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Managing Manure Nutrients at Concentrated Animal Feeding Operations

Draft Guidance

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Appendices

DISCLAIMER

Mention of trade names or commercial products does not constitute endorsement or recommendation for use. The policies set forth in this manual are not final Agency actions but are intended solely as guidance. The manual does not substitute for the Clean Water Act or EPA's regulations; nor is it regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA and local decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. EPA may change this guidance in the future.

FOREWORD

This manual discusses the applicability and implementation of the proposed effluent limitations guidelines and standards (ELGs) and National Pollutant Discharge Elimination System (NPDES) permit requirements for concentrated animal feeding operations (CAFOs). The main purpose of this manual is to provide guidance to CAFO owners and/or operators and permitters on complying with the permit nutrient plan requirements. This is a draft document that is based on the proposed rule.

Confusion on the applicability of this manual may arise as other federal and state agencies have also developed approaches for nutrient management planning. Specifically, the U.S. Department of Agriculture (USDA) has developed the *Technical Guidance for Developing Comprehensive Nutrient Management Plans*. The USDA guidance is designed to provide technical guidance for the development of comprehensive nutrient management plans (CNMPs) under USDA's voluntary incentive program.

The U.S. Environmental Protection Agency (EPA) has developed this manual to serve as a companion to USDA's guidance and has structured the manual to match closely with USDA's guidance. The primary difference, however, is that this manual is designed to assist CAFO owners and/or operators and permit writers in complying with the Federal requirements contained in EPA's proposed regulation. USDA's guidance is designed to assist CAFO owners and/or operators in developing voluntary CNMPs. Although this manual also provides additional recommended (voluntary) practices for developing and implementing permit nutrient plans at CAFOs, which are largely based on USDA's technical guidance, it's main purpose is to provide guidance for complying with the Federal requirements associated with developing and implementing permit nutrient plans.

CHAPTER 1: INTRODUCTION

I Nutrients in Animal Waste

Animal feeding operations (AFOs) generate manure, in some cases more than 100,000 tons per year. Manure, which refers to the combination of feces and urine, consists primarily of nutrients (e.g., nitrogen, phosphorus, and potassium), organic matter, salts, and metals. Amounts of hair, bedding, soil, feed, and water in manure will vary on the type of operation and manure management practices at the facility, but can be significant. Manure may also contain pathogens, hormones, and antibiotics depending on the feed, supplements, and medications given to the animals.

AFOs also generate process wastewaters and other wastes during the normal course of operation. These wastes must be managed similarly to manure because of their nutrient content. In the context of this guidance, process wastewaters refer to water directly or indirectly used in the operation of the feedlot. This includes spillage or overflow from animal or poultry watering systems; washing, cleaning or flushing pens, barns, manure pits, or other feedlot facilities; direct contact swimming, washing, or spray cooling of animals; and dust control. Process wastewater also refers to any precipitation (rain or snow) that comes into contact with any manure, litter, bedding, or any other raw material or product used or generated from the production of animals or poultry. Another waste of concern at AFOs is silage leachate. Bunk silos are particularly noted for producing silage leachate. The amount of leachate produced depends on the production methods, especially the moisture content of the forage when harvested, and on precipitation and resultant runoff from the bunk silo and its drainage area.

Concerns About Nutrients at AFOs

AFOs have been identified as a major source of nutrients impairing surface waters and groundwater in the United States. Surface waters are affected by storm water runoff from fields where feedlot waste (i.e., animal manure) has been applied, direct runoff from feedlot facilities, and in some cases, the failure of manure containment structures such as lagoons. National water quality data suggest that feedlots alone, which does not account for potential runoff from farms using manure as a fertilizer, are estimated to adversely impact 16% of waters impaired by agricultural practices. (*National Water Quality Inventory: 1994 Report to Congress*. U.S. EPA, Office of Water, 1995.)

Nutrients entering surface water can result in or contribute to eutrophication (the main cause of impaired surface water quality in the United States). This results in excessive growth of algae and other nuisance aquatic plants. These plants can reduce available dissolved oxygen and reduce the normal distribution of sunlight, which inhibits the photosynthesis of resident plants and results in losses of resident plants, habitat for benthic invertebrates, and cover for fish. The oxygen reduction also leads to fish kills. Nutrients produced at AFOs have caused many fish kills nationwide. In New York, for example, manure handling, disposal, or lagoon runoff resulted in 14 fish kills from 1988 to 1992. (Gillette, D. Common Environmental Problems Arising from Liquid Manure Systems, Proceedings from the Liquid Manure Application System Conference, 1994).

The manure, wastewaters, and other wastes produced at AFOs are often mixed together at some point in the operation. Therefore, for the purposes of this document, we use the term “animal waste” to refer to the combination of manure, process wastewater, and other wastes produced at the operation.

The nutrient and organic matter content of animal waste makes it a valuable resource that can be effectively used for crop production and soil improvement. The nutrient content (primarily the nitrogen content), however, is not stable and varies depending on waste storage and handling practices, age of the waste, and land application practices used at the AFO. If not properly utilized, animal waste can be a major source of surface water and groundwater pollution. This happens through mechanisms such as surface runoff, erosion, leaching into groundwater, and atmospheric releases of nutrients.

II Benefits of Nutrient Management

Nutrient accumulation can occur on cropland of livestock farms. To preserve the fertilizer value of the animal waste, efforts must be taken to conserve the nutrients through nutrient management. The objective of nutrient management is to supply adequate nutrients to the soil and plants without creating an imbalance in the ecosystem. The goal of nutrient management is to prevent the excessive application of nutrients from animal waste, biosolids, and commercial fertilizers at rates exceeding the capacity of the soil and planned crops to assimilate nutrients and prevent pollution. Thus, nutrient management must account for nutrients already present in the soil before animal waste application.

The practice of nutrient management serves four major functions:

- Supplies essential nutrients to soils and plants so that adequate food, forage, and fiber can be produced.
- Provides for efficient and effective use of nutrient resources so that these resources are not wasted.
- Minimizes environmental degradation caused by excess nutrients in the environment.
- Helps maintain or improve the physical, chemical, and biological condition of the soil.

III Requirement for Permit Nutrient Planning At AFOs

In February 1998, the President released the Clean Water Action Plan, which provides a blueprint for restoring and protecting water quality across the United States. The plan describes more than 100 specific actions to expand or strengthen existing efforts to improve water quality. It also identifies polluted runoff as the most important remaining source of water pollution and provides for a coordinated effort to reduce polluted runoff from a variety of sources. As part of this effort, the Clean Water Action Plan called for the joint development of a unified national strategy by the U.S. Department of Agriculture (USDA) and U.S. Environmental Protection Agency (EPA) to minimize the water quality and public health impacts of AFOs. In March, 1999, EPA and USDA issued the *Unified National Strategy for Animal Feeding Operations*.

One important area that the Unified Strategy focuses on is the development of site-specific animal waste nutrient management plans by AFOs. USDA has developed the *Comprehensive Nutrient Management Planning Technical Guidance,* which will serve as the primary technical reference for USDA, state personnel, private consultants, and AFO owners/operators.

IV Applicability of NPDES Permitting Requirements and Effluent Limitations Guidelines and Standards

Concentrated animal feeding operations (CAFOs) are a subset of AFOs defined as point sources and are regulated by EPA and authorized states under the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES permit program (40 CFR Part 122) regulates the discharge of pollutants from point sources to waters of the United States. EPA has also issued Effluent Limitations Guidelines and Standards (ELGs) for the Feedlots Point Source Category (40 CFR Part 412) which establish the technology-based discharge requirements that are imposed in NPDES permits.

Definition of Point Source

The term "point source" means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture. (Section 502 of the Federal Water Pollution Control Act, as amended)

EPA's proposed rule co-proposes two alternatives for how to structure the revised NPDES program for CAFOs. The first alternative is a "two-tier structure" that establishes a single threshold for each animal sector. This alternative would establish a single threshold at the equivalent of 500 animal units above which operations would be defined as CAFOs and below which facilities would become CAFOs only if designated by the permit authority. The second alternative is a "three-tier structure" in which all operations with 1,000 animal units or more would be defined as CAFOs; those with 300 to 1,000 animal units would be CAFOs only if they meet certain conditions or if designated by the permit authority; and those with fewer than 300 animal units would only be CAFOs if designated by the permit authority. The 500, 1,000, and 300 animal unit equivalent number of animals for each sector would be as follows:

Animal Type	Two-Tier Structure	Three-Tier Structure	
	500 Animal Unit Equivalent (no. of animals)	1,000 Animal Unit Equivalent (no. of animals)	300 Animal Unit Equivalent (no. of animals)
Cattle excluding mature dairy or veal	500	1,000	300
Veal	500	1,000	300
Mature dairy cattle	350	700	200
Swine weighing more than 55 pounds	1,250	2,500	750
Swine weighing 55 pounds or less	5,000	10,000	3,000
Chickens	50,000	100,000	30,000
Turkeys	27,500	55,000	16,500
Ducks	2,500	5,000	1,500
Horses	250	500	150
Sheep or Lamb	5,000	10,000	3,000

See Section VII of the preamble to the proposed rule for a more detailed description of the CAFO definition and limitations under EPA's NPDES permit and ELG programs.

V Objectives of the Guidance

This manual provides guidance on developing and implementing animal waste permit nutrient plans and minimizing water pollution at your CAFO, both required components of the ELGs for CAFOs. This manual is intended for use by CAFO owners and managers, permit writers, other regulatory agency representatives, federal and state auditors, and consultants. The term "you" in this guidance, however, specifically means the CAFO owner and/or operator. EPA has prepared this manual to work in conjunction with USDA's technical guidance and other state nutrient management planning regulations and policies.

This guidance document includes both EPA required and recommended practices. At a minimum, CAFOs subject to ELGs and NPDES permitting requirements, which incorporate ELG requirements where appropriate, must comply with all requirements in their permit as described in this guidance. EPA's hope is that these facilities will also comply with all recommendations described in this guidance. This guidance describes numerous best management practices for managing and land-applying animal manure. It is EPA's hope that all other AFOs will also use this guidance to ensure proper management of their animal manure.

The four major objectives of this guidance are:

- Defining nutrient management goals at CAFOs.
- Identifying actions and priorities that will be followed to meet the goals.
- Identifying measures and schedules for attaining the goals.
- Reducing threats to water quality and public health.

This manual is organized into four chapters and nine appendices.

- Chapter 2 identifies and briefly describes requirements and recommendations for developing and implementing permit nutrient plans at CAFOs.
- Chapter 3 provides a sample CAFO Permit Nutrient Plan, including sample reporting forms and calculations.
- Chapter 4 provides a listing of the references used to develop the manual.
- Appendix A provides a list definitions and acronyms used in the manual.
- Appendix B provides a copy of the proposed ELG and NPDES rule for feedlots.
- Appendix C provides methods and calculations for determining the amount of animal waste managed in a storage facility.
- Appendix D provides a description of animal waste sampling procedures.
- Appendix E provides a description of soil sampling and testing procedures.
- Appendix F provides a description of the Leaching Index and Phosphorus Index tools used to assess nutrient movement in water bodies.

- Appendix G provides methods for calculating agronomic nutrient application rates for animal waste.
- Appendix H provides methods for calibrating animal waste application equipment.
- Appendix I provides recommended best management practices/conservation practice standards.

CHAPTER 2: MANAGING MANURE AND ITS NUTRIENTS AT CAFOS

To prevent adverse environmental impacts, you should properly manage animal manure, process wastes, wastewaters, and silage leachate from the time the animal excretes them or the animal operation generates them to the time they are applied to the land. EPA believes a well-designed plan for managing nutrients will help you become fully aware of the needed steps to successfully manage nutrients produced at your operation and protect your community's natural resources.

This chapter provides information on animal waste permit nutrient plan development and implementation. EPA used USDA's *Technical Guidance for Developing Comprehensive Nutrient Management Plans* draft as the template for this guidance document. EPA believes USDA documents and standards will serve as the primary technical references for developing animal waste permit nutrient plans at CAFOs. To ensure adequate protection of surface water, however, EPA has developed specific regulatory requirements that you must follow. The Agency has also identified additional voluntary recommendations you should follow. This chapter also lays out the specific components required by EPA in an animal waste permit nutrient plan. A checklist that you can use to ensure all components have been addressed in your plan is located at the end of this chapter.

I Development and Implementation of the Permit Nutrient Plan for CAFOs

A Preparation of the Plan

As a CAFO owner, you must prepare and implement a Permit Nutrient Plan (PNP) for your operation. PNPs are complex documents that require knowledge in a number of different areas. Therefore, you should undergo general nutrient management training to understand plan components and to successfully implement your plan. Free training, which lasts between 1 and 4 days, is often available from state agricultural Cooperative Extension Offices.

Your plan must be developed or approved by a certified specialist. These certified nutrient management specialists are available nationwide to help you prepare your plan. Generally, nutrient management specialists must complete a precertification training course, pass an examination, and receive continuing education on a variety of topics. To earn certification, nutrient management specialists must have competence in or an understanding of the following areas:

- Soil science and soil fertility
- Nutrient application and management
- Crop production
- Soil and manure testing and results interpretation
- Fertilizer materials and their characteristics
- Best management practices for use of nutrients and water management
- Environmental and economic impacts associated with improper nutrient management
- Applicable laws and regulations

Accredited PNP Organizations

Approved organizations for certifying nutrient management specialists include:

- Certified Crop Advisor Program of the American Society of Agronomy.
- Land Grant University Certification Programs.
- National Alliance of Independent Crop Consultants.
- State Certification Programs.
- American Registry of Professional Animal Scientists.

B Components of the Plan

Your PNP must include the following components (described in greater detail in section II of this chapter):

- # A cover sheet identifying the facility, who prepared the plan, and when the plan was prepared.
- # An executive summary that briefly describes the overall operation, animal production, crop production, application method and rates, and any environmental concerns at the local watershed.
- # An evaluation and discussion of animal waste collection, handling, storage, treatment, and transfer facilities and practices, including estimates of waste produced and collected at the operation and analyses of the waste contents.
- # An evaluation, including soil test analyses and results of the fields that will receive animal waste via land application.
- # Documentation on how, when, and where animal waste was applied to the land, including calculations used to develop an appropriate application rate, the method of land application, and the date of animal waste application.
- # Maintenance of specific records documenting animal waste management activities for a period of 5 years.

In addition, EPA recommends evaluating possible opportunities to reduce the nutrient content of manure through animal nutrition management, and if necessary, developing alternative uses for your animal wastes.

C Amendments to the Plan

You are required to amend your PNP whenever the CAFO design or operation described in your previous plan changes to an extent that materially affects the nutrient management requirements for the animal operation. Examples of changes that would trigger the need to amend your PNP include a substantial (>20%) change in the annual production of manure nitrogen and phosphorus, new or substantially modified waste/runoff collection and storage facilities, changes to crop rotations, or elimination or addition of fields receiving animal waste applications.

D Review and Certification of the Plan

Your original animal waste permit nutrient plan and any amendments to the plan must be reviewed and approved by a certified nutrient management specialist. You may prepare and approve your own plan if you are certified in nutrient management planning. In addition, you must review your plan annually and rewrite it every five years to ensure that appropriate measures and practices are in place to protect surface water quality.

Regulatory Requirements for Developing and Implementing PNPs at CAFOs

CAFOs must, at a minimum, comply with the following requirements:

- # Prepare and implement a PNP containing the components specified in Section II of this chapter.
- # Amend the PNP when conditions at the CAFO have changed that materially affect the nutrient requirements for the operation.
- # Review the PNP annually.
- # Rewrite the PNP every five years.
- # Use certified nutrient management specialists to prepare, review, and approve the original plan and all amendments.

Additional Recommended (Voluntary) Practices for Developing and Implementing PNPs at CAFOs

EPA recommends that CAFOs implement the following voluntary practice:

- # Undergo general nutrient management training.

II Components of CAFO Permit Nutrient Plans

EPA requires specific topics to be addressed in your plan. As necessary for your operation, your PNP should address animal waste collection, storage, and treatment practices; land application of the animal waste; and record keeping practices. In addition, you might want to address animal nutrition management as a method of reducing manure's nutrient content. If animal waste is not applied to your land as a source of nutrients, describe all relevant alternative uses of the waste such as selling it to other farmers, composting and selling it, or using it for power generation. While nutrients such as nitrogen and phosphorus are often major pollutants of concern, also address risk from other pollutants such as pathogens, and identify ways to minimize water quality and public health impacts.

This section provides guidance on the preparation of the following components of your plan:

- Cover sheet
- Executive summary
- Animal waste collection, handling, storage, treatment and transfer
- Evaluation and treatment of sites proposed for land application
- Land application
- Record keeping

A Cover Sheet and Executive Summary

To facilitate the review process of your permit nutrient plan, you must prepare a brief cover sheet and an executive summary of your plan. The cover sheet must contain the following information:

- Name and location of operation
- Name and title of the owner or operator
- Name and title of the person who prepared the plan
- Date (month, day, year) that plan was prepared
- Date (month, day, year) that plan was amended

The executive summary must contain the following information:

- Total average herd/flock size
- Total animal waste produced annually
- Description of manure collection, handling, storage, and treatment practices
- Identification of planned crops (rotation), including realistic yield goals
- Field condition as determined by appropriate soil phosphorus test for each field that will receive manure
- Number of acres that will receive manure
- Animal waste application rate (gallons or tons/acre)
- Amount of manure transported off site
- Identification of watershed or nearest surface water body

B Animal Waste Collection, Handling, Storage, Treatment, and Transfer

To develop a permit nutrient plan, you must have a thorough understanding of the entire animal operation and animal waste management system. Animal manure and other wastes generated at a CAFO can only be managed effectively if they are identified and classified in terms of their management requirements.

Manure and wastewater management systems at CAFOs must be designed and operated in a manner that minimizes water quality degradation. These systems vary by operation, but generally consist of five basic components:

Animal waste production
Animal waste collection
Animal waste storage
Animal waste treatment/utilization
Animal waste transfer

1 Animal Waste Production

To properly manage animal waste you must know how much is produced and its composition. Always try to minimize and/or reduce the amount of waste generated at your operation. One way to accomplish this is to divert clean water (e.g, rain falling on roofs of buildings, runoff from adjacent lands) from contact with feedlots and holding pens, animal manure, or animal waste storage systems. Another option is to use proper feeder designs and perform regular maintenance and adjustment of the feeder equipment to prevent excess feed waste and spilled drinking water. As a CAFO owner and operator, you must perform routine inspections of the animal production areas. The following inspections must be conducted:

Weekly inspections of all stormwater devices such as roof gutters to ensure they are free of debris that could interfere with the diversion of clean stormwater.

Weekly inspections of all stormwater devices that channel contaminated water to the wastewater and manure storage and containment structure, to ensure they are free of debris.

Daily inspections of all water lines providing drinking water to the animals to ensure there are no leaks in these lines that could contribute unnecessary volume to liquid storage systems or cause dry manure to become too wet.

Any deficiencies found as a result of these inspections must be corrected as soon as possible. Documentation of these inspections and any repairs performed must be included in your PNP.
The amount and composition of animal waste that you can collect and apply to the land varies considerably from farm to farm and from species to species. These variations are caused by differences in operating practices (e.g., composition of the feed ration; type and amount of bedding and water added or lost; animal waste collection, handling, and storage practices; and method and time of land application) and geographical factors such as climate.

Quantity of Animal Waste Produced

To develop appropriate animal waste application rates, you must obtain accurate estimates of the amount and composition of animal waste and process wastewater available for land application. The amount of waste generated at your facility is directly linked to the number of animals you maintain. However, because the composition of animal waste changes as it ages, the amount collected and applied to the land is often much less than the amount generated by the animals. Therefore, you should estimate the amount of animal waste that will be available for land application by calculating the volume of manure and waste stored on site and/or by calculating the quantity of animal waste removed during cleaning times. Your estimates must include milk parlor washwater and egg washwater. *See Appendix C for methods for determining the amount of animal waste in a pile, pond, or lagoon.*

Animal Waste Sampling & Testing

Because the nutrient content of animal waste depends on many site-specific practices, do not use average values to develop your plan. As a CAFO owner, you must sample your animal waste annually and send the samples to an accredited laboratory for analyses of at least total nitrogen, phosphorus, and potassium. Consider analyzing the animal waste for percentage of dry matter, ammonium nitrogen (NH_4-N), moisture content, calcium, manganese, magnesium, sulfur, zinc, copper, pH, and electrical conductivity (a common measurement of total dissolved salts) to better assess the resource value of the animal waste. Additional analyses on pathogen levels can also be performed. Check with state and local Cooperative Extension Offices for a list of analyses you should conduct on your animal waste. Samples must be collected from all manure storage areas, both liquid and dry, as well as any wastewater or stormwater storage areas.

