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Monday, September 22, 2025

Re: United States Steel Corp – Keewatin Taconite and Tailings Basin Draft Wastewater Permits

Dear Comment Review Committee,

Thank you for this opportunity, and previous, to provide input on these two Draft NPDES Permits. I approach this opportunity as an independent individual more interested and focused on one particular interest – to grow wild rice (WR). For approximately 12 years, I have had generous and fortunate opportunities to participate in various research projects, including my own Ph. D. studies, focused overall on growing WR. It is with this training and experience that I respectfully submit this document in support of using recently published Minnesota Pollution Control Agency (MPCA) site-specific sulfate standard (SSS) guidance (MPCA Dec 2023) and WR field monitoring guidance (Kjerland 2015) when considering NPDES Permit criteria specific to aqueous sulfate (SO4) concentration(s) in discharges entering WR-containing waters. Within this overall approach, three primary foci appear logical:

1) An agreement between regulatory and industry partners will take immediate pressure off both entities re: WR-SO4 tensions, and allow both time to discern more scientifically defensible aqueous SO4 NPDES Permit criteria, if necessary;
2) In my experience, this MPCA (Dec 2023) guidance document reads quite similarly to a WR enhancement and / or restoration opportunities plan; and
3) Within the previous, beneficial long-term WR management and enhancement practices may become apparent, adding even more value to an initial effort of SSS development

Although one may think the opposite, information provided below is meant to highlight time and study required for completion of successful SSS development, and potential WR restoration and enhancement projects. As mentioned, and detailed in MPCA (Dec 2023), SSS development will take years; however, the overall outcome may be multi-fold beneficial: SSS development in agreement between regulatory authorities and industry, and development of a WR restoration and / or enhancement plan, also site-specific.

1) Time and Pressure

Currently, exceptional pressure exists on both regulatory and industry partners specific to this topic of mitigating potential harm to WR resultant from characteristics of industry discharges; specifically, aqueous SO4. Pressure on regulatory authorities to be defensible in their NPDES Permit decisions, and pressure on industry to comply with NPDES Permit criteria to maintain effective and efficient operations. As so much plant biomass has transformed into coal, these two entities may begin to harden, but into their own beliefs; working together may become more and more difficult. Although much time, energy, and resources have been spent debating and studying this topic, only in December 2023 was the more recent iteration of MPCA SSS guidance published. It is with application of this SSS guidance that at least some resource expense in general may become valuable.

Over the past 10-12 years, multiple peer-reviewed articles have been published in pursuit of this elusive 'what is the defensible [SO4] that WR can tolerate and remain sustainable' (examples: Fort et al. 2014, 2017; Pastor et al. 2014; 2017; Myrbo et al. 2017, LaFond Hudson et al. 2018, 2020; Tedrow and Lee 2021, 2022). For better or for worse, one general conclusion is that there is no single datum which answers this question. In short, each aquatic system in which WR grows is unique and at least in terms of [SO4] will no doubt have its own specific 'tolerance' value. With this in mind, applying guidance detailed in MPCA (Dec 2023), in combination with field study guidance in Kjerland (2015) provides a defensible overall methodological framework from which to begin investigating and developing a SSS for an individual aquatic WR system. Completing this process will take time, several years in fact. MPCA (Dec 2023) cites at least a 10-year duration to allow for sufficient field WR population data to temporally contain at least one 'boom and bust' cycle. These can occur within a few years, or not within the cited 10-year duration; again, a WR population characteristic specific to each aquatic system ('site').

In my experience, WR 'boom-bust' cycles can be substantially dependent on weather conditions, both larger (ecosystem) and smaller (specific lake or river segment) scale. More particularly, one may have difficulty discerning between 'natural' boom-bust cycle(s) and a 'bust' resultant from weather-related influences (i.e., flooding), not nutrient-element sequestration or litter accumulation as described by **Walker et al. (2006, 2010)**. Therefore, allocating sufficient time to studying any given aquatic WR-containing system is critical to acquiring sufficient and defensible data to inform development of a SSS.

2) Restoration and / or Enhancement – MPCA (Dec 2023) Has been Done Before(!)

