ILLINOIS Extension

Certified Livestock Manager Training Workshop

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Handout and worksheets can be downloaded from:

go.illinois.edu/CLMT

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Illinois Animal Units Worksheet

Species	Production Phase	Facility Design Capacity (head)	AU Multiplier	Subtotals
Dairy	Milk cows		x 1.4	
	Heifers, calves		x 0.6	
Beef	Feeder, cows		x 1.0	
Swine	Pigs **under** 55 lbs		x 0.03	
	Pigs **over** 55 lbs		x 0.4	
Turkeys			x 0.02	
Laying hens or broilers (facilities with continuous overflow watering)			x 0.01	
Laying hens or broilers (facilities with a liquid manure handling system)			x 0.03	
Laying hens or broilers (other manure handling systems)			x 0.005	
Ducks			x 0.02	
Horses			x 2.0	
Sheep, lambs, goats			x 0.1	
			Total _____	

Illinois EPA CAFO Designation

Animal Type[1]	CAFO Designation (defined by number of animals)		
	Small[2]	Medium[3]	Large[4]
Mature Dairy Cows	< 200	200-699	≥ 700
Veal Calves	< 300	300-999	≥ 1,000
Cattle (all other types)	< 300	300-999	≥ 1,000
Swine >55 lbs	< 750	750-2,499	≥ 2,500
Swine <55 lbs	< 3,000	3,000-9,999	≥ 10,000
Turkeys	< 16,500	16,500-54,999	≥ 55,000
Laying Hens & Broilers	< 9,000	9,000-29,999	≥ 30,000

[1] Partial list taken from Illinois Administrative Code 35 Subtitle E Chapter I Part 502 Sections 103-106.

[2] Small CAFO facility designation is based on animal numbers AND whether there is a discharge AND if it is designated a Small CAFO by the IEPA (Section 502.105)

[3] Medium CAFO facility designation is based on animal numbers AND whether there is a discharge OR if it is designated a Medium CAFO by the IEPA (Section 502.104)

[4] Large CAFO designation based solely on animal numbers (Section 502.103)

What To Do In The Event Of A Livestock Manure Release

1) **Stop the spill** immediately! Do whatever is necessary or available to stop further flow of manure as soon as possible.

2) **Contain the spill** next, this should be your major effort, especially to keep it from entering surface water or other environmentally sensitive areas. Creating a liquid manure "pond" in a field can be a good short term option. Don't forget to close any tile inlets or block tile outlets in the vicinity.

3.) **Assess the extent of the spill** and note any obvious damages.

Did the manure reach any surface waters?
Approximately how much was released and for what duration?
Any damage noted, such as human injury, fish kills, or property damage?

4.) **Contact** appropriate agencies.

In Illinois, the Illinois Emergency Management Agency is the primary contact if the spill leaves your property or enters waters of the state. **IEMA Phone in Illinois call (800) 782-7860. Outside of Illinois call (217) 782-7860 - 24 hours per day, seven days a week.**

Also contact your IL EPA Regional Ag Engineer – found at this site: www.epa.state.il.us/water/cafo/regions/index.html

Name _____ Phone _____

IEMA will notify the Illinois Environmental Protection Agency and the Illinois Department of Agriculture. Your phone call should be made within 24 hours **(immediately if release is to waters of the State**) and include:

- your name
- facility name
- telephone number
- the details of the incident (realistic amount of gallons involved)
- the exact location of the facility and/or spill
- the location and direction of movement of the spill
- weather and wind conditions (i.e. rain forecast, pre-spill and post-spill)
- what corrective measures have been taken
- the seriousness of the situation (threat to surface or ground water, spill under control, need for assistance).

For other contacts, see the Emergency Phone Number list.

5) **Start cleanup activities, even if state or federal agency staff has not arrived on the scene. DO NOT WAIT!!!**

- As soon as possible begin clean-up procedures
- Notify agencies and local authorities, including the local county public health department and appropriate public/private water supplies.
- Attempt application of spilled manure onto cropland
- Assess environmental impact of fish kill, surface water pollution, well or groundwater impact, and amount of manure released and for what duration.

What To Do In The Event Of A Livestock Manure Release

6) A **written report** (form optional) to the Illinois EPA confirming the information provided by telephone **is required within 5 days** after discovery of the release. An example form from IEPA: http://www.epa.state.il.us/water/watershed/forms/livestock-waste.pdf

Attach additional pages if more space is required to answer questions.

Send Written Reports to:
Illinois EPA Bureau of Water, Compliance Assurance Section
P.O. Box 19276 Springfield, IL 62794-9276
Send Faxes to: (217) 557-1407

All responses to emergencies should be documented and kept with your manure management plan as required in the Livestock Facilities Management Act, and Illinois EPA NPDES General Permit. This documentation should include all agency and local authority contacts made during the response phase. This information can be used to assess response to the emergency, prepare for future problems, and train employees.

7.) Implement procedures to prevent similar occurrences, seek professional assistance if problem is an earthen berm or structurally-related.

The State of Illinois requires an owner or operator of a livestock "waste" handling facility to report any release of 25 gallons or more of "livestock waste" within 24 hours after discovery of the release into the environment. This reporting requirement includes releases from livestock "waste" handling facilities and releases from the transportation of livestock "waste."

Releases of any quantity that enter surface waters (including releases to sinkholes, drain inlets, broken subsurface drains or other conduits to groundwater or surface water) must be reported immediately, except when immediate notification would impede the owner's or operator's efforts to correct the cause of the release or contain the livestock "waste." In such cases, the report must be made as soon as possible, but no later than 24 hours after discovery. In addition to the reporting requirement, **the owner or operator is responsible for correcting the cause** of the release as soon as possible in order to minimize environmental damage.

The reporting requirement applies to manure storage, handling facilities, piping, pumps, and transportation equipment. Reporting is not required for releases of less than 25 gallons, provided no quantity is released to waters of the state, or from a controlled and recovered release during field application. A release does not include the normal application of livestock manure to cropland at established agronomic rates.

Failure to report a release could result in fines of up to $1,000 for the first violation, $2,500 for a second violation, and up to $5,000 for a third or subsequent violations. Any environmental damage resulting from the release (such as a fish kill) may subject the owner or operator to additional fines and require him/her to reimburse the state for the value of the damage.

Inquiries concerning the release reporting requirements may be directed to:
Illinois EPA, Bureau of Water, Field Operations Section, (217) 782-3362.

Winter Manure Spreading in Illinois – EPA CAFO Rules

The most challenging time to avoid a discharge from land application of manure is during winter months when the ground is frozen and may have snow or ice cover. The best advice for all livestock farms, and especially for Large CAFOs, is to have enough manure storage capacity so that no winter manure spreading (defined as winter months when manure cannot be soil injected or incorporated) is necessary.

Chronic weather conditions, emergencies such as a major water leak into a pit, and other unforeseen events may force a producer to land apply manure in winter. Even in these difficult circumstances, the Agricultural Stormwater Exemption for unpermitted Large CAFOs may be claimed if a discharge occurs after winter land application. But, eligibility for the Exemption is NOT automatic. Rules regarding Agricultural Stormwater Discharge after manure application are explained in Illinois Administrative Code Title 35 Subtitle E, Chapter I, Part **502.102**. Here are the steps that must be taken to make such a claim:

1. Have and use a nutrient management plan. See **502.510 (b)** for unpermitted Large CAFOs.
2. A compliant winter manure application plan is allowed in part of **502.510(b)12** if done according to three key points found in **502.630** and summarized below:
   a. **502.630 (a).** Winter Application **Prohibition**. This part states that you should not apply on frozen or snow-covered ground unless absolutely necessary. But if you have to, six conditions to follow are listed here that must be met for winter land application.
   b. **502.630 (b). Winter Application Plan**. This part explains how winter application is done.
   c. **502.630 (c). Availability of Individual Fields** for Winter Application. This part spells out your responsibility for pre-identifying and prioritizing fields where winter application would produce the least environmental risk.
3. To be eligible for this exemption, the six specific conditions in **502.630(a)**, key requirements listed in **502.630(b)** and limitations listed in **630(c)**. Some are highlighted here:
   a. Most critical is the December 1 notification requirement found in **502.630 (a) 1) (E)**. It states that the owner/operator must notify the Agency in writing by December 1. We suggest you not include any manure volume calculations [**502.630 a) 1) C)** and **502.630 a) 2)**] in this letter.
   b. In the letter, do include the following statements:
      i. the manure storage levels are being carefully monitored, **[502.510 (b) 3)]** and **[502.630 (a) 1) C)]** but storage COULD require some winter spreading due to unforeseen conditions,
      ii. appropriate fields for winter spreading have been identified and prioritized per **502.630 (c)**,
      iii. written protocols for winter spreading are in your manure management plan per **502.630 (b)** and will be followed,
      iv. IEPA will be notified if winter spreading is necessary, and
      v. you wish to maintain the facility's Agricultural Stormwater Exemption for winter spreading by virtue of having followed the protective actions in **502.630**.

