

# **Beef Feed Nutrient Management Planning Economics (BFNMP\$)**

Connecting Feed Decisions with Crop Nutrient Management Plans

## **Software Instructions**

December, 2009

This tool estimates:

- 1) Manure mass and nutrient content
- 2) Mass and nutrient losses during housing, storage, and land application
- 3) Land requirements for agronomic utilization of the manure
- 4) Labor and equipment time requirement and cost for manure handling and land application and travel distance of manure hauling
- 5) Potential nutrient value of manure

# Table of Contents

<b>Introduction</b> .....	<b>4</b>
<b>Overview of the Four-step Process</b> .....	<b>5</b>
<b>4 Steps of BFNMP\$</b> .....	<b>5</b>
Step 1. Manure Management Facility/ System .....	5
Step 2. Animal Characteristics.....	5
Step 3. Manure Management .....	5
Step 4. Crop System.....	5
<b>Setup Instructions</b> .....	<b>7</b>
<b>Installing Software from a CD</b> .....	<b>7</b>
<b>Starting the Program</b> .....	<b>7</b>
General considerations .....	7
<b>Adding users</b> .....	<b>8</b>
<b>Starting Scenarios</b> .....	<b>9</b>
<b>Manage Contacts</b> .....	<b>9</b>
<b>Creating Scenario</b> .....	<b>9</b>
<b>Start Page</b> .....	<b>11</b>
<b>BFNMP\$ Steps</b> .....	<b>12</b>
<b>Step 1.0 Manure Management Systems</b> .....	<b>12</b>
<b>Step 2.0 – Animal Characteristics</b> .....	<b>13</b>
Step 2.2.0 Beef Summary.....	13
Step 2.2.1 Beef Cattle Animal & Feed Management Characteristics.....	13
<b>Step 3.0 Excreted and harvested Manure nutrients and solids summary</b> .....	<b>15</b>
Step 3.1 Updating Manure management factors- Nutrient and Solids Retention.....	16
Runoff.....	17
Manure Handling.....	17
Managing Equipment .....	18
Editing Equipment Parameters .....	18
Pen Cleaning .....	19
Composting.....	19
Manure Transport to Spreading Site.....	20
Manure Spreading .....	20
<b>Step 4.0 Crop System</b> .....	<b>21</b>
Crop System Step 1).....	22
Crop System Step 2) Setup Manure Application Method .....	22
Explanation of crop available nutrients:.....	22
Crop System Step 3) Setup Crop Management .....	23
Simple .....	23
Comprehensive.....	23
Crop System Step 4) Setup Crop Fields (Comprehensive only) .....	23
Crop System Step 5) Setup Crop Priorities (Comprehensive only) .....	24
Crop System Step 6) Setup Additional Acres .....	24
<b>Reports</b> .....	<b>25</b>
<b>References</b> .....	<b>26</b>
<b>Appendix</b> .....	<b>27</b>
<b>Project Team</b> .....	<b>27</b>

<b>Funding Provided by:</b> .....	<b>27</b>
<b>Abbreviations</b> .....	<b>28</b>

List of Tables

<b>Table 1. Summary of key user inputs and outputs of individual modules within FNMP\$.</b>	<b>6</b>
<b>Table A 1. Percent manure moisture of manure management system.</b>	<b>29</b>
<b>Table A 2. Manure excretion equations.</b>	<b>29</b>
<b>Table A 3. Manure content retention post housing during summer and winter<sup>1</sup>.</b>	<b>30</b>
<b>Table A 4. Manure content found in runoff post housing during summer and winter<sup>1</sup>.</b>	<b>30</b>
<b>Table A 5. Manure management systems' default values for organic-N, ammonium-N, organic-N availability, and solids and nutrient retentions.</b>	<b>31</b>
<b>Table A 6. Ammonia nitrogen availability by application type</b>	<b>32</b>
<b>Table A 7. Simple crop system haul distance equations.</b>	<b>33</b>
<b>Table A 8. Comprehensive crop system haul distance equations.</b>	<b>33</b>

## Introduction

The Beef Feed Nutrient Management Planning Economics (BFNMP\$) software tool has been developed to aid producers and their advisors with the ability to integrate feed and manure management decisions and animal performance measures into the nutrient planning processes. The primary purposes of BFNMP\$ are to estimate the impact of feed program decisions on nutrient excretion, manure handling decisions on nutrient retention, and overall nutrient planning on crop acreage and manure application.

Feeding crude protein and phosphorus above minimum animal requirements produces manure with additional nutrients. Therefore feeding decisions will influence the land requirements to apply manure nutrients. Extra nutrients in manure will increase the labor and equipment needs, costs associated with land application, and the value of the manure.

Overfeeding phosphorus can increase land requirements when applying on a phosphorus rate. However, nitrogen will be applied below crop requirements in this scenario: the ratio of N:P in manure decreases due to nitrogen volatilization (loss of nitrogen to the atmosphere). This can have negative environmental or social implications but it is also an economical loss of nutrients to the crops. Manure handling decisions can alter the amount of nutrients lost over time. This model calculates the relative value of the nitrogen lost (based on fertilizer value) during each manure handling step.

The BFNMP\$ software generates individualized data as it estimates excretion based on operation-specific feed rations and animal performance. Generalized data contained in the program can be modified by the user for maximum customization and, in return, maximum relevance and benefit.

# Overview of the Four-step Process

The software is organized into four steps as described below and summarized in Table 1.

## 4 Steps of BFNMP\$

### *Step 1. Manure Management Facility/ System*

Each manure management system is chosen to best match the operation's facilities. Each facility is associated with nutrient and solid retention factors. These factors can be altered at later steps to better fit the specific operations conditions. The manure systems are determined first so that animal groups can be associated with a specific system if more than one facility is available.

### *Step 2. Animal Characteristics*

Diet, production, and season (winter or spring) are entered for each animal group. This information is used to determine an estimate of manure nitrogen, phosphorus, and potassium excretion as well the mass of manure produced. Excretion is estimated as a difference between intake and retention in body mass. Dry matter excretion was based on estimates of feed dry matter digestibility, with adjustments based upon research literature for solids in urine. Housing losses of nutrients and mass are determined by season based on research data.

### *Step 3. Manure Management*

Manure management factors (nutrient and solids retention) can be updated or defaults can be used to determine post-storage manure content (manure nutrients and solids after storage and housing losses). Other factors including bedding additions and manure moisture can be updated. Manure handling includes equipment, time, and labor expenses during pen cleaning, storage (compost, stockpile, or no storage), transport, and application.

### *Step 4. Crop System*

Depending on the operation's crop system or user's preferences, one of two options for the crop system is chosen: simple or comprehensive. Manure application methods, field description, crop types, and additional nutrient credits can be entered. This information is used to determine crop available nutrients, acres needed to spread manure at agronomic rates, distance traveled and detailed crop information.

Table 1. Summary of key user inputs and outputs of individual modules within BFNMP\$.

