**. Data from a majority of the field sampling sites show that the range of 150 to 300 µg/L sulfide in the sediment relates to a water column concentration of sulfate between 4.3 and 16.2 mg/L. This range illustrates that conditions at some of the field sites are more effective than others at converting sulfate to sulfide, in part due to the availability of iron in the sediment (see Figure 1).
>
> Preliminary Conclusions and Recommendations:
> 1. **The 10 mg/L sulfate standard is needed and reasonable to protect wild rice production from sulfate-driven sulfide toxicity.** The MPCA will also consider including a sediment sulfide concentration as a component of this water quality standard, in the range of 150 to 300 µg/L sulfide.
>
> 2. **The 10 mg/L wild rice sulfate standard should continue to apply to both lakes and streams**. Analysis of the field data does not support placing lakes and streams into separate subclasses. Iron availability, not water body type, appears to be a key controlling factor in the concentration of sulfide.
>
> 3. **Site-specific standards are expected for some waters**. Considerable data suggest that in some cases the development of a site-specific standard would be protective of wild rice production. This is most likely to occur in waters where the sediment iron is elevated and therefore a higher sulfate water column concentration may not result in a sulfide sediment concentration above 150 to 300 µg/L. There are also data to suggest that a site-specific standard lower than 10 mg/L

may be needed for waters where sulfate is more efficiently converted to sulfide.

4. **MPCA will continue to explore if the sulfate standard is needed to protect paddy-grown wild rice production.** The Study data do not suggest that paddy-grown wild rice is less susceptible to impacts from elevated sulfide. However, the land- and water-management activities associated with paddy wild rice production likely reduce the potential for sulfide production in the sediment.

5. **MPCA does not currently have a recommendation regarding the "period of susceptibility" of wild rice to sulfate effects, but will continue to analyze data to further explore this question.** The sediment incubation experiment data show that sulfate can be converted to sulfide in both warm and cold conditions, and that sediment sulfide concentrations decrease once sulfate concentrations in the overlying water decrease. This is a complex interaction and more data analysis is needed before recommendations can be developed about this important question; any recommendation may also need to consider site-specific factors that affect this question.

6. **Consideration should be given to changing the use class of the wild rice sulfate standard:** The MPCA is considering moving the wild rice sulfate standard from Class 4 where it currently resides to Class 2 and creating a new subclass to clarify that the wild rice sulfate standard is designed to protect the growth of wild rice grains for consumption by humans and wildlife. The MPCA is also considering revising the term "water used for production of wild rice." The MPCA has received comments asserting this wording is not the best descriptor for natural stands of wild rice that provide benefits to humans and wildlife.

The MPCA's bottom line after reviewing the research was consistent with WaterLegacy's review of the scientific research: "**The 10 mg/L sulfate standard is needed and reasonable to protect wild rice production from sulfate-driven toxicity . . . The 10 mg/L wild rice sulfate standard should continue to apply to both lakes and streams**." (emphasis in original).

MPCA's February 2014 Findings and Preliminary Recommendations were never released to the public. Internal documents obtained by WaterLegacy reveal that MPCA first presented its findings and recommendations to a small group of Iron Range legislators. An email from the Governor's staff reported that the "meeting with range legislators went poorly" and the issue "became a big deal" that was "blowing up" as a result. A phone conference was set with the Governor, the MPCA Commissioner and a cabinet member representing Iron Range economic development interests.

Later that evening, the MPCA communicated to others, including legislators, the wild rice researchers and the MPCA's Wild Rice Advisory Committee that the MPCA "thought we would be ready to release preliminary findings on the wild rice sulfate standard on Thursday, but we are not." (emails provided with these comments in Exhibit 3).

Since February 26, 2014, none of MPCA's proposals or analyses have suggested or implied that Minnesota's existing 10 mg/L wild rice sulfate standard is needed, reasonable or should be applied to lakes and streams. In fact, although the MPCA convened a Scientific Peer Review Panel to review potential recommendations resulting from the Wild Rice Standards scientific research, the MPCA preclude the Panel from reviewing whether retaining the existing wild rice sulfate standard is needed and reasonable.