This is only a summary of the new rules. Please refer to **502.630** to note other key items. These include how to identify and prioritize fields for land application, specification of setbacks that depend on site slope, and tile inspection plans. These items should be in your written winter manure application plan.

Report Number
12-201-5422

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Midwest Laboratories, Inc.

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UNIVERSITY OF ILLINOIS
LAURA PEPPLE STE 332
1304 W PENNSYLVANIA AVE
URBANA IL 61801

Lab Number: 10058208
Description: MANURE ANALYSIS
Sample Id: **SWINE**

Report Date: Jul 19, 2012
Received Date: Jul 17, 2012
Sampled Date: Jul 16, 2012
P.O. Number:

Account Number: 21565

Parameters	Analysis as Received	Nutrients lbs/1000 gals	Est. First Year Availability lbs/1000 gals
Ammonium Nitrogen(N)	0.56 %	47.1	47
Organic Nitrogen(N)	0.28 %	23.9	8
Total Nitrogen(N)	0.84 %	71.0	55
Phosphorus(P2O5)	0.32 %	27.5	19
Potassium(K2O)	0.36 %	30.3	27
Sulfur(S)	0.08 %	6.8	3
Calcium(Ca)	0.11 %	9.6	7
Magnesium(Mg)	0.07 %	5.8	4
Sodium(Na)	0.11 %	9.3	7
Copper(Cu)	42 ppm	0.35	0.25
Iron(Fe)	110 ppm	0.93	0.65
Manganese(Mn)	22 ppm	0.19	0.13
Zinc(Zn)	102 ppm	0.86	0.60
Moisture	95.3 %		
Total Solids	4.7 %	397.2	
Total Salts		102.1	
pH	8.0		

First year availability of nitrogen is calculated based on preplant application with incorporation. Nitrogen available from previous years application not considered.

Total manure salts should not exceed 500 lbs/acre. Less than 500 lbs/acre if annual rainfall is less than 25 inches and/or the soil CEC is less than 12 meq/100g. Salt contributions from commercial fertilizer applications must also be considered. Soil test yearly to monitor phosphorus levels, organic matter, pH, and micronutrients. Spring soil test for residual nitrate - make accurate sidedress recommendations! Nitrogen availability will vary with methods of application and field conditions. The nitrogen availability values used on a manure management plan must comply with state regulation. These regulations vary from state to state.

Rob Ferris
Client Service Representative
rob@midwestlabs.com (402)829-9871

The result(s) issued on this report only reflect the analysis of the sample(s) submitted. For applicable test parameters, Midwest Laboratories is in compliance with NELAC requirements.

Midwest Laboratories, Inc.

Lab # 2322601 **Report of Analysis** Report Number: 14-274-4076

Account: 21565

LAURA PEPPLE STE 332
UNIVERSITY OF ILLINOIS
1304 W PENNSYLVANIA AVE
URBANA IL 61801

Robert Ferris
Client Service Representative
402-829-9871

Date Sampled:
Date Received:
Sample ID: **Bedded Pack Beef**

NUTRIENT ANALYSIS

		Analysis (as rec'd)	Analysis (dry weight)	Total content, lbs per ton (as rec'd)
NUTRIENTS				
Nitrogen				
Total Nitrogen	%	1.36	4.14	27.2
Organic Nitrogen	%	1.10	3.36	22.0
Ammonium Nitrogen	%	0.258	0.786	5.2
Nitrate Nitrogen	%	< 0.01	----	---
Major and Secondary Nutrients				
Phosphorus	%	0.44	1.34	8.8
Phosphorus as P2O5	%	1.01	3.08	20.2
Potassium	%	0.90	2.74	18.0
Potassium as K2O	%	1.08	3.29	21.6
Sulfur	%	0.20	0.61	4.0
Calcium	%	0.78	2.38	15.6
Magnesium	%	0.41	1.25	8.2
Sodium	%	0.160	0.488	3.2
Micronutrients				
Zinc	ppm	77.1	235	0.2
Iron	ppm	3520	10725	7.0
Manganese	ppm	131	399	0.3
Copper	ppm	< 20	----	---
Boron	ppm	< 20	----	---
OTHER PROPERTIES				
Moisture	%	67.18		
Total Solids	%	32.82		656.4
Organic Matter	%	19.40	59.11	388.0
Ash	%	13.40	40.83	268.0
C:N Ratio		8 : 1		
Total Carbon	%	10.41	31.72	
Chloride	%	0.33	1.01	
pH		8.2		

Nutrient Budget References (NBR)

Table 1. Typical ammonium (inorganic) nitrogen losses during land application of manure

Use these percentages to adjust the ammonium nitrogen values you estimated or got from a laboratory analysis. These numbers represent losses within 4 days after land application.			
Application method	**Type of manure**	**Loss, percent of ammonium – N**	
		lower limit: cool, dry weather	higher limit: warm weather
broadcast	solid	15	30
	liquid	10	25
broadcast with immediate incorporation	solid	1	5
	liquid	1	5
knife or sweep injection	liquid	0	2
Sprinkler irrigation	liquid	15	40

Source: MWPS-18, **LIVESTOCK WASTE FACILITIES HANDBOOK**, 1993 printing.

Table 2. Mineralization factors of organic nitrogen for different manure type and handling methods

Amount of organic nitrogen mineralized (made available to crops) during the first cropping season after manure application[1].		
Species	**Manure type and handling**	**Mineralization factor**
Swine	fresh	0.50
	anaerobic liquid[2]	0.35
	aerobic liquid[3]	0.30
Beef	solid without bedding	0.35
	solid with bedding	0.25
	anaerobic liquid[2]	0.30
	aerobic liquid[3]	0.25
Dairy	solid without bedding	0.35
	solid with bedding	0.25
	anaerobic liquid[2]	0.30
	aerobic liquid[3]	0.25
Poultry	deep pit	0.45
	solid with litter	0.30
	solid without litter	0.35

[1]Nitrogen credits for the mineralized organic nitrogen in livestock waste applied **during the previous three years** are calculated at the rate of 50%, 25%, and 12.5%, respectively, of that mineralized during the first year.
[2]pit, above-ground storage, or unaerated lagoon
[3]well-aerated lagoon or oxidation ditch

Source: MWPS-18, **LIVESTOCK WASTE FACILITIES HANDBOOK,** 1993 printing.

Nutrient Budget References (NBR)

Soil Fertility Information (Illinois Agronomy Handbook 2009)

NOTE: The maintenance values for grain corn, soybeans, and wheat were updated in 2017-2018. **Use the new values** rather than the numbers listed in Table 8.6 of the IAH. See next page for new values.

Table 8.6. Maintenance fertilizer required for various crops.

	P_2O_5	K_2O
Grains		
Corn	~~0.43 lb/bu~~	~~0.28 lb/bu~~
Oats	0.38 lb/bu[a]	0.20 lb/bu
Soybean	~~0.85 lb/bu~~	~~1.30 lb/bu~~
Grain sorghum	0.42 lb/bu	0.21 lb/bu
Wheat	~~0.90 lb/bu[a]~~	~~0.30 lb/bu~~
Biomass		
Alfalfa, grass, or alfalfa–grass mixes	12.0 lb/ton	50.0 lb/ton
Corn silage	2.7 (0.53)[b] lb/ton	7.0 (1.4)[b] lb/ton
Corn stover	7.0 lb/ton	30 lb/ton[c]
Wheat straw	4.0 lb/ton	30 lb/ton[c]

To obtain total nutrient removal by the crop (maintenance rate), multiply value by the expected yield.
[a]Values given are 1.5 times actual P_2O_5 removal for oats and wheat.
[b]Values in parentheses correspond to pounds per bushel.
[c]Value will vary depending on amount of precipitation received between the time of physiological maturity and the time the material was baled and by the potassium fertility level of the soil.