Module	Primary User Inputs	Module Outputs
Excretion	Number and weights of animals Ration nutrient concentration Feed intake Animal performance ( e.g. weight gain, days on feed) Facility housing animals Season	Excreted solids and nutrient concentration Fertilizer value of excreted manure Manure content and mass after housing loss
Nutrient Availability	Manure housing/storage type Nutrient retention in storage (optional) Crop availability of nutrients (optional) Manure moisture and ash concentrations	Manure content and mass after storage loss Crop available nutrients and mass
Cropping system	Crops, yield, and crops receiving manure Crop nutrient requirements (optional) and credits from non-manure sources Basis for application rate Average field size Land availability Value of nutrients.	Land application rate Land requirements Average and maximum travel distance Excess/ deficient nutrients applied
Economics	Manure handling equipment Application and nurse tank/truck equipment Application equipment operating characteristics Operating costs (optional)	Manure handling costs and nutrient loss Application time for spreading equipment and nurse tank/truck Total annual costs for manure application Nutrient value of manure Total annual costs of feed Net costs of manure application
Summary	Summary of conditions	Excreted and crop available N and P <sub>2</sub> O <sub>5</sub> Manure handling costs Land required per year Transportation distances Application time by activity Nutrient value estimates Application cost estimates Net value estimates

# Setup Instructions

## Installing Software from a CD

- 1) Insert CD
- 2) Copy setup folder to hard drive
- 3) Open setup folder and then open Setup.exe
- 4) Follow further setup instructions

Note: if your computer is not current with Microsoft updates, it may be necessary to manually update with the following programs found in the setup folder-

Dotnetfx  
ReportViewer  
WindowsInstaller3\_1

## Starting the Program

A shortcut will automatically be placed on your desktop. You can also start the program from the Start menu listed under programs.

### General considerations

- Saving Data – all entered data is automatically saved unless “cancel” is selected on data entering pages
- Messages:

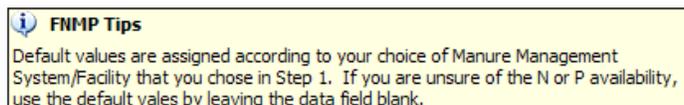


Warning: data is missing



Information: drag mouse over “i” and instructions will appear in a message window

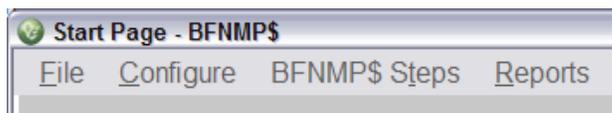
BFNMP\$ Tips:



Helpful reminders and tips as you enter data

- Navigation

Tool bar:



Navigation Buttons:

Go to Previous Step  
2.0 Beef Characteristics

Return to Start Page

Go to Next Step  
4.0 Crop System

o Defaults

Defaults will appear in grey boxes to the right of data entry boxes. They are based on the most current information but changing this information will allow the user to make the information more specific and relevant to the operation.

Adding users

Click on 'New User' on the login page. Follow instructions to create users.  
Note: passwords are OPTIONAL

Close

Beef Feed Nutrient Management Planning Economics (BFNMP\$)...

Select a user and enter your password to log in.

User name:  
Test (no password needed)

Password:

Login

New User

**Software Development**  
Rick Koelsch, University of Nebraska  
Ray Massey, University of Missouri  
Virgil Bremer, University of Nebraska  
Galen Erickson, University of Nebraska  
Rebecca White, Washington State University  
Mike Dehart, Veridian Development, LLC WA

**Equation Contributors**  
Beef Galen Erickson, University of Nebraska  
Manure & Cropping Rick Koelsch, University of Nebraska  
Virgil Bremer, University of Nebraska  
Economics Ray Massey, University of Missouri  
Virgil Bremer, University of Nebraska

This project was funded in part by CSREES and a USDA-NRCS Conservation Innovation Grant.

Add User - BFNMP\$

**Instructions**

1. Enter a user name and password (optional) and click "Add User" to create a new BFNMP\$ user.

Users may be removed from the system by selecting a user name in the list box and clicking "Delete User". You will be prompted to enter the password for the user. Deleting a user will remove all BFNMP\$ data for that user.

**BFNMP\$ Users**

**Add New User**  
Enter a User Name and Password and click "Add User"

User name

Password

Re Enter Password

Add User

**Users in System**  
Test (no password needed)

Delete User

Close Window

# Starting Scenarios

## Manage Contacts

Before starting a scenario, you can add a farm or business contact by clicking on “Manage Contacts”. This allows the user to keep records but entering this information is optional. Only a farm or business name is required.

## Creating Scenario

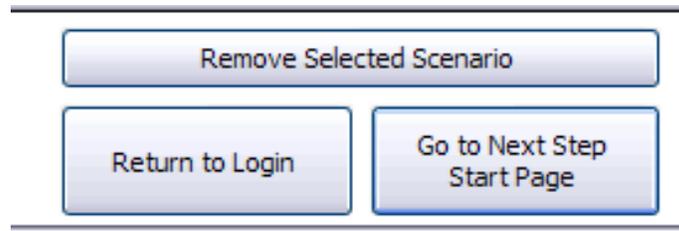
By clicking on a scenario line, today’s date will automatically appear.

1. Enter the “conditions to be evaluated”. These are user defined and can be any description.  
Examples: ‘low P diet’, ‘ration with soybean meal’, ‘increased corn acres’
2. Select farm/ business contact from the drop down menu
3. Only English units are available
4. Choose how feeds will be reported: “dry basis” or “as-fed basis”

Scenarios					
	Scenario creation date	1. Conditions to be evaluated.	2. Farm / Contact	3. Unit System	4. Feeds reported on Dry or As-Is basis?
▶	10/1/2009 2:29 PM	Example Feedlot	Test Feedlot	English	Dry Basis
*					Select a Feed Basis As-Is Basis Dry Basis

The feed basis chosen will be used through out the program. If at anytime you wish to change the units, you can return to 'manage scenarios' from the start page.

If multiple scenarios are entered, make sure the scenario you wish to work with is highlighted and the arrow on the left hand side is indicated on the chosen scenario before continuing on by clicking on "Go to Next Step Start Page". If a scenario is not highlighted, clicking on "Go to Next Step Start Page", will not work.



# Start Page

All steps of the BFNMP\$ program are outline on the start page. You can return back to this page at anytime by clicking "Go to Start Page" at the bottom of each window OR selecting the "BFNMP\$ Steps" from the toolbar menu.

Start with Step 1.0 Manure Management Systems as indicated in the red note.

The screenshot shows the 'Start Page - BFNMP\$' window. At the top, there is a menu bar with 'File', 'Configure', 'BFNMP\$ Steps', and 'Reports'. Below the menu bar is a header section titled 'BFNMP\$ Start Page' with a sub-header 'Scenario / User Information'. This section contains user information: 'Current User: Test (no password needed)', 'Current Scenario: Test', and 'Will feeds be reported on a Dry or As-Is basis? Dry'. There are 'Log Off' and 'Modify Scenario' buttons on the right. Below this is an 'Instructions' section with a yellow background, providing guidance on how to use the program. The main area is titled 'BFNMP\$ Steps' and lists four steps with corresponding buttons: Step 1.0 (Manure Management Facility/System) with a red note to 'Add a manure management facility/system to access Animal Characteristics'; Step 2.0 (Beef Characteristics); Step 3.0 (Manure Management); and Step 4.0 (Crop System) with a 'View Reports' button.

**BFNMP\$ Start Page**  
Scenario / User Information

Current User: Test (no password needed) Log Off

Current Scenario: Test Modify Scenario

Will feeds be reported on a Dry or As-Is basis? Dry

**Instructions**

To begin an BFNMP\$ estimate, start by creating a manure management facility/system.  
Modify contacts and scenarios by using the buttons under "Scenario / User Information"  
You may return to this page at any time by clicking "Go to Start Page" at the bottom of each window OR selecting the "BFNMP\$ Steps" from the toolbar menu.

