

Land Application: Minimum Requirements

Anyone that land applies manure in the State of Minnesota is required to follow the requirements of Minnesota rule ch. 7020 (feedlot rule) in order to protect water quality.

There are also additional requirements associated with land application of manure from feedlots that have a National Pollutant Discharge Elimination System (NPDES) or State Disposal System (SDS) permit. Refer to the [Applying Manure from NPDES or SDS Permitted Feedlots](http://www.pca.state.mn.us/feedlots) fact sheet available at: www.pca.state.mn.us/feedlots for more information.

Manure nutrient testing

- Manure testing is required for facilities or manure storage areas of 100 animal units (AU) or more but is recommend for all sites.
- Manure testing is required annually for three years and can then be reduced to once every four years. Sampling is also required anytime there may be changes in expected manure nutrient content.

A list of manure testing laboratories is available at: <http://www2.mda.state.mn.us/webapp/lis/manurelabs.jsp>.

Table 1. How to take a representative manure sample

Sample source	Sampling method
Liquid tanker or solids spreader	Take sub-samples from many loads and mix in a bucket. Avoid large chunks of manure.
Liquid manure storage structures	Take sub-samples from many depths and locations and mix in a bucket. Avoid sampling the bottom foot, edges, scum, and debris.
Stockpile or manure pack	Take many sub-samples from different depths and locations and mix together in a bucket. Avoid sampling the outer 1 ½ feet.
Scrape and haul	Scrape the floor or lot at many locations and mix together in a bucket. Avoid areas very close to waterers, drains, or feedbunks.
Litter	Take many sub-samples to the depth of the floor throughout the house and mix together in a bucket. Avoid areas very close to feeders or waterers.
Overhead irrigation, traveling gun, or towed hose	Prior to application place many catch pans or buckets in the field, or take many sub-samples at the pump, and mix in together in a bucket.

More information: <https://extension.umn.edu/manure-management/manure-sampling-and-nutrient-analysis>

Future changes

The University of Minnesota has undertaken an effort to update its guidance for calculating the amount of nitrogen available from manure. While that process is not yet complete, the MPCAs Nutrient Management Tool was built to accommodate the anticipated changes, which includes testing for organic and inorganic fractions of manure. If not tested, an estimate of inorganic nitrogen content can be calculated by multiplying the total nitrogen content of manure by the percentage found in Table 2.

Table 2. Estimated inorganic nitrogen content

Animal species	Inorganic N (% of total N)	
	Solid	Liquid
Beef	10%	62%
Dairy	18%	50%
Swine	62%	69%
Poultry	20%	73%
Horse	0%	62%
Sheep	22%	62%

Nitrogen management

Wherever manure is applied, application rates must be limited so that the estimated plant-available nitrogen (N) from **all N sources** does not exceed the expected crop N needs for non-legume crops or the expected N removal for legume crops. Potential sources of N include:

- Commercial fertilizer (including starter)
- Manure applied during the current crop year
- Manure applied during the previous crop year
- Irrigation water
- Legumes grown during previous years

Determinations of crop N needs, removal rates, and the amount of N available from manure or legumes must be based on published recommendations of the University of Minnesota (U of M) Extension Service. The most current U of M recommendations for manure can be found on their website:

<https://extension.umn.edu/manure-management/manure-application-rates>.

Table 3. U of M recommendations for manure application to non-irrigated corn (as of September 2024)

Crop prior to corn	Crop 2 years prior to corn	Maximum plant available N to apply (lbs/acre) ^a
Corn (or other non-legume crop)	Not applicable	195
Corn	Alfalfa (1-year-old stand)	120
Corn	Alfalfa (>2-year-old stand)	80
Soybean	Not applicable	150
Alfalfa (1-year-old stand)	Not applicable	80
Alfalfa (>2-year-old stand)	Not applicable	40

- a. Some fields can achieve highly productive and profitable yields by applying N at rates below the maximum N allowed or by using best management practices (BMPs) for improved N utilization. More info about these BMPs can be found at: <https://www.mda.state.mn.us/pesticide-fertilizer/nitrogen-fertilizer-bmps-agricultural-lands>.

The feedlot rule allows for deviations above the U of M recommendations in limited situations.

- N deficiencies are measured/observed during the growing season and N can be side-dressed.
- The results of a soil nitrate test suggests additional N is recommended.
- Recommendations from a land grant college in a contiguous state with similar soils and climatic conditions suggest a higher rate of N application.

The allowable deviations are not intended for application of N at rates greater than the U of M recommendations as a standard practice. If you believe a deviation is warranted, you should document your justification for the additional N application as part of your land application of manure records.

Choosing the appropriate nitrogen recommendation

Some fields can achieve highly productive and profitable yields by applying N at rates below the maximum University of Minnesota recommendations.

