Agram, Belle Prairie, and Ripley Townships in Morrison County Nitrogen Fertilizer Management Plan Summary

Groundwater, Nitrogen Fertilizer Management, and Nitrogen Loading Analysis

Updated: 12-16-2024

Introduction

This document summarizes the Minnesota Department of Agriculture's (MDA) current understanding of the nitrate-nitrogen levels in domestic (private) wells in Agram, Belle Prairie, and Ripley townships in Morrison County and the MDA's understanding of nitrogen management information. 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.

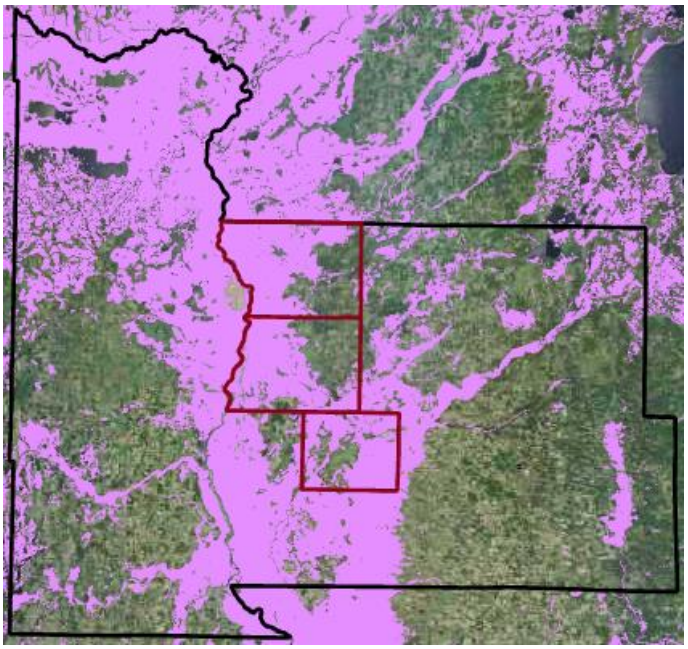

Figure 1 Morrison County, Minnesota coarse-textured soils (in pink). Agram, Belle Prairie, and Ripley townships are outlined in red.

Project Area and Private Well Nitrate-Nitrogen Data

Groundwater protection is fundamental to the Nitrogen Fertilizer Management Plan (NFMP). The NFMP called for an assessment of nitrate conditions at the township scale. Accordingly, the MDA offered nitrate tests to private well owners in 11 townships in Morrison County in 2013-2015. Agram, Belle Prairie, and Ripley townships had at least 10% of samples over the Health Risk Limit (HRL) of 10 mg/L nitrate-nitrogen. This threshold prompted the establishment of a Local Advisory Team made up of farmers, agronomists, and local conservation professionals working within these townships.

Table 1. Final Morrison County Township Testing Private Well Dataset

Township	Number of Wells	Wells ≥ 10 mg/L Nitrate-N Count	Wells ≥ 10 mg/L Nitrate-N Percentage
Agram	93	44	47.3%
Belle Prairie	87	10	11.5%
Bellevue	126	9	7.1%
Buh	44	3	6.8%
Culdrum	55	5	9.1%
Elmdale	131	4	3.1%
Little Falls	266	15	5.6%
Ripley	94	12	12.8%
Swan River	61	5	8.2%
Swanville	44	2	4.5%
Two Rivers	104	10	9.6%
Total	**1105**	**119**	**10.8%**

The land within Agram, Belle Prairie, and Ripley townships includes approximately 38,000 acres of cropland. Approximately 75% of this cropland is on coarse-textured soils. The cropland with coarse-textured soils is made up of 46% loamy sand and 29% sandy loam. The remaining cropland is 13.5% loam soils and 11.5% that are mucky or frequently ponded.

Agram, Belle Prairie, and Ripley Township Land Use

The NFMP designates Mitigation Level 2 for townships that have at least 10% of samples submitted from private wells over the Health Risk Limit (HRL) of 10 mg/L nitrate-nitrogen. Level 2 of the NFMP recommends the formation of a Local Advisory Team (LAT) including local farmers, agronomists, and others to get input on agricultural practices that can reduce nitrate losses below cropland.

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 Agram, Belle Prairie, and Ripley townships shows that the land use is predominately cropland. The data illustrated in Figure 2 is from the February 2022 data release. Additionally, Table 2 shows the average number of acres of the primary crops grown in the three-township area from 2017-2022.