**BFNMP\$ Steps**

Step 1. Enter Manure Management Facility/System Information. Step 4. Enter cropping system information and review land requirements.

Step 1.0  
Manure Management  
Facility/System **Add a manure management facility/system to access Animal Characteristics.** Step 4.0  
Crop System

Step 2. Enter Beef groups to estimate manure excretion. View Summary and reports.

Step 2  
Beef Characteristics View Reports

Step 3. Enter manure management factors and view excreted and

Step 3.0  
Manure Management

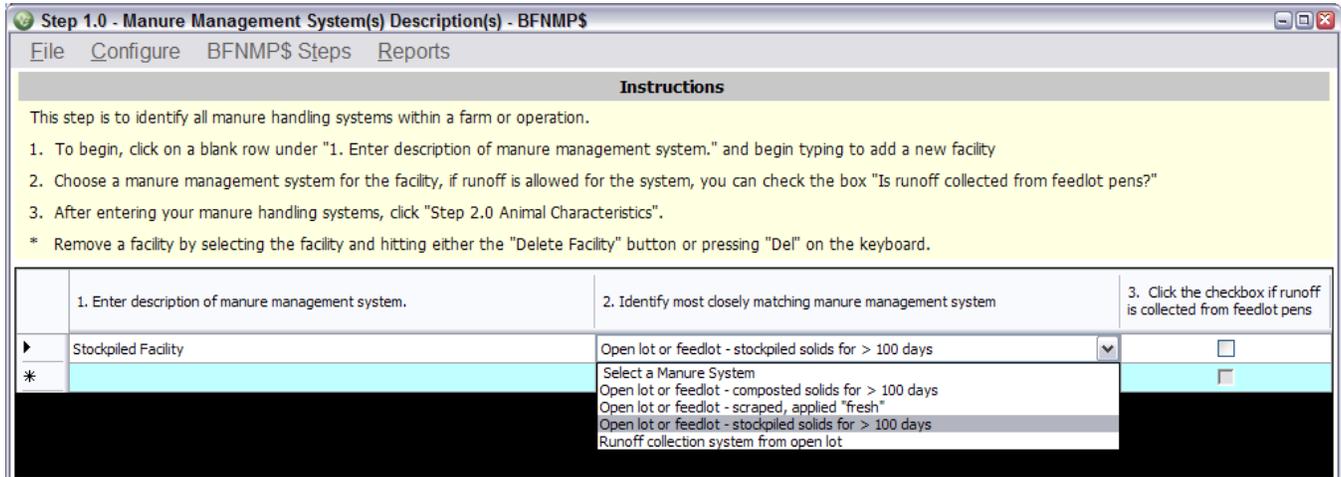
# BFNMP\$ Steps

## Step 1.0 Manure Management Systems

1) Pick a manure management system that best fits the farms' management.

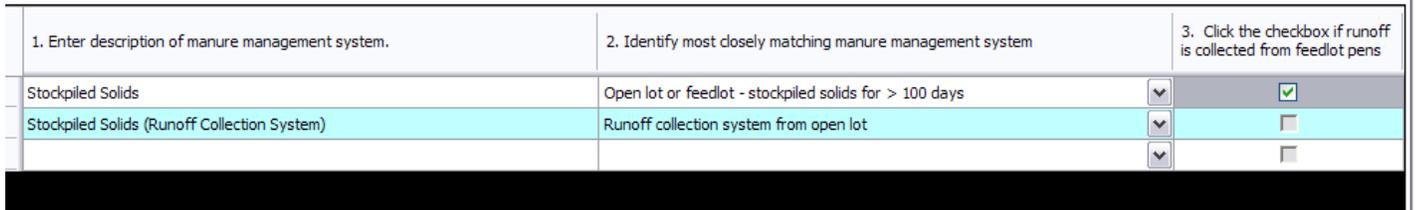
Multiple manure management systems can be entered for one farm.

Storage and treatment options are associated with default values for nutrient and solid retention (Table A2). However, these can be changed at a later step.



2) Check “is runoff collected from feedlot pens” if applicable.

Remove a facility by selecting the facility and hitting either the "Delete Facility" button or pressing "Del" on the keyboard.



## Step 2.0 – Animal Characteristics

Continue on to Animal Characteristics by selecting “Go to next step: 2.0 Beef Characteristics”

Delete Facility	Cancel Changes
Go to Start Page	Go to Next Step 2.0 Beef Characteristics

### Step 2.2.0 Beef Summary

This page will show a summary of the Beef animals entered. To add groups, select “Add New Beef Group”.

Manure Management Facility/System	Group Description	Feed Season	Weight Entering Feedlot (lb)	Weight Exiting Feedlot (lb)	Targeted Grade for Marketed Beef	Number of Cattle (Single Turn)	Number of Cattle Finished per Year	Average Days on Feed	Feed Cost (\$ / head / day)	Total Feed Cost (\$ / year)
Stockpiled Facility(Open lot or feedlot - stockpiled solids for > 100 days)	Default Beef Group	Winter	750	1,300	Choice	5,000	5,000	157	\$0.00	\$0

**Instructions**

- Enter your Beef groups:
  - \* Add a new group by clicking the "Add New Beef" button.
  - \* Update a group by highlighting the item above and clicking "Update Beef Group".
  - \* Remove a group by highlighting the record above and clicking "Delete Beef Group".
- After creating your groups, click "Go to Step 3.0 Manure Management" to set up your manure systems.

### Step 2.2.1 Beef Cattle Animal & Feed Management Characteristics

- 1) Choose the Feed Season.
- 2) Enter animal group information. To use defaults, select “Use Default Values”.
- 3) Next, select “Go to Feed Management”. Enter at least one diet for each group (multiple diets can be entered for each group).

\*This information will be used to determine nutrient excretion and the feed season will determine the manure nutrient and solids retention post housing (see appendix tables A2-A4).

By selecting “Return to Beef Summary”, all data will be saved.

Step 2.1.1 - Beef - Animal & Feed Management Characteristics - BFNMP\$

Close

### Beef Animal & Feed Management Characteristics

Beef Characteristics | Feed Management

**Instructions**

1. Enter a group description and select the manure management facility/system the beef group is housed at.
2. Enter the following animal characteristics and click "Go to Feed Programs" to add feed rations for the beef group.

Hitting cancel will undo the characteristic changes made on this page.

**User Inputs**

**Feed Season**

**Winter** Cattle fed from November to May.

**Summer** Cattle fed from April to October.

Group Description:

Manure Management Facility/System:

Live Weight of Cattle...

Entering Feedlot (lb):

Exiting Feedlot (lb):

Targeted Grade for Marketed Beef:

Number of Cattle in Management Group:

Enter dry bedding if you use straw or sawdust (without liquid solid separation) not applicable for sand or solid separation. Added as 100% DM to solids (lb/animal/day):

Step 2.1.1 - Beef - Animal & Feed Management Characteristics - BFNMP\$

Close

### Beef Animal & Feed Management Characteristics

Beef Characteristics | Feed Management

**User Inputs**

Ration Description:

Days on feed for this diet:

Feed Intake (lb dry wt./head/day):

Dry Matter Concentration (%):

Dry Matter Digestibility (Optional % DB):

Organic Matter Digestibility (% DB):

Ash (% DB):

Dietary Crude Protein (% DB):

Dietary Phosphorus (% DB):

Dietary Potassium (% DB):

Feed Cost (\$/head/day):

**Instructions**

To add new feed ration, begin typing on a blank row in the grid below, or click "Add New Ration" and enter data in the text boxes.

