Edgerton DWSMA Groundwater Protection Rule Summary

Groundwater, Nitrogen Fertilizer Management, and Nitrogen Loading Analysis

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Introduction

This document summarizes the Minnesota Department of Agriculture's (MDA) current understanding of the City of Edgerton's Drinking Water Supply Management Area (DWSMA), public well nitrate-nitrogen levels, and nitrogen management information. Also included is a summary of the MDA's analysis of nitrogen loss below cropland within this DWSMA. This summary provides the detail the MDA considered to determine whether the proposed list of nitrogen fertilizer best management practices (BMPs) and Alternative Management Tools (AMTs) will be protective of groundwater.

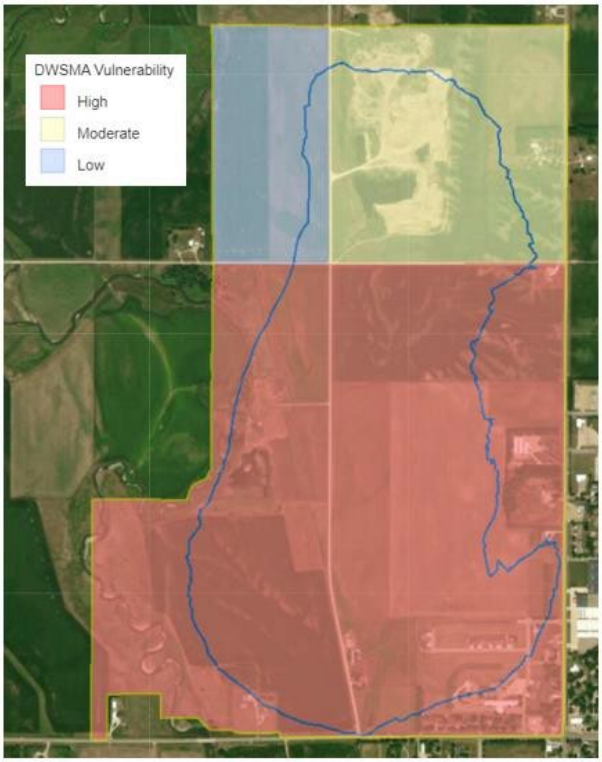

Figure 1. Edgerton DWSMA Vulnerability Designated by the MDH.

DWSMA and Public Well Nitrate-Nitrogen Data

The DWSMA boundary defined by the Minnesota Department of Health (MDH) for the City of Edgerton's public well covers 792.5 acres. The groundwater below 79.9 of those acres (10% of the DWSMA) is designated by the MDH as low vulnerability. Areas classified as low vulnerability by the MDH are not included in the mitigation area designation under the Groundwater Protection Rule (Minnesota Statute 1573.0040, Subp 3, D (2)). A total of 549.9 acres nearest to the public well are designated as highly vulnerable and 162.7 acres in the northeast corner of the DWSMA are designated as moderately vulnerable (Figure 1). The Groundwater Protection Rule applies to the moderate and highly vulnerable portions of the DWSMA that amount to 712.6 acres (90% of the DWSMA).

The MDA relies on the water quality data provided by the MDH to evaluate nitrate-nitrogen levels in the public water supply. Nitrate-nitrogen levels have exceeded 8 mg/L in Edgerton's municipal well within the past ten years. Between 2013 and 2019, nitrate levels measured in the Edgerton public well show an increase up to 20 mg/L followed by a decrease down to 12 mg/L in September of 2022 (Figure 2).

Between 2013 and 2019, nitrate levels measured in the Edgerton public well show an increase up to 20 mg/L followed by a decrease down to 12 mg/L in September of 2022. Well #9 is a shallow well installed in 1976 to a depth of 44 feet (Table 1). Within the highly vulnerable portion of the Edgerton DWMSA, perennial land cover increased from 33% in 2018 up to 70% of cropland in 2021. These changes in land cover correspond with the nitrate level decline observed in the public well. Wet conditions in the region from 2017-2019 during the period that nitrate levels increased could have been a contributing factor to this increase.