Animal Waste Sampling

The key to an accurate analysis is proper sampling. Samples of your animal waste should be taken as close as possible to spreading to account for nutrient losses during handling and storage. However, you should allow sufficient time between sampling and spreading to obtain and interpret results of manure analyses.

To develop good estimates of the nutrient content of your animal waste, you should sample waste stored on site each time it is removed, unless you are a daily spread operation, where waste should be sampled several times throughout the year. Collect samples as close to the time of land application as possible, leaving sufficient time between sampling and land application to obtain and interpret the results of the analyses. If you provide bedding to your animals, make sure to include both bedding and manure in your samples. You should also sample each form of animal waste stored on site (e.g., stockpiled solids, separated solids, lagoon or pond effluent, lagoon or pond sludge) because they will often be applied to the land separately. *See Appendix D for a description of sampling procedures for solid waste, semi-solid waste, liquid waste, and poultry litter.*

Over time you should compare your feed rations, numbers of animals maintained, and weights of animals against the values used in your plan. The plan must be amended if the current nutrient levels are significantly different than those present when developing the plan.

2 *Animal Waste Collection*

The ease of collecting livestock and poultry waste often depends on the amount of freedom given to the animals. If animals are allowed to move freely within a given space, animal waste will be deposited randomly. Collection can be automated as in scrape and flush dairy barns or manual as in removal of waste from a dry lot with a front-end loader. You can improve the efficiency of animal waste collection by paving alleys and by installing gutters and slotted floors with mechanical and hydraulic equipment. Also you must properly maintain your animal waste collection systems to ensure proper flow of animal wastes.

You should keep production and collection of unnecessary waste to a minimum. For example, you can reduce the amount of contaminated runoff from open holding areas by restricting the size of open holding areas, roofing part of the holding area, and installing gutters and diversions to direct uncontaminated water away from animal waste. You can also cover stockpiles of animal waste to reduce nutrient losses and contaminants in the runoff.

Unroofed confinement areas such as dry lots must have a system for collecting and confining contaminated runoff. You can accomplish this by using curbs at the edge of paved lots and reception pits where the runoff exits the lots, or by using diversions, sediment basins, and underground outlets at unpaved lots. At unpaved beef feedlots, carefully remove animal waste so as not to break the seal on the soil the waste has created. This seal helps prevent the downward movement of contaminated water. You should also recycle flush water used at dairy and swine operations to the maximum extent possible to reduce the volume of contaminated water that must be managed. Dirt lots should have soil added to fill holes and retain the original grade of the lot.

3 Animal Waste Storage

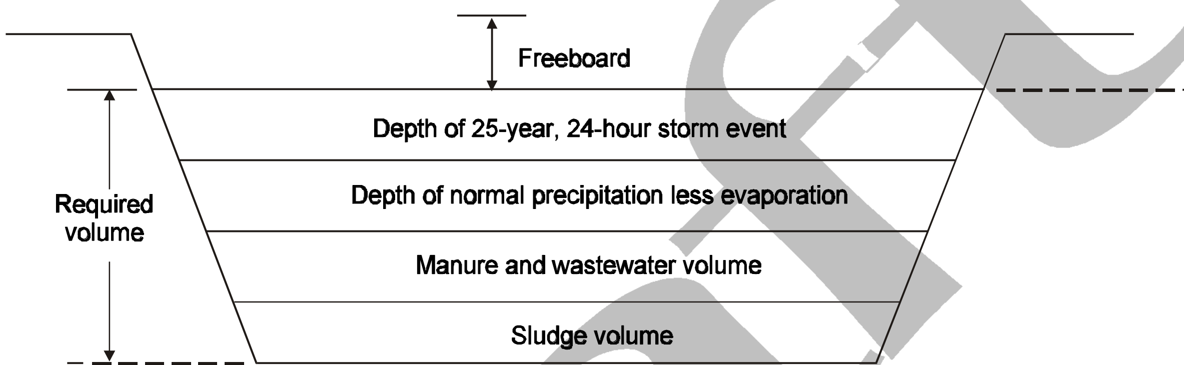
You should evaluate the soils, geology, and topography of the site, as well as the location and layout of your operation to determine the best type of storage facility for your operation. Animal waste storage facilities should be built following approved standards (e.g., USDA NRCS standards) and should be located away from water bodies, floodplains, drinking water wells, and other environmentally sensitive areas. Construction and maintenance of buildings, collection systems, conveyance systems, and permanent and temporary storage facilities should prevent leakage of organic matter, nutrients, and pathogens to surface or groundwater. Lagoons and ponds should have sufficient freeboard and be structurally sound (e.g., free of cracks and not eroding). You must conduct weekly visual inspections of the manure storage areas to check for integrity of the structures and to note the depth of the manure and process wastewater in the impoundment.

Design

The type and design of your storage facilities ultimately dictates when and how you must use animal waste. For example, if you have more than adequate storage for all the waste you expect your operation to produce and collect, you will have the flexibility to schedule land application of waste when weather and field conditions are suitable and when nutrients in the waste can best be used by crops.

Storage facilities for solid animal waste include waste storage structures such as houses for poultry litter, pits, stockpiles, dry lots, compost piles, and pads. As a CAFO owner, you must manage all seepage and runoff from these units. Liquid and slurry animal waste can be stored in storage ponds/lagoons or in aboveground or belowground tanks. Storage ponds/lagoons must be designed to provide capacity for the waste generated at the operation, plus normal precipitation less expected evaporation, precipitation expected from the 25-year, 24-hour storm, runoff generated during the storage period, and accumulated solids. Storage lagoons that are used to anaerobically degrade animal waste also need a specified treatment volume. A minimum of 1 foot of freeboard is also required. Figure 1 provides a cross section view of a storage pond and identifies the components necessary to determine the adequate volume of the pond. CAFO owners must install permanent depth markers in all surface impoundments to monitor the unit's storage capacity. These depth markers must indicate the design volume, the minimum freeboard necessary to allow for the 25-year, 24-hour storm, and the depth of the animal waste and process wastewater. Check water levels weekly to ensure capacity for the 25-year, 24-hour storm exists and monitor weather forecasts for predictions of major storm events.

Figure 1
Cross Section of Animal Waste Storage Pond



In the event of a catastrophic or chronic rainfall event, you must document the rainfall duration, amount of rainfall, and the estimated volume of any overflow that occurs as the result of this event.

You might want to consider designing a remote animal waste storage facility located near fields receiving waste as opposed to near animal housing facilities. Animal waste is typically transported by pump or tanker to the remote storage facilities throughout the year, minimizing labor for moving animal waste during field application. Remote storage facilities might also provide location options where odor or visual nuisances are of less concern or where soil permeability is better suited for animal waste storage.

Animal Mortalities

A by-product of all animal feeding operations is dead animals. Despite improved health and production practices, intermittent mortality is expected. Regardless of the cause of the mortality, proper disposal of carcasses is required to ensure biosecurity, to avoid creating nuisance conditions, and to manage the nutrients and possible pathogens decaying carcasses produce. As a CAFO owner, you must develop and implement a plan for properly handling and disposing of dead animals in a timely manner. Dead animals should be disposed within 2 days.

Methods for disposal include burial, incineration, rendering, and composting. Mortalities may not be disposed of in any liquid manure or stormwater storage or treatment system. You must determine the most appropriate method based on the type(s) of animal(s) maintained at your operation, state laws, and storage capabilities. For example, many poultry producers previously used fabricated pits for burying dead birds, but due to potential contamination of groundwater from nutrients leaching from these pits, many states have prohibited them. Currently, many poultry producers are effectively composting dead birds between layers of litter/cake and straw. Because of the size of cattle carcasses, most beef and dairy producers use rendering as their primary method of disposal. Swine producers bury, incinerate, render, and compost their mortalities. During the last several years, more swine producers have switched from burial to composting.

Maintenance of Storage Facilities

Animal waste storage areas that are constructed, maintained, or operated improperly might overflow, leak, or burst. You might not notice a small leak from your storage structure, but animal waste could flow through tile drains or old well casings into the water system. If an animal waste storage unit breaks down or bursts, you will have extensive property and environmental damage. Therefore, diligently maintain your storage areas and identify potential problems before they arise. This can be accomplished by performing daily and weekly visual inspections of all areas that store or handle animal wastes. Look for the following common problems during your inspections:

- Visible seepage or erosion of waste storage embankments
- Vegetation growing in storage areas
- Animals accessing storage areas
- Reduced freeboard
- Improperly functioning rain gauges
- Improperly functioning irrigation equipment

Safety precautions are also important around animal waste storage areas. Proper fences, barriers, and signs should be installed at all storage areas. Safety equipment should also be available, and everyone who works in the storage areas should know how to operate it safely.

Emergency Response Plan

Any type of storage system can fail and cause a major release of pollutants into the environment. You can minimize the impact of these releases if you are prepared, however. This means developing and implementing an emergency response plan. A copy of you emergency response plan must be placed in your permit nutrient plan. The plan should identify all the steps to take when a spill or release of animal waste occurs. A copy of the plan should be posted so employees can quickly determine what actions to take and who to contact. Figure 2 provides an example emergency response plan for a CAFO.

Generally, an emergency response plan for CAFOs should include the following actions:

- Take initial steps to eliminate the source of the spill, if possible. This might involve turning off all pumping equipment, plugging tile outlets or leaks, or repairing broken lines.

- Review the extent of the emergency. Determine how much help is needed to control and clean up the release. Determine the type of emergency (e.g., rainfall caused an overflow of storage pond A); estimate the area covered and distance the waste has traveled from the spill area (e.g., 5 acres, 1/4 mile); determine whether the waste has reached wells, tile lines, ditches, waterways, roads, etc; provide a damage report (e.g., fish kill, property damage); and determine what type of assistance is needed (e.g., earth moving equipment to block the gully leading to the nearby creek).

- Immediately contact designated personnel and/or appropriate state or local agencies. Your plan should identify the name(s) and phone number(s) of the appropriate office(s) to call.

- Develop an emergency action plan. This might require a number of different activities such as placing soil on the edge of the storage pond to plug the discharge area, removing remaining waste from the pond, and applying it to surrounding fields at appropriate application rates.

An important part of any emergency response plan is prevention. You can prevent spills from liquid irrigation and drag hose systems by having an automatic shutoff on pumping equipment or by establishing radio communications with the pump operator to turn off the animal waste flow in emergency situations. You should also check all irrigation, transfer lines, or valves before pumping or transferring animal waste. Look for defects and insecure connections. Put only solid pipe sections over any watercourse, stream, municipal drain, and catchbasins. Also, make sure there is no chance of back-siphoning when transferring to another tank.

You should also monitor tile outlets before, during, and after applying animal wastes for any sign of water contamination. A change in the water color of running tiles indicates a potential animal waste spill. If any trace of animal waste is noticed, stop applying, plug the tile, and take necessary steps to handle the contaminated flow.

Figure 2
Sample Emergency Response Plan for CAFOs

Emergency Response Plan for Animal Waste Spills or Emergencies

Facility Name: ______________________ County/Region: ______________________
Address: ______________________ Township: ______________________
Telephone: ______________________ Lot Number: ______________________

To prepare for an event such as an overtopped storage structure, animal waste spill, milkhouse waste spill, sludge spill, or any other occurrence that conveys animal waste into surface or groundwater, I will make the following equipment available to contain and control the spill:

____
____
____
____

Steps to be taken if an animal waste, milkhouse waste, or sludge spill occurs are:

1. Eliminate the source of the spill, if possible:

____
____
____
____

2. Contact the following designated personnel/agencies:

Name: ______________ Agency: ______________ Phone: ______________

Name: ______________ Agency: ______________ Phone: ______________

Name: ______________ Agency: ______________ Phone: ______________

3. Contain and clean up the spill/release:

____
____
____
____
____
____

4 Animal Waste Treatment

Treatment can be considered any action designed to reduce the pollution potential of the animal waste, including physical, biological, and chemical treatment. You should handle and treat animal waste in a manner to prevent or minimize the loss of nutrients to the atmosphere during storage; to make the material a more stable fertilizer when land-applied; or to reduce pathogens, vector attraction, and odors, as appropriate. Removing nutrients in an appropriate fashion from animal waste can be an important strategy if you are faced with limited storage capacity and/or limited cropland when applying wastes at agronomic rates for the crops being grown.

Many treatment systems have been developed for use with animal wastes. Typical reasons for treating animal wastes include ease of storage or transport; reducing odor potential; extracting energy; and concentrating, partitioning, or removing nutrients. Some commonly used treatment options are briefly described below.

Solids separation. Solid and liquid wastes are separated to reduce the solids entering a liquid storage facility to extend its storage capacity, to facilitate reusing the liquid in a flushing system, to reduce clogging of irrigation sprinklers, or when volume reduction aids treatment. Animal waste can be separated through sedimentation (gravity), centrifuging, or screening.

Treatment in lagoons. After solids removal, waste can be treated as a liquid in an anaerobic or aerobic lagoon or in an anaerobic digester. An anaerobic lagoon changes the waste composition by reducing the nitrogen content through ammonia volatilization. Anaerobic lagoons can also effectively reduce odors if managed properly. If minimizing odors is a critical concern at your operation, however, you should consider treatment in an aerobic lagoon or a covered digester. Aerobic lagoons operate within a depth range of 2 to 5 feet to allow oxygen entrainment necessary for the aerobic bacteria, but typically require significant aeration and space. In an anaerobic digester, liquid waste is confined in an air-tight vessel such as a covered lagoon and decomposed, producing biogas that can be used as an energy source.

Composting. Composting consists of the aerobic biological decomposition of the animal waste's organic matter. Many farmers use composting to improve handling, enhance marketability, and/or reduce odor and nuisance problems associated with animal wastes. During composting, animal waste is stabilized when nitrogen is converted from the unstable ammonia form to a more stable organic form.

5 Animal Waste Transfer

Manure and waste collected from within a barn or confinement area must be transferred to the storage or treatment facility or directly to an end use such as land application. In many cases, the transfer function is just an extension of the collection function. At more complex facilities, however, transfer methods must be designed to overcome distance and elevation changes between collection and storage facilities. In these situations, mechanical equipment such as pumps, pipelines, and tank wagons, might be needed to move the animal waste.

Animal waste transported off site must be sampled at least once a year for total nitrogen, phosphorus, and potassium. EPA is co-proposing two options for managing off-site transfer of animal waste. Under one option, CAFO owners and operators would be required to obtain a certification from off-site land applicators stating that they are land applying CAFO-generated manure at proper agricultural rates. As part of this option, you as the CAFO owner would also be required to maintain records of transfer, including the name of the recipient and quantity transferred, and would be required to provide the recipient with an analysis of the contents of the waste and a brochure describing the recipient's responsibilities for proper management of the animal waste. Under the second co-proposed option, CAFO owners and operators would only be required to keep records of off-site transfer of animal waste.

Regulatory Requirements for Animal Waste Collection, Handling, Storage, Treatment, and Transfer

CAFOs must, at a minimum, comply with the following requirements:

Animal production areas must be routinely inspected.
Animal waste must be sampled annually.
Each form of animal waste must be sampled.
Animal waste must be tested annually by an accredited laboratory.
Analyses of animal waste must include total nitrogen, phosphorus, and potassium.
Feedlot runoff must be contained and adequately managed.
Runoff diversion structures and animal waste storage structures must be visually inspected for seepage, erosion, vegetation, animal access, reduced freeboard, and functioning rain gauges and irrigation equipment, on a weekly basis.
Water lines must be visually inspected on a daily basis.
Deficiencies based on visual inspections must be identified and corrected within a reasonable timeframe.
Depth markers must be permanently installed in all surface impoundments.
Lagoons, ponds, and tanks must be maintained to retain capacity for the 25-year, 24-hour storm event.

At a minimum, CAFO PNPs must include the following information:

Quantity of animal waste produced and collected during each 12 month period.
Calculations for estimating the amount of animal waste collected.
Animal waste sampling techniques.
Animal waste test results.
Emergency response plan.
Plan for properly handling and disposing of dead animals in a timely manner.
Records of off-site transfer of animal waste.
Records of rainfall duration, amount of rainfall, and the estimated volume of any overflow that occurs as the result of any catastrophic or chronic rainfall event.

Additional Recommendations (Voluntary) for Animal Waste Collection, Handling, Storage, Treatment, and Transfer

In addition to the Regulatory Requirements listed above, EPA recommends that CAFOs conduct the following activities:

- Estimate the maximum livestock capacity of the animal operation.
- Estimate the maximum number of livestock maintained at the CAFO at any one time if substantially different than the maximum livestock capacity.
- Estimate the annual number of livestock produced.
- Divert clean water from contact with animal housing and animal waste collection and storage areas.
- Estimate the amount of animal waste produced by calculating the volume of manure and waste stored on site or removed during cleaning.
- Sample stored waste each time it is to be used.
- Periodically, analyze animal waste for percentage of dry matter, ammonium nitrogen, total nitrogen, phosphorus, potassium, moisture content, calcium, manganese, magnesium, sulfur, zinc, copper, and electrical conductivity.
- Improve the efficiency of manure collection.
- Inspect animal waste handling and storage areas frequently for potential problems.
- Review of potential water contamination sources from existing animal waste handling, collection, storage, and spreading practices.
- Estimate the capacity needed for storage.

C Evaluation and Treatment of Sites Proposed for Land Application

Land application is the most common, and usually the most desirable method, of using manure and other animal wastes because of the value of the nutrients and organic matter in these materials. Therefore, it is extremely important that you thoroughly evaluate and properly maintain all land that will receive animal waste applications. This evaluation can be accomplished in five major steps:

- Identify lands to receive animal waste applications.
- Identify nearby water bodies and environmentally sensitive areas.
- Assess the potential for feedlot and animal waste storage facilities to contaminate groundwater, and assess the potential for groundwater to have a direct hydrologic link to surface water.
- Conduct soil tests and analyses.
- Identify conservation practices and management activities needed for erosion control and waste management.

Each of these steps is described in more detail below.

1 Identify Lands Receiving Animal Waste Applications

To accurately identify lands receiving animal waste applications, you must identify and provide the counties and watershed codes where the feedlots and lands receiving animal wastes are located. This identification must include all lands under your operational control, both owned and rented. You should also provide farm maps or aerial photographs that identify the animal feeding operation's boundaries, individual field boundaries, field numbers and acreages, and soil types and slopes. Aerial photographs will also provide information on vegetation, surface runoff patterns, erosion conditions, proximity to cultural features, and other details.

2 Identify Nearby Water Bodies and Environmentally Sensitive Areas

You must identify, preferably on the maps, locations of nearby surface water bodies. You should also identify other environmentally sensitive areas such as sinkholes, streams, springs, lakes, ponds, wells, gullies, and drinking water sources where the application of animal wastes is restricted. Environmentally sensitive areas should be considered as areas that would facilitate the transport of nutrients, pathogens, and other potential contaminants into surface water bodies or groundwater. You should remain aware of these areas and, if necessary, modify your animal waste collection, storage, and treatment practices to ensure that animal waste does not come into contact with these areas. US Geological Survey topographic quadrangles might assist you in identifying sensitive areas. The quadrangles provide information about slopes; location of forested areas; topographic relief; and distances to identified resource features, such as wells, watercourses, houses, roads, and other cultural features.

3 Conduct Assessment of Surface Water and Groundwater

To develop appropriate animal waste application rates and identify appropriate conservation practices, you should understand the potential for animal waste nutrients and other potential contaminants such as pathogens to migrate to surface and groundwater via surface runoff and leaching. CAFOs subject to effluent limitations guidelines that require zero discharge from the production area to surface water via groundwater (i.e., all existing and new beef and dairy operations, and new swine and poultry operations, see proposed §§412.33(a), 412.35(a), and 412.45(a) in Appendix B) are assumed to have a direct hydrologic connection to surface water. These CAFOs, therefore, are required to either achieve zero discharge from the production area via groundwater and perform the required groundwater monitoring or provide a hydrologist's statement that there is no direct connection of groundwater to surface water at the facility. The remainder of this section discusses the type of assessment that EPA expects to be performed by CAFO owners and operators to determine if there is a direct connection of groundwater to surface water.