Modify feed rations by editing the data in grid, or select the row and use the text boxes.

Delete feed rations by selecting the row in the grid and hit "Del" on the keyboard.

To recover a deleted feed ration, click "Undo Deleted Records"

Ration Description	Days On Feed	Feed Intake (lb Dry Basis wt. / head / day)	Dry Matter Digestibility (% DB)	Organic Matter Digestibility (% DB)	Ash (% DB)	Dietary Crude Protein (% DB)	Dietary Phosphorus (% DB)	Dietary Potassium (% DB)	Feed Cost (\$/head/day)	Total Feed Cost (\$/year)
▶ Default Ration	157	23.00	80	83	4	15.5	.42	.8	\$0.00	\$0
* <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

### Step 3.0 Excreted and harvested Manure nutrients and solids summary

It is important that you “Update Manure Management Factors”. If the manure source is a liquid or slurry, the volume estimation can not be completed if you do not enter data.

**Instructions**

1. Please update the manure management factors for each of your manure management facilities/systems. Select the facility and click "Update Manure Management Factors", make sure that you complete information in the Nitrogen, Phosphorus, Potassium, and Solids tab.
2. If you have Beef animal groups, you may complete detailed manure handling options for pen cleaning, loading and composting.
3. After updating the manure management factors for each manure management facility/system, click "Step 4.0 Crop System".

\* You can view a detailed report of excreted manure by animal species by clicking "View as Excreted Manure".

\* Note: It is important that you "Update Manure Management Factors". If the manure source is a liquid or slurry, the volume estimation can not be completed if you do not enter data. In addition, if "Check if liquid or slurry" is not selected, Manure Volume Excreted will show up as 0 on all forms.

**Manure Management Systems in Scenario**

		Manure Nutrients After Housing Losses (lb/year)					Manure Nutrients After Storage (lb/year)					After Storage Manure Value (\$/year)			Manure Mass / Volume		
	Manure Management Facility/System	N	P	P205	K	K20	N	P	P205	K	K20	N	P	K	Total Solids After Storage (DM tons / year)	Total Manure Mass After Storage (as-is tons/yr)	Manure Volume After Storage (1,000 gallons / yr)
▶	Stockpiled Facility(Open lot or feedlot - stockpiled solids for > 100 days)	191,863	61,343	140,476	126,096	151,315	164,427	58,276	133,452	119,791	143,750	\$98,656	\$15,734	\$25,219	6,251	8,929	0
	Stockpiled Facility(Runoff collection system from open lot)	11,883	1,897	4,345	3,900	4,680	11,883	1,897	4,345	3,900	4,680	\$7,130	\$512	\$780	83	N/A	N/A

**Manure Management Status: Complete**

Go to Previous Step  
2.0 Beef Characteristics

Update Manure Management Factors

View Report

Return to Start Page

Go to Next Step  
4.0 Crop System

After housing – value after accounting for housing losses  
 After storage – value after accounting for housing and storage losses  
 Crop available - value after accounting for housing, storage, application losses, and nutrient availability to crops  
 Economic results were calculated using the following prices  
 Nitrogen (\$0.60 per lb. of N), Phosphorus (\$0.27 per lb. of P205), and Potassium (\$0.20 per lb. K20).

After you have updated the manure management factors, the status will turn to “complete”.

### Step 3.1 Updating Manure management factors- Nutrient and Solids Retention

Nutrient and solids losses occur during housing and storage. Default values are assigned but the user may alter the storage retention value. If you are unsure of the N or P retention, use the default values by leaving the data field blank. Housing losses of nutrients and solids have already been applied (see table A3 for default manure content retention post housing during summer and winter). Only the nitrogen retention during housing can be changed by the user.

Ash content- Default ash content of manure has been set at 75% to account for soil contamination of manure during pen cleaning.

Moisture % - Enter the moisture % if known or use the “typical manure moisture levels” (Table A1).

## Runoff

Nutrients expected to be retained in runoff are shown in table A4. Total pounds of nutrients and solids are reported however, mass and volume are not calculated due to rain water addition not being accounted for.

## Manure Handling

Manure Handling is organized into 4 steps:

- 1) Pen cleaning
- 2) Manure storage (compost, stockpile, or no storage)
- 3) Manure transport to application site
- 4) Manure spreading

Begin by choosing the equipment that is used throughout each step OR start at Step 1) and choose equipment as each step is completed.

Step 2) Has already been completed when the manure management system was selected at the beginning of the program. If you choose to change the manure management system, you may do so at this point.

Step 3) If composting manure is selected, setup composting equipment. If stockpile or apply fresh is selected, only setup transport will be allowed.

Step 4) Setup manure spreading equipment

Step 3.1 - Manure Management Factors - BFNMP\$

Close

Current Manure Management Facility/System: Stockpiled Facility (Open lot or feedlot - stockpiled solids for > 100 days)

Nitrogen, Phosphorus, and Potassium Solids Manure Handling (Beef Only)

Manure Handling Progress Complete

Manage Your Equipment Disable Manure Handling

Step 1 Pen Cleaning - Complete

Setup / Modify Pen Cleaning

Step 2 Select Manure Handling Option - Complete

Go Straight to Spreading **BFNMP\$ Tips** If you haul manure straight to the field after pen cleaning, choose this option.

Stockpile Manure **BFNMP\$ Tips** If you stockpile manure after pen cleaning, choose this option. Stockpiling assumes you stockpile over 100 days.

Compost Manure **BFNMP\$ Tips** If you compost manure after pen cleaning, choose this option.

Step 3 Manure Transport to Application Site - Complete

Setup Transport to Application Site **BFNMP\$ Tips** Enter equipment information about loading and hauling manure for transport.

Step 4 Manure Spreading - Complete

Setup Spreading **BFNMP\$ Tips** Enter equipment information about spreading manure