Table 2. Five-Year Cropland Acres

Crop	Acres (5-yr Ave)	% Cropland
Corn	12,663	33.6%
Grass/pasture	9,701	25.8%
Soybeans	4,661	12.4%
Alfalfa	4,225	11.2%
Grass Hay	2,724	7.2%
Edible Beans	1,673	4.4%
Potatoes	988	2.6%
Small Grains	672	1.8%
Other Crops	352	0.9%

The number of acres and percentages are estimates from the USDA's Crop Scape tool. The MDA defines cropland as land used primarily for the production or harvest of annual or perennial field, forage, food, fiber, or energy crops including pasture but excluding forestland. Within the three-township area, the most common annual crops are corn, soybeans, potatoes, and edible beans. In 2017-2022, these crops accounted for 53% of the total cropland. Perennials—pasture, alfalfa, and grass hay—have covered an average of 44% of the cropland over the five-year timeframe.

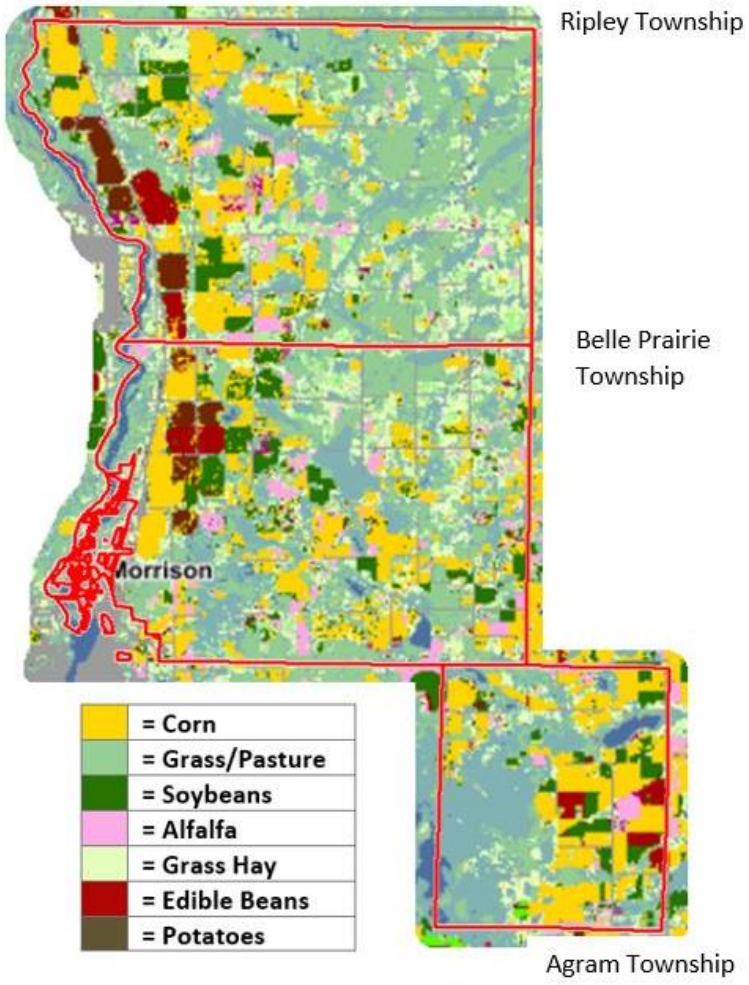

Figure 2. 2022 Cropland in Agram, Belle Prairie, and Ripley townships based on the USDA Cropland Data Layer

The MDA surveyed agronomists and farmers to understand the nitrogen fertilizer management practices used in the three-township area. Having current and accurate nitrogen fertilizer management data is critical to the discussion of BMPs and AMTs. The management information collected includes crop planting, harvest, and nitrogen fertilizer use information.

Nitrogen fertilizer BMPs are widely used within Agram, Belle Prairie, and Ripley townships. Surveys indicate that splitting nitrogen fertilizer applications on corn, edible bean, and potatoes is a common practice. Additionally, accounting for all nitrogen sources, crediting for manure applications and previous crops, and avoiding fall applications of nitrogen fertilizer are practices followed on most of the cropland.

In 2018, the MDA surveyed three fertilizer dealers about nitrogen fertilizer BMP use in Agram, Belle Prairie, and Ripley townships, and dealers provided updated nitrogen rates for corn in a follow-up survey in 2022. Nitrogen rates provided in the 2022 survey are shown in Table 3.

