



September 8, 2025

Minnesota Pollution Control Agency
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Re: Establishing Outcomes-Based Data Collection and Alternative Pathways to Nitrogen Reduction in Minnesota’s Nutrient Reduction Strategy

I. Introduction

The undersigned groups write to request revisions to the Draft Updated 2025 Nutrient Reduction Strategy (Draft NRS or NRS). We appreciate the Draft NRS’s fact-intensive inquiry into Minnesota’s progress towards its nitrogen and phosphorus reduction goals, as well as its identification of the work that remains to be done. The Draft NRS effectively highlights that continued efforts to reduce total nitrogen and phosphorus loads will not only help us meet our obligations to downstream states in the Mississippi River Basin and other large watersheds, but it will also help Minnesota meet its goals to protect drinking water and aquatic life in priority watersheds. We also appreciate the recognition within the Draft NRS that agricultural nutrient reduction practices have many co-benefits such as climate resiliency, wildlife habitat, soil health, and even long-term agricultural productivity.

This comment focuses on nitrogen pollution from cropland, a major source of pollution with significant health and environmental harms.¹ While we appreciate the Minnesota Pollution Control Agency’s (MPCA) work to revise the NRS in order to scale up adoption of voluntary agricultural management practices, these efforts alone are not enough to help Minnesota reach its nutrient reduction targets, particularly for nitrogen.² In the 2014 NRS, MPCA set a long-term goal of reducing nitrogen pollution in the state by 45% by 2040 with a mid-point reduction target of 20% by 2025.³ Today, state-wide nitrogen pollution has only decreased between 6-9%, depending on the watershed.⁴ The majority of remaining reductions will need to come from the agricultural sector.⁵ We support this 45% nitrogen reduction target. Yet, to make up for this

missed milestone, and keep Minnesota on track to reach its nutrient reduction goals by 2040, we urge MPCA to include in the NRS outcomes-based metrics, institute application limits to reduce nitrogen pollution from croplands in Minnesota and require adoption of best management practices (BMPs) in the most vulnerable parts of the state.

II. Nitrogen Pollution Continues to Harm People, Ecosystems, and the Climate

Nitrogen pollution in Minnesota has been an issue since the 1980s, when federal and state agencies first identified rising nitrate contamination in Minnesota's groundwater sources.⁶ Nitrogen is a major contaminant and presents a risk to human and ecosystem health while contributing to climate change. In Minnesota, 72% of all excess nitrogen in rivers comes from agriculture, specifically from the overapplication of chemical fertilizer and manure.⁷

When nitrogen fertilizer is applied to soil, it can transform into nitrate, a major contaminant in drinking water. If excess fertilizer is applied, nitrate that is not taken up by the plant has the potential to leach into drinking water supplies. Research links nitrate contamination in drinking water to increased risk of numerous types of cancer and thyroid disorders.⁸ Children and pregnant women are particularly vulnerable, as nitrate exposure can result in birth defects and "blue baby syndrome" in newborns.⁹ Drinking water testing shows that millions of Minnesotans are harmed by nitrogen pollution. One study estimates that one in eight Minnesotans rely on groundwater-based public systems which have exceeded the federal and state limit (10 mg N/L) for nitrate in their drinking water source.¹⁰ This does not include the 1.1 million Minnesotans that rely on private drinking wells.¹¹ While people on municipal water systems can trust that their water supply is tested regularly for nitrates, private well users must test and treat their water themselves. As a result, Minnesotans on private wells are distinctly vulnerable to nitrate contamination, and 80% of private well users have not tested their water quality as frequently as recommended.¹²

Minnesota's southeastern karst region faces especially concerning levels of nitrate contaminated groundwater. In 2017, 19% of wells in Winona County tested above 10mg N/L, with half of wells in Fremont Township testing above this limit. Newer research indicates certain cancers and birth defects are linked to drinking contaminated water with 5mg N/L or lower.¹³ A combination of vulnerable geology, a high quantity of animal feeding operations, the transition from a diverse production of small grains to a corn/soybean monoculture, and other agricultural activity have forced many residents in this region to rely on unhealthy, potentially dangerous, drinking water sources.¹⁴

Excess nitrogen also harms downstream water quality, threatening biodiversity and fishing economies. From 2010 to 2020, six Minnesota communities faced financial costs of over 3 million dollars to remediate waterbodies from harmful algal blooms.¹⁵ Nitrate pollution flowing through the state's northern regions contributes to severe algal blooms and eutrophication in the Lake Winnipeg Basin.¹⁶ MPCA has concluded that nitrate levels of more than 5 mg/L for cold waters and 8 mg/L for other waters are unsafe for aquatic life, although it has not adopted a water quality standard based on this conclusion.¹⁷ Nitrogen runoff from Minnesota agriculture also flows beyond state boundaries, down the Mississippi River and contributes to the annual hypoxic zone in the Gulf of Mexico.¹⁸ This hypoxic zone has inflicted up to 2.4 billion dollars in damage to fisheries and marine life every year.¹⁹

Excessive fertilizer use contributes to climate change and air pollution in the form of nitrous oxide (N₂O), a greenhouse gas that is 273 times more potent than carbon dioxide.²⁰ N₂O also depletes stratospheric ozone, which is associated with increased rates of skin cancers and cataracts.²¹ Overapplication of nitrogen fertilizer is the primary driver of N₂O emissions in agriculture.²² One study reported that at least 35% of Corn Belt's N₂O emissions could be attributed to sources like fertilizer leaching and runoff.²³ A similar study reported that N₂O emissions in the region as a result of unabated nitrogen pollution may further increase with a warming climate.²⁴

In all three major watersheds in Minnesota, the largest source of nitrogen pollution into waterways comes from croplands.²⁵ The NRS can and should play a critical role in supporting state-wide efforts to curb nitrogen pollution from croplands in a meaningful way by 2040. To achieve these goals, MPCA states that “successful implementation [of nitrogen reductions] will require building on Minnesota’s existing voluntary and regulatory foundations”.²⁶ In an effort to support MPCA in achieving these goals, we urge the agency to advance data collection and reporting approaches within existing programs and to introduce additional policies or programs that can help ensure that the state’s downstream nitrogen reduction targets are met by 2040 and that significant progress is made to meet drinking water and aquatic life standards within the state.

III. Tracking Voluntary Practice Adoption is Not Enough to Ensure Reductions in Nitrogen Pollution

In the Draft NRS, MPCA targets cropland nitrogen reductions over the next 15 years through three main pathways: the University of Minnesota (UMN) Continuous Living Cover campaign, agriculture improvement programs (e.g. the Agricultural Water Quality Certification Program), and increased research and development.²⁷ These strategies build on existing efforts focused on developing and adopting effective best management practices through education and incentive-based voluntary approaches. To estimate progress, the Draft NRS relies on proxy indicators for nitrogen pollution reduction: theoretical estimates of nitrogen reduction for each BMP and the number of acres adopting a practice.

The Draft NRS leans heavily on a 2025 UMN literature review. The literature looks at four practice types where better nitrogen management can be scaled up, including nitrogen fertilizer management practices, cover cropping, land use change to perennials, and conservation drainage practices.²⁸ These in-field management practices have a wide range of nitrogen reduction potentials that are thoroughly explored and documented in the literature review.²⁹ However, to ensure that MPCA can meet its targets, these estimates of nitrogen reduction efficiencies are not sufficient to ensure MPCA can meet its targets. Instead, there needs to be greater focus collecting in-field practice performance data.

MPCA also rolled out the BMP Effects Estimator Tool (BEET), which utilizes practice performance estimates and acreage enrolled to report an estimate of the load reductions to water from the adoption of BMPs through local, state, and federal programs.³⁰ The tool reports that since 2014, over 4 million acres of land have been treated by new practices adopted through government programs (roughly 18% of cropland).³¹ The tool estimates that in the last 19 years, BMP adoption has only resulted in between 4-5% of nitrogen reductions at the watershed level.³² Not only has practice adoption resulted in marginal water quality improvements, but MPCA is

not collecting the data needed to ground-truth whether these practices are working in the field. Without outcomes-focused metrics, policymakers cannot determine or track whether programs are reducing nitrogen pollution in a meaningful way.

IV. The NRS Must Include Outcomes-Focused Metrics on Nitrogen Reductions in the Agriculture Sector

To accelerate nitrogen reduction from croplands, MPCA should build out data collection and reporting metrics that will help track the state's progress towards achieving the NRS's goal of 45% total nitrogen reductions by 2040. Currently, data collected for local, state and federal programs all focus on proxy metrics, like the number of acres enrolled in various programs, which says nothing about the measurable reductions in runoff or pollution.³³ Tracking acres enrolled and relying on theoretical estimates of nutrient reductions from BMPs does not help MPCA determine if its nutrient reduction programs are effective. Instead, MPCA must consider collecting and publishing data which take an outcomes-focused reporting approach – focusing on measuring, monitoring and reporting nutrient reductions at spatial scales that are relevant to groundwater quality in nearby wells, which is often at the field or per-acre level.³⁴

In the Draft NRS, MPCA states that “in-field nutrient management practices for both nitrogen and phosphorus are particularly difficult to track and know, with certainty, the potential opportunities for improvement.”³⁵ While perfection may not be possible, there are available strategies to adequately estimate, measure, and monitor impact at the field-level. For instance, as was recommended by the Southeast Minnesota Nitrate Working Group (Nitrate Working Group), MPCA should coordinate with the Minnesota Department of Agriculture (MDA) to require nutrient management plans for all cropland farmers, similar to what is required by MPCA of livestock farmers through Manure Management Plans.³⁶ These plans should be submitted to a state agency (MDA or MPCA) and used to track progress on fertilizer management approaches, including overall application rates. Anonymized field-level nitrogen application data can provide MPCA with helpful information about nutrient management practices and their associated water quality improvements with certainty of their pollution reduction outcomes.

Additionally, agencies need to employ occasional field audits of BMP effectiveness, to better track outcomes associated with nutrient reduction BMPs. For example, farms enrolled in programs like the Agricultural Water Quality Certification Program should be subject to occasional field audits, where water and soil data can be measured to track BMP effectiveness. This approach also provides early indicators of if practices are meeting pollution reduction outcomes, given that there is often a lag time between nutrient reduction and groundwater quality.

We also support the recommendation of the Nitrate Working Group to require collection of finer scale fertilizer sales reporting, moving from the township to field scale, in areas where groundwater vulnerability is high.³⁷ Finally, MPCA should expand the tracking of groundwater and well testing. This data should be publicly accessible and available similar to data collection and reporting for nitrates in rivers and streams throughout the state.³⁸ This should also involve more regular groundwater and well testing, particularly in vulnerable groundwater areas.

V. Voluntary Programs Alone are Unlikely to Achieve MPCA's Goal of Reducing Nitrogen Pollution by 45 Percent by 2040.

We support MPCA's goal of achieving a 45 percent reduction in nitrogen pollution by 2040. Yet, to achieve the nutrient reduction goals in the approach laid out in the Draft NRS, Minnesota will need widespread adoption of agricultural practices that are proven to reduce nutrient runoff.³⁹ MPCA acknowledges in the Draft NRS that "all BMPs can have feasibility constraints related to scalability" and that a dramatically higher level of adoption compared to historic rates of adoption is required to reach 2040 targets.⁴⁰ Although the focus on voluntary program adoption can result in some nutrient reductions, the available evidence does not demonstrate that these practices will be voluntarily adopted on the scale needed to meet these targets. In other words, voluntary programs alone will not get Minnesota to its nitrogen reduction targets.

State agencies need to introduce additional measures beyond the voluntary measures that MDA and MPCA have traditionally utilized. We urge MPCA to pursue in-field nutrient reduction measures for croplands, focusing major efforts on limiting manure application rates, and coordinating with MDA to do the same with chemical fertilizer. This management issue is important because "the combination of nitrogen fertilizer and manure crop-available nitrogen applied to all croplands exceed UMN recommended rates by an estimated statewide average of 18%".⁴¹ The literature review conducted by UMN estimated that bringing application rates down to the maximum return to nitrogen level would reduce nitrate leaching by 15%.⁴² Yet, the Draft NRS concluded that there is "limited ability to reduce large-scale fertilizer rates by an amount expected to substantially decrease nitrate losses to waters".⁴³ The extent of overapplication indicates that application rate reductions are possible without reducing yield, and that MPCA and MDA should implement programs that limit nitrogen application rates to UMN recommended rates. No one solution can get Minnesota to 45% nitrogen reductions in the next 15 years, but a focus on application rates is needed, in addition to the necessary adoption of tile water management and treatment, expansion of continuous living cover, and implementation of other on-farm practices to reduce runoff.

VI. MPCA Should Consider Approaches Which Have Reduced Nitrate Pollution in Water in Other Countries

To successfully reach the MPCA's goal of a nitrate load reduction of 40% by 2040 in Minnesota's rivers and vulnerable groundwater, we recommend that the MPCA consider alternative approaches to managing nutrient pollution from croplands, including establishing numeric limits on fertilizer applications. A literature review prepared by Dr. Daniel Rath of the Natural Resources Defense Council (NRDC) for a California proceeding shows how Denmark, the Netherlands, Germany, and parts of Belgium have improved their water quality after setting numeric limits on fertilizer applications under the European Union's (EU) Nitrates Directive.⁴⁴ The Nitrates Directive requires countries in the EU to designate Nitrate Vulnerable Zones (NVZs) with regulatory action programs, establish voluntary BMPs for all regions, and limit the application of nitrogen from manure to 170 kg N/ha.

Denmark has complied with the Nitrates Directive by setting nitrogen application limits at economically optimal rates determined by factors such as fertilizer price and crop yield rate. Limits are then regionally tailored given the protein content of the crop, soil type, manure and cover crop residue, and forecasts of the nitrogen mineralization for that region.⁴⁵ Denmark experienced improvements in both surface and groundwater after setting limits. Nitrate levels in Danish groundwater have fallen significantly since 1990, and stream nitrate loads have fallen by

30-50%.⁴⁶ In addition, Denmark's intensive agricultural areas saw a leaching reduction of 48% between 2001-2008.⁴⁷

The Netherlands, Germany, and the Flanders region of Belgium have also seen improvements in nitrate leaching after setting their own limits. The Netherlands saw a 50% reduction in nitrogen pollution, much of which occurred in the first ten years after limits were introduced.⁴⁸ In addition, the country's Nitrate Vulnerable Zones saw a 60% reduction in nitrate leaching by 2008.⁴⁹ In Germany, nitrogen pollution has been decreasing since 2015 and is approaching its target of 70kg N/ha.⁵⁰ According to the same study, nitrate loads in surface water and groundwater in Flanders, Belgium have been improving since 2019.⁵¹

In preparing these limits, the NRS should require collection and reporting of on-farm data such as drainage tile type, synthetic fertilizer and manure application levels, and runoff calculations. These data points would consider Minnesota's variety of soil types and land management practices, provide a more accurate picture of where significant nutrient reductions can be achieved at the lowest economic cost, and would allow MPCA to assess where policies and programs can be strategically targeted to meet the agency's long-term goals.

VII. Minnesota Should Adopt Regulatory Approaches in the Most At-Risk Areas of the State

Informed by successful approaches in other jurisdictions and the most up-to-date science, Minnesota should also supplement continued support for voluntary approaches (with outcomes-based measurements of effectiveness), with common sense regulatory approaches in the most impacted areas of the state. The regional vulnerability of Minnesota's surface waters and groundwater from cropland sources of nitrogen varies based on soils, geology, and other factors. As a result, there is a need for state agencies to intervene in the areas most vulnerable to nitrate groundwater contamination.

MPCA has defined Vulnerable Groundwater Areas as areas with coarse-textured soils, shallow bedrock, karst geology, and highly vulnerable Drinking Water Supply Management Areas (DWSMAs).⁵² In a recent comment submitted to MPCA on the Minnesota Feedlot Rule (Minn. R. ch. 7020), Minnesota Center for Environmental Advocacy (MCEA) identified several specific ways to mitigate nitrate loss from the land application of manure through permit and rule requirements for animal feedlots in Vulnerable Groundwater Areas (see Exhibit A). These BMP requirements, like the planting of cover crops and diversified crop rotations, have the potential to meaningfully improve in-field nitrogen management and to increase continuous cover on the landscape. Additionally, improved oversight of in-field nitrogen management through a lower State Disposal System (SDS) permit threshold would help to address nitrogen overapplication on cropland, where nitrogen excess is particularly high in regions like southern Minnesota, at 20-30 pounds per acre.⁵³

To address the loss of nitrogen through cropland drain tile, Minnesota should focus potential regulatory approaches on tile water management and treatment practices in priority areas like the Minnesota River Basin. Approximately 35% of cropland harvested in Minnesota is tile drained, yet less than 1% (less than 35,000 acres) of acreage has adopted controlled drainage management practices designed to slow down water from these heavily drained areas or treat drainage runoff to reduce nutrient load (see Exhibit B). The UMN literature review cited in the Draft NRS confirms the effectiveness of these practices: controlled or shallow drainage,

saturated buffers, and constructed treatment wetlands can achieve 41-45% nitrate reductions.⁵⁴ A different study found that floodplain reconnection can lead to 64% nitrate reductions.⁵⁵ MPCA should look to the recent MCEA report (Exhibit B) on the cumulative impacts of tile drainage in the Minnesota River Basin which includes four policy recommendations to increase the adoption of tile water management and treatment practices, such as a general permit system for public drainage system projects (improvements and new systems).

These recommendations would counter statewide trends that are headed in the wrong direction and help Minnesota reach the “landscape levels of change” that the Draft NRS recognizes are necessary. This change would include addressing the expansion of cropland tile drainage and the decline in small grain production. The Draft NRS cites a statistic from the U.S. Census of Agriculture that between 2012 and 2022, Minnesota had eight of the top ten counties in the nation with cropland tile drainage increases.⁵⁶ Additionally, federal data shows that planted acres of hay, haylage, and alfalfa decreased by about 700,000 acres in Minnesota between 2014 and 2024.⁵⁷ Targeted regulatory programs in priority areas of the state can raise the baseline of BMP adoption in Minnesota so the onus of nutrient reduction is not borne solely by voluntary adopters. This is critical, as the Draft NRS states that “to meet in-state and downstream nitrate and TN reduction goals, most acres of cropland will need at least one practice.”⁵⁸

VIII. Conclusion

The science is clear that excess fertilizer from nitrogen overapplication harms people by leaching into drinking water, degrades biodiversity through toxic algal blooms, and contributes to climate change through nitrous oxide emissions. Minnesotans have been dealing with harmful levels of nitrogen contamination for over 40 years. MPCA has an opportunity to develop and implement a plan to combat this problem. While we appreciate that MPCA has established bold nutrient reduction targets, we urge the agency to consider data collection and reporting of fertilizer sales and application rates at the field scale, introduce programs that limit nitrogen fertilizer overapplication, and require adoption of effective BMPs such as in-field nitrogen management, continuous living cover, and drainage water management and treatment.

These approaches, collectively, give Minnesota the best chance to hit the targets set for 2040. Part of setting goals includes robust measurement and reporting, to ensure the agency has data to measure interim progress and ensure that Minnesota is on track. We urge MPCA to integrate these requests related to data and alternative nutrient reduction strategies into their finalized version of the 2025 Updated Nutrient Reduction Strategy.

Respectfully,

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Endnotes:

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³ Minnesota Pollution Control Agency, *The Minnesota Nutrient Reduction Strategy*, 4.

⁴ Minnesota Pollution Control Agency, *Minnesota Nutrient Reduction Strategy – DRAFT*, July 2025, 55, <https://www.pca.state.mn.us/sites/default/files/wq-s1-87a.pdf>. [Note: MPCA does not report estimates of state-level nitrogen reductions for this 2025 milestone report, only watershed level estimates.]

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- ⁴⁸ Hans J.M. Van Grinsven, Aaldrik Tiktak and Carin W. Rougoor, “Evaluation of the Dutch Implementation of the Nitrates Directive, the Water Framework Directive and the National Emission Ceilings Directive,” *NJAS - Wageningen Journal of Life Sciences* 78 no.1 (September 2016):69–84. <https://doi.org/10.1016/j.njas.2016.03.010>.
- ⁴⁹ Gerard Velthof et al., “The Impact of the Nitrates Directive on Nitrogen Emissions from Agriculture in the EU-27 During 2000–2008,” (January 15, 2014).
- ⁵⁰ Duncan Liefferink, M. Kaufmann and Daan Boezeman. “Nature-Agriculture Debates and Policies: Denmark, Germany, Flanders, and France Compared,” *Institute for Management Research Radboud University* (March, 2023) <https://repository.ubn.ru.nl/bitstream/handle/2066/291460/291460.pdf?sequence=1&isAllowed=y>.
- ⁵¹ Duncan Liefferink, M. Kaufmann and Daan Boezeman. “Nature-Agriculture Debates and Policies: Denmark, Germany, Flanders, and France Compared,” *Institute for Management Research Radboud University* (March, 2023) <https://repository.ubn.ru.nl/bitstream/handle/2066/291460/291460.pdf?sequence=1&isAllowed=y>.
- ⁵² Minnesota Pollution Control Agency, *MPCA Feedlot Program Vulnerable Groundwater Areas*, (August 31, 2024), <https://gisdata.mn.gov/dataset/env-feedlot-vuln-gw-areas>.
- ⁵³ Minnesota Pollution Control Agency, *Minnesota Nutrient Reduction Strategy – DRAFT*, July 2025, 168.
- ⁵⁴ Laura Christianson and Carl Rosen, *Science Assessment of Cropland Practices for Minnesota's Nutrient Reduction Strategy: Part 1 Nitrogen*, University of Minnesota, St. Paul, Minnesota. 754-941 (May 2025), <https://www.pca.state.mn.us/sites/default/files/wq-s1-87b.pdf>.
- ⁵⁵ Brad Gordon, Olivia Dorothy and Christian Lenhart, “Nutrient Retention in Ecologically Functional Floodplains: A Review,” *Water* 12 no.10 (October 4, 2020), <https://www.mdpi.com/2073-4441/12/10/2762>.
- ⁵⁶ Minnesota Pollution Control Agency, *Minnesota Nutrient Reduction Strategy – DRAFT*, July 2025, 10.
- ⁵⁷ Minnesota Pollution Control Agency, *Minnesota Nutrient Reduction Strategy – DRAFT*, July 2025, 173.
- ⁵⁸ Minnesota Pollution Control Agency, *Minnesota Nutrient Reduction Strategy – DRAFT*, July 2025, 158.

Re: Establishing Outcomes-Based Data Collection and Alternative Pathways to Nitrogen Reduction in Minnesota's Nutrient Reduction Strategy

Exhibit A

Minnesota Center for Environmental Advocacy Comments to Minnesota Pollution Control Agency on Planned Amendments to Rules Governing Animal Feedlots

Minnesota Center for Environmental Advocacy

**Comments to Minnesota Pollution Control Agency on
Planned Amendments to Rules Governing Animal Feedlots, Minnesota Rules Chapter 7020,
Revisor’s ID Number R-04928**

July 22, 2025

I. Introduction

Minnesota Center for Environmental Advocacy (“MCEA”) appreciates the opportunity to submit these comments on the Minnesota Pollution Control Agency’s (“MPCA”) planned amendments to the rules governing animal feedlots, Minnesota Rules ch. 7020 (“Animal Feedlot Rule”). Minnesota has more than 20,000 feedlots, which produce 49 million tons of manure each year.¹ This manure, when stored in massive lagoons or spread on fields as fertilizer, runs off into surface waters, leaches into groundwater, and volatilizes into the air, ultimately polluting Minnesota’s waters with dangerous bacterial coliforms and nutrients, particularly nitrate. The Animal Feedlot Rule, which governs these feedlots in order to limit discharges of pollutants, has not been comprehensively revised for 25 years. During that time, feedlot practices and our knowledge about nitrate pollution have changed significantly—but nitrate pollution in the state remains widespread, persistent, and dangerous to the health of Minnesota’s residents and its rivers, lakes, and streams. Both MPCA and the U.S. Environmental Protection Agency (“EPA”) have acknowledged that the state’s current approach is not sufficient to address nitrate pollution in the state’s surface waters and groundwater.

¹Ethan Bahe, *Five Years After EWG’s First Analysis, Manure Still Overloads Minnesota*, Environmental Working Group (May 15, 2025), <https://www.ewg.org/research/five-years-after-ewgs-first-analysis-manure-still-overloads-minnesota> (MCEA Ex. 23) (“EWG, Manure Overloads Minnesota”).

In this context, MPCA has proposed considering changes to the Animal Feedlot Rule. To protect Minnesota's health and environment, and to comply with the strict protections for surface waters and groundwater in Minnesota law, MPCA must make significant changes to the Animal Feedlot Rule, including the following:

- Require State Disposal System Permits for feedlots with more than 600 animal units.
- Require Manure Management Plans to be submitted through the online Nutrient Management Tool for feedlots with more than 300 animal units, including feedlots from out of state that apply manure in Minnesota, and make manure application information from the online tool publicly available.
- Require monitoring of feedlot production areas and land application areas, including visual inspections for surface discharges, and underground monitoring for subsurface discharges based on the requirements of a Subsurface Discharge Monitoring Plan.
- Require additional best management practices for fall application of manure in Vulnerable Groundwater Areas, similar to practices required by the revised feedlot water pollution permits.
- Prohibit risky manure application practices statewide by (1) requiring larger setbacks from sensitive features, (2) prohibiting application of manure on frozen or snow-covered ground, and (3) prohibiting manure application when the risk of runoff from rainfall is high.
- Reduce allowed manure application rates to the rates recommended by the University of Minnesota Extension Service, with no deviations allowed or use of rates from contiguous states.
- Explicitly prohibit discharges from production areas or land application areas that may limit the use of groundwater as a potable water supply or may pollute the underground waters.
- Prohibit livestock from all feedlots from entering waters of the state, or at a minimum livestock from medium and large feedlots.
- Ensure multiple feedlots are considered a single feedlot for purposes of permit determinations when they (1) have common ownership, including ownership by entities that share some common owners, and (2) are located within three miles of each other or share a common liquid or solid manure storage area.

II. Minnesota has an ongoing nitrate pollution crisis, and a major source is manure from feedlots

Nitrogen is a nutrient that is applied to crops, in the form of animal manure or commercial fertilizer, to help them grow.² Once it has been applied to cropland, some of the nitrogen converts to different forms, including nitrate and ammonia, that can be used by plants.³ When commercial fertilizer and manure are applied to croplands at too-high rates, at inopportune times, in vulnerable areas or near sensitive features, some of the nitrate may not be taken up by crops.⁴ Nitrate is highly soluble in water, and it moves easily through soil, so unused nitrate is likely to leach through the soil and ultimately enter the groundwater.⁵ As MPCA has stated, “[I]f it is not managed correctly, manure can result in pollution, and it can be a threat to human health.”⁶

A. Nitrate is dangerous to humans, animals, and aquatic life

When too much nitrate makes its way to surface waters and groundwater, it endangers human health and aquatic life.⁷ For humans, federal and state regulatory standards set the limit for nitrate in drinking water at 10 mg/L.⁸ Drinking water with nitrate levels above this limit can cause methemoglobinemia, or blue-baby syndrome, which can lead to severe injury or death,

² MDA, *Groundwater Protection Rule Statement of Need and Reasonableness* 10 (April 30, 2018), <https://www.mda.state.mn.us/sites/default/files/2018-08/sonargwprule.pdf> (“Groundwater Protection Rule SONAR”).

³ *Id.* at 11.

⁴ See MDA, *Nitrogen Fertilizer Management Plan* 40 (March 2015), <https://www.mda.state.mn.us/sites/default/files/inline-files/NFMP%202015.pdf> (“2015 Nitrogen Fert. Mgmt. Plan”).

⁵ Groundwater Protection Rule SONAR at 12, 85; Minn. Pollution Control Agency, *Animal Feedlot Rule Statement of Need and Reasonableness* 14 (Dec. 8, 1999), <https://www.winona-county.gov/DocumentCenter/View/1688/MN-Feedlot-Rule-7020-SONAR-PDF> (“1999 Feedlot Rule SONAR”).

⁶ MPCA, *Animal Feedlot Rule Statement of Need and Reasonableness* 2 (May 20, 2013), <https://www.leg.mn.gov/archive/sonar/SONAR-04109.pdf>.

⁷ MPCA, *The Condition of Minnesota’s Groundwater Quality, 2013-2017*, at 13 (July 2019), <https://www.pca.state.mn.us/sites/default/files/wq-am1-10.pdf>.

⁸ 40 C.F.R. § 141.62(b)(7); Minn. R. 7050.0221, subps. 2-4 (incorporating the federal standard).

particularly for infants or pregnant people.⁹ Recent research, however, has demonstrated that long-term exposure to nitrate levels well below the 10 mg/L limit is also linked to serious health risks.¹⁰ Peer-reviewed medical research demonstrates that exposure to nitrate at or above 3 mg/L—less than one-third of the 10 mg/L limit—is linked to a variety of cancers, birth defects, and pregnancy complications. Numerous human-based epidemiological studies now show that exposure to nitrate at levels below the 10 mg/L limit and as low as 3 to 5 mg/L leads to a statistically significant increase in the risk for colorectal cancer,¹¹ thyroid cancer,¹² ovarian cancer,¹³ and pregnancy/birth complications.¹⁴

In addition, the MPCA has concluded that nitrate levels of more than 5 mg/L for cold waters and 8 mg/L for other waters are unsafe for aquatic life, although it has not adopted a water quality standard based on this conclusion.¹⁵ For ammonia, another form of nitrogen, Minnesota has set an aquatic life water quality standard of 4.1 mg/L for cold waters and 10.1 mg/L for other waters, but MPCA has recommended adopting EPA’s even stricter, temperature-dependent standards for total

⁹ MPCA, *The Condition of Minnesota’s Groundwater Quality, 2013-2017*, at 13 (July 2019), <https://www.pca.state.mn.us/sites/default/files/wq-am1-10.pdf>.

¹⁰ Groundwater Protection Rule SONAR at 63; MPCA, *Nitrogen in Minnesota Surface Waters A2-7* (June 2013), <https://www.pca.state.mn.us/sites/default/files/wq-s6-26a.pdf> (“Nitrogen in Minnesota Surface Waters”).

¹¹ Nadia Espejo-Herrera et al., *Colorectal cancer risk and nitrate exposure through drinking water and diet*, 139 *Intl. J. of Cancer* 334-346 (2016) (MCEA Ex. 1); Jorg Schullehner et al., *Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study*, 143 *Intl. J. of Cancer*, 73-79 (2018) (MCEA Ex. 2).

¹² See Mary H. Ward et al., *Drinking Water Nitrate and Human Health: An Updated Review*, *Intl. J. Envntl. Research and Public Health* 12 (2018) (internal citations omitted) (MCEA Ex. 3).

¹³ See Maki Inoue-Choi et al., *Nitrate and nitrite ingestion and risk of ovarian cancer among postmenopausal women in Iowa*, 137 *Intl. J. of Cancer*, 173-182 (2015) (MCEA Ex. 4).

¹⁴ See Ward et al., *Drinking Water Nitrate and Human Health: An Updated Review* (internal citations omitted) (MCEA Ex. 3); Jason Semprini, *Early prenatal nitrate exposure and birth outcomes: A study of Iowa’s public drinking water (1970-1988)*, *PLOS* 4(6) (2015) (MCEA Ex. 5).