In mid-summer of 2014, WaterLegacy learned that the MPCA had not informed its Scientific Peer Review Panel that the Wild Rice Standards Study objective was to determine whether Minnesota's existing water quality standard limiting sulfate to 10 milligrams per liter in waters used for the production of wild rice is appropriate. The MPCA had focused the scope of Panel discussions on the proposed iron mitigation theory. WaterLegacy requested that the Panel be allowed to answer additional Charge Questions, including the #1 question: "Do the field data, mesocosm data and hydroponic data taken together support the existing 10 milligrams per liter (mg/L) sulfate standard to protect wild rice or some other standard?"[5] We expressed concern that "MPCA's charge questions appear to be constrained by political factors, overstate the support for an "iron mitigation" theory advanced by the mining industry, and do not provide the peer review committee with sufficient latitude to provide independent analysis of the issues before the MPCA for which the research was instituted and funded by the Minnesota Legislature." (*WL Charge Question Comments*, p. 1).

The MPCA did not broaden the Panel's charge questions, did not request peer review of whether the research supported or conflicted with the existing standard, and took the additional step of preventing peer reviewers from speaking directly to researchers.

The continuing and relentless pressure of the mining industry to weaken or eliminate the wild rice sulfate standard is a matter of record as is the reluctance of the state of Minnesota to confront this powerful special interest.[6] However, in the context of rulemaking to weaken or eliminate water quality standards, Minnesota does not have unfettered discretion to defer to mining industry special interests. Clean Water Act authority to set water quality standards is contingent on compliance with the CWA and implementing regulations.

The only choice consistent with the Clean Water Act is for the MPCA to determine that there is *no* scientific evidence supporting weakening the wild rice sulfate standard, fundamentally flawed and insufficient evidence to support the *MPCA Proposal* for an equation, and a strong and consistent body of evidence from several integrated modes of investigation – hydroponic, mesocosm and field study research performed by the University of Minnesota under contract with the MPCA – all of which supports retention of the existing 10 mg/L limit on sulfate in wild rice waters.

2. Establishing a threshold for wild rice waters based on the current number of wild rice stems impermissibly excludes existing uses of water for wild rice and improperly removes designated uses of water for wild rice in violation of the Clean Water Act.

In addition to restricting a State's discretion to weaken water quality standards so that they no longer protect a designated use of waters, under the Clean Water Act and its implementing

[5] WaterLegacy *Comments and Proposed Charge Questions for Peer Review of the Wild Rice Sulfate Standards*, July 8, 2014, attached as Exhibit 4, to these comments. (hereinafter "*WL Charge Question Comments*").
[6] See *WaterLegacy Petition for Withdrawal of Program Delegation from the State of Minnesota for NPDES Permits Related to Mining Facilities*, July 2, 2015, pp. 21- 28, available at http://www.epa.gov/mn/npdes-petition-program-withdrawal-minnesota.

regulations, a state may not use a new designation to remove an existing use of a water body. 40 C.F.R. §131.10(h)(1). Existing uses are uses "actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards," *Id*. at § 131.3(e). Federal regulations protect the existing use – e.g. the highest use attained in the water body on or after November 28, 1975 -- whether or not that use was specifically included previous state water quality standards. *Id*. at §131.12(a). *See e.g.*, *Ohio Valley Envtl. Coalition v. Horinko*, 279 F. Supp. 2d 732, 751 (W. D. Va. 2003).