Table 3. 2022 Corn Nitrogen Fertilizer Rates in Agram, Belle Prairie, and Ripley Townships

Crop Rotation	Acres	Percent of Corn Acres	Nitrogen Rate (lbs. N per acre)
Corn following corn-dryland	1,400	10%	160-190
Corn following soybean-dryland	1,240	9%	140-150
Corn following corn-irrigated	1,910	14%	210-245
Corn following soybean-irrigated	1,160	8%	180-220
Corn following other crops	1,500	11%	Unknown
Corn receiving manure	6,565	48%	Unknown

Fertilizer dealers surveyed did not have total nitrogen rate information for corn acres that received manure or followed crops other than corn and soybeans. However, follow-up communication with the Morrison County feedlot officer indicated that most producers applying manure to corn acres within the county are applying nitrogen at the rates listed in the table below.

Table 4. Corn Nitrogen Rates for Acres Receiving a Combination of Manure and Commercial Fertilizer in Morrison County

Crop Rotation	Nitrogen Rate (lbs. N per acre)
Corn following corn-dryland	195
Corn following soybean-dryland	150
Corn following corn-irrigated	235
Corn following soybean-irrigated	205

Nitrate-Nitrogen Loss Below Cropland

Using a crop and soil computer simulation model called the Environmental Policy Integrated Climate model (EPIC) (https://epicapex.tamu.edu/epic/) the MDA has estimated the nitrogen loss below soils and weather conditions that are similar to Agram, Belle Prairie, and Ripley townships. This provides a reference that we can consider here. Based on this model a reduction from 220 lbs. N/acre to 195 lbs. N/acre (currently the high end of the University of Minnesota's 0.10 nitrogen rate range) on irrigated corn following soybean can reduce nitrogen loss by 18% on each acre this rate reduction is adopted. This estimate of nitrogen loss is based on a preplant nitrogen application along with two in-season (split) nitrogen applications. Nitrogen fertilizer dealership survey and review with the local advisory team indicates that this nitrogen application timing is most common for the irrigated corn-soybean rotation acres within these townships.

Based on the same EPIC model, nitrogen leaching estimates for irrigated corn following corn show that a reduction from 245 lbs. N/acre to 225 lbs. N/acre (currently the high end of the University of Minnesota's 0.10 nitrogen rate range) can reduce nitrogen leaching by up to 29% on each acre this change is adopted. This estimate of nitrogen loss is also based on nitrogen application timing that includes a preplant nitrogen application along with two in-season (split) nitrogen applications.

Fertilizer dealerships were able to provide total nitrogen rate information for 41% of the corn acres in these townships. Based on this, the nitrogen rate thresholds listed above would reduce the nitrogen rate applied to 20% of irrigated corn receiving only commercial nitrogen. Follow-up communication with the county feedlot officer provided an estimate of nitrogen rates on the 48% of corn acres that receive manure in these townships (Table 4). Based on this communication, the nitrogen rates in this published list reduce the total nitrogen applied to corn acres receiving manure in these townships. The EPIC model results noted above illustrate the nitrogen loss reduction (18-29%) that reduced nitrogen rates can have.

Currently the common practice within these townships is to apply nitrogen pre plant and twice in-season on irrigated corn acres. Based on EPIC model estimates of nitrogen leaching below similar soils and weather conditions adding a third in-season (split) application of nitrogen while remaining at or below 195 lbs. N/acre for irrigated corn-soybean and 225 lbs. N/acre for irrigated corn-corn could result in an additional 1.4 and 1.6% nitrogen leaching reduction, respectively. Additional split applications of nitrogen in smaller amounts can reduce the risk of loss compared with fewer applications in larger amounts. However, based on this model estimate, the benefit of a third in-season application of nitrogen on irrigated corn may not greatly reduce nitrogen leaching over the long term.

MDA Recommended Nitrogen Fertilizer Best Management Practices for Agram, Belle Prairie, and Ripley Townships

In consultation with the Local Advisory Team that includes farmers and agronomists operating cropland within the Agram, Belle Prairie, and Ripley townships, the MDA has developed the following list of BMPs to protect groundwater.

- Apply nitrogen to irrigated corn in a corn-corn or corn-soybean rotation at or below the high end of the 0.10 nitrogen rate range in the University of Minnesota's nitrogen fertilizer application guidelines.
- Apply nitrogen to dryland corn in a corn-corn or corn-soybean rotation at or below the high end of the 0.10 nitrogen rate range in the University of Minnesota's nitrogen fertilizer application guidelines.
- Account for all nitrogen sources when calculating nitrogen rate.
- Take appropriate credits for previous legume crops and manure used in the crop rotation.
- Split applications of nitrogen fertilizer.
- Use a nitrogen rate for potatoes based on variety, harvest date, and realistic yield goals.