¹⁵ MPCA, *Aquatic Life Water Quality Standards Draft Technical Support Document for Nitrate* (Oct. 2022), <https://www.pca.state.mn.us/sites/default/files/wq-s6-13.pdf>.

ammonia nitrogen.¹⁶ Excess nitrate is toxic to fish and other aquatic life, and elevated levels of nitrate and other nutrients in surface waters cause algae blooms and eutrophication, which harm aquatic life by lowering oxygen levels in the water.¹⁷ Exposure to nitrate and ammonia at toxic levels can lead to massive fish population die-offs, called “fish kills.” In heavily agricultural areas, fish kill events have increased in intensity and frequency: the Rush Creek fish kill in July 2022, where MPCA concluded contaminated runoff killed more than 2,500 fish, was the fourth major fish kill in the Winona County area since 2015.¹⁸

Unfortunately, the effects of nitrate pollution do not stop in Minnesota. The 158 million pounds of nitrate that leave Minnesota annually via the Mississippi River are in part to blame for the hypoxic “dead zone” that forms every year in the Gulf of Mexico.¹⁹ As of a 2025 draft update to the state’s Nutrient Reduction Strategy, Minnesota needs to reduce total nitrogen loads from agriculture to the Mississippi River by 62 million pounds to meet its goals to improve downstream water quality.²⁰ One study estimates that nitrate from the Mississippi has caused \$2.4 billion in annual damages to fish stocks and habitat for more than 30 years.²¹

¹⁶ MPCA, *Aquatic Life Quality Standards for Ammonia: Draft Technical Support Document 19* (July 2022), <https://www.pca.state.mn.us/sites/default/files/wq-rule4-25b.pdf>.

¹⁷ Nitrogen in Minnesota Surface Waters at A2-11.

¹⁸ MPCA, *Rush Creek fish kill response – Winona County*, at 2, 4 (April 2023), <https://www.pca.state.mn.us/sites/default/files/tdr-g1-24.pdf> (MCEA Ex. 24).

¹⁹ Nitrogen in Minnesota Surface Waters, at A2-14 – A2-16, B2-24.

²⁰ MPCA, *Minnesota Nutrient Reduction Strategy – DRAFT* at 179 (July 2025), <https://www.pca.state.mn.us/sites/default/files/wq-s1-87a.pdf>.

²¹ Rebecca Boehm, *Reviving the Dead Zone: Solutions to Benefit both Gulf Coast Fishers and Midwest Farmers* 12, Union of Concerned Scientists (2020), <https://www.ucs.org/sites/default/files/2020-06/reviving-the-dead-zone.pdf> (MCEA Ex. 25).

B. Nitrate pollution in Minnesota’s groundwater is widespread and longstanding, particularly in vulnerable groundwater areas

The contamination of Minnesota’s surface waters and groundwater with nitrate is a pervasive problem that has been well documented for decades.²² Contamination has remained persistent over time. In groundwater, an analysis from 2019 showed that 16% of wells in shallow aquifers tested had significant increases in nitrate, and another 63% had no improvement, between 2005 and 2017.²³ A more recent analysis by MDA of nitrate trends in 253 monitoring wells and 14 springs showed “that most sites continued to exhibit no change in nitrate concentrations from 2013-2023.”²⁴ While some sites had downward trends, these trends “should not be interpreted to mean that concentrations are below the [10 mg/L limit]. Several sites, primarily in the state’s agricultural areas, have downward trends in nitrate from 2013-2023, but the most recent concentration measured still was above 10 mg/L.”²⁵ One monitoring well in Morrison County, for example, still showed a nitrate level of 33 mg/L despite a downward trend.²⁶

Similarly, in surface waters, trends do not show significant improvement. A 2020 analysis of trends over the previous 20 years in the state’s major rivers found increasing trends at half of the sites, with increases ranging from 21% to 55%.²⁷ Narrowing the focus to only the previous

²² 2015 Nitrogen Fert. Mgmt. Plan at 21-30 (describing sampling results from monitoring wells, private wells, and public water systems); MPCA, *Five-Year Progress Report on Minnesota’s Nutrient Reduction Strategy* 30-31 (Aug. 2020) (“Five Year Progress Report on NRS”), <https://www.pca.state.mn.us/sites/default/files/wq-s1-84a.pdf>; Nitrogen in Minnesota Surface Waters at C1-1 – C2-10.

²³ Five Year Progress Report on NRS at 31.

²⁴ MPCA, *The Condition of Minnesota’s Groundwater Quality, 2018-2023*, at 16-17 (April 2025), <https://www.pca.state.mn.us/sites/default/files/wq-am1-11.pdf>.

²⁵ *Id.*

²⁶ *Id.*

²⁷ Five Year Progress Report on NRS at 18.

decade showed that nitrate levels increased or at best showed no clear trend—none of the 38 sites studied by MPCA showed nitrate decreases in that time period.²⁸

The problem of nitrate groundwater contamination is particularly acute in areas identified by MPCA as vulnerable groundwater areas—areas with karst geology, shallow depth to bedrock, or coarse textured soils, which are particularly susceptible to pollutants from the surface moving through soil to underground aquifers.²⁹ MPCA created a map of these regions, which will be referred to as “Vulnerable Groundwater Areas” or “VGAs.”³⁰ This includes the Central Sands area, with its coarse-textured soil, in the middle of the state, and the southeastern karst region, which has significant areas of karst geology and shallow bedrock; these two areas “were determined to be the most vulnerable to and the most impacted by nitrate contamination.”³¹

Nitrate pollution in groundwater in the karst region has been well-documented for decades. In karst geology, fractured bedrock is generally overlaid with shallow soils, allowing nitrate in soil water to move easily down into groundwater.³² More than 30 years ago, MPCA documented high nitrate concentrations in wells in Minnesota’s karst region, with nearly half of wells tested already exceeding the 10 mg/L limit.³³ In the past dozen years, numerous state studies have documented

²⁸ *Id.* at 20.

²⁹ Groundwater Protection Rule SONAR at 85; MPCA, *MPCA proposes changes to feedlot permits to protect waters from nitrate pollution*, <https://www.pca.state.mn.us/news-and-stories/mpca-proposes-changes-to-feedlot-permits-to-protect-waters-from-nitrate-pollution>.

³⁰ MPCA, *Vulnerable Groundwater Areas Map*, https://resources.gisdata.mn.gov/pub/gdrs/data/pub/us_mn_state_pca/env_feedlot_vuln_gw_areas/preview/preview.jpg.

³¹ Groundwater Protection Rule SONAR at 46.

³² *Id.* at 91.

³³ MPCA, *Water Quality and Sensitivity of the Prairie du Chien-Jordan Aquifer in Western Winona County*, Executive Summary (June 1991), <https://www.leg.mn.gov/docs/pre2003/other/910740.pdf>.

wide-spread and persistent exceedances of the 10 mg/L limit in southeastern Minnesota's groundwater in both shallow wells and drinking wells. For example:

- From 2008–2018, the Southeast Volunteer Nitrate Monitoring Network tested approximately 300-500 private drinking water wells each year. Results ranged from a low of 7.5% (in 2012) to a high of 14.6% (in 2008) of wells testing above the 10 mg/L standard.³⁴
- From 2013-2019, the Township Testing Program tested wells in vulnerable townships and found that 12.1% of the private drinking water wells tested across eight karst counties had nitrate levels above the 10 mg/L standard.³⁵ In two townships in Winona County, samples taken in 2017 showed more than 40% of wells in the initial testing set had more than 10 mg/L of nitrate.³⁶
- In 2023, the Southeast Volunteer Nitrate Monitoring Network tested 374 private drinking water wells and found that 8% were over the 10 mg/L limit.³⁷
- From 2014-2024, Minnesota Department of Agriculture (“MDA”) analyzed between 37 and 43 samples of groundwater each year from ambient groundwater monitoring sites in southeastern Minnesota (PMR 9). Every year between 24% (in 2015) and 34% (in 2017 and 2018) of wells tested had nitrate levels above the 10 mg/L limit.³⁸

Coarse-textured, or sandy, soils like those in the Central Sands pose a similar susceptibility to nitrate pollution³⁹ because sandy soils have a lower water-holding capacity and accordingly have more potential to lose nitrate from leaching than do finer textured soils.⁴⁰ One study showed that background losses of nitrogen in coarse-textured soils were around 20 to 50 pounds per acre,

³⁴ MDA, *Nitrate Results and Trends in Private Well Monitoring Networks 2008-2018*, at 3 (June 2019), <https://wrl.mnpals.net/islandora/object/WRLrepository%3A3395> (MCEA Ex. 26).

³⁵ Letter from U.S. Env. Prot. Agency to Minn. Dep’t of Health, MDA, and MPCA re: Safe Drinking Water Act Petition 2 (Nov. 3, 2023) (MCEA Ex. 27).

³⁶ MDA, *Winona County: Final Overview of Nitrate Levels in Private Wells (2016-2017)*, at 2 (Sept. 2019), <https://wrl.mnpals.net/islandora/object/WRLrepository%3A3853> (MCEA Ex. 28).

³⁷ MDA, *Southeast Minn. Volunteer Nitrate Monitoring Network 2023 Results 1* (Nov. 2024), <https://wrl.mnpals.net/node/4338> (MCEA Ex. 29).

³⁸ See MDA, *Water Quality Monitoring Reports (2014-2024)*, available at the Minnesota Digital Water Research Library, <https://wrl.mnpals.net/> (MCEA Ex. 30).

³⁹ Groundwater Protection Rule SONAR at 80.

⁴⁰ Univ. of Minn. Extension Serv., *Understanding Nitrogen in Soils* (2021), <https://extension.umn.edu/nitrogen/understanding-nitrogen-soils> (MCEA Ex. 31).

as compared to 10 pounds per acre for fine-textured soils.⁴¹ Data from state agencies show that exceedances of the 10 mg/L limit are also widespread and persistent in the Central Sands in both shallow wells and drinking water wells. For example:

- From 2011-2018, MDA's Central Sands Private Well Network tested approximately 300-500 private drinking water wells each year. Results ranged from a low of 2.2% (in 2017) to a high of 4.5% (in 2015) of wells tested above the 10 mg/L limit.⁴²
- From 2013-2019, MDA's Township Testing Program tested thousands of private drinking water wells in vulnerable townships and found many violations of the 10 mg/L limit. In Morrison County, 15% of the 1,222 wells tested in the initial set were over the limit.⁴³ In Wadena County, 11.9% of the 269 wells in the initial set were over the limit.⁴⁴ In Hubbard County, 10.5% of the 1,106 wells in the initial set were over the limit.⁴⁵
- From 2014-2024, a study by MDA analyzed between 74 and 86 samples of groundwater each year from ambient groundwater monitoring sites in the Central Sands region (PMR 4) and found that between 48% (in 2022) and 72% (in 2015 and 2016) had nitrate levels above the 10 mg/L limit.⁴⁶
- In 2024, the Central Sands had the highest median concentration (14.7 mg/L); the highest 90th percentile concentration (28.0 mg/L), and the highest nitrate level (an astonishing 81.2 mg/L) of any region in the state.⁴⁷

⁴¹ Groundwater Protection Rule SONAR at 35.

⁴² MDA, *Nitrate Results and Trends in Private Well Monitoring Networks 2008-2018*, at 11-12 (June 2019), <https://wrl.mnpals.net/islandora/object/WRLrepository%3A3395> (MCEA Ex. 26).

⁴³ MDA, *Morrison County: Overview of Nitrate Levels in Private Wells (2013-2015)* at 2 (Aug. 2016), <https://www.mda.state.mn.us/sites/default/files/inline-files/nitrate2015morrison.pdf> (MCEA Ex. 32).

⁴⁴ MDA, *Initial Township Testing of Nitrate in Private Wells, Wadena County 2013 Summary* 20 (April 2015), <https://www.mda.state.mn.us/sites/default/files/inline-files/wadena2013summary.pdf> (MCEA Ex. 33).

⁴⁵ MDA, *Hubbard County: Overview of Nitrate Levels in Private Wells (2016)*, at 1 (Jan. 2017), https://www.mda.state.mn.us/sites/default/files/inline-files/hubbard2016initial_0.pdf (MCEA Ex. 34).

⁴⁶ See MDA, *Water Quality Monitoring Reports (2014-2024)*, available at the Minnesota Digital Water Research Library, <https://wrl.mnpals.net/> (MCEA Ex. 30).

⁴⁷ MDA, *2024 Water Quality Monitoring Report*, at 6-3, 6-6 (June 2025), <https://wrl.mnpals.net/node/4355> (MCEA Ex. 30).

Unfortunately, many of these vulnerable areas are also heavily agricultural, which makes the risks of nitrate pollution higher. More than 6,400 feedlots are located within VGAs.⁴⁸

C. Most of Minnesota’s nitrate groundwater pollution comes from croplands, including from manure applied to croplands

MPCA has acknowledged that the greatest source of Minnesota’s groundwater nitrate pollution, including in the VGAs, is croplands. According to MPCA, “More than 70% of the nitrate in Minnesota waters is coming from cropland, the rest from regulated sources such as wastewater treatment plants, septic and urban runoff, forests, and the atmosphere.”⁴⁹ In intensively agricultural areas of the state, nitrogen loads from cropland sources are even higher; such sources produce an estimated 89 to 95 percent of the load in the Minnesota, Missouri, and Cedar rivers, and the Lower Mississippi River basin.⁵⁰ State studies confirm this by showing intense groundwater pollution in agricultural areas. Groundwater monitoring data shows median nitrate concentrations in shallow wells in agricultural areas are four to eight times higher than the concentrations in urban areas.⁵¹ Almost 40% of shallow wells in agricultural areas had nitrate levels above the 10 mg/L limit.⁵² Water in soil beneath fields where corn is grown had far higher levels of nitrate—an average of 22.3 mg/L—than other lands uses, such as forests, lawns, or golf courses.⁵³

⁴⁸ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23) (“In 2024, 6,480 animal feeding operations were located within a vulnerable groundwater area”).

⁴⁹ MPCA, *Nitrogen*, <https://www.pca.state.mn.us/pollutants-and-contaminants/nitrogen> (MCEA Ex. 35); *see also* Five Year Progress Report on NRS at 21.

⁵⁰ MPCA, *Nitrogen*, <https://www.pca.state.mn.us/pollutants-and-contaminants/nitrogen> (MCEA Ex. 35).

⁵¹ MPCA, *The Condition of Minnesota’s Groundwater Quality 2018-2023*, at 12 (April 2025), <https://www.pca.state.mn.us/sites/default/files/wq-am1-11.pdf>.

⁵² *Id.*

⁵³ Kevin Kuehner et al., *Examination of Soil Water Nitrate-N Concentrations from Common Land Covers and Cropping Systems in Southeast Minnesota Karst* 14 (Oct. 2020), <https://wrl.mnpals.net/islandora/object/WRLrepository%3A3654> (MCEA Ex. 48).

The main cropland sources of nitrate pollution are both commercial fertilizer and manure applied as fertilizer, MPCA has acknowledged.⁵⁴ These two sources together accounted for 1.8 billion pounds of the nitrogen added to land in Minnesota in 2013, compared to 12 million pounds for lawn fertilizer and 9 million pounds for septic system drain fields.⁵⁵ Although manure accounts for only about 25% of the nitrogen applied to fields in the state (as compared to 75% for commercial fertilizer),⁵⁶ the use of manure is particularly problematic for nitrate pollution because producers often overapply nitrogen when they use manure as one of their nitrogen sources.

There are two key reasons why producers commonly overapply nitrogen when they use manure as fertilizer. First, manure often is treated as a waste product. Minnesota's feedlots house up to 1.6 million beef and dairy cattle, 10.8 million hogs, and 58.7 million turkeys and chickens, which produce nearly 49 million tons of manure every year—which is disposed of by spreading it, untreated, on croplands.⁵⁷ The need to dispose of manure leads some producers to apply it not in response to crop needs but instead because storage space is running out or because of the need to work around wet weather or other production processes.⁵⁸ Manure also may be overapplied at fields nearest the livestock operation to free up storage capacity without incurring the expense of transporting the manure further away.⁵⁹

Second, producers often fail to accurately account for the amount of nitrogen in manure, and thus overapply it. The nitrogen content in manure is highly dependent on many variables,

⁵⁴ MPCA, *The Condition of Minnesota's Groundwater Quality 2018-2023*, at 11 (April 2025), <https://www.pca.state.mn.us/sites/default/files/wq-am1-11.pdf>.

⁵⁵ Nitrogen in Minnesota Surface Waters, at D1-2.

⁵⁶ *Id.*

⁵⁷ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

⁵⁸ Chryseis Modderman, *Manure Is Complicated: 5 Reasons You Need a Manure Management Plan*, Minn. Crop News (June 26, 2023), <https://blog-crop-news.extension.umn.edu/2023/06/manure-is-complicated-5-reasons-you.html> (last visited Jan. 24, 2025) (MCEA Ex. 11).

⁵⁹ *See id.*

including type of manure, storage methods, climatic conditions, and more,⁶⁰ and the nitrogen in manure is not all immediately available for plants to use for growth.⁶¹ The uncertainties mean producers “frequently over-apply manure” because they do not properly credit the amount of nitrogen in the manure.⁶² Encouraging this practice, the University of Minnesota Extension Service (“Extension Service”) recommends applying *more* nitrogen per acre when manure is used, as compared to commercial fertilizer.⁶³ Studies and farmer interviews show producers apply more nitrogen when manure and fertilizer are applied than when only non-manure sources are used.⁶⁴

Across the state, Minnesota’s producers are simply applying more nitrogen than crops need through a combination of commercial fertilizer and manure. In 2018, MDA stated that by a conservative estimate, Minnesota producers could reduce nitrogen application by 200 million pounds each year while still maintaining “optimum yields.”⁶⁵ With respect to the southeastern karst region in particular, an analysis by environmental scientist Christopher Jones found that between the commercial fertilizer sold and the animal manure produced in the region, producers are applying 60 million pounds of nitrogen more than their crops need each year.⁶⁶ This amount of nitrogen could contaminate approximately 722 billion gallons of water to a level exceeding the

⁶⁰ Groundwater Protection Rule SONAR at 54.

⁶¹ Univ. of Minn. Extension Serv., *Guidelines for Manure Application Rates* 1 (2022) (MCEA Ex. 6).

⁶² Groundwater Protection Rule SONAR at 51, 54; 1999 Feedlot Rule SONAR at 20, 205.

⁶³ *Compare* Univ. of Minn. Extension Serv., *Guidelines for Manure Application Rates* 2 (2022) (MCEA Ex. 6) (recommendation for corn after corn is a maximum of 195 pounds of plant available nitrogen per acre) *with* Univ. of Minn. Extension Serv., *Fertilizing Corn in Minnesota* 2 (2024) (MCEA Ex. 7) (recommendation for corn after corn is a rate of 185 pounds of nitrogen per acre when the ratio of the nitrogen price to crop value is .10).

⁶⁴ Groundwater Protection Rule SONAR at 51-52; Five Year Progress Report on NRS at 78; 1999 Feedlot Rule SONAR at 205.

⁶⁵ Groundwater Protection Rule SONAR at 51.

⁶⁶ Christopher S. Jones, Ph.D., *Report on Nitrogen Surplus in Minnesota Driftless* 12 (2025) (MCEA Ex. 21).

10mg/L limit and water quality standard.⁶⁷ A 2025 study by the Environmental Working Group found that in nine Minnesota counties, nitrogen in manure produced by feedlots combined with nitrogen in fertilizer purchased in the county exceeded recommendations for the Extension Service’s nitrogen application rates by more than 40%.⁶⁸

D. Unsafe manure management practices also lead to coliform impairments

Beyond the widely documented nitrate contamination trends in public and private water supplies, there are also other microbial contaminants associated with manure that impact public health—further emphasizing the need for responsible manure management. Coliforms are a standard indicator of drinking water quality associated with acute gastrointestinal illness, and the goal under the Safe Drinking Water Act for these contaminants is set at zero.⁶⁹ Yet 243 Minnesota waters are listed as impaired for fecal coliform, and another 672 are listed as impaired for *E. coli* (one of the main fecal coliforms).⁷⁰

One of the main sources of bacteria in surface waters—including coliforms—is runoff from feedlots and land application sites. MPCA has stated that one of the most effective ways to reduce coliforms in water is to ensure this runoff is controlled.⁷¹ This is supported by a 2021 study in Northeastern Wisconsin that analyzed private well contamination data across a five-county region with vulnerable fractured bedrock and concentrated dairy feedlot production, similar to the karst region of Southeastern Minnesota. Of the 6,739 wells sampled for microbial contamination, 23%

⁶⁷ *Id.*

⁶⁸ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

⁶⁹ EPA, *Revised Total Coliform Rule and Total Coliform Rule* (January 2017), https://19january2017snapshot.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule_.html (MCEA Ex. 36).

⁷⁰ MPCA, *2024 Impaired Waters List*, <https://www.pca.state.mn.us/air-water-land-climate/minnesotas-impaired-waters-list>.

⁷¹ MPCA, *Bacteria*, <https://www.pca.state.mn.us/pollutants-and-contaminants/bacteria> (MCEA Ex. 37).

tested positive for total coliforms.⁷² The primary risk factors for coliform detection were bedrock depth (which determines groundwater vulnerability) and distance to the nearest manure storage structure, with wells located within 48 meters of manure storage structures 87% more likely to have coliform detection than wells 4,000 meters away.⁷³ The single risk factor most associated with an increase in coliform concentration levels was the distance to the nearest field with a nutrient management plan where commercial fertilizer and animal manure were land applied.⁷⁴ Practices that reduce manure runoff, accordingly, are critical to addressing not only nitrates but also dangerous bacteria.

E. Minnesota’s efforts to control nitrate pollution have not met the state’s nutrient reduction goals or adequately protected drinking water supplies

Although the causes and dangers of nitrate and bacterial pollution have long been known, Minnesota state agencies have not taken effective steps to control this pollution, despite express direction from the Legislature to the state agencies to address groundwater pollution from agricultural sources.⁷⁵ For decades, Minnesota’s agencies have implemented programs, policies, and even rules—including the Animal Feedlot Rule—that attempt to address nitrate pollution. Yet groundwater and surface waters across the state continue to show persistent levels of contamination and even increases in nitrate loads and concentrations. The state’s Clean Water Fund alone has directed at least \$148 million to the nitrate problem since 2010, according to a Star Tribune analysis, and millions more in federal and state funding have paid for efforts that include nitrate research, programs and training to encourage farmers to make voluntary changes to

⁷² Mark A. Borchardt et al., *Sources and Risk Factor for Nitrate and Microbial Contamination of Private Household Wells in the Fractured Dolomite Aquifer of Northeastern Wisconsin*, Environmental Health Perspectives 129(6), at 3-4 (June 2021) (MCEA Ex. 8).

⁷³ *Id.* at 26.

⁷⁴ *Id.* at 23-24.

⁷⁵ *See generally* Groundwater Protection Act, Minn. Stat. § 103H.001-.280.

practices, and nitrate filtration systems for several cities.⁷⁶ The response from state agencies has included a combination of regulatory and voluntary conservation programs, with an emphasis on voluntary incentives. These voluntary incentives, encouraged by technical and financial assistance from governmental programs, have not achieved the necessary reductions in nitrate pollution.⁷⁷ Despite the development of the updated Nitrogen Fertilizer Management Plan, the Groundwater Protection Rule, and the Nutrient Reduction Strategy over the past decade, there have not been significant decreases in nitrate levels in surface waters or groundwater.

MPCA has acknowledged that its current regulations and voluntary best management practices are insufficient to protect groundwater from pollution.⁷⁸ MPCA's own progress report on nutrient management practices in 2020 admitted that none of the nutrient management practices adopted during the past decade were "expected to yield measurable nutrient reductions to surface waters at a large scale."⁷⁹ MPCA's website acknowledged that refinements in fertilizer rates and application timing could reduce nitrate loads by roughly 13% statewide, but "additional and more costly practices will be needed to make further reductions."⁸⁰ As the agency has stated, "statewide reductions of more than 30% are not realistic with current practices."⁸¹ In making incremental

⁷⁶ Jeff Hargarten and Jennifer Bjorhus, *Nitrate contamination of Minnesota waters shows little sign of going away, despite years of effort*, Star Tribune (Nov. 28, 2023), <https://www.startribune.com/nitrate-pollution-minnesota-groundwater-farm-fertilizer-mpca-wells-epa/600310942> (MCEA Ex. 38).

⁷⁷ See Kurt Stephenson et. al, *Confronting our Agricultural Nonpoint Source Control Policy Problem*, 58(4) Journal of the Am. Water Resources Assn. (June 2022) (MCEA Ex. 9) (explaining that programs to reduce agricultural non-point source pollution that depend on voluntary adoption, with technical and financial assistance from federal and state programs, have not been successful in reducing pollution loads).

⁷⁸ MPCA, *Groundwater quality*, <https://www.pca.state.mn.us/air-water-land-climate/groundwater-quality> (MCEA Ex. 39).

⁷⁹ Five Year Progress Report on NRS at 53.

⁸⁰ MPCA, *Nitrogen*, <https://www.pca.state.mn.us/pollutants-and-contaminants/nitrogen> (MCEA Ex. 35).

⁸¹ *Id.*

changes to the water pollution permits that govern the state’s largest feedlots, MPCA stated, “There are serious nitrate issues in the vulnerable areas of Minnesota that will necessitate changes to current crop production practices.”⁸² Only with significant regulatory changes—and enforcement of those changes—will Minnesota make progress on the nitrate pollution problem.

F. EPA has instructed Minnesota to make changes to address nitrate pollution

Not only are changes to address Minnesota’s nitrate pollution compelled by the facts, the EPA has instructed MPCA to address this problem. In April 2023, MCEA led a coalition of 11 national, regional, and local organizations in submitting a petition that asked the EPA to use its powers under the Safe Drinking Water Act to address the “imminent and substantial endangerment to human health” posed by groundwater nitrate contamination in Minnesota’s karst region.⁸³

On November 3, 2023, the EPA responded with a letter to the MPCA, MDA, and Minnesota Department of Health regarding nitrate pollution in the karst region, stating “there is an evident need for further actions to safeguard public health.”⁸⁴ The EPA directed state agencies to take immediate action to safeguard public health in the region, and to “hold sources of nitrate accountable using all available tools to reduce the amount of nitrate they release to ground water.”⁸⁵ Specifically, the EPA encouraged the state to consider modifications to its nutrient management standards in karst areas with regard to land application of manure.⁸⁶

⁸² MPCA, *Responses to Comments on the General NPDES and SDS Animal Feedlot Permits* 10 (Jan. 2025), <https://www.pca.state.mn.us/sites/default/files/wq-f3-64.pdf> (“MPCA Responses to Feedlot Permit Comments”).

⁸³ See MCEA et al., *Petition to EPA for Emergency Action Pursuant to the Safe Drinking Water Act* (April 24, 2023) (MCEA Ex. 10).

⁸⁴ Letter from EPA to Minn. Dep’t of Health, MDA, and MPCA re: Safe Drinking Water Act Petition 2 (Nov. 3, 2023) (MCEA Ex. 27).

⁸⁵ *Id.* at 4.

⁸⁶ *Id.*

II. MPCA has the authority and the duty to change the Animal Feedlot Rule to comply with water protection requirements in state and federal law

MPCA has the authority and the duty under Minnesota and federal law to protect the state’s groundwater and surface waters from manure-related pollution, but its current Animal Feedlot Rule does not fulfill this duty, based on the widespread and persistent violations of water quality standards caused by feedlot-related pollution.

Federal and state laws contain critical and stringent protections for the state’s surface waters and groundwater, and MPCA has the duty to enforce these protections.⁸⁷ Under the Clean Water Act, MPCA has the obligation to set and enforce water quality standards to protect “designated uses” in particular water bodies—such as waters used for drinking, recreation, or aquatic life.⁸⁸ These water quality standards must protect public health or welfare, enhance the quality of water, and ensure that the water is clean enough to be safe for the designed uses.⁸⁹ Under state law, this authority is confirmed and expanded, with MPCA required to protect “waters of the state,” which include both surface waters and groundwater.⁹⁰ The agency’s duties include adopting

⁸⁷ Minn. Stat. § 115.03, subd. 1(a)(1).

⁸⁸ *See* 33 U.S.C. § 1313; 40 C.F.R. §§ 131.3(f), .10, .11.

⁸⁹ 33 U.S.C. § 1313(c)(2)(A); 40 C.F.R. § 131.11(a)(1).

⁹⁰ Minn. Stat. § 115.01, subd. 22 (“Waters of the state’ means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof.”).

and enforcing rules “in order to prevent, control or abate water pollution.”⁹¹ Specifically, MPCA must issue rules that:

- Prohibit the discharge of wastes⁹² into the waters of the state, or to deposit wastes “where the same is likely to get into any waters of the state” in violation of Minnesota’s rules and pollution standards.⁹³
- Require adoption of remedial measures “to prevent, control or abate any discharge or deposit of ... wastes by any person.”⁹⁴
- Require establishment of systems of recordkeeping, sampling, monitoring, and reporting by dischargers for provision of information to the agency.⁹⁵
- Include additional limits if technology-based standards are not adequate to maintain water quality standards.⁹⁶

Pursuant to this authority, MPCA has set policies and rules to protect both groundwater and surface waters. For groundwater, MPCA has adopted an antidegradation policy, under which it must “consider the actual or potential use of the underground waters for potable water supply as constituting the highest priority use and as such to provide maximum protection to all underground waters.”⁹⁷ For surface waters, MPCA’s policy “is to protect and maintain surface waters in a condition which allows for the maintenance of all existing beneficial uses.”⁹⁸ In other words, surface waters should not be polluted in a way that stops a current use—such as for drinking water or sustaining aquatic life.

⁹¹ Minn. Stat. § 115.03, subd. 1(a)(5).

⁹² Although certain components of land-applied manure may be used by plants, where manure, nutrients, or other pollutants escape their intended use and are instead discharged into waters of the state those pollutants are properly characterized as “other wastes,” which as defined includes “agricultural waste” and “biological materials.” Minn. Stat. § 115.01, subd. 9.

⁹³ Minn. Stat. § 115.03, subd. 1(a)(5)(ii).

⁹⁴ Minn. Stat. § 115.03, subd. 1(a)(5)(iv).

⁹⁵ Minn. Stat. § 115.03, subd. 1(a)(5)(vii).

⁹⁶ Minn. Stat. § 115.03, subd. 1(a)(5)(viii).

⁹⁷ Minn. R. 7060.0200.

⁹⁸ Minn. R. 7050.0150, subp. 1.

To implement these policies, MPCA has adopted water quality standards to protect surface waters and groundwater. For Class 1 waters—all waters used for drinking water, including all groundwater in the state—MPCA has set a water quality limit for nitrate at 10 mg/L.⁹⁹ MPCA also prohibits any wastes from point or nonpoint sources to be discharged into or permitted to gain access to any Class 1 waters in the state “so as to cause any material undesirable increase in the . . . nutrient content, or in any other manner to impair the natural quality or value of the waters for use as a source of drinking water.”¹⁰⁰ As an additional protection for groundwater, MPCA adopted a prohibition against discharges of waste and pollutants into the unsaturated zone (the area between the land surface and the water table) that “may actually or potentially preclude or limit the use of the underground waters as a potable water supply, nor shall any such discharge or deposit be allowed which may pollute the underground waters.”¹⁰¹

For Class 2 waters—those that may support aquatic life, which includes virtually all surface waters in Minnesota—there is no numeric standard for nitrate. However, there is a “narrative” water quality standard—an enforceable, descriptive standard—that prohibits degrading the water quality “in any material manner.” The narrative standards also require that

there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters . . . the normal aquatic biota and the use thereof shall not be seriously impaired or endangered, . . . and the propagation or migration of aquatic biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste, or other wastes to the waters.¹⁰²

⁹⁹ Minn. R. 7050.0221, subps. 2–4 (incorporating the limit from 40 C.F.R. § 141.62(b)(7)).