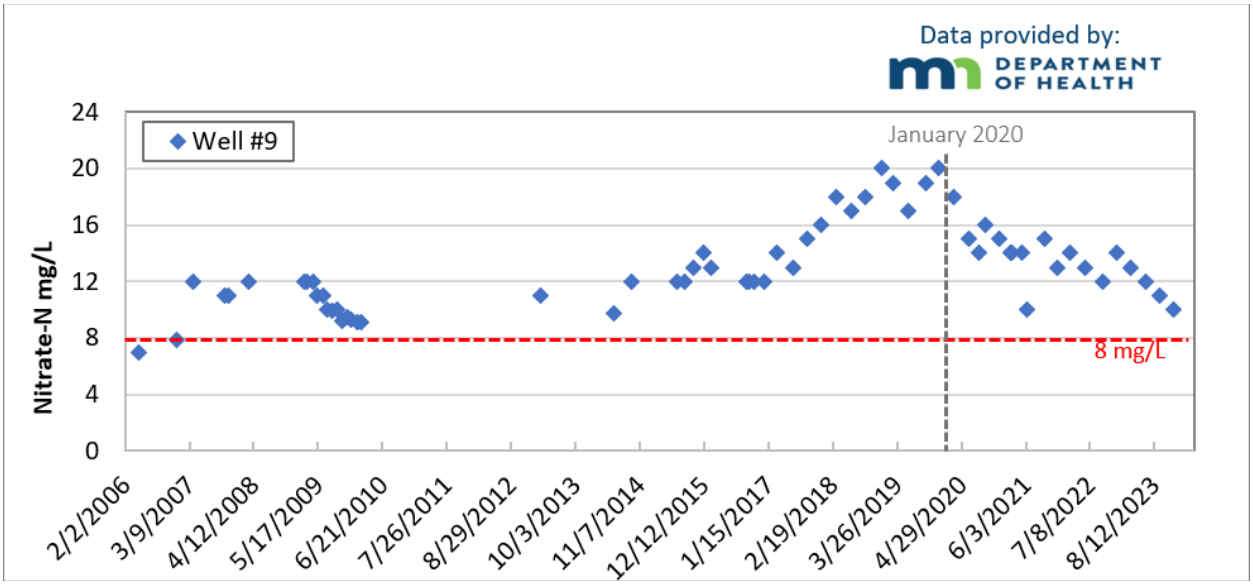

Figure 2. Edgerton public well nitrate results for May 2006 through December 2023.

Table 1. City of Edgerton public well information.

Local Well ID	MDH Status	Casing Diameter (in)	Casing Depth (ft)	Well Depth (ft)	Date Constructed
Well #9	Primary	36	16	44	8/26/1976

DWSMA Land Use and Potential Nitrate-Nitrogen Point Source Consideration

The MDA conducted a detailed review of potential contaminant sources to determine whether a point source of nitrogen could be the cause of the public well exceeding the criteria for mitigation level designation (Minnesota Statute 1573.0040, Subp. 3, C). In the Edgerton DWSMA, the MDA review did not identify a point source for nitrate-nitrogen. With nitrate levels exceeding 8.0 mg/L within the past ten years and without a point source contribution, this highly vulnerable portion of this DWSMA was designated at Mitigation Level 2 under Part 2 of the Groundwater Protection Rule in January 2020 (Minnesota Statute 1573.0040, Subp. 7, C, 2).

Part 2 of the Groundwater Protection Rule responds to DWSMAs which have elevated nitrate. The goal is to take action to reduce nitrate in groundwater before a public well exceeds the health standard for nitrate, 10 mg/L. In Level 2 DWSMAs, the MDA works with a local advisory team (LAT) including local farmers, and agronomists to get input on management practices (BMPs and AMTs) that can reduce nitrate levels in groundwater.