A complete list of the MDA recommended BMPs is available on the Agram, Belle Prairie, and Ripley Townships webpage (www.mda.state.mn.us/agram-belleprairie-ripley-twps)

Alternative Management Tools (AMTs) and Additional Practices for Agram, Belle Prairie, and Ripley Townships

In addition to BMPs, other practices, including AMTs, can be protective of groundwater. The LAT acknowledges that the following list of practices can be protective of groundwater. While BMPs are applicable to most cropland acres, AMTs and some additional practices tend to be less universal but very appropriate in select situations or fields. At a township scale, even small improvements in nitrogen management can reduce nitrogen loss below cropland and over the long term reduce nitrate levels in groundwater. AMTs or additional practices implemented can further reduce nitrogen loss beyond the impact of BMPs alone.

Approved AMTs

- Minnesota Ag Water Quality Certification Program
- Land Conservation Programs
- Increasing Continuous Cover: Perennial Vegetation
- Increasing Continuous Cover: Cover Crops
- On-Farm Nitrogen Rate Trials
- Precision Nitrogen Management
- Intermediate Wheatgrass (Kernza)

In the future AMTs will be added to this approved list and posted on the Approved AMTs webpage (www.mda.state.mn.us/pesticide-fertilizer/approved-amts). Once posted online the new approved AMTs will be applicable in these townships.

Additional practices

- Keep records of nitrogen use, including rates, crediting of nitrogen sources, timing, placement, and source.
- Attend educational activities approved by the MDA.
- Field testing to determine nitrogen requirements for specific crops.
- Test manure using a lab approved or certified by the MDA.

- Test as needed to monitor nitrate-nitrogen concentrations in the groundwater.
- Schedule irrigation according to crop needs (evapotranspiration information) and soil water holding capacity and apply only enough to fill the effective crop root zone to avoid leaching.
- Manage irrigation in a way that there is always some room left in the root zone for possible precipitation.

The local advisory team acknowledged other practices as protective of groundwater. When compared with typical crop rotations, these are practices that would be protective of groundwater.

- Including perennial crops such as alfalfa in crop rotations.
- Growing crops with low nitrogen needs such as small grains and soybeans.

In addition to the items listed above, the MDA acknowledges the prevalence of manure use on the cropland within these townships. Careful manure management is critical to make efficient use of this resource and avoid practices with inherently higher risk of nitrogen loss below the crop root zone. Careful crediting of nitrogen available from manure is fundamental. In addition to crediting, the promotion and support for manure testing, applicator calibration, and improvements to manure application equipment and storage facilities can all improve the crop utilization of nitrogen available from manure and reduce the amount of nitrogen available for loss below the crop root zone.

Conclusion

In Agram, Belle Prairie, and Ripley townships, the MDA has reviewed the cropping history, surveyed nitrogen management practices, and discussed current practices with the LAT. The cropland in perennial cover including grass hay, alfalfa, and pasture accounts for a substantial amount of cropland within the three-township area. In 2017-2022, perennials have accounted for an average of 44% of the cropland. Maintaining and increasing this type of perennial land use is important to minimizing nitrate leaching.

The current University of Minnesota nitrogen fertilizer timing, placement, and product BMPs are already being widely used within Agram, Belle Prairie, and Ripley Townships. Adoption of these BMPs on all cropland acres would have water quality benefits. However, MDA modeling suggests that fine-tuning nitrogen rates can be the most effective practice to reduce nitrate leaching from cropland. Limiting nitrogen rates on corn to the University of Minnesota's 0.10 ratio range would reduce nitrate leaching and have positive water quality impacts. Similarly, the use of precision nitrogen management or on-farm rate trials can help identify the optimal nitrogen rate and protect groundwater.

Alternative management tools have great potential to reduce nitrate leaching losses. The LAT acknowledges the additional groundwater protection AMTs could provide if adopted. Where possible, maintaining or increasing perennial cover is encouraged. Funding to support the adoption of these practices would help increase adoption.

Based on the understanding and information provided above, the MDA believes that the recommended nitrogen management practices within Agram, Belle Prairie, and Ripley Townships are appropriate and that maximizing use of these practices over the long-term will prevent nitrogen loss below cropland from increasing. These recommendations can be found on the Agram, Belle Prairie, and Ripley Townships webpage (www.mda.state.mn.us/agram-belleprairie-ripley-twps). Additionally, further reductions to nitrogen loss are possible with the increased use of alternative management tools where they are practicable and economical. Promotion and additional funding to support the establishment of alternative management tools within the Agram, Belle Prairie, and Ripley Townships is needed to increase their adoption.