- Fields with low organic matter (3% or less) or poor drainage have less response to N.
- Yields in northern Minnesota might be lowered by a shorter growing season.
- Farms in southeast Minnesota with loess soils may be able to maximize yield with lower rates of N.

The University of Minnesota has produced various documents that outline BMPs for improved nitrogen utilization that give you best chance to grow a profitable crop while limiting N loss to the environment. Links to these BMP documents can be found on the Minnesota Department of Agriculture's [Nitrogen Fertilizer BMPs](#) webpage. In addition, anyone that applies manure from a NPDES or SDS permitted site is required to comply with the nitrogen BMPs and other land application requirements of those permits.

Nitrogen supplied by manure

Nitrogen in manure is found in two primary forms, organic and inorganic. The inorganic portion of manure is readily available for plant uptake while the organic portion is converted over time to a plant available form through natural processes in the soil. For example, manure applied in the fall of 2024 will not only provide nitrogen to a corn crop planted in the spring of 2025 (first-year) but also the crop to be grown in 2026 (second-year). To calculate the plant available nitrogen in the manure, multiply the total nitrogen content of the manure by the percent available for the appropriate species and year (table 4).

Example: Nitrogen from sweep injected swine manure with a total N test of 50 lbs/1,000 gal is 80% available in the first-year (40 lbs/1,000 gal) and 15% available in the second-year (7.5 lbs/1,000 gal).

Table 4. Nitrogen availability (%) as affected by method of manure application and animal species.

Year available	% of total nitrogen available per year						
	Broadcast incorporation timing ¹				Injection		
	None to 96 hrs	12 to 96 hrs	Within 12 hrs	Double disks	Sweep	Knife	Coulter
Beef							
Year 1	25%	45%	60%	60%	60%	50%	50%
Year 2	25%	25%	25%	25%	25%	25%	25%
Dairy, Horse, Sheep							
Year 1	20%	40%	55%	55%	55%	50%	50%
Year 2	25%	25%	25%	25%	25%	25%	25%
Swine							
Year 1	35%	55%	75%	75%	80%	70%	70%
Year 2	15%	15%	15%	15%	15%	15%	15%
Poultry							
Year 1	45%	55%	70%	70%	70%	70%	70%
Year 2	25%	25%	25%	25%	25%	25%	25%

1. Timing categories refer to the length of time between manure application and incorporation.

Phosphorus management

In addition to the nitrogen requirements, anyone applying manure from a feedlot or manure storage area with 300 or more AU must comply with phosphorus (P) requirements as well.

For land receiving manure from a facility with 300 or more AU, soil samples from the upper six inches must be collected at least once every four years and analyzed for P using the Bray P1 or Olsen test.

Laboratories certified by the MDA must be used. A list of laboratories providing soil testing services is available at: <http://www2.mda.state.mn.us/webapp/lis/manurelabs.jsp>.

Table 5. Phosphorus management requirements^a

Bray P1 (ppm)	< 22	22-75	76-150	> 150
Olsen (ppm)	< 17	17-60	61-120	> 120
More than 300 ft to waters ^b	No requirements	No requirements	No requirements	Permit required
Within 300 ft of waters ^b	No requirements	Prevent long-term Soil P build-up ^a	Permit required Prevent long-term Soil P build-up	Permit required Prevent long-term Soil P build-up

a Requirements do not apply if a vegetative buffer is maintained as outlined in Table 7.

b Lakes, rivers, streams, intermittent streams, protected wetlands, or unbermed drainage ditches. Also includes tile intakes when soil P levels are above 75 Bray (60 Olsen).

Preventing long-term soil P build-up

It is a common occurrence that manure application intended to satisfy the nitrogen needs of a crop will provide more phosphorus than that crop needs. To prevent long-term soil P build-up you will need to balance your phosphorus applications with the amount of P removed by the crops over a six year period.

Below are the steps to determine if you will build soil P long-term.

Step 1 Determine P uptake by crops.

- For each crop during the 6 year period, multiply crop yields by P removal values found in Table 6.
 - Ex: 45 bu Soybeans - $[45 * 0.82] = 37$ lbs P removed per year
- Sum all 6 years to get the total P removed by the crops over 6 years.

Step 2 Determine the amount of P that is applied from manure.

- For each manure application during the 6 year period, multiply the application rate by the manure test value. 80% of the resulting value is available to the crop.
 - Ex: 4000 gals/acre * 35 lbs P/1000 gals * 0.8 (availability factor) = 112 lbs P applied
- Sum all 6 years to get the total P from manure applied over 6 years.

Step 3 Determine the amount of P that is applied from commercial fertilizer.

- Sum all fertilizer P applied to the crops over the 6 years (include starter fertilizers).