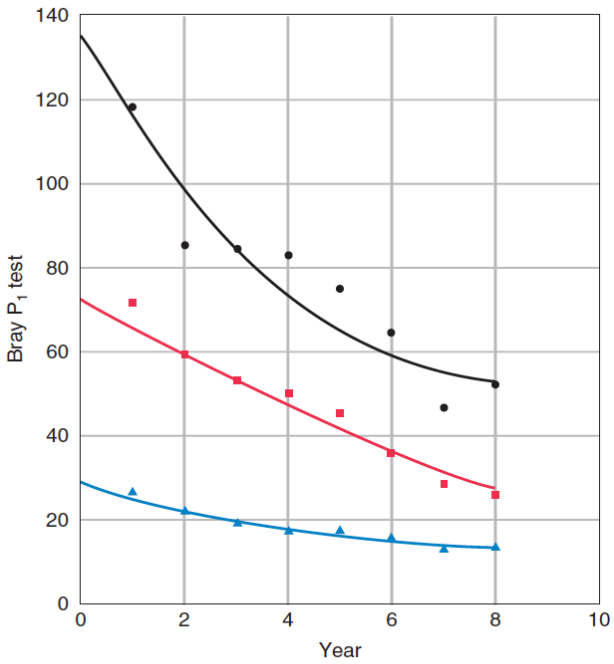

Figure 8.6. Effect of elimination of P fertilizer on P_1 soil test.

Table 9.2. Recommended spring nitrogen application rates for wheat.

Soil situation	Organic matter	Amt of N that 1 bushel of wheat will "buy"			
		Very high (>13 lb)	High (9–13 lb)	Medium (5–9 lb)	Low (<5 lb)
		lb N/A			
Low in capacity to supply nitrogen: inherently low in organic matter (forested soils)	<2%	150	120–150	90–120	60–90
Medium in capacity to supply nitrogen: moderately dark-colored soils	2–4%	100–120	80–100	60–80	40–60
High in capacity to supply nitrogen: deep, dark-colored soils	>4%	70–90	50–70	30–50	30

Rates assume no more than 30 lb of fall-applied N and spring application at greenup.

Table 9.5. Reductions in nitrogen rates resulting from agronomic factors.

Crop to be grown	After soybean	1st year after alfalfa or clover			2nd year after alfalfa or clover		Manure
		5 plants/sq ft	2–4 plants/sq ft	<2 plants/sq ft	5 plants/sq ft	<5 plants/sq ft	
	Nitrogen reduction (lb/A)						
Corn	N/A	100	50	0	30	0	5*
Wheat	10	30	10	0	0	0	5*

*Nitrogen contribution in pounds per ton of manure. See Table 9.6 for adjustments for liquid manure.

Note for the CLM workshop: use Line 11 in the Manure Nutrient Budget Worksheets to properly credit prior year manure applications. Do not use Table 9.6, or the values in the manure column here.

Nutrient Budget References (NBR)

Table 3. UPDATED Phosphorus and Potassium Maintenance Needs for Corn, Soybean, and Wheat

Crop Nutrient (lb/bushel)		New Values	Previous Values
Corn	P_2O_5	**0.37**	~~0.43~~
	K_2O	**0.24**	~~0.28~~
Soybean	P_2O_5	**0.75**	~~0.85~~
	K_2O	**1.17**	~~1.30~~
Wheat	P_2O_5	**0.47**	~~0.60~~
	K_2O	**0.28**	~~0.30~~

Excerpt below taken from http://bulletin.ipm.illinois.edu/?p=3967:

the Bulletin

pest management and crop development information for Illinois

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New Grain Phosphorus and Potassium Numbers

Posted on September 7, 2017 by Emerson Nafziger

Corn and soybean take up relatively large amounts of phosphorus (P) and potassium (K), and much of this P and K ends up in the grain that is taken off the field during harvest. In order to keep soil nutrient levels from dropping over time, the amounts removed need to be replaced by applying fertilizer or manure.

.....

We took this same approach for corn K, soybean P, and soybean K. Table 1 has averages and quartile numbers, as well as "book values" for the other nutrients. Average and 50th percentile (also called the "median") are not all exactly the same because the distribution is not perfectly uniform, as illustrated in Figure 1. The median is a little better value to use for such things, because extremely low and high values, though rare, affect the average but not the median.

		Distribution, percentile			Book
Nutrient	Average	25%	50%	75%	value
	----------lb P/K (oxide) per bushel----------				
Corn P	0.34	0.31	0.34	0.37	0.43
Corn K	0.23	0.22	0.23	0.24	0.28
Soybean P	0.71	0.66	0.71	0.75	0.85
Soybean K	1.11	1.06	1.12	1.17	1.30

Table 1. Average, 25th, 50th (median), 75th percentile, and "book values" for corn (2,335 samples) and soybean (2,620 samples) grain P and K levels found in the survey.

For corn, the new grain removal numbers of 0.37 lb. P_2O_5 and 0.24 lb. K_2O per bushel are both about 15 percent lower than the book values currently in the Illinois Agronomy Handbook. For soybean, the new numbers of 0.75 lb. P_2O_5 and 1.17 lb. K_2O per bushel are 12 and 10 percent lower than the book values, respectively. Because we used the 75th percentile values as the removal numbers, these values are 4 to 8 percent higher than the average or median values; in other words, they're a little higher than actual removal for a field with average grain nutrient content.

The new numbers we found are very close to those that Iowa State University reported several years ago, after going through a similar exercise and using the 75th percentile values. It's possible that new numbers are lower than the older values because nutrient levels have dropped as yields have increased. It's also possible that older numbers were not based on very many samples, or that, in order to make sure that these numbers would never underestimate actual removal, they were chosen as the highest values found.

Nutrient Budget References (NBR)

Using the MRTN Calculator for Corn

Purpose: Explain how to use the Maximum Return To Nitrogen (MRTN) calculator for manure application.

For determining corn nitrogen needs, the MRTN is required for use in Illinois, Wisconsin, Minnesota and Iowa. MRTN calculates the economic return to N application with different nitrogen and corn prices, crop rotation patterns (corn following soybean, or corn following corn), and for different regional soils. The MRTN calculator is free and accessed from: http://cnrc.agron.iastate.edu/nRate.aspx. Follow these steps to run it:

Steps:

1. Select the "**Single Price**" or "**Multiple Price**" tabs at the top (price ratio of N and corn)
2. **Select State**: pick Illinois
3. **Select Region**: choose from north, central or south
4. **Select Rotation**: Choose either *corn following soybean* or *corn following corn*.
5. **Set Corn and Nitrogen Prices**:
   a. Choose the N fertilizer product (anhydrous, UAN 28%, UAN 32%, Urea or Ammonium Sulfate)
   b. Enter fertilizer cost in gross $/ton, or alternatively as $/lb of equivalent Nitrogen.
   c. Enter corn grain price, $/bushel.
   d. If you use the Multiple Price ratio option, then you can choose four prices for N and corn grain (four ratios). The prices for N and corn have default values already entered.
6. Click "CALCULATE" and you will be taken to the Results screen. You will be presented with a summary of input values, the "best" N rate, a range of profitable N rates, the $/acre net return for the recommended rate, percent of maximum yield and a graph of the return to nitrogen vs application rate.
7. Use this Nitrogen rate in the CLM worksheet, LINE 9 "Crop N needs, lb/acre".

Example:

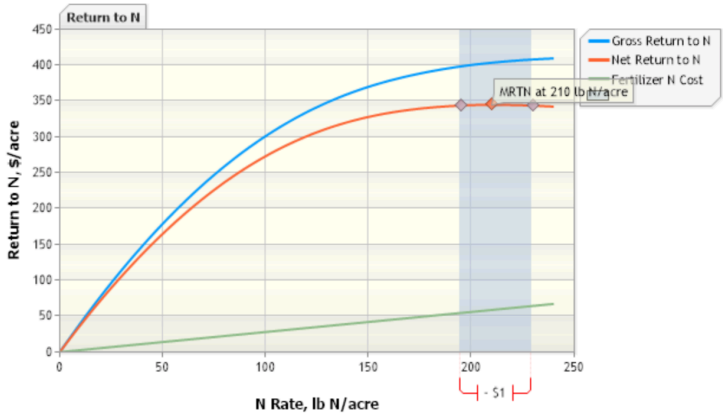
Using 2018 information: Central Illinois, corn following corn, anhydrous ammonia costing $0.28/lb-N, and $3.50/bu corn. This results in a maximum return to nitrogen rate of 210 lbs. N/acre with a profitable N rate range of 194 to 229 lbs. N/acre.