¹⁰⁰ Minn. R. 7050.0221, subp. 6.

¹⁰¹ Minn. R. 7060.0600, subp. 2. This rule does not prohibit the use of chemicals and fertilizers for crops only if “such practices do not pose a significant pollution hazard.” Minn. R. 7060.0600, subp. 5. As land application of manure is causing pollution of groundwater—as admitted by MPCA—this exception for fertilizer does not apply.

¹⁰² Minn. R. 7050.0150, subp. 3.

Additionally, for Class 2 waters, ammonia is limited to 4.1 mg/L in cold waters and 10.1 mg/L for other waters.¹⁰³

Accordingly, under state and federal law, MPCA is required to take actions to protect both surface waters and groundwater from nitrate, nutrient, and bacterial pollution in excess of these standards. As the Animal Feedlot Rule self-evidently is not ensuring that these standards are met, it is inadequate under state and federal law, and it must be revised to ensure these water quality standards are not subject to further exceedances due to pollution from manure.

III. MPCA must make changes to its Animal Feedlot Rule to comply with state and federal law and address nitrate pollution

Based on decades of research, MPCA knows of practices that significantly reduce or prevent nitrogen loss from croplands. However, these practices have not been required in the Animal Feedlot Rule, making it inadequate to protect Minnesota’s surface waters and groundwater. MPCA must make extensive changes to make the rule more effective and address nitrate pollution.

A. MPCA should require water pollution permits for feedlots with more than 600 animal units

Under the current Animal Feedlot Rule, only the largest feedlot operations, called Concentrated Animal Feeding Operations, or CAFOs—those with more than 1,000 animal units¹⁰⁴—require federal National Pollutant Discharge Elimination System (“NPDES”) or State

¹⁰³ MPCA, *Aquatic Life Quality Standards for Ammonia: Draft Technical Support Document 19* (July 2022), <https://www.pca.state.mn.us/sites/default/files/wq-rule4-25b.pdf>.

¹⁰⁴ An animal unit is a way of comparing different-sized animals by the amount of manure they produce. One animal unit is equal to one 1,000 lb. beef steer, .3 hogs of 55 to 300 lbs., or .005 chickens over 5 lbs. Minn. R. 7020.0300, subp. 5. To require a water pollution permit, then, a feedlot would need to have more than 1,000 beef cattle, 3,334 market hogs, or 200,000 chickens. See Minn. R. 7020.0300, subp. 5 (defining animal units under Minnesota Rules); Minn. R. 7020.0405, subp. 1(B) (requiring an SDS permit for feedlots with 1,000 or more animal units). MPCA, *Livestock and the Environment* 4 (Jan. 2021), <https://www.pca.state.mn.us/sites/default/files/wq-f1-01.pdf> (MCEA Ex. 40).

Disposal System (“SDS”) permits for water pollution.¹⁰⁵ This means only about 4% of Minnesota’s more than 23,000 feedlots require federal or state water pollution permits.¹⁰⁶ It is critical for these largest feedlots to have permits, because they produce about one-third of the state’s manure.¹⁰⁷ However, the remaining feedlots produce two-thirds of the manure generated in Minnesota and have fewer restrictions on their management and application of manure because of their lack of permit coverage. MPCA should lower the SDS permit threshold to 600 animal units to ensure that more feedlots are required to follow the stricter provisions of state water pollution permits. Based on current registration data, this would cover approximately 10% of registered cattle, poultry, and swine feedlots in Minnesota and an additional 26% of manure generated by animal feedlots in the state.¹⁰⁸

The benefit of this rule change to better protect groundwater from the improper application of nutrients from animal manure on cropland is clear: when combined with the current permit coverage under state and federal law, this would mean that approximately 60% of the manure generated by animal feedlots in Minnesota would be subject to the land application requirements of state and federal permits. These permit requirements were revised in January 2025 to better

¹⁰⁵ 40 CFR § 122.23; Minn. R. 7020.0405, subp. 1(B)(1) (requiring SDS permits for feedlots with 1,000 or more AUs).

¹⁰⁶ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

¹⁰⁷ *Id.* (“Four percent of facilities were large [CAFOs] but generated 33 percent of manure”).

¹⁰⁸ *See Environmental Work Group Comments to the Minnesota Pollution Control Agency; request for comments on the Animal Feedlots Rule* (July 8, 2025), https://speakup-us-production.s3.amazonaws.com/uploads/attachment/file/686d4c6544253872de02e4eb/EWG_Feedlot_Rule_Comment_2025_pdf.pdf (“EWG Response to MPCA Request for Comments”) (noting that facilities with 600+ animal units produced 12,640,899 tons of manure annually); EWG, *Manure Overloads Minnesota* (MCEA Ex. 23) (stating that “[I]ivestock facilities in the state generated almost 49 million tons of manure in 2024”). *See also* EWG Response to MPCA Request for Comments (“there were 2,316 feedlots with between 600 and 999 animal units in Minnesota in 2024); EWG, *Manure Overloads Minnesota* (MCEA Ex. 23) (“Minnesota had 25,503 animal feeding operations in 2024”).

protect VGAs of the state with additional steps to minimize the risk of nitrate loss to groundwater when manure is land-applied in the fall or on frozen, snow-covered ground. Of the registered feedlots that fall between 600 and 999 animal units that would be covered under a lower permit threshold, approximately 14% are located within VGAs as defined in the January 2025 permit feedlot revision, and approximately 35% of all feedlots in the 600-999 animal units range are within a one-mile buffer of VGAs and therefore likely land apply manure within VGAs¹⁰⁹ (see Figures 1 and 2).

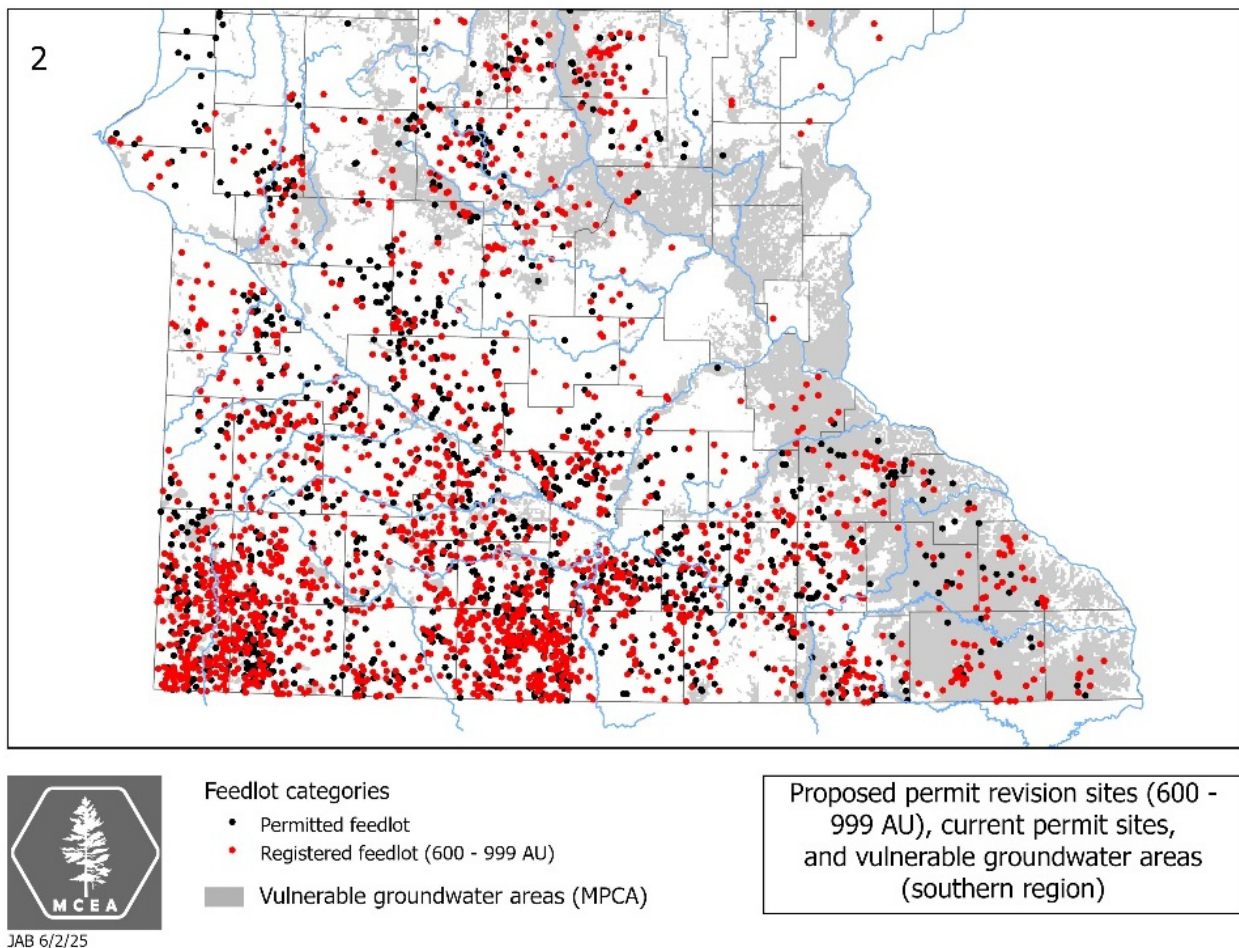


Figure 1: Proposed permit revision feedlot sites in southern region vulnerable groundwater areas. Map created by Jim Berg with data from the Minnesota Geospatial Commons.

¹⁰⁹ Data from Minnesota Geospatial Commons, *Feedlots in Minnesota*, <https://gisdata.mn.gov/sv/dataset/env-feedlots> and *MPCA Feedlot Program Vulnerable Groundwater Areas*, <https://gisdata.mn.gov/sv/dataset/env-feedlot-vuln-gw-areas>.

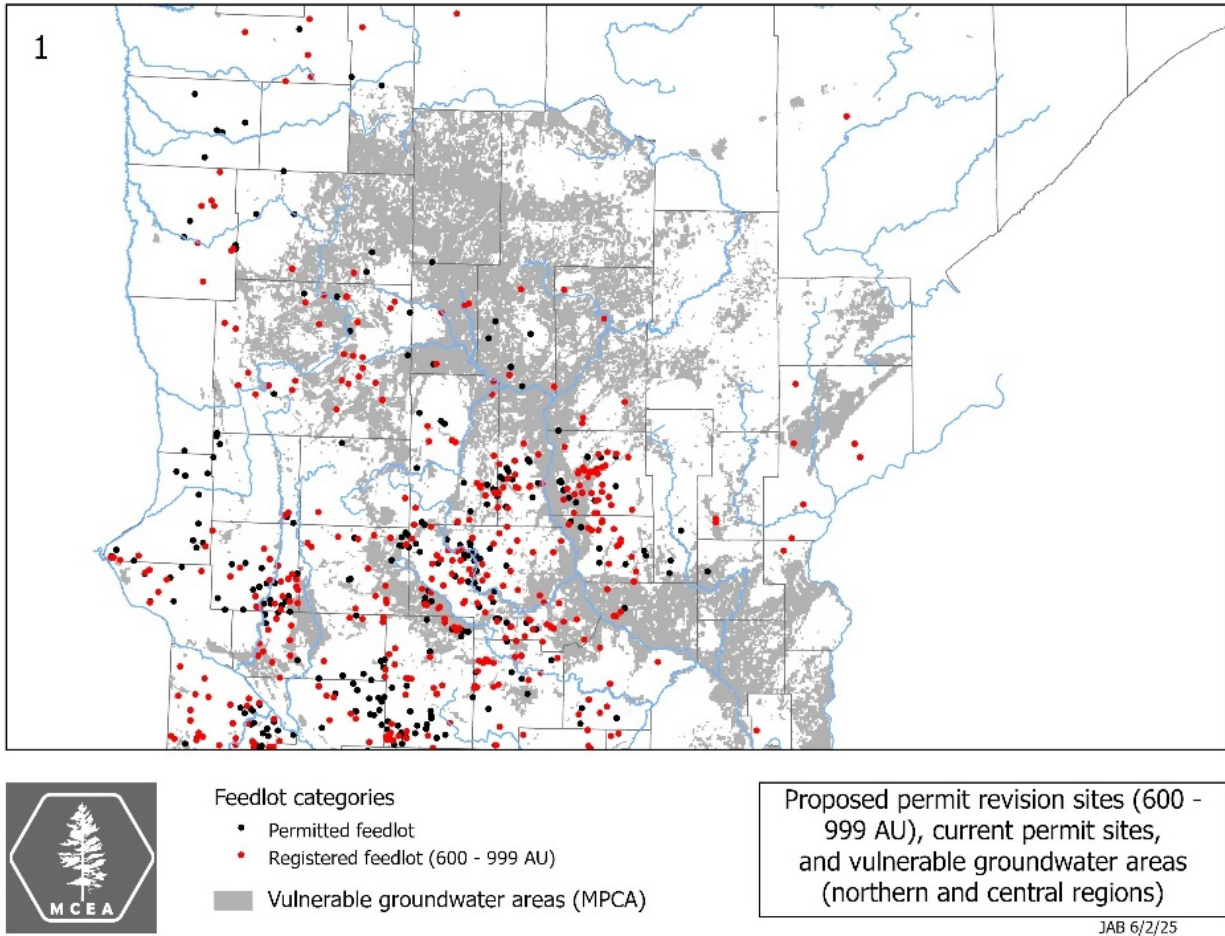


Figure 2: Proposed permit revision feedlot sites in northern and central regions vulnerable groundwater areas. Map created by Jim Berg with data from the Minnesota Geospatial Commons.

MPCA’s NPDES and SDS permits impose a number of conditions that are not explicitly set forth in the Animal Feedlot Rule in order to “achieve compliance with state and federal statutes/rules” and “to protect human health and the environment.”¹¹⁰ For example, both permits impose additional limits on application of manure, including requiring manure to be incorporated into the soil if rainfall is predicted¹¹¹ requiring manure applied in June, July, August, or September to be added to a growing crop or cover crop¹¹² imposing additional restrictions on application of

¹¹⁰ MPCA Responses to Feedlot Permit Comments at 11.

¹¹¹ MPCA, *Permit to Construct and Operate a CAFO under the NPDES Program* §13.3 (2026-2031), <https://www.pca.state.mn.us/sites/default/files/wq-f3-62.pdf/>.

¹¹² *Id.* at § 13.4.

manure in October and November in VGAs,¹¹³ and restricting application of manure to frozen or snow-covered ground.¹¹⁴ The permits also require some visual inspections and monitoring of discharges¹¹⁵ and that manure transferees follow the feedlot's manure management plan,¹¹⁶ along with other provisions to control pollution discharges. Feedlots with permits are also required to follow additional reporting requirements,¹¹⁷ including submission of their manure management plans and manure application records,¹¹⁸ construction reports,¹¹⁹ facility maintenance reports,¹²⁰ and discharge reports.¹²¹ These are important provisions for nitrate pollution, but the vast majority of the state's feedlots do not have to follow them.

Minnesota has many feedlots that are quite large, and that produce many tons of manure every year, but that are not subject to these rules. More than 2,300 cattle, poultry, and swine feedlots fall between 600 and 999 animal units, and these feedlots produce 25.8% of all the manure generated in the state.¹²² For certain animal categories like swine, feedlots that fall between 600 and 999 animal units account for approximately 44% of the manure generated by swine feedlots statewide.¹²³ While currently not subject to the state SDS permit, each of these feedlots still produces a massive amount of manure. For example, a feedlot with 600 animal units of beef cows, or about 600 cows, would produce around 10,000 tons of solid manure or 2.4 million gallons of

¹¹³ *Id.* at §§ 13.5-13.7.

¹¹⁴ *Id.* at § 13.8-13.10.

¹¹⁵ *Id.* at §§ 14.3, 28.3-28.4.

¹¹⁶ *Id.* at §§ 9.3, 9.4, 24.7.

¹¹⁷ *Id.* at § 25.2.

¹¹⁸ *Id.* at §§ 10.2-10.5, 24.7.

¹¹⁹ *Id.* at § 5.4.

¹²⁰ *Id.* at § 24.3.

¹²¹ *Id.* at §§ 27.2, 28.4.

¹²² EWG Response to MPCA Request for Comments; EWG, Manure Overloads Minnesota (MCEA Ex. 23).

¹²³ Data from Minnesota Geospatial Commons, *Feedlots in Minnesota*, <https://gisdata.mn.gov/sv/dataset/env-feedlots>.

liquid manure each year.¹²⁴ This quantity of manure should require careful handling in order to minimize water pollution. The practices required by the permits have been determined by MPCA to be useful for reducing pollution and reasonable for feedlots to follow. Accordingly, requiring certain feedlots of less than 1,000 animal units to follow these requirements would help reduce water pollution.

MPCA has the authority to reduce the permit threshold for SDS permits to 600 animal units. NPDES permits are federal permits, and federal law requires that they be issued for feedlots with more than 1,000 animal units that discharge to the waters of the United States.¹²⁵ SDS permits, however, are state permits, and MPCA has the authority within the Animal Feedlot Rule to set the threshold for these permits at a different level than 1,000 animal units.¹²⁶ Currently, a feedlot that is required to obtain an SDS permit may choose to obtain a NPDES permit instead, so if the threshold for SDS permits decreased, producers might choose to obtain a NPDES permit instead.¹²⁷ As the provisions of the SDS and NPDES permits are largely similar with respect to land application of manure, inspection requirements, reporting obligations, and other provisions, allowing producers to obtain NPDES permits instead of SDS permits would provide many of the same protections. Lowering the SDS threshold to 600 animal units would increase the number of feedlots that have to follow critical regulation that would reduce water pollution, and MPCA should revise Minnesota Rule 7020.0405, subpart 1 to make this change.

¹²⁴ See MDA & University of Minnesota, *Nutrient & Manure Management Tables*, at 1, <https://www.mda.state.mn.us/sites/default/files/2018-05/nutmantables.pdf> (last visited July 17, 2025) (MCEA Ex. 41).

¹²⁵ 40 C.F.R. § 122.23(b)(4).

¹²⁶ See Minn. R. 7020.0405, subp. 1(B) (setting SDS permit threshold).

¹²⁷ MPCA, *NPDES and SDS permits for feedlots*, <https://www.pca.state.mn.us/business-with-us/npdes-and-sds-feedlot-permits> (MCEA Ex. 42).

B. MPCA should require Manure Management Plans to be submitted for feedlots with more than 300 animal units through the new Online Nutrient Management Tool

Although the current Animal Feedlot Rule requires most feedlots with more than 300 animal units to create a Manure Management Plan (“MMP”),¹²⁸ only the largest feedlots—those that are required to apply for an SDS or NPDES permit (and feedlots that need interim permits because they were identified as pollution hazards)—are required to submit that plan to MPCA (or the county feedlot officer).¹²⁹ Requiring all feedlots with more than 300 animal units to create and submit MMPs annually through MPCA’s new online Nutrient Management Tool would ensure that more feedlots manage and apply their manure according to appropriate plans, which would help to reduce pollution. It would also ensure that those plans are readily available for review by the MPCA or, in delegated counties, by the county feedlot officer. In addition, information from the online tool regarding manure application in fields should be made publicly available to community members for review. This rule change would provide greater oversight and accountability for the land application of manure from medium feedlots in Minnesota, which accounted for 18% of all feedlot operations in the state as of 2025 but generated the largest share of manure at 43%.¹³⁰

¹²⁸ Under Minn. R. 7020.2225, subp. 4(A)(1), a facility must prepare a Manure Management Plan when it applies for a NPDES, SDS, or construction short-form permit construction permit for a facility capable of holding 100 or more animal units. Facilities with 300 or more animal units need to obtain a construction short-form permit under Minn. R. 7020.0405, subp. 1(D). A feedlot with 300 or more animal units that is not required to obtain a permit must prepare a manure management plan when manure is applied by someone other than a professional applicator. Minn. R. 7020.2225, subp. 4(A)(2). Accordingly, under the rules, most feedlots with more than 300 animal units need to create an MMP and once it is created, to update it annually. Minn. R. 7020.2225, subp. 4(C).

¹²⁹ Minn. R. 7020.2225, subp. 4(B).

¹³⁰ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

Manure, “in general, is complicated.”¹³¹ When manure is applied to fields, the risks of nitrate pollution can depend on factors such as “rate calculations, sampling, setbacks and buffers, [and] spreader calibration [application].”¹³² MMPs are critical to ensuring that manure is applied at appropriate rates, times, and places, as such plans require producers to identify the amount of manure that will be spread, where and how it will be spread, the planned application rate, the other sources of nutrients that will be applied, and a description of the protective measures to minimize water pollution when applying manure in sensitive areas.¹³³ Without creating such a plan, it is difficult for producers to determine whether they are applying their manure appropriately to minimize the risk of water pollution.¹³⁴ Because overapplication of nitrogen is so common in Minnesota, particularly when manure is used, the use of MMPs is crucial for decreasing the risk of water pollution.

Changes to the rule will make the use of MMPs more effective. First, requiring all medium feedlots of 300 to 999 animal units (hereinafter, “medium feedlots”)¹³⁵ to submit an MMP to a regulatory authority will ensure that medium-sized feedlots are required to do critical annual planning to ensure excess nitrogen is not applied to their fields. Most of these feedlots are already supposed to create a MMP,¹³⁶ so simply requiring them to use the online Nutrient Management Tool to submit it would provide little extra burden on producers.

¹³¹ Chryseis Modderman, *Manure Is Complicated: 5 Reasons You Need a Manure Management Plan* (MCEA Ex. 11).

¹³² *Id.* at 2.

¹³³ See Minn. R. 7020.2225, subp. 4(D).

¹³⁴ Chryseis Modderman, *Manure Is Complicated: 5 Reasons You Need a Manure Management Plan* (MCEA Ex. 11).

¹³⁵ Medium feedlots are defined by the EPA as those with more than 300 animal units. EPA, *Regulatory Definitions of Large CAFOs, Medium CAFO, and Small CAFOs*, https://www3.epa.gov/npdes/pubs/sector_table.pdf (last visited July 18, 2025) (MCEA Ex. 43).

¹³⁶ See Minn. R. 7020.2225, subp. 4(A).

Second, requiring all feedlots to use MPCA’s new Nutrient Management Tool will make MMPs more effective at minimizing water pollution. Currently, only feedlot operators that submit permits directly to the MPCA, rather than to delegated county feedlot officers, are required to use the online tool. The new tool incorporates maps with information on where manure application restrictions apply, including VGAs, sinkholes, tile inlets, wells, surface waters, ditches, and floodplains.¹³⁷ These features will help users identify sensitive features at the field scale and are an improvement from previous MMP practices, when MPCA merely provided a list of sensitive features that the feedlot operator had to then identify themselves in their fields. The new tool will also allow an analysis of acres used for land application to ensure that the same fields are not being used by more than one feedlot.¹³⁸ Operators that receive manure from a registered feedlot operator should be required to use the digital Nutrient Management Tool as well to ensure they are following the requirements of the land application rule, and if appropriate, the feedlot’s permit.¹³⁹

Third, any medium and large feedlots located outside of Minnesota that intend to spread manure inside the state should be required to create, submit, and follow an MMP that meets the requirements of the Animal Feedlot Rule (and require their transferees to follow that MMP) if they have more than 300 animal units. Manure does not become less polluting merely because it crosses state lines, and in recent years more large feedlots constructed on the borders of the state have sent—or plan to send—their manure into Minnesota for field application. For example, Riverview Dairy plans to build a 12,500-cow dairy near Abercrombie, N.D., and a 25,000-cow dairy near

¹³⁷ See MPCA, Nutrient Management Planning Map, <https://experience.arcgis.com/experience/b99690542f364a6dace31df6fab2e55a/page/Page> (last visited July 18, 2025) (“MPCA Nutrient Management Map”); MPCA Responses to Feedlot Permit, at 95.

¹³⁸ MPCA Responses to Feedlot Comments, at 93.

¹³⁹ The January 2025 revision of the Minnesota General Feedlot Permit requires people who receive transferred manure from feedlots with a NPDES or SDS permit to follow the requirements of the permit in addition to the requirements of the feedlot rule.

Hillsboro, N.D., both along the Minnesota border.¹⁴⁰ Both of these facilities intend to apply some of the 321 million gallons of manure they will produce¹⁴¹ across the border in Minnesota—the dairy near Hillsboro intends to spread its manure on around 1,180 acres in Minnesota.¹⁴² This may only be the vanguard of more across-the-border feedlots, as North Dakota is taking steps to encourage more livestock production.¹⁴³ Facilities should not be allowed to circumvent regulations that protect the health of Minnesotans and its waters by simply locating across state lines.

Finally, the information from the new tool regarding how manure will be applied should be made public through the Minnesota Geospatial Commons, so that community members can confirm that producers are following their MMPs and that fields are not receiving manure from multiple feedlots. Because of MPCA's and delegated counties' limited resources for enforcement and inspections, enlisting the public will help ensure MMPs are properly followed.

These proposed rule changes are particularly important in VGAs. In a May 2025 report, the Environmental Working Group found significant overlap between counties overloaded with nitrogen (defined as counties where nitrogen from manure and commercial fertilizer inputs exceed the Extension Service crop recommendations by more than 40%) and VGAs as defined by the MPCA (see Figure 3). Of the 6,480 feedlot operations that fell within VGAs in 2024, only 161 are above the 1,000-animal unit permit threshold and required to submit MMPs directly to MPCA

¹⁴⁰ Delaney Otto, *As dairy declines in ND, could new facilities prompt a renewal? Boosters, and opponents, are watching*, Grand Forks Herald (June 14, 2025), <https://www.grandforksherald.com/news/north-dakota/amid-dairy-decline-in-north-dakota-planned-facilities-could-prompt-a-renewal-in-the-industry-2> (MCEA Ex. 44).

¹⁴¹ *Id.*

¹⁴² Herberg Dairy Manure Application Fields (MCEA Ex. 45).

¹⁴³ Delaney Otto, *As dairy declines in ND, could new facilities prompt a renewal? Boosters, and opponents, are watching*, Grand Forks Herald (June 14, 2025), <https://www.grandforksherald.com/news/north-dakota/amid-dairy-decline-in-north-dakota-planned-facilities-could-prompt-a-renewal-in-the-industry-2> (MCEA Ex. 44).

through the new online Nutrient Management Tool. Nearly five times that number (791 facilities) fall into the medium category.¹⁴⁴ Therefore, this proposed rule change would increase the number of feedlot operations within VGAs that have to submit MMPs through the MPCA’s online Nutrient Management Tool from approximately 2% to just under 15%,¹⁴⁵ further ensuring that more feedlots are creating appropriate plans to reduce pollution.

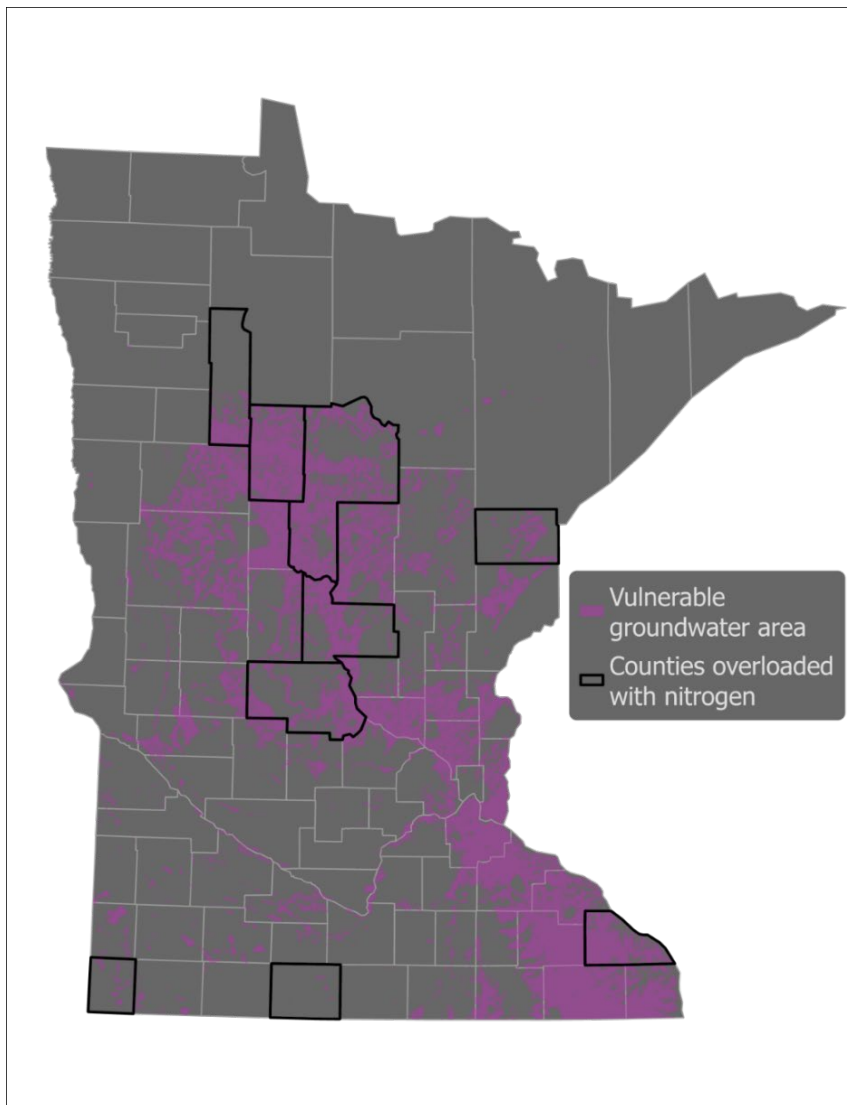


Figure 3: Minnesota counties and vulnerable groundwater areas at risk of nitrogen overload. EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

¹⁴⁴ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

¹⁴⁵ *Id.* (161 facilities represents just under 2.5% of the 6,480 feedlots in VGAs; adding the 791 medium facilities to this figure results in just under 15% of the 6,480 feedlots in VGAs).

C. MPCA should require monitoring of feedlot production areas and land application areas for surface and subsurface discharges

Although MPCA added some minimal visual inspection requirements to its new NPDES and SDS permits for feedlots, the Animal Feedlot Rule currently has few requirements for inspections or monitoring to ensure that Minnesota's feedlots are not causing water pollution. The rule has some provisions for inspections of newly constructed liquid manure storage areas, manure compost sites, and poultry barn floors,¹⁴⁶ but it contains no other requirements for inspections or monitoring of production areas or land application areas. To ensure compliance with the Animal Feedlot Rule and identification of facilities that are causing pollution problems, MPCA should add inspection and monitoring requirements, both for production areas and land application sites.

The Animal Feedlot Rule has several prohibitions on discharges to Minnesota's waters. It prohibits discharges of manure from any feedlots into any channels that convey fluids to groundwater or from CAFOs to surface waters of the state unless authorized by a permit.¹⁴⁷ The rule also prohibits land application of manure in a manner that will result in a discharge to the waters of the state during the application process or cause pollution of the waters of the state due to manure-contaminated runoff.¹⁴⁸ In addition, Minnesota's rules prohibit the discharge of wastes to the unsaturated zone that "may pollute the underground waters"¹⁴⁹ and for surface waters prohibit significant increases in harmful residues and pollutants that harm aquatic life.¹⁵⁰ However, there are essentially no monitoring or inspection requirements to ensure that these prohibitions are

¹⁴⁶ Minn. R. 7020.2100, subp. 6; Minn. R. 7020.2150, subp. 2(C); Minn. R. 7020.2120, subp. 2(B).

