

**APPENDIX H**  
**A Method to Determine Manure Application Rates**  
**(Adapted from MWPS-18, Livestock Waste Facilities Handbook)**

\* Please note this methodology takes into account residual nitrogen in the soil from manure applications for the three previous years.

**Section A. Manure Composition and Soil Information**

**1. Manure composition:**

a. Values from chemical analysis of manure.

Composition		Your Farm
Laboratory data are often given in ppm. To convert ppm to percent, divide by 10,000. If composition data are not available, use Table H.1 or H.2.	Total N	_____ %
	Ammonium N	_____ %
	Nitrate N	_____ %
	P <sub>2</sub> O <sub>5</sub>	_____ %
	K <sub>2</sub> O	_____ %

b. Determine the amount of each nutrient per ton of solid manure or per 1,000 gal. of liquid manure. If nutrient contents are given in percent:

! % nutrient in manure x 20 = lb nutrients/ton; or,

! % nutrient in manure x 100 = lb nutrients/1,000 gal. (e.g., 0.5% Total N = 10 lb/ton or 42.5 lb/1,000 gal.).

Composition	Example (Table H.2)	Your Farm
Total N	36 lb/ 1,000 gal.	_____ lb/ _____
Ammonium N*	26 lb/ 1,000 gal.	_____ lb/ _____
Nitrate N*	-- lb/ --	_____ lb/ _____
P <sub>2</sub> O <sub>5</sub>	27 lb/ 1,000 gal.	_____ lb/ _____
K <sub>2</sub> O	22 lb/ 1,000 gal.	_____ lb/ _____

\* If only total N is determined, assume 50% ammonium N and 5% nitrate N.

N.B. Figures in Section A.1.b needs to be consistent with what's in Table H2. Also Section B - "Nutrient Needs of Crop" needs to have figures consistent with Table H.4.

N.B. Original report Tables J1 - J4 should be I.1 - I.4.

2. Soil information:

Soil Information	Example	Your Soil
Texture	<u>Sandy loam</u>	_____
Soil pH	<u>6.2</u>	_____
Available P	- _____ lb/acre	_____ lb/acre
Exchangeable K	- _____ lb/acre	_____ lb/acre

**Section B. Nutrient Needs of Crop**

	Example	Your Crop
Crop to be grown	<u>Timothy</u>	_____
Expected yield/acre	<u>2.5 T</u>	_____
Nutrients required/acre (based on soil test report or Table H.4)	N = <u>100</u> lb/acre P <sub>2</sub> O <sub>5</sub> = <u>55</u> lb/acre K <sub>2</sub> O = <u>250</u> lb/acre	_____ lb/acre _____ lb/acre _____ lb/acre

**Section C. Annual Rate of Manure Application**

1. Calculate amount of organic N in manure (either per ton or per 1,000 gal):

$$\text{lb total N} - (\text{lb ammonium N} + \text{lb nitrate N}) = \text{lb organic N}$$

Example:

$$\underline{36} - (\underline{26} + \underline{\quad}) = \underline{10} \text{ lb organic N/1,000 gal.}$$

Your manure:

$$\underline{\quad} - (\underline{\quad} + \underline{\quad}) = \underline{\quad} \text{ lb organic N/}\underline{\quad}$$

2. Calculate amount of organic N in manure made available the first year.

$$\text{lb organic N/(ton or 1,000 gal)} \times \text{mineralization factor (Table J.3)} = \text{lb available organic N/(ton or 1,000 gal)}$$

Example:

$$\underline{10} \times \underline{0.35} + \underline{3.5} \text{ lb available organic N/}\underline{1,000 \text{ gal.}}$$

Your farm:

$$\underline{\quad} \times \underline{\quad} = \underline{\quad} \text{ lb available organic N/}\underline{\quad}$$

**3. Calculate amount of plant-available N in manure (use either a or b below).**

- a. Incorporated application of manure (assume 25% of ammonium N is lost by identification if knifed-in; assume no loss if immediately incorporated by other methods):

Available organic N (sec C.2) + [Ammonium N (Sec A.1.b) x 0.75] + Nitrate N (Sec A.1.b) = lb plant - available N/(ton or 1,000 gal)

Example:

$$\underline{3.5} + [\underline{26} \times 0.75] + \underline{-} = \underline{23} \text{ lb available N/1,000 gal.}$$

Your farm:

$$\underline{\quad} + [\underline{\quad} \times 0.75] + \underline{\quad} = \underline{\quad} \text{ lb available N/}\underline{\quad}$$

- b. Surface application of manure (assumes 50% of ammonium N is lost by ammonia volatilization):

Available organic N (Sec C.2) + [Ammonium N (Sec A.1.b) x 0.50] + Nitrate N (Sec A.1.b) = lb plant-available N/(ton or 1,000 gal)