Hydrologic Link Assessment

For more information on groundwater, contact your state or local Cooperative Extension Office. Or, see the following NRCS references:

- # National Engineering Handbook (NEH) Section 16, Drainage of Agricultural Lands
- # NEH Section 18, Ground Water
- # Engineering Field Handbook (EFH) Chapter 12, Springs and Wells
- # EFH Chapter 14, Drainage

To conduct your assessment, use a qualified technical expert to ensure that all aspects of nutrient transport have been evaluated. To determine if there is a hydrologic link from surface water to groundwater, you must evaluate a number of parameters including soil depth and type, depth to water table, hydrogeologic characteristics of the surficial aquifer, proximity to surface water, and other physical features of the watershed. Other critical features may include land-surface form, geologic texture, and climate. Land-surface form can be used to quantify land-surface slopes and relief. Geologic texture provides estimates of surficial and deep subsurface permeability which control infiltration, the production of overland flow, and groundwater flow rates. Climate characteristics can be used to approximate available water to surface and groundwater systems. Areas that are likely to have surface water and groundwater interactions are wet plains with highly permeable surface and subsurfaces such as bedrock, and wet plateaus with poorly permeable surface and highly permeable subsurface. One way to determine if you have a hydrologic link is to evaluate the water depths between the closest surface water body and groundwater and then stress (e.g., pump) one of the water bodies to see if it affects the other. Check with state and local Cooperative Extension Offices to identify the most appropriate method of determining if you have a hydrologic link between surface and groundwater.

Surface Runoff & Leaching Assessment

You need to understand how nutrients and other contaminants can migrate from your operation to water bodies before assessing the potential risks associated with your operation. Surface runoff of animal waste nutrients occurs when precipitation exceeds soil permeability. In this situation, excess water runs off the land carrying soluble and suspended materials such as nitrogen and phosphorus. Groundwater contamination is likely in areas where soils have high leaching potential, and in areas with thin soils over fractured limestone or poorly cemented or fractured sandstone bedrock. Local geologic maps and reports can provide information on types of bedrock, bedrock structure, depth to bedrock, location of fault zones, characteristics of unconsolidated deposits, depth to water table, aquifer characteristics, and other geologic and groundwater information at your operation.

Soils vary in their abilities to transmit water. Differences in soil permeability are caused by varying pore sizes, which are related to the soil's texture and structure. Soils with lower permeability might allow the time needed for transformation and plant uptake of nutrients, while soils with high permeability might leach contaminants or nutrients. Permeability can be measured in a laboratory or estimated based on soil characteristics. You can assess the potential for surface loss and leaching for each soil group identified at your operation by using soil survey reports, available from USDA Natural Resource Conservation Services. These reports provide soil map units, photos of features near a site, information on seasonal flooding and the water table, and engineering interpretation and soil classification.

Several tools, such as the Soil Nitrogen Leaching Index (LI) and Phosphorus Site Index (PI), might assist your assessment of the potential risk of nitrogen and phosphorus movement to water bodies. The LI was developed by USDA Agricultural Research Services to help determine the degree to which water containing soluble nutrients such as nitrate-nitrogen percolates below the crop root zone. The LI provides an estimate of the average percolation below 1-meter crop root zone based on the hydrologic soil group, the amount of average annual precipitation, and the average amount of seasonal precipitation (October through March). The unit of measurement or vulnerability rating for the LI is inches of water infiltrating below the 1-meter root zone. The LI does not look at the leaching potential of specific nutrients, but rather the intrinsic probability of leaching occurring if nutrients are present and available to leach. A high vulnerability rating (or inches of water infiltrating below the root zone) indicates that the leaching potential of nutrients through the soil and into the groundwater is high for that site. In that case, additional applications of animal waste might not be recommended. The LI is available in section II of USDA's Field Office Technical Guide.

The Phosphorus Index, also developed by USDA, is a simple assessment tool that examines the potential risk of phosphorus movement to water bodies in two steps. Part A evaluates potential phosphorus loss due to site and transport characteristics (e.g., soil erosion, subsurface drainage, leaching potential, distance to surface water). Part B evaluates potential phosphorus loss due to management practices (e.g., animal waste application rate, application method). The final phosphorus loss rating should range from <8 to >32 with 32 considered a "very high" potential for phosphorus movement from the site. The PI is available in USDA's Field Office Technical Guide, state supplements to the National Agronomy Manual, or state technical notes. *See Appendix F for more information on the Nitrogen Index and the Phosphorus Index.*

Your assessment of the potential transport of nutrients and other contaminants from the feedlot and crop fields to surface and groundwater should contain a narrative description of the overall risks associated with your operation. This includes risks associated with topography and other geographical considerations and risk associated with operating and management practices.

4 Conduct Soil Tests and Analyses

Soil testing is an important agronomic tool for determining crop nutrient needs. A soil test is a laboratory procedure that measures the plant-available portion of soil nutrients. This measurement is used to predict the amount of nutrients that will be available during the growing season. Soil test results form the basis for determining nutrient recommendations at your operation. Traditional soil tests include tests for pH, nitrogen, phosphorus, potassium, soil organic matter, and electrical conductivity. As a CAFO owner you must conduct soil tests every 3 years on all fields receiving animal waste and analyze the soil for at least phosphorus. EPA also recommends analyzing the soil for nitrogen, potassium, pH, salinity, metals, micronutrients, and organic matter content.

Generally, the soil test report contains the laboratory test results, plus fertilizer and liming recommendations for the next two crops in the rotation. Additional information regarding the recommended time and method of fertilizer and lime applications will also be provided in the form of a soil test note accompanying the report. In certain parts of the country, the pre-plant nitrate test and pre-sidedress nitrate test are used to determine whether additional nitrogen is necessary after the crop has begun growing.

You should sample each field area where animal waste nutrients are to be applied. If different field areas have different soil types, past cropping histories, or different production potentials, you should sample and manage the fields separately. To ensure that a *representative* soil sample is collected from each field, sample the entire area for each individual field at an appropriate depth, and thoroughly mix all samples for an individual field together. Apportion part of this mixed soil as a representative sample for this individual field. Next, send samples for each field to an accredited laboratory for analyses. An accredited laboratory is one that has been accepted in one or more of the following programs:

- State certified programs.
- The North American Proficiency Testing Program (Soil Science Society of America).
- Laboratories participating in other programs whose tests are accepted by the Land Grant University in the state in which the tests are used as the basis for nutrient application.

Soil fertility specialists at state land grant universities have conducted extensive research to determine the most suitable extraction solutions, to correlate soil tests and crop yields, and to calibrate soil tests with nutrient recommendations. These specialists can provide valuable information and work with you to ensure accurate testing. As a CAFO owner, you must collect and analyze your soil samples in accordance with acceptable extension protocols and state nutrient management standards. These protocols must be included in your PNP.

The analytical results from a soil test extraction are relatively meaningless by themselves. Soil nutrient levels must be interpreted by you and/or the certified nutrient management specialist in terms of the soil's ability to supply the nutrients to crops. Most soil test laboratories indicate the interpretation of the results by use of qualitative terms such as "low," "medium or optimum," and "high or very high." Results are related to quantities of nutrients extracted. When several samples have been collected from the same field, you should compare the soil test reports to determine the best rate of animal waste application and liming. *See Appendix E for information on soil sampling, soil testing, and soil analysis interpretations.*

5 Identify Conservation Practices and Management Activities Needed for Erosion Control and Waste Management

Reducing the amount of runoff and eroded sediment that can reach surface water will in turn reduce the amount of nutrients that can reach the surface water. Numerous management practices for the control of runoff and soil erosion have been researched, developed, and implemented. Runoff and erosion control practices range from changes in agricultural land management (e.g., cover crops, diverse rotations, conservation tillage, contour farming, contour strip cropping) to the installation of structural devices (e.g., diversions, grade stabilization structures, grassed waterways, terraces). You should implement an approved USDA/NRCS conservation plan on all fields.

The principal causes of soil erosion are insufficient vegetative cover (usually the result of inappropriate tillage and cropping practices for local site conditions); overexposure through use of cultivated crops on soils not suited to cultivation; and use of improper tillage implements and methods used in preparation and tillage of the soil. You can minimize soil erosion by using the soil to produce crops to which it is suited, using adequate fertilizer and lime to promote vigorous growth of plants, and using appropriate soil preparation and tillage methods or conservation tillage.[1]

[1] Nagle S., G. Evanylo, W.L. Daniels, D. Beegle, V. Groover. Chesapeake Bay Region Nutrient Management Training Manual. Chapter 2: Basic Soil Science.

No-Till & Strip-Till Systems

In a no-till system, the residue is left undisturbed from harvest through planting except for narrow strips that cause minimal soil disturbance.

In a strip-till system, the residue is often left undisturbed from harvest through planting except for strips up to a third of the row width. These strips are cleared of residue or tilled for warming and drying purposes either before or during the planting operation.

Leaving all or part of the previous crop's residue on the soil surface is one conservation tillage practice that can reduce soil erosion. This practice reduces erosion by decreasing the splash effect of rainfall and surface runoff and increasing infiltration. On a bare soil surface, soil particles are dislodged from soil aggregates by the explosive action of falling raindrops. Once soil particles are dislodged, they can be transported by sheet or concentrated flow across the soil surface. Surface residue cover protects soil particles from the forces of precipitation and reduces any movement. Surface residue can also form small dams that slow surface runoff, increase opportunities for infiltration, and reduce soil crusting. With no-till/strip-till systems, the amount of surface residue cover can approach 80% to 90% after high residue crops, which can reduce erosion by 94 percent. Residue management also reduces the amount of sediment reaching surface water.[2] When animal waste is surface-applied in no-till/strip-till and ridge-till systems, however, you might need to change your application practices and/or carefully plan your application to reduce chances of surface runoff because incorporation of animal waste might not be appropriate. Incorporation of animal waste by injection is the recommended application method in a no-till or strip-till situation.[3] *See Appendix I for a listing of commonly considered conservation practice standards that can be used when developing a permit nutrient plan.*

[2] USDA/NRCS CORE4 Conservation Practices Training Guide. Chapter 2: Impacts of Residue Management Practices. Core4 Conservation Practices, August 1999.

[3] USDA/NRCS CORE4 Conservation Practices Training Guide. Chapter 4: Conservation Tillage Equipment. Core4 Conservation Practices, August 1999.

Regulatory Requirements for Evaluation and Treatment of Sites Proposed for Land Application

At a minimum, CAFOs must comply with the following requirements:

Perform soil tests every 3 years using accepted Extension protocols.
Conduct separate soil samples on each field receiving animal waste.
Analyze soil for total phosphorus in accordance with state nutrient management standards.

At a minimum, CAFO PNPs must contain the following information:

County(ies) and watershed code(s) where feedlot and land receiving animal waste applications are located.
Location of nearby surface water bodies.
Total acres of operation under the control of the CAFO (owned and rented) and total acres where animal waste will be applied.
Soil sampling methods.
Soil analytical methods.
Soil test results.

Additional Recommendations (Voluntary) for Evaluation and Treatment of Sites Proposed for Land Application

In addition to the Regulatory Requirements listed above, EPA recommends that CAFOs conduct the following activities:

- Analyze soils for pH, salinity, metals, micronutrients, and organic matter content.
- Implement an approved USDA/NRCS conservation plan on all fields receiving animal wastes.
- Perform the surface water and groundwater assessment using a certified nutrient management specialist.
- Evaluate soil leaching and permeability at the feedlot in the surface water and groundwater assessment.
- Classify soils at the feedlot and manure storage areas in terms of their hydrologic classification.
- Provide farm maps or aerial photos indicating:
  - Location and boundaries of operation.
  - Individual field boundaries.
  - Field number (identification) and acreages.
  - Soil types and slopes.
  - Location of nearby surface waters and other environmentally sensitive areas (e.g., wetlands, sinkholes) where animal waste application is restricted.
- Provide results and discussion of the surface water and groundwater assessment including the date of the assessment, name of person performing the assessment, and supporting research and/or analyses used in the assessment.

CAFOs located within a hydrologic unit area identified or designated as having impaired water quality associated with nitrogen or phosphorus should assess the potential export of nitrogen and/or phosphorus from fields receiving animal waste using a specified crop rotation. The assessment should include:

- Record of the phosphorus site rating for each field according to the selected assessment tool.
- Discussion of potential phosphorus accumulation in the soil and potential impact on the environment, animal health, and human health.
- Discussion of potential soil phosphorus draw-down from the production and harvesting of crops.
- Information about conservation practices and animal waste management actions that could reduce potential phosphorus movement from the field.
- Amount of land needed to properly apply animal waste on a phosphorus basis.
- Identification of the desired soil phosphorus level.

D Land Application

As a CAFO owner you must evaluate the environmental impacts of the land application of all nutrients from animal wastes, commercial fertilizers, biosolids, and other nutrient sources. You must also plan your nutrient applications to ensure that the proper amounts of all nutrients are applied in a way that minimizes risks to water quality and public health. You can develop appropriate land application practices, which are those that maximize the nutrient value of animal waste and minimize surface runoff and leaching of nutrients, by using the following six-step process:

Identify planned crop rotations and document crop nutrient requirements.
Develop an appropriate animal waste application rate.
Identify and use an appropriate animal waste application method.
Evaluate the timing of animal waste applications.
Understand animal waste application restrictions.
Calibrate animal waste application equipment.

Each of these steps are described more fully below.

1 Identify Planned Crop Rotations, and Document Crop Nutrient Requirements

The first step in developing appropriate land application practices is to identify your planned crop rotations. A rotation is the growing of a sequence of crops to optimize yield and crop quality, minimize the cost of production, and maintain or improve soil productivity. As a CAFO owner you must describe your planned sequence of crops (e.g., corn for silage, soybeans), preferably for 5 years. This should include your planting and harvesting dates and residue management practices. You should start with last year's crop and project the crop rotation for the next 4 years. Crop rotation is important in calculating total nutrient needs over the period of the rotation, nutrient buildup, and nutrient removal via harvesting.

Benefits of Crop Rotations

A cropping sequence with a variety of crop types (grasses, legumes) and rooting characteristics (shallow roots, deep roots, tap roots) better utilizes available soil nutrients. Following a shallow-rooted crop with a deep-rooted crop helps scavenge nutrients that might have moved below the root zone of the first crop.

Source: CORE4 Conservation Practices, August 1999

Once your have identified your crops, determine and document the crops' nutrient requirements (i.e., nitrogen, phosphorus, and potassium) and include a description of the expected crop yield. Plant growth can require more than 20 chemical elements; 16 of these elements are considered essential for plant growth. The primary essential elements include nitrogen, phosphorus, and potassium. Nutrient requirements of specific crops are readily available from your state and local Cooperative Extension Offices.

Sixteen Essential Elements for Plant Growth

Carbon	Iron
Hydrogen	Manganese
Oxygen	Boron
Nitrogen	Molybdenum
Phosphorus	Copper
Potassium	Zinc
Calcium	Chlorine
Magnesium	Sulfur

Source: Chesapeake Bay Region Nutrient Management Training Manual

The total nutrient requirements for your fields are largely based on your expected crop yields. Generally, the higher the yield expectation, the higher the nutrient requirement. Methods for calculating expected yield goals include using past crop yields for that field, county yield records, soil productivity tables, or local research. Your expected yield must be based on realistic soil, climate, and management parameters. An unrealistic estimate can result in either too many or too few nutrients being applied. Because climate can significantly affect yields, you should base your expectations on data from at least the last 5 years. Given a crop rotation, Cooperative Extension Offices and/or soil laboratories can and often do provide recommended nutrients/amendments to meet your expected yield. This recommendation takes the current soil test for that field into consideration and should be used as the crop nutrient requirements for that year.

2 Develop an Appropriate Nutrient Application Rate

The objective for determining an application rate is to match, as closely as possible, the amount of available nutrients in animal waste with the amount required by the crop. The basic equation for calculating agronomic application rates for animal wastes is:

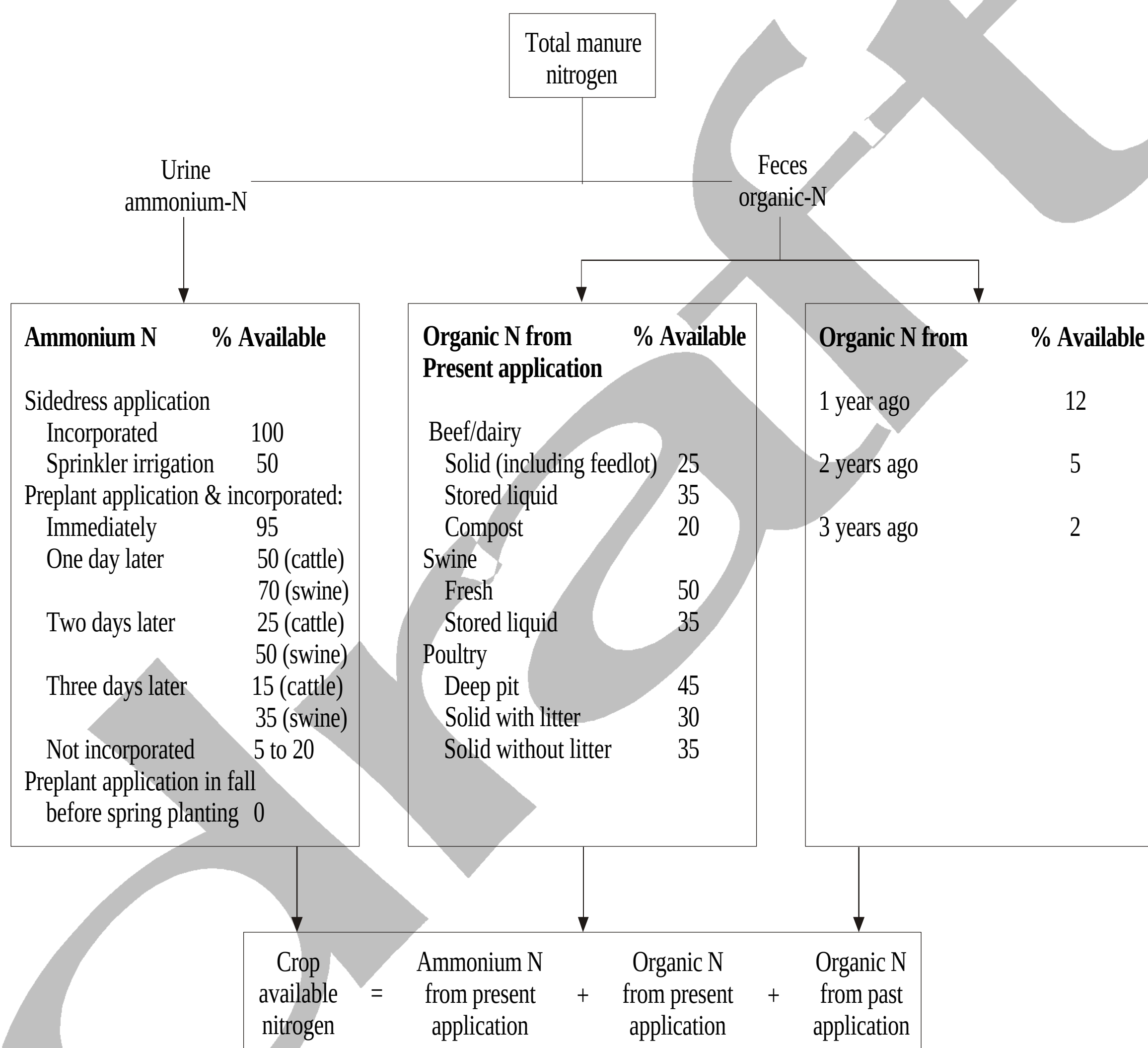
Agronomic application rate	=	Crop nutrient requirement - Nutrient credits
Crop nutrient requirement	=	Crop nutrient uptake x crop yield
Nutrients credits	=	Legume nitrogen credits + nitrogen residual from past animal waste applications + nutrients from commercial fertilizer applications + irrigation water nitrate nitrogen + other nitrogen credits

Essentially, nutrient credits are all other nutrients available to your crop in addition to the nutrients you apply in the animal waste. Each of these credits is described further below.

- **Credits from previous legume crops**. Atmospheric nitrogen is fixed by legume plants and brought into the soil. Amounts of nitrogen added by legume production vary by plant species and growing conditions. Check with your local Cooperative Extension Office or Land Grant University to determine appropriate legume credits for your crop rotations.

- **Residuals from long-term animal waste applications**. Nitrogen is a mobile nutrient that occurs in the soil and plants in many forms. Figure 3 presents estimated availability of different forms of nitrogen in animal waste. Not all nitrogen that you apply in animal waste applications is available to the crop during the year of application. Some of the nutrients require organic material decomposition before they are made available for plants. A percentage of last year's nitrogen and a smaller percentage of previous years' nitrogen will become plant-available during the crop season. For example, 12% of organic nitrogen might be available from 1 year ago, 5% might be available from 2 years ago, and 2% might be available from 3 years ago. Because these values depend on animal types and local climate, you should use mineralization rates from your local Cooperative Extension Office to determine the amount of nitrogen available from previous animal waste application. Typically, phosphorus and potassium are considered 100% plant-available the year of application. Therefore, little or no residual amounts of phosphorus and potassium are calculated.