For nitrogen-limited manure applications use the higher number if desired; for phosphorus-limited applications consider the lower value for computing manure rate but the higher value for supplemental nitrogen application.

MRTN Nitrogen Rate Calculator Results for Example in CLM Training

State: Illinois
Number of sites: 152
Rotation: Corn Following Corn

Nitrogen Price ($/lb):	0.28
Corn Price ($/bu):	3.50
Price Ratio:	0.08
MRTN Rate (lb N/acre):	210
Profitable N Rate Range (lb N/acre):	194 - 229
Net Return to N at MRTN Rate ($/acre):	$344.73
Percent of Maximum Yield at MRTN Rate:	99%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	256
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$58.80



Obtained 01/07/2018

Source: http://cnrc.agron.iastate.edu

Nitrogen-Limited Manure Application

Purpose: Provide help in how to determine an appropriate manure application rate when manure supplies all of the plant available nitrogen (PAN) required by the crop. This is nitrogen-limited manure application, and is used when the soil phosphorus test results are under the threshold value of 300 lb/acre.

Crop nitrogen requirements may be found in Illinois Agronomy Handbook (IAH). The MRTN calculator must be used to determine the nitrogen application rate needed by grain corn. This method also determines how much phosphorus and potassium will be carried over as phosphorus and potassium credits for next year's crop.

Steps:

Referring to the CLM worksheet "**Manure Nutrient Budget Worksheet: Nitrogen limiting" (using grain corn as example crop):**

1. Start by filling in ***Lines 1- 14*** with livestock and crop information:
    a. Fill out ***Lines 2 – 6*** with manure lab test results.
    b. Fill out ***Lines 7 – 13*** with your crop information, previous records, and information in Nutrient Budget Reference (NBR) or Illinois Agronomy Handbook (IAH) provided in this handout.
2. The total plant available N in the first year, manure application rate, and acres needed at this N application rate are calculated in ***Lines 15-18***.
3. Calculate the phosphorus applied at that N application rate in ***Line 19***. Document the phosphorus (P) needs for corn grain (previously 0.43 lb P_2O_5/bu, new number 0.37 lb/bu), and then multiply the "proven" crop yield (Line 8) by 0.37 to determine the amount of P_2O_5 removed by the corn and enter on ***Line 20***. The excess phosphorus, carried out as phosphorus credit for the following year's crop is entered in ***Line 21***.
4. ***Lines 22 – 24***: follow the same format as the previous step for potassium information.
5. The amount of manure organic nitrogen that becomes available in Year 2 and 3 are calculated in ***Lines 25 & 26***.
6. Fill in ***Lines 27 – 29*** with most recent commercial fertilizer market price.
7. Nitrogen, Phosphorus, Potassium value, and the total NPK value at the N application rate are calculated in ***Lines 30 – 33***. The equivalent fertilizer value of the manure after application costs is calculated in ***Line 36***, with your input of application cost.

Table 4. Reference Manure Nutrient Content Values for the Examples in this Handout. These are the values used in the budget worksheet examples on the following pages. Use your **OWN** lab analysis numbers for budget worksheets.

Nutrient	Swine Slurry	Beef or Dairy Solids	Turkey Litter
	lbs per 1,000 gallons	lbs/ton	lbs/ton
TKN	58	14	50
NH_4-N	41	6	16
Organic	17	8	34
P_2O_5	23	9	36
K_2O	33	5	33

The following examples using grain corn are based on the MRTN example calculation on the previous page. The values in these worksheets reflect winter 2018 pricing.

Blank Worksheets may be downloaded from go.illinois.edu/clmt. Worked examples on following pages.

Manure Nutrient Budget Worksheet: Nitrogen limiting

		Livestock/Manure:	
1	Annual manure production quantity	***(1 unit = 1000 gallons or 1 ton)***	
	Manure lab test results, lb/unit		
2	Total N		
3	Ammonium N		
4	Organic N	*(L2 -L3)*	
5	P_2O_5 equivalent		
6	K_2O equivalent		
7	Crop where you want to spread manure		
8	Proven yield, bu/acre		
9	Crop N needs, lb/acre (N needs times proven yield)	***IAH or MRTN***	
10	Ammonium-N loss, percent	***NBR – Table 1***	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 25 + 26)		
12	Crop N needs minus all N credits	*(L9 -L11)*	
13	Manure mineralization factor	***NBR - Table 2***	
14	Manure organic N x mineralization factor, lb. N per unit manure	*(L4 x L13)*	
15	**Total plant available N first year, lb. N per unit of manure**	*((100% -L10) x L3) + L14*	
16	Manure application rate, units/acre (1,000 gallons or tons)	*(L12 / L15)*	
17	Nitrogen Applied, lb/acre	*L15 x L16*	
18	Acres needed at this N application rate	*(L1 / L16)*	
19	Phosphorus applied, lb/acre	*(L5 x L16)*	
20	Crop phosphorus need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	
21	Excess phosphorus, carried over as phosphorus credit	*(L19 – L20)*	
22	Potassium applied, lb/acre	*(L6 x L16)*	
23	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	
24	Excess potassium, carried over as potassium credit	*(L 22 - L23)*	
25	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L16)*	
26	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L25)*	
27	Nitrogen Price, $/lb		
28	Phosphorus Price, $/lb		

Blank Worksheets may be downloaded from go.illinois.edu/clmt. Worked examples on following pages.

29	Potassium Price, $/lb		
30	Nitrogen Value, $/acre	*(L17 x L27)*	
31	Phosphorus Value, $/acre	*(L19 x L28)*	
32	Potassium Value, $/acre	*(L22 x L29)*	
33	Total NPK Value, $/acre	*(L30 + L31 + L32)*	
34	Application Cost, $/gal		
35	Total Application Cost, $/acre	*(L34 x L16) x1000* [if 1 unit = 1,000 gal] *(L34 x L16)* [if 1 unit = 1 ton]	
36	Total Value After Application, $/acre	*(L33 – L35)*	

IAH – Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Manure Nutrient Budget Worksheet: Nitrogen limiting

	Livestock/Manure:		**Swine Slurry**	
1	Annual manure production quantity	***(1 unit = 1000 gallons or ~~1 ton~~)***	900	
	Manure lab test results, lb/unit			
2	Total N		58	
3	Ammonium N		41	
4	Organic N	*(L2 -L3)*	17	
5	P_2O_5 equivalent		23	
6	K_2O equivalent		33	
7	Crop where you want to spread manure		Corn	
8	Proven yield, bu/acre		200	
9	Crop N needs, lb/acre (N needs times proven yield)	***IAH or MRTN***	229	
10	Ammonium-N loss, percent	***NBR – Table 1***	2%	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 25 + 26)		0	
12	Crop N needs minus all N credits	*(L9 -L11)*	229	
13	Manure mineralization factor	***NBR - Table 2***	35%	
14	Manure organic N x mineralization factor, lb. N per unit manure	*(L4 x L13)*	6	
15	**Total plant available N first year, lb. N per unit of manure**	*((100% -L10) x L3) + L14*	46	
16	Manure application rate, units/acre (1,000 gallons or tons)	*(L12 / L15)*	5	
17	Nitrogen Applied, lb/acre	*L15 x L16*	229	
18	Acres needed at this N application rate	*(L1 / L16)*	181	
19	Phosphorus applied, lb/acre	*(L5 x L16)*	114	
20	Crop phosphorus need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	74	
21	Excess phosphorus, carried over as phosphorus credit	*(L19 – L20)*	40	
22	Potassium applied, lb/acre	*(L6 x L16)*	164	
23	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	48	
24	Excess potassium, carried over as potassium credit	*(L 22 - L23)*	116	
25	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L16)*	15	
26	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L25)*	7	
27	Nitrogen Price, $/lb		$0.28	
28	Phosphorus Price, $/lb		$0.48	