Your farm:

$$\underline{\quad} + [\underline{\quad} \times 0.50] + \underline{\quad} = \underline{\quad} \text{ lb available N/}\underline{\quad}$$

**4. Adjust N fertilizer recommendation to account for residual N from manure applications in the last 3 years.**

- a. Manure applied to field 1 year ago (if none, proceed to b):

lb organic N/(ton or 1,000 gal) of manure x (mineralization factor x 0.50) x tons or 1,000 gals applied/acre = lb residual N/acre

Example:

$$\underline{10 \text{ lb/1,000 gal}} \times (\underline{0.35} \times 0.50) \times \underline{6,000} = \underline{10.5} \text{ lb residual N/acre}$$

Your farm:

$$\underline{\quad} \times (\underline{\quad} \times 0.50) \times \underline{\quad} = \underline{\quad} \text{ lb residual N/acre}$$

- b. Manure applied to field 2 years ago (if none, proceed to c.):

lb organic N/(ton or 1,000 gal) or manure x (mineralization factor x 0.25) x tons

or 1,000 gal applied/acre = lb residual N/acre

Your farm:

\_\_\_\_\_ x (\_\_\_\_\_ x 0.25) x \_\_\_\_\_ = \_\_\_\_\_ lb residual N/acre

c. Manure applied 3 years ago (if none, proceed to d.):

lb N/(ton or 1,000 gal) of manure x (mineralization factor x 0.125) x tons or 1,000 gal applied/acre = lb residual N/acre

Your farm:

\_\_\_\_\_ x (\_\_\_\_\_ x 0.125) x \_\_\_\_\_ = \_\_\_\_\_ lb residual N/acre

d. Total residual N:

Sec C.4.a + Sec C.4.b + Sec C.4.c = total lb residual N/acre

Example:

10.5 + - + - = 10.5 total lb residual N/acre

Your farm:

\_\_\_\_\_ + \_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ total lb residual N/acre

e. Adjust N requirement of crop:

lb N required by crop (Sec B) - lb residual N (Sec C.4.d) = lb N required/acre

Example:

100 - 10.5 = 89.5 lb N required/acre

Your farm:

\_\_\_\_\_ - \_\_\_\_\_ = \_\_\_\_\_ lb N required/acre

**5. Annual manure applications based on amount of N required by crop:**

Adjusted N required (Sec C.4.e) ÷ lb available N/(ton or 1,000 gal) (Sec C.3.a or C.3.b)  
= tons of manure/acre or number of 1,000 gal units of manure/acre

Example:

$$\underline{89.5} \div \underline{23} = \underline{3.891} \text{ tons of manure/ac or 1,000 gal units of manure/ac}$$

Your farm:

$$\underline{\quad} \div \underline{\quad} = \underline{\quad} \text{ tons of manure/ac or 1,000 gal units of manure/ac}$$

**6. Annual manure application based on amount of P<sub>2</sub>O<sub>5</sub> required by crop:**

P<sub>2</sub>O<sub>5</sub> required by crop (Sec B) ÷ lb P<sub>2</sub>O<sub>5</sub>/(ton or 1,000 gal) (Sec A.1.b) = tons manure/acre or number of 1,000 gal units of manure/acre

Example:

$$\underline{55} \div \underline{27/\text{lb}/1,000 \text{ gal}} = \underline{2.037} \text{ tons of manure/ac or 1,000 gal units of manure/ac}$$

Your farm:

$$\underline{\quad} \div \underline{\quad} = \underline{\quad} \text{ tons of manure/ac or 1,000 gal units of manure/ac}$$

**7. Select annual rate of manure to be applied. If manure is to supply all N and P<sub>2</sub>O<sub>5</sub> needs of the crop, select the HIGHER of the two values (Sec C.5 or Sec C.6) as your application rate per acre. If your aim is to maximize use of nutrients in animal manure, select the LOWER of the two values, then supplement with commercial fertilizer to supply the remainder of the nutrients required by the crop.**

Rate of manure to be applied is:

Example:

$$\underline{2.037} \text{ tons of manure/acre}$$

Your farm:

$$\underline{\quad} \text{ tons of manure/acre}$$

**Section D. Additional Fertilizer Required**

**1. Nitrogen (do not complete if manure rate selected in Sec C.7 supplies all of the required N).**

a. Available N added in manure:

$$\text{Tons or 1,000 gal units of manure added/acre (Sec C.7) x lb available N/(ton or 1,000}$$

gal) (Sec C.3.a or C.3.b) = lb available N applied

Example:

$$\underline{2.037} \times \underline{23 \text{ lb/1,000 gal}} = \underline{46.9 \text{ lb}} \text{ available N applied}$$