The Groundwater Protection Rule defines cropland as land used primarily for the production or harvest of

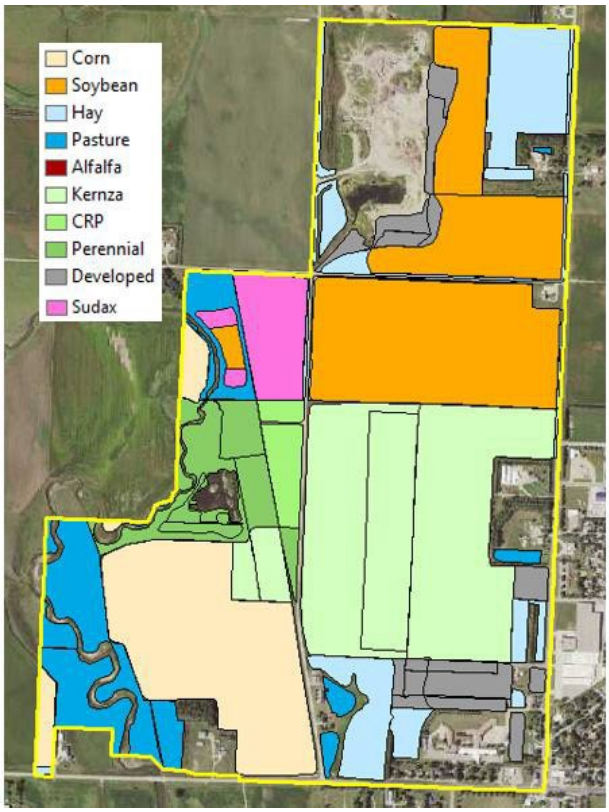

Figure 3. 2023 Cropland cover within the high and moderately vulnerable portions of the Edgerton DWSMA based on the USDA cropland data layer.

annual or perennial field, forage, food, fiber, or energy crops including pasture but excludes forestland. A review of the publicly available USDA Cropland Data Layer (hosted on Crop Scape, nass.usda.gov/Research_and_Science/ Cropland/Release/ index.php) in the highly vulnerable portion of the Edgerton DWSMA shows that the land use here is predominately cropland. Data illustrated in Figure 3 is from the Feb 2022 data release.

The MDA surveyed local agronomists and farmers to understand the nitrogen fertilizer management practices used in the Edgerton area. Having current and accurate nitrogen fertilizer management data is critical to the discussion of BMPs and AMTs. With computer modeling the MDA compares nitrogen leaching loss below current management practices and under the nitrogen fertilizer BMPs proposed to protect groundwater. The farming practice information collected includes crop type, planting date, harvest date, and nitrogen fertilizer use information.

Due to the small number of operators farming within the Edgerton DWSMA, the farming practice information the MDA collected is not included in this document. The state statute on Agricultural Data (Minnesota Statute 13.643 Subd. 7) protects the identities and location of producers who are cooperating with the MDA in an assessment of farm practices. If farm practice information could identify an individual, it is considered private information and cannot be shared by the MDA.

Table 2. 2023 Cropland cover within the high and moderately vulnerable portion of the Edgerton DWSMA.

Crop Type	Acres	% of Cropland
Kernza	139	26%
Hay/Pasture	113	22%
Corn	86	16%
Soybean	124	24%
CRP	11	2%
Perennial	32	6%
Sudax	21	4%

Within the high and moderately vulnerable portion of the Edgerton DWSMA the crops grown in 2023 include Kernza, hay/pasture, corn, soybeans, and sudax (Table 2). The land area in a corn-soybean rotation is 210 acres and amounts to 40% of the cropland within the DWSMA. There are a combined 295 acres of Kernza®, CRP, pasture/hay, and perennial grass adjacent to the public well accounting for an additional 56% of the cropland area. Twenty-one acres of sudax account for the remaining 4% of cropland within the DWSMA. Included in the planted perennial cover is a 38-acre farmstead purchased by the City of Edgerton with a Board of Soil and Water Resources (BWSR) Wellhead Protection Partnership Program Grant requiring that the land be permanently managed to protect groundwater (Minnesota Statute 103F.515, Subd. 2, paragraph (d)). After this purchase the city razed all buildings on the property in 2022 and converted the property to perennial grass cover. In 2023, the BWSR Wellhead Partner Protection Grant funded a separate 30-year contract for 126 acres near the city's public well that requires zero nitrogen fertilizer be applied to this cropland during the contract. In addition to these two successful applications for grant funding, there are currently two more BWSR Wellhead Partner Protection Grant applications in the works and under review that if funded would assure additional cropland acres in this DWSMA are managed for the protection of groundwater.