Regulations promulgated under the Clean Water Act also do not permit the removal of a designated use that is not an existing use unless an appropriate process is followed and findings made. Where the designated use proposed to be removed from a body of water is among the uses specified in section 101(a)(2) of the Clean Water Act, namely a use pertaining to fish, shellfish, wildlife or recreation, the designated use cannot be removed without a use attainability analysis. 40 C.F.R. § 131.10(j)(2). The use attainability assessment is a specific structured scientific assessment of the factors demonstrating that the attainment of the use is not feasible. 40 C.F.R. §§131.3(g); 131.10(g). Since use of Minnesota waters to grow natural stands of wild rice is a wildlife use pursuant to Minnesota Rules 7050.0224, Subpart 1, removing the designation of any body of water designated to contain natural stands of wild rice would require an individual use attainability assessment for that lake or stream.

The MPCA's proposal to define "wild rice water" based on a "self-perpetuating population of wild rice plants" represented by "a minimum of 8,000 wild rice stems over the surface of a lake, wetland, or reservoir water body or a minimum of 800 wild rice stems over a river-mile reach for a riverine water body" (*MPCA Proposal*, p. 21) violates the Clean Water Act prohibition on removal of existing uses. Although the proposal asserts that this definition would also apply if it could be shown that waters contained the prescribed minimum number of stems either "currently present" or "present in the given water body since November 28, 1975," this is a contrivance.

A showing that wild rice was previously present in a Minnesota water body and had a specified number of stems would require an impossible proof, particularly if pollution since November 28, 1975 has degraded or extirpated wild rice. Lakes and streams where sulfate discharge has resulted in decimation of wild rice – the lakes the Clean Water Act and federal antidegradation rules were written to protect – would be completely excluded from protection as existing uses due to the impossibility of demonstrating that a certain number of stems existed at a specified location as much as forty years ago.

In addition, the limitation of a beneficial use to a threshold of presumed indefinite self-perpetuation or the ability to feed a certain number of migratory waterfowl (*MPCA Proposal*, p. 21) has no precedent in Minnesota or in federal law. In every other classification under Minnesota rules, the designation is based on potential use or habitat characteristics. For example, Class 1 waters, protected for domestic consumption, include "all waters of the state that *are or may be used* as a source of supply for drinking, culinary or food processing use," not just waters that currently have a certain number of homes or industries engaged in consumption. Minn. R. 7050.0140, Subp. 2 (emphasis added).

Class 2 waters, protected for aquatic life and recreation, include "all waters of the state *that support or may support* fish, other aquatic life, bathing, boating, or other recreational purposes and for which quality control is or may be necessary to protect aquatic or terrestrial life or their habitats or the public health, safety, or welfare." Minn. R. 7050.0140, Subp. 3 (emphasis added). In order to protect a Class 2 stream, there is no requirement to prove that the number of fish in that lake would feed other animals or sustain the population indefinitely. In fact, where pollution has diminished the number of fish in a water body, rather than consigning an existing use to the dustbin of history, that water body is considered "impaired" under the Clean Water Act section 303(d) and additional constraints on pollution applied.

The MPCA has acknowledged in discussions with WaterLegacy and other stakeholders that handbooks for other beneficial uses (such as trout streams) don't require a certain density of fish, so long as there is evidence that finding a fish is not an "anomaly."

It is only for wild rice that the beneficial use of water is now proposed to be limited based on extraneous factors. This devaluation of wild rice is inconsistent with Minnesota's legislative designation of wild rice as the official state grain of the state of Minnesota. Minn. Stat. 1.148, Subd. 1. It is also inconsistent with Minnesota's existing rules, which explicitly affirm the "ecological importance" of wild rice and state, "The quality of these waters and the aquatic habitat necessary to support the propagation and maintenance of wild rice plant species must not be materially impaired or degraded." Minn. R. 7050.0224, Subp. 1.

Dr. Schimpf's comments add the perspective of a professional plant ecologist.

> More than almost any other form of life in Minnesota afforded some protective measures by the State, its Zizania palustris variety palustris [wild rice] has national significance. In the United States, Minnesota is the center of extensive self-sustaining natural stands with frequent high abundance, with only the Kakagon and Bad River Sloughs in Wisconsin being of comparable importance. The State has a wider-than-usual responsibility here that must be addressed when considering revision of the sulfate standard. (Schimpf 2015, pp. 11-12, parenthetical reference omitted for clarity).

