SEASONAL APPLICATION OF THE WILD RICE SULFATE STANDARD – PARTRIDGE RIVER

Draft MPCA Staff Recommendation - August 27, 2012 (Update/Clarification)

ISSUE:

Minnesota Rule 7050.0224 identifies a Class 4A water quality standard of 10 mg/L for sulfate, "...applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels". In order to effectively apply the standard, the period when wild rice may be susceptible to high sulfate levels needs to be determined.

OBJECTIVE:

This document focuses on the development of a MPCA draft staff recommendation for the time period of application of the wild rice standard for waters used for the production of wild rice in the Partridge River, a water which is potentially affected by the current Mesabi Nugget facility and the proposed PolyMet project and for which sufficient information is available to make a recommendation.

DISCUSSION:

There appears to be an overall consensus from experts testifying in the 1975 Minnesota Power hearings that the primary period of both nutrient uptake from the water column and susceptibility of the wild rice plant to high sulfate levels is from seed germination to leaf emergence. Additionally, more recent discussion with a wild rice expert at UMD suggested that there may be a secondary period of susceptibility when the seed of the plant is developed, which in Minnesota typically occurs in mid to late August.

It is reasoned that germination of the wild rice seed takes place at approximately ice-out, which according to DNR records for lakes in northeastern Minnesota (e.g., Vermilion, Fall, Shagawa and Island Lakes) generally occurs from mid April to mid May, with leaf emergence taking place by early July and seed 'setting' occurring in mid to late August. It therefore seems reasonable to conclude that the main period of sulfate susceptibility extends primarily from mid April to mid July with a secondary period in August.

Testimony during the Minnesota Power hearings from Dr. Grava and Dr. Stewart also mentioned in general terms the potential for transfer of sulfate in the water column to the sediment with the resulting potential for generation of adverse levels of hydrogen sulfide in the sediment. They further suggested that this conversion of sulfate to hydrogen sulfide requires reducing/anaerobic (oxygen-free) conditions and that an oxygenated environment would not be favorable for this to occur. Dr. Grava also testified that hydrogen sulfide toxicity to wild rice would be less likely in flowing water conditions. Thus a river system with flowing water and morphology that does not promote reducing/anaerobic conditions has less likelihood of hydrogen sulfide toxicity to wild rice.

Testimony from the 1975 Minnesota Power hearings, despite being from 35+ years ago, is considered to be relevant to this staff recommendation because much of the testimony during the hearings was focused on the annual growth cycle and nutrient needs of the wild rice plant and on the physical characteristics of the water body hosting wild rice resources, both of which in many respects are similar

in nature to that of the Partridge River. The Grand Rapids, Minnesota area, where the Minnesota Power facility is located, has a similar climate to that of the Partridge River area; thus it would be expected that the timing of the wild rice growth cycle would also be similar. The Minnesota Power hearings included discussion on the flow regime of 'Blackwater Lake', a naturally impounded segment of the Mississippi River through which the main channel flows, and the importance of flowing water in limiting the creation or accumulation of hydrogen sulfide. This characteristic of a general flowing condition of the host water body is also comparable to conditions in the Partridge River.

Field studies conducted on the Partridge River in support of the Environmental Impact Study for the proposed PolyMet project (e.g. flow monitoring, Rosgen surveys) provide information that suggests, notwithstanding the inclination of wild rice to grow at the edges and other slower moving portions of river systems, that the Partridge River, in general, does not appear to have the morphology or hydrology characteristics that would promote the anaerobic/reducing conditions necessary to result in hydrogen sulfide toxicity towards wild rice.

DRAFT MPCA STAFF RECOMMENDATION:

MPCA staff have concluded that the 10 mg/L sulfate standard identified in Minnesota Rule 7050.0224 is applicable for portions of the Partridge River used for the production of wild rice from April 1 through August 31. These dates take into account general variability associated with annual climatic variations, geographic locations and individual stand variability within the Partridge River watershed.

The April 1st through August 31st timeframe applies at the specific reaches of these river systems that have been determined to be waters used for the production of wild rice. This would mean that when the sulfate contribution from any specific discharge point is evaluated, the travel and residence time of the river system from the point of discharge to the location of wild rice will need to be considered.

MPCA staff further recommends that continuation of ongoing annual monitoring of wild rice areas to identify cyclical and/or long-term trends be included, as appropriate, in water quality permits issued for projects discharging to the Partridge River system with the understanding that should monitoring indicate an unacceptable potential for impact to wild resources, the permit reopening provisions already included as standard conditions in water quality permits can be used to modify the permit to incorporate appropriate changes to the terms and conditions of the permit.

The MPCA staff specifically considered the following information in the development of its recommendation:

- The variability of the date of ice out from year to year. The April 1st date included in the draft staff recommendation is generally within the recorded range of ice out dates for lakes in northern Minnesota. (For example, in 2012 record early ice out occurred on or about April 1st in the region while the second earliest year on record, 2010, ice out occurred approximately April 6th.)
- The travel/residence time within the river system from upstream/headwater portions of the river where a discharge may be located to locations further downstream where the wild rice may be growing. This time could range from days in the free flowing upstream portions of the rivers to weeks in the river segment downstream of Colby Lake.
- The potential for elevated sulfate in the water column during the 'non-growing season' resulting in the formation of toxic levels of hydrogen sulfide in the sediments. The flow and stream characteristics of the river systems was considered with the resulting recognition that, consistent with expert testimony presented in the Minnesota Power hearings, deleterious levels of hydrogen

sulfide would not be expected to develop in identified wild rice areas that have relatively free-flowing flow characteristics or a relatively oxygenated substrate. While the exact nature of the substrate within the Partridge River is not well known, the documented average flow rate of the river in areas with wild rice is on the order of 90 cubic feet per second (cfs). This would suggest, as Dr. Grava alluded to in the Minnesota Power hearings, that hydrogen sulfide toxicity would be less likely to occur in the relatively free-flowing conditions of the Partridge River than it would be if flow conditions were more stagnant.