The MDA has also reviewed the USDA Cropland Data Layer over the past ten years in the high and medium vulnerability portions of the Edgerton DWSMA. During this time, the perennial cover (CRP, Grass hay, or Pasture) in place has exceeded 30% of the cropland area every year (Table 3). Kernza, which is a perennial wheat grass has accounted for 25-26% of the cropland in the DWSMA since 2019. Combined, these two categories of perennial cover in the DWSMA total 56% of the cropland.

Table 3. Edgerton DWSMA cropland crop history acreage and percent of cropland with the DWSMA.

Year	CRP, Hay, Pasture Acres	CRP, Hay, Pasture %	Corn Acres	Corn %	Soybean Acres	Soybean %	Alfalfa Acres	Alfalfa %	Kernza Acres	Kernza %	Oats, Wheat, Rye Acres	Oats, Wheat, Rye %	Sudax Acres	Sudax %
2012	194	35	61	11	297	54	-	-	-	-		-	-	-
2013	179	33	296	54	-	-	-	-	-	-	74	13	-	-
2014	179	33	197	36	173	31	-	-	-	-	-	-	-	-
2015	179	33	163	30	138	25	14	3	-	-	54	10	-	-
2016	179	33	211	39	144	26	14	3	-	-	-	-	-	-
2017	159	30	95	18	260	49	14	3	-	-	-	-	-	-
2018	160	30	79	15	277	52	14	3	-	-	-	-	-	-
2019	159	30	95	18	125	24	15	3	133	25	-	-	-	-
2020	160	30	79	15	85	16	64	12	139	26	-	-	-	-
2021	179	34	86	16	74	14	49	9	139	26	-	-	-	-
2022	179	34	74	14	135	26	-	-	139	26	-	-	-	-
2023	156	30	86	16	124	24	-	-	139	26	-	-	21	4

DWSMA Nitrate-Nitrogen Loss Below Cropland

Based on University of Minnesota modeling of nitrogen loss below cropland using a decision support system for agrotechnology transfer (DSSAT) model simulation[1], the MDA has estimated the nitrogen loss below the root zone in the Edgerton DWSMA. To estimate the benefit of groundwater protection practices that have gone in place since 2019, the MDA compared the estimated nitrogen loss below cropland in 2018 and 2023 (Table 4a and 4b).

Table 4a. Estimate of nitrogen leaching below cropland in the Edgerton DWSMA in 2018.

Crop Type	Acres	Fraction of Cropland	N Leaching Rate (lbs./ac/yr)	Note
Kernza	0	0	2.4	Zero N applied[2]
CRP, Hay, Pasture, Perennial	160	0.30	2.4	Zero N applied[2]
Corn-Soybean	355.7	0.67	31.5	Estimate based on corn N rate of 143 lbs. N/ac/year[3]
Alfalfa	14	0.03	N/A	Unknown
			22.5	Average area weighted nitrogen leaching rate (excluding alfalfa acres)

Table 4b. Estimate of nitrogen leaching below cropland in the Edgerton DWSMA in 2023.

Crop Type	Acres	Fraction of Cropland	N Leaching Rate (lbs./ac/yr)	Note
Kernza	139.3	0.26	2.4	Zero N applied[2]
CRP, Hay, Pasture, Perennial	155.7	0.30	2.4	Zero N applied[2]
Corn-Soybean	231.4	0.44	31.5	Estimate based on corn N rate of 143 lbs. N/ac/year[3]
Alfalfa	0	0	N/A	Unknown
			15.2	Average area weighted nitrogen leaching rate (excluding alfalfa acres)

[2] Zero pounds nitrogen/acre is applied in Edgerton on the Kernza, CPR, pasture, and perennial acres. This nitrogen rate matches the input for the UMN model that estimated 2.4 pounds nitrogen/acre leaching rate.

[3] 143 pounds nitrogen/acre on corn following soybeans was based on the UMN study and not reference to the nitrogen management practices used in the Edgerton DWSMA.