Step 4 Compare P Removed vs P applied

- If the result of step 1 is greater than the sum of step 2 and 3, soil P is not considered to be building.
- If the result of step 1 is less than the sum of step 2 and 3, you will need to adjust your management of soil P. This may include applying manure at a lower rate and supplementing with commercial nitrogen only or revising your current commercial fertilizer applications to provide less P.

Table 6. P removal of common crops in Minnesota (U of M and NRCS crop nutrient data base)

Crop	Yield units	P removal (lb/unit)
Alfalfa	ton	10.8
Alsike Clover	ton	11
Barley	bu	0.41
Barley with straw removal	bu	0.55
Birdsfoot Trefoil	ton	11
Buckwheat	lb	0.25
Buckwheat with straw removal	lb	1.95
Canola	cwt	1.3
Corn-Field	bu	0.34
Corn-Silage	ton	3.8
Corn-Sweet	ton	11.0
Edible Beans	lb	0.01
Hay-Grass	ton	8.9
Hay-Legume-Grass	ton	11.2
Millet	lb	0.4
Oats	bu	0.25

Crop	Yield units	P removal (lb/unit)
Oats with straw removal	bu	0.32
Peas	lb	0.01
Potatoes	cwt	0.14
Radish	ton	0
Red Clover	ton	10.8
Rye	bu	0.44
Rye-Forage	ton	12
Rye with straw removal	bu	0.59
Sorghum	ton	9.5
Soybeans	bu	0.82
Sudan	ton	9.5
Sugarbeets	ton	0.73
Sunflowers	lb	0.01
Triticale	ton	0
Wheat	bu	0.53
Wheat with straw removal	bu	0.64

Manure application setbacks

Wherever manure is applied the following setbacks must be observed.

Table 7. Manure application setbacks

Sensitive area	No incorporation or incorporation after 24 hours	Injection or incorporation within 24 hours	Permanent vegetated buffer ^d
Lake or stream	300 ft	25 ft ^c	100 ft
Intermittent stream ^a , public waters wetland ^b , or drainage ditch without berms	300 ft	25 ft ^c	50 ft
Open tile intake	300 ft	0 ft	35 ft
Well, mine, or quarry	50 ft	50 ft	50 ft
Sinkhole without diversion berm	Downslope 50 ft Upslope 300 ft	50 ft	Downslope 50 ft Upslope 300 ft

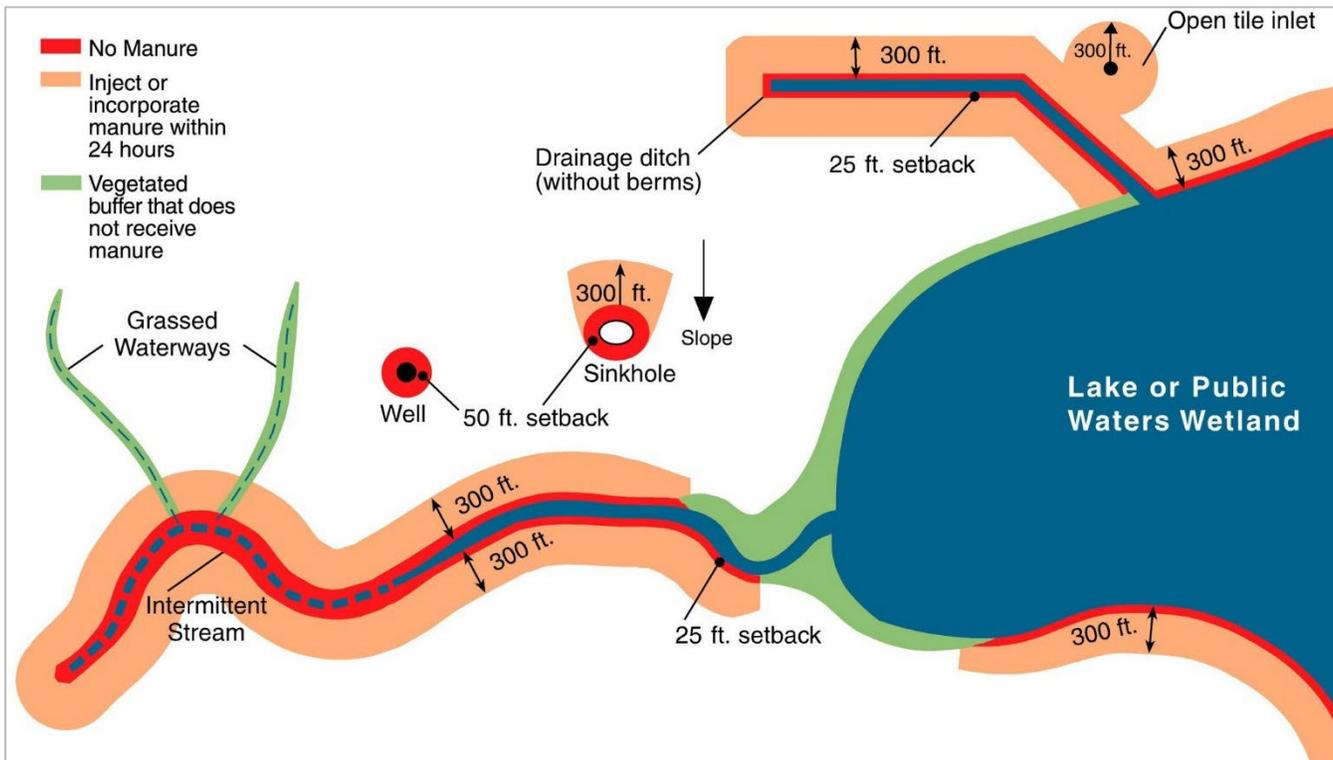
- a As identified on the United States Geological Survey (USGS) quadrangle maps – except those managed as a grassed waterway
- b As identified on the Department of Natural Resources (DNR) protected waters maps – generally all wetlands over 10 acres.
- c Increased to 300ft if soil test values are greater than 21 ppm Bray or 16 ppm Olsen and long-term Soil P build-up is not prevented. (see phosphorus management section for more information)
- d No manure can be applied to the vegetative buffer.