29	Potassium Price, $/lb		$0.27	
30	Nitrogen Value, $/acre	*(L27 x L17)*	$64	
31	Phosphorus Value, $/acre	*(L19 x L28)*	$55	
32	Potassium Value, $/acre	*(L22 x L29)*	$44	
33	Total NPK Value, $/acre	*(L30 + L31 + L32)*	$163	
34	Application Cost, $/gal		$0.01	
35	Total Application Cost, $/acre	*(L34 x L16) x 1000*	$50	
36	Total Value After Application, $/acre	*(L33 – L35)*	$114	

IAH – Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Manure Nutrient Budget Worksheet: Nitrogen limiting

	Livestock/Manure:	**Beef Solids w/Bedding**		
1	Annual manure production quantity	***(1 unit = ~~1000 gallons~~ or 1 ton)***	500	
	Manure lab test results, lb/unit			
2	Total N		14	
3	Ammonium N		6	
4	Organic N	*(L2 -L3)*	8	
5	P_2O_5 equivalent		9	
6	K_2O equivalent		5	
7	Crop where you want to spread manure		Corn	
8	Proven yield, bu/acre		200	
9	Crop N needs, bu/acre (N needs times proven yield)	***IAH or MRTN***	229	
10	Ammonium-N loss, percent	***NBR – Table 1***	5%	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 25 + 26)		0	
12	Crop N needs minus all N credits	*(L9 -L11)*	229	
13	Manure mineralization factor	***NBR - Table 2***	25%	
14	Manure organic N x mineralization factor, lb. N per unit manure	*(L4 x L13)*	2	
15	**Total plant available N first year, lb. N per unit of manure**	*((100% -L10) x L3) + L14*	8	
16	Manure application rate, units/acre (1,000 gallons or tons)	*(L12 / L15)*	30	
17	Nitrogen Applied, lb/acre	*L15 x L16*	229	
18	Acres needed at this N application rate	*(L1 / L16)*	17	
19	Phosphorus applied, lb/acre	*(L5 x L16)*	268	
20	Crop phosphorus need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	74	
21	Excess phosphorus, carried over as phosphorus credit	*(L19 – L20)*	194	
22	Potassium applied, lb/acre	*(L6 x L16)*	149	
23	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	48	
24	Excess potassium, carried over as potassium credit	*(L 22 - L23)*	101	
25	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L16)*	30	
26	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L25)*	15	
27	Nitrogen Price, $/lb		$0.28	
28	Phosphorus Price, $/lb		$0.48	

29	Potassium Price, $/lb		$0.27	
30	Nitrogen Value, $/acre	*(L27 x L17)*	$64	
31	Phosphorus Value, $/acre	*(L19 x L28)*	$128	
32	Potassium Value, $/acre	*(L22 x L29)*	$40	
33	Total NPK Value, $/acre	*(L30 + L31 + L32)*	$233	
34	Application Cost, $/ton		$2.50	
35	Total Application Cost, $/acre	*(L34 x L16)*	$74	
36	Total Value After Application, $/acre	*(L33 – L35)*	$158	

IAH – Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Manure Nutrient Budget Worksheet: Nitrogen limiting

	Livestock/Manure:		**Turkey Litter**	
1	Annual manure production quantity	***(1 unit = ~~1000 gallons~~ or 1 ton)***	100	
	Manure lab test results, lb/unit			
2	Total N		50	
3	Ammonium N		16	
4	Organic N	*(L2 -L3)*	34	
5	P_2O_5 equivalent		36	
6	K_2O equivalent		33	
7	Crop where you want to spread manure		Corn	
8	Proven yield, bu/acre		200	
9	Crop N needs, lb/acre (N needs times proven yield)	***IAH or MRTN***	229	
10	Ammonium-N loss, percent	***NBR – Table 1***	5%	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 25 + 26)		0	
12	Crop N needs minus all N credits	*(L9 -L11)*	229	
13	Manure mineralization factor	***NBR - Table 2***	30%	
14	Manure organic N x mineralization factor, lb. N per unit manure	*(L4 x L13)*	10	
15	**Total plant available N first year, lb. N per unit of manure**	*((100% -L10) x L3) + L14*	25	
16	Manure application rate, units/acre (1,000 gallons or tons)	*(L12 / L15)*	9	
17	Nitrogen Applied, lb/acre	*L15 x L16*	229	
18	Acres needed at this N application rate	*(L1 / L16)*	11	
19	Phosphorus applied, lb/acre	*(L5 x L16)*	325	
20	Crop phosphorus need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	74	
21	Excess phosphorus, carried over as phosphorus credit	*(L19 – L20)*	251	
22	Potassium applied, lb/acre	*(L6 x L16)*	298	
23	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	48	
24	Excess potassium, carried over as potassium credit	*(L 22 - L23)*	250	
25	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L16)*	46	
26	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L25)*	23	
27	Nitrogen Price, $/lb		$0.28	
28	Phosphorus Price, $/lb		$0.51	

29	Potassium Price, $/lb		$0.26	
30	Nitrogen Value, $/acre	*(L27 x L17)*	$64	
31	Phosphorus Value, $/acre	*(L19 x L28)*	$166	
32	Potassium Value, $/acre	*(L22 x L29)*	$77	
33	Total NPK Value, $/acre	*(L30 + L31 + L32)*	$307	
34	Application Cost, $/ton		$2.50	
35	Total Application Cost, $/acre	*(L34 x L16)*	$23	
36	Total Value After Application, $/acre	*(L33 – L35)*	$284	

IAH – Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Lab test results courtesy of Hodel Farm, IL

Manure TYPE: **Swine Slurry**

Input Fields

Section 1: Current Fertilizer Costs and % *Input market fertilizer price in cost/ton column*

Type of Commercial Fertilizer	cost/ton	%N	%P_2O_5	%K_2O	$/ton PAN	$/ton P_2O_5	$/ton K_2O
Anhydrous Ammonia	$ 460.00	82%	0%	0%	$ 560.98	$ -	$ -
Urea	$ 319.90	46%	0%	0%	$ 695.43	$ -	$ -
UAN (Liquid Nitrogen)	$ 214.00	28%	0%	0%	$ 764.29	$ -	$ -
DAP	$ 447.00	18%	46%	0%	$ 2,483.33	$ 971.74	$ -
MAP	$ 452.67	11%	52%	0%	$ 4,115.18	$ 870.52	$ -
Potash	$ 328.00	0%	0%	60%	$ -	$ -	$ 546.67

Section 2: Slurry Application Rate - from Nutrient Mangement Plan Worksheet

Application rate	4960	gal/acre	Input your application rate
Application cost	0.01	$/gal	and cost calculated from
Manure application cost	49.6	$/acre	Nutrient Budget Worksheet

Section 3: Solids Nutrients and Crop Requirements - from Agronomy Handbook, Nitrogen Limiting

	Unit	PAN	P_2O_5	K_2O	
Nutrient appplied[*1]	lb/acre	229	114	164	Input nutrient applied and
Crop maintenance needs[*2]	lb/acre	229	74	48	crop maintenance needs from Nutrient Budget
Buildup (carry over)	lb/acre		40	116	Worksheet

Section 4: Fertilizer Value (equivalent commercial fertilizer cost)

Select fertilizer you use		PAN	P_2O_5	K_2O	Totals	
Anhydrous Ammonia		$ 0.280	-	-	-	Select an
DAP		-	$ 0.486	-	-	equivalent
Potash		-	-	$ 0.273	-	commercial
Fertilizer cost[*3]	$/lb	$ 0.280	$ 0.486	$ 0.273	$ 1.040	fertilizer
Maintenance value	$/acre	$ 64	$ 36	$ 13	$ 113	from the
Full replacement value	$/acre	$ 64	$ 55	$ 45	$ 164	drop list

Section 5: Results - Manure Value at Specified Application Rate, Nutrient Content and Crop Needs

Maintenance value after application	$ 64	$/acre
	0.01	$/gallon
Full replacement value after applicaton	$ 115	$/acre
	0.02	$/gallon

*[*1] : from Lines 17, 19 & 22 of CLM 2018 Manure Nutrient Budget Worksheet for Swine Slurry: Nitrogen Limiting, 200 bu/acre corn after corn, no prior year N credits*

*[*2] : from Lines 9, 20 & 23 of CLM 2018 Manure Nutrient Budget Worksheet for Swine Slurry: Nitrogen Limiting, 200 bu/acre corn after corn, no prior year N credits*

*[*3] : Costs of commercial fertilizer equivalents, from "cost/ton" field in Section 1*