¹⁴⁷ Minn. R. 7020.2003, subps. 1-2.

¹⁴⁸ Minn. R. 7020.2225, subp. 1(A)(1)-(2).

¹⁴⁹ Minn. R. 7060.0600, subp. 2. This rule does not prohibit the use of chemicals and fertilizers for crops only if "such practices do not pose a significant pollution hazard." Minn. R. 7060.0600, subp. 5.

¹⁵⁰ Minn. R. 7050.0150, subp. 3.

met. Nor do inspections by MPCA’s feedlot staff fill this hole. MPCA has only a limited staff to inspect the state’s more than 20,000 feedlots—generally, the goal is for agency staff to inspect each MPCA-permitted feedlot once per decade. For counties with delegated authority over feedlots, the goal is to inspect at least 7% of the total number of registered feedlots in the county per year:¹⁵¹ in counties with many feedlots this can lead to inspections even less frequently than once per decade.

Clearly, neither feedlot inspections nor monitoring are sufficient to prevent discharges from production facilities and land application areas that are causing or contributing to water pollution. While the NPDES and SDS feedlot permits in Minnesota require regular visual inspections of liquid manure storage area freeboard markers and perimeter drain tile, there are no requirements to monitor impacts to groundwater below production areas or to groundwater or drain tile below land application fields.¹⁵² This makes it impracticable or even impossible to consistently identify facilities that meet the definition of a pollution hazard or have violated the Animal Feedlot Rule or the terms of the NPDES and SDS permits.

Multiple courts have held that feedlot permits that do not include monitoring provisions sufficient to ensure compliance with their terms do not meet the requirements of the law, as such permits are of little use.¹⁵³ For example, the Washington Court of Appeals found that “[m]onitoring is necessary because it is meant to ensure that dischargers act in compliance with permit

¹⁵¹ Minn. Stat. § 116.0711 subd. 2c.

¹⁵² See MPCA, *Feedlot Inspection Records: NPDES and SDS Permitted Sites* (2025), <https://www.pca.state.mn.us/sites/default/files/wq-f5-21.pdf> (MCEA Ex. 46).

¹⁵³ *Food & Water Watch v. Env’t Prot. Agency*, 20 F.4th 506, 515 (9th Cir. 2021) (“Our case law confirms that NPDES permits must contain monitoring provisions sufficient to ensure compliance with the terms of a permit.”) (internal citation omitted); *Nat. Res. Def. Council v. Env’t Prot. Agency*, 808 F.3d 556, 583 (2d Cir. 2015) (quoting *Nat. Res. Def. Council, Inc. v. Cnty. of Los Angeles*, 725 F.3d 1194, 1207 (9th Cir. 2013)) (“Generally, ‘an NPDES permit is unlawful if a permittee is not required to effectively monitor its permit compliance.’”).

conditions.”¹⁵⁴ The court explained that without such monitoring, permits “contain inherent contradictions that would render them unenforceable,” because they prohibit certain discharges while simultaneously allowing conduct which would result in those same discharges.¹⁵⁵ The court found this concept specifically applied to groundwater monitoring. The previous permits contained a condition “that “[d]ischarges conditionally authorized by this permit must not cause or contribute to a violation of water quality standards.””¹⁵⁶ The Washington Court of Appeals stressed that “[e]nsuring compliance with this condition requires analyzing the effects of a CAFO’s activities on groundwater”; and that the agency’s own research concluded that “groundwater monitoring . . . is the single method available to ascertain a CAFO’s direct impact on groundwater quality.”¹⁵⁷

Similarly, the Ninth Circuit vacated an Idaho permit due to lack of monitoring requirements. The Idaho permit prohibited “discharges of pollutants from production areas” (with a single exception) and “[d]ry-weather discharges from the land-application area,” but had no monitoring provisions to ensure these prohibitions were met.¹⁵⁸ The court concluded that “[w]ithout a requirement to monitor runoff from irrigated CAFO fields, there is no way to ensure that a CAFO is complying with the Permit’s dry weather no-discharge requirement for land-application areas.”¹⁵⁹ In reaching this conclusion, the Ninth Circuit relied on a prior ruling in which

¹⁵⁴ *Washington State Dairy Fed'n v. State*, 18 Wash. App. 2d 259, 301 (2021) (citing *Nat. Res. Def. Council, Inc. v. Cnty. of Los Angeles*, 725 F.3d 1194, 1207 (9th Cir. 2013)). *See also id.* at 303 (internal citation omitted) (stressing the importance of monitoring requirements in permits for groundwater as well)).

¹⁵⁵ *Id.* at 300.

¹⁵⁶ *Id.* at 301 (internal citation omitted).

¹⁵⁷ *Id.* at 302.

¹⁵⁸ *Food & Water Watch v. U.S. Env't Prot. Agency*, 20 F.4th 506, 513, 517-18. (9th Cir. 2021).

¹⁵⁹ *Id.* at 518 (internal citation omitted).

it found explicitly that “an NPDES permit is unlawful if a permittee is not required to effectively monitor its permit compliance.”¹⁶⁰

To address the Ninth Circuit’s decision in that case, the EPA established new permit requirements for CAFOs in Idaho.¹⁶¹ For production areas, the Idaho permit now requires all permitted feedlots to prepare a Subsurface Discharge Monitoring Plan (“SDMP”) “to identify and monitor any functionally equivalent subsurface discharges to Waters of the United States [“WOTUS”] from each wastewater or manure storage structure.”¹⁶² The only exceptions to this requirement are if one of the following criteria are met: either a) a “Professional Engineer, geologist, hydrogeologist or another qualified individual” documents that the storage structure does NOT have a subsurface discharge to WOTUS; or b) the permittee confirms and maintains documentation in the MMP “that each wastewater and manure storage structure is constructed of concrete or steel, or with a double-layer synthetic liner with leak detection.”¹⁶³ The SDMP itself must include “site-specific information and procedures” that outline routine, periodic monitoring “adequate to identify leaks, damage, and other issues that could cause a functionally equivalent subsurface discharge, including the frequency of monitoring and the site-specific technology or protocols that will be used.”¹⁶⁴

¹⁶⁰ *Nat. Res. Def. Council v. Env’t Prot. Agency*, 808 F.3d 556, 583 (2d Cir. 2015) (quoting *Nat. Res. Def. Council, Inc. v. Cnty. of Los Angeles*, 725 F.3d 1194, 1207 (9th Cir. 2013)).

¹⁶¹ *Authorization to Discharge under the National Pollutant Discharge Elimination System: Idaho*, EPA, <https://www.epa.gov/system/files/documents/2024-12/r10-npdes-idaho-cafo-gp-idg010000-final-permit-mod-2024.pdf> (MCEA Ex. 12) (“Idaho Permit”) (“The general permit was modified to includes [sic] new and revised conditions to address the Ninth Circuit Court of Appeal’s Order and Opinion filed on December 16, 2021”).

¹⁶² *Id.* § III.A.2.a.iii.

¹⁶³ *Id.* § III.A.2.iii.a-b.

¹⁶⁴ *Id.* § IV.D.6.b.

To assess compliance with the prohibition on dry weather discharge for land application areas, the Idaho Permit imposes specific monitoring requirements, including the collection of grab samples “prior to mixing with the receiving waters” as well as upstream and downstream of the point of discharge to the receiving stream.¹⁶⁵ The permit also requires soil samples to be “taken from every field to which manure, litter, and process wastewater will be applied.”¹⁶⁶ The soil samples must be analyzed by a certified laboratory for pH, soil organic matter, Nitrate-Nitrogen, Ammonium-Nitrogen, and phosphorus.¹⁶⁷ Finally, the results of these soil sample analyses must be included in the MMP and used to determine application rates.¹⁶⁸

This concept established in both the Washington and Idaho court decisions that permits must include adequate monitoring to ensure compliance applies equally to the Animal Feedlot Rule—a rule that requires feedlots to take no steps to ensure they are complying with its prohibitions is not an effective rule. MPCA has the authority to include monitoring and inspection provisions in the rule. It has been specifically entrusted by the Legislature with the authority to require owners or operators of point sources to install and maintain monitoring equipment needed to prevent and abate pollution.¹⁶⁹ Accordingly, it should add provisions to the Animal Feedlot Rule to require adequate monitoring both at land application areas and production areas to ensure compliance with the Rule.

1. Land application areas

At a minimum, the Animal Feedlot Rule should be revised to add visual inspection requirements for land application areas for all medium (over 300 animal units) and large feedlots,

¹⁶⁵ *Id.* § IV.E.1.

¹⁶⁶ *Id.* § III.A.2.g.ii.

¹⁶⁷ *Id.* § III.A.2.g.ii-iii.

¹⁶⁸ *Id.* § III.A.2.g.ii.

¹⁶⁹ Minn. Stat. § 115.03, subd. 1(a)(5)(vii).

similar to those added to the NPDES and SDS feedlot permits. The new feedlot permits have added requirements for visual inspections of land application fields at all downgradient field edges; sensitive features including tile intakes, sinkholes, and wells; ditches; and other features that could convey manure to waters.¹⁷⁰ These inspections must take place at least once on each day of manure application, at the end of each day of application, and after any significant rainfall within 14 days after application unless the manure is injected or incorporated.¹⁷¹ Any discharge must be responded to and reported to the State Duty Officer and the MPCA.¹⁷² These requirements are not overly burdensome; they do not require investing in expensive equipment or even expending a significant amount of time. Instead, they are common-sense provisions that take the first necessary step toward adding monitoring provisions that will ensure compliance with Minnesota’s rules protecting groundwater. Producers cannot know whether they are causing pollution if they do not—at an absolute minimum—look to see if manure is visibly running from their fields during or immediately after application, or after a significant rainfall. To comply with state and federal law, MPCA should include *at least* these monitoring provisions in the Animal Feedlot Rule.

In addition to visual inspections, MPCA should require groundwater monitoring on fields with the highest risk of nitrate loss to groundwater for feedlots with a NPDES or SDS permit. Subsurface monitoring of this kind is the only way to ensure that unauthorized discharges to groundwater, which would not be discovered by a visual inspection, are not occurring in violation of the prohibitions in the Animal Feedlot Rules and Minnesota’s water quality standards. Based on conversations with MPCA feedlot staff, there are currently fewer than 20 feedlots statewide where

¹⁷⁰ See MPCA, *Authorization to Construct and Operation a Concentrated Animal Feeding Operation Under the National Pollutant Discharge Elimination System (NPDES) Program*, § 14.3 <https://www.pca.state.mn.us/sites/default/files/wq-f3-62.pdf> (“Minnesota NPDES Permit”).

¹⁷¹ *Id.*

¹⁷² *Id.* §§ 14.3, 27.2, 27.3.

MPCA has installed a well network to monitor groundwater discharges. At a minimum, MPCA should undertake a risk-based assessment to determine whether further well networks are necessary, such as investigatory geo-probes to collect temporary well data at permitted feedlots located in VGAs or where contamination exceeds a certain threshold. Possible thresholds include townships with a highly vulnerable Drinking Water Supply Management Area (“DWSMA”)¹⁷³ where nitrate levels have exceeded 5.4 mg/L nitrate or a township where more than 10% of private wells have tested above the 10 mg/L limit.

Such risk assessments are already used in Wisconsin. There, the state’s Department of Natural Resources “may require the installation of a leakage collection of monitoring system or secondary containment.”¹⁷⁴ The Wisconsin rule provides a series of factors to consider in determining whether to require installation of such a system:

- a. Whether facilities are located on or near areas that are susceptible to groundwater contamination such as direct conduits to groundwater, sandy soils, and sites with minimal separations between bedrock and high water tables.
- b. The size and depth of the facility.
- c. The type of liner used.
- d. Characteristics of waste being stored.
- e. Other considerations based on potential impacts to waters of the state.¹⁷⁵

In addition to the above, the Wisconsin Department of Natural Resources “may require the installation of groundwater monitoring wells in the vicinity of manure storage facilities, runoff control systems, permanent spray irrigation systems and other treatment systems where [it]

¹⁷³ The Minnesota Department of Health defines vulnerable DWSMAs as those where the land is “highly vulnerable to contamination from the land surface because of their geologic conditions.” *Protecting Vulnerable Drinking Water Sources*, Minn. Dep’t of Health (Mar. 23, 2021), <https://www.health.state.mn.us/communities/environment/water/docs/cwf/vulnacres.pdf> (MCEA Ex. 47). “Currently, there are approximately 400,000 acres in vulnerable groundwater DWSMAs” that “represent less than 1% of the overall land area of the state.” *Id.*

¹⁷⁴ Wi. Admin. Code DNR § 243.15(3)(c)(2).

¹⁷⁵ Wi. Admin. Code DNR §§ 243.15(3)(c)(2)(a)-(e).

determines monitoring is necessary to evaluate impacts to groundwater and geologic or construction conditions warrant monitoring.”¹⁷⁶ MPCA should adopt a similar approach to protect groundwater from pollution.

MPCA has already determined that fields in the VGAs are those most at risk of discharging nitrate and other pollutants to groundwater because of their soil and geologic conditions. State agency data and producer surveys demonstrate that producers who land apply manure in addition to commercial fertilizer are likely to exceed recommended nitrogen application rates. And MPCA has determined that the largest feedlots, those that are required to obtain NPDES or SDS feedlots, should be required to comply with additional regulations because of the dangers of overapplication that come with the vast amounts of manure they produce. Based on this combination of risk factors, the Animal Feedlot Rule should require that feedlots that need a NPDES or SDS permit should create a SDMP for any land application fields within the VGAs as part of their MMPs.

For land application areas in VGAs, a SDMP would require the use of soil probes to take annual soil samples to inform agronomic application rates, as well as soil moisture probes or lysimeters to monitor water quality within high-risk fields. These steps would allow the feedlot operator and the MPCA to determine whether manure applications are likely to “cause pollution of waters of the state due to manure-contaminated runoff.”¹⁷⁷ Annual soil sample requirements in the SDMP could be modeled on the recently revised Idaho Permit: samples should be taken from every field to which manure, litter, and process wastewater will be applied and should then be analyzed by a certified laboratory for pH, soil organic matter, Nitrate-Nitrogen, Ammonium-

¹⁷⁶ Wi. Admin. Code DNR § 243.15(7).

¹⁷⁷ Minn. R. 7020.2225, subp. 1(A)(2).

Nitrogen, and phosphorus. The results of these analyses must be included in the MMP and used to determine application rates.

Informed by the language in the recent Washington state court decision, the SDMP for land application areas in VGAs should also include the use of soil moisture probes or lysimeters to monitor for subsurface discharges to groundwater. Soil moisture probes and lysimeters require uniform installation across a field to generate representative data,¹⁷⁸ so a field-wide system must be used. Generally, one sample should be taken for every 20 acres, and monitoring should occur during land application or irrigation of fields where manure has been land applied. If a discharge is discovered at a land application area and it is clear that there has not been an appropriate agronomic utilization of nutrients, the producer must have a professional engineer or hydrogeologist review the MMP.¹⁷⁹ Results of the assessment would then be uploaded to the new online Nutrient Management Tool and any deficiencies would have to be addressed by the feedlot to ensure no additional discharges occurred. This combination of visual and subsurface monitoring would ensure that feedlots were not discharging from land application areas in violation of Minnesota’s water quality standards, the Animal Feedlot Rule, and their permits.

2. Production areas

The few inspection requirements imposed by the Animal Feedlot Rule on production areas are entirely inadequate to stop the many ways feedlots discharge from production areas. MPCA should require more monitoring of feedlot production areas—specifically, requiring that all

¹⁷⁸ Kevin Kuehner et al., *Examination of Soil Water Nitrate-N Concentrations from Common Land Covers and Cropping Systems in Southeast Minnesota Karst* at 9, MDA (Oct. 2020), <https://bearworks.missouristate.edu/cgi/viewcontent.cgi?article=4638&context=articles-cnas> (MCEA Ex. 48).

¹⁷⁹ See Idaho Permit, § III.A.2.a.ii (MCEA Ex. 12).

feedlots conduct frequent visual inspections of production area elements and requiring feedlots that need NPDES or SDS permits to create a SDMP.

At a minimum, the Animal Feedlot Rule should require regular visual inspections of the production areas most prone to polluting—specifically, Liquid Manure Storage Areas (“LMSAs”), manure stockpiling areas, manure composting areas, and any other areas where manure or process wastewater accumulate. All of these areas should be inspected at least weekly to determine whether visible leaks or runoff are occurring in violation of the Animal Feedlot Rule’s prohibition on discharges. For feedlots with LMSAs “designed and operated to provide storage for only manure-contaminated runoff or process wastewater,” this should include weekly visual inspection of the LMSA freeboard marker to ensure that the LMSA has adequate capacity “to accommodate the volume generated from a 25-year, 24-hour storm event and any additional volume needed to be consistent with the proposed [MMP] application frequency” to ensure compliance with the design standards of the Animal Feedlot Rule.¹⁸⁰ This is not a theoretical problem— as one example, in June 2024, 17 manure pits in the state overflowed due to heavy rains.¹⁸¹ Regular visual inspections could ensure that leaks or runoff are found earlier and steps taken to address discharges.

In addition, feedlots that require a NPDES or SDS permit should be required to create a SDMP as part of their MMP. Visual inspections of LMSAs cannot determine whether the pit is leaking below the surface, because an inspector cannot visually see a leak below the opaque manure-laden process wastewater. With visual inspections only the most catastrophic leaks will be detected, as measuring lagoon seepage and leakage through observation of a freeboard measuring

¹⁸⁰ Minn. R. 7020.2100 subp 3(B).

¹⁸¹ Greg Stanley, *Seventeen manure pits reportedly overflow at large feedlots in southern Minnesota*, Minnesota Star Tribune (June 26, 2024), <https://www.startribune.com/manure-pits-reportedly-overflow-at-16-large-feedlots-in-southern-minnesota/600376074> (MCEA Ex. 49).

stick alone is imprecise, particularly given that the level of manure within any LMSA will change as its inputs and outputs change. In addition, LMSAs are *designed to leak*—leaks of 500 gallons per acre per day are allowed by the design standards under the Animal Feedlot Rule.¹⁸² When MPCA explicitly allows feedlots to store manure in a manner that allows the subsurface discharge of thousands of gallons of liquid manure into the unsaturated zone every day, it must require monitoring to determine whether that seepage is polluting groundwater in violation of Minnesota’s water quality standards and groundwater protection rules.

Requiring SDMPs would prevent discharges that would cause pollution while also ensuring that permittees are not burdened with a “one-size-fits-all” groundwater monitoring plan that might impose more monitoring than their feedlot truly needs. For each feedlot, the SDMP would (a) identify the structures and locations to be monitored, (b) establish a routine periodic inspection schedule adequate to identify leaks, damage, and other issues that could cause a subsurface discharge, (c) identify “[c]riteria or protocols that will be used to determine whether a . . . subsurface discharge has occurred,” and (d) establish site-specific protocols for monitoring subsurface discharges.¹⁸³ Monitoring equipment could include a series of up and downgradient groundwater monitoring wells, or a designed leak detection sump system to determine whether discharges are occurring in violation of Minnesota’s rules against pollution of groundwater.¹⁸⁴ The type of monitoring system used could be progressively more rigorous depending on the type of

¹⁸² Minn. R. 7020.2100, subp. 3(C)(1) (LSMAs “must be designed and constructed to achieve a maximum theoretical seepage rate of not more than 1/56 inch per day,” which allows a discharge of approximately 500 gallons per acre per day. *See* Natural Resources Conservation Service, *Agricultural Waste Management Field Handbook, Agricultural Waste Management System Component Design*, Appendix D, 10D-3 (2009), <https://nrcspad.sc.egov.usda.gov/distribution-center/pdf.aspx?productID=565> (MCEA Ex. 50).

¹⁸³ *See* Idaho Permit, § IV.D.6.a-d (MCEA Ex. 12).

¹⁸⁴ Well drilling, sampling and analysis protocols are well documented in EPA regulations. *See* 40 C.F.R. §§ 257.91, .93-.95.

waste impoundment liner used. Earthen liners should require a full groundwater monitoring plan,¹⁸⁵ while synthetic liners could require an abbreviated monitoring scenario, and a double synthetic liner with leak detection or a sump and pump design would not require a groundwater monitoring system at all *if* the operation and maintenance standards outlined in Minnesota Rule 7020.2100 subpart 6 were met. This is consistent with the requirements of the revised Idaho Permit, which requires a SDMP for production areas unless a professional engineer, geologist, hydrogeologist or other qualified individual documents that the storage structure does not have a subsurface discharge to WOTUS or if the storage structure is constructed of concrete or steel, or with a double-layer synthetic liner.¹⁸⁶

To ensure that feedlots are actually complying with the requirements of the Animal Feedlot Rule and Minnesota's water quality standards, and to identify feedlots that are creating water pollution problems in violation of the rules, MPCA should include revisions or add a new provision that would (1) require visual inspections of land application areas similar to those included in the NPDES and SDS feedlot permits, (2) require regular visual inspections of elements at production areas that pose the greatest risk of water pollution for all medium and large feedlots, and (3) require SDMPs for land application areas within VGAs and production areas for all feedlots that are required to obtain NPDES or SDS permits.

¹⁸⁵ For a full groundwater monitoring plan, wells should be placed upgradient and downgradient of the lagoon or area to be monitored, and sampling should be conducted quarterly or semiannually to establish seasonal fluctuation in groundwater quality or quantity, to collect representative data, and to establish statistically significant background data. Data analysis requires statistical evaluation of the data to determine if upgradient water quality is different than downgradient water quality. A statistically significant delta between these two data sets establishes that the monitored area is contributing pollutants to groundwater.

¹⁸⁶ Idaho Permit, § III.A.2.iii.a-b (MCEA Ex. 12).

D. MPCA should require additional restrictions on manure application in the Vulnerable Groundwater Areas to protect groundwater

The Animal Feedlot Rule provides no additional protections for the VGAs, the areas with the most vulnerable and polluted groundwater in the state. The rule should be revised to require additional restrictions on land applying manure in the VGAs, at a minimum similar to those included in the NPDES and SDS permits.

Minnesota's water quality rules not only set an antidegradation standard for all groundwater that calls for "maximum protection to all underground waters,"¹⁸⁷ but also set an enforceable limit of 10 mg/L for nitrate,¹⁸⁸ and prohibit discharge of wastes into the unsaturated zone in a manner that will cause pollution of underground waters.¹⁸⁹ But the current Animal Feedlot Rule does not control pollution in a way that meets these standards; it vaguely forbids application of manure in a way that will "cause pollution of waters of the state due to manure-contaminated runoff,"¹⁹⁰ and includes some manure setbacks from some specific features.¹⁹¹ Largely, however, the Animal Feedlot Rule imposes few restrictions aimed at preventing groundwater pollution from land applied manure, and those restrictions that exist have proven remarkably ineffective, particularly in the VGAs, as shown by the state's own data and the EPA direction to take further action to address nitrate groundwater pollution in the karst region.

This is particularly problematic when the Minnesota Legislature has specifically directed MPCA to adopt mandatory "water source protection requirements" as needed to "prevent and minimize the pollution to the extent practicable."¹⁹² When voluntary best management practices

¹⁸⁷ Minn. R. 7060.0200.

¹⁸⁸ Minn. R. 7050.0221, subps. 2–4; *see* 40 C.F.R. § 141.62.

¹⁸⁹ Minn. R. 7060.0600, subp. 2.

¹⁹⁰ Minn. R. 7020.2225, subp. 1(A)(2).

¹⁹¹ Minn. R. 7020.2225, subps. 7-8.

¹⁹² Minn. Stat. § 103H.275, subd. 2.

(“BMPs”) have proven to be ineffective—as the state agency data showing widespread and persistent violation of the 10 mg/L limit has shown that they are—MPCA is obligated to adopt mandatory rules to protect groundwater.¹⁹³ In particular, the Legislature directed MPCA to consider the specific risks to groundwater in sensitive areas, which include the VGAs, in imposing water source protection requirements.¹⁹⁴ But the Animal Feedlot Rule includes no additional rules taking the VGAs into account.

One of the most serious issues in the VGAs is the application of nitrogen to cropland in the fall when there are no crops to take it up.¹⁹⁵ Applying manure in the fall greatly increases the risk of nitrogen loss—in fact, the Extension Service states that any nitrate left in the soil in the fall “is usually lost during the spring before the next year’s crop can take it up.”¹⁹⁶ For this reason, the Extension Service does not even recommend taking a nitrogen credit for late season nitrate; according to their recommendations, producers should simply assume that *all nitrate from the fall has been lost* over the winter and spring unless it has been a particularly dry year.¹⁹⁷

In vulnerable groundwater areas, fall application becomes even more risky. As early as 1990, MDA stated, “The risk of leaching loss of nitrate from fall nitrogen application is heightened in southeastern Minnesota due to the high average annual precipitation, the well-drained and permeable nature of the soils and the presence of karstic terrain.”¹⁹⁸ For that reason, the practice

¹⁹³ Minn. Stat. § 103H.275, subd. 1.

¹⁹⁴ Minn. Stat. § 103H.101, subd. 5.

¹⁹⁵ Groundwater Protection Rule SONAR at 58–59.

¹⁹⁶ Brad Carlson, *Taking soil samples for nitrogen analysis could pay big this year* (Mar. 30, 2022) (MCEA Ex. 13).

¹⁹⁷ *Id.* This is contrary to the feedlot rules, which require producers to take credit for *all* sources of nitrogen, but the recommendation is nevertheless telling with regard to how much nitrogen the Extension Service expects to remain in the soil. See Minn. R. 7020.2225, subp. 3(A)(1).

¹⁹⁸ MDA, *Nitrogen Fertilizer Management Plan 59* (Aug. 1990), <https://www.lrl.mn.gov/docs/pre2003/mandated/900659.pdf>.

of not applying expensive chemical fertilizer (as opposed to manure, which producers already have on hand in massive quantities and which must be disposed of) in the fall has been widely adopted by crop producers in the VGAs. MDA-funded research showed that in 2009 only 5% of producers in areas of the state with karst geology or coarse-textured soils applied commercial fertilizer to corn in the fall.¹⁹⁹ In 2015, MDA said that fall and winter application in these areas was “clearly inappropriate, and that the vast majority of Minnesota farmers and their crop advisors do not fall apply or apply fertilizer when it is not recommended by the U of M.”²⁰⁰

What is true for commercial fertilizer is also true for manure—applying nitrogen in this form in the fall comes with a high risk of nitrate loss to groundwater.²⁰¹ Mandating that producers who apply manure in the fall use BMPs can help address this problem. Some of these BMPs are already required by MPCA’s feedlot permits and applying them more broadly could be accomplished by either (1) lowering the permit threshold to 600 animal units, as stated above, or (2) mandatory adoption of certain BMPs for medium and large feedlots. These BMPs include:

Use of cover crops. Cover crops, which take up leftover nitrogen in the soil at a time when fields are generally fallow, are a “well-established” way to reduce nitrate loss.²⁰² The Draft Nutrient Reduction Strategy Update highlighted the importance of cover crops, stating plainly that

¹⁹⁹ Pete Bierman et al., *Survey of Nitrogen Fertilizer Use on Corn in Minnesota*, MDA (2011) at 22, https://www.mda.state.mn.us/sites/default/files/inline-files/nfertilizersurvey2011_0.pdf (MCEA Ex. 51).

²⁰⁰ 2015 Nitrogen Fert. Mgmt. Plan at 82.

²⁰¹ With manure the situation is more complex, because while commercial fertilizer contains inorganic forms of nitrogen such as nitrate and ammonium that are immediately plant-available, manure contains both inorganic and organic forms of nitrogen. The organic forms of nitrogen need to be converted into inorganic forms by soil microbes, and therefore some of the nitrogen applied in the fall may remain in the soil when a crop is planted in the spring. However, the risk of nitrate loss to groundwater remains exceedingly high with the fall application of manure.

²⁰² Univ. of Minn. Extension Service, *Cover Crops*, <https://extension.umn.edu/soil-and-water/cover-crops> (last visited July 18, 2025) (MCEA Ex. 52).

“Nitrogen water quality goals cannot be achieved without transformative changes in crop system rotations and more months of living cover each year.”²⁰³ Research supports the effectiveness of cover crop practices: One study on nitrate reduction strategies showed that planting cover crops such as rye can reduce nitrogen loads by more than 45%,²⁰⁴ and a literature review showed that cover crops can result in approximately 20 to 40% reductions in nitrogen loss.²⁰⁵ Despite doubts from producers, research shows that certain cover crops may reliably be planted in October and even into November.²⁰⁶ Accordingly, one option for fall application is to apply manure only to fields where cover crops are growing or will be planted imminently.

Perennial crops in rotation: Rotating annual crops with perennials decreases leaching losses because perennial grasses have greater root biomass that extends deeper into the soil.²⁰⁷ Diversified crop rotations can reduce nitrogen loads by more than 77%.²⁰⁸ A three-year study in Lamberton, Minnesota found losses of nitrate through subsurface drains were four to five times greater for a corn-soybeans or continuous corn rotation compared to a rotation with alfalfa and 13 to 15 times greater than in rotations with perennial grasses.²⁰⁹ Another study from the University of Minnesota showed that one year of planting wheatgrass decreased soil nitrate-N concentrations

²⁰³ MPCA, *Minnesota Nutrient Reduction Strategy – DRAFT* at 154 (July 2025), <https://www.pca.state.mn.us/sites/default/files/wq-s1-87a.pdf>.

²⁰⁴ Laura Christianson et al., *Financial comparison of seven nitrate reduction strategies for Midwestern agricultural drainage*, 2-3 *Water Resources and Economics* 30, 44 (2013) (MCEA Ex. 14).

²⁰⁵ MPCA, *Minnesota Nutrient Reduction Strategy – DRAFT* at 159 (July 2025), <https://www.pca.state.mn.us/sites/default/files/wq-s1-87a.pdf>.

²⁰⁶ MPCA Responses to Feedlot Permit Comments at 2-3.

²⁰⁷ Evelyn C. Reilly et al., *Reductions in soil water nitrate beneath a perennial grain crop compared to an annual crop rotation on sandy soil*, *Frontiers in Sustainable Food Systems* (Sept. 2022) at 2 (internal citations omitted) (MCEA Ex. 15).

²⁰⁸ Laura Christianson et al., *Financial comparison of seven nitrate reduction strategies for Midwestern agricultural drainage*, at 44 (MCEA Ex. 14).

²⁰⁹ David Huggins et al., *Subsurface drain losses of water and nitrate following conversion of perennials to row crops*, 93 *Agronomy Journal* 477, 484 (2001) (MCEA Ex. 16).

by 77%.²¹⁰ Another BMP option, therefore, is to apply manure only to fields that have perennial crops for at least two years in the previous five-year period.

Cool soils and nitrogen inhibitor: When manure is applied to soil that has a temperature of 50 degrees or less, the cool soil temperatures slow conversion of nitrogen into nitrate, the form that most easily leaches into groundwater.²¹¹ Less nitrogen in the form of nitrate means less water pollution. However, this BMP is not as effective as cover crops or perennials, because it does not remove the nitrogen from the soil, but merely slows its conversion to nitrate. In addition, for this BMP to be effective, the soil must be at and remain at 50 degrees when the manure is applied. If soils remain at 50 degrees or lower until freeze up, only around 15% of the nitrogen will nitrify, but if soils are just slightly warmer—55 degrees for 10 days—approximately 40% of the nitrogen will nitrify.²¹² Because of the risk of this occurring, in the NPDES and SDS permits, MPCA combined this BMP with the use of a nitrate inhibitor, which further slows the nitrification process. However, nitrate inhibitors are also rendered less effective by warmer soils.²¹³ This means that nitrate loss will increase significantly if soil temperatures unexpectedly rise, and as MPCA has acknowledged, average temperatures in Minnesota continue to rise as the state experiences climate change.²¹⁴ Accordingly, if MPCA includes this as a BMP option for fall application, it should be allowed only in November, when soils reliably remain under 50 degrees.²¹⁵

²¹⁰ Reilly, *Reductions in soil nitrate* at 5-6 (MCEA Ex. 15).