Figure 3. Availability of Manure Nitrogen



Source: Core4 Conservation Practices, August 1999

Nutrients supplied by commercial fertilizer and/or biosolids applications. Pound-for-pound, animal waste does not have the same value as commercial fertilizer. Farmers often supplement animal waste applications with commercial fertilizer applications. Furthermore, since animal waste contains relatively high concentrations of phosphorus, crops are not supplied with sufficient amounts of nitrogen when waste is applied on a phosphorus basis. Therefore, commercial nitrogen fertilizer will likely be required to meet the crop's nitrogen requirements. You must include the nutrient contribution from commercial fertilizers and biosolids in your animal waste application rate calculations. Provide the date (day, month, year) of each commercial fertilizer and/or biosolids application.

Irrigation water. Irrigation water, especially from shallow aquifers, contains some nitrogen in the form of nitrate nitrogen. Also, water from runoff ponds and storage lagoons contains nutrients. To calculate the amount of nitrogen applied with irrigation water, you must conduct a water analysis to determine the concentration of nitrate nitrogen in the water (in ppm or mg/l). The amount of nitrogen added in irrigation water equals the nitrate nitrogen concentration multiplied by the irrigation water volume (in acre-inches) and a conversion factor of 0.23.

Other nitrogen credits. Other nitrogen credits come from atmospheric deposition from dust and ammonia in rainwater. Atmospheric deposition is recorded by a number of weather stations throughout the United States and can be obtained from the National Atmospheric Deposition Program, Fort Collins, Colorado. Atmospheric deposition can range from a few pounds of nitrogen per acre to more than 30 pounds.

The use of animal waste as a nutrient source requires careful planning because the nutrients contained in the waste are not balanced in the same proportion as crop requirements. While most animal waste has a nitrogen-phosphorus-potassium ratio from 3-2-3 to 2-1-2, crops require nutrients in a ratio of 8-1-3 or 3-1-2. Therefore, applying animal waste based on one of the crops' nutrient requirements creates either a nutrient deficiency or excess for the other two elements. Most state guidelines/policies allow animal waste applications at rates sufficient to meet, but not exceed the nitrogen needs of agronomic crops. In areas with high soil phosphorus levels, however, states often recommend that animal waste be applied at rates sufficient to meet, but not exceed the phosphorus needs of agronomic crops.

Excess levels of phosphorus application will build up in the soil and be expressed by higher soil test levels. The rate of buildup depends on the soil type, soil test method, and excess level of phosphorus application. As a general guidance rule, it takes between 8 to 16 pounds of excess phosphorus to raise the soil test level of phosphorus by 1 pound.[4] Many states have developed a relationship between soil test levels of phosphorus and the potential for significant phosphorus movement to surface or groundwater. Some states have set threshold soil test levels of phosphorus at which either animal waste application should be based on the crops' phosphorus requirements or management practices should be put into place to control runoff and erosion. Above some soil test phosphorus levels, there might even be a total restriction of additional phosphorus application to the field. Some states also use the results from the Phosphorus Site Index to determine whether animal waste should be applied on a nitrogen or phosphorus basis.

As a CAFO owner you must not exceed the crops' and soils' nitrogen requirements. In addition, you must not exceed annual agronomic crop or soil requirements for phosphorus under the following circumstances:

[4] USDA/NRCS CORE4 Conservation Practices Training Guide. Appendix A - Phosphorus Buildup Calculation.

Phosphorus Test/Indicator	Rating
Soil test	"high" or "very high"
Soil phosphorus thresholds	3/4 to 2 times the threshold
Phosphorus Index	"high"

You must not apply any animal waste or wastewater under the following circumstances:

Phosphorus Test/Indicator	Rating
Soil test	"excessive"
Soil phosphorus thresholds	> 2 times the threshold
Phosphorus Index	"very high"

In addition, multiyear applications of animal wastes or wastewater on a phosphorus basis are prohibited under the following circumstances unless manure application equipment designed for dry poultry manure or litter cannot obtain an application rate low enough to meet a phosphorus based application rate as determined by the PNP.

Phosphorus Test/Indicator	Rating
Soil test	"high" or "very high"
Soil phosphorus thresholds	3/4 to 2 times the threshold
Phosphorus Index	"high"

In the situation of the dry poultry manure application, if a phosphorus-based application occurs during one given year that exceeds the crop removal rate for that given year, no additional manure, litter, or wastewater can be applied to the same land in subsequent years until all of the applied phosphorus has been removed from the field via crop removal and harvest.

In some areas animal waste application rates might need to be based on parameters other than nutrients. For example, in regions of the country where farmlands are overloaded with salt, the salt content of animal waste, often measured as electrical conductivity, might be the appropriate parameter for limiting land application rates. If you are using these alternative application rates, you must not exceed the nutrient requirements of the planned crops. *See Appendix G for information on calculating nutrient application rates*.

3 Identify and Use an Appropriate Animal Waste Application Method

You should always apply animal waste uniformly and at your approved application rate. As a CAFO owner, you must provide the date (day, month, year) and method of each animal waste application. To better describe the conditions on the day of the application, you must also provide rainfall amounts for the 24-hour period before and after application. Although many equipment options exist, there are basically two general methods of application: subsurface application and surface application. The method of application is generally dictated by the form of the waste (i.e., solid, semisolid, liquid).

- **Subsurface application**. Solid, semisolid, and liquid waste can all be applied using this method. When feasible, this is the preferred method of animal waste application. Subsurface applications can be conducted by mechanically incorporating the waste into the soil or by injecting the waste directly into the soil. Mechanical incorporation can be performed using moldboard plows, chisel plows, or heavy discs. To reduce nutrient losses, mechanical incorporation should be conducted before waste dries, usually within 2 days or less of application. Injection requires a liquid waste spreader and equipment to deposit waste below the soil surface. To prevent nutrient losses, the openings made by the injectors must be closed following application.

  Immediate incorporation of waste in the spring will increase the amount of plant-available nitrogen by reducing ammonia loss. Incorporation in soils with low runoff potential can help prevent the movement of nutrients and pathogens from animal waste to surface waters. Where soil erosion is a problem, however, tillage might result in unacceptable losses of soil and nutrients.

  Injection is likely the best method of incorporating liquid and semisolid animal waste in reduced-till or no-till cropping systems because crop residues left on the surface act as a mulch, and exposed soil surface is minimal.

- **Surface application of liquid waste (irrigation)**. The three predominant systems used for surface application of liquid animal wastes (irrigation) are solid sets, center pivots, and traveling guns. Solid set systems are series of sprinklers generally supplied by underground pipe. Center pivot systems are generally used in large fields and must be able to travel in a circle. Traveling guns are high-pressure, high-output, single-nozzle systems that crawl down travel lanes in the field. Liquid wastes can also be surface applied with tank spreaders.

  Irrigation can save considerable amounts of time and labor when applying large volumes of wastewater and/or liquid animal waste. Sometimes is might be necessary to dilute liquid animal wastes with fresh water for salinity or other plant requirements, or to facilitate application via irrigation. Irrigation provides you with flexibility in applying animal wastes during the growing season and has the added advantage of supplying water during the growing season’s drier periods. Infiltrating liquid can carry much of the easily volatilized ammonia into the soil, although some ammonia will still be lost from the spray before it reaches the soil. The irrigation system must, however, be matched to the topography, cropping program, nutrient, and water needs of the crops, as well as infiltration, percolation rate, and water holding capacity of the soil. You should not use irrigation to apply animal wastes unless solids have been removed or chopped very fine. If solids are present, the nozzles will clog and the system will not operate properly. Irrigation may also produce aerosol sprays that can cause odor problems.

Surface application of dry, solid waste. This application method is very effective at applying dry, bulky animal wastes such as poultry litter. Surface application is typically conducted using a box spreader with a chain-drag delivery to a fan or beater spreader mechanism or tank wagon equipped with splash plates.

Although this is a relatively easy method for applying animal wastes to the land, it has several disadvantages. First, when you apply animal wastes to the surface of the soil without incorporation, most of the unstable, rapidly mineralized organic nitrogen from the waste will be lost through the volatilization of ammonia gas. Volatilization will increase with time, temperature, wind, and low humidity. Surface application without incorporation also increases the likelihood of nutrient losses via surface runoff. Surface runoff losses are more likely on soils with high runoff potential, soils subject to flooding, soils that are snow-covered and/or frozen (via runoff once the snow melts or soil thaws), and soils with little or no vegetative cover. Second, aerosol sprays produced by mixing animal wastes and air during this type of application can carry odors considerable distances. Third, this application method provides poor distribution of nutrients, which can be aggravated with heavy winds. In addition, precision application of animal wastes, such as poultry litter, with a geared box spreader can be difficult.

You can reduce nutrient losses when using surface application by implementing soil conservation practices such as contour strip cropping, crop residue management, cover crops, diversion terraces, vegetative buffer strips, and grass waterways. You can get more information about conservation practices from your local soil and water conservation district and USDA's Natural Resources Conservation Service.

4 Evaluate the Timing of Animal Waste Applications

Timing of animal waste application is an important consideration for nutrient availability. The longer waste is in the soil before crops take up the nutrients, the more those nutrients, especially nitrogen, can be lost through volatilization, denitrification, leaching, and surface runoff. In essence, the timing of application should be driven by common sense. You should carefully consider the hydrologic cycle and hydrologic sensitivity of your fields when making management decisions. Ideally, you should apply all animal waste after the threat of spring runoff has diminished and just prior to the period of maximum crop uptake.

Spring applications. Applications made during this time are best for conserving nutrients because the threat of surface runoff and leaching diminish in late spring. This time period is also favorable because it is just before the period of maximum crop uptake, allowing for efficient nutrient utilization.

Summer applications. Early summer is an ideal time to apply animal waste because it is generally the time of maximum crop uptake. The problem is applying the waste without damaging crops, however. Options for applying animal waste in the early summer include side-dressing waste by injecting it between corn rows, irrigating liquid waste over corn rows when the corn is 3 to 12 inches tall (taller corn stalks can suffer more leaf damage), or applying waste to forages such as hay fields and grasses after the first and second cuttings, or to pastures with small stubble. You can also apply mid to late summer applications onto harvested stubble fields. Nitrogen in the animal waste stimulates more growth of the cover crop, especially for non-legume species that require nitrogen. The cover crop takes up the nutrients and holds them in

an organic form in the plant, preventing them from leaching or being tied up in the soil complex. These nutrients might then be available for next year's crop when the crop residue breaks down.[5]

Fall applications. Fall application of animal waste generally results in greater nutrient loss than spring application regardless of the application method, but especially if the waste is not incorporated into the soil. The increase in nutrient loss results from mobile nutrients such as nitrogen leaching out of the soil during this period. Many of the nonleachable nutrients react with the soil to form insoluble compounds that build soil fertility but some are bound so tightly that they might not be available for the next crop. In fall, waste is best applied at low rates to fields that will be planted in winter grains or cover crops. If winter crops are not planted, waste should be applied to the fields containing the most vegetation or crop residues. Sod fields to be plowed the next spring are also acceptable, but fields where corn silage was removed and a cover crop will not be planted are undesirable sites.

Winter applications. Winter waste applications typically result in the greatest nutrient losses. Research indicates that winter applications increase runoff during rainfall events. Most of the seasonal runoff occurs during snowmelt in late winter or early spring. Also, animal waste applied in winter generally does have the opportunity to dry and anchor to the soil surface or to be incorporated into the soil. If you must apply waste during the winter, apply it to fields that have the lowest runoff and erosion potential. The fields should not be subject to spring flooding, and you should try to incorporate the waste into the soil.

5 Understand Animal Waste Application Restrictions

Although animal waste is a valuable resource, it can also cause extensive damage if placed in environmentally sensitive areas or applied at inappropriate times. To protect water quality, you must <u>not</u> apply animal waste closer than 100 feet to any surface water body, tile line intake structure, sinkhole, or agricultural well head. In addition, you should not apply animal waste in the following areas or under the following conditions:

Near or in wetlands, riparian buffer areas, water sources, wells, drinking water supplies, high slope areas, and high erosion areas.

Within concentrated water flow areas (vegetated or nonvegetated) such as ditches, waterways, gullies, swales, and intermittent streams.

When the hydraulic load/irrigation water exceeds the infiltration rate of the soil.

When crops are not being grown.

When the ground is frozen or snow-covered.

When measurable precipitation is occurring on the day of application.

[5] Martin H.D., and C. Brown. Manure Application Scheduling. Proceeding from the Liquid Manure Application Systems Conference. Rochester, NY. 1994.

6 Calibrate Animal Waste Application Equipment

You must calibrate your spreaders and irrigation equipment at a minimum of once per year. You should calibrate you equipment before each application period to ensure that animal wastes are delivered at the proper rate of application. Spreaders can discharge waste at varying rates depending on forward travel speed, power takeoff speed, gear box settings, discharge opening, width of spread, overlap patterns, and other parameters. Calibration defines the combination of settings and travel speed needed to apply animal waste at a desired rate. There are two basic calibration techniques:

- The load-area method, which involves measuring the waste amount in a loaded spreader and then calculating the number of spreader loads required to cover a known land area.

- The weight-area method, which requires weighing waste spread over a small surface and computing the quantity of waste applied per acre.

The best calibration method depends on the type of spreader you plan to use. Soil-injection, liquid spreaders must be calibrated using the load-area method because soil-injected waste cannot be collected. Liquid waste that is surface-applied through a tank spreader is also best measured by the load-area method because of the difficulty in collecting the liquid waste. But it can be measured with the weight-area method. You can use either method to measure solid and semisolid waste. *See Appendix H for more information on calibration of animal waste spreaders and irrigation equipment.*

Regulatory Requirements for Land Application

At a minimum, CAFOs must comply with the following requirements:

- Do not exceed nitrogen requirements of the crops or soils.
- Do not exceed the annual agronomic or soil requirements for phosphorus if:
  - Soil phosphorus tests are rated as "high" or "very high."
  - Soil phosphorus tests are equal to 3/4, but not greater than 2 times the soil phosphorus threshold value.
  - Phosphorus Index rating is "high."
- Do not apply animal wastes if:
  - Soil phosphorus tests are rated as "excessive."
  - Soil phosphorus tests are greater than 2 times the soil phosphorus threshold value.
  - Phosphorus Index rating is "very high."
- Muliyear applications of animal waste on a phosphorus basis under the following conditions, unless manure application equipment designed for dry poultry litter cannot obtain the require application rate:
  - Soil phosphorus tests are rated as "high" or "very high."
  - Soil phosphorus tests are equal to 3/4, but not greater than 2 times the soil phosphorus threshold value.
  - Phosphorus Index rating is "high."
- Calibrate manure spreader and irrigation equipment at least once per year.

At a minimum, CAFO owners and managers must **not** apply animal wastes to the following areas:

- Within 100 feet of any surface water, tile line intake structure, sinkhole, or agricultural well head.

At a minimum, CAFO PNPs must include the following information:

- Identification of all planned crops.
- Expected crop yields and the basis for yield estimates for each crop.
- Crop planting dates.
- Actual crop yields.
- Identification of fields receiving animal waste.
- Total acreage receiving animal waste.
- Animal waste application rate.
- Identification of whether animal waste application rate is based on nitrogen, phosphorus, or other parameter.
- Amount of any other nutrients applied to the land in terms of nitrogen, phosphorus, and potassium.
- Calculations showing total nutrients applied to the land.
- Animal waste application method.
- Estimate of nitrogen losses based on application method and route of the nitrogen loss.
- Date of animal waste application.
- Date of calibration of application equipment.
- Rainfall amounts 24 hours before and after application.

Additional Recommendations (Voluntary) for Land Application

In addition to the Regulatory Requirements listed above, EPA recommends that CAFOs conduct the following activities:

- Incorporate animal wastes into the soil within 2 days of application, whenever possible.
- Apply animal wastes just prior to the period of maximum crop uptake.
- Do not apply animal wastes when measurable precipitation is occurring on the day of application.
- Do not apply animal wastes to riparian buffer areas.
- Do not apply animal wastes within 200 feet of wells, springs, and pubic drinking water supplies.
- Do not apply animal wastes within 200 feet of a water source when the slope is greater than 8%.
- Do not apply animal wastes where land is eroding at more than 5 tons per acre per year.
- Do not apply animal wastes where land is eroding at 5 to 10 tons per acre per year unless grass filter strips are installed at the points where runoff/erosion leave the field.
- Do not apply animal wastes prior to 30 days before the normal growing season.
- Do not apply animal wastes when soil is snow-covered to a depth greater than 1 inch.
- Do not apply animal wastes when soil is snow-covered to a depth of less than 1 inch unless the animal waste is incorporated.
- Do not apply animal wastes when soil is frozen and/or saturated.

E Record of PNP Implementation

As a CAFO owner you must maintain a record of activities related to animal waste management and animal waste application to the land. These records will assist you in your annual review of the permit nutrient plan and in making management decisions that might affect your operation's manure and waste production, collection, storage, treatment, and application to the land.

You must maintain records associated with the "Regulatory Requirements" in the tables identified at the end of sections II.B through II.D for a period of at least 5 years. In addition, if you sell or otherwise transport your animal waste off site for usage on lands that are not under your operational control, you must maintain the following records for a period of at least 5 years:

- Animal waste analyses
- Amount of animal waste, by weight, sold or transported off site
- Dates (day, month, year) when manure was sold or transported off site
- Destination or third party hauler

You should consider keeping all records related to animal waste management and permit nutrient planning together in one centralized area (e.g., a three-ring binder). Centralized record keeping can assist you in performing the requirements and additional recommendations identified in this chapter. These include reviewing past test results to determine if changes should be made to your animal waste application rate, tracking when activities such as soil sampling need to be performed, and recording required data such as the dates of animal waste application and equipment calibration.

F Animal Nutrition Management

If you have determined that you need to reduce the nutrient content of the animal waste because you do not have enough available cropland to apply all of your waste at the recommended application rate, consider animal nutrition management. With animal nutrition management, you can reduce the amount of both nitrogen and phosphorus, in animal manure. Animal nutrition management can include the use of low-phosphorus corn and enzymes such as phytase, which can be added to nonruminant animal diets to increase the utilization of phosphorus and/or the use of finely ground or pelletized feed to increase digestion. You can also reduce the input of nutrients and better utilize the nutrients in the forage to reduce the amount of nitrogen and phosphorus excreted by the animal. These approaches will produce manure with a nitrogen-phosphorus ratio closer to that required by crops and forage plants, thereby reducing the amount of excess nutrients applied to the land and the amount of animal waste requiring increased storage times.

It is becoming more common for poultry, swine, and dairy producers to develop and implement feeding strategies as part of their overall nutrient management plans. An animal nutritionist, such as a certified professional from the American Registry of Professional Animal Scientists, should be consulted if voluntary animal nutrition management area is included in a PNP. A brief discussion of the strategies used at these operations is provided below. Whether or not animal nutrition management is included in a PNP, an animal nutritionist should be consulted before making any changes in feeding strategies to ensure changes will maintain animal health and productivity.

- **Poultry feeding strategies**. Three possible strategies for decreasing the amount of phosphorus excreted by broilers and layers are: feeding the birds a formulation closer to the actual amount of phosphorus required by them[6]; using feed additives (e.g., enzymes such as phytase, enzyme cocktails, and vitamin D_3 metabolites) that maximize the availability of phosphorus for broilers; and using new ingredients that are low in phytate phosphorus, such as the high available phosphorus corns currently being developed and tested.[7] You can also decrease the nutrients in the animal waste by controlling feed spills and wasteage that would otherwise become part of the collected animal waste.

Swine feeding strategies. Possible strategies for reducing the nutrient content of swine manure are: feeding the pigs a formulation closer to the actual amount required by the animals for optimum rather than maximum performance[8]; implementing multi-phase feeding and separate sex feeding; improving feed efficiency; using high-quality protein sources and crystalline amino acids; and improving the availability of phosphorus in feeds with phytase[9].

Dairy feeding strategies. The amount of nutrients excreted in dairy manure can be reduced by feeding the cows a formulation that better matches their nutritional requirements[10] and by improving feeding accuracy. Monitoring milk urea nitrogen levels is a tool for evaluating protein feeding levels in dairy cows, and routine use could lower the nitrogen content of dairy manure[11].