Calculator worksheets may be downloaded from web.extension.illinois.edu/lfmm/nmp

Manure TYPE: **Beef Bedded Pack**

Input Fields

Section 1: Current Fertilizer Costs and % *Input market fertilizer price in cost/ton column*

Type of Commercial Fertilizer	cost/ton	%N	%P_2O_5	%K_2O	$/ton PAN	$/ton P_2O_5	$/ton K_2O
Anhydrous Ammonia	$ 460.00	82%	0%	0%	$ 560.98	$ -	$ -
Urea	$ 319.90	46%	0%	0%	$ 695.43	$ -	$ -
UAN (Liquid Nitrogen)	$ 214.00	28%	0%	0%	$ 764.29	$ -	$ -
DAP	$ 447.00	18%	46%	0%	$ 2,483.33	$ 971.74	$ -
MAP	$ 452.67	11%	52%	0%	$ 4,115.18	$ 870.52	$ -
Potash	$ 328.00	0%	0%	60%	$ -	$ -	$ 546.67

Section 2: Slurry Application Rate - from Nutrient Mangement Plan Worksheet

Application rate	30	tons/acre	Input your application rate
Application cost	2.5	$/ton	and cost calculated from
Manure application cost	75	$/acre	Nutrient Budget Worksheet

Section 3: Solids Nutrients and Crop Requirements - from Agronomy Handbook, Nitrogen Limiting

	Unit	PAN	P_2O_5	K_2O	
Nutrient appplied[*1]	lb/acre	229	268	149	Input nutrient applied and
Crop maintenance needs[*2]	lb/acre	229	74	48	crop maintenance needs from Nutrient Budget
Buildup (carry over)	lb/acre		194	101	Worksheet

Section 4: Fertilizer Value (equivalent commercial fertilizer cost)

Select fertilizer you use		PAN	P_2O_5	K_2O	Totals	
Anhydrous Ammonia		$ 0.280	-	-	-	Select an
DAP		-	$ 0.486	-	-	equivalent
Potash		-	-	$ 0.273	-	commercial
Fertilizer cost[*3]	$/lb	$ 0.280	$ 0.486	$ 0.273	$ 1.040	fertilizer
Maintenance value	$/acre	$ 64	$ 36	$ 13	$ 113	from the
Full replacement value	$/acre	$ 64	$ 130	$ 41	$ 235	drop list

Section 5: Results - Manure Value at Specified Application Rate, Nutrient Content and Crop Needs

Maintenance value after application	$ 38	$/acre
	1.28	$/ton
Full replacement value after applicaton	$ 160	$/acre
	5.34	$/ton

*[*1] : from Lines 17, 19 & 22 of CLM 2018 Manure Nutrient Budget Worksheet for Swine Slurry: Nitrogen Limiting, 200 bu/acre corn after corn, no prior year N credits*

*[*2] : from Lines 9, 20 & 23 of CLM 2018 Manure Nutrient Budget Worksheet for Swine Slurry: Nitrogen Limiting, 200 bu/acre corn after corn, no prior year N credits*

*[*3] : Costs of commercial fertilizer equivalents, from "cost/ton" field in Section 1*

Calculator worksheets may be downloaded from web.extension.illinois.edu/lfmm/nmp

Phosphorus-Limited Manure Application

Purpose: Provide help in how to determine how much commercial nitrogen (N) fertilizer may be needed when manure application supplies only a part of the total N requirement for corn grain – specifically when the manure application rate was limited because soil phosphorus is too high (> 300 lb/acre). This is phosphorus-limited manure application. However, just as in the conventional nitrogen-limited manure application method, this method utilizes the MRTN to determine the nitrogen application rate needed by corn, and Illinois Agronomy Handbook (IAH) for other crops.

Steps:

Referring to the CLM worksheet "**Manure Nutrient Budget Worksheet: Phosphorus limiting" (using grain corn as example crop):**

1. Start by filling in ***Lines 1- 15*** in the same way as for the Nitrogen-limited case (page 7).
2. Document the phosphorus (P) needs for corn grain in ***Line 16*** (previously 0.43 lb P_2O_5/bu, new number 0.37 lb/bu), and then multiply the "proven" crop yield (Line 8) by 0.37 to determine the amount of P_2O_5 removed by the corn and enter on ***Line 17***.
3. The maximum rate of manure application to just satisfy the P_2O_5 requirements of the corn is calculated in ***Lines 18 & 19***. The corresponding N application that results in calculated in ***Line 20.***
4. ***Line 21,*** nitrogen deficit: This is the amount of additional Nitrogen fertilizer that needs to be applied per acre to meet corn needs that will not be provided by the manure.

The remainder of the worksheet follows the same format as the Nitrogen-limiting case. It guides you to calculate the amount of Potassium applied ***(Lines 22 & 23)***, the amount of manure nitrogen that becomes available in Year 2 and 3 ***(Lines 24 &25)***, and summarizes the N, P_2O_5 and K_2O rates and manure value estimates ***(Lines 26-36).***

Table 4 (repeated). Reference Manure Nutrient Content Values for the Examples in this Handout.
These are the values used in the budget worksheet examples on the following pages. Use your **OWN** lab analysis numbers for budget worksheets.

Nutrient	Swine Slurry	Beef or Dairy Solids	Turkey Litter
	lbs per 1,000 gallons	lbs/ton	lbs/ton
TKN	58	14	50
NH_4-N	41	6	16
Organic	17	8	34
P_2O_5	23	9	36
K_2O	33	5	33

The following examples using grain corn are based on the MRTN example calculation on page 10. The values in these worksheets reflect winter 2018 pricing.

Blank Worksheets may be downloaded from go.illinois.edu/clmt. Worked examples on following pages.

Manure Nutrient Budget Worksheet: Phosphorus limiting

		Livestock/Manure:	
1	Annual manure production quantity (units)	***(1 unit = 1000 gallons or 1 ton)***	
	Manure lab test results, lb/unit		
2	Total N		
3	Ammonium N		
4	Organic N	*(L2 -L3)*	
5	P_2O_5 equivalent		
6	K_2O equivalent		
7	Crop where you want to spread manure		
8	Proven yield, bu/acre		
9	Crop N needs, bu/acre (N needs x proven yield)	***IAH or MRTN***	
10	Ammonium-N loss, percent	***NBR – Table 1***	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 24+25)		
12	Crop N needs minus all N credits	*(L9 – L11)*	
13	Manure mineralization factor	***NBR – Table 2***	
14	Manure organic N x mineralization factor, lb. N per unit of manure	*(L4 x L13)*	
15	Total plant available N first year, lb. N per unit of manure	*((100% -L10) x L3) + L14*	
16	P_2O_5 needs, pounds available P_2O_5 per unit of proven yield	***IAH Table 8.6 or NBR Table 3***	
17	Crop P_2O_5 needs, lb/acre (P needs x proven yield)	*(L16 x L8)*	
18	Total plant available P_2O_5, lb/unit of manure (assume 100% first year availability)	*(L5)*	
19	**Phosphorus-limited manure application rate, units of manure/acre**	*(L17/L18)*	
20	Nitrogen applied, lb available N / acre	*(L19 x L 15)*	
21	**Nitrogen deficit, lb/acre**	*(L12 - L20)*	
22	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR Table 3***	
23	Potassium applied, lb/acre	*(L19 x L6)*	
24	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L19)*	
25	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L24)*	

Blank Worksheets may be downloaded from go.illinois.edu/clmt. Worked examples on following pages.