- The limited potential in the natural river systems for freeze/thaw impacts on the wild rice seed bed as suggested by the documented base flow of the Partridge River ascribed to year-round groundwater contributions. (However, this potential should be re-evaluated for projects/permits that may result in artificial fluctuations to natural stream flow.)

This MPCA draft staff recommendation is based on information currently available. MPCA staff will consider additional information that may become available in the future, whether from project proposers or from other interested/affected parties, and reserves the right to modify the staff recommendation accordingly.

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SUPPORTING INFORMATION:

- Minnesota Power Hearings (1975)
    - General consensus of the three wild rice experts testifying (Drs. Stewart, Grava and Moyle) was that if sulfate concentrations in water did affect wild rice, the most critical time would be during the spring of the year
    - Dr. Stewart testified that wild rice gets most of its nutrients from the water column from germination (late April to early May) to the aerial leaf stage with the most critical time being the early leaf stage (May)
    - Dr. Grava testified that high sulfate concentrations in the water at the time the seed germinates would be detrimental with this period of sensitivity extending until the aerial leaf is developed – he concludes that the overall period of sensitivity would be the months of April, May and June
    - Dr. Moyle testified that the period when high sulfate concentrations would be more critical than other times would be May and early June
    - Dr. Stewart testified that sulfate in the water column can be deposited or transferred to the sediment which can, under certain conditions (e.g. anaerobic or reducing conditions) create hydrogen sulfide which is known to be toxic to wild rice – oxygenated environments would be unfavorable for the conversion of sulfate to hydrogen sulfide in the sediment.
    - Dr. Grava testified that hydrogen sulfide toxicity would be less likely in flowing water conditions than in stagnant water conditions – due generally to oxygenated sediment conditions preventing the formation of hydrogen sulfide and the moving water preventing accumulation of any hydrogen sulfide that may form
    - The Hearing Officer concluded, based on the testimony provided, that the more stringent discharge limits should be included in the permit for the critical months for wild rice (late April to mid June)

- Grava and Raisenen (1978)
    - Approximately 80% of nutrient (e.g., N, K, P) accumulation in the wild rice plant takes place between day 15 and day 90 following seed germination – up to 50% of that occurs between approximately day 55 and day 65.

- Oelke (1982)
  - Wild rice requires 106 – 130 days to mature in north central Minnesota, depending upon temperature during the growing season and variety. Flowering begins in late July and grain formation in August

- Rogosin (1986)
  - Seed germination occurs about the middle of May in northern areas when waters are free of ice. Stems begin to emerge in July

- Meeker (1993)
  - Germination of wild rice seed begins immediately at ice-out, which in his study area in northern Wisconsin can vary between mid April and early May depending on year and geographic location

- Lohse-Hanson Internal Memo (1988)
  - Memo prepared for Jim Strudell in NPDES permitting in response to questions raised by DNR Waters regarding the discharge from the Minntac tailings basin
  - Advised that the sulfate standard applies April 1 to June 30 and recommended no discharge of high sulfate basin water during this period
  - Advised that the sulfate standard does not apply July 1 to August 31 but recommended that a discharge be controlled so as not to adversely affect water levels
  - Advised that the sulfate standard does not apply September 1 to March 31 and stated that no information was available to suggest that a discharge was harmful at that time
  - These recommendations were based largely on recommendations from the Hearing Officer in the 1975 Minnesota Power hearing

- Doug Hall Letter to USX (2000)
  - Stated that the draft reissued permit for the Minntac tailings basin would likely include a discharge limit for sulfate of 10 mg/L effective April through September
  - The letter did not provide a rationale for the recommended effective period

- Strudell / White Internal Email (2004)
  - NPDES permitting requested of Environmental Outcomes confirmation of the effective period of April through September identified in the 2000 Doug Hall Letter to Minntac
  - Environmental Outcomes confirmed the recommendation of the entire growing season from April through September

- Minntac EIS – Wild Rice Technical Memo (2004)
  - By referencing the 2000 Doug Hall letter, the EIS stated that "the MPCA considers the 10 mg/L sulfate standard applicable to industrial discharges between the months of April and September"
  - Identified that this period "brackets the critical germination, boot stages and emergence stages of wild rice" (Note that these critical plant stages are completed well before September, the end of the identified period)
  - Reviewed various research data on higher sulfate levels and from this concluded that "it is reasonable to assume that "appropriate' sulfate levels for wild rice growth are bracketed within a range of 10-250 mg/L.

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- Did not include sulfate as a 'baseline criteria for assessing impacts to wild rice (instead focused on water level, alkalinity, pH, hardness, heavy metals, etc.)

- MPCA Staff Oral Communication with Dr. John Pastor (UMD) (2010)
  - Approximately 60 – 65 percent of the plant's nitrogen nutrient is taken up before it enters the reproductive growth phase. Then there is a secondary uptake "burst" from the sediments right before seed production. Also referenced internal translocation of nitrogen from parts of the plant into the developing grain.

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