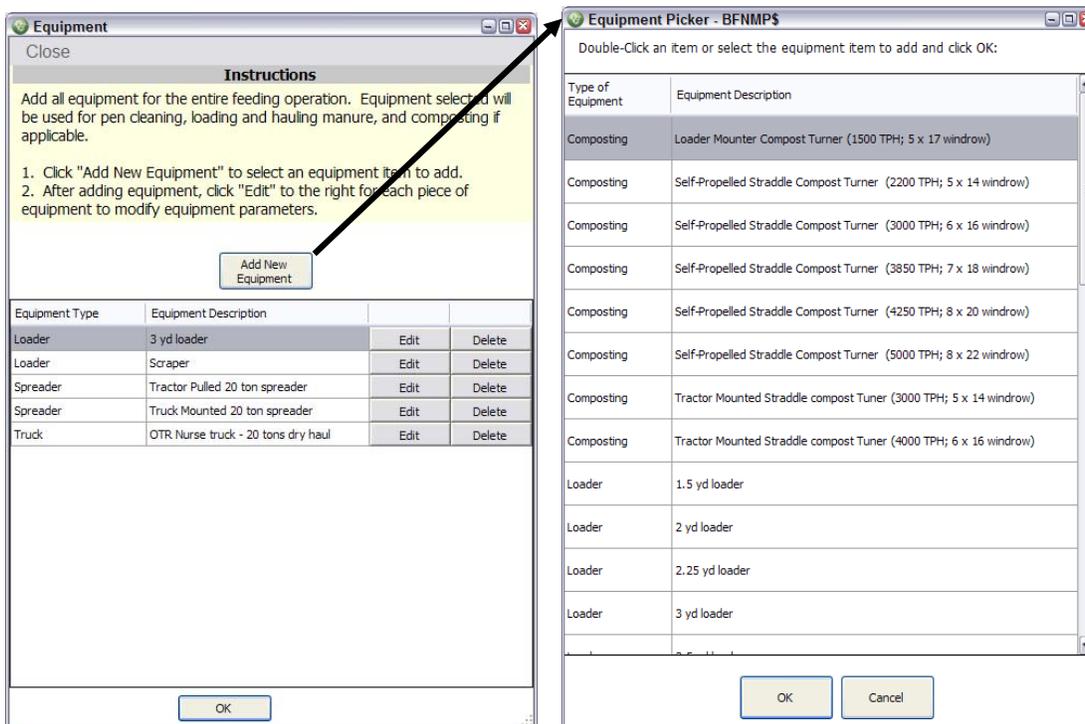
Save / Return to Manure Management Cancel

## Managing Equipment

You may choose all equipment types before you start and edit the equipment parameters.

Each step is allowed the following equipment types:

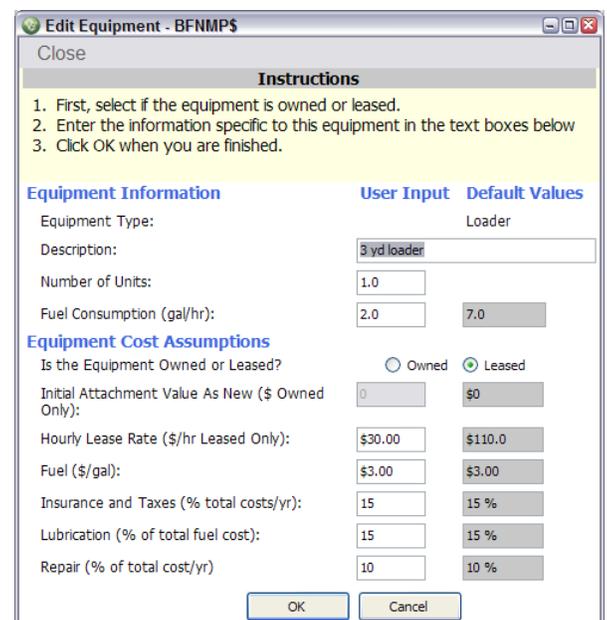
Step	Equipment type
Pen Cleaning	Skid steer, front-end loader, box scraper
Loading	Skid steer, front-end loader
Composting	Compost turner, front-end loader, skid steer
Transport	OTR truck, manure spreader
Spreading	Manure spreader



## Editing Equipment Parameters

All equipment types have default values for each parameter but the user can enter their own values.

Note: OTR trucks can only be leased and the lease rate includes all equipment costs parameters.



## Pen Cleaning

Number of animals- this will automatically be entered from the previous entries

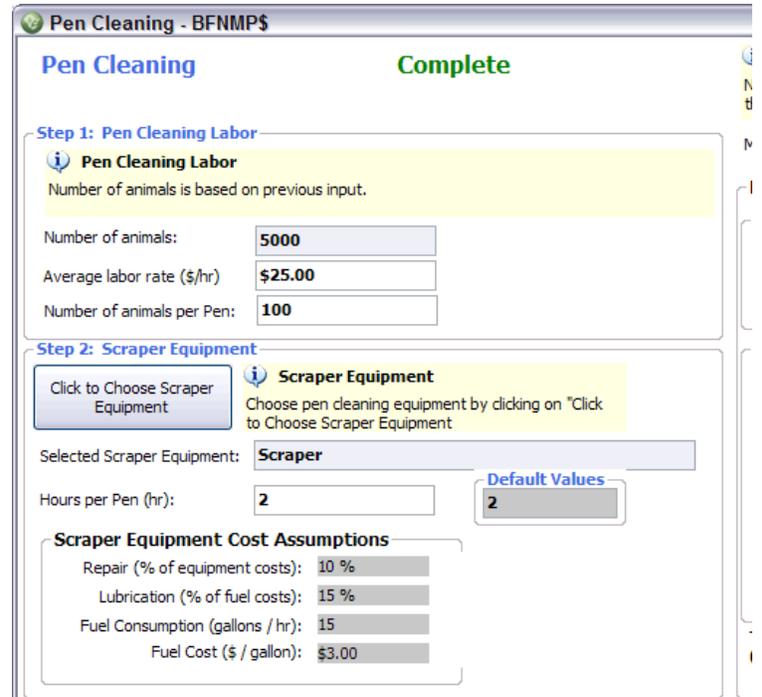
Average labor rate- When this number is entered, the value will carry throughout the manure handling steps

Number of animals per pen- Will calculate the number of pens for time and expense estimates

Choose equipment used for pen cleaning

Hours per pen- A default of 2 hrs is used for all pen cleaning equipment but the user may enter their own value in.

Pen Cleaning Output reports totals for each parameter, total labor, total equipment, and total cost (labor and equipment) per ton of manure available at pen cleaning.



**Pen Cleaning - BFNMP\$** Complete

**Step 1: Pen Cleaning Labor**

**Pen Cleaning Labor**  
Number of animals is based on previous input.

Number of animals:

Average labor rate (\$/hr):

Number of animals per Pen:

**Step 2: Scraper Equipment**

**Scraper Equipment**  
Choose pen cleaning equipment by clicking on "Click to Choose Scraper Equipment"

Selected Scraper Equipment:

Hours per Pen (hr):  **Default Values**

**Scraper Equipment Cost Assumptions**

Repair (% of equipment costs):

Lubrication (% of fuel costs):

Fuel Consumption (gallons / hr):

Fuel Cost (\$ / gallon):

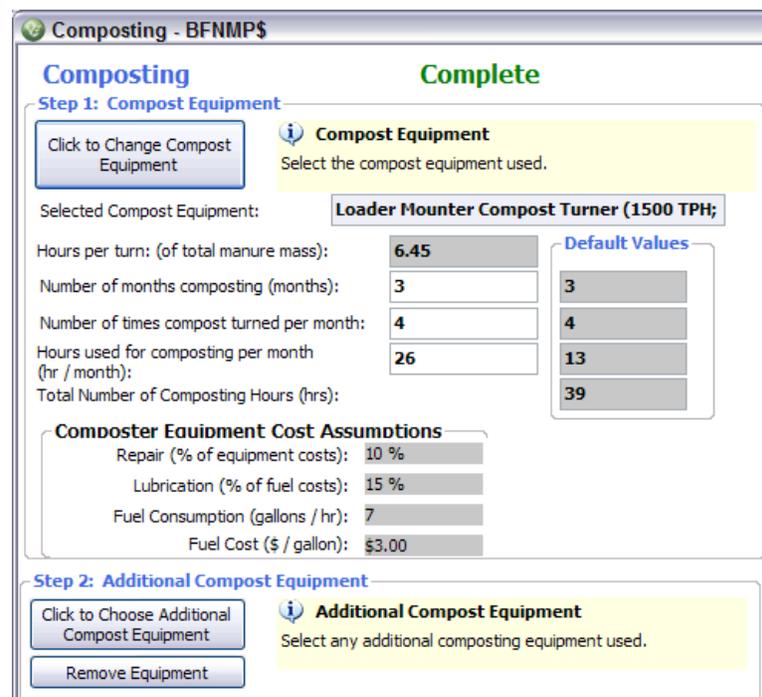
## Composting

Hours per turn- this is calculated by the default tons per hour (TPH) associated with compost turning equipment

Number of months composting- the default is set at 3 months. The nutrient and solid losses are assumed for complete composting (>100 days)

Number of times compost turned per month- is used to calculate total equipment time needed for composting

If more than one type of equipment is used for composting, this can be added at step 2 on the compost page.