26	Nitrogen Price, $/lb		
27	Phosphorus Price, $/lb		
28	Potassium Price, $/lb		
29	Nitrogen Value, $/acre	*(L20 x L26)*	
30	Phosphorus Value, $/acre	*(L17 x L27)*	
31	Potassium Value, $/acre	*(L23 x L28)*	
32	Total NPK Value, $/acre	*(L29 + L30 + L31)*	
33	Application Cost, $/gal (or ton)		
34	Total Application Cost, $/acre	*(L33 x L19) x1000* [if 1 unit = 1,000 gal] *(L33 x L19)* [if 1 unit = 1 ton]	
35	Total Value After Application, $/acre	*(L32 – L34)*	

IAH-Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Manure Nutrient Budget Worksheet: Phosphorus limiting

		Livestock/Manure:	Swine Slurry	
1	Annual manure production quantity (units)	***(1 unit = 1000 gallons ~~or 1 ton~~)***	900	
	Manure lab test results, lb/unit			
2	Total N		58	
3	Ammonium N		41	
4	Organic N	*(L2 -L3)*	17	
5	P_2O_5 equivalent		23	
6	K_2O equivalent		33	
7	Crop where you want to spread manure		Corn	
8	Proven yield, bu/acre		200	
9	Crop N needs, lb/acre (N needs x proven yield)	***IAH or MRTN***	229	
10	Ammonium-N loss, percent	***NBR – Table 1***	2%	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 24+25)		0	
12	Crop N needs minus all N credits	*(L9 – L11)*	229	
13	Manure mineralization factor	***NBR – Table 2***	35%	
14	Manure organic N x mineralization factor, lb. N per unit of manure	*(L4 x L13)*	6	
15	Total plant available N first year, lb. N per unit of manure	*((100% -L10) x L3) + L14*	46	
16	P_2O_5 needs, pounds available P_2O_5 per unit of proven yield	***IAH or NBR – Table 3***	0.37	
17	Crop P_2O_5 needs, lb/acre (P needs x proven yield)	*(L16 x L8)*	74	
18	Total plant available P_2O_5, lb/unit of manure (assume 100% first year availability)	*(L5)*	23	
19	**Phosphorus-limited manure application rate, units of manure/acre**	*(L17/L18)*	3	
20	Nitrogen applied, lb available N / acre	*(L19 x L 15)*	148	
21	**Nitrogen deficit, lb/acre**	*(L12 - L20)*	81	
22	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH or NBR – Table 3***	48	
23	Potassium applied, lb/acre	*(L19 x L6)*	106	
24	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L19)*	10	
25	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L24)*	5	

26	Nitrogen Price, $/lb		$0.28	
27	Phosphorus Price, $/lb		$0.48	
28	Potassium Price, $/lb		$0.27	
29	Nitrogen Value, $/acre	*(L20 x L26)*	$42	
30	Phosphorus Value, $/acre	*(L17 x L27)*	$36	
31	Potassium Value, $/acre	*(L23 x L28)*	$29	
32	Total NPK Value, $/acre	*(L29 + L30 + L31)*	$106	
33	Application Cost, $/gal		$0.01	
34	Total Application Cost, $/acre	*(L33 x L19) x1000*	$32	
35	Total Value After Application, $/acre	*(L32 – L34)*	$74	

IAH-Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Manure Nutrient Budget Worksheet: Phosphorus limiting

	Livestock/Manure:		**Beef Solids w/Bedding**	
1	Annual manure production quantity (units)	***(1 unit = ~~1000 gallons or~~ 1 ton)***	500	
	Manure lab test results, lb/unit			
2	Total N		14	
3	Ammonium N		6	
4	Organic N	*(L2 -L3)*	8	
5	P_2O_5 equivalent		9	
6	K_2O equivalent		5	
7	Crop where you want to spread manure		Corn	
8	Proven yield, bu/acre		200	
9	Crop N needs, bu/acre (N needs x proven yield)	***IAH or MRTN***	229	
10	Ammonium-N loss, percent	***NBR – Table 1***	5%	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 24+25)		0	
12	Crop N needs minus all N credits	*(L9 – L11)*	229	
13	Manure mineralization factor	***NBR – Table 2***	25%	
14	Manure organic N x mineralization factor, lb. N per unit of manure	*(L4 x L13)*	2	
15	Total plant available N first year, lb. N per unit of manure	*((100% -L10) x L3) + L14*	8	
16	P_2O_5 needs, pounds available P_2O_5 per unit of proven yield	***IAH Table 8.6 or NBR – Table 3***	0.37	
17	Crop P_2O_5 needs, lb/acre (P needs x proven yield)	*(L16 x L8)*	74	
18	Total plant available P_2O_5, lb/unit of manure (assume 100% first year availability)	*(L5)*	9	
19	**Phosphorus-limited manure application rate, units of manure/acre**	*(L17/L18)*	8	
20	Nitrogen applied, lb available N / acre	*(L19 x L 15)*	63	
21	**Nitrogen deficit, lb/acre**	*(L12 - L20)*	166	
22	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR – Table 3***	48	
23	Potassium applied, lb/acre	*(L19 x L6)*	41	
24	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L19)*	8	
25	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L24)*	4	

26	Nitrogen Price, $/lb		$0.28	
27	Phosphorus Price, $/lb		$0.48	
28	Potassium Price, $/lb		$0.27	
29	Nitrogen Value, $/acre	*(L20 x L26)*	$18	
30	Phosphorus Value, $/acre	*(L17 x L27)*	$36	
31	Potassium Value, $/acre	*(L23 x L28)*	$11	
32	Total NPK Value, $/acre	*(L29 + L30 + L31)*	$64	
33	Application Cost, $/ton		$2.50	
34	Total Application Cost, $/acre	*(L33 x L19)*	$21	
35	Total Value After Application, $/acre	*(L32 – L34)*	$44	

IAH-Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Manure Nutrient Budget Worksheet: Phosphorus limiting

		Livestock/Manure:	Turkey Litter	
1	Annual manure production quantity (units)	*(1 unit = ~~1000 gallons or~~ 1 ton)*	100	
	Manure lab test results, lb/unit			
2	Total N		50	
3	Ammonium N		16	
4	Organic N	*(L2 -L3)*	34	
5	P_2O_5 equivalent		36	
6	K_2O equivalent		33	
7	Crop where you want to spread manure		Corn	
8	Proven yield, bu/acre		200	
9	Crop N needs, lb/acre (N needs x proven yield)	***IAH or MRTN***	229	
10	Ammonium-N loss, percent	***NBR – Table 1***	5%	
11	Mineralized N credits, prev. 2 yrs (lb N per acre) (previous year's worksheet lines 24+25)		0	
12	Crop N needs minus all N credits	*(L9 – L11)*	229	
13	Manure mineralization factor	***NBR – Table 2***	30%	
14	Manure organic N x mineralization factor, lb. N per unit of manure	*(L4 x L13)*	10	
15	Total plant available N first year, lb. N per unit of manure	*((100% -L10) x L3) + L14*	25	
16	P_2O_5 needs, pounds available P_2O_5 per unit of proven yield	***IAH Table 8.6 or NBR – Table 3***	0.37	
17	Crop P_2O_5 needs, lb/acre (P needs x proven yield)	*(L16 x L8)*	74	
18	Total plant available P_2O_5, lb/unit of manure (assume 100% first year availability)	*(L5)*	36	
19	**Phosphorus-limited manure application rate, units of manure/acre**	*(L17/L18)*	2	
20	Nitrogen applied, lb available N / acre	*(L19 x L 15)*	52	
21	**Nitrogen deficit, lb/acre**	*(L12 - L20)*	177	
22	Crop potassium need, maintenance, lb/acre	*L8 x* ***IAH Table 8.6 or NBR – Table 3***	48	
23	Potassium applied, lb/acre	*(L19 x L6)*	68	
24	Next year's (Year 2) manure nitrogen credit, lb/acre	*50% of (L14 x L19)*	10	
25	Next year's (Year 3) manure nitrogen credit, lb/acre	*(50% of L24)*	5	

26	Nitrogen Price, $/lb		$0.28	
27	Phosphorus Price, $/lb		$0.51	
28	Potassium Price, $/lb		$0.26	
29	Nitrogen Value, $/acre	*(L20 x L26)*	$15	
30	Phosphorus Value, $/acre	*(L17 x L27)*	$38	
31	Potassium Value, $/acre	*(L23 x L28)*	$18	
32	Total NPK Value, $/acre	*(L29 + L30 + L31)*	$70	
33	Application Cost, $/ton		$2.50	
34	Total Application Cost, $/acre	*(L33 x L19)*	$5	
35	Total Value After Application, $/acre	*(L32 – L34)*	$65	

IAH-Illinois Agronomy Handbook, Land Grant University
NBR – Nutrient Budget References

Lab test results courtesy of Hodel Farm, IL

As you may know, there have been significant rule changes to 35 Illinois Administrative Code, Subtitle E, Parts 501 & 502.

The significant changes to Parts 501 & 502 became effective in August 2014. These changes directly affect Illinois' livestock management and livestock waste-handling facilities.

What are some of the major changes to Part 501?