²¹¹ MPCA Responses to Feedlot Permit Comments at 4.

²¹² *Id.* at 6.

²¹³ *Id.* at 7.

²¹⁴ MPCA, *Climate Change Impacts*, <https://www.pca.state.mn.us/air-water-land-climate/climate-change-impacts> (last visited July 18, 2025) (MCEA Ex. 53).

²¹⁵ MPCA Responses to Feedlot Permit Comments at 9. Allowing this BMP only in November will also eliminate the need to define how to determine when soils have reached 50 degrees. As a comparison, in its Groundwater Protection Rule, MDA considered whether to define “frozen soil” as soil with a temperature of 32 degrees. However, MDA decided there could be variability in soil temperature at different depths as well as different locations, and it would be difficult for producers

E. MPCA should prohibit risky manure application practices that threaten waters statewide

While the VGAs have the most sensitive and most polluted groundwater in the state, nitrate and bacterial pollution are not limited to these areas. The rules that require MPCA to limit surface water and groundwater pollution in the VGAs also require MPCA to limit nitrate pollution across the state, but the current Animal Feedlot Rule land application rules have not adequately addressed nitrate pollution.²¹⁶ Some manure application practices are sufficiently risky—and provide such little benefit for crop nutrient needs—that they should not be allowed anywhere in the state. Accordingly, these practices should be prohibited not only in the VGAs, but across the state.

1. Requiring larger setbacks for manure spreading from sensitive features

The Animal Feedlot Rule prohibits application of manure within 50 feet of water supply wells, sinkholes, mines, or quarries, and requires incorporation of manure within 300 feet from a sinkhole where the land slopes toward the sinkhole.²¹⁷ This is important, because these features provide channels for pollutants to enter surface and groundwaters.²¹⁸ However, federal feedlot rules for CAFOs require that manure and wastewater not be applied closer than 100 feet to any down-gradient surface waters, “sinkholes, agricultural well heads, or other conduits to surface

to take temperature measurements and for MDA to verify them. (Groundwater Protection Rule SONAR at 82.) Accordingly, MDA decided to take a more practical approach to defining “frozen soil.” (*Id.*) Similarly, here it would be difficult for both producers and MPCA to know when soil temperatures had fallen below 50 degrees. MPCA should, therefore, simply reserve this BMP for November, when soil temperatures are reliable below this level, preventing confusion and the need for producers to measure soil temperatures.

²¹⁶ See Minn. R. 7020.2225.

²¹⁷ Minn. R. 7020.2225, subp. 8(A)-(B).

²¹⁸ Minn. Pollution Control Agency, *Applying Manure in Sensitive Areas 1* (2005), <https://www.pca.state.mn.us/sites/default/files/feedlots-manureapplication.pdf> (MCEA Ex. 54).

waters” unless a compliance alternative is exercised.²¹⁹ While this federal rule applies only to CAFOs, the danger from applying manure near to these sensitive features does not change whether the manure comes from a feedlot with 10,000 animal units or 100 animal units. The Animal Feedlot Rule, accordingly, should be revised to require at least a 100-foot setback from these sensitive features. For the VGAs, even greater setbacks are appropriate. In Wisconsin, producers in areas of shallow bedrock are prohibited from spreading manure “within 250 feet of a private well, 1,000 feet of a community well, or 300 feet upslope or 100 feet downslope of a direct conduit to groundwater” such as a sinkhole because of the unique vulnerabilities of shallow bedrock areas.²²⁰ MPCA should similarly consider stricter setback distance standards in its VGAs.

2. Prohibiting application of manure on frozen or snow-covered ground

Applying manure in winter conditions, when it cannot sink into the ground, creates a significant risk of runoff and volatilization to the air, and therefore increases the risk of nitrate pollution.²²¹ When the ground is frozen or snow-covered, manure applied to the surface cannot seep into the ground, creating a significant risk of runoff and consequent loss of nitrate.²²² In an average year in Minnesota, nearly half of the total surface runoff volume occurs when the soil is

²¹⁹ 40 C.F.R. § 412.4(c)(5). The federal rule also prohibits application within 100 feet of open tile intakes, *see id.*; however, the Animal Feedlot Rule already prohibits application of manure within 300 feet of open tile intakes. Minn. R. 7020.2225, subp. 7.

²²⁰ Christine Anne Clark & Laura Paletta, *Best Management Practices to Use on Karst and Silurian Soil*, University of Wisconsin-Madison, Division of Extension, <https://cropsandsoils.extension.wisc.edu/articles/best-management-practices-to-use-on-karst-and-silurian-soil/> (last visited July 17, 2025) (MCEA Ex. 17).

²²¹ Univ. of Minn. Extension Serv., *Reducing Water Quality Issues from Manure* (2020), <https://extension.umn.edu/manure-management/reduce-water-quality-issues> (MCEA Ex. 18) (“Do not apply on saturated or frozen soils as this will increase runoff”).

²²² Melissa Wilson, *Manure applied on frozen soil or snow—what will happen to my nitrogen?* Minnesota Crop News, (Jan. 1, 2024), <https://blog-crop-news.extension.umn.edu/2019/01/manure-applied-on-frozen-soil-or-snow.html> (MCEA Ex. 19).

frozen.²²³ In addition, when the manure remains on the surface of the frozen ground, there is a longer opportunity for volatilization—in which ammonium-nitrogen on the surface is turned into ammonia gas.²²⁴ Ultimately, most of this gas turns back into ammonium and is redeposited on the ground, generally in the same watershed—meaning that it remains a local pollution hazard.²²⁵ Accordingly, the Extension Service advises producers not to apply manure to frozen soils.²²⁶ MDA also has recognized that this is not an effective practice, stating unequivocally, “No benefit[s] were identified from the application of nitrogen fertilizer to frozen soils.”²²⁷ Although this statement was made with regard to commercial fertilizer, application of manure to frozen soils similarly would have no benefits for crops. The Animal Feedlot Rule should be revised to prohibit applying manure to frozen or snow-covered soils throughout the state.

3. Prohibiting manure application when the risk of runoff from rainfall is severe

Applying manure before a significant rainfall creates a significant risk of runoff, and thus of nutrient loss. However, the Animal Feedlot Rule has no explicit prohibition on applying manure before—or even during—a rain event. MPCA should decrease the risk of manure runoff by requiring producers to use the Runoff Risk Advisory Forecast (“RRAF”)—a tool specifically

²²³ Five Year Progress Report on NRS at 27.

²²⁴ Melissa Wilson, *Manure applied on frozen soil or snow—what will happen to my nitrogen?* (MCEA Ex. 19). While freezing temperatures slow down volatilization, research suggests that the process does not stop entirely. In addition, freezing and thawing cycles mean that there will be at least some time for volatilization to occur but make it difficult to determine how much nitrogen has been lost. *Id.*

²²⁵ Christopher S. Jones et al., *Livestock manure driving stream nitrate*, 48 *Ambio* 1143, 1148 (Dec. 2018) (internal citation omitted) (MCEA Ex. 20).

²²⁶ Univ. of Minn. Extension Serv., *Reducing Water Quality Issues from Manure* (MCEA Ex. 18).

²²⁷ Groundwater Protection Rule SONAR at 102.

created by MDA to help producers determine the best time to apply manure—and prohibiting application of manure when the risk of runoff is severe.²²⁸

The RRAF was created specifically to help reduce manure nutrient runoff.²²⁹ Rainfall during or immediately after manure application is a significant source of runoff—in one study, more than half of the runoff from fields was caused by one or two rain events each year.²³⁰ The RRAF is more accurate in predicting a runoff risk than a weather report, as it considers not only upcoming rainfall, but also soil moisture content, temperatures, snow melt, and other factors.²³¹ It is more precise than a weather report as well, as it assigns a specific runoff risk to each 2 square kilometer area of the state: No Runoff Expected, Low, Moderate, or Severe. Producers can sign up to receive texts on their phones for their fields, making the system extremely user-friendly. However, relatively few producers have signed up to use the tool, despite its usefulness. To reduce the risk of runoff—at times when the state’s own model has determined risk of runoff is high—MPCA should add a provision to the Animal Feedlot Rule that prohibits feedlots from applying manure in fields when the risk of runoff is “severe.”

F. MPCA should reduce the allowed manure application rates to the Extension Service recommended rates

The Animal Feedlot Rule limits manure application rates, essentially, to the “most recent published recommendations of the University of Minnesota Extension Service or of another land grant college in a contiguous state.”²³² However, the rule allows application rates to deviate up to

²²⁸ MDA, *Runoff Risk Advisory Forecast*, <https://www.mda.state.mn.us/protecting/cleanwater/fund/toolstechnology/runoffrisk> (last visited July 18, 2025).

²²⁹ *Id.*

²³⁰ MDA, *Field Runoff: Root River Field to Stream Partnership*, <https://www.mda.state.mn.us/sites/default/files/inline-files/rootrivfieldrunoff.pdf> (last visited July 18, 2025) (MCEA Ex. 55).

²³¹ MDA, *Runoff Risk Advisory Forecast*, <https://www.mda.state.mn.us/protecting/cleanwater/fund/toolstechnology/runoffrisk> (last visited July 18, 2025).

²³² Minn. R. 7020.2225, subp. 3(A)(1).

20% from Extension Service recommendations “where site nutrient management history, soil conditions, or cool weather warrant additional nitrogen application,” and even further “[w]hen crop nitrogen deficiencies are visible or measured.”²³³ But the loopholes in this rule mean that in effect there are few restrictions on the rates at which producers can apply manure to their fields. The Animal Feedlot Rule should be revised to allow feedlots to apply at the Extension Service’s recommended rates as a maximum, without additional deviations or the ability to resort to the recommendations of other states.

The most important factor in avoiding nitrate pollution is applying nitrogen at appropriate rates, commensurate with the needs of the crops currently growing.²³⁴ Once application rates exceed the Extension Service’s recommended nitrogen application rates, “losses tend to increase in a quadratic response.”²³⁵ Reducing nitrogen application rates can lower nitrogen losses by as much as 70%, according to a review by MPCA.²³⁶ More recently, the Draft Nutrient Reduction Strategy Update stated that a 25% reduction to lower the nitrogen application rate to the MRTN resulted in approximately a 20% nitrate loss reduction.²³⁷ In addition, overapplication is a well-documented problem in Minnesota, particularly when manure is combined with commercial fertilizer as a nutrient source.²³⁸ Producers in the southeastern karst region of the state are overapplying nitrogen by approximately 60 million pounds²³⁹ and in nine counties across the state,

²³³ Minn. R. 7020.2225, subp. 3(A)(2).

²³⁴ Groundwater Protection Rule SONAR at 52.

²³⁵ Groundwater Protection Rule SONAR at 35; 2015 Nitrogen Fert. Mgmt. Plan at 37 (nitrate leaching losses “increase dramatically” above recommended rates).

²³⁶ Nitrogen in Minnesota Surface Waters, at F1-3.

²³⁷ MPCA, *Minnesota Nutrient Reduction Strategy – DRAFT* at 159 (July 2025), <https://www.pca.state.mn.us/sites/default/files/wq-s1-87a.pdf>.

²³⁸ Groundwater Protection Rule SONAR at 51-52; *Five Year Progress Report on NRS* at 78.

²³⁹ Christopher S. Jones, Ph.D., *Report on Nitrogen Surplus in Minnesota Driftless 12* (2025) (MCEA Ex. 21).

nitrogen from a combination of manure produced and fertilizer purchased exceeded the Extension Service’s recommendations by more than 40%.²⁴⁰ Yet the Animal Feedlot Rule does little to control this overapplication, allowing applications 20% higher than recommendations for essentially any reason or applications with no apparent restrictions if nitrogen deficiencies are “visible.”²⁴¹

Requiring producers to apply only at the Extension Service’s recommended rates would not harm crop yields or profitability for producers, while producing important environmental benefits. Notably, the Extension Service’s recommendations are *not* aimed at preventing nitrogen loss to the environment—their environmental effects are incidental. Instead, they are intended to maximize profitability for producers, so following the recommendations should not harm producers.²⁴² Right now, there is well-documented evidence that nitrogen inputs (both commercial fertilizer and manure) continue to exceed crop nitrogen needs statewide. By one estimate, producers could reduce application by 200 million pounds per year while still maintaining optimum yields.²⁴³ In the draft update to the Minnesota Nutrient Reduction Strategy, state agencies documented that nitrogen inputs (fertilizer and manure) continue to exceed crop nitrogen needs in pounds per cropland acre by an estimated statewide average of 18%. In most of the sensitive karst region, the documented surplus is over 30 pounds per acre.²⁴⁴ By following the Extension Service recommendations, producers can save money, improve their economic return, and reduce nitrate pollution at the same time.

²⁴⁰ EWG, *Manure Overloads Minnesota* (MCEA Ex. 23).

²⁴¹ Minn. R. 7020.2225, subp. 3(A)(2).

²⁴² 2015 Nitrogen Fert. Mgmt. Plan, *Appendix D: Maximum Return to Nitrogen (MRTN) Values for Fertilizer 1*, <https://www.pca.state.mn.us/sites/default/files/wq-s1-84g.pdf>.

²⁴³ Groundwater Protection Rule SONAR at 51.

²⁴⁴ MPCA, *Minnesota Nutrient Reduction Strategy – DRAFT* at 170 (July 2025), <https://www.pca.state.mn.us/sites/default/files/wq-s1-87a.pdf>.

Allowing applications of up to 20% over the recommended rates is entirely unnecessary because—concerningly—the Extension Service’s current recommended rates have steadily grown over past years. As of 2025, the general recommendation for non-irrigated corn is 195 lbs./acre. For irrigated corn in sandy soils, the recommendation is even higher, at 235 lbs./acre—an unfortunate recognition that these soils are going to lose more nitrogen than other soils.²⁴⁵ Even for non-irrigated corn, the current recommendation is *40 lbs. higher* than the recommended rate in 2006 (at the .05 MRTN usually considered appropriate for manure). The following chart shows the increase in the MRTN:

	2006 ²⁴⁶	2016 ²⁴⁷	2025 ²⁴⁸
Corn after corn (nonirrigated)	155	180	195
Corn after soybeans	120	140	150

Considering that the recommended rate is 26% higher than it was in 2006 for corn after corn, and 25% higher than it was in 2006 for corn after soybeans, allowing an additional 20% application is unnecessary. The recommended rate clearly has flexibility written into it already, as it allows for the application of so much more nitrogen than was considered appropriate only 20 years ago, and it is specifically labeled as a “maximum,” not a mid-range recommendation.²⁴⁹

²⁴⁵ The fact that the recommendations allow *higher* nitrogen application rates in the state’s leakiest soils is alarming—instead of allowing additional nitrogen on these soils, appropriate recommendations would allow less.

²⁴⁶ 2015 Nitrogen Fert. Mgmt. Plan, *Appendix D: Maximum Return to Nitrogen (MRTN) Values for Fertilizer 1-2*, <https://www.pca.state.mn.us/sites/default/files/wq-s1-84g.pdf>.

²⁴⁷ *Id.*

²⁴⁸ Univ. of Minn. Extension Serv., *Guidelines for Manure Application Rates 2* (2022) (MCEA Ex. 6).

²⁴⁹ *Id.*

Nor should producers be allowed to seek out higher rate recommendations from other states. The Extension Service recommendations are based on 170 experiments throughout the state, mostly within the last five years.²⁵⁰ The recommendations are specific to our state, and allowing producers to follow recommendations of other states could result in far higher rates than are appropriate for Minnesota conditions. As of 2019, South Dakota’s recommendation (at the .10 MRTN considered appropriate for commercial fertilizer) was 27 lbs./acre higher than Minnesota’s, and North Dakota’s recommendation was an astonishing 57 lbs./acre higher than Minnesota’s.²⁵¹ This example shows that allowing producers to “shop around” for the highest recommendation to justify their manure application could be disastrous for Minnesota’s water quality.

For these reasons, MPCA should revise Minnesota Rule 7020.2225, subpart 3 to require producers to follow the Extension Service’s recommendations for manure application as a maximum rate, without additional deviations and without resort to other states’ recommendations.

G. MPCA should amend the Animal Feedlot Rule to explicitly prohibit discharges that pollute groundwater

The Animal Feedlot Rule includes two main water quality discharge standards. The first prohibits any feedlot from discharging manure into a “sinkhole, fractured bedrock, well, surface tile intake, mine, quarry, or other natural or constructed channels that convey fluids to groundwater.”²⁵² The second prohibits a CAFO from discharging manure to waters of the United States or surface waters of the state except as allowed by a permit.²⁵³ These water quality discharge standards are entirely inadequate to protect surface waters and groundwater in the state, and they

²⁵⁰ *Id.* at 6-7.

²⁵¹ 2015 Nitrogen Fert. Mgmt. Plan, *Appendix D: Maximum Return to Nitrogen (MRTN) Values for Fertilizer 2* (Aug. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-s1-84g.pdf>.

²⁵² Minn. R. 7020.2003, subp. 1.

²⁵³ Minn. R. 7020.2003, subp. 2.

are inconsistent with the state's water quality standards protecting groundwater. MPCA must revise Minnesota Rule 7020.2003 to explicitly prohibit discharges that would pollute the groundwater.

As explained above, Minnesota has robust protections in its rules for groundwater, which is the source of drinking water for 75% of the state's residents. The state has designated all groundwater as potential drinking water and has put strict protections in place to ensure that this critical resource is preserved in as close to its natural state as possible. MPCA has adopted a nondegradation policy for groundwater, which recognizes this resource's "immeasurable value" and states that it must be "protected as nearly as possible in its natural condition."²⁵⁴ In other words, no pollution of the state's groundwaters should be allowed, at all, to the extent possible. MPCA also has adopted a prohibition against the discharge of wastes into the unsaturated zone that "may actually or potentially preclude or limit the use of the underground waters as a potable water supply, nor shall any such discharge or deposit be allowed which may pollute the underground waters."²⁵⁵ Discharges that cause exceedances of the 10 mg/L nitrate limit for groundwater or that contaminate the groundwater with bacteria would unquestionably limit the use of the groundwater as a potable water supply and would be considered to pollute the underground waters.

While the nondegradation policy is a goal, the prohibition on discharges of wastes to the unsaturated zone and the 10 mg/L nitrate limit for groundwater are MPCA's own rules, which it adopted and which it is required to enforce. Accordingly, no feedlot should be allowed to discharge manure or other pollutants to the unsaturated zone if such discharge would pollute the groundwater. But the Animal Feedlot Rule only prohibits discharges to *channels* that convey fluids to

²⁵⁴ Minn. R. 7060.0200.

²⁵⁵ Minn. Stat. 7060.0600, subp. 2.

groundwater. It does not include an explicit prohibition on all discharges of manure that would pollute the groundwater—and much of the contamination that enters groundwater from manure application simply leaches through the soil, not a specific sinkhole, well, or other channel. To protect Minnesota’s groundwater as required by the state’s water quality rules, MPCA should revise Minnesota Rule 7020.2003 to explicitly prohibit all discharges of manure or pollutants from manure, both from feedlots and from land application areas, into groundwater in a manner that would pollute the groundwater.

H. MPCA should amend the animal feedlot rule to prohibit all livestock from medium or large feedlots from accessing waters of the state

The Animal Feedlot Rule prohibits “[a]nimals of a CAFO or of a facility capable of holding 1,000 or more animal units” from entering waters of the state.²⁵⁶ Non-CAFO animals, however, are only prohibited from entering “a lake classified by the Minnesota Department of Natural Resources as a natural environment lake, recreational development lake, or a general development lake, as defined in part 6120.3000.”²⁵⁷ As a result, non-CAFO animals are currently permitted to enter other waters of the state not identified in the rule, such as streams and ponds.²⁵⁸ MPCA should revise Minnesota Rule 7020.2015 to prohibit all livestock from entering waters of the state or, at a minimum, prohibiting animals from any medium (over 300 animal units) or large feedlot from entering waters of the state.

²⁵⁶ Minn. R. 7020.2015, subp. 1.

²⁵⁷ Minn. R. 7020.2015, subp. 2.

²⁵⁸ See Minn. R. 7050.0130, subp. 2 (“The terms ‘waters of the state,’ ‘groundwater,’ ‘water pollution,’ and ‘toxic pollutants,’ . . . as used herein have the meanings given to them in Minnesota Statutes, sections 115.01 and 115.41, with the exception that disposal systems or treatment works operated under permit or certificate of compliance of the agency are not ‘waters of the state.’”). See also Minn. Stat. § 115.01, subd. 22 (defining “waters of the state” as including streams and ponds).

1. Livestock access to waters of the state negatively impacts water quality

Pollution from non-CAFO livestock access to waters of the state is a widespread issue in Minnesota: Watershed Restoration and Protection Strategy Reports (“WRAPs”) covering 52 of Minnesota’s watersheds (including some updates) specifically identified livestock access to streams as an issue for the area.²⁵⁹ Although non-CAFO animals are, by definition, part of smaller feedlots, they can still cause significant damage, causing not only nitrate pollution, but significant and dangerous bacterial pollution. The Mississippi River – Brainerd WRAP noted that “[w]hile smaller, these feedlots are the most likely to be contributing bacteria directly via defecation in the stream, and indirectly from field runoff that livestock grazes and defecates on.”²⁶⁰

²⁵⁹ See Annex I (MCEA Ex. 56). Livestock in CAFOs are prohibited from entering waters of the state, therefore the “livestock” referred to here are likely to be non-CAFO livestock. Note that some watersheds are combined in a single WRAP and some are divided into multiple WRAPs. Thus, this comment refers to the total number of WRAPs and total number of watersheds in the state as two separate figures. MCEA reviewed a total of 73 distinct WRAPs covering 79 of the major watersheds in Minnesota. Some watersheds also had updates since the original filing, which MCEA reviewed as well. MCEA was unable to review WRAPs for the Lower St. Croix River Watershed and the Mississippi River – Twin Cities Watershed.

²⁶⁰ *Mississippi River – Brainerd WRAP* 40 (Aug. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-65a.pdf>.

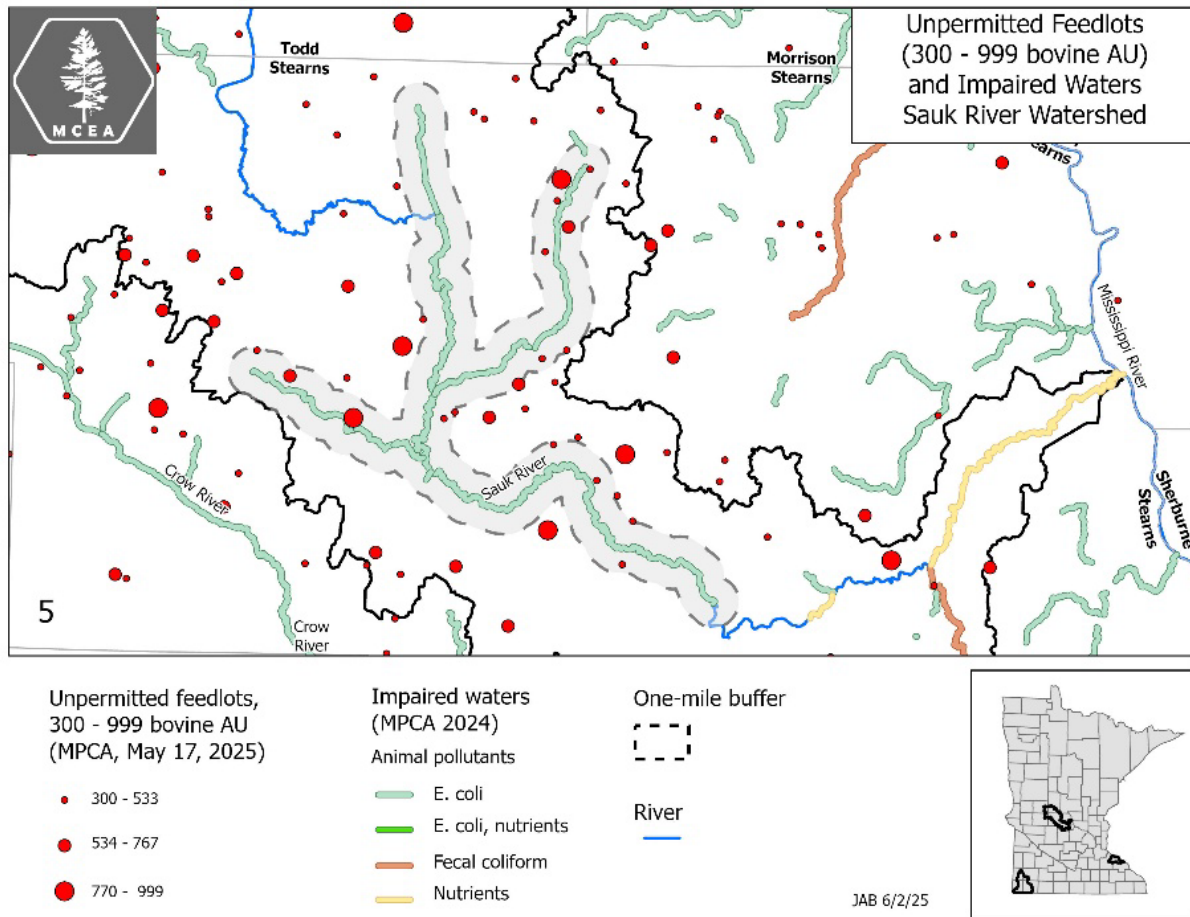


Figure 4 showing impaired waters in the Sauk River Watershed in relation to bovine feedlots with 300-999 AUs. Map created by Jim Berg with data from Minnesota Geospatial Commons.

Many WRAPs detailed specific harms caused by livestock access to waters of the state. For example, “[d]irect access of cattle to the Sauk River and its tributaries is causing damage, loss of habitat, increased nutrient concentrations, and increased fine sediment transport that is filling coarse substrate used by fish and macroinvertebrates.”²⁶¹ The Big Fork River WRAP identified livestock access to streams as a common source of pollution in the watershed, noting that “[l]ivestock grazing/watering in the riparian zone can cause localized damage and erosion of the

²⁶¹ *Sauk River WRAP* 11 (Mar. 2015), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-08a.pdf>.

stream bank, and is a source of phosphorus and bacteria pollutants.”²⁶² Similar language was included in WRAPs for Crow Wing River,²⁶³ Mississippi River – Brainerd,²⁶⁴ and Mississippi River – Headwaters.²⁶⁵ Additionally, “[l]ivestock are potential sources of bacteria, phosphorus, and nitrogen to streams in the Blue Earth River Watershed, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas”;²⁶⁶ similar findings were reported in Cottonwood River,²⁶⁷ La Sueur River’s 2025 Update,²⁶⁸ and Redwood River.²⁶⁹

²⁶² *Big Fork River WRAP* 16-17 (Oct. 2017), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-37a.pdf>.

²⁶³ *Crow Wing River WRAP* 15 (Jan. 2015), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-09a.pdf>.

²⁶⁴ *Mississippi River – Brainerd WRAP* 15 (Aug. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-65a.pdf>.

²⁶⁵ *Mississippi River – Headwaters WRAP* 34 (Aug. 2018), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-50a.pdf>

²⁶⁶ *Blue Earth River Wrap* 22 (July 2023), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-95a.pdf>.

²⁶⁷ *Cottonwood River WRAP* 21 (Dec. 2022), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-93a.pdf> (“Livestock animals are potential sources of bacteria, phosphorus, and nitrogen to streams in the Cottonwood River Watershed, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas.”).

²⁶⁸ *La Sueur River WRAP Update* 36 (May 2025), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-102a.pdf> (“Livestock are potential sources of bacteria, phosphorus, and N to streams in the Le Sueur River Watershed, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas.”).

²⁶⁹ *Redwood River WRAP* 27 (Apr. 2023), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-94a.pdf>. (“Livestock animals are potential sources of bacteria phosphorus, and nitrogen to streams in the Redwood River Watershed, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas.”).

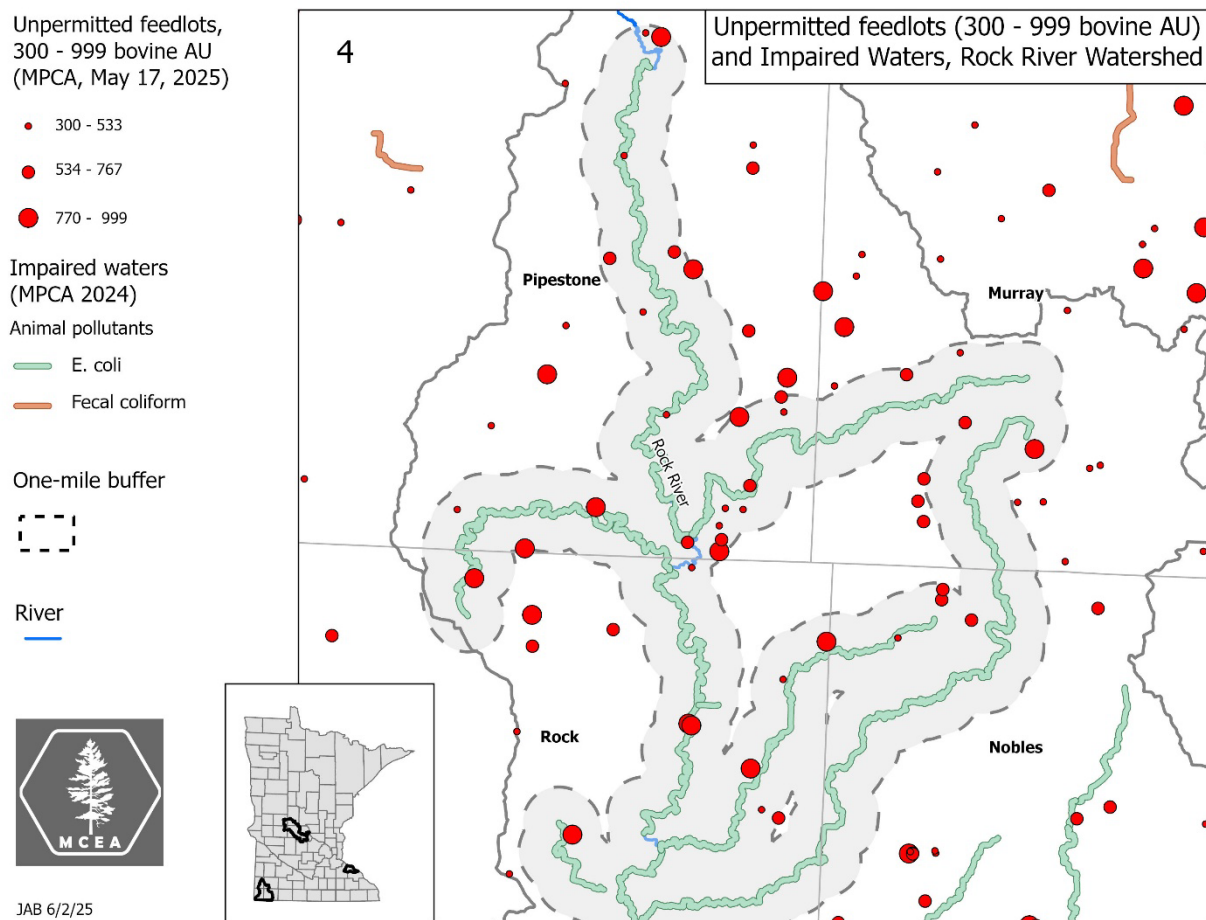


Figure 5 showing impaired waters in the Rock River Watershed in relation to bovine feedlots with 300-999 AUs. Map created by Jim Berg with data from Minnesota Geospatial Commons.

