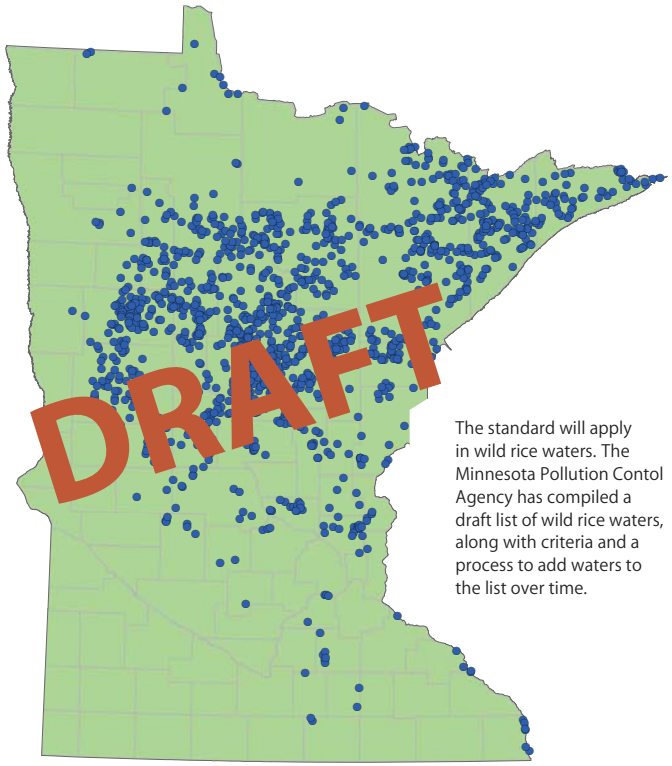
Protecting wild rice from too much sulfate

The impacts of sulfate on the growth of wild rice are affected by how much iron and organic carbon are in the sediment. An equation that accounts for these variables will determine if a water body needs protection or not.



The standard will apply in wild rice waters. The Minnesota Pollution Contol Agency has compiled a draft list of wild rice waters, along with criteria and a process to add waters to the list over time.

Proposed definition: *"Wild Rice Water" means a surface water of the state that contains a self-perpetuating population of wild rice plants, either currently present or that have been present in the given waterbody since November 28, 1975. The self-perpetuating wild rice population must be represented by a minimum of 8,000 wild rice stems over the surface of a lake, wetland, or reservoir waterbody or a minimum of 800 wild rice stems over a river-mile reach for a riverine waterbody. Waters designated as wild rice waters are specifically listed as such in Minn. R. 7050.0470 and are identified with the symbol [WR] preceding the name of the waterbody.*

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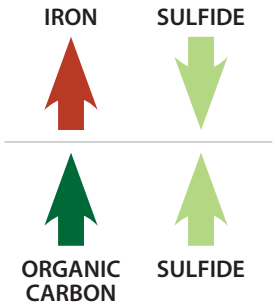
A tale of two variables: iron vs. organic carbon

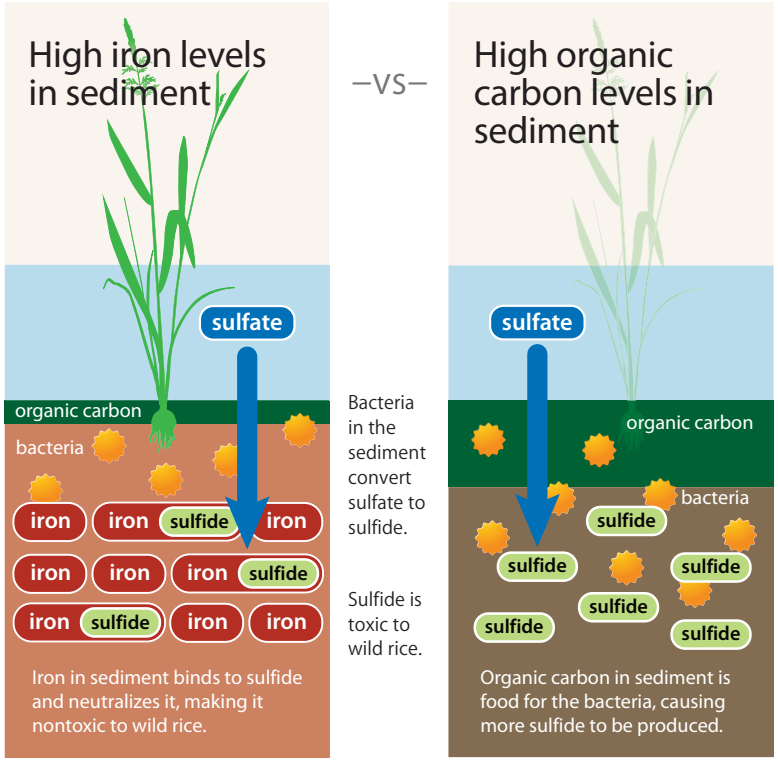
In general, sulfide is toxic to wild rice and other living things. When sulfate is added to surface waters, the sulfide concentrations in the sediment also increase.

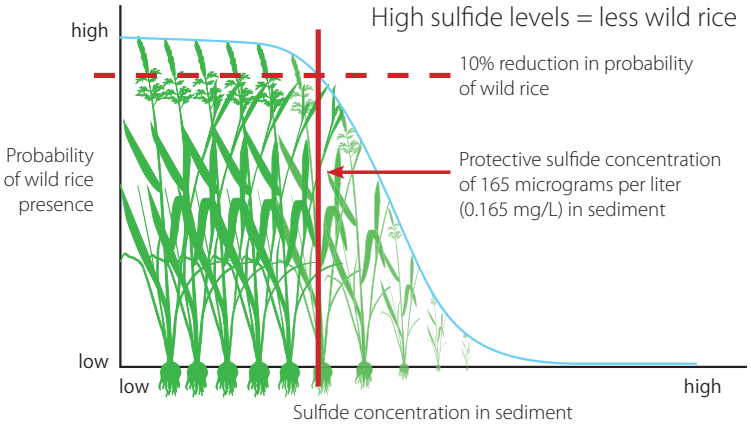
In Minnesota lakes, streams, and wetlands, the conversion of sulfate to sulfide is highly variable due to environmental differences. The most important of these differences are the concentrations of iron and organic carbon in the sediment.



The relationship between sulfide and wild rice

From 2011 to 2013, monitoring data from 112 Minnesota lakes, wetlands, streams, and rivers shows that wild rice was observed less frequently in waters with higher concentrations of sulfide in sediment.





An equation to protect wild rice

The concentration of sulfate that would be protective of wild rice at a site can be calculated using this equation:

$$Sulfate = 0.0000136 \times Organic\ Carbon^{-1.410} \times Iron^{1.956}$$ (Equation 1)

Sediment organic carbon and sediment iron data from a wild rice site must be entered into the equation to get the protective concentration of sulfate. Calculating the appropriate sulfate level based on iron and total organic carbon measurements is a more precise approach than relying on a single sulfate concentration as a protective threshold for all sites.

Sample calculations

To illustrate the calculation of protective sulfate concentrations, Equation 1 was applied to three MPCA study site locations: Little Round Lake, Elk Lake, and Rice Lake. These sites are in minimally disturbed lakesheds, and have widely varying protective sulfate concentrations (see the table below). Note that these examples are for illustrative purposes only.

Study site	Total organic carbon in sediment (%)	Extractable iron in sedment (µg/g)	Protective sulfate concentration (mg/L)
Little Round Lake	27.5	3,069	0.8
Elk Lake	10.2	8,480	25
Rice Lake	35.6	50,389	140