- The requirements in Part 501 apply to ALL livestock management and livestock waste-handling facilities, whether or not those facilities are defined as AFOs or CAFO & without regard to whether the facility has an NPDES Permit.
- Definitions have been Added, Changed, & Repealed
- Operational Rules for ALL Livestock Management and Livestock Waste-Handling Facilities
  - ➢ All livestock management and livestock waste handling facilities have an obligation to make a site specific determination of whether the facility is subject to NPDES Permit requirements and to follow those requirements when and where they are applicable.
  - ➢ Any runoff or overflow from a livestock management or livestock waste handling facility shall not cause a water quality violation.
- Temporary Manure Stack Handling & Storage Changes
  - ➢ Temporary manure stacks are a potential secondary source, and subject to minimum setback zones as established in the Illinois Environmental Protection Act.
  - ➢ A temporary manure stack must not be located within 75 feet of water well, except monitoring wells.
  - ➢ A temporary manure stack must be constructed or established & maintained to prevent runoff & leachate from reaching surface & groundwater.
    - ✓ A cover or pad or other control must be provided to prevent runoff and leachate from entering surface & groundwater.
- For Livestock management and livestock waste-handling facilities that are not required to obtain an NPDES Permit, contents shall be kept at such levels that there is adequate storage capacity so that an overflow does not occur except in the case of a 25-year, 24-hour storm.
- Limits runoff field application systems to livestock management facilities that are not CAFOs and less than 300 animal units.
- Restricts the field applications requirements under Section 501.405 to livestock management and livestock waste handling facilities that are not required to obtain an NPDES Permit.

- Facilities required to obtain an NPDES Permit are subject to the discharge limitations and technical standards in Part 502.
- Unpermitted large CAFOs claiming an agricultural exemption must comply with Section 502.102 & the practices listed in Section 502.510(b) to qualify for the exemption.

What are some of the major changes to Part 502?

- Small , Medium, & Case-by-Case CAFO Designation Requirements
- NPDES Permit Application & Coverage Requirements
- Permitted CAFO Recordkeeping Requirements
- Permitted CAFO Annual Report Content and Submission Requirements
- Required Nutrient Management Practices for Large Unpermitted CAFOs Claiming the Agricultural Stormwater Discharge Exemption
- Nutrient Management Plan Information, Requirements, and Terms
- Nutrient Management Plan Change Procedures
- CAFO Discharge Limitations and Technical Standards
  - Production Area Discharge Limitations and Additional Measures
  - Field Assessment of Nutrient Transport Potential
  - Land application Protocols
  - Land Application Rate Determination
  - Winter Land Application Protocols
  - Manure and Soil Sampling/Analysis requirements
  - Land Application Equipment Inspections

Where can I get a copy of the new rules?

Copies of Parts 501 & 502 can be downloaded at the Illinois Pollution Control Board's website:

http://www.ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.aspx

Who should I call if I have questions about the rule changes?

CAFO Field inspectors will be able to answer most questions about the new rule changes. If you need more information, you may contact the local Illinois EPA CAFO Field Inspector or Regional Manager at the below Regional Offices, or Jim Miles , Manager of Field Operations for the Division of Water Pollution Control in Springfield at (217) 558-2012.

What to Expect from an Illinois EPA Livestock Facility Inspection

1. Why is the Illinois EPA visiting my facility?

Inspections of livestock management facilities are scheduled for several reasons, including the following:

- Investigation of a complaint of water pollution or air pollution
- Follow-up visits at facilities that have had previous problems
- Investigations of facilities in a particular watershed or other geographical area
- Visits to facilities subject to significant public interest, due to size or location
- Visits to obtain information for permit purposes
- Investigations of possible problems observed by Illinois EPA staff

Field staff will discuss the reasons and purposes for the visit with the facility operator at the time of the visit.

2. What authority does the Illinois EPA have for inspections?

State law and regulations give the Illinois EPA authority to inspect livestock management facilities and livestock waste handling facilities. Field staff will attempt to locate a facility representative upon arriving at a site. In some situations, such as investigation of a fish kill or other emergency, field staff may need to observe unattended waste handling facilities. In general, though, inspections of unattended facilities are limited to areas visible from public roads and the facility driveway. Staff may also leave a business card or note with a request that a facility representative call the Illinois EPA to schedule a follow up visit.

Illinois Environmental Protection Act (415 ILCS 5/4)

Section 4(b): The Agency shall have the duty to collect and disseminate such information, acquire such technical data, and conduct such experiments as may be required to carry out the purposes of this Act, including ascertainment of the quantity and nature of discharges from any contaminant source and data on those sources….

Section 4(c): The Agency shall have authority to conduct a program of continuing surveillance and of regular or periodic inspection of actual or potential contaminant…sources….

Section 4(d): In accordance with constitutional limitations, the Agency shall have authority to enter at all reasonable times upon any private or public property for the purpose of...(i) inspecting and investigating to ascertain possible violations of the Act or of regulations thereunder, or of permits or terms or conditions thereof....

35 Illinois Administrative Code 501.406

a) The Agency shall have the authority to enter at all reasonable times upon any private or public property for the purpose of inspecting and investigating to ascertain possible violations of the Act or regulations thereunder, in accordance with constitutional limitations....

b) The activities of inspecting and investigating include:

1) Having access to and the right to copy any records required to be kept under the terms of the permit; and

2) Having access to, sampling and monitoring any discharge of pollutants to ground and surface waters.

3. What happens during an inspection?

Upon arrival at a livestock facility, field staff will discuss biosecurity requirements with a facility representative. Illinois EPA staff is required to comply with reasonable biosecurity practices at the request of the operator. Field staff will also discuss the reason for the visit, and a proposed plan for the inspection.

During the visit, Illinois EPA staff will observe and discuss the size and type of livestock at the facility and the areas where livestock are housed. In most cases, field staff will not need to enter any area where livestock are confined or housed, and they will not do so without the authorization of the owner or operator. The majority of the inspection will focus on waste management, including storage structures, capacities, and management practices. Regulations relating to operation of the facility and management of livestock waste will be discussed with the operator. Photographs and samples may be obtained to document conditions at the facility. Also, records required by regulations or permits issued to the facility may be reviewed.

Finally, field staff will review any problems noted during the inspection with the facility representative before leaving. The discussion will usually include options for correcting the problems, and information about sources of technical assistance available to the facility.

4. What happens after the inspection?

When no violations are found after completion of the inspection, the process ends. If violations are found, one of the following actions may be initiated depending on the seriousness of the problems:

- Noncompliance Advisory: When relatively minor problems are found, a Noncompliance Advisory letter may be sent to the facility owner or operator. This letter will document the violations of water or air pollution control regulations and laws observed during the inspection, and include recommendations for correcting the problems.
- Violation Notice: More serious violations, or failure to correct problems noted in a Noncompliance Advisory, may result in a Violation Notice letter to the facility from Illinois

EPA headquarters in Springfield. Examples of violations that may lead to this response include livestock waste releases causing water quality violations, or documented instances of air pollution. The Violation Notice contains a description of the alleged violations and actions that the Agency believes may resolve the violations, and begins a series of steps described in the Environmental Protection Act. These steps include an opportunity to meet with the Illinois EPA and to propose a Compliance Commitment Agreement to resolve the violations. If no agreement is reached, or the compliance commitment is not met, the Illinois EPA may follow up with a notice that it intends to pursue legal action. This notice provides an opportunity for a second meeting with the Agency; if the violations still remain unresolved, the matter may be referred to the Illinois Attorney General, the U.S. Environmental Protection Agency, or a county State's Attorney's office for enforcement.

- Request for Injunctive Relief: Section 43 of the Environmental Protection Act allows the Illinois EPA to request an injunction from the local circuit court to halt an activity causing or contributing to "substantial danger to the environment or to the public health of persons or to the welfare of persons where such danger is to the livelihood of such persons." A significant release of livestock waste to surface water or a serious, ongoing air pollution episode meeting the above criteria are some of the violations that could trigger this response.

5. Who should I call if I have questions?

Field inspectors will be able to answer most questions about a facility inspection. If you need more information, you may contact the local Illinois EPA regional manager at the same address and phone number as the field inspector, or Tim Kluge, manager of Field Operations for the Division of Water Pollution Control in Springfield at (217) 782-3362.

<Inspector's Site Visit Inspection Checklist> can be downloaded from: go.illinois.edu/clmt