In the Rock River, nearly one-third of fecal bacteria in the watershed is attributed to livestock access to streams;²⁷⁰ an astonishing two-thirds of fecal bacteria is attributed to crop-applied manure (both surface-applied and subsurface applied) and runoff from feedlots combined.²⁷¹

²⁷⁰ *Missouri River Basin Watersheds WRAP 48* (Jan. 2018), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-40a.pdf> (explaining the graphs and that the “pastures adjacent waterways” indicates livestock access to streams).

²⁷¹ *Id.*

The current Animal Feedlot Rule, permitting non-CAFO animals to access waters of the state not otherwise identified in the Animal Feedlot Rule, results in widespread pollution and fails to adequately protect the state’s watersheds.

2. Prohibition of livestock access to waters of the state is already used in many areas to protect waters of the state in Minnesota

Livestock exclusion (or limitation) is a common conservation method. The National Resource Conservation Service identifies access control (Code 472) as a Conservation Practice Standard.²⁷² Many WRAPs cross-reference NRCS Code 472 in the watersheds’ proposal to limit or fully exclude livestock from access to streams.²⁷³

Livestock exclusion/limitation is also a common strategy in Minnesota: the vast majority (three-quarters) of watersheds identified livestock exclusion and/or limitation as a strategy for improving water quality in their respective watersheds.²⁷⁴ Some of the WRAPs go so far as to say that livestock exclusion is *necessary* to reduce *E. coli*: the WRAP for Red River of the North – Marsh River specified that “[r]educing *E. coli* concentrations within the waterbodies of the MRW will require livestock to be kept away from waterbodies,” among other strategies.²⁷⁵ The Mississippi River – Brainerd WRAP uses similarly strong language, opining that “limiting

²⁷² *Conservation Practice Standard: Access Control, Code 472*, NATURAL RESOURCES CONSERVATION SERVICE, (Oct. 2017), https://www.nrcs.usda.gov/sites/default/files/2022-08/Access_Control_472_CPS_Oct_2017.pdf (MCEA Ex. 58).

²⁷³ *See, e.g. Lake of the Woods WRAP* 76 (Feb. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-66a.pdf>; *North Fork Crow River WRAP* 62 (Dec. 2014), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-06a.pdf>; *Rainy River – Headwaters WRAP* 78 (June 2022), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-87a.pdf>; *Roseau River WRAP* 55-64 (Dec. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-76a.pdf>; *Sand Hill River WRAP [Red River of the North – Sand Hill River]* 67 (Oct. 2017), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-26a.pdf>; *Sauk River WRAP* 60 (Mar. 2015), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-08a.pdf>; *Snake River – St. Croix Basin WRAP* 38 (Aug. 2014), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-04.pdf>.

²⁷⁴ *See Annex II* (MCEA Ex. 57).

²⁷⁵ *Marsh River WRAP [Red River of the North – Marsh River]* 27 (July 2021), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-83a.pdf>.

livestock access to streams and properly managing manure application rates and runoff is vital to addressing the bacteria impairments.”²⁷⁶ The Minnesota River – Headwaters WRAP also acknowledges that livestock exclusion is a necessary part of the long-term effort to reduce *E. coli* in the watershed.²⁷⁷ WRAPs generally do not distinguish between *E. coli* and other impairments from animals from a CAFO or non-CAFO animals,²⁷⁸ and as such, MPCA should similarly forgo such a distinction and prohibit all livestock from entering waters of the state.

Livestock exclusion strategies are effective measures to protect waters of the state. In providing an update on its original WRAP, the Pomme de Terre Watershed reported that, in one area, “[e]fforts to control access of cattle to the creek in the past 10 years appear to have improved instream habitat enough to remove the macroinvertebrate AQL impairment suggesting that further efforts upstream may do the same.”²⁷⁹ Although voluntary adoption on a watershed-by-watershed basis (or even stream-specific basis) is a step in the right direction, significant progress will not be achieved on a statewide level unless the Animal Feedlot Rule is revised to prohibit livestock access to waters of the state. Even though livestock exclusion/limitation is a common strategy discussed

²⁷⁶ *Mississippi River – Brainerd WRAP* 40 (Aug. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-65a.pdf>.

²⁷⁷ *Minnesota River – Headwaters WRAP* 134 (Mar. 2022), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-75a.pdf> (“Although restoration efforts have been taking place since the initial impairment listings in 2006, further reductions of *E. coli* concentrations within the waterbodies of the MRHW will require livestock to be kept away from waterbodies. . .” among other points.).

²⁷⁸ *See, e.g. St. Louis River WRAP* 72 (Sept. 2018), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-46a.pdf> (identifying “[a]ll livestock and hobby farms practicing livestock exclusion and appropriate manure management” as a recommended goal, without delineating between CAFO- and non-CAFOs.); *Thief River WRAP* 113 (Mar. 2019), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-49a.pdf> (discussing issues of livestock access to the Mud River, but not identifying whether the animals were from a CAFO, although the farm is no longer operational); *But see Mississippi River – Brainerd WRAP* 40 (Aug. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-65a.pdf> (delineating and noting that smaller AFOs *still* cause problems in the watershed).

²⁷⁹ *Pomme de Terre WRAP Update* 70 (Aug. 2024), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-100a.pdf>.

in the WRAPs, its implementation varies widely between watersheds.²⁸⁰ Additionally, while it may be possible to work with landowners to reduce livestock access to streams voluntarily,²⁸¹ this may not always be the case without a rule in place.

Because of the effectiveness of livestock exclusion strategies in reducing *E. coli* concentrations and water pollution, MPCA should revise Minnesota Rule 7020.2015, subpart 2 to prohibit all livestock from entering waters of the state to protect our watersheds. Alternatively, MPCA should, at a minimum, extend this prohibition to all medium feedlots so that animals from feedlots with more than 300 animal units are prohibited from entering waters of the state.

I. MPCA should amend the animal feedlot rule to reflect existing agency policy regarding multi-site feedlots

The Animal Feedlot Rule currently does not have any provisions regarding multi-site feedlots, but dividing feedlots between multiple different sites is a potential way for feedlots to avoid obtaining a NPDES or SDS feedlot permit (or other feedlot permit) and the additional regulatory requirements that come along with such a permit. Accordingly, MPCA should include a new provision in the Animal Feedlot Rule that explains the scenarios under which two or more feedlots should be considered to be one for purposes of meeting the permit threshold.

1. Current MPCA policy on multi-site feedlots

While the Animal Feedlot Rule does not contain specific guidance on the matter, MPCA has a policy regarding multi-site feedlots for the purposes of permit determinations under

²⁸⁰ Compare *Blue Earth River Wrap* 102 (July 2023), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-95a.pdf> (showing that 0.1% of the watershed area adopted livestock restrictions) with *Lake of the Woods WRAP* 57 (Feb. 2020), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-66a.pdf> (showing a 75% adoption rate, with a goal of 100%).

²⁸¹ See, e.g., *Pine River WRAP* 22-23 (Oct. 2017), <https://www.pca.state.mn.us/sites/default/files/wq-ws4-33a.pdf> (noting that “[t]he landowners have been willing to work with the team to fence off key areas and keep livestock away from stream banks to allow them to re-vegetate with native grasses, sedges, and shrubs.”).

Minnesota Rule 7020.0405. MPCA’s current policy is modeled on federal regulations. Federal regulations anticipate potential multi-site feedlots and include in the definition of “CAFOs” that “[t]wo or more AFOs under common ownership are considered to be a single AFO for the purposes of determining the number of animals at an operation, if they adjoin each other or if they use a common area or system for the disposal of wastes.”²⁸² “MPCA policy is to use the same criteria to determine the need for [state] permit coverage as well.”²⁸³ As such, multi-site feedlots exist in Minnesota when:

- The sites have common ownership and
- One of the following conditions apply:
 - Any portion of the animal feedlots are located within ¼ mile of each other.
 - The animal feedlots share a liquid or solid manure storage area.²⁸⁴

MPCA defines common ownership as “when at least one person or entity is the full or partial owner of two or more animal feedlots.”²⁸⁵ Common ownership also “includes instances where a single person owns one site but is a partner in a group that owns a second site” and when a married couple each own one feedlot.²⁸⁶

After ownership, the considerations of (1) proximity and (2) shared manure storage are the two criteria for multi-site feedlots. With respect to the distance requirement, MPCA policy

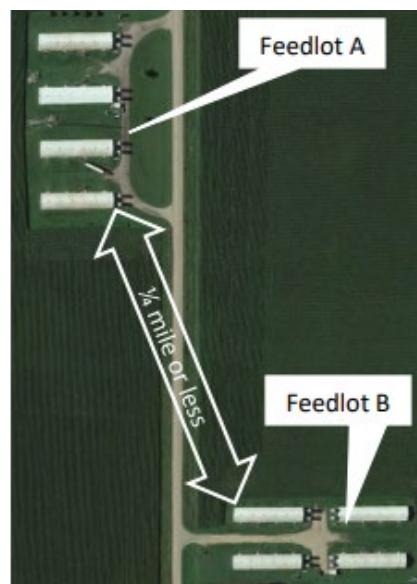


Figure 6: MPCA Illustration of Distance Requirement

²⁸² 40 CFR § 122.23(b)(2).

²⁸³ MPCA, *NPDES and SDS Permits for Multi-Site Feedlot Operations* (Oct. 2021), <https://www.pca.state.mn.us/sites/default/files/wq-f6-83.pdf> (MCEA Ex. 59).

²⁸⁴ *Id.*

²⁸⁵ *Id.*

²⁸⁶ *Id.*

is to measure distance from the closest components of each of the feedlots; see Figure 6 for MPCA’s example,²⁸⁷ included in the policy.²⁸⁸ For shared manure storage, “[f]eedlots that transport solid or liquid manure from one feedlot site to storage structures at another feedlot site are considered to share a manure storage area.”²⁸⁹ MPCA clarifies that the following conditions do not constitute “[s]haring a liquid or solid manure storage area”:

- Two or more animal feedlots including the same fields in a manure management plan.
- Manure transfer to a third party who collects from numerous feedlots then manages the manure as a separate entity.
- Manure/litter transfer to another site to be used as bedding material. [sic] (i.e., litter from a turkey brood barn transported with the birds to a finishing barn)²⁹⁰

This policy applies to NPDES and SDS permit determinations under Minnesota Rule 7020.0405;²⁹¹ it does not apply to registration under Minnesota Rule 7020.0350.²⁹²

2. MPCA should amend the animal feedlot rule to strengthen existing agency policy regarding multi-site feedlots

MPCA should codify its policy on multi-site feedlots to provide clarity regarding identification and operation of multi-site feedlots. The current policy, however, has some shortcomings, which can be addressed by the current rulemaking. MPCA should address both the distance provision of its current policy and the definition of “common ownership” to strengthen the Animal Feedlot Rule.

²⁸⁷ *Id.*

²⁸⁸ *Id.*

²⁸⁹ MPCA, *NPDES and SDS Permits for Multi-Site Feedlot Operations* (Oct. 2021), <https://www.pca.state.mn.us/sites/default/files/wq-f6-83.pdf> (MCEA Ex. 59).

²⁹⁰ *Id.*

²⁹¹ *See id.* (“It is important to note that this is only used to determine the need for a NPDES or SDS permit and does not affect other aspects of Minnesota Rule 7020 implementation”). *See also* Minn. R. 7020.0405, subp. 1 (A)-(B) (defining when permits are required).

²⁹² MPCA, *NPDES and SDS Permits for Multi-Site Feedlot Operations* (Oct. 2021), <https://www.pca.state.mn.us/sites/default/files/wq-f6-83.pdf> (MCEA Ex. 59). *See also* Minn. R. 7020.0350 (registration requirements).

i. Distance

With respect to distance, the current MPCA policy designates multi-site feedlots as operations within ¼ mile of each other.²⁹³ MPCA should extend the distance to 3 miles so that multi-site feedlots operating within close enough proximity to one another to share land application fields are subject to the permitting requirement under Minnesota Rule 7020.0405.

MPCA's Request for Comments identified that since the last revision of the Animal Feedlot Rule, there are "[m]ore feedlots with 500 or more animal units (animal units), many designed to be just under permit thresholds."²⁹⁴ Currently, two feedlots owned by the same individual or entity could operate feedlots with 750 animal units each without a permit if the feedlots were located only ½ mile away from each other (and did not share manure storage). In this circumstance, the two feedlots would not have less environmental impacts than one 1,500 AU feedlot, and yet they would be regulated very differently.

Given that the environmental effects of CAFOs are largely related to land application, it is important to consider the distance between CAFOs and land application sites when determining whether a multi-site feedlot operation exists. A 2017 study of CAFOs in southeastern Michigan found that 51% "of field acreage used for manure application . . . was within 5 km (3.1 mi)."²⁹⁵ For on-site manure application, the median distance was 3.5 miles.²⁹⁶ This means that for CAFOs within 3 miles one of another, their land application sites are highly likely to overlap or abut. The greatest factor in nitrate loss from land application areas is applying nitrogen at too high of rates²⁹⁷

²⁹³ MPCA, *NPDES and SDS Permits for Multi-Site Feedlot Operations* (Oct. 2021), <https://www.pca.state.mn.us/sites/default/files/wq-f6-83.pdf> (MCEA Ex. 59).

²⁹⁴ MPCA, *Request for Comments*, 1-2 (2025).

²⁹⁵ Long et al., *Use of Manure Nutrients from Concentrated Animal Feeding Operations*, J. OF GREAT LAKES RESEARCH 3 (2018), <https://graham.umich.edu/media/files/WLEB/WLEB-Science-Panel-Long-et-al.-2018.pdf> (MCEA Ex. 22).

²⁹⁶ *Id.*

²⁹⁷ Groundwater Protection Rule SONAR at 52.

and when more manure is produced in one area, the risk that overapplication will occur increases because of the expense of transporting manure.²⁹⁸ For permitting purposes, accordingly, it is critical that operations with land application sites that overlap or abut should be required to create one coordinated plan for their manure application.

To account for multi-site feedlots operating within close proximity, MPCA should add its current policy to the Animal Feedlot Rule and extend the distance from ¼ mile to 3 miles so that the operations described above are considered multi-site feedlots subject to the permitting requirements under Minnesota Rule 7020.0405.

ii. Common Ownership

MPCA considers common ownership to exist “when at least one person or entity is the full or partial owner of two or more animal feedlots”;²⁹⁹ this “includes instances where a single person owns one site but is a partner in a group that owns a second site” and when a married couple each own one feedlot.³⁰⁰ MPCA should adopt and expand this definition in the Animal Feedlot Rule to avoid potential obfuscation by larger entities. Under this definition, if two separate corporate entities each owned a feedlot, and those two entities shared some shareholders (or members or partners), arguably this would not meet the definition of “common ownership,” which refers to a *single person* who owns one site and is a partner in an entity owning the other.

The Animal Feedlot Rule currently lacks a definition of “common ownership.” While the definition of “owner” under Minnesota Rule 7020.0300, subpart 17 refers to “all persons having possession, control, or title to an animal feedlot or manure storage area”,³⁰¹ *common* ownership is

²⁹⁸ See Chryseis Modderman, *Manure Is Complicated: 5 Reasons You Need a Manure Management Plan* (MCEA Ex. 11).

²⁹⁹ MPCA, *NPDES and SDS Permits for Multi-Site Feedlot Operations* (Oct. 2021), <https://www.pca.state.mn.us/sites/default/files/wq-f6-83.pdf> (MCEA Ex. 59).

³⁰⁰ *Id.*

³⁰¹ Minn. R. 7020.0300, subp. 17.

not defined. MPCA should formally adopt its definition of “common ownership” from the multi-site feedlot policy in the Animal Feedlot Rule, and expand it as follows to ensure that other common shared ownership scenarios are also covered:

Common ownership exists when at least one person or entity is the full or partial owner of two or more animal feedlots, or when two entities that own two or more feedlots share one or more common shareholders, members, partners, or other holders of ownership interests. This includes instances where a single person owns one site but is a partner in a group that owns a second site. This also includes instances where spouses own sites individually.

This is particularly important because it helps ensure that individuals and entities are not able to avoid permitting requirements by creating multiple entities with common ownership.

MPCA should add a new provision to the Animal Feedlot Rule that explains when two or more feedlots are considered to be multi-site feedlots for the purposes of permitting under Minnesota Rule 7020.0405. This provision should strengthen existing MPCA policy regarding multi-site feedlots by (1) extending the distance in the policy to cover feedlots within 3 miles of each other; and (2) defining “common ownership” to ensure that separate corporate entities are not able to skirt permit requirements.

V. Conclusion

As a final point, MPCA has asked for feedback on how to maintain flexibility for feedlots within the rules, based on the Legislature’s direction that “whenever feasible,” state agencies should develop regulatory programs that “emphasize superior achievement in meeting the agency’s regulatory objectives and maximum flexibility for the regulated party and the agency in meeting those goals.”³⁰² Notably, this policy does not direct MPCA to only ensure flexibility for regulated parties—it explicitly requires MPCA to develop programs that *achieve regulatory objectives*. Indeed, this policy of encouraging flexibility “whenever feasible” cannot overcome MPCA’s

³⁰² Minn. Stat. § 14.002.

obligations to ensure compliance with federal and state water quality standards. Nor does this policy bar MPCA from adopting rules that regulated parties may consider inflexible if they are necessary to achieve water quality standards.³⁰³ For too long, MPCA has depended on “flexibility” for feedlots, encouraging BMPs and voluntary measures instead of imposing regulatory measures known to be more effective. These measures have not addressed nitrate and bacterial pollution. Due to the demonstrated ineffectiveness of voluntary measures, it is past time for MPCA to adopt further regulatory measures to address pollution from feedlots.

For decades, Minnesota has attempted, with tepid results to date, to address the crisis of nitrate pollution in its surface waters and groundwater, which threatens its residents, its livestock and wildlife, its aquatic ecosystems, and the health of its lakes, rivers, and streams. The EPA has directed MPCA to do more to address nitrate pollution and hold polluters accountable, and MPCA itself has recognized that current practices are not adequately addressing the problem. MPCA now has an opportunity to make transformational changes that will address this long-standing, widespread, intractable problem, and it should do so by making the following changes:

- Minn. R. 7020.0405, subp. 1: Lower the threshold for State Disposal System permits to feedlots with 600 or more animal units.
- Minn. R. 7020.2003: Add an explicit prohibition on all discharges of manure or pollutants from manure from a feedlot or land application area that may limit the use of groundwater as a potable water supply or may pollute the underground waters.
- Minn. R. 7020.2100, subp. 4(N): Add a requirement for weekly visual inspections of Liquid Manure Storage Areas and freeboard markers.
- Minn. R. 7020.2015: Revise to prohibit livestock from all feedlots from entering waters of the state, or at a minimum livestock from medium and large feedlots.
- Minn. R. 7020.2125: Require weekly visual inspections of manure stockpiling sites.

³⁰³ See *Coal. of Greater Minnesota Cities v. Minnesota Pollution Control Agency*, 765 N.W.2d 159, 169 (Minn. App. 2009) (finding rule allowing MPCA to deny exemptions from effluent limit of 1 mg/L of phosphorus was consistent with Minn. Stat. § 14.002).

- Minn. R. 7020.2150: Require weekly visual inspections of manure compost sites.
- Minn. R. 7020.2225, subp. 3: Revise to limit manure application rates to a maximum of the recommendations by the University of Minnesota Extension Service, with no deviations allowed or rates from contiguous states.
- Minn. R. 7020.2225, subp. 4: Require feedlots with more than 300 animal units to submit a Manure Management Plan each year to MPCA or the county feedlot officer through the online Nutrient Management Tool. Feedlots located out of state with more than 300 animal units that apply manure to fields within Minnesota must submit and follow a Manure Management Plan. Information about manure application fields from the online tool must be made publicly available.
- Minn. R. 7020.2225, subp. 4: Require Manure Management Plans to include Subsurface Discharge Monitoring Plans for both land application areas and production areas for feedlots that are required to obtain NPDES or SDS permits.
- Minn. R. 7020.2225, subp. 8: Revise this section to prohibit application of manure within 100 feet of surface waters, water supply wells, sinkholes, mines, quarries, or other conduits to surface waters. For the Vulnerable Groundwater Areas, application of manure should be prohibited within 250 feet from private wells, 1,000 feet from a community well, and 300 feet upslope or 100 feet downslope of other conduits to groundwater including sinkholes, mines, or quarries.
- Minn. R. 7020.2225: Add a new subpart that would require visual inspections of land application areas similar to those included in the NPDES and SDS feedlot permits.
- Minn. R. 7020.2225: Add a new subpart that would require additional best management practices in Vulnerable Groundwater Areas when manure is applied in the fall, including cover crops, perennial crops, and waiting for cool soils and using a nitrate inhibitor.
- Minn. R. 7020.2225: Add a new subpart that would prohibit applying manure to frozen or snow-covered ground statewide.
- Minn. R. 7020.2225: Add a new subpart that would require producers to use the Minnesota Department of Agriculture’s Runoff Risk Advisory Tool and prohibiting application of manure when the risk of runoff is “severe.”
- Minn. R. 7020.0405: Add a new subpart that would require permits for multi-site feedlots that meet the other criteria included in the existing Rule.
- Minn. R. 7020.0300: Add new subparts that would define “multi-site feedlot operations” to ensure that feedlots with common owners that are located within three miles of each other are considered a single feedlot for purposes of permit determinations and to broaden the definition of “common ownership” to include multiple entities with some common owners.

With these changes, MPCA would take a necessary step toward addressing the nitrate pollution crisis in our state as well as the bacterial contamination of surface waters.

Respectfully submitted,

MINNESOTA CENTER FOR ENVIRONMENTAL ADVOCACY

/s/Joy R. Anderson

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Re: Establishing Outcomes-Based Data Collection and Alternative Pathways to Nitrogen Reduction in Minnesota's Nutrient Reduction Strategy

Exhibit B

Minnesota Center for Environmental Advocacy Report: Replumbing Minnesota's Landscape



Replumbing Minnesota's Landscape

How Agricultural Drainage Alters Rivers and Degrades Water Quality



Replumbing Minnesota's Landscape

How Agricultural Drainage Alters Rivers and Degrades Water Quality

The artificial drainage of Minnesota's agricultural land has increased over the past several decades, with profound costs to the quality of our lakes and streams, fish and aquatic species, recreation, and downstream infrastructure. Beginning around the mid-1970s, corn and soybeans, which require relatively dry soil conditions to thrive, became dominant crops among Minnesota growers. Because Minnesota was naturally home to many wetlands, prairie potholes, and low-lying saturated areas, farmers needed to drain their fields to achieve dry soil conditions. As a result, many agricultural fields in Minnesota are now underlain by perforated plastic pipes (referred to as "drain tile"), which collect and deliver water to public and private ditches and ultimately to our lakes, rivers, and streams.

These drainage systems negatively impact water quality in two main ways. First, the increased volume of water delivered from below agricultural fields to our waterbodies causes dramatic physical alterations of watercourses and surrounding infrastructure. This increased volume of water causes riverbanks to erode, sediment to build up in downstream waters, and floods that are more common and severe. Agricultural drainage has nearly doubled the total flow of river systems like the Minnesota River, exacerbating downstream flooding and increasing damage to infrastructure in and along the river.

Second, agricultural drainage harms aquatic life and water quality in downstream waters. Increased erosion results in more turbidity—or amount of suspended sediment—in rivers and streams, which degrades aquatic habitat and can make

waters unsuitable to fish or swim in. Nutrients like nitrogen and phosphorus in chemical fertilizer and manure escape the farm through the drainage network, bypassing nature's filtration systems and polluting many streams, rivers, and lakes. The effects of agricultural drainage on water quality are particularly pronounced in the Minnesota River Basin, where many waters do not meet state standards for maintaining a healthy aquatic ecosystem and supporting aquatic recreation.

The harms to water quality caused by agricultural drainage are exacerbated by the added influence of climate change on our water resources. The changes in water flows over time are not due solely to changes in precipitation patterns caused by climate change. However, the increased likelihood of severe rainfall events due to climate change compounds the negative impacts from agricultural drainage.






The good news is that there are known practices that can help reduce the consequences of agricultural drainage. We need a combination of best management practices that include changes in land use, changes in nutrient use, and edge-of-field practices to ultimately make Minnesota's waters fishable, swimmable, and drinkable again. Retaining water on fields before it enters lakes and streams is the most effective way to reduce erosion caused by the increased volume of water due to drainage. And there are other practices that help to "treat" drainage water (i.e. allow pollutants to naturally filter out) or slow it down. But despite knowing the consequences of agricultural drainage and the means to mitigate those consequences, the promotion of voluntary practices has not resulted in the widespread adoption needed to make a difference.

We recommend four policy changes that can begin to mitigate the harms to water quality from agricultural drainage. First, we support efforts to quantify and include the externalized economic costs of drainage projects in the information considered by drainage authorities when evaluating petitions for new or improved public drainage systems. Second, we recommend a more robust process for considering the environmental effects of drainage projects, which could also aid the state in determining how to meet its nutrient reduction goals. Third, cap-and-trade systems have been successfully used to reduce other pollutants in Minnesota and could be used to reduce nitrate and sediment pollution from drainage. Last, we recommend that the Minnesota Pollution Control Agency ("MPCA") develop a permitting system for new and improved drainage projects. The water quality issues caused by agricultural drainage are similar to stormwater management problems observed as a result of intensive development in the 1950s, which eventually resulted in the development of a robust and effective stormwater management permit program at the national and state levels. MPCA could implement a similar system to mitigate water quality harms for agricultural drainage projects through a state permit.

Minnesota values its lakes, rivers, and streams. Yet many are impaired to the point that we cannot swim or fish in them or the water is not safe for drinking. MPCA and other state agencies recognize that agricultural drainage is one of our biggest hurdles to improving our waters in intensively-drained watersheds. We need to address this hurdle if we hope to have water that is fishable, swimmable, and drinkable again.



Agricultural drainage systems are found throughout Minnesota and have been in use for more than 100 years.

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SECTION ONE

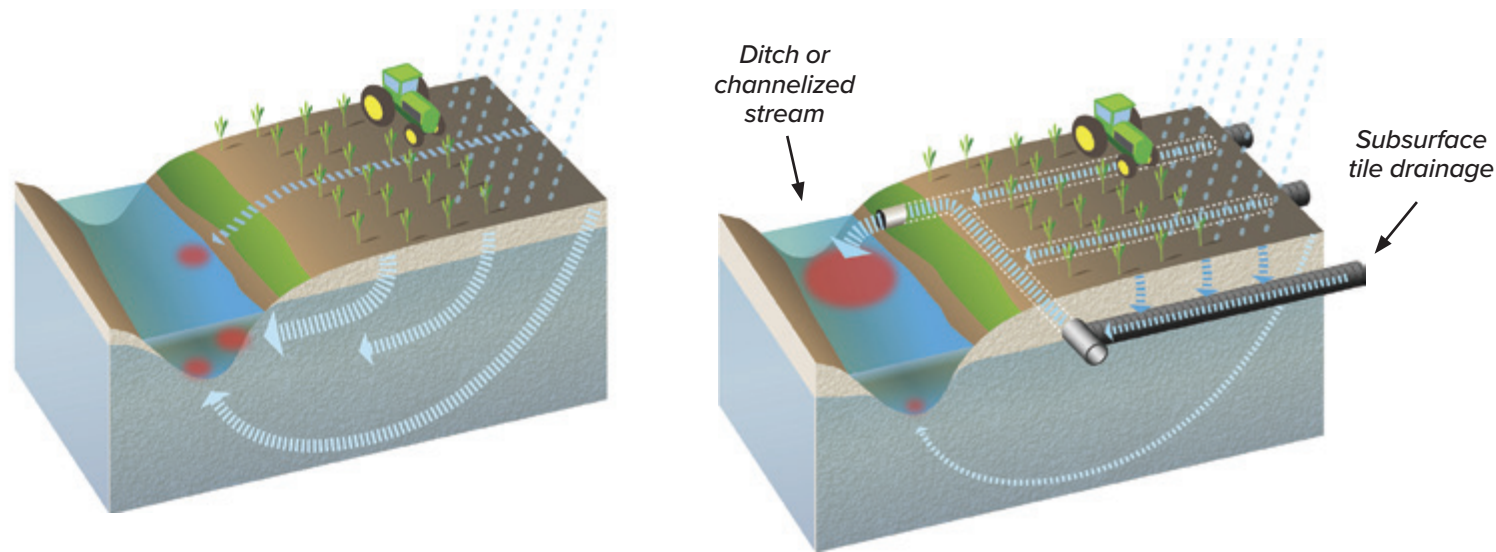
The Drainage Landscape in Minnesota

*How does agricultural drainage work, and what are its positive and negative impacts?
What is the legal framework for agricultural drainage in Minnesota, and where are the gaps?*

If you have driven around in farm country, you have likely noticed ditches that parallel the road and crisscross the landscape. You may also have noticed formerly natural streams that have been dredged and channelized to accommodate drainage runoff. In addition to these visible landscape alterations, below the surface there are countless miles of perforated plastic pipe that play a hugely important role in modern agriculture. Farmers install these pipes below the soil to help lower the water table below cultivated fields, which allows crops to grow in unsaturated soils to maximize yield. But this comes at a cost. Water from rain and snowmelt quickly moves off the field and into a network of private and public drainage systems. This “short circuits” the natural hydrological cycle, and shuttles water from below

fields and into Minnesota’s lakes, streams, and rivers at rates that dramatically increase downstream flows, scour riverbanks, and artificially accelerate erosion. This drainage water is also rich in nitrogen and phosphorus, two of the primary nutrients in fertilizer and manure, which at elevated levels can harm aquatic life and make rivers unsuitable for fishing, swimming, or for drinking water. Artificial agricultural drainage is a major reason why many Minnesota waterbodies are listed as “impaired” or below state water quality standards.

Artificial agricultural drainage refers to surface and subsurface components that work together to remove excess water from farmland to maximize crop production. Below the surface, perforated pipes buried under cultivated fields funnel water



The Effects of Artificial Agricultural Drainage In cropland without tile drainage (left), most rainwater flows through the ground to get to surface waters. As it travels through the earth, some of the nitrates are removed, resulting in less nitrates reaching our streams and rivers. In tiled cropland (right), most of the rainwater that ends up in surface water (ditches, streams, wetlands) flows through the tile drainage. This water can be high in nitrates.

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Replumbed
Channelized streams are natural streams that have been artificially straightened, deepened, or widened. The effect of channelization can be seen in these aerial photographs of Lower Brush Creek in the Blue Earth River Watershed.

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from the soil profile into a network of larger pipes that direct water to discharge points. This part of the drainage system is often referred to as “drain tile” or “pattern tile” because in the early days of agriculture farmers used clay tiles rather than plastic pipes to drain their fields. The water from the underground pipes typically outlets into an **altered watercourse**, which is either a ditch or a channelized stream designed to convey water away from agricultural land. **Ditches** on private land are often excavated channels where no channel previously existed, and **channelized streams** are natural streams that have been artificially straightened, deepened, or widened to function more like a ditch. Altered watercourses ultimately outlet into larger bodies of water, such as rivers or lakes.