More information on feeding strategies to reduce nutrient production at your operation can be obtained from your industry associations (e.g., National Cattlemen's Beef Association), your local Cooperative Extension Office, and land grant universities that are conducing research in this area.

G Other Animal Waste Utilization Options

Animal manure and waste collected from CAFOs is typically utilized as a fertilizer for plants or as a soil amendment. You can also use animal waste as a source of energy, bedding, animal feed, and mulch, however. Although there are a number of alternative uses for animal waste, in practice only a small fraction of animal waste is used for purposes other than land application.

Alternative uses of cattle waste include composting, recovery of energy, refeeding to livestock, bedding, algae and fish production in lagoons, and reclamation of sandy and mined soil. You can use solids from solids separation operations for livestock bedding; mix it with grains and other materials for refeeding to

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[6] National Research Council Nutrient Requirements of Poultry, Ninth Revised Edition. National Academy Press, Washington, D.C. 1994.

[7] Angel, R. Feeding Poultry to Minimize Manure Phosphorus. Proceedings from Managing Nutrients and Pathogens from Animal Agriculture. Camp Hill, PA. 2000.

[8] National Research Council Nutrient Requirements of Swine, Tenth Revised Edition. National Academy Press, Washington, D.C. 1998.

[9] Harper, A. F. Managing Swine Feeding to Minimize Manure Nutrients. Proceedings from Managing Nutrients and Pathogens from Animal Agriculture. Camp Hill, PA. 2000.

[10] National Research Council Nutrient Requirements of Dairy Cattle, Seventh Revised Edition. National Academy Press, Washington, D.C. 2000.

[11] Jonker, J.S., R.A. Kohn, and R.A. Erdman. Milk Urea Nitrogen Target Concentrations for Lactating Dairy Cows Fed According to National Research Council Recommendations. J. Dairy Sci. 82: 1261-1273. 1999.

cattle; or dry, bag, and sell it on the retail market. Waste can also be treated in an anaerobic digester to produce a source of energy. During anaerobic digestion, liquid waste is confined in an airtight vessel and decomposed, producing methane, carbon dioxide, hydrogen sulfide, and water vapor as gaseous by-products. You can then use this biogas for powering electricity generating equipment. The electricity can be used at the animal operation or sold to a local utility. You can also use the gas directly to run animal heating equipment. Additional uses of waste include pyrolysis, hydrogasification, oil conversion processes, and fish farming. Pyrolysis is a process in which animal waste is pretreated by thermochemical processes in a closed system at elevated temperatures. This process produces a gas fraction that is an oil or fuel when condensed.[12]

Broiler (not turkey) litter, when mixed with feed grains, is a successful feed for cattle. More than 4% of the poultry litter produced in the United States was fed to cattle in 1992. You can also sell poultry litter to nurseries and garden stores as an organic soil amendment for home owners or have it pelletized and marketed as a fertilizer.[13] In addition, you can incinerate the litter and use it as a fuel source or compost the litter and reuse it as bedding materials for animals such as turkeys.

Swine waste has been used to generate energy via anaerobic digestion to heat pig housing. It is also occasionally refed to other animals. In some instances, however, the copper levels and antimicrobial drug residues found in swine waste have limited its beneficial uses. Treating and/or drying swine waste makes it much easier and cheaper to transport off site.

III Permit Nutrient Plan Requirement Checklist

The following list summarizes the minimum requirements for a CAFO permit nutrient plan. You should include additional components, as necessary, to adequately characterize and describe your operation and the land areas that will receive animal waste applications. Chapter 3 provides a sample permit nutrient plan that provides a suggested template for formatting your plan, as well as an example of the type of information you should provide.

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[12] Eghball B., and J. F. Power. Management of Manure from Beef Cattle in Feedlots and Minor Classes of Livestock. Agricultural Utilization of Municipal, Animal and Industrial Byproducts.

[13] Moore P.A, T.C. Daniel, A.N. Sharpley, and C.W. Wood. Poultry Manure Management. Agricultural Utilization of Municipal, Animal and Industrial Byproducts.

CAFO Permit Nutrient Plan Requirements

General Information
- ❑ Cover sheet
- ❑ Executive summary

Animal Waste Production
- ❑ Quantity of animal waste produced and collected during each 12 month period
- ❑ Calculations for estimating the amount of animal waste collected
- ❑ Animal waste sampling techniques
- ❑ Animal waste test results

Animal Waste Handling, Collection, Storage, and Treatment
- ❑ Emergency response plan
- ❑ Plan for properly handling and disposing of dead animals in a timely manner
- ❑ Records of catastrophic or chronic rainfall event that cause overflows

Land Application Sites
- ❑ County(ies) and watershed code(s) where feedlot and land receiving animal waste applications are located
- ❑ Location of nearby surface water bodies
- ❑ Total acres of operation under the control of the CAFO (owned and rented) and total acres where animal waste will be applied
- ❑ Soil sampling methods
- ❑ Soil analytical methods
- ❑ Soil test results

Land Application
- ❑ Identification of all planned crops
- ❑ Expected crop yields and the basis for yield estimates
- ❑ Crop planting dates
- ❑ Actual crop yields
- ❑ Identification of fields receiving animal waste
- ❑ Total acreage receiving animal waste
- ❑ Animal waste application rate
- ❑ Identification of whether animal waste application rate is based on nitrogen, phosphorus, or other parameter
- ❑ Amount of any other nutrients applied to the land in terms of nitrogen, phosphorus, and potassium
- ❑ Calculations showing total nutrients applied to the land
- ❑ Animal waste application method
- ❑ Estimate of nitrogen losses based on application method and route of the nitrogen loss
- ❑ Date of animal waste application
- ❑ Date of calibration of application equipment
- ❑ Rainfall amounts 24-hours before and after application

Other Uses/Off-Site Transfer
- ❑ Description of other use
- ❑ Date of off-site transfer (day, month, year)
- ❑ Quantity of waste transported off site
- ❑ Name and location of recipient of animal waste

CHAPTER 3: SAMPLE CAFO PERMIT NUTRIENT PLAN

This chapter presents an example of a CAFO permit nutrient plan that complies with all of EPA's regulatory requirements described in this guidance manual. EPA believes this example serves as the minimum plan for CAFOs. Additional information might be required in your plan to properly characterize your operation and nutrient management practices. Consult with your state and local Cooperative Extension Office to determine the information that should be included in your site-specific plan.

COVER SHEET

Facility Name: The Dairy Farm

Operator Name: Joe Farmer

Telephone Number: (301) 555-1212

Street Address: 1234 Milk House Road

City: Farm Town

County: Holstein

State: MD

Zip Code: 12345

Prepared By: Mr. N. Planner

Date Prepared: March 30, 2000

Revisions (Date and Description):

Original plan prepared March 30, 2000

EXECUTIVE SUMMARY

Annual Number of Livestock Produced or Housed On Site:

Approximately 850 cows (lactating, dry, heifers, and calves) are housed on site annually.

Average Herd/Flock Size:

The average herd is 500 lactating cows, 150 heifers, 100 dry cows, and 50 calves.

Total Amount of Animal Waste Produced Annually:

Waste Type	Annual Production/Collection
Solid	5,875 tons
Liquid	6.6 million gallons

Description of Animal Waste Collection, Handling, Storage, and Treatment Practices:

A waste storage lagoon is used to store liquid wastes from the milking center and flush barns, runoff from the feedlot, and direct precipitation. Wastes from the milking center and flush barns are treated with a solid/liquid separator prior to discharge into the storage lagoon. A concrete slab is used to store solid wastes from the dry lot, calf hutches, and solids separator.

Crop Production History for Past 5 Years:

Field Number	Acres	Year	Crop	Yield (tons/acre)
1	250	1995 - 1997	Alfalfa	5, 5, 6
1	250	1998 - 1999	Corn-silage	20, 22
1	250	1998 - 1999	Winter wheat	3, 4
2	125	1995 - 1997	Alfalfa	5, 5, 6
2	125	1998 - 1999	Corn-silage	21, 22
2	125	1998 - 1999	Winter wheat	3, 4
3	175	1995 - 1997	Corn-silage	23, 21, 20
3	175	1998 - 1999	Alfalfa	5, 5
4	200	1995 - 1997	Corn-silage	23, 20, 20
4	200	1998 - 1999	Alfalfa	5, 5

EXECUTIVE SUMMARY (CONT.)

Animal Waste Application Rate:

Field Number	Crop	Nutrient Basis for Application Rate	Application Rate (lb/acre)
1	Corn-silage	Nitrogen	143
1	Winter wheat	Nitrogen	13
2	Corn-silage	Nitrogen	143
2	Winter wheat	Nitrogen	13
3	Alfalfa	Nitrogen	0
4	Alfalfa	Nitrogen	0

Watershed Information Including Environmental Concerns:

The Dairy Farm is located in the "Livestock" watershed (code 01-01-01-01) and 0.5 miles southeast from Freestall Creek, the nearest water body. The watershed nutrient of concern is nitrogen.

ANIMAL WASTE PRODUCTION & MANAGEMENT

(This section of the plan should quantify the number of animals maintained at the operation and the amount of animal waste produced and collected. It should also describe the required animal waste storage capacity for the operation and compare that to the available animal waste storage capacity.)

Maximum Livestock Capacity:

The Dairy Farm's maximum capacity is 1,250 head.

Maximum Number of Livestock Maintained at Any One Time:

(Only required if substantially different than the maximum livestock capacity.)

The Dairy Farm has maintained a maximum of 900 head at any one time.

Annual Number of Livestock Produced or Housed On Site:

500 milking cows; 150 dry cows; 100 heifers; 100 calves (approximately 50% of the calves born are transferred to beef backgrounding operations after weaning).

Quantity of Animal Waste Produced and Collected Annually:

(Include all calculations used to estimate the quantity of waste produced and collected.)

Solid Waste: Solid waste is collected from the dry lot where the dry cows and heifers are housed and the hutches where the calves are housed. Approximately 8,000 pounds of manure are collected weekly and transferred to a concrete slab for storage until land application. This was calculated by weighing the front-end loader before and after a load of manure was removed from the dry lot.

In addition 31,000 pounds of solids from the solids separator are generated daily. This is from milking center and freestall barn waste. This was also calculated by weighing the front-end loader before and after removing the solids.

Therefore, annual collection of solid animal waste can be calculated from the following equation.

Solid waste = (8,000 lbs/week x 52 weeks/yr) + (31,000 lbs/day x 365 days/yr)
= 11,730,000 lbs/yr ÷ 2000 lbs/ton
= 5,875 tons/yr

Liquid Waste: Liquid waste collected and stored in the waste storage pond consists of flush water from the milking center (parlor, holding area, and milk room); flush water from the freestall barns where the milking cows are housed; runoff from the feedlot; and direct precipitation. An estimated total of 6.6 million gallons/year of liquid waste is produced at the operation. The following calculations were used to estimate the quantity of liquid waste produced and collected at The Dairy Farm.

Milking Center = 30 gallons/cow/day x 500 cows/day
= 15,000 gallons/day x 365 days/yr
= 5,475,000 gallons/yr

ANIMAL WASTE PRODUCTION & MANAGEMENT (CONT.)

Flush Barns	=	Most of the water used to flush the freestall barns is recycled from the lagoon. However, one day's worth of flushing is calculated as part of the lagoon's design capacity.
	=	100 gallons/cow/day x 600 cows/day
	=	60,000 gallons/yr.
Runoff	=	Collection area = 15 acres
	=	Annual precipitation is assumed to be 5 inches and 40% is assumed to runoff the dry lot
	=	15 acres x 43500 sf/acre x 5 inches/yr ÷12 inches/ft x 40%
	=	108,800 cf x 7.48 gal/cf
	=	813,824 gallons/yr
Direct Precipitation	=	Inches precipitation/yr x surface area x 1 inch/12 ft
	=	5 inches/yr x 1 inch/12 ft x 200 ft x 425 ft
	=	35,500 cf/yr
	=	265,000 gallons/yr
Total Liquid Waste	=	5,475,000 gal/yr + 60,000 gal/yr + 813,824 gal/yr + 265,000 gal/yr
	=	6,613,824 gallons/yr

Storage Capacity of Animal Waste Storage Facilities:

(Describe the required annual animal waste storage capacity for the operation and compare that to the available animal waste storage capacity.)

The storage facilities used at The Dairy Farm are a waste storage lagoon and a concrete slab for storage of solid animal wastes including separated solids. The waste storage lagoon and concrete slab were both designed for 180 days of storage. The storage lagoon is 12 feet deep, 425 feet long, and 200 feet wide with a maximum capacity of 7.6 million gallons. The concrete slab is 300 feet long by 200 feet wide, and assuming a pile height of 10 feet, has a maximum capacity of 200,000 cubic feet or 6,100 tons of animal waste.

The available storage capacity is more than adequate for 180 days of storage. The design capacity of the lagoon and concrete slab both exceed the annual volume of waste. However, all of the animal waste can not be applied to the four fields in the current crop rotation. The operation is currently selling some of the solid manure to neighboring farms for use as a nutrient source.

ANIMAL WASTE ANALYSIS

(This section of the plan should describe the methods used to sample animal wastes at the operation and provide the results of the animal waste testing)

Animal Waste Sampling Techniques:

(Describe the sampling techniques used to sample each form of animal waste managed on site.)

Solid Waste Sampling:

Sampled the solid waste stored on the concrete slab using a hand-made sampling device (similar to a soil auger). Collected 6 random samples from wastes stored on the slab and mixed all 6 samples together in a 5-gallon bucket. Filled the sample container with this "mixed" sample, leaving 2 inches of air space, and put it in a cooler until shipping later that day. A diagram identifying all of the sample locations is attached to this plan.

Liquid Waste Sampling:

Sampled the waste storage lagoon using a plastic cup attached to a long pole. Collected 8 random samples from around the shoreline of the lagoon and mixed all 8 samples together in a 5-gallon bucket. Filled the sample container with the mixed sample, leaving 2 inches of air space, and put in a cooler with ice until shipping later that day.

Results of Animal Waste Analyses:

(For each waste form or location that was sampled, provide the results of the current analysis. Also, attach a copy of the actual lab results.)

Animal Waste Type	Date Sampled	Nutrient Content			
		TKN	TP	K	pH
Solids from concrete slab	March 1, 2000	9 lbs/ton	3 lbs/ton	6 lbs/ton	7.4
Liquid waste from storage lagoon	March 1, 2000	12 lbs/1000 gal	6 lbs/1000 gal	10 lbs/1000 gal	7.5

Name and Address of Laboratory Conducting the Analysis:

The animal wastes were shipped to:

Waste Plus
1122 Laboratory Rd.
Analysis, MD 12345

REVIEW OF POTENTIAL WATER CONTAMINATION SOURCES

(This section of the plan should identify and describe all of the potential sources of nutrient contamination at the operation, the best management practices used by the operation to minimize water contamination, and the operation's animal mortality plan.)

Description of All Animal Waste Handling, Collection, Storage, and Land Application Practices:

Liquid animal wastes from the milking center and freestall barns, used to house the milking cows, are flushed and stored in an earthen lagoon. Animal waste is collected from the freestall barns with flush alleys. Temporary storage is provided by a below-ground, reinforced concrete reception pit. Flush water used in the system is recycled from the waste storage lagoon. Flush tanks are filled using a pump and pipeline. Runoff from the feedlot and leachate from the feed storage is also directed to the storage lagoon. Wastes from the lagoon are pumped from the lagoon using a 6-inch PVC pipeline that is buried and the pipeline is flushed with clean water following each use.

Animal wastes from the dry lot, used to house dry cows and heifers, is scraped weekly and transferred via a front-end loader to the concrete storage slab. Animal wastes from the calf hutches are also collected weekly and stored on the concrete storage slab.

Wastes from the flush alleys, milk parlor, and milk house are treated with a stationary, inclined-screen solid/liquid separator prior to discharge into the storage lagoon. Separated solids are stored on an adjacent concrete slab. Wastes collected in the reception pit are agitated and pumped to the separator once a day. The screen on the solid/liquid separator is clean-water rinsed following each use to prevent solids from drying and adhering to the screen.

Animal wastes are land applied to 750 acres of adjacent cropland prior to each crop planting. Solid wastes are applied using a surface spreader with incorporation within 2 days of application. Liquid wastes are applied via a center pivot irrigation system.

Identification of Best Management Practices Used to Protect Surface Water and Groundwater:

A number of best management practices are currently used by The Dairy Farm to protect surface and groundwater. First, all clean water is diverted away from animal housing and animal waste handling areas by using roof gutters and down spouts and all runoff from the feedlot itself is directed to the waste storage lagoon. Second, The Dairy Farm uses a permanently installed lagoon depth marker to estimate the volume of waste in the lagoon and ensure that it does not exceed the design standards of the lagoon. The top of the lagoon embankment elevation is 1.5 feet above the spillway crest, which is an allowance for the head to operate the spillway and freeboard. The vegetative cover within the lagoon area is mowed frequently during the growing season and weeds and woody vegetation are controlled with herbicides.

The Dairy Farm also performs periodic inspections of the lagoon and concrete storage pad looking for cracks and checking drains to see that they are operative. All necessary repairs are made soon after they are identified. The Dairy Farm also leaves all crop residues on the soils until a new crop is planted to minimize nutrient losses from the fields.

REVIEW OF POTENTIAL WATER CONTAMINATION SOURCES (CONT.)

Description of Plan for Properly Handling and Disposing of Dead Animals in a Timely Manner:

All mortalities are picked up daily by the local rendering plant.

DESCRIPTION OF LAND APPLICATION FIELDS

(This section of the plan should describe the location and size of all fields designated to receive animal waste applications. In addition, this section should describe the methods used to sample the soils at the fields and present the results of the soil tests.)

Location (County) of Operation and Land Application Fields:

The Dairy Farm and all land application fields are located in Holstein County, Maryland.

Watershed Code(s) of Operation and Land Application Fields:

The Dairy Farm and all land application fields are located within the "Livestock" watershed. The Livestock watershed code is 01-01-01-01.

Total Acres of Operation:

The Dairy Farm owns and operates a total of 770 acres; 750 acres of cropland and 20 acres for the dairy operation. No land is currently rented.

Total Acres of Land Application Fields:

Four fields are used for land application for a total of 750 acres. The fields are identified on the site map attached to this plan.

Field Number	Acres
1	250
2	125
3	175
4	200

Describe the Methods Used to Sample the Soils of the Land Application Fields:

The soils of each of the 4 fields used for land application were sampled separately. Soil samples were collected at a depth of approximately 8 inches using a soil auger. Twenty samples were obtained from each field. Sample locations were identified using a zig-zag pattern across the field. The samples from one field were mixed together in a clean 5-gallon bucket. The soil sample jar was then filled with the mixed sample. All samples were sent via Fed Ex to the laboratory on the day that they were collected.

DESCRIPTION OF LAND APPLICATION FIELDS (CONT.)

Describe the Analytical Methods Used to Sample the Soils of the Land Application Fields:

Soil samples were sent to Waste Plus, an accredited laboratory, and analyzed for pH, nitrogen, phosphorus, potassium, soil organic matter, and electrical conductivity (EC). The laboratory used the recommended/standardized chemical extraction and testing procedure for the crop, climate, and soils of the area. A listing of the analytical methods used by Waste Plus is attached to this plan.