[1] Mulla, D.J., Tahir, M., and Jungers, J.M. (2023). Comparative simulation of crop productivity, soil moisture and nitrate-N leaching losses for intermediate wheatgrass and maize in Minnesota using the DSSAT model. *Front. Sustain. Food Syst*. 7:1010383. doi: 10.3389/fsufs.2023.1010383

Between 2018 and 2023, the perennial cover expanded from 30% of the cropland to 56% within the DWSMA. This perennial cover includes Kernza, perennial grass cover, CRP, pasture, and hay. The estimated average nitrogen loss rate in 2018 was 22.5 pounds of nitrogen/acre. Following the increase in perennial cover the estimated nitrogen loss is 15.2 pounds of nitrogen/acre. This is a 32.4% reduction in estimated nitrogen loss below the cropland rootzone (Table 4a and 4b). See how the reduction percentage was calculated in Figure 4.

22.5 lb N/ac estimated loss rate in 2018
-15.2 lb N/ac estimated loss rate in 2023
7.3 lb N/ac difference
→ 7.3 lb N/ac ÷ 22.5 lb N/ac = 0.324
0.324 x 100 = **32.4 % reduction**

Figure 4. Calculation for the reduction in estimated nitrogen loss below the cropland rootzone between 2018 and 2023.

The list of BMPs published for this DWSMA maintain the current practices already in use including accounting for all sources of nitrogen, crediting previous crops and manure, splitting applications of nitrogen and applying nitrogen to corn at rates at or below the MRTN of the 0.075 ratio range in the University of Minnesota's nitrogen fertilizer application guidelines.

If the recommended nitrogen fertilizer BMPs are adopted and the current perennial cover within the DWSMA is maintained the modeling data reviewed indicates that nitrogen leaching below cropland will be reduced.

MDA Recommended Nitrogen Fertilizer Best Management Practices for the Edgerton DWSMA

In consultation with the local advisory team that includes farmers and agronomists managing cropland within the DWSMA, the MDA has developed the following list of BMPs to protect groundwater. A more detailed list of these BMPs is available on the MDA's Edgerton DWSMA webpage (www.mda.state.mn.us/edgerton-dwsma).

- Maintain the existing perennial cover.
- Apply nitrogen to corn in a corn-soybean rotation at or below the MRTN of the 0.075 ratio range in the University of Minnesota's nitrogen fertilizer application guidelines for dryland corn. (Currently at 150 lbs. N /ac)
- Apply nitrogen to corn in a corn-corn rotation at or below the MRTN of the 0.075 ratio range in the University of Minnesota's nitrogen fertilizer application guidelines for dryland corn. (Currently at 190 lbs. N /ac)
- Account for all nitrogen sources when calculating nitrogen rate.
- Take appropriate credits for legume and manure used in the rotation.
- Split applications of nitrogen fertilizer.
- For all other crops grown within the DWSMA, follow the current University of Minnesota guidance applicable to that crop.

The MDA will conduct an evaluation in this Level 2 DWSMA to determine whether these nitrogen fertilizer BMPs have been implemented on 80% of the cropland, excluding soybeans. The evaluation will occur no sooner than three growing seasons after the BMP list is published.

Conclusion

In the moderate and highly vulnerable portion of the Edgerton DWSMA the MDA has reviewed the cropping history, surveyed nitrogen management practices, and reviewed modeled nitrogen loading estimates below cropland.

The land in perennial cover nearby the city well is owned by the City of Edgerton and conditions of the grant funding used to acquire this 38-acre property require that it is permanently managed to protect groundwater from nitrogen contamination. An additional 126 acres of cropland adjacent to the well is under a 30-year contract to protect groundwater that requires perennial hay to be grown in a rotation that includes zero nitrogen fertilizer. These long-term commitments for groundwater protection combined with an additional 131 cropland acres in pasture, hay, and perennial grass accounts for 56% of the cropland in the moderate and highly vulnerable portion of the Edgerton DWSMA.

Modeling of nitrogen loss below cropland estimates a 32.4% reduction in nitrogen loss by maintaining the perennial cover that has been established and following the MDA recommended Nitrogen Fertilizer Best Management Practices.

If the percentage of perennial cover within the DWSMA were to be reduced from its current level additional review of the appropriate nitrogen fertilizer BMPs for this DWSMA may be needed and a new list of recommended nitrogen fertilizer BMPs. Other examples that could cause such a change include, but are not limited to, changes in the cropping rotations, changes to the MDH groundwater vulnerability designations, and changes to the MDH approved DWSMA boundary.