The MPCA's proposal to set a threshold for the number of wild rice stems that must be counted has already had other implications that directly conflict with the Clean Water Act and its implementation. The March 24, 2015 *MPCA Proposal* states that a draft list of 1,268 wild rice lakes and streams was developed using information from various inventories. (MPCA Proposal, pp. 20-21). The MPCA doesn't explain that this draft list resulted from eliminating dozens if not hundreds of the wild rice lakes already designated by the Minnesota Department of Natural Resources (MDNR) in a 2008 Study Report submitted to the Minnesota Legislature.[7]

The details of the MPCA's process of eliminating previously designated wild rice lakes is described in a January 7, 2013 MPCA draft discussion document presented to the Wild Rice Standards Study Advisory Committee. In this document, the MPCA proposed eliminating 509 of

[7] MDNR, *Natural Wild Rice in Minnesota: A Wild Rice Study document submitted to the Minnesota Legislature by the Minnesota Department of Natural Resources*, (hereinafter "*MDNR Wild Rice Study Report*") February 15, 2008, available at http://files.dnr.state.mn.us/fish_wildlife/wildlife/shallowlakes/natural-wild-rice-in-minnesota.pdf.

the 1,286 wild rice water bodies identified by the MDNR on the grounds that these locations "do not have reported wild rice acreage estimates noted in the report." (MPCA, *Draft Water Used for the Production of Wild Rice*, p. 1, attached to these comments as Exhibit 5). As in the current *MPCA Proposal,* the MPCA's threshold for finding that a lake is a wild rice water in its January 2013 *Draft Water Used for the Production of Wild Rice* was based on approximately 8,000 wild rice stems and the consumption patterns of a duck. (*Id*., p. 3).

Since the current draft MPCA proposal lists 18 fewer wild rice waters than the MDNR listed in 2008, it is certain that the MPCA proposes to remove the designation of at least that many wild rice waters. Since the *MDNR Wild Rice Study Report* focused almost exclusively on lakes,[8] and the proposed MPCA list also includes stream and river reaches, it is likely that dozens if not hundreds of wild rice lakes were removed from the MDNR's designation. No findings of any kind, let alone a use attainment analysis consistent with Chapter 40 Section 131 of the Code of Federal Regulations have been provided by MPCA to justify removal of another State agency's expert designation of wild rice lakes in a 2008 study designed and funded by Minnesota taxpayers expressly for this purpose.

When MPCA first informed stakeholders of the Agency's intention to proceed with rulemaking to define wild rice waters using some form of numeric threshold, 799 citizens signed postcards or petitions asking that the definition of wild rice waters be inclusive to protect tribal rights and comply with the Clean Water Act. A copy of WaterLegacy's October 3, 2012 cover letter transmitting copies of these postcards to the MPCA is attached as Exhibit 6 to these comments.

WaterLegacy requests that all existing wild rice waters identified in the *MDNR Wild Rice Study Report*, through MPCA research, and as a result of research by the 1854 Treaty Authority and Minnesota Tribes be designated in rule as wild rice waters. In addition, consistent with the designations for other classes of beneficial uses in Minnesota, all waters where natural wild rice grows or may grow should be protected unless it is convincingly proved that the presence of wild rice at a specific location is an anomaly. Where there is historical or other (e.g. phytolith) evidence that wild rice once grew at a certain location where wild rice is no longer present, that water should be presumed to be a wild rice water unless it can be clearly demonstrated that wild rice had been completely extirpated by November 28, 1975 without any anthropogenic interference with water quality or natural habitat.

The *MPCA Proposal* to set a threshold for the number of wild rice stems before a water body can be considered a wild rice water robs wild rice of its intrinsic value and creates an impossible barrier to protecting some waters where wild rice is an existing use under the Clean Water Act. This proposal also conflicts with the designation of every other beneficial use of State waters, removes designations made by the Minnesota Department of Natural Resources in consultation with Tribes without any findings, let alone a use attainment analysis, and conflicts with the Clean Water Act and its implementing regulations. This proposal must be rejected.