**Composting - BFNMP\$** Complete

**Step 1: Compost Equipment**

**Compost Equipment**  
Select the compost equipment used.

Selected Compost Equipment:

Hours per turn: (of total manure mass):  **Default Values**

Number of months composting (months):

Number of times compost turned per month:

Hours used for composting per month (hr / month):

Total Number of Composting Hours (hrs):

**Composter Equipment Cost Assumptions**

Repair (% of equipment costs):

Lubrication (% of fuel costs):

Fuel Consumption (gallons / hr):

Fuel Cost (\$ / gallon):

**Step 2: Additional Compost Equipment**

**Additional Compost Equipment**  
Select any additional composting equipment used.

## Manure Transport to Spreading Site

Step 1 and 2) Choose loading equipment and hauling equipment that is used to transport manure from either the facility or the stockpile/ composting site to the manure application site

If the manure is loaded directly into the manure spreader, chose the manure spreader as the hauling equipment

Step 3)

Distance is calculated based on inputs that will be entered during the next step (Crop System) If the distance s known, the user can override the calculated value (tables A7 and A8)

Loading time- Equipment loading time has default values based on the cubic yards of the loaders but can be overridden. Loading time for the idling manure transport equipment is charged as a loading expense.

**Manure Transport - BFNMP\$**

### Transport From Stockpile to Application Site

**Step 1: Choose Loading Equipment**

Click to Choose Loading Equipment **Loading Equipment**  
What Equipment are you going to use to load this manure? Click "Choose Loading Equipment"

Selected Loading Equipment: **3 yd loader**

**Loading Equipment Cost Assumptions**

Repair (% of equipment costs):	10 %
Lubrication (% of fuel costs):	15 %
Fuel Consumption (gallons / hr):	2
Fuel Cost (\$ / gallon):	\$3.00

**Step 2: Choose Equipment for Receiving Manure**

Click to Choose Equipment to Receive Manure **Hauling Equipment**  
What are you going to load this manure into? (Assumed to be the same equipment used to haul.)

Selected Hauling Equipment: **OTR Nurse truck - 20 tons dry haul**

**Hauling Equipment Cost Assumptions**

Repair (% of equipment costs):	10 %
Lubrication (% of fuel costs):	15 %
Fuel Consumption (gallons / hr):	8
Fuel Cost (\$ / gallon):	\$3.00

**Step 3: Transport Inputs**

Labor Rate (\$/hr):  **Default Values**

If distance to site is unknown, enter 0 and a calculated value will be used (Distance travelled will be calculated after Step 4 Crop Systems is completed):  **1.15**

Enter the loading time (min/ton):  **0.65**

## Manure Spreading

Choose the equipment used to spread the manure. If manure is transported to the field with a nurse truck, the model will account for reloading the manure with a tractor onto the spreader. This cost includes loader use and the idling manure spreader. Additional manure application information will be entered during the next step (Crop Systems)

**Manure Spreading - BFNMP\$**

### Manure Spreading Status Complete

**Step 1: Choose Spreader Equipment**

Click to Choose Spreader Equipment **Spreader Equipment**  
What equipment are you going to use to spread this manure? Click "Choose Spreader Equipment"

Selected Spreader Equipment: **Tractor Pulled 20 ton spreader**

**Spreading Equipment Cost Assumptions**

Repair (% of equipment costs):	10
Lubrication (% of fuel costs):	15
Fuel Consumption (gallons / hr):	10.00
Fuel Cost (\$ / gallon):	\$3.00

## Step 4.0 Crop System

Follow further instructions of each step

- 1) Choose between simple and comprehensive crop systems approaches
- 2) Setup Manure Application Method
- 3) Setup Crop Management
- 4) Setup Crop Fields (Comprehensive only)
- 5) Setup Crop Priorities (Comprehensive only)
- 6) Setup Additional Acres

Step 4.0 - Crop System Nutrient and Yield Summary - BFNMP\$
File Configure BFNMP\$ Steps Reports

**Instructions**

1. To begin, select the type of crop system [Comprehensive or Simple]. If you know yields and specific acres of the crops grown on currently managed land, click Comprehensive.  
 Comprehensive Crop System: A comprehensive evaluation requires input of specific field information about currently owned and/or leased land. This approach will determine additional acres required to utilize manure nutrients beyond what is currently cropped.  
 Simple Crop System: A simple evaluation calculates total land base required to utilize the manure nutrients based on typical crops, yields, and field size in the local area of the operation.

**Crop System Status: Complete** Clear Crop System Inputs

**Step 1. Select the Type of Crop System.**

Comprehensive  Simple

**Step 2. Enter Manure application method.**

Setup Manure Application Method

**Step 3. Setup Crop Management**

Setup Crop Management

**Step 4. Setup Crops and Removal Rates (Comprehensive Only)**

Setup Crop Fields

**Step 5. Setup Crop Priorities (Comprehensive Only)**

Setup Crop Priorities

**Step 6. Setup Additional Acres**

Setup Additional Acres

	Manure Nutrient Concentration (lbs per unit)				Land Required (acres) <sup>1</sup>		Manure Mass Applied (vol/ton)	Transport Distance (miles)
	N	P2O5	K2O	Units	Within Farm	Total Required	Mass Applied	Average
Manure Management Facility/System								
Stockpiled Facility (Open lot or feedlot - stockpiled solids for > 100 days)	8.3	14.9	16.1	lbs per ton	N/A	3,510	8,929	10.00

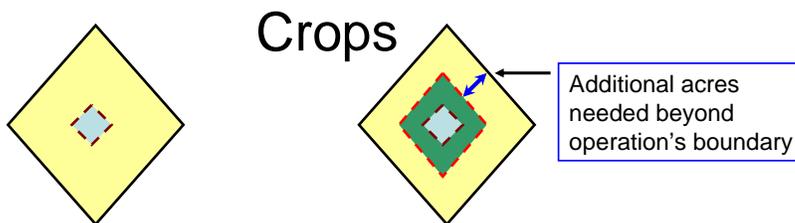
<sup>1</sup>When P-2 yr or P-4 yr application rates are selected, acres required are for 2 or 4 yrs total.

Go to Previous Step  
3.0 Manure Management
Go to Start Page
Finish / View Reports

*Crop System Step 1)* Choose either simple or comprehensive crop system approach.

Simple: calculates total land base required to utilize the manure nutrients based on typical crops in area, typical field size and percentage of land available to apply manure.