In my research experiences, there have been three (3) specific projects focused on WR restoration and enhancement of existing WR areas. All three were ultimately successful in their individual project objectives, but were several years in the making. Additionally, for each of the following, sediment, porewater, overlying water, WR plants (and other plants if they were at least of partial project focus), and WR seeds were sampled in support of system characterization years prior to publication of MPCA (Dec 2023). Although only recently published, these WR system characterization methods have been used for many years.

WR Restoration Opportunities: Overall objectives of this project were focused on discerning opportunities for WR restoration in a combined multi-lake aquatic system. For approximately six (6) years, characterization of this combined system were studied and evaluated for WR restoration potential – sediment, pore water, overlying water, aquatic plant assemblage, and lake water depth characteristics were of principal importance. Ultimately, WR grew in all seeded test plots throughout this system where water depth, sediment type, and other aquatic vegetation met acceptability criteria for WR seeding. Despite not having MPCA (Dec 2023) as guidance, this project integrated nearly all, if not more, focal points and concluded after approximately six years. Ultimately, combined opportunities existed as initial approaches to begin WR restoration: 1) manage competing aquatic plant assemblages; 2) decrease water depths throughout this system; and 3) begin an intensive WR seeding program, preferably with active water fowl management to mitigate problematic herbivory.

Wild Rice Enhancement: In a major watershed in Ontario near the Minnesota-Ontario border east of International Falls, WR was frequently adversely influenced by 'man-made' Spring water depth increases; basically, water releases from dammed impoundments. Whole crops had been lost due to anthropogenic flooding. This project focused on how specific water depth increases did or did not adversely influence WR at specific developmental stages (submerged, floating leaf, aerial). For three growing seasons, rafts were used to simulate development-stage specific water depth increases. Ultimately, guidance was provided to impoundment managers and as water releases were adjusted WR populations became more stable and did not suffer catastrophic loss due to man-made flooding in this region.

Wild Rice Restoration: In true boundary waters between Minnesota and Ontario, within the Rat River Bay watershed area, cattails (CT) of multiple varieties, including hybrid *Typha glauca*, have out-competed WR in many areas. This overall project focused on removal of CT with plans for seeding and restoring WR to areas of CT removal. Mechanical CT removal was initiated in August 2014, and during May-June 2015, WR was observed growing (dominant) throughout multiple areas of CT removal without active WR seeding (Dysievick 2019). Throughout the following three years, CT were removed from multiple additional areas, all of which responded with WR the following growing season. For at least the following four to five growing seasons, WR continued to dominate in areas of CT removal. Overall, WR was successfully restored to many areas dominated by CT one to three years prior to CT removal. Some CT dominated areas had been so for ~ 25 years according to First Nation contacts, which means WR seed remained dormant and viable for 25 or more years before germination following CT removal.

3) Additive benefits of WR System Characterization

Because MPCA (Dec 2023) reads similarly to a WR enhancement and / or restoration plan, no doubt beneficial WR management and enhancement opportunities will become evident during SSS development. Practices such as beginning control of competing aquatic vegetation. Despite what we all know about biodiversity and ecosystem stability, WR prefers, and needs, to grow as a monoculture – it does not compete well with perennials, and can be easily and quickly outcompeted if other aquatic plants become established within a WR area.

While completing SSS development over multiple consecutive years, a sub-focus of detailing adverse influence on WR and mitigation tactics for these adverse influences could easily be involved. This may be as simple as considering water depth management based on water depth data; harvesting WR seed only to broadcast to areas currently sparse or void of WR growth; or slightly more intense tactics such as active management of other aquatic vegetation. Small areas could be 'test plotted,' with WR responses monitored along with SSS development requirements. No doubt WR would respond well to more active management focused on increasing its density and distribution.

Summary
Since MPCA (Dec 2023) was published not two (2) years ago at writing of this suggestion, and all details of this publication have been done before re: characterization of WR systems, it seems logical to allow industry permittees subject to inclusion of an NPDES Permit aqueous SO4 limit at least the suggested 10-year duration for SSS development. Two specific documents will be used to acquire data in support of this pursuit: MPCA (Dec 2023) and Kjerland (2015). Both industry and regulatory partners would have to sign-off on the overall plan, with an agreement that since projects of this planned duration will change, likely multiple times, throughout their completion, data obtained throughout the project will remain use-able at conclusion for consideration of SSS development for an individual receiving system.