[8] *MDNR Wild Rice Study Report, supra*, listing of water bodies by Lake ID or river segment provided at pp. 54-84.

3. Scientific data and the 2011 Wild Rice Session Law require amendment to Minnesota rules to remove seasonal limitations on application of Minnesota's wild rice sulfate standard.

WaterLegacy finds the MPCA's failure to address the seasonal limitation contained in the existing wild rice sulfate rule troubling. The 2011 Minnesota Legislature specifically directed the MPCA, upon completion of the research to amend the existing rule to "designate the specific times of year during which the standard applies." (Laws of Minnesota 2011, 1st Special Session, Chapter 2, Article 4. Section 32(a)(3)). We believe that the research performed by the University of Minnesota researchers in the Wild Rice Sulfate Standard Studies demonstrates that the wild rice sulfate standard must be applied year-round in order to prevent the formation of the sulfide in sediments that is toxic to wild rice.

Although the MPCA's Findings and Preliminary Recommendations Regarding the Wild Rice Sulfate Standard prepared in February 2014, but never released to the public, concluded, "The sediment incubation experiment data show that sulfate can be converted to sulfide in both warm and cold conditions" (Exhibit 2, p. 2), the MPCA has blocked rather than facilitated consideration of the need to amend the seasonal restriction now contained in the existing wild rice rule.

The MPCA's June 9, 2014 *Analysis of the Wild Rice Sulfate Standard Study: Draft for Scientific Peer Review*[9] told the Scientific Peer Review Panel only half of the truth about the studies designed to evaluate whether a wild rice sulfate limit should be applied year round.

The MPCA *Draft for Scientific Peer Review* stated that research had shown that sulfate movement into sediments and reduction to sulfides occurred 49% faster in the warmer temperature of 23°C as compared to the colder temperature of 4.5°C. (MPCA *Draft for Scientific Peer Review*, p. 34). However, the MPCA omitted from its *Draft for Scientific Peer Review* the more significant DeRocher and Johnson study results demonstrating that, under cold conditions, 3,000 of 3,800 micrograms per centimeter squared ($\mu g/cm^2$) total sulfate that fluxed into sediment during the 80-day loading phase reacted to form sulfide. (Will DeRocher, Nathan W. Johnson, *Temperature Dependent Diffusion Rates of Sulfate in Aquatic Sediments*, Report Dec. 31, 2013, pp. 30, 33).[10]

From this data, Mr. DeRocher and Dr. Johnson concluded, "regardless of adjustments of diffusion and reaction rates to field conditions, a great majority of the sulfate that diffuses into sediments during an ~80 day loading phase is likely to be reduced to sulfide in either warm or cold conditions." (*Id*., p. 35). Thus, "over an 80 day sulfate loading phase, a vast majority of the sulfate added to sediment reacts to form sulfide, even at 4°C when biological rates are slower." (*Id*., p. 38). Mr. DeRocher and Dr. Johnson further explained how their findings addressed the study question pertaining to seasonal sulfate loading and sulfide formation:

[9] MPCA, *Analysis of the Wild Rice Sulfate Standard Study: Draft for Scientific Peer Review,* June 9, 2014, available at https://www.pca.state.mn.us/sites/default/files/wq-s6-42z.pdf.
[10] Will DeRocher, Nathan W. Johnson, *Temperature Dependent Diffusion Rates of Sulfate in Aquatic Sediments*, Report Dec. 31, 2013 can be found on the MPCA website at ftp://files.pca.state.mn.us/pub/wild_rice/Johnson_Sediment_Incubation_Experiment/Temperature_Dependent_Diffusion_Rates_of_Sulfate_in_Aquatic_Sediments_final.pdf.