Artificial agricultural drainage is comprised of privately and publicly owned components. Much of the drain tile, or perforated pipes under cultivated land, are privately owned and not subject to regulation. A farmer who wishes to install drain tile below their fields does not need a permit or permission to do so. Privately owned drain tile

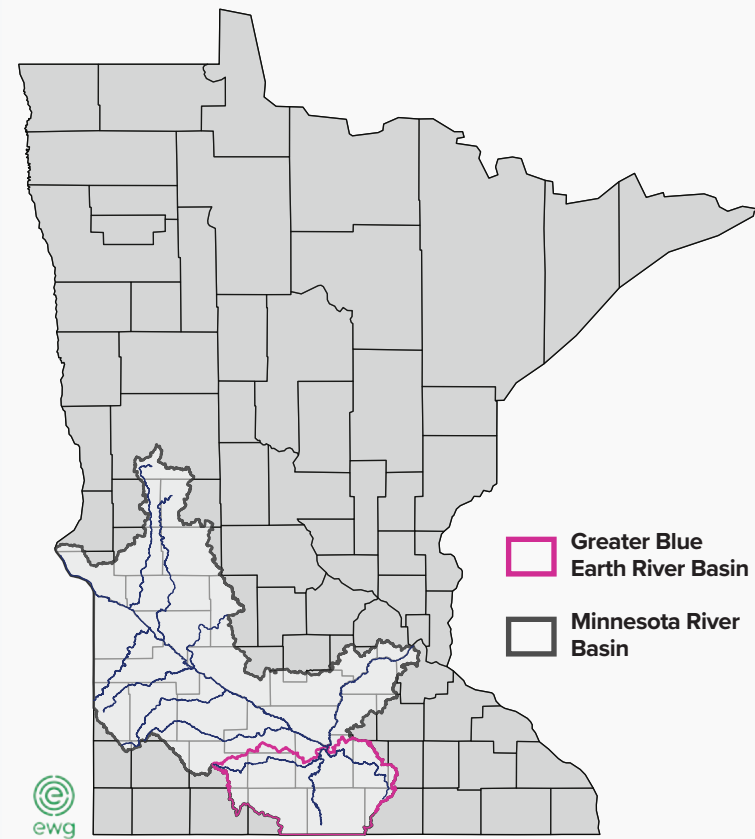
usually outlets into a public drainage system, a network of larger subsurface pipes and county ditches (usually channelized streams) within a defined boundary that is overseen by elected officials in their role as county drainage authorities. If a landowner is within the defined area of a public drainage system, they do not need a permit or permission to discharge water from their privately owned fields into the public drainage system.

Public drainage systems were created under **Minnesota’s Drainage Code**, a series of laws enacted over a century ago to help facilitate the drainage of wetlands, swamps, and low-lying areas for agricultural development. Today, there are 100 public drainage authorities across Minnesota. These bodies of government are controlled by county boards of commissioners or watershed districts, and they have broad authority to establish new drainage systems, authorize an existing drainage system to be enlarged, extended, straightened, or deepened, or order the repair or restoration of an existing drainage system.

Artificial agricultural drainage has “replumbed” much of Minnesota. Gone are most of the wetlands, prairie potholes, and other landscape features endemic to Minnesota that absorb and retain water. In their place are acres of monoculture crops like corn and soybeans with vast networks of perforated plastic pipes laid below the surface. This practice is widespread; approximately 50% of the land in Blue Earth County, for example, drains to a county ditch, and Minnesota farmers continue to add over 100 million feet of subsurface drainage pipe each year. The result is drier soil, fewer isolated wet spots in low-lying areas, and a dramatic increase in the amount and speed at which water, and associated agricultural pollutants, are funneled into natural streams, rivers, and lakes. These drainage systems are one of the reasons why water quality in streams, rivers, and lakes across the state are impaired or in decline.

Southern Minnesota is one of the most heavily drained regions of the state. In the Minnesota River Basin, agricultural drainage is why our state’s namesake river is one of Minnesota’s

most polluted. Altered watercourses are common in this region: meandering streams have been channelized and straightened to better move water off the landscape, ditches have been constructed to collect water draining off fields, and each year miles of channelized streams and ditches are excavated to restore flow to its constructed condition. More producers are installing “pattern tiling”—laying dense concentrations of pipe in a large grid system under every acre under cultivation. This practice has increased alongside the shift to corn and soybean production, and the newer plastic pipes are easier to install and are better at removing water from the landscape than the clay or concrete tile of yesterday. These changes have greatly increased the volume of water carried into ditches, streams, or lakes, which can raise water levels by five feet or more. These newer practices also increase pressure on the existing drainage system, and landowners are petitioning drainage authorities for permission to increase the water capacity of public drainage systems through larger subsurface pipe sizes and wider and deeper ditches.



The Minnesota River Basin

This report focuses on the Minnesota River Basin, one of the areas of the state most impacted by agricultural drainage. This report includes case studies from the Greater Blue Earth River Basin—which includes the Le Sueur, Watonwan, and Blue Earth River watersheds—and the mainstem Minnesota River downstream from its confluence with the Blue Earth River. To help policymakers take corrective action to restore the ecological and biological integrity of Minnesota’s waters, we need to understand the baseline environmental consequences of artificial agricultural drainage in heavily drained watersheds like the Minnesota River Basin.



A History of Land Management Clay drain tile pipes were once laid by hand as shown in this historic photo (left) of early Minnesota farming. (Ayer, Harry Darius, circa 1910, Minnesota Historical Society) Modern equipment (right) like excavators and tile plows allows farmers to install perforated plastic piping quicker and easier.

Regulatory Framework

The environmental impacts from agricultural drainage are largely unregulated in Minnesota. Here is a snapshot of the legal landscape for agricultural drainage.

The Drainage Code is a chapter of Minnesota laws that explain the process for establishing, improving, or repairing public drainage systems. These statutes were developed over a century ago to legally allow wetlands, swamps, and other landscape features to be drained to permit agricultural expansion. The limited environmental considerations in the Drainage Code have been ineffective at slowing or preventing water quality deterioration from agricultural drainage.

The Minnesota Pollution Control Agency monitors environmental quality and helps prevent and reduce air, land, and water pollution through permitting programs and regulations. The agency

does not have a permit program for agricultural drainage and does not currently evaluate drainage projects for environmental effects.

The Minnesota Department of Natural Resources manages the state’s aquatic resources. The agency can require a permit for a proposed drainage project if the project may impact public waters. However, this authority has limited application; in Blue Earth and Martin counties, two of the most extensively drained counties in the state, the department has required a permit in six instances in the past fourteen years. In addition, the public waters permit program is designed to address changes to the course, current, or cross-section of public waters rather than cumulative water quality impacts.

The Clean Water Act is designed to address and prevent water pollution. Agricultural drainage largely falls outside the sweep of this law.

SECTION TWO

Muddy Waters: the Role of Drainage in Altered Hydrology

How has agricultural drainage transformed water flow and sediment transport across the Minnesota River Basin?

In the Minnesota River Basin, decades of artificial agricultural drainage and the recent expansion of many agricultural drainage systems have physically altered surface waters and are a key contributor to the poor water quality in the region. More specifically, artificial agricultural drainage has increased the flow and velocity of surface waters in this region. That additional flow and velocity exacerbate streambank erosion and channel scour, which means more sediment clouds our waters and degrades aquatic habitat.

Background: The Minnesota River Basin covers approximately 16,770 square miles in southwestern Minnesota and drains into the Mississippi River. It includes three watersheds—Blue Earth River, Le Sueur River, and Watonwan River—which together drain land from 14 counties in southern Minnesota and northern Iowa. Historically dominated by tall grass prairie and wetlands and characterized by fine-grained, slowly drained soils, the region is now mainly used to grow corn and soybeans (often referred to as “row-crop” agriculture). This change in land use has been accompanied by the extensive installation of subsurface drainage pipes and ditch systems, which began in the late 19th century. Over the past several decades, farmers in this region have increasingly requested permission from public drainage authorities to expand the capacity of public drainage systems (i.e. increase pipe size and ditch width to allow them to carry more water) in order to improve crop productivity. Expanded drainage has contributed to significant increases in streamflow, which has degraded water

quality and aquatic habitats. These impacts are the most profound in the Blue Earth and Le Sueur River watersheds that make up the Greater Blue Earth River Basin. These impacts can also be seen in most tributaries to the Minnesota River and many other watersheds throughout the Upper Midwest.

The Minnesota River Basin was largely shaped by glacial events nearly 11,500 years ago that lowered the elevation of the Minnesota River by up to 250 feet. As a result of this glacial history, the basin is highly sensitive to erosion and changes in hydrology, and its rivers have some of the fastest rates of incision in the world.

The Minnesota River Basin is vulnerable to erosion because of its unique geologic history, but land-use decisions have exacerbated rather than protected it from this vulnerability. The instability and erosion of the lower reaches of Minnesota River tributaries and the mainstem Minnesota River have been accelerated by the extensive expansion of agricultural drainage systems, which has contributed to excessively high river flows. The expansion of drainage systems in Minnesota dates back to the late 19th century, when European settlement first began to transform Minnesota from a wetland-rich prairie landscape to one dominated by monoculture row-crop agriculture. This transformation was accomplished through the installation of drainage ditches and the channelization of natural streams to better accommodate water drained from agricultural land.

The most dramatic transition in the Minnesota River Basin came with the shift from hay and small-grain production to corn and soybeans from the mid-1970s through the early 1990s. This transition from diverse perennial land cover to annual monoculture systems was accompanied by an increased reliance on subsurface drainage systems to lower the water table. This further altered the natural hydrology of the Minnesota River Basin. With perennial cover, excess water infiltrates further down into the soil, aided by deep prairie roots, where it either eventually becomes groundwater or flows through the sediment to nearby wetlands, streams, and lakes. In contrast, crops like corn and soybeans only grow for part of the year (typically between late May and late August) and do not have deep root structures. This reduces water infiltration in the soil and causes more “flashy” peaks in water volume delivered to streams, rivers, and lakes.

Agricultural drainage systems rapidly convey water to streams, which leads to faster and more intense streamflow events than would occur with

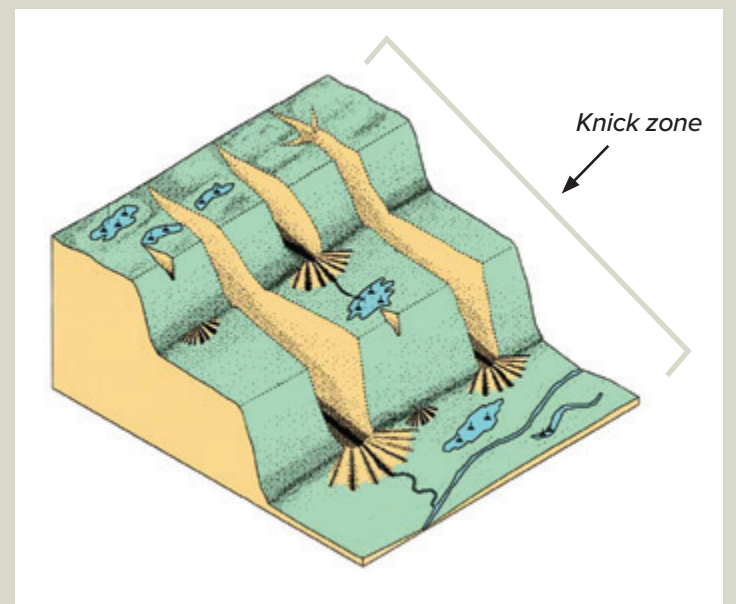
the natural infiltration of water through the soil in the absence of extensive drainage. In urban and suburban landscapes, impermeable surfaces like pavement and concrete have a similar effect on the hydrological cycle, but federal and state laws address this through permit requirements as well as research and grant opportunities for stormwater-design innovation to remain compliant with state and federal rules. We have yet to develop the same permit requirements and level of grant support for innovation in agricultural drainage system design.

Hydrological impacts

Artificial agricultural drainage networks alter natural hydrology in ways that increase the flow and velocity of water in stream and river networks. This additional flow and velocity exacerbates streambank erosion and degrades channel stability. Ditch channels artificially extend the network of streams that drain into a mainstem river further upstream and increase the amount of water drained to downstream areas, while channelized natural streams send water downstream faster.

Glacial History

The landscape and extensive network of streams and rivers in the Minnesota River Basin are geologically young, shaped by events that occurred during the most recent glacial period that ended around 11,500 years ago. The most consequential of these events was the catastrophic drainage of Glacial Lake Agassiz, which carved out the Minnesota River Valley and lowered the elevation of the Minnesota River by as much as 250 feet. This caused tributary streams and rivers to **incise**, or downcut their channels with the steep increase in slope and energy gradient as they dropped in elevation to meet the Minnesota River. The area where rivers steeply drop in elevation from their original floodplain to the carved-out Minnesota River Valley is called the “**knick zone**.”



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Finally, artificial drainage networks bypass historic stormwater storage areas such as wetlands, lakes, and side-channel oxbows of rivers. In the Minnesota River Basin, the net impact of these hydrological changes is that drainage networks have increased the **total flow volume** of the Minnesota River and its major tributaries. The total flow volume of a river, or the discharge, is the volume of water that passes a given point within a specific amount of time. The increase in flows due to artificial drainage are large and unambiguous.

For evidence of this change, we can look at **flow duration curves**, a tool that hydrologists use to evaluate changes in a river system across low, moderate, and high flows. Flow duration curves for the extensively drained Blue Earth and Le Sueur rivers were examined for the period of 1940 to 2009. These curves show that the volume of water that flowed from these rivers into the Minnesota River increased dramatically beginning around 1976. This increase in total flow volume correlates with the shift from hay and small-grain production to corn and soybeans, and the expansion of subsurface

tile drainage throughout the Minnesota River Basin. Flow increases in tributaries like the Blue Earth and Le Sueur rivers have a large cumulative impact on the mainstem Minnesota River. In fact, research shows that the installation and expansion of artificial agricultural drainage systems in the Minnesota River Basin have caused a 2- to 4-fold increase in low flows and a 1.5- to 3-fold increase in high flows, which includes floods.

Increases of flow of this magnitude are exceedingly rare in the world for such a large river system and cannot be attributed to climate change-induced shifts in precipitation alone. A study of Minnesota watersheds found that heavily drained watersheds had more than a 50% increase in annual water yields since 1940, and that artificial drainage and the loss of water storage on the landscape accounted for more than one-half of the increase, on average. Streamflow analysis in the Minnesota River Basin shows that, while precipitation has increased slightly in recent decades from November to February, streamflow has increased over time in every month of the

year. There has also been no discernable change in precipitation in May and June over time, but there has been a large increase in streamflow during these months; this is the time when subsurface tile drains are the most active. Notably, researchers have not observed such a hydrological change in river basins that have not been extensively drained, such as the Chippewa River Basin of Wisconsin.

In addition to increased river flows, artificial agricultural drainage has increased the **“flashiness”** of the Minnesota River and its tributaries, or how quickly peaks in streamflow rise and fall after precipitation events. This is because drainage systems are designed to accelerate the drainage of water below crop roots, whereas under natural conditions this underground water would drain to nearby lakes and streams very slowly through the intricate labyrinth of pore spaces between sand, silt, and clay particles. Because drainage systems alter natural water retention patterns in the soil and on the landscape, they contribute to larger peak discharges after storms.

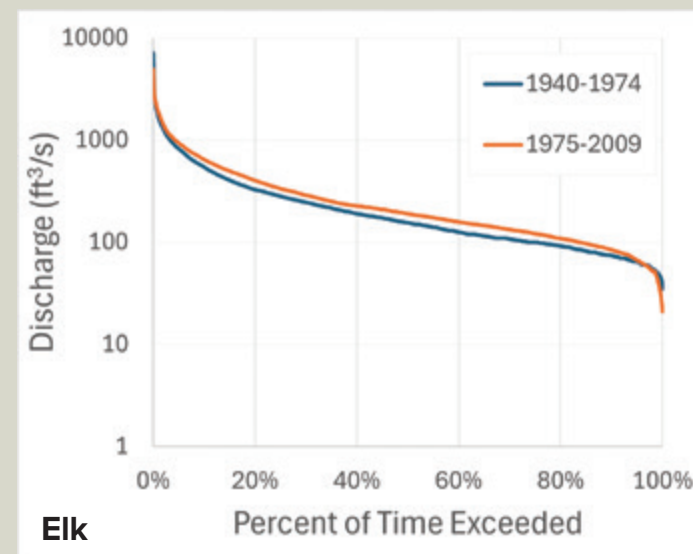
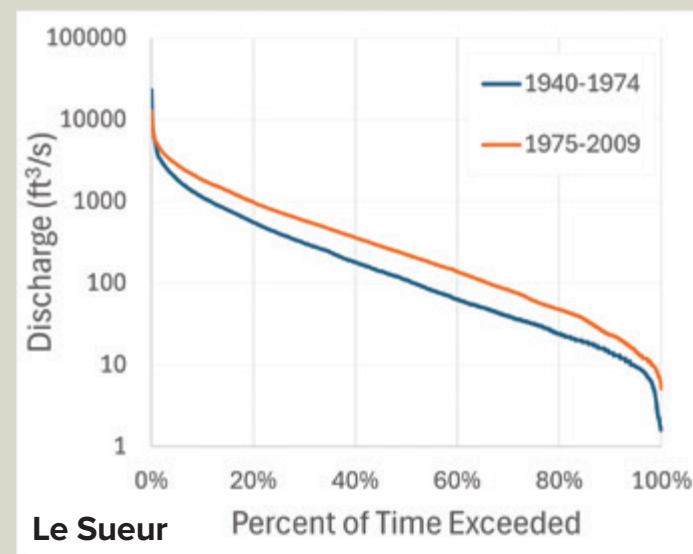
In extensively drained river systems like the Minnesota River, hydrologists have studied the rate of streamflow rise and fall over time. What they have found is that streamflow is “flashier” in these river basins after the historical land use conversion from small grains to corn and soybeans—and the associated installation of sub-surface drainage that accompanied this shift in crop production.

The net impact of excessively high and flashy flows caused by the expansion of artificial agricultural drainage systems can be seen in the cloudy waters of the Minnesota River and its tributaries. Increased high flows due to artificial agricultural drainage have more quickly eroded riverbanks and bluffs, which has dramatically increased sediment loads in the Minnesota River Basin. This is especially pronounced in the “knick zones,” or the geologically vulnerable river reaches throughout the Minnesota River Basin. In these areas, artificial agricultural drainage has accelerated natural erosion and made



Climate Change Increases the Challenge

The observed increases in streamflow across the Minnesota River Basin over the past 30+ years are not the result of changes in precipitation alone. But increases in precipitation due to climate change exacerbate the problem, and heavily drained watersheds are less resilient to these intense precipitation events. For example, the Minnesota State Climate Office reports that, since the early 20th century, the frequency of 3-inch rainfall events has increased by 65%, and rain events that dump more than six inches of rain have spiked dramatically, with eleven such events recorded in the last two decades. The increased water volume from these rain events overwhelms the rate of soil absorption, even with the increased drainage capacity of pattern-tiled landscapes, which leads to heavy volumes of surface runoff in addition to subsurface water delivery through drainage pipes. And without adequate water storage on the landscape, heavily drained watersheds cannot buffer the impact of these intense precipitation events.



Flow duration curves allow us to compare the full range of flows for any two time periods. These plots show that the entire range of flows has increased in magnitude (i.e., the entire curve shifted up) for the 1975-2009 time period in the watershed that has been extensively tiled (Le Sueur, shown at left) much more dramatically than the watershed that has minimal tiling (Elk, shown at right).

river channels wider, deeper, and more prone to move within their floodplain (a process called lateral migration).

A study of Minnesota watersheds found that, on average, rivers with increased flows because of agricultural drainage have widened by 10 to 40% in a process driven by more frequent erosive flood events. In one dramatic example, a study in the Le Sueur River found that the river's channel area increased by 60% from 2008 to 2015. The mainstem Minnesota River has also increased in channel width between Mankato and Jordan. Downstream from Jordan, where the geology changes, the Minnesota River has increased in flow but has not widened or deepened to the same extent, which means that towns along

the riverbanks have been more frequently flooded in this area.

These flashy flows have resulted in considerably increased risks and damage to downstream infrastructure built near riverways, at a great cost to the people of Minnesota. For example, artificial agricultural drainage played a role in the partial failure of the Rapidan Dam in June 2024. Heavy rainfall and excessive sedimentation in the reservoir triggered the dam failure, both of which were amplified by artificial agricultural drainage. This breach caused severe erosion, destroyed a nearby home, and led to the demolition of the historic Rapidan Dam Store. The adjacent County Road 9 bridge suffered irreparable damage, with erosion that compromised its structural integrity.



Erosion Due to Increased Flow *Over the past few decades, erosion of river-channel beds, banks, and bluffs has increased due to increased flows exacerbated by pervasive artificial agricultural drainage. This photo illustrates bank erosion along Hawk Creek in Renville County.*

Preliminary assessments found that the County Road 9 bridge is “likely not repairable or not economically feasible to do repairs” and that costs to replace the bridge would be at least \$15 million, with some estimates as high as \$80 million if you include the loss of use of the road for three years.

These costs extend beyond single catastrophic events like the Rapidan Dam's failure and include significant infrastructure improvement costs over the years. In the last 15 years, the Minnesota Department of Transportation spent over \$35 million on four roadway and bridge projects in the Mankato area to address riverbank stabilization and flood resiliency.

In the Greater Blue Earth River Basin, increased flows caused by agricultural drainage in upstream counties like Blue Earth, Martin, Faribault, and Waseca cause widespread erosion in downstream locations. Erosion of river-channel beds, banks, ravines, and bluffs has dramatically increased **sediment loads** in our streams and rivers and directly caused or contributed to the degradation of aquatic habitat and increase in suspended solids (soils) in the water. Sediment sources that are derived from river banks, ravines, and bluffs

(referred to as “**near-channel sources**”) can be traced to increased flows from artificial drainage. Studies show that while soil health practices and riparian buffers have reduced sediment that runs directly off farm fields, those gains have been offset by increased sediment from near-channel sources like bluffs.

In the Minnesota River Basin, sediment pollution is primarily from near-channel sources like bluffs that can definitively be traced to increased flows from agricultural drainage. In the Le Sueur River Watershed and the Greater Blue Earth River Watershed, scientists compared natural background rates of erosion and deposition before and after the onset of intensive row-crop agriculture. What they found is that recent bluff erosion rates were more than double the natural background rates of erosion. A key insight from these studies is that erosion rates were elevated due in large part to increased flows that erode downstream banks, ravines, and bluffs, rather than directly from farm field runoff. In fact, increased flows correlated with the expansion of agricultural drainage have more than doubled bluff erosion rates in Blue Earth County and elsewhere in the Minnesota River Basin.

Significant Changes

Extensive agricultural drainage has resulted in significant changes to hydrology in the Minnesota River Basin, including:

Increased total flow volume through increased hydrologic connectivity that amplifies recent increases in precipitation

More “flashy” river flows that quickly rise and fall after precipitation events and cause increased flood damage

Increased sediment loads from the accelerated erosion of river banks, ravines, and bluffs that degrade aquatic habitat and damage downstream infrastructure

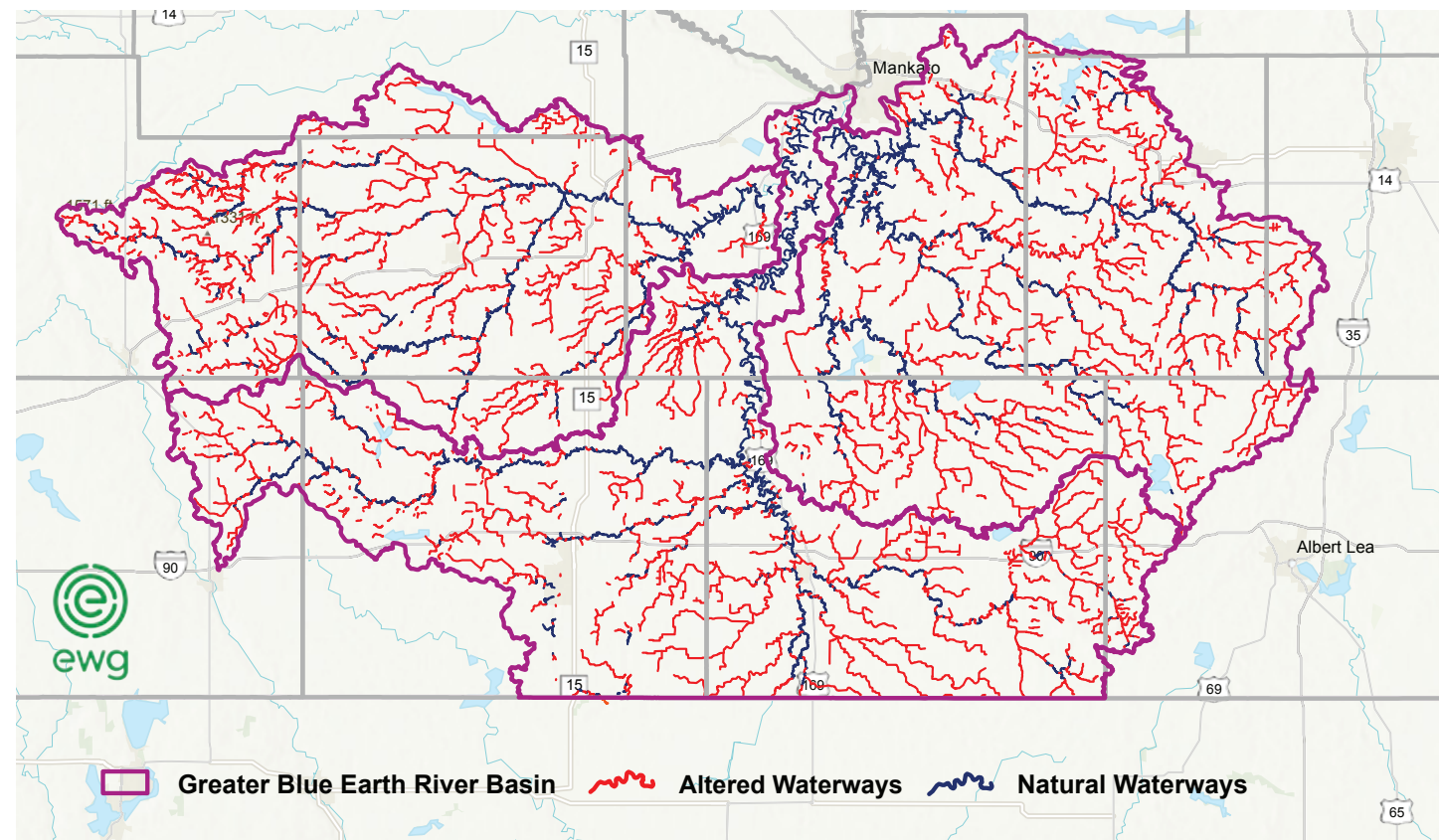
These changes have, in turn, impacted water quality and ecology, with serious implications for aquatic life, recreation, and human health.

Fishable, Swimmable, and Drinkable: the Role of Drainage Systems in Water Quality and Ecology

How do the hydrological changes outlined above connect to Minnesota’s framework for impaired waters? How does agricultural drainage cause or contribute to individual water quality impairments in the Minnesota River Basin and beyond?

The cumulative impact of the hydrological changes outlined in the previous section is widespread water quality impairments and the degradation of ecological habitat throughout the Minnesota River and Greater Blue Earth River Basin. These impairments occur

primarily in **altered watercourses** like county ditches, or formerly natural, meandered streams that were channelized to better accommodate increased runoff from agricultural drainage systems. Impairments are also widespread in the downstream waterbodies that receive runoff from



Altered Watercourses in the Greater Blue Earth River Basin

An “altered watercourse” is defined as any stream whose habitat has been compromised through hydrological alteration. This includes artificially constructed ditches as well as natural streams and rivers whose channels are visibly modified.

these altered watercourses, such as the Minnesota River. These impairments make waterbodies unsuitable for activities like boating, fishing, and swimming, and can impact drinking water sources. Other negative impacts include the loss of fish habitat and biodiversity, increased sediment, eutrophication, and elevated nitrates.

Loss of habitat and biodiversity: Watercourses that are altered to function as ditches are often dredged deeply to allow subsurface drainage tile outlets to drain into the ditch and not flood adjacent farmland. But this practice also eliminates important ecosystems. Fish rely on stream-side floodplain habitats as a refuge to escape the strong currents during high flows and to spawn, and the natural meander of a waterway through its floodplain dissipates the speed of the flow and allows riparian vegetation to remove excess sediment and nutrients.

Excavated ditches and channelized streams are often dredged to be unnaturally wide and uniform in depth. A natural stream widens, narrows, and alternately flows through deep pools and broad shallows. This creates habitat diversity to support large and small and older and younger fish, and a diversity of insects, mussels, and other aquatic species that each have a habitat niche. Watercourses altered for drainage typically lack this habitat diversity and are not able to support the existence of as many fish and invertebrate species as a natural stream with a similar drainage area.

Increased sediment: Increased sediment carried from farm fields and created through downstream erosion clouds the water (turbidity) and reduces the amount of sunlight that reaches the bottom of the stream. This limits the growth of plants and diatoms (single-celled beneficial algae) on rocks that fish and insects use for food. Soil and other organic matter suspended in the water can make it hard for fish and aquatic insects to breathe and locate food. When the suspended sediment settles to the bottom of the stream, it can bury streambed habitat



and affect the quality of the gravel used by fish for spawning. In the Greater Blue Earth River Basin, levels of total suspended solids were two to seven times over state standards between 2000-2008.

Eutrophication: Nutrients applied to agricultural fields that aren’t absorbed by the crops are carried by drainage systems into waterways in concentrations much higher than occur in those waters naturally. This can lead to eutrophication, which refers to an increase or accumulation of nutrients (such as nitrogen and phosphorous) that sets off a chain reaction of algal blooms, dissolved oxygen loss, and ultimately species loss in an aquatic ecosystem. Algal blooms can also make waters unsuitable for recreational activities like boating or swimming.