Thank you very much for your time and consideration; this comment and suggestion period; and for reading all of this. Much appreciated. I look forward to any response; and of course, I am hopeful that both regulatory authorities and industry can take advantage of this beneficial SSS guidance document and allow some time to do some good science and help enhance our WR resources.

Sincerely,

O'Niell Tedrow, Ph. D.

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Dr. O'Niell Tedrow, Ph. D.

References

Dysievick K (2019) Wild rice re-establishment through mechanical removal of invasive cattails (*Typha angustifolia* L.). Lakehead University Master of Science Thesis. https://knowledgecommons.lakeheadu.ca/handle/2453/4391. Accessed August 12, 2025. Saved as .PDF.

Fort DJ, Mathis MB, Walker R, Tuominen LK, Hansel M, Hall S, Richards R, Gratten SR, Anderson K (2014) Toxicity of sulfate and chloride to early life stages of wild rice (*Zizania palustris*). Environ. Toxicol. Chem. 33(12), 2802-2809.

Fort DJ, Todhunter K, Fort TD, Mathis MB, Walker R, Hansel M, Hall S, Richards R, Anderson K (2017) Toxicity of sulfide to early life stages of wild rice (*Zizania palustris*). Environmental Toxicology and Chemistry 36(8), 2217-2226.

Kjerland T (2015) Wild rice monitoring handbook. The University of Minnesotan Sea grant Program. Publication #SH16.

LaFond-Hudson S, Johnson NW, Dewey B (2020) Interactions between sulfide and reproductive phenology of an annual aquatic plant, wild rice (*Zizania palustris*). Aquatic Botany 164, 103230.

LaFond-Hudson, S., Johnson, N.W., Pastor, J., Dewey, B. (2018) Iron sulfide formation on root surfaces controlled by the life cycle of wild rice (*Zizania palustris*). Biogeochemistry. https://doi.org/10.1007/s10533-018-0491-5.

Myrbo A, Swain EB, Engstrom DR, Coleman Wasik J, Brenner J, Dykhuizen Shore M, Blaha G (2017). Sulfide generated by sulfate reduction is a primary controller of the occurrence of wild rice (*Zizania palustris*) in shallow aquatic ecosystems. J. Geophys. Research: Biogeosciences, 122, 2736–2753. https://doi.org/10.1002/2017JG003787.

Pastor J, Dewey B, Johnson NW, Swain EB, Monson P, Peters EB, and Myrbo A (2017) Effects of sulfate and sulfide on the life cycle of *Zizania palustris* in hydroponic and mesocosm experiments. Ecological Applications 27(1), pp. 321-336.

Tedrow O (2020) Laboratory- and field-scale bioassays for predicting responses of wild rice (*Zizania palustris* L.) to exposures of site-specific sediments and waters. Lakehead University Doctor of Philosophy Dissertation.

Tedrow O, Lee PF (2021) Mesocosm and microcosm bioassays to examine effects of mine-influenced sediments on the growth of wild rice (*Zizania palustris* L.). Water, Air, and Soil Pollution (2021) 232:508. https://doi.org/10.1007/s11270-021-05467-8

Tedrow O, Lee PF (2022) Use of wild rice (*Zizania palustris* L.) in paddy-scale bioassays for assessing potential use of mining-influenced water for irrigation. Mine water and the Environment. https://doi.org/10.1007/s10230-022-00908-0

Walker RD, Pastor J, Dewey BW (2006) Effects pf wild rice (*Zizania palustris*) straw on biomass and seed production in northern Minnesota. Can. J. Bot. 84, 1019-1024.

Walker RED, Pastor J, Dewey BW (2010) Litter quantity and nitrogen immobilization cause oscillations in productivity of wild rice (*Zizania palustris* L.) in northern Minnesota. Ecosystems 13, 485-498.