Your farm:

$$\underline{\quad} \times \underline{\quad} = \underline{\quad} \text{ available N applied}$$

b. Additional fertilizer N required:

Adjusted N requirement (Sec C.4.e) - lb N applied (D.1.a) = lb fertilizer N required

Example:

$$\underline{89.5} - \underline{46.9} = \underline{42.6} \text{ lb fertilizer N}$$

Your farm:

$$\underline{\quad} - \underline{\quad} = \underline{\quad} \text{ lb fertilizer N}$$

**2. Phosphorus (do not complete if manure rate selected in Sec C.7 supplies all of the required amount of P<sub>2</sub>O<sub>5</sub> added in manure:**

Tons or 1,000 gal units of manure/acre (Sec C.7) x lb P<sub>2</sub>O<sub>5</sub>/(ton or 1,000 gal) (Sec A.1.b)  
= lb P<sub>2</sub>O<sub>5</sub> applied

Your farm:

$$\underline{\quad} \times \underline{\quad} = \underline{\quad} \text{ lb P}_2\text{O}_5 \text{ applied}$$

b. Additional fertilizer P<sub>2</sub>O<sub>5</sub> required:

P<sub>2</sub>O<sub>5</sub> required by crop (Sec B) – lb P<sub>2</sub>O<sub>5</sub> applied (Sec D.2.a) = lb fertilizer P<sub>2</sub>O<sub>5</sub> required

Your farm:

$$\underline{\quad} - \underline{\quad} = \underline{\quad} \text{ lb fertilizer P}_2\text{O}_5 \text{ required}$$

**3. Potassium:**

a. K<sub>2</sub>O added in manure:

Tons or 1,000 gal units of manure/acre (Sec C.7) x lb K<sub>2</sub>O/(ton or 1,000 gal) (Sec A.1.b)  
= lb K<sub>2</sub>O applied

Example:

$$\underline{2.037} \times \underline{22 \text{ lb}/1,000} = \underline{44.8} \text{ lb K}_2\text{O added}$$

Your farm:

$$\underline{\quad} \times \underline{\quad} = \underline{\quad} \text{ lb K}_2\text{O added}$$

b. Additional K<sub>2</sub>O required:

$$\text{K}_2\text{O required by crop (Sec B)} - \text{lb K}_2\text{O applied (Sec D.3.a)} = \text{lb fertilizer K}_2\text{O required}$$

Example:

$$\underline{250} - \underline{44.8} = \underline{205.2} \text{ lb fertilizer K}_2\text{O required}$$

Your farm:

$$\underline{\quad} - \underline{\quad} = \underline{\quad} \text{ lb fertilizer K}_2\text{O required}$$

**TABLE H.1**

**Nutrients in Solid Manure at the Time of Land Application**

Species	Bedding or Litter	Dry Matter	Ammonium N	Total N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
		%	lb/ton manure			
Poultry	No	45	26	33	48	34
	Yes	75	36	56	45	34
	Deep Pit	76	44	68	64	45
Turkey	No	22	17	27	20	17
	Yes	29	13	20	16	13

Source: MWPS-18, Livestock Waste Facilities Handbook.

**TABLE H.2**

**Nutrients in Liquid Manure at the Time of Land Application**

Species	Waste Handling	Dry Matter	Ammonium N	Total N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
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		<b>%</b>	<b>lb/ton manure</b>			
Poultry	Liquid Pit	13	64	80	36	96

Source: MWPS-18, Livestock Waste Facilities Handbook.

**TABLE H.3**

**Amount of Nitrogen Mineralized or Released from  
Organic Nitrogen Forms in Manure to Plant Available  
Forms During the Growing Season**

<b>Manure Type</b>	<b>Manure Handling</b>	<b>Mineralization Factor</b>
Poultry	Deep pit	0.45
	Solid with litter	0.30
	Solid without litter	0.35

**TABLE H.4**

**Estimated Removal of Plant Nutrients By Various Crops**



Crop	D.M. Yield (t/ha)	Kilograms per hectare				
		Nitrogen N	Phosphorus P <sub>2</sub> O <sub>5</sub>	Potassium K <sub>2</sub> O	Calcium Ca	Magnesium Mg
Oat Grain	3.1	56	22	17	3	4
Oat Straw	4.5	28	11	67	9	10
Barley Grain	3.2	56	28	17	2	3
Barley Straw	3.4	22	11	50	13	3
Wheat Grain	2.7	56	28	17	1	7
Wheat Straw	3.4	22	5	39	7	3
Corn Silage	12.3	112	56	151	12	21
Alfalfa Hay	8.9	213	50	275	132	27
Timothy Hay	8.9	151	39	163	20	11
Red Clover Hay	8.9	168	39	179	121	29

Source: Atlantic Provinces Field Crop Guide.