In addition, manure application directly into road ditches is prohibited. Also, there are no specific setbacks applicable for manure application to floodplains, shoreland areas, or steeply sloping fields; however, applications can lead to pollution issues if manure is applied shortly before a rainfall or spring flooding event.

There are no setbacks to cities, residences, churches, cemeteries, etc. in the state feedlot rule. Some counties may have setbacks to these features and may also have more restrictive setbacks than the state feedlot rules.

More information about setbacks can be found in the publication [Applying Manure in Sensitive Areas](#) available on the MPCA website.

Figure 1. Manure application setbacks (graphical representation)



Manure management plans (MMP)

A MMP looks into the future to identify the location and rate for manure applications. A feedlot owner should plan one crop year ahead. For example, during the 2024-2025 crop year a MMP would be developed for the 2025-2026 crop year. A MMP illustrates how manure is going to be utilized during the upcoming cropping year to maximize the nutrients from manure and yet protect surface and groundwater resources. MMPs are encouraged for all feedlots but are required for:

- Any facility with a NPDES or SDS permit.
- Any facility of 300 or more AU applying for a construction short form (CSF) permit.
- Any facility of 100 or more AU applying for an Interim permit.
- Any facility of 300 or more AU where manure is not applied by a licensed commercial animal waste technician (CAWT).

The Nutrient Management Tool is a free online program to assist in the MMP development process. Any registered feedlot can access the tool at: www.pca.state.mn.us/business-with-us/land-application-of-manure. Any permit application to the MPCA must include an MMP created by using the Nutrient Management Tool.

Land application records

Land application records document the manure application activities taking place in the current crop year and those that happened in previous crop years. Information from the records is used to calculate the amount of nitrogen from manure application that will be available for the crop grown the following year.

Land application records are required to be kept by:

- Any feedlot with 100 or more animal units (AU).
- Anyone that receives and land applies manure from a feedlot with 100 or more AU.

Forms to assist with recordkeeping can be found at: www.pca.state.mn.us/business-with-us/land-application-of-manure. Records can also be kept within the Nutrient Management Tool.

Historical records must be kept for at least 3 years. This timeframe is extended to 6 years when manure is applied in a sensitive area or for feedlot facilities that have NPDES or SDS permit coverage.

Transferred ownership of manure

When manure ownership is transferred to a third party for land application there are less planning and record keeping requirements. Manure ownership is transferred when both of the following conditions are met:

- The feedlot owner* does not own, lease, or rent the land used for manure application.
- The feedlot owner*, or employee under the direction of the feedlot owner, does not control the crop and nutrient planning decisions of land used for manure application.

*Feedlot owner includes the feedlot operator or a member of the feedlot ownership entity (Inc., LLP, LLLP, etc).

A feedlot owner that transfers ownership of manure completes a less rigorous MMP. The form for this MMP is available at: www.pca.state.mn.us/sites/default/files/wq-f8-12.docx or can be completed using the Nutrient Management Tool. Manure recipients must follow the MMP of the feedlot where the manure was generated.

Manure recipients must keep the same records that would be required of a feedlot owner that did not transfer manure ownership. Refer to the land application records section of this factsheet for more information.

The manure recipient must also report back to the feedlot owner the location, rate, and method of application. A form to assist with this recordkeeping is available at: www.pca.state.mn.us/sites/default/files/wq-f6-43.docx. A Manure Transfer Tracking form from the Nutrient Management Tool is another option for this recordkeeping.

More information

For more information visit: www.pca.state.mn.us/business-with-us/land-application-of-manure.