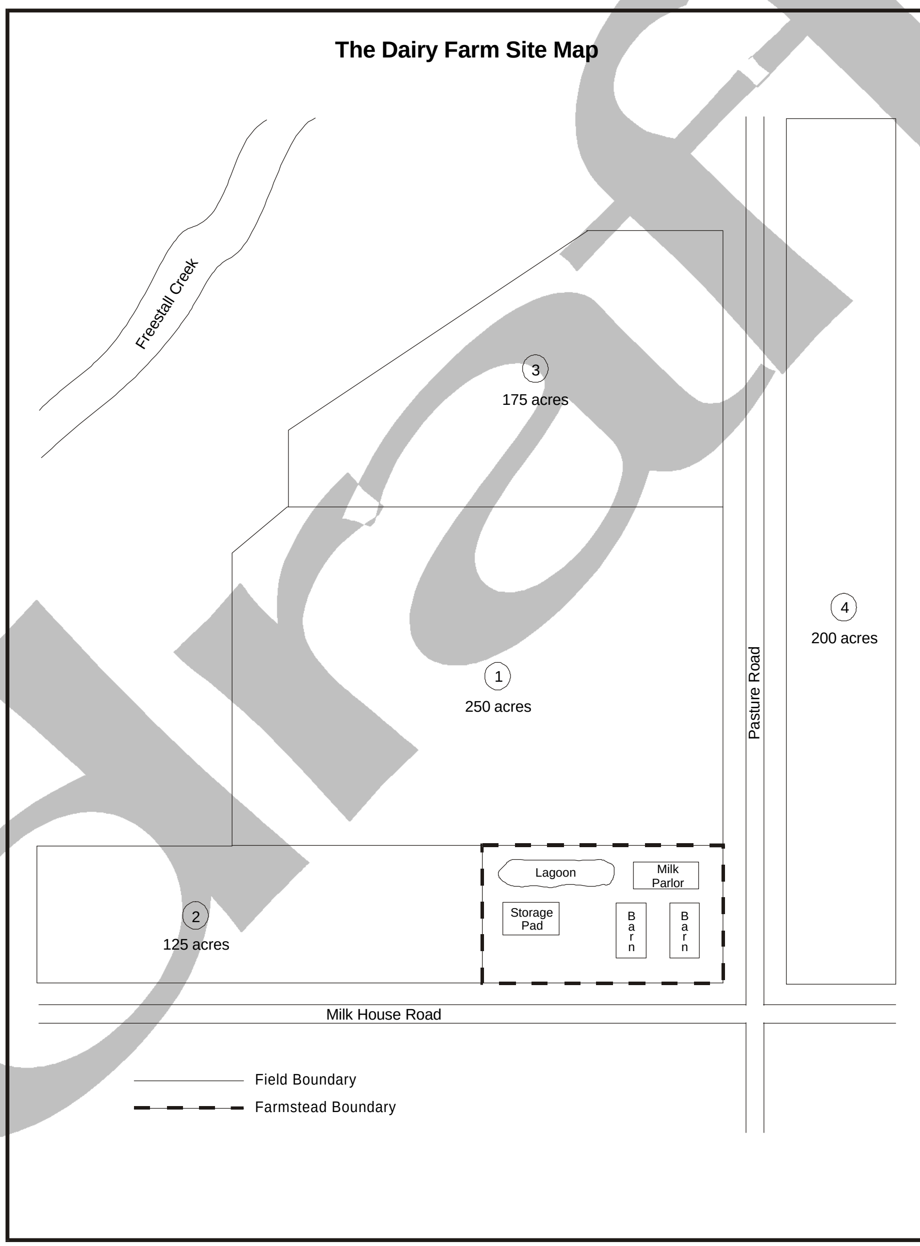
Results of Current Soil Test:

(For each field that was sampled, provide the results of the current soil test. Also, attach a copy of the actual lab results.)

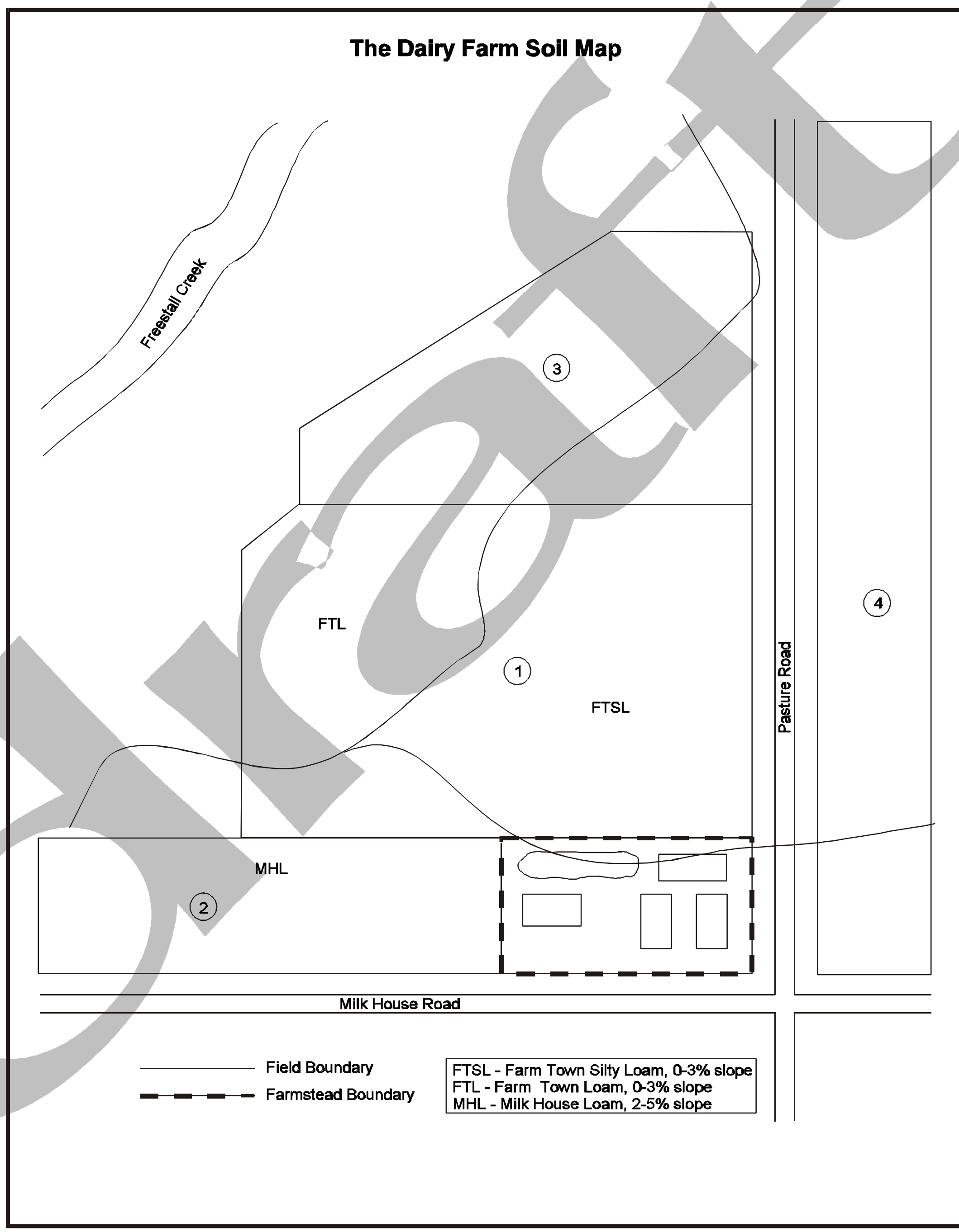
Field Number	Current Soil Test Levels (lb/acre)				
	N	P	K	pH	Soil Organic Matter (%)
1	20	75	90	6.2	2.2
2	25	70	110	5.8	2.6
3	26	60	80	6.3	2.4
4	22	78	95	6.1	2.6

FARM MAP

(This section of the plan should identify the location and boundaries of the operation; individual field boundaries; field numbers and acreages; soil types and slopes; location of nearby surface waters and other environmentally sensitive areas.)



FARM MAP (CONT.)



SURFACE & GROUNDWATER ASSESSMENT

(This section of the plan should thoroughly describe the surface and groundwater assessment that was conducted at the operation. The assessment must include an evaluation of soil leaching and permeability index at the feedlot and land application fields.)

Name of Person Performing Surface & Groundwater Assessment and Date That Assessment Was Performed:

Mr. N. Planner, March 5, 2000

Name, Location, and Description of Closest Surface Water Body:

The closest surface water body is the "Freestall" creek which is located southwest of The Dairy Farm approximately 0.5 miles. The Freestall creek is a slow flowing creek running north to south.

Depth to Aquifer:

The groundwater aquifer is located approximately 80 feet below the soil surface of The Dairy Farm and adjacent land application fields. The depth to aquifer was obtained from local geologic maps provided by the local Cooperative Extension Office.

Hydrologic Classification of Soils:

There are 3 primary soil types present at the operation: Farm Town Silty Loam, Farm Town Loam, and Holstein Loam. All of these soils are moderately drained and classified in the "B" hydrologic soil group. These "B" soils are described as moderately deep to deep, moderately drained, moderately fine to moderately coarse texture. The infiltration capacity/permeability, leaching potential, and runoff potential are considered moderate. This information was obtained from local soil maps for the area that were provided by the local Cooperative Extension Office.

Results and Discussion of Surface and Groundwater Assessment:

(Include or reference supporting research and/or analyses used in the assessment.)

<u>Surface Runoff & Leaching Assessment</u>

Each of the 4 land application fields and the feedlot at The Dairy Farm were assessed in terms of their potential for surface runoff and leaching. For surface runoff, the areas were assessed with respect to drainage, areas of concentrated flow, slope gradient, slope length, ability to access the fields in the winter moths, and proximity to neighbors. The results of these assessments, by area, are presented in the following table.

SURFACE & GROUNDWATER ASSESSMENT (CONT.)

Area	Characteristic				
	How well do the soils drain?	**Are there any areas of concentrated flow?**	**Does the slope gradient and length increase potential for runoff?**	**Is winter access a problem?**	**Is proximity to neighbors a problem?**
Field 1	Moderately drained	No	0-5% gradient and 0-300 ft length; therefore, little potential for runoff	No	No
Field 2	Moderately drained	No	0-5% gradient and 0-300 ft length; therefore, little potential for runoff	No	No
Field 3	Moderately drained	No	0-5% gradient and 0-300 ft length; therefore, little potential for runoff	No	No
Field 4	Moderately drained	No	0-5% gradient and 0-300 ft length; therefore, little potential for runoff	No	No
Feedlot	Moderately drained	No	0-5% gradient and 0-300 ft length; therefore, little potential for runoff	No	No

The potential for phosphorus transport to water bodies was assessed using the Phosphorus Index. The Phosphorus Index provides a rating based on soil erosion, subsurface drainage, leaching potential, distance to surface water, and land application practices. For each of the land application fields and the feedlot, the Phosphorus Index loss rating was <8 and considered to be low. Therefore, based on all of these assessments, the surface runoff potential at The Dairy Farm appears to be very low and land application of animal wastes should not pose an increased risk to surface and groundwater.

For leaching potential, the areas were assessed with respect to their leaching index rating. The leaching index is a simple index which was used to assess the soils based on their saturated hydraulic conductivity and storage capacity, and the average annual rainfall and the seasonal distribution of the rainfall for the area. The leaching index ratings were obtained from the Field Office Technical Guide, Section II-3 for Holstein County, MD. (A copy of this information is attached to this plan.) The leaching index for all four fields and the feedlot were below 2 inches. Therefore, it is assumed that proper land application of animal wastes would not contribute to soluble nitrogen leaching below the root zone.

<u>Hydrologic Link Assessment</u>

An assessment was conducted to determine if there is a hydrologic link between the groundwater and surface water at The Dairy Farm. Local geologic maps and reports, made available through the local Cooperative Extension agent, were used to thoroughly characterize the soils, subsurface, and groundwater aquifer at the operation. Additional maps and reports were used to characterize “Freestall” creek. After reviewing the maps and reports, it was determined that there is not a hydrologic link between surface and groundwater at The Dairy Farm.

LAND APPLICATION OF ANIMAL WASTES

(This section of the plan should identify all planned crops with associated planting and harvesting dates and expected yields. In addition, this section should identify the recommended nutrient requirements for the planned crops and expected yields, provide calculations for determining all applicable nutrient credits for each field, and provide calculations for determining the recommended animal waste application rate for each field.)

Identify All Planned Crops and Expected Planting Dates, Harvesting Dates, and Yields:

(Describe the basis for all expected crop yields (e.g., based on previous yields for that crop, based on county yields for the last 5 years).)

Field Number	Planned Crop	Expected Planting Date	Expected Harvesting Date	Expected Yield
1	Corn-silage	April 2000	September 2000	20 tons/acre
1	Winter wheat	September 2000	December 2000	6 tons/acre
Basis for Expected Yields: Average historic yields for corn-silage and winter wheat on Field Number 1.				
2	Corn-silage	April 2000	September 2000	20 tons/acre
2	Winter wheat	September 2000	December 2000	6 tons/acre
Basis for Expected Yields: Average historic yields for corn-silage and winter wheat on Field Number 2.				
3	Alfalfa	March 2000	September, 2000	5 tons/acre
Basis for Expected Yield: Average historic yield for alfalfa on Field Number 3.				
4	Alfalfa	March 2000	September, 2000	5 tons/acre
Basis for Expected Yield: Average historic yield for alfalfa on Field Number 4.				

Describe Crop Residue Management Practices:

Crop residues are left on all of the fields until planting begins for the next crop.

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Recommended Crop Nutrient Requirements:

(This information is generally provided by the local Cooperative Extension Office and based on planned crops, expected crop yields, and current soil test results.)

Field Number	Acres	Crop	Nutrient Requirements (N)	Nutrient Requirements (P)
1	250	Corn-silage	180 lb/acre	20 lb/acre
1	250	Winter wheat	40 lb/acre	30 lb/acre
2	125	Corn-silage	180 lb/acre	20 lb/acre
2	125	Winter wheat	40 lb/acre	30 lb/acre
3	175	Alfalfa	0 lb/acre	0 lb/acre
4	200	Alfalfa	0 lb/acre	0 lb/acre

Alfalfa is a legume crop which can obtain all of its required nitrogen from the atmosphere and soil. Therefore, to prevent additional build up of phosphorus in the soils, animal wastes will not be applied to them.

Nutrients in Animal Wastes:

(Provide an estimate of the total number of pounds or gallons of nitrogen, phosphorus, and potassium that are available in the animal wastes produced at the operation.)

Animal Waste	Total Waste Produced	Nitrogen Content of Waste	Phosphorus Content of Waste	Potassium Content of Waste	Total Nitrogen in Waste	Total Phosphorus in Waste	Total Potassium in Waste
Liquid	6,613,824 gallons	6 lb/ 1,000 gal	3 lb/1,000 gal	4 lb/1,000 gal	39,683 lb	19,841 lb	26,455 lb
Solids	5,875 tons	9 lb/ton	3 lb/ton	6 lb/ton	52,875 lb	17,625 lb	35,250 lb
TOTAL					92,558 lb	37,466 lb	61,705 lb

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Nutrient Credits:

(Calculate the nutrient credits for the fields receiving animal waste based on previous legume crops, residue nitrogen from previous animal waste applications, commercial fertilizer/biosolids applications, residue nitrogen from irrigation water, and other sources deemed appropriate from your local Cooperative Extension Office. Provide a basis for each nutrient credit.)

Field Number	Nutrient Credits - Nitrogen					
	Previous Legume Crops	Residual N from Previous Animal Waste Applications	N from Commercial Fertilizer/Biosolids Applications	Residue N from Irrigation Water	Other Sources	Total
1 (Corn-silage)	0	17 lb/acre	10 lb/acre	0	0	27
1 (Winter wheat)	0	17 lb/acre	10 lb/acre	0	0	27
2 (Corn-silage)	0	17 lb/acre	10 lb/acre	0	0	27
2 (Winter wheat)	0	17 lb/acre	10 lb/acre	0	0	27

Fields 3 and 4 are not included in this calculation as animal wastes will not be applied to them.

<u>Discussion of Nutrient Credits</u>

Fields 1 & 2:
No legume crops were planted the year before on this field. Therefore, credits from previous legume crops = 0.

Animal waste was applied at a rate of 100 lbs of nitrogen/acre for last 2 years. Therefore, residual nitrogen exists from these previous applications. The residual nitrogen was calculated by multiplying the mineralization factor by the application rate for the three previous years of animal waste application. The following mineralization factors were used: 12% for 1 year ago and 5 % for 2 years ago. These mineralization factors were obtained from the local Cooperative Extension Office.

$$\text{N residual} = 0.12 \times 100 \text{ lb/acre} + 0.05 \times 100 \text{ lb/acre} = 17 \text{ lb/acre}$$

Starter commercial fertilizer will be applied to the fields prior to planting of corn-silage. A nitrogen credit of 10 lb/acre will be obtained from this commercial fertilizer application.

Irrigation water is applied to these fields. Water tests conduced by the county indicate that only very small concentrations of nutrients are present in the water, and are therefore, assumed negligible and not included in these calculations.

The local Cooperative Extension Office did not identify any additional sources of nutrient credits for this operation.

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Plant Available Animal Waste Nutrients:

(Provide a calculation of the amount of nutrients (nitrogen and phosphorus) in the animal wastes that would be available to the crops in the first year for the application method to be used by the operation.)

All calculations and factors used for The Dairy Farm were obtained from the local Cooperative Extension Office.

Plant Available Nitrogen (PAN)

PAN_{liquid} = (% Available Organic N + % Available NH4) x 83.45
PAN_{solid} = (% Available Organic N + % Available NH4) x 20

% Available Organic N_{liquid} = (%Total N - %NH4) x Mineralization Factor
= (0.15 - 0.06) x 0.35
= 0.03

% Available $NH4_{liquid}$ = %NH4 x Conservation Factor
= 0.06 x 0.64
= 0.04

% Available Organic N_{solid} = (%Total N - %NH4) x Mineralization Factor
= (0.61 - 0.12) x 0.35
= 0.17

% Available $NH4_{solid}$ = %NH4 x Conservation Factor
= 0.12 x 0.64
= 0.08

PAN_{liquid} = (0.03 + 0.04) x 83.45
= 5.8 lb/1,000 gal

PAN_{solid} = (0.17 + 0.08) x 20
= 5 lb/ton

Plant Available Phosphorus

Assume 100% of phosphorus in animal waste is available to the plants.

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Land Application Rate:

(Provide the calculated land application rate for each field and each crop and all formulas and assumptions used to calculate the rate. Also calculate the total amount of animal wastes that will be applied to the fields and compare that to the annual amount of animal wastes produced at the operation.)

All animal waste applications to Fields 1 and 2 will be made on a nitrogen-basis. No animal wastes are applied to Fields 3 and 4.

Manure Application Rate $_{nitrogen}$ = Recommended Crop Nutrient Requirements $_N$ - Nutrient Credits $_N$

Field Number	Acres	Crop	Recommended Crop Nutrient Requirements (Nitrogen)	Nutrient Credits (Nitrogen)	Application Rate (Nitrogen) PAN
1	250	Corn-silage	170 lb/acre	27 lb/acre	143 lb/acre
1	250	Winter wheat	35 lb/acre	27 lb/acre	8 lb/acre
2	125	Corn-silage	170 lb/acre	27 lb/acre	143 lb/acre
2	125	Winter wheat	35 lb/acre	27 lb/acre	8 lb/acre

Therefore 143 pounds/acre of PAN will be applied to corn-silage planted on Fields 1 and 2 in the spring and 13 pounds/acre of PAN will be applied to winter wheat planted on Fields 1 and 2 in the fall.

Liquid animal waste will be applied to the corn-silage on Field 1 at a rate of 24,655 gallons/acre for a total of 6,163,750 gallons of animal waste.

Application rate gallons/acre = 143 lb PAN/acre x 1,000 gal/5.8 lb PAN
= 24,655 gallons/acre

The rate of 143 lb PAN/acre results in 74 lbs/acre of phosphorus being applied to the field.

Phosphorus application rate = 24,655 gallons/acre x 3 lb P/1,000 gallons
= 74 lb/acre

Liquid animal waste will be applied to the winter wheat on Field 1 at a rate of 1,379 gallons/acre for a total of 344,750 gallons of animal waste.

Application rate gallons/acre = 8 lb PAN/acre x 1,000 gal/5.8 lb PAN
= 1,379 gallons/acre

The rate of 8 lb PAN/acre results in 4 lbs/acre of phosphorus being applied to the field.

Phosphorus application rate = 1,379 gallons/acre x 3 lb P/1,000 gallons
= 4 lb/acre

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Solid animal waste will be applied to the corn-silage on Field 2 at a rate of 29 tons/acre for a total of 3,625 tons of animal waste.

Application rate gallons/acre	=	143 lb PAN/acre x 1ton/5 lb PAN
	=	29 tons/acre

The rate of 143 lb PAN/acre results in 87 lbs/acre of phosphorus being applied to the field.

Phosphorus application rate	=	29 tons/acre x 3 lb/ton
	=	87 lb/acre

Solid animal waste will be applied to the winter wheat on Field 2 at a rate of 1.6 tons/acre for a total of 200 tons of animal waste.

Application rate gallons/acre	=	8 lb PAN/acre x 1 ton/5 lb PAN
	=	1.6 ton/acre

The rate of 8 lb PAN/acre results in approximately 5 lbs/acre of phosphorus being applied to the field.