Comprehensive: calculates total land base required to utilize the manure nutrients within currently owned and/or leased land and calculates additional acres needed beyond owned or leased land. This is based on specific field and crop information for currently owned land and additional acres are calculated similar to “simple” approach.



**Simple inputs:**

- Crops in region
- % of types of crops

**Comprehensive inputs:**

- Defined acreage of each crop type

**Outputs:**

- Estimated amount of total acres needed

**Outputs:**

- Acres needed within and beyond farm's boundaries
- Estimated excess/deficiency of nutrients

*Crop System Step 2) Setup Manure Application Method*

For each manure management system, choose a manure application method from the drop down menu that matches the operation's application method as closely as possible.

This will determine the amount of N and P that will be crop available (Tables A2 and A4). The user may override the defaults.

**Explanation of crop available nutrients:**

**Crop Nitrogen availability accounts for transformations and forms of N lost during storage and availability based on application type.**

Organic N and NH<sub>4</sub>-N accounts for all harvested nitrogen and the ratio of each depends on the storage type (Table A5). For example, composted N will be 100% in the form of organic N because of NH<sub>3</sub> losses and N transformations. The availability of organic-N depends on storage and treatment type and NH<sub>4</sub>-N availability depends on the application type (Table A5

and A6). Applications that involve direct injection will be more available compared to surface application with no incorporation.

Crop available Nitrogen = (N retained x ratio of NH<sub>3</sub>-N: total N x NH<sub>4</sub> availability) + (N retained x organic N availability x ratio of org-N: total N)

- Ratio of NH<sub>3</sub>-N to total N depends on storage type
- Organic-N: total N depends on storage type
- Organic N availability depends on storage
- NH<sub>4</sub>-N availability depends on application type OR application type and soil conditions and days to incorporation if surface broadcast or dragline surface application is used

**Crop Phosphorus Availability is assumed to be 100% unless changed by the user. Phosphorus is converted to P<sub>2</sub>O<sub>5</sub> by multiplying P by 2.29.**

\*From this point forward P and P<sub>2</sub>O<sub>5</sub> can be used interchangeably.

#### *Crop System Step 3) Setup Crop Management*

##### **Simple**

- a) Average field size, portion of land cropped, and portion of land accessible for applying manure needs to be estimated in order to estimate the distance traveled.
- b) Select the manure application rate: N, P, or P 2 or 4 years.
- c) Enter fertilizer prices to estimate nutrient value of manure.

##### **Comprehensive**

- a) Enter total land within the operation's boundaries or leased land. This includes land under water, non-manured fields or other land.
- b) Select the manure application rate: N, P, or P 2 or 4 years.
- c) Enter fertilizer prices to estimate nutrient value of manure.

#### *Crop System Step 4) Setup Crop Fields (Comprehensive only)*

- a) Enter all crops manured on owned or leased land.
- b) if fertilizer or N credits from a previous crop will contribute to N, enter that value under "Non-manure credits"

## Crop System Step 5) Setup Crop Priorities (Comprehensive only)

### Setting crop priorities

To set crop priorities [Click here](#)

Close

**Instructions**

1. Prioritize the source of manure that you would like applied first.
2. Rank or exclude each crop within that manure source.
3. Repeat steps 1 and 2 until each manure source and crops are ranked or excluded.

\* You may reset your priorities by clicking "Reset Priorities".

**Manure use priority**      **Manure-crop application priority**

Reset Priorities

Manure Management Facility/System	Priority
Liquid (all lactating and older heifers)(Lagoon, solids removed annually for Dairy)	1
Solids (young heifers and dry)(Manure pack under roof - composted)	2

Crop	Crop Priority
Hi Moisture Forages - Corn Silage	1
Hi Moisture Forages - Corn Silage	2
Hi Moisture Forages - Alfalfa Haylage, mid-bloom	3
Grains - Soybeans	0

- a) If there are more than one manure management system, choose the system that you wish to use first.
- b) within that system, choose the crops (if more than one) you wish to manure first or exclude crops if you do not want that manure type to be used on that crop.
- c) repeat with each crop system

## Crop System Step 6) Setup Additional Acres

- a) Enter crops in the
- b) Determine the percent of each crop relative to total crops in the area. This allows user to define the crop use in the area and manure application rates and land base estimates will be more accurate.

### Crop Summary Reports:

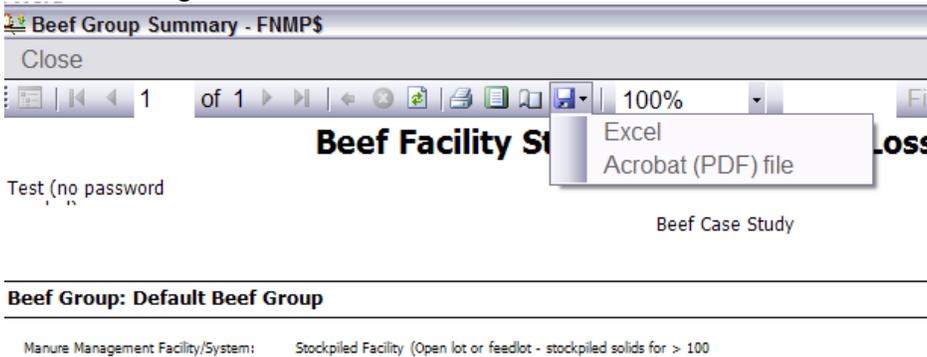
Reports can be accessed from the crop summary page. Crops, application rates, nutrient balances and distanced travelled are all reported. See table A7 and A8 for distance calculations.

# Reports

Reports can be selected at any point from the menu bar.



Once a report is open, it can be saved as a pdf or excel document by selecting the save icon and choosing the format.



## References

Agricultural Waste Management Field Handbook (AWMFH) 1992. Natural Resources Conservation Services (NRCS).

American Society of Agriculture Engineers (ASAE). 2005. Manure production and characteristics. ASAE Standards D384.2. ASAE, St. Joseph, MI.

Luebbe, M. K., G. E. Erickson, T. J. Klopfenstein, and J. R. Benton. 2008a. Aerobic composting or anaerobic stockpiling of beef feedlot manure. *J. Anim. Sci.* 86(E-Suppl. 2):323. (Abstr.)

Luebbe, M. K., G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist. 2008b. Aerobic composting or anaerobic stockpiling of feedlot manure. *J. Anim. Sci.* 86(E-Suppl. 3):102. (Abstr.)

National Research Council (NRC). 1996. *Nutrient Requirements of Beef Cattle* (7th Ed.). National Academy Press, Washington, DC.

# Appendix

## Project Team

### ASABE Standard Leaders

Wendy Power, Iowa State University  
Rick Koelsch, University of Nebraska

### Software Development

Rick Koelsch, University of Nebraska  
Ray Massey, University of Missouri  
Virgil Bremer, University of Nebraska  
Galen Erickson, University of Nebraska  
Rebecca White, Washington State University  
Mike Dehart, Veridian Inc, WA  
Joe Harrison, Washington State University

### Equation Contributors

Beef Galen Erickson, University of Nebraska  
Manure & Cropping Rick Koelsch, University of Nebraska  
Virgil Bremer, University of Nebraska  
Economics Ray Massey, University of Missouri  
Virgil Bremer, University of Nebraska

### Funding Provided by:



USDA-NRCS Conservation Innovation Grant - Development and Integration of a National Feed Management Education Program and Assessment Tools into a Comprehensive Nutrient Management Plan (CNMP).