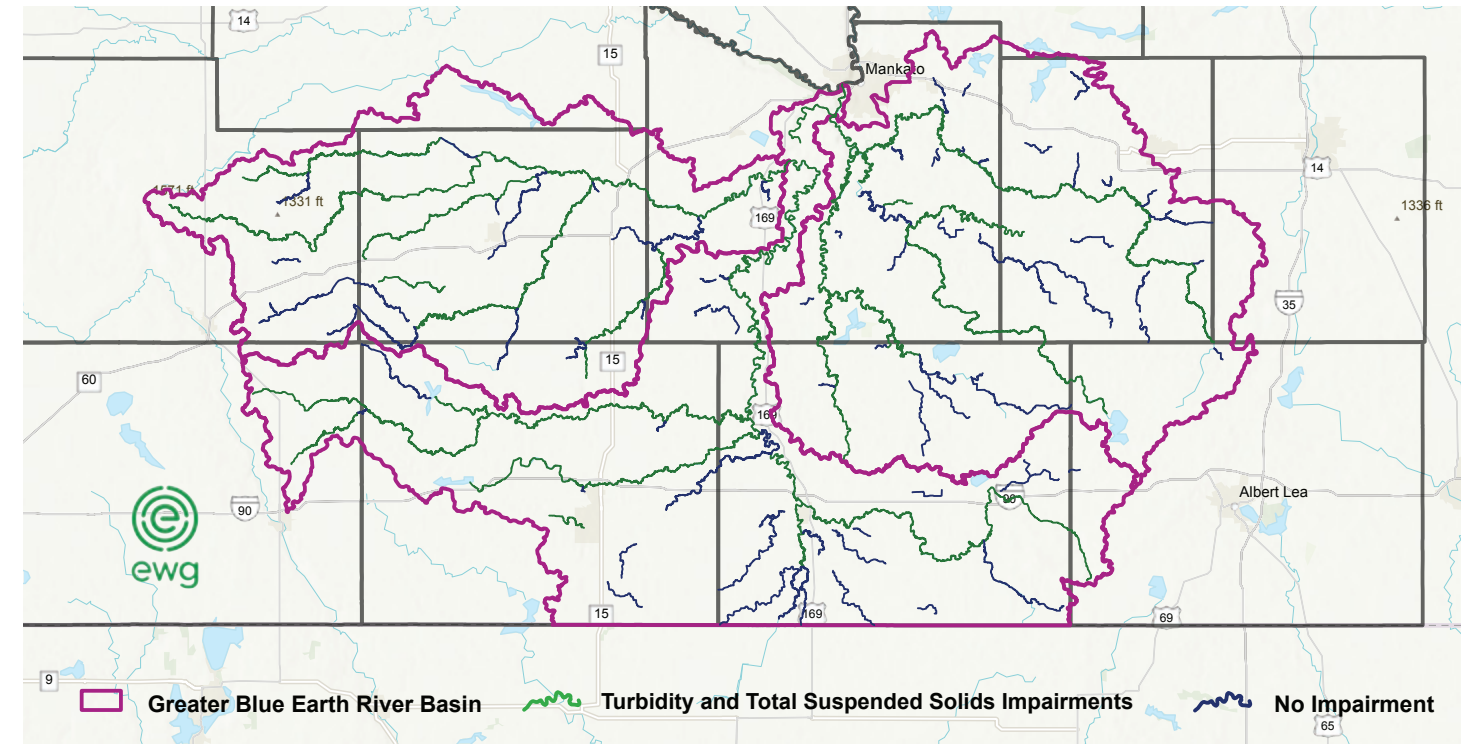
Elevated Nitrates: High nitrate levels endanger the safety of drinking water and cause stress to sensitive fish and aquatic insects. Nitrogen fertilizers are often applied to cropland in excess of what the crop needs; the excess remains in and on the soil after application and the nitrogen converts to nitrate, which is harmful to human and aquatic health. Snowmelt or rainwater then moves the nitrate into the drainage system and ultimately to nearby streams or rivers. Because of the artificial drainage system, this water has little opportunity for soil biology to remove harmful pollutants, which magnifies the nitrate delivered to ditches and streams. MPCA estimates that 76% of the nitrogen delivered to the surface waters in the Blue Earth River Watershed is from cropland drainage.

While most of Minnesota draws its public drinking water from groundwater sources, the cities of Mankato and Fairmont, both in the Greater Blue Earth River Basin, draw their drinking water from lakes or shallow groundwater connected to rivers. The Minnesota Department of Health (“MDH”) has identified nitrate as a contaminant of concern for these cities, and in 2016 Fairmont had levels of nitrate in the city water supply that exceeded the human health standard of 10 mg/L. The MDH acknowledged the role of artificial agricultural drainage in the nitrate exceedance and stated that for both cities, high concentrations of nitrate were **“likely to recur each spring and fall due to tile drainage and agricultural runoff through upstream watersheds.”** The City of Mankato has had to blend water from the contaminated wells with deeper groundwater to keep the city’s drinking water below the 10mg/L threshold, and Fairmont has at times had to draw its water from a backup well. Without regulatory controls to mandate nitrate treatment at drainage system outlets, cleanup costs to protect drinking water supplies are left to the public: the Martin Soil and Water Conservation District has received approximately \$400,000 in state and federal grants to pay landowners to adopt best management practices like saturated buffers, water and sediment control basins, and conservation easements that take marginal lands out of agricultural production.

Water Quality Impairments in the Greater Blue Earth River Basin

The Greater Blue Earth River Basin has been studied extensively due to the large amount of sediment and nutrients that the Blue Earth River and tributaries produce and send downstream to the Minnesota River, Lake Pepin, and ultimately the Gulf of Mexico. More than 62% of the stream miles in the Blue Earth River, LeSueur River, and Watonwan River watersheds have been altered for drainage, which includes both ditches that have been artificially constructed as well as natural streams and rivers that have been channelized to better accommodate runoff from drainage systems. According to the Department of Natural Resources, only 2.2% of the Blue Earth River watershed has surface water storage features like wetlands and lakes, and approximately 85% of the formerly abundant wetlands in the watershed have been lost due to drainage. In another example, wetlands in the Watonwan River Watershed have decreased by roughly 92%.

In the Greater Blue Earth River Basin watershed alone, there are 168 impaired waterbodies. These impairments are for both aquatic life (the water is too polluted to support the type of aquatic life it should) and aquatic recreation (the water is too polluted for aquatic recreation). Altered hydrology, or changes in the amount of and way that water



Turbidity and Total Suspended Solids Impairments in the Greater Blue Earth River Basin

The total maximum daily load for the Greater Blue Earth River Basin found that near-channel sources of sediment account for approximately 75% of the total suspended solids load in the Blue Earth, Le Sueur, and Watonwan River watersheds and that subsurface tile drainage exacerbates sediment erosion in near-channel areas.

moves through the landscape, has been shown to be the main cause of most aquatic life impairments in the basin. More specifically, state agencies and the University of Minnesota have attributed these impairments to the expansive network of drainage ditches and tile drainage, loss of wetlands, changes in vegetation from perennial to annual row crops, and changes in speed and volume of stormwater delivery to surface waters.

The Total Maximum Daily Load (“TMDL”) for the Minnesota River and Greater Blue Earth River Basin lists a total of 61 total suspended solids (“TSS”) impairments along the Minnesota River and its tributaries. The report found that near-channel sources of sediment (such as bank and bluff erosion) comprise approximately 75% of the TSS loads in the Blue Earth, Le Sueur, and Minnesota (at Mankato) rivers. By comparison, less than one percent of the sediment loads in each of these watersheds came from urban stormwater sources. These results affirm the conclusion that increased

flows, amplified by artificial agricultural drainage, have directly increased erosion rates and sediment loading from river bluffs and banks in these watersheds. Ultimately, we cannot feasibly reduce excessive flows in and meet sediment reduction targets for the Blue Earth, Le Sueur, and Minnesota rivers unless we mitigate the impacts of artificial agricultural drainage.

What is an Impairment?

There are seven classes of water in Minnesota that include **Class 1 (drinking water)** and **Class 2 (aquatic life and recreation)**. Nearly all surface waters are Class 2, which is further subdivided into subclasses based on habitat type.

For each use classification, the state establishes **“water quality standards,”** expressed as the allowable pollutant concentration that will maintain the water’s designated use. Every two years, MPCA

assesses which waters do not meet the water quality standards for that waterbody’s designated use class. Waters that do not meet water quality standards are considered **impaired**.

Once a waterbody has been assessed as impaired, MPCA takes a series of steps to determine the ‘probable cause’ of the impairment and prepares a clean-up plan (referred to as a Total Maximum Daily Load) to identify pollution-reduction measures needed to restore the waterbody.

“Minnesota failed to meet its goal to have reduced sediment pollution in the Minnesota River by 25% by 2020 and has no viable plan to achieve the 50% reduction by 2030 goal established by the MPCA. If we want to have any hope to meet our goals to reduce sediment pollution in this region, the state of Minnesota must address how agricultural drainage has altered the physical and biological integrity of waters of the state.”

*- Geomorphologist and report co-author
Patrick Belmont*

SECTION FOUR

We Can Do Better: Innovation in Drainage Design

What are the proven effective measures to address this problem?

The good news is there are best management practices that can help fix the consequences of altered hydrology in the Minnesota River Basin and the entire Mississippi River Basin. There is widespread recognition across Minnesota and other Upper Midwest states that to meet water pollution goals, we need a combination of best management practices that include changes in land use, changes in nutrient use or crops, and edge-of-field practices such as saturated buffers, wetlands, and bioreactors. These types of practices are often referred to as “conservation drainage” or “controlled drainage.” The need to adopt these types of practices has been emphasized repeatedly by MPCA.

So, what are some examples of conservation drainage and controlled drainage practices and how can we increase their adoption across heavily drained watersheds like the Blue Earth River Watershed? Below are some of the key practices that experts recommend and their pollution-reduction benefits.

Water Retention & Storage

Retaining water on the land before it enters a waterway such as a stream or river is a primary intervention to reduce flow volumes and velocity, sediment, and nitrate contamination from artificial agricultural drainage. Water storage can look like wetlands, ponds, water and sediment control basins,

“Many within the agricultural community are open to water storage practices, especially when activities that increase water holding capacity of productive farmlands are combined with targeted practices such as sediment basins and wetlands.”

- The stakeholder group Collaborative for Sediment Source Reduction that met from 2011-2017 to discuss solutions for sediment pollution in the Blue Earth River.

or adding perennial cover or cover crops to cropland which allows for more water storage in the soil.

Reducing flow velocity by adding water storage capacity near the headwaters of a river system helps reduce bank erosion and the resulting sedimentation, accelerating the aquatic ecosystem’s return to stability. Water retention measures have been found to be the most favorable approach to reducing sediment pollution because they address the cause of erosion rather than measures that

only address the symptoms (such as hardening streambanks with concrete or riprap to stabilize the streambank), and because water retention also reduces nutrient pollution and protects ecological habitat. Water retention does not require removal of artificial agricultural drainage, but rather management of the excess water added to streams, rivers, and lakes from drainage through controls on drainage outlets and creating water storage to slow delivery of water to the river system.

Gains Erased

In-field agricultural soil erosion has decreased over the past several decades due to improved tillage and other conservation practices, but the extensive installation of agricultural drainage simultaneously exacerbated erosion of Minnesota River tributaries. This explains why sediment in the Minnesota River and Lake Pepin continues to be a problem in recent decades, despite considerable public investments and efforts by agricultural producers to reduce soil erosion. Unless appropriate investments are made in drainage practices to mitigate the impacts of artificial agricultural drainage and specifically hold more water back on the landscape, we will continue to waste large public investments in stream restoration, agricultural management, and soil health practices, and the State of Minnesota will not be able to provide reasonable assurance that state water quality standards will be met.



Water Storage

Even modest water storage can have a big impact: **model predictions estimate a 40% reduction of sediment in the Le Sueur watershed if 4% of the landscape—using existing, natural depressions—is used for temporary water storage.** These marginal lands converted to storage sites could still potentially be used to grow hay or other crops. However, the inclusion of water storage is largely discretionary when public drainage systems are repaired or expanded, and there has been limited voluntary incorporation of water storage in many areas of the state.

Conservation Drainage Practices

Conservation drainage refers to “edge-of-field” practices that remove nutrients from subsurface drainage water before it enters streams, rivers, or lakes. It includes practices such as saturated buffers, bioreactors, and treatment wetlands.

Minnesota requires vegetative “buffers” between agricultural fields and waterways to help reduce water pollution. And there is a very high rate of buffer implementation in the state (approximately 99% of the appropriate land area has buffers). But buffers will not solve the problems caused by drainage. Stream destabilization, sediment overload, and nitrate contamination caused by drainage are not prevented or intercepted by riparian buffers because the water passes under the buffers via subsurface drain tile, and sediment erosion from increased river flows magnified by drainage happens within the river channel itself. But unlike riparian buffers, **saturated buffers** can be used to reduce nutrients and sediment in water from subsurface drainage. Saturated buffers perform similarly to treatment wetlands (about 50% nitrate removal effectiveness) but have lower installation costs and require less management.

Bioreactors are another edge-of-field practice that can be used to effectively treat subsurface drainage

water. In the context of drainage, a bioreactor is a buried trench on the edge of a farm field that is traditionally filled with woodchips. Bacteria in the woodchips convert the nitrate in tile water into nitrogen gas. Bioreactors have a small footprint, which makes them well-suited to retrofit current drainage system outlets. Bioreactors require little-to-no land to be taken out of production and fit into grassy edge-of-field areas. They can reduce nitrate loads by 20-50% dependent on site-specific conditions.

Finally, **treatment wetlands** are constructed wetlands that are designed and strategically located to reduce pollutant loads and improve water quality. Treatment wetlands can reduce nitrate loads by up to 50% and can treat large drainage areas, which makes them well-suited to public drainage systems. While wetland restoration in the upper third of a watershed helps provide water-storage benefits, as described in the Water Retention and Storage section above, treatment wetlands are often located near the outlet of a drainage system to help with nutrient and sediment removal. Treatment wetlands can take substantial amounts of land out of production but are effective for watershed-scale treatment. Wetlands provide a variety of additional ecosystem services beyond nutrient removal, such as wildlife habitat and recreation.



Bioreactors (shown here) are edge-of-field practices used to filter nutrients from drainage systems. Photo by Purdue University.

Controlled Drainage Practices

Controlled drainage is complementary but distinct from the water retention and storage practices outlined above, which use or modify existing depressions in the landscape to hold water on the land surface. Controlled drainage modifies the drainage system design itself to control water table depth and flow volume to reduce erosion and sediment loads.

Controlled drainage practices include two-stage ditches, peat filters, and gravel or blind inlets. Controlled drainage is expensive and generally more difficult than edge-of-field practices like bioreactors to retrofit to current drainage systems. But drainage system improvements provide an opportunity to include both controlled drainage and conservation drainage practices in the project design. Several controlled drainage practices are outlined below:

Two-Stage Ditches

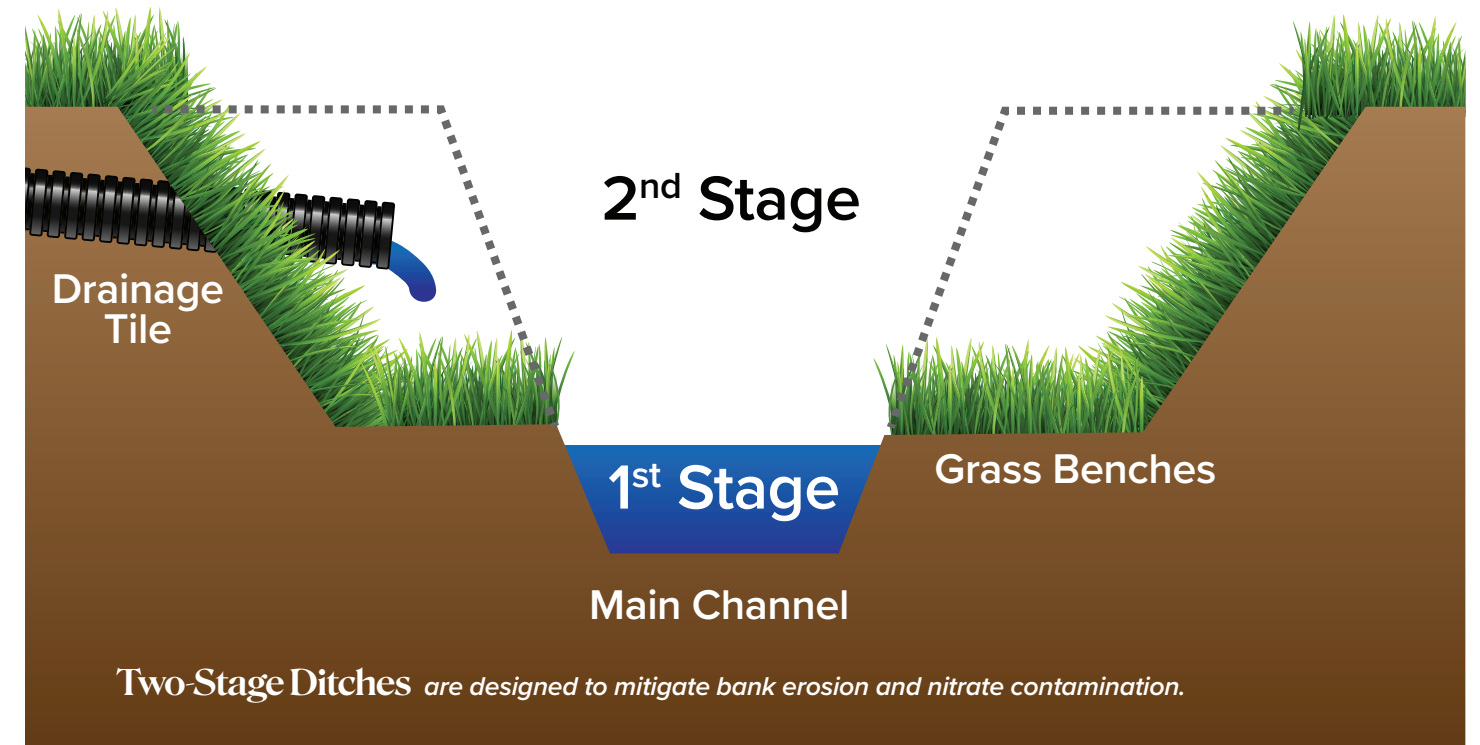
Once water reaches the drainage ditches, water control structures that mimic natural hydrology patterns can help reduce negative impacts from drainage. Two-stage ditches are constructed with

a deep, narrow channel beneath a shallower, wider channel and can help mitigate bank erosion and nitrate contamination. The narrow inner channel can meander and have space to overflow. This mimics a more stable, natural stream structure, reducing bank erosion and providing better habitat for fish and other wildlife. The inset floodplain of a two-stage ditch can also allow nitrates to be taken up by plants and hold water long enough to allow bacteria to reduce the nitrates.

Similar to upstream wetland restoration and water storage areas, restoring streamside riparian zones (the area next to a stream) can lead to a reduction in peak discharge and nitrate removal. Water control structures such as two-stage ditches or other features that allow flows to more easily access the floodplain and reconnect side channels to hold water and sediment will help reduce bank erosion and restore aquatic ecosystem stability. This can be one of the most cost-effective ways to meet water quality targets.

Elimination/Reduction of Ditch Clean Outs

When ditches are re-dredged due to sediment build-up and erosion, the ground is once again



Two-Stage Ditches are designed to mitigate bank erosion and nitrate contamination.

disturbed, which deposits loose soil along the banks and the bottom of the channel. This causes more sediment production from banks, creating a repeating cycle of sediment production and clean-outs. Drainage authorities can reduce the need to re-dredge ditches through alternatives such as localized waterway restoration, two-stage ditches, or water storage basins, and limiting the re-dredging of ditches helps improve water quality. Some formerly dredged ditches have evolved to resemble constructed two-stage ditches; for these, additional dredging may not be necessary.

The 2021 Blue Earth River Watershed Stressor Identification Report focused on the need to eliminate or reduce ditch clean outs when ditches are functioning as they need to be. It also emphasized the need to transform shallow, wide, and homogenous channelized ditches into two-stage ditches to dissipate stream energy, reduce stream fragmentation, increase habitat availability, increase denitrification rates, and reduce eutrophic growth.

Despite the many co-benefits of conservation drainage and controlled drainage practices, we have not made adequate progress in the adoption of these practices to slow down water from heavily drained landscapes or otherwise treat drainage runoff to reduce nutrients. Statewide, as of 2025 we have approximately 34,000 acres using water retention and treatment practices such as wetland restoration and controlled drainage management. In comparison, over 1.3 million acres are engaged in best management practices for cropland erosion control and about 900,000 acres use continuous living cover.



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► In Blue Earth County

County Ditch 57 in Blue Earth County incorporated a multi-benefit approach using storage basins (ponds), water control structures, and two-stage ditch construction to reduce peak flow volume, stabilize the ditch for less maintenance, reduce nutrient (phosphorous and nitrate) and sediment reduction, and provide more diverse wildlife habitat. From annual reports of monitoring data, the flow volume, sediment load, and nitrate concentrations were reduced in most flow events. Additional interventions in the upland cropland areas, such as adjusting fertilizer application timing and amount and planting cover crops would help further sequester the land-applied nitrate fertilizer before it enters the tile lines and flows into the ditch.

► Vulnerable Landscape

Lake Pepin in southeastern Minnesota continues to be subject to sediment pollution that is filling in the lake at a much faster rate than would occur naturally.



SECTION FIVE

A Path Forward: Policy Recommendations

What are policy measures that would help to mitigate this problem?

Artificial agricultural drainage dramatically changes river-basin hydrology with significant impacts to water quality. As discussed, agricultural drainage in the Greater Blue Earth River Basin has significantly increased flow volumes, velocity, and flashiness in the Minnesota River and its tributaries. This, in turn, has caused significant increases in streambank and bluff erosion, which has undermined progress we have made to reduce cropland erosion and has significantly increased the amount of sediment and nutrients in the Minnesota River and ultimately the upper Mississippi River. These pollutants cloud our rivers, degrade aquatic habitat, jeopardize infrastructure, and impact human health. And Minnesota's drainage law and other environmental statutes have done little to slow the rapid expansion of artificial agricultural drainage and its attendant environmental consequences. **Minnesota cannot provide reasonable assurance that water quality targets in the Minnesota River Basin will be met unless and until it addresses the pollution caused by artificial agricultural drainage.**

Given the important crop-production benefits that agricultural drainage provides to Minnesota farmers, what are the potential pathways forward? Below are four policy measures that would help mitigate this problem and better balance agricultural production with environmental protection.

ECONOMICS Quantify economic value for downstream damages attributable to upstream agricultural drainage

When drainage authorities consider a proposed drainage project, they are required under Minnesota law to determine whether the estimated benefits of the project are greater than the estimated costs. This is supposed to include an estimation of "damages," but we currently lack consistent methods to estimate the in-system and downstream damages to water resources from artificial agricultural drainage. Economists have begun to estimate the public costs of different types of pollution, such as nitrogen, carbon, and sediment. But none of these studies have specifically looked at the role of agricultural drainage systems in these damages. We support proposed studies that would use watershed models and economic analysis to develop a way to calculate economic damages from changes in the level of sediment, pollutants, and annual flow that are attributable to drainage systems. For example, externalized economic costs could include increased public expenditures for flood resiliency and riverbank stabilization projects, or the installation of treatment systems at public water treatment plants to remove nutrients. These values can then be used by local drainage authorities to include the cost of downstream damages in their evaluation of proposed drainage projects.

ENVIRONMENTAL REVIEW Adequately capture cumulative water quality impacts in environmental review

Minnesota law requires a review of projects that may have the potential for significant environmental effects. But despite the stark evidence that artificial agricultural drainage negatively impacts water quality in the Minnesota River Basin and other watersheds throughout the state, these impacts are not adequately reviewed. In the past, the environmental impacts of some drainage projects have been studied because of their impact on public waters. However, state environmental rules lack a tool to more holistically evaluate cumulative water quality impacts in heavily drained watersheds, such as stream channel instability and the associated negative impacts on aquatic habitat. The Environmental Quality Board ("EQB") should add a requirement to review drainage projects for cumulative water quality impacts. The EQB could do this through a new mandatory category in the state rules for environmental review. The thresholds for a new category of this type should focus on increases in flow volume and annual peak flows, because these are critical measures to capture how much hydrological change a watershed can endure before physical and biological degradation starts to occur. Like the mandatory environmental review category for animal feedlots in state rule, this could include a general threshold that applies across the state and a more conservative threshold that applies to sensitive areas, such as waterbodies impaired for turbidity and total suspended solids. Environmental review would also better inform decision makers about whether the costs of the drainage project exceed its benefit.

Alternatively, Minnesota could conduct a generic environmental review for drainage improvements in the Minnesota River Basin. A Generic Environmental Impact Statement would help the state assess how to reach its water quality goals. In 2015, MPCA's Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi

River set out to reduce sediment in the Minnesota River by 25% in 2020, which it did not achieve, and by 50-60% in 2030, which it is not on track to achieve. Furthermore, the Nitrogen in Minnesota Surface Waters Report outlines that agricultural drainage accounts for an estimated 67% of nitrogen in the Minnesota River. These reports make clear that to meet our state water quality goals, we must study and mitigate the cumulative water quality impacts from agricultural drainage.

MARKET-BASED STRATEGIES A cap-and-trade system would share the burden of meeting pollution targets with the wastewater sector

Another approach to mitigate the cumulative impact of artificial agricultural drainage in the Minnesota River Basin for specific pollutants would be a cap-and-trade system where pollution sources could trade pollution allowances with one another to achieve established pollution-reduction goals. This may be a necessary step for the state to implement a nitrate water quality standard for aquatic life, which is on MPCA's Work Plan for 2025-2027. Statewide, the wastewater sector only accounts for about 9% of the total nitrogen load in Minnesota waters, and even less in intensively tile-drained watersheds like the Minnesota River Basin. However, while wastewater treatment plants are required to meet certain pollution reduction targets in their permits, agricultural drainage systems are not required to meet pollution limits. To enforce a nitrate water quality standard for aquatic life, MPCA could use a cap-and-trade system to ensure that the burden to meet pollution targets is shared between permitted "point sources" like wastewater treatment plants and other pollution sources like agricultural drainage systems. This has been done successfully for other pollutants and for impaired waters in Minnesota, such as the Lower Minnesota River dissolved oxygen TMDL. This TMDL addressed a dissolved oxygen impairment in the Lower Minnesota River caused by excess phosphorus. The TMDL required the development

of the Minnesota River Basin General Phosphorus Permit – Phase 1, which gave wastewater treatment plants the option to buy or sell phosphorus credits with un-permitted sources to reach their pollutant reduction targets under the permit.

REGULATORY PROGRAMS

Permit system for drainage projects

State regulators should develop a permit system for drainage projects to require the integration of appropriate water storage, conservation drainage practices, and/or controlled drainage practices when drainage systems are expanded (i.e. designed to hold more water) or new drainage systems are built. This would not need to include the repair of drainage systems that already exist. A permit system of this type could be modeled after the stormwater permit system, which refers to a manual that sets minimum design requirements for runoff retention, sediment reduction, and/or peak flow requirements.

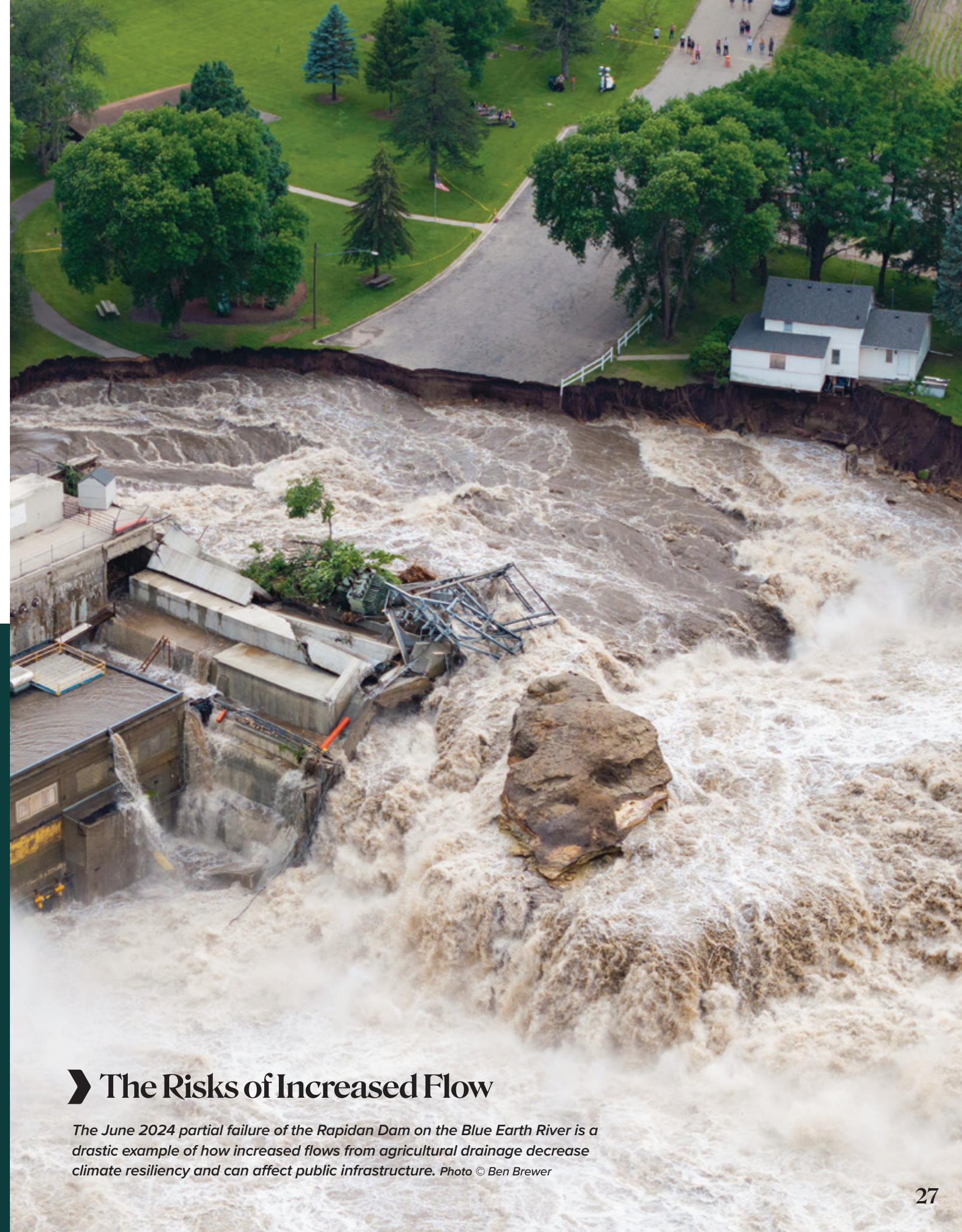
In the case of agricultural drainage management, the design manual could be informed by the Watershed Restoration and Protection Strategies and One Watershed One Plan studies, which have been completed for nearly every major watershed in the state as of this report’s publication.

As a model, the stormwater permit system is designed to give permittees the flexibility to select from best management practice options and adapt the requirements to their local circumstances. The guidance can vary based on the character of the waterbody that will receive the runoff, such as whether it has trout stream protection, if it falls within a source water protection area, and whether it drains to an impaired water. A similarly structured permit system for agricultural drainage projects could be piloted in a specific watershed to help establish the effectiveness and scalability of water storage, conservation drainage practices, and controlled drainage practices at the watershed scale.

Conclusion

Minnesota has ambitious watershed pollution reduction targets that will not be met unless we account for the cumulative impact of agricultural drainage systems. Within Minnesota River Basin tributaries like the Blue Earth River Watershed, MPCA acknowledges that the “drainage network has replaced prairies and wetland and created a ‘short circuit’ in hydrologic conditions that can increase the volume of water delivered and decrease the amount of time water would remain on the landscape.” These changes are a primary driver of increases in the volume and duration of stream flow which “have in turn increased nutrient and sediment loads to the watershed.” Watershed pollution reduction targets for the Blue Earth River Watershed include a 25% reduction in stream flow, a 45% reduction in nitrogen stream concentrations and loads, and a 60% reduction in sediment loads.

In a February 2024 letter, MPCA outlined priority issues and concerns to be addressed in the Blue Earth River Watershed. The top priority was drainage watershed management, followed by the closely related issues of aquatic life, altered hydrology, sediments and nutrients. Given the extensive impairments throughout the watershed, it will not be able to meet the ambitious goals laid out for it unless and until Minnesota takes serious steps to address agricultural drainage as a primary driver of altered hydrology and associated sediment, nutrient, and aquatic life impairments. As this report has outlined, there are ways to do that and continue to realize the benefits of drainage for agricultural production.



The Risks of Increased Flow

The June 2024 partial failure of the Rapidan Dam on the Blue Earth River is a drastic example of how increased flows from agricultural drainage decrease climate resiliency and can affect public infrastructure. Photo © Ben Brewer

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Maps were created by the **Environmental Working Group** using public data.



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