Phosphorus application rate	=	1.6 tons/acre x 3 lb/ton
	=	4.8 lbs/acre

The total amount of liquid animal waste applied to Field 1 over the course of the year is:

Liquid waste applied to the field =	6,163,750 + 344,750		
	=	6,508,500 gallons per year	

The total amount of solid animal waste applied to Field 2 over the course of the year is:

Solid waste applied to the field	=	3,625 + 200
	=	3,825 tons

Nearly all of the liquid wastes will be removed from the lagoon and applied to the fields over the course of the year. Approximately 65% of the solid animal waste will be applied to the fields over the course of the year. The excess 2,050 tons of solid waste will be sold to neighboring farms.

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Land Application Summary:

(For each application of animal manure and commercial fertilizer/biosolids, by field, provide the date of application, the method of application, and the application rate. Also provide the date of application equipment calibration and the rainfall amounts 24 hours before and after each application.)

Field Number	Crop	Application Type (animal waste, commercial fertilizer, biosolids)	Application Date	Application Method	Application Rate	
					N	P
1	Corn-silage	Commercial fertilizer (starter nitrogen)	April 15, 2000	Solids spreader	10 lb/acre	0
1	Corn-silage	Animal waste	May 1, 2000 - June 1, 2000	Center Pivot Irrigation System	143 lb/acre	74 lb/acre
1	Winter wheat	Commercial fertilizer (starter nitrogen)	October 1, 2000	Solids spreader	10 lb/acre	0
1	Winter wheat	Animal waste	October 1, 2000 - October 30,2000	Center Pivot Irrigation System	8 lb/acre	4 lb/acre
2	Corn-silage	Commercial fertilizer (starter nitrogen)	April 15, 2000	Solids spreader	10 lb/acre	0
2	Corn-silage	Animal waste	May 1, 2000	Solids spreader	143 lb/acre	87 lb/acre
2	Winter wheat	Commercial fertilizer (starter nitrogen)	October 1, 2000	Solids spreader	10 lb/acre	0
2	Winter wheat	Animal waste	October 30,2000	Solids spreader	8 lb/acre	5 lb/acre

Application Date	Rainfall Amount 24 Hours Before Application	Rainfall Amount 24 Hours After Application
April 15, 2000	0 inches	0 inches
May 1, 2000 - June 1, 2000	Animal waste was applied every day over the course of the month. Rainfall for the month was 0.5 inches between May 3 and May 7.	Animal waste was applied every day over the course of the month. Rainfall for the month was 0.5 inches between May 3 and May 7.
October 1, 2000	0 inches	0 inches
October 1, 2000 - October 30, 2000	Animal waste was applied every day over the course of the month. Rainfall for the month was 1.2 inches between October 15 and October 30.	Animal waste was applied every day over the course of the month. Rainfall for the month was 1.2 inches between October 15 and October 30.

LAND APPLICATION OF ANIMAL WASTES (CONT.)

Type of Application Equipment	Calibration Date
Solid spreader	April 14, 2000
Center Pivot Irrigation System	April 30, 2000
Center Pivot Irrigation System	September 30, 2000

Alternative Uses of Animal Wastes:

(Describe alternative uses of animal wastes, if applicable. If animal wastes are sold or given away to a third party, provide the date that the animal waste was removed from the operation and the amount, by weight, of the animal waste that was taken off site.)

Some solid animal waste is sold to local farmers for use as a nutrient source.

Amount of Animal Waste Transported Off Site	Date Animal Waste was Transported Off Site
2,050 tons solid animal waste	October 16, 2000

CHAPTER 4: REFERENCES

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APPENDICES

APPENDIX A: DEFINITIONS AND ACRONYMS

[Most of these definitions were taken from the USDA Agricultural Waste Management Field Handbook.]

AFO	Animal feeding operation
Aerobic	Having or occurring in the presence of free oxygen.
Aerobic bacteria	Bacteria that require free elemental oxygen for their growth.
Ammonia nitrogen	The nitrogen component of the gas (NH_3) released by the microbiological decay of plant and animal proteins, usually reported as NH_3N.
Ammonia volatilization	The loss of ammonia gas to the atmosphere.
Anaerobic	The absence of molecular oxygen, or growing in the absence of oxygen.
Anaerobic bacteria	Bacteria that do not require the presence of free or dissolved oxygen.
Anaerobic digestion	Conversion of organic matter in the absence of oxygen under controlled conditions to such gases as methane and carbon dioxide.
Anaerobic lagoon	A unit to treat animal waste by predominantly anaerobic biological action using anaerobic organisms, in the absence of oxygen, for the purpose of reducing the strength of the waste.
Animal waste	The combination of all wastes generated and/or produced at an animal feeding operation. This includes manure, silage leachate, process wastewater, and process generated wastewater.
Bacteria	A group of universally distributed, rigid, essentially unicellular procaryotic micro-organisms.
Bedrock	The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
Best management practices	Activities, prohibitions, maintenance procedures, and other management practices found to be the most effective and practicable methods to prevent or reduce the discharge of pollutants to waters of the United States. Best management practices include operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.
Biochemical oxygen demand (BOD)	An indirect measure of the concentration of biodegradable substances present in an aqueous solution. Determined by the amount of dissolved oxygen required for the aerobic degradation of the organic matter at 20^{N} C.
CAFO	Concentrated animal feeding operation.

Composting A process of aerobic biological decomposition of organic material characterized by elevated temperatures that, when complete, results in a relatively stable product suitable for a variety of agricultural and horticultural uses.

Conservation practice A specific structural, managerial, or cultural treatment of natural resources commonly used to meet a specific need in planting and carrying out soil and water conservation programs.

Cover crop A close-growing crop, whose main purpose is to protect and improve the soil and use excess nutrients or soil moisture during the absence of the regular crop, or in the nonvegetated areas of orchards and vineyards.

Crop rotation A planned sequence of crops.

Denitrification The chemical or biological reduction of nitrate (NO_3) or nitrite (NO_2) to gaseous nitrogen, either as molecular nitrogen (N_2) or as an oxide of nitrogen (e.g., N_20)

ELGs Effluent limitations guidelines and standards.

EPA The United States Environmental Protection Agency.

Effluent The liquid discharge from a waste treatment process.

Electrical conductivity Conductivity of electricity through water or an extract of soil.

Erosion The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Eutrophication A natural or artificial process of nutrient enrichment whereby a water body becomes abundant in plant nutrients and low in oxygen content.

Evapotranspiration The loss of water from an area by evaporation from the soil or snow cover and transpiration by plants.

Feedlot A concentrated, confined animal or poultry growing operation for meat, milk, or egg production, or stabling, in pens or houses wherein the animals or poultry are fed at the place of confinement and crop or forage growth or production is not sustained in the area of confinement.

Groundwater Water filling all the unblocked pores of underlying material below the water table.

Hydraulic conductivity The rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient, at the prevailing temperature (gpd/ft^2).

Hydrologic soil groups — A classification system used by the Natural Resource Conservation Service to group soils according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material.

Infiltration — The downward entry of water into the immediate surface of soil or other material.

Infiltration rate — The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Karst topography — A type of topography that is formed in limestone, gypsum, and other similar type rock by dissolution and is characterized by sinkholes, caves, and rapid underground water movement.

Lagoon — A reservoir or pond built to contain materials such as water and animal wastes until they can be removed or decomposed either by aerobic or anaerobic purposes.

Land application — Application of material such as animal waste to land for reuse of the nutrients and organic matter for their fertilizer and soil conditioning values.

Leaching — The removal of soluble constituents, such as nitrates or chlorides, from soils or other material by the movement of water.

Liquid manure — A mixture of water and manure that behaves more like a liquid than a solid, usually less than 10% solids.

Macronutrient — A chemical element required, in relatively large amounts, for proper plant growth (e.g, nitrogen).

Manure — The fecal and urinary excretions of livestock and poultry.

Micronutrient — A chemical element required, in relatively small amounts, for proper plant growth (e.g., magnesium).

Mineralization — The microbial conversion of an element from an organic to an inorganic state.

NPDES — National Pollutant Discharge Elimination System

Nitrogen — A chemical element, commonly used in fertilizer as a nutrient, which is also a component of animal wastes.

Nitrogen fixation — The biological process by which elemental nitrogen is converted to organic or available nitrogen.

No-till — A planting procedure that requires no tillage except that done by a coulter in the immediate area of the crop row.

Nonpoint source — Entry of effluent into a water body in a diffuse manner so there is no definite point of entry.

Nutrients — Elements required for plant or animal growth such as nitrogen, phosphorus, or potassium.

Nutrient management — Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments to ensure adequate soil fertility for plant production and to minimize the potential for environmental degradation, particularly water quality impairment.

Nutrient management specialist — A person who provides technical assistance for nutrient management and has the appropriate certification.

Open lot — Pens or similar confinement areas with dirt, concrete paved or hard surfaces, wherein animals are substantially or entirely exposed to the outside environment, except where some protection is afforded by windbreaks or small shed-type shade areas. “Open lot” is synonymous with the terms “cowyard,” “dirt lot,” and “dry lot,” which are terms widely used in the industry.

Organic matter — The organic fraction of the material such as soil exclusive of undecayed plant and animal residue.

PNP — Permit nutrient plan.

Pathogens — Disease causing micro-organisms; generally associated with viruses or bacteria (e.g., *E coli*).

Percolation — The downward movement of water through soil.

Permeability — The quality of the soil that enables water to move downward through the profile. Permeability is generally measured as the number of inches per hour that water moves downward through the saturated soil.

Permit nutrient plan — A documented record of how nutrients will be used for plant production prepared for reference and use by the producer or landowner.

pH — The negative logarithm of the hydrogen ion concentration. The pH scale ranges from 0 to 14. Values below 7 are considered acidic and those above are considered alkaline.

Phosphorus — One of the primary nutrients required for the growth of plants.

Point source	Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture. (Section 502 of the Federal Water Pollution Control Act, as amended)
Process generated waste water	Water directly or indirectly used with the operation of the CAFO for any and all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other CAFO facilities; direct contact swimming, washing, or spray cooling of animals; litter or bedding; dust control; and stormwater which comes into contact with any raw materials, products or by-products of the operation
Process waste water	Any process-generated wastewater and any precipitation (rain or snow) which comes into contact with any manure, litter, or bedding, or any other raw material or intermediate or final material or product used in or resulting from the production of animals or poultry or direct products (e.g., milk, eggs).
Reduced tillage	A management practice whereby the use of secondary tillage operations is significantly reduced.
Runoff	The part of precipitation or irrigation water that appears in surface streams or water bodies; expressed as volume (acre-inches) or rate of flow (gallons per minute, cubic feet per second).
Sheet erosion	Soil erosion occurring from a thin, relatively uniform layer of soil particles on the soil surface.
Slope	The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100.
USDA	United States Department of Agriculture
USGS	Unites States Geological Society
25-year, 24-hour storm event	The maximum 24-hour precipitation event expressed in inches with a probable recurrence interval of once in 25 years, as defined by the National Weather Service

APPENDIX B: COPY OF PROPOSED ELG AND NPDES RULE FOR FEEDLOTS

PART 122--EPA ADMINISTERED PERMIT PROGRAMS: THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

1. The authority citation for part 122 continues to read as follows:

Authority: The Clean Water Act, 33 U.S.C. 1251 et seq.

2. Amend § 122.21 by adding subparagraphs (i)(1)(iv) through (ix) to read as follows:

§ 122.21 Application for a permit (applicable to State programs, see § 123.25).

* * * * *

(i) * * *

(1) * * *

(iv) Either a copy of the cover sheet and executive summary of the permittee's current Permit Nutrient Plan that meet the criteria in 40 CFR 412.37(b) and is being implemented, or draft copies of these documents together with a statement on the status of the development of its Permit Nutrient Plan. If the CAFO is subject to 40 CFR Part 412 and draft copies are submitted, they must, at a minimum, demonstrate that there is adequate land available to the CAFO operator to comply with the land application provisions of part 412 of this Chapter, if applicable, or describe an alternative to land application that the operator intends to implement.

(v) Acreage available for application of manure and wastewater;

(vi) Estimated amount of manure and wastewater that the applicant plans to transfer off-site;

(vii) Name and address of any person or entity that owns animals to be raised at the facility, directs the activity of persons working at the CAFO, specifies how the animals are grown, fed, or medicated, or otherwise exercises control over the operations of the facility;

(viii) Indicate whether buffers, setbacks or conservation tillage are implemented at the facility to control runoff and protect water quality; and

(ix) Latitude and longitude of the CAFO, to the nearest second.

3. Section 122.23 is revised to read as follows:

§ 122.23 Concentrated animal feeding operations (applicable to State NPDES programs, see § 123.25).

(a) **Definitions applicable to this section:**

(1) For land on which manure from an animal feeding operation or concentrated animal feeding operation has been applied, the term "*agricultural storm water discharge*" means a discharge composed entirely of storm water, as defined in § 122.26(a)(13), from a land area upon which manure and/or wastewater has been applied in accordance with proper agricultural practices, including land application of manure or wastewater in accordance with either a nitrogen-based or, as required, a phosphorus-based manure application rate.

(2) An *animal feeding operation or AFO* is a facility where animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period. Animals are not considered to be stabled or confined when they are in areas such as pastures or rangeland that sustain crops or forage growth during the entire time that animals are present. Animal feeding operations include both the production area and land application area as defined below.

OPTION 1 FOR PARAGRAPH (a)(3)

(3) _Concentrated animal feeding operation or CAFO_ means an AFO that either:

(i) Confines a number of animals equal to or greater than the number specified in any one or more of the following categories. For the purposes of determining the number of animals at an operation, two or more AFOs under common ownership are considered to be a single AFO if they adjoin each other or if they use a common area or system for the disposal of wastes. Once an operation is defined as a CAFO, the requirements of this section apply with respect to all animals in confinement at the operation and all wastes and waste waters generated by those animals, regardless of the type of animal.

(A) 350 mature dairy cattle;
(B) 500 veal;
(C) 500 cattle other than veal or mature dairy cattle;
(D) 1,250 swine each weighing over 25 kilograms (approximately 55 pounds);
(E) 5000 swine each weighing less than 25 kilograms (approximately 55 pounds);
(F) 250 horses;
(G) 5,000 sheep or lambs;
(H) 27,500 turkeys;
(I) 50,000 chickens; or
(J) 2,500 ducks; or

(ii) Is designated as a CAFO under paragraph (b) of this section.

OPTION 2 FOR PARAGRAPH (a)(3):

(3) _Concentrated animal feeding operation or CAFO_ means an AFO which either is defined as a CAFO under paragraph (a)(3)(i) or (ii) of this section, or is designated as a CAFO under paragraph (b) of this section. Two or more AFOs under common ownership are considered to be a single AFO for the purposes of determining the number of animals at an operation, if they adjoin each other or if they use a common area or system for the disposal of wastes. Once an operation is defined as a CAFO, the requirements of this section apply with respect to all animals in confinement at the operation and all wastes and waste waters generated by those animals, regardless of the type of animal.

(i) **Tier 1 AFOs.** An AFO is a CAFO if more than the numbers of animals specified in any of the following categories are confined:

(A) 700 mature dairy cattle;
(B) 1,000 veal;
(C) 1,000 cattle other than veal or mature dairy cattle;
(D) 2,500 swine each weighing over 25 kilograms (approximately 55 pounds);
(E) 10,000 swine each weighing less than 25 kilograms (approximately 55 pounds);
(F) 500 horses;
(G) 10,000 sheep or lambs;
(H) 55,000 turkeys;
(I) 100,000 chickens; or
(J) 5,000 ducks.

(ii) **Tier 2 AFOs.** (A) If the number of animals confined at the operation falls within the following ranges for any of the following categories, the operation is a Tier 2 AFO. A Tier 2 AFO is a CAFO unless it meets all of the conditions in paragraph (a)(3)(ii)(B) of this section and its operator submits to the Director a certification that it meets those conditions. The certification shall take the form specified in section 122.22(d).

(_1_) 200 to 700 mature dairy cattle,
(_2_) 300 to 1,000 veal,
(_3_) 300 to 1,000 cattle other than veal or mature dairy cattle,
(_4_) 750 to 2,500 swine each weighing over 25 kilograms (approximately 55 pounds),
(_5_) 3,000 to 10,000 swine each weighing less than 25 kilograms (approximately 55 pounds),
(_6_) 150 to 500 horses,
(_7_) 3,000 to 10,000 sheep or lambs,
(_8_) 16,500 to 55,000 turkeys,
(_9_) 30,000 to 100,000 chickens, or

(*10*) 1,500 to 5,000 ducks.

(B) A Tier 2 AFO is not a CAFO if it meets all of the following conditions and its operator submits to the Director a certification that it meets the following conditions:

(*1*) Waters of the United States do not come into direct contact with the animals confined in the operation;

(*2*) There is sufficient storage and containment to prevent all pollutants from the production area from entering waters of the United States as specified in 40 CFR Part 412.

(*3*) There has not been a discharge from the production area within the last five years;

(*4*) No part of the production area is located within 100 feet of waters of the United States;

(*5*) In cases where manure or process-generated wastewaters are land applied, they will be land applied in accordance with a Permit Nutrient Plan that includes the BMP requirements identified at 40 CFR 412.31(b) and 412.37; and

OPTION 1 FOR PARAGRAPH (a)(3)(ii)(B)(6):

(6) With respect to the off-site transfer of manure or process-generated wastewaters to persons who receive 12 tons or more of manure or wastewater in any year, the owner or operator will first obtain assurances that, if the manure will be land applied, it will be applied in accordance with proper agriculture practices, which means that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using one of the methods specified in 40 CFR 412.31(b)(1)(iv); adequate assurances include a certification from the recipient, the fact that the recipient has a permit, or the existence of a State program that requires the recipient to comply with requirements similar to 40 CFR 412.31(b). The owner or operator will provide the recipient of the manure with a brochure to be provided by te state permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management.

OPTION 2 FOR PARAGRAPH (a)(3)(ii)(B)(6):

(6) With respect to manure or process-generated wastewaters that are transferred off-site, the owner or operator will first provide the recipient of the manure with an analysis of its content and a brochure to be provided by the State permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management.

(4) The term *land application area* means any land under the control of the owner or operator of the production area whether it is owned, rented, or leased, to which manure and process wastewater from the production area is or may be applied.

(5) The term *operator*, for purposes of this section, means:

(i) An operator as that term is defined in § 122.2; or

(ii) A person who the Director determines to be an operator on the basis that the person exercises substantial operational control of a CAFO. Whether a person exercises substantial operational control depends on factors that include, but are not limited to, whether the person:

(A) Directs the activity of persons working at the CAFO either through a contract or direct supervision of, or on-site participation in, activities at the facility;

(B) Owns the animals; or

(C) Specifies how the animals are grown, fed, or medicated.

(6) The term *production area* means that part of the AFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyard, exercise yards, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, sheds, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms, and diversions which separate uncontaminated storm water Also included in the definition of production area is any eggwash or egg processing facility.

(b) **Designation as a CAFO.** The EPA Regional Administrator, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, may designate any AFO as a CAFO upon determining that it is a significant contributor of pollutants to the waters of the United States.

(1) In making this designation, the Director or the EPA Regional Administrator shall consider the following factors:

(i) The size of the AFO and the amount of wastes reaching waters of the United States;

(ii) The location of the AFO relative to waters of the United States;

(iii) The means of conveyance of animal wastes and process waste waters into waters of the United States;

(iv) The slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of animal wastes and process waste waters into waters of the United States; and,

(v) Other relevant factors.

OPTION 1 FOR PARAGRAPH (b)(2)

(2) No AFO shall be designated under this paragraph (b) until the Director or the EPA Regional Administrator has conducted an on-site inspection of the operation and determined that the operation should and could be regulated under the permit program; except that no inspection is required to designate a facility that was previously defined or designated as a CAFO.

OPTION 2 FOR PARAGRAPH (b)(2)

(2) No AFO shall be designated under this paragraph (b) until the Director or the EPA Regional Administrator has conducted an on-site inspection of the operation and determined that the operation should and could be regulated under the permit program; except that no inspection is required to designate a facility that was previously defined or designated as a CAFO. In addition, no AFO with less than 300 animal units may be designated as a concentrated animal feeding operation unless:

(i) Pollutants are discharged into waters of the United States through a manmade ditch, flushing system, or other similar manmade device; or

(ii) Pollutants are discharged directly into waters of the United States which originate outside of the facility and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.

(c) Who must apply for an NPDES permit?

(1) *All CAFOs must apply for a permit.* For all CAFOs, the CAFO owner or operator must apply for an NPDES permit, except as provided in paragraph (c)(2) of this section. Specifically, the CAFO owner or operator must either apply for an individual NPDES permit or submit a notice of intent for coverage under a CAFO general permit. If the Director has not made a general permit available to the CAFO, the CAFO owner or operator must apply for an individual permit.