CSREES: "An Integrated Approach to Reduced Risk of Phosphorus Pollution of Surface Waters in Crop-Livestock Based Managed Ecosystems of the Midwest"

## Abbreviations

Dietary CP	Dietary Crude Protein % of DMI
Dietary P	Dietary Phosphorus % of DM
Dietary K	Dietary Potassium % of DM
DM	Dry matter
DMI	Dry Matter intake lbs/hd/day
Hd	Head or number of cattle
SRW	Standard Reference Wt (lbs)
	Choice (28% marbling) = 1054
	Select (26.8% marbling) = 1019
	Standard (25.2% marbling) = 959
SBW	Shrunk body weight (lbs)
TS	Total Solids
Wt	Body Weight (lbs)
Yr	Year or total days on feed

Table A 1. Percent manure moisture of manure management system.

Manure Management System	% Manure Moisture
Fresh manure	86
Manure stored in covered tank	86
Bedded manure pack under roof	80
Open lot storage; cold, humid climates	70
Open lot storage; warm, semi-arid climate	30
Open lot storage; hot, arid climates	20

Adapted from tables 11-10 to 11-13; AWMFH Chapter 11

Table A 2. Manure excretion equations<sup>1</sup>.

Component	Equation
Nitrogen	$N_{\text{Excreted}} \text{ (lbs)} = (\text{diet CP}\% \times \text{DMI} \times \text{number of ani} \times \text{days on feed} / 6.25) - \text{N retained} [\text{number of ani} ((41.2 \times \text{live wt gain} / \text{days on feed}) - (0.243 \times (\text{average live weight}^{0.75}) \times ((\text{SRW} / \text{SBW})^{0.75}) \times ((\text{live wt gain} / \text{days on feed})^{1.097})) ] / 1000]$
Phosphorus	$P_{\text{Excreted}} \text{ (lbs)} = (\text{diet P}\% \times \text{DMI} \times \text{number of ani} \times \text{days on feed}) - (0.039 \times \text{g of retained N} \times 6.25)$
Potassium	$K_{\text{Excreted}} \text{ (lbs)} = \text{K intake} \times 90\%$
DM or TS	$\text{Manure Solids (lbs)} = (\text{days on feed} \times \text{DMI} \times (1 - \text{DM Digestibility})) + (\text{days on feed} \times 0.0203 \times 0.06 \times \text{ave live wt}) \times \text{number of ani}$
Volatile Solids/ OM <i>if OM digestibility and diet ash is known</i>	$\text{Manure Volatile Solids (lbs)} = ((\text{days on feed} \times \text{DMI} \times (1 - \text{OM dig}) \times (1 - \text{ash}\%)) + (\text{days on feed} \times 17 \times 0.06 \times \text{ave live wt} / 1000)) \times \text{number of ani}$
Volatile Solids/ OM <i>if OM digestibility and diet ash is unknown</i>	$\text{Manure Volatile Solids (lbs)} = 85\% \text{ of DM excretion}$ <i>Assumes a VS:TS of .85</i>

<sup>1</sup>NRC, 1996

Table A 3. Default manure content retention post housing during summer and winter<sup>1,2</sup>.

Component	% Retained <sup>3</sup>	
	Summer	Winter
Nitrogen	25%	48%
Phosphorus	97%	97%
Potassium	97%	97%
DM	44%	3%
OM	43%	89%

<sup>1</sup>Luebbe et al., 2008

<sup>2</sup>Summer is defined as cattle fed from April to October and winter is defined as cattle fed from November to May.

<sup>3</sup>Percent of manure content excreted.

Table A 4. Default manure content in runoff post housing during summer and winter<sup>1,2</sup>.

Component	% in Runoff <sup>3</sup>	
	Summer	Winter
Nitrogen	3%	3%
Phosphorus	3%	3%
Potassium	3%	3%
DM	9%	4%
OM	6%	2%

<sup>1</sup>Luebbe et al., 2008

<sup>2</sup>Summer is defined as cattle fed from April to October and winter is defined as cattle fed from November to May.

<sup>3</sup>Percent of manure content excreted.

Table A 5. Manure management systems' default values for organic-N, ammonium-N, organic-N availability, and solids and nutrient retentions<sup>1</sup>.

Manure Management System	Organic-N : Total N	NH <sub>3</sub> -N : Total N	Organic N Availability	OM Retention	Solids Retention	Nutrient Retention <sup>2</sup>		
						N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Open lot or feedlot - stockpiled solids for >100 days	0.8	0.2	50%	60%	86%	86%	95%	95%
Open lot or feedlot - composted solids	0.9	0.1	50%	46%	81%	56%	95%	95%
Open lot or feedlot - scraped, applied "fresh"	0.9	0.1	50%	100%	100%	100%	100%	100%
Runoff Collection System from Open Lot	0.1	0.9	70%	100%	100%	100%	100%	100%

<sup>1</sup>Luebke et al., 2008

<sup>2</sup>Percent of manure content post housing.

Table A 6. Default ammonia nitrogen availability by application type

Application type	Ammonia-N Availability Assumption
Immediate Incorporation	0.95
Surface Broadcast and Dragline <sup>1</sup>	$= 1/2^{(days\ to\ incorporation / 1/2\ life)}$

<u>Soil Condition</u>	<sup>1</sup> Assumed Half Life of NH <sub>3</sub> -N in Days
Warm, Dry Soils	1
Warm, Wet Soils	4
Cool Soils	14

Table A 7. Simple crop system haul distance equations.

Average Distance	$\left( \frac{((\text{Secondary Total Land} + \text{Primary Total Land}) / 2 / \% \text{ Manured} / \% \text{ Cropped} / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$
Maximum Distance	$\left( \frac{((\text{Secondary Total Land} + \text{Primary Total Land}) / \% \text{ Manured} / \% \text{ Cropped} / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$

Table A 8. Comprehensive crop system haul distance equations.

Condition	Facility	Equations estimating:	
		Average Distance	Maximum Distance
Owned or Leased Land	Primary Facility	$\left( \frac{((\text{acres in crops manured by primary facility} / 2) * 1 / (\text{total acres in cropped} / \text{total land owned}) / 1 / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$	$\left( \frac{((\text{acres in crops manured by primary facility}) * 1 / (\text{total acres in cropped} / \text{total land owned}) / 1 / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$
	Secondary Facility	$\left( \frac{((\text{acres in crops manured by primary facility} + \text{acres in crops manured by secondary facility} / 2) * 1 / (\text{total acres in cropped} / \text{total land owned}) / 1 / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$	$\left( \frac{((\text{acres in crops manured by primary facility} + \text{acres in crops manured by secondary facility}) * 1 / (\text{total acres in cropped} / \text{total land owned}) / 1 / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$
Additional Acres Needed	Primary Facility and Secondary Facility	$\left( \frac{((\text{Total owned land} + \text{Secondary Total Land} + \text{Primary Total Land}) / 2 / \% \text{ Manured} / \% \text{ Cropped} / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$	$\left( \frac{((\text{Total owned land} + \text{Secondary Total Land} + \text{Primary Total Land}) / \% \text{ Manured} / \% \text{ Cropped} / 1280)^{.5}}{(\text{AvgFieldSize} / 640)^{.5}} \right) -$