> Elevated sulfate levels in the porewaters provide favorable conditions for sulfate reducing bacteria that, over time, could produce sulfide in excess of the iron availability in a system and result in an accumulation of dissolved sulfide in pore fluids (Johnson 2014). Sufficient quantities of dissolved sulfide could have detrimental effects on aquatic vegetation and organisms. This study provided both a physical and mathematical model to describe the porewater sulfate response to seasonal sulfate loading into surface water under different temperatures. These results will help to answer the question of how much sulfate diffuses into, and reacts within sediment, as a function of temperature and inform management decisions regarding the timing of sulfate release to natural waterways. (*Id*., p. 38).

Mesocosm studies also raise questions about seasonal application of the wild rice sulfate standard, since adverse effects of elevated sulfate levels were observed from the time of seedling emergence to the seed weights observed at harvest and the proportion of viable seeds (those able to germinate and grow) reflected in the next year's growing season.[11]

When none of the MPCA's questions for the Scientific Peer Review Panel asked about the appropriateness of a seasonal limitation, WaterLegacy requested that the Panel be charged to respond to the following question: "Do study data related to sulfide toxicity and the data pertaining to conversion of sulfate to sulfide at various temperatures support any limits on the time of year during which the sulfate standard would apply to protect natural beds of wild rice? If so, what specific temporal limits?" (*WL Charge Question Comments, supra*, p. 1, Exhibit 4).

No such question was posed to the Peer Review Panel, and several reviewers commented "on the two study components by Nate Johnson, the root zone profiles and sediment incubation experiments, which were not featured in the [MPCA's] Analysis." (*Peer Review Report*, Summary of Discussions, p. 35). One reviewer "strongly recommend to use all studies in the analysis, i.e., also the incubation study and rooting zone geochemistry study." (*Peer Review Report*, Comments of Dr. Gertie H.P. Arts, p. F-9).

Conclusion

The MPCA Proposal to use an equation to set sulfate limits lake by lake is statistically invalid, scientifically unsound, would fail to protect the designated use of waters for wild rice, would impair other beneficial uses of Minnesota waters and would violate the Clean Water Act and its implementing regulations. The MPCA lacks the discretion to enact such a revision of water quality standards and the EPA would lack the discretion to approve it. Despite the MPCA's concerted effort to hide and reject its February 2014 conclusion that the existing wild rice sulfate standard of 10 mg/L is reasonable and needed to protect wild rice in both lakes and streams, that is both the default position and the conclusion clearly supported by the scientific data and technical analysis provided in Minnesota's Wild Rice Sulfate Standard Studies.

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[11] MPCA, *Peer Review Draft, supra*, pp. 27, 30, derived from John Pastor, *Effects of enhanced sulfate concentrations on wild rice populations: results from a mesocosm experiment,* pp. 11-13, available at ftp://files.pca.state.mn.us/pub/wild_rice/Mesocosm_experiment/Pastor_Mesocosm_report.pdf.

The MPCA proposal to count wild rice stems to designate wild rice waters would violate the Clean Water Act and federal regulations, is inconsistent with all other classifications of beneficial uses of Minnesota waters, and would serve to remove designations of wild rice waters already provided by the State in consultation with Tribes, which should, instead, be incorporated into rule. The MPCA's proposed rule amendment to define and list wild rice waters must be modified as discussed in our comments to reflect applicable law and the intrinsic value of the resource.

Finally, the MPCA's failure to consider the implications of the Wild Rice Sulfate Standard Study research on the seasonal limitation applied to the existing wild rice sulfate standard must be reconsidered. Mesocosm studies demonstrating diverse endpoints where addition of sulfate to surface waters impairs wild rice, incubation studies reflecting the conversion of sulfate to toxic sulfide under low temperatures, and the integrated finding that sulfate-driven sulfide toxicity is what impairs wild rice all require amendment of Minnesota rules to require that the wild rice sulfate standard contain no seasonal limitation.

WaterLegacy looks forward to the MPCA's revision of its proposal for amendment of Minnesota's existing wild rice sulfate standard consistent with applicable law and the issues raised in these comments.

Sincerely yours,

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Enclosures