Based on the understanding and information provided above, the MDA believes that the recommended nitrogen fertilizer BMPs within the moderate and highly vulnerable portion of the Edgerton DWSMA are appropriate and that over time nitrate-nitrogen loss below the cropland rootzone will be reduced following these practices.

Supplemental Data

The following table is supplemental information for the "Edgerton DWSMA Groundwater Protection Rule Summary". The data included below is presented as a graph (Figure 2) in the summary document.

Table 5. Nitrate-nitrogen levels within the Edgerton public well that exceeded 8 mg/L within the past ten years.

Well Number	Collection Date	Nitrogen Test Levels in mg/L
9	5/2/2006	7
9	12/20/2006	7.9
9	4/2/2007	12
9	10/11/2007	11
9	11/8/2007	11
9	3/12/2008	12
9	2/17/2009	12
9	3/10/2009	12
9	4/13/2009	12
9	5/12/2009	11
9	6/16/2009	11
9	7/13/2009	10
9	8/10/2009	9.9
9	9/14/2009	10
9	10/13/2009	9.2
9	11/12/2009	9.5
9	12/7/2009	9.3
9	1/14/2010	9.1
9	2/11/2010	9.1
9	2/27/2013	11
9	6/2/2014	9.7
9	9/15/2014	12
9	6/24/2015	12
9	8/12/2015	12
9	10/6/2015	13
9	12/8/2015	14
9	1/26/2016	13
9	8/29/2016	12
9	9/14/2016	12
9	10/17/2016	12
9	12/19/2016	12
9	3/6/2017	14
9	6/16/2017	13
9	9/13/2017	15
9	12/5/2017	16
9	3/9/2018	18
9	6/13/2018	17
9	9/12/2018	18
9	12/20/2018	20
9	3/4/2019	19
9	6/5/2019	17
9	9/25/2019	19
9	12/10/2019	20
9	3/12/2020	18
9	6/11/2020	15
9	8/18/2020	14
9	9/21/2020	16
9	12/16/2020	15
9	2/25/2021	14
9	3/9/2021	14
9	5/12/2021	14
9	6/9/2021	10
9	9/28/2021	15
9	12/14/2021	13
9	3/8/2022	14
9	6/6/2022	13
9	9/21/2022	12
9	12/20/2022	14
9	3/20/2023	13
9	6/15/2023	12
9	9/13/2023	11
9	12/11/2023	10

Addendum: Updated Corn Nitrogen Fertilizer Rate Guidance

Added 5/15/25

This addendum explains changes to University of Minnesota nitrogen fertilizer rates for corn. Other text in the document has not been edited and reflects the University of Minnesota guidance available at the time this summary was published in October 2024.

In April 2025 the University of Minnesota (UMN) nitrogen rate recommendations for dryland corn were updated. The updated UMN corn nitrogen rate guidance is based on the latest research available in Minnesota. To align with the current guidance, the corn nitrogen rates included in the BMP list published for this DWSMA were updated. The tables below are adapted from the UMN rate guidance released in April 2025 and reflect the new rate guidance to which the BMPs published in this DWSMA will refer.

Guidelines for use of nitrogen fertilizer for corn grown following soybeans when supplemental irrigation is not used.

N Price/Crop Value Ratio	Maximum Return to Nitrogen	Acceptable Range
0.075	155	145-170
0.100	150	135-160
0.125	140	130-155
0.150	135	125-145

Guidelines for use of nitrogen fertilizer for corn grown following corn when supplemental irrigation is not used.

N Price/Crop Value Ratio	Maximum Return to Nitrogen	Acceptable Range
0.075	200	180-220
0.100	185	170-200
0.125	175	160-190
0.150	165	150-175

Adoption of the BMPs can be evaluated no sooner than three growing seasons after the DWSMA BMP list is published. For the Edgerton DWSMA the evaluation could occur as soon as 2027. Following that evaluation, the BMP list for the Edgerton DWSMA may be adjusted considering water quality information, input from the LAT and any new Nitrogen Fertilizer BMP updates from the University of Minnesota.