(2) *Exception.* The CAFO owner or operator does not need to apply for an NPDES permit if the owner or operator has received from the Director a determination under paragraph (e) of this section that the CAFO has no potential to discharge.

(3) *Co-permitting.* Any person who is an "operator" of a CAFO on the basis that the person exercises substantial operational control of a CAFO (see §122.23(a)(5)(ii)) must apply for a permit. Such operators may apply for an NPDES permit either alone or together as co-permittees with other owners or operators of the CAFO.

(d) **In which case will the Director not issue an NPDES permit?** The Director shall not issue an NPDES permit if the Director has determined that the CAFO has "no potential to discharge" pursuant to paragraph (e) of this section.

(e) **"No potential to discharge" determinations.**

(1) *Determination by Director.* The Director, upon request, may make a case-specific determination that a CAFO has no potential to discharge pollutants to waters of the United States. In making this determination, the Director must consider the potential for discharges from both the production area and any land application areas, and must also consider any potential discharges via ground waters that have a direct hydrologic connection to surface waters. For purposes of this subsection, the term "no potential to discharge" means that there is no potential for any CAFO manure or waste waters to be added to waters of the United States, without qualification. For example, a CAFO may not claim that there is no potential to discharge even if the only pollutants that the CAFO has a

potential to discharge would be exempt from NPDES requirements. A CAFO has a potential to discharge if it has had a discharge within the preceding five years.

(2) *Supporting information.* In requesting a determination of no potential to discharge, the CAFO owner or operator must submit any supporting information along with the request. The Director has discretion to accept or reject any additional information that is submitted at a later date.

(3) *Requesting a "no potential to discharge" determination does not postpone the duty to apply for a permit.* The owner or operator must apply for a permit according to the date specified in section (f) unless it has received a no potential to discharge determination before that date.

(4) *CAFO bears the risk of any actual discharge.* Any unpermitted CAFO that discharges pollutants into the waters of the United States is in violation of the Clean Water Act even if it has received a "no potential to discharge" determination from the Director.

(f) **By when must I apply for a permit for my CAFO?**

(1) For all CAFOs, the owner or operator of the CAFO must apply for an NPDES permit no later than [insert date that is three years after the date of publication of the final rule], except as provided in subsections (2) through (6).

(2) Operations that are defined as CAFOs prior to [insert date that is three years after the date of publication of the final rule]. For operations that are CAFOs under regulations that are in effect prior to [insert date that is three years after the date of publication of the final rule], the owner or operator must apply for an NPDES permit under 40 CFR 122.21(a) within the time period specified in 40 CFR 122.21(c).

(3) Operations that become CAFO new sources or new dischargers after [insert date that is three years after the date of publication of the final rule]. For operations that meet the criteria in 40 CFR 122.23 for being defined as a CAFO for the first time after [insert date that is three years after the date of publication of the final rule], the owner or operator must apply for an NPDES permit 180 days prior to the date on which they first meet those criteria.

(4) Operations that are designated as CAFOs. For operations for which EPA or the Director has issued a case-specific designation that the operation is a CAFO, the owner or operator must apply for a permit no later than 90 days after issuance of the designation.

(5) Persons who are operators because they exercise "substantial operational control" over a CAFO. Persons who the Director determines to be operators because they exercise substantial operational control over a CAFO must apply for a permit within 90 days of the Director's determination.

(6) No potential to discharge. Notwithstanding any other provision of this section, a CAFO that has received a "no potential to discharge" determination under paragraph (e) of this section is not required to apply for an NPDES permit.

(g) **Are AFOs subject to Clean Water Act requirements if they are not CAFOs**? AFOs that are neither defined nor designated as CAFOs are subject to NPDES permitting requirements if they discharge the following from a point source:

(1) *Non-wet weather discharges*: discharges from their production area or land application area that are not composed entirely of storm water as defined in § 122.26(b)(13).

(2) *Wet weather discharges*: discharges from their land application area that are composed entirely of storm water as defined in § 122.26(b)(13), if the discharge has been designated under § 122.26(a)(1)(v) as requiring an NPDES permit. Discharges may be designated under § 122.26(a)(1)(v) if they are not agricultural storm water discharges as defined in § 122.23(a)(1).

(h) **If I do not operate an AFO but I land apply manure, am I required to have a NPDES permit?** If you have not been designated by your permit authority, you do not need a NPDES permit to authorize the discharge of runoff composed entirely of storm water from your manure application area. The land application of manure that results in the point source discharge of pollutants to waters of the United States may be designated pursuant to §122.26(a)(1)(v) as requiring a NPDES permit if the application is not in accordance with proper agriculture practices. Proper agricultural practices means that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using one of the methods specified in 40 CFR 412.31(b)(1)(iv).

(i) **What must be required in NPDES permits issued to CAFOs**. Permits issued to CAFOs must require compliance with the following:

(1) All other requirements of this part.

(2) The applicable provisions of part 412.

(3) *Duty to Maintain Permit Coverage.* No later than 180 days before the expiration of the permit, the permittee must submit an application to renew its permit. However, the permittee need not reapply for a permit if the facility is no longer a CAFO (e.g., where the numbers of confined animals has been reduced below the level that meets the definition of a CAFO) and the permittee has demonstrated to the satisfaction of the Director that there is no remaining potential for a discharge of manure or associated waste waters that were generated while the operation was a CAFO. With respect to CAFOs, this section applies instead of §§ 122.21(d) and 122.41(b).

(4) *Co-permittees.* In the case of a permit issued to more than one owner or operator of the CAFO, the permit may allocate to one of the permit holders the sole responsibility for any permit requirement, except that all permit holders must be jointly responsible for the management of manure in excess of what can be applied on-site in compliance with part 412

(5) Permits issued to CAFOs that meet the applicability requirements of Subpart C (Beef and Dairy) or Subpart D (Swine, Poultry and Veal) of 40 CFR Part 412 shall also require compliance with paragraph (j) of this section.

(6) Permits issued to CAFOs that do not meet the applicability requirements of Subpart C or Subpart D of 40 CFR Part 412 (including beef, dairy, swine, poultry or veal facilities not subject to those parts, and facilities with other types of animals) shall also require compliance with paragraph (k) of this section.

(j) **What must be required in NPDES permits issued to CAFOs that are subject to part 412, Subparts C (Beef and Dairy) and D (Swine, Poultry and Veal)?** Permits issued to CAFOs that meet the applicability requirements of Subpart C or Subpart D of 40 CFR Part 412 must require compliance with all of the following:

(1) Requirements to use the method in 40 CFR 412.31(b)(1)(iv) chosen by the Director to determine phosphorous field conditions and to determine appropriate manure application rates. The permit shall specify the factors to be considered and the analytical methods to be employed when determining those rates.

(2) Prohibitions against or restrictions on applying manure to land during times and using methods which, in light of local crop needs, climate, soil types, slope and other factors, would not serve an agricultural purpose and would be likely to result in pollutant discharges to waters of the United States.

(3) Requirement to notify the Director when the permittee's Permit Nutrient Plan has been developed or revised. Notification of the development of the permittee's initial Permit Nutrient Plan must be submitted no later than 90 days after the CAFO submits its NOI or obtains coverage under an individual permit. With the notice, the permittee shall provide a copy of the cover sheet and executive summary of the permittee's current Permit Nutrient Plan that has been developed under 40 CFR 412.37(b).

OPTION 1 FOR PARAGRAPHS (j)(4) AND (5)

(4) *Transfer of manure to other persons*. The Director may waive the requirements of this paragraph if an enforceable state program subjects the recipient of CAFO wastes to land application requirements that are equivalent to the requirements in 40 CFR 412.31(b). The requirements of paragraph (f) of this section apply only to transfers to persons who receive 12 tons or more of wastes from the CAFO in any year. Prior to transferring manure and other wastes to other persons, the permittee shall:

(i) Obtain from each intended recipient of the CAFO waste (other than haulers that do not land apply the waste) a certification that the recipient will do one of the following. The certification must contain a statement that the recipient understands that the information is being collected on behalf of the U.S. Environmental Protection Agency or State and that there are penalties for falsely certifying. The permittee is not liable if the recipient violates its certification;

(A) Land apply the wastes in accordance with proper agriculture practices, which means that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using the method specified in 40 CFR 412.31(b)(1)(iv) chosen by the Director;

(B) Land apply the wastes in compliance with the terms of an NPDES permit that addresses for discharges from the land application area; or

(C) Use the manure for purposes other than land application.

(ii) Obtain from any commercial waste hauler the name and location of the recipient of the wastes, if known;

(iii) Provide the recipient of the manure with an analysis of its content; and

(iv) Provide the recipient of the manure with a brochure to be provided by the State permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management.

(5) *Record keeping requirements.* Requirements to keep, maintain for five years and make available to the Director or the Regional Administrator:

(i) Records of the inspections and of the manure sampling and analysis required by 40 CFR 412.37(a);

(ii) Records required by 40 CFR 412.37(e) related to the development and implementation of Permit Nutrient Plans required by 40 CFR 412.37(b); and

(iii) Records of each transfer of wastes to a third party, including date, recipient name and address, quantity transferred, an analysis of manure content and a copy of the certifications required by paragraph (j)(4) of this section. If the waste is transferred to a commercial waste hauler, records of where the hauler indicated it would take the waste, if known. If the waste is to be packaged as fertilizer, incinerated or used for a purpose other than direct land application, records of the analysis of the manure are not required.

OPTION 2 FOR PARAGRAPHS (j)(4) and (5):

(4) *Transfer of manure to other persons*. Prior to transferring manure and other wastes to other persons, the permittee shall:

(i) Provide the recipient of the manure with an analysis of its content;

(ii) Provide the recipient of the manure with a brochure to be provided by the State permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management; and

(iii) Obtain from any commercial waste hauler the name and location of the recipient of the wastes, if known.

(5) *Record keeping requirements.* Requirements to keep, maintain for five years and make available to the Director or the Regional Administrator:

(i) Records of the inspections and of the manure sampling and analysis required by 40 CFR 412.37(a);

(ii) Records required by 40 CFR 412.37(e) related to the development and implementation of Permit Nutrient Plans required by 40 CFR 412.37(b); and

(iii) Records of each transfer of wastes to a third party, including date, recipient name and address, quantity transferred, and an analysis of manure content. If the waste is transferred to a commercial waste hauler, records of where the hauler indicated it would take the waste, if known. If the waste is to be packaged as fertilizer, incinerated or used for a purpose other than direct land application, records of the analysis of the manure are not required.

(6) For CAFOs subject to 40 CFR 412.43 (existing swine, poultry and veal facilities), the Director must determine based on topographical characteristics of the region whether there is a likelihood that a CAFO may discharge from the production area via ground water that has a direct hydrologic connection to waters of the United States. If the Director finds there is such a likelihood, and the Director determines there is the potential for an excursion of State water quality standards due to such discharge, the Director must impose any water quality-based effluent limits necessary to comply with §122.44(d). The Director may omit such water quality-based effluent limits from the permit if the permittee has provided a hydrologist's statement that demonstrates to the Director's satisfaction that there is no direct hydrologic connection from the production area to waters of the United States.

(k) **What additional terms and conditions must be required in NPDES permits issued to CAFOs that are not subject to part 412, Subparts C and D?**

(1) *<u>All CAFOs not subject to part 412</u>.* In cases where a CAFO has fewer than the number of animals necessary to make it subject to the requirements 40 CFR Part 412, and the Director is establishing effluent limitations on a case-by-case basis based on best professional judgment under section 402(a)(1)(B) of the Act, the Director shall consider the need for the following effluent limitations:

(i) Limits on the discharge of process wastewater pollutants from the production area, including limits based on the minimum duration and intensity of rainfall events for which the CAFO can design and construct a system to contain all process-generated wastewaters from such event;

(ii) Limits on discharges resulting from the application of manure to land, including restrictions on the rates of application of nitrogen and phosphorous;

(iii) Requirements to implement best management practices to ensure the CAFO achieves limitations under paragraphs (1) and (2);

(iv) Requirements to develop and implement a Permit Nutrient Plan that addresses requirements developed under paragraphs (1), (2) and (3); and

(v) If the CAFO is in an area with topographic characteristics that indicate a likelihood that ground water has a direct hydrologic connection to waters of the United States, requirements necessary to comply with § 122.44, unless the permittee submits a hydrologist's statement that the production area is not connected to surface waters through a direct hydrologic connection.

(2) *<u>CAFOs subject to part 412, Subparts A and B</u>*. In addition to the applicable effluent limitations, when developing permits to be issued to CAFOs with horses, sheep or ducks subject to Subparts A and B of 40 CFR 412, the Director shall consider the need for effluent limitations for wastestreams not covered by Subparts A and B, including the need for the requirements described in paragraphs (k)(1)(ii) through (v) of this section.

(l) **How will the public know if a CAFO is implementing an adequate permit nutrient plan?**

(1) The Director shall make publicly available via the worldwide web or other publicly available source, and update every 90 days:

(i) A list of all CAFOs that have submitted a notice of intent for coverage under a general permit, and

(ii) A list of all CAFOs that have submitted a notice that their permit nutrient plan has been developed or revised.

(2) The Director shall make publicly available the notices of intent, notice of plan development, and the cover sheet and executive summary of the permittee's Permit Nutrient Plan. If the Director does not have a copy of the cover sheet and executive summary of the permittee's current Permit Nutrient Plan and the cover sheet and executive summary are not publicly available at the CAFO or other location, the Director shall, upon request from the public, obtain a copy of the cover sheet and executive summary. Until required by the Director, the CAFO operator is not required to submit cover sheet or executive summary to the Director.

(3) *<u>Confidential business information</u>.* The information required to be in Permit Nutrient Plan cover sheet and executive summary, and required soil sampling data, may not be claimed as confidential. Any claim of confidentiality by a CAFO in connection with the remaining information in the Permit Nutrient Plan will be subject to the procedure in 40 CFR Part 2.

4. Section 122.28 is amended by:

a. Removing the word "or" at the end of paragraph (a)(2)(i) and adding the word "or" at the end of paragraph (a)(2)(ii)(D).

b. Adding paragraph (a)(2)(iii).

c. Adding two sentences to the end paragraph (b)(2)(ii)

d. Redesignating paragraph (b)(3)(i)(G) as paragraph (b)(3)(i)(H) and adding a new paragraph (b)(3)(i)(G).

e. Adding paragraph (b)(3)(vi).

The additions read as follows:

§ 122.28 General permits (applicable to State NPDES programs, see § 123.25).

(a) * * *

(2) * * *

(iii) Concentrated animal feeding operations.

* * *

(b) * * *

(2) * * *

(ii) * * * Notices of intent for coverage under a general permit for confined animal feeding operations must include: a topographic map as described in § 122.21(f)(7); name and address of any other entity with substantial operational control; a statement whether the owner or operator has developed and is implementing its Permit Nutrient Plan and, if not, the status of the development of its Permit Nutrient Plan. New sources subject to 40 CFR Part 412 shall also provide a copy of a draft plan that, at a minimum, demonstrates that there is adequate land available to the CAFO operator to comply with the land application provisions of 40 CFR Part 412 or describes an alternative to land application that the operator intends to implement.

* * *

(3) * * *

(i) * * *

(G) The discharge is from a CAFO. In addition to the other criteria in paragraph (b)(3) of this section, the Director shall consider whether general permits are appropriate for the following CAFOs:

(1) CAFOs located in an environmentally or ecologically sensitive area;

(2) CAFOs with a history of operational or compliance problems;

(3) CAFOs that are exceptionally large operation as determined by the Director; or

(4) Significantly expanding CAFOs.

* * *

(vi) Prior to issuing any general permits for CAFOs, the Director, after considering input from the public, shall issue a written statement of its policy on which CAFOs will be eligible for general permits, including a statement of how it will apply the criteria in paragraph (b)(3)(i)(G) of this section.

6. Remove Appendix B to part 122.

9. Part 412 is amended to read as follows:

PART 412 - CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFOs) POINT SOURCE CATEGORY

Sec.
412.0 General applicability.
412.1 General definitions.
412.2 General pretreatment standards.

Subpart A - Horses and Sheep

412.10 Applicability.
412.11 Special definitions.
412.12 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).
412.13 Effluent limitations attainable by the application of the best available control technology economically achievable (BAT).
412.15 New source performance standards (NSPS).

Subpart B - Ducks

Subpart C - Beef and Dairy

Subpart D - Swine, Veal and Poultry

Authority: 33 U.S.C. 1311, 1314, 1316, 1317, 1318, 1342 and 1361.

§ 412.0 General applicability.

This part applies to process wastewater discharges resulting from concentrated animal feeding operations (CAFOs). Manufacturing activities which may be subject to this part are generally reported under one or more of the following Standard Industrial Classification (SIC) codes: SIC 0211, SIC 0213, SIC 0241, SIC 0259, or SIC 3523 (1987 SIC Manual).

§ 412.1 General Definitions.

As used in this part:

(a) The general definitions and abbreviations at 40 CFR part 401 shall apply.

(b) *Concentrated Animal Feeding Operation (CAFO)* is defined at 40 CFR 122.23(a)(3).

(c) *Fecal coliform* means the bacterial count (Parameter 1) at 40 CFR '136.3 in Table 1A, which also cites the approved methods of analysis.

(d) *Process wastewater* means water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other CAFO facilities; direct contact swimming, washing or spray cooling of animals; litter or bedding; dust control; and stormwater which comes into contact with any raw materials, products or by-products of the operation.

(e) *Certified specialist* shall mean someone who has been certified to prepare Comprehensive Nutrient Management Plans (CNMPs) by USDA or a USDA sanctioned organization.

(f) *Land application area* means any land under the control of the CAFO operator, whether it is owned, rented, or leased, to which manure and process wastewater is or may be applied.

(g) *New source* means a source that is subject to subparts C or D of this part and, not withstanding the criteria codified at 40 CFR 122.29(b)(1): (i) Is constructed at a site at which no other source is located; or (ii) Replaces the housing including animal holding areas, exercise yards, and feedlot, waste handling system, production process, or production equipment that causes the discharge or potential to discharge pollutants at an existing source; or (iii) constructs a production area that is substantially independent of an existing source at the same site. Whether processes are substantially independent of an existing source, depends on factors such as the extent to which the new facility is integrated with the existing facility; and the extent to which the new facility is engaged in the same general type of activity as the existing source.

(h) *Overflow* means the process wastewater discharge resulting from the filling of wastewater or liquid manure storage structures to the point at which no more liquid can be contained by the structure.

(i) *Production area* means that part of the CAFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyard, exercise yards, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, sheds, under house or pit storage, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms, and diversions which separate uncontaminated stormwater . Also included in the definition of production area is any egg washing or egg processing facility.

(j) *Setback* means a specified distance from surface waters or potential conduits to surface waters where manure and wastewater may not be land applied. Examples of conduits to surface waters include, but are not limited to, tile line intake structures, sinkholes, and agricultural well heads.

(k) *Soil test phosphorus* is the measure of the phosphorus content in soil as reported by approved soil testing laboratories using a specified analytical method.

(l) *Phosphorus threshold or TH* level is a specific soil test concentration of phosphorus established by states. The concentration defines the point at which soluble phosphorus may pose a surface runoff risk.

(m) *Phosphorus index* means a system of weighing a number of measures that relate the potential for phosphorus loss due to site and transport characteristics. The phosphorus index must at a minimum include the following factors when evaluating the risk for phosphorus runoff from a given field or site:

(1) Soil erosion.
(2) Irrigation erosion.
(3) Run-off class.
(4) Soil phosphorus test.
(5) Phosphorus fertilizer application rate.
(6) Phosphorus fertilizer application method.
(7) Organic phosphorus application rate.
(8) Method of applying organic phosphorus.

(n) *Permit Nutrient Plan* means a plan developed in accordance with §412.33 (b) and '412.37. This plan shall define the appropriate rate for applying manure or wastewater to crop or pasture land. The plan accounts for soil conditions, concentration of nutrients in manure, crop requirements and realistic crop yields when determining the appropriate application rate.

(o) *Crop removal rate* is the application rate for manure or wastewater which is determined by the amount of phosphorus which will be taken up by the crop during the growing season and subsequently removed from the field through crop harvest. Field residues do not count towards the amount of phosphorus removed at harvest.

(p) *Ten(10)-year, 24-hour rainfall event* and *25-year, 24-hour rainfall event* mean precipitation events with a probable recurrence interval of once in ten years, or twenty five years, respectively, as defined by the National Weather Service in Technical Paper No. 40, Rainfall Frequency Atlas of the

United States, May, 1961, and subsequent amendments, or equivalent regional or State rainfall probability information developed from this source.

(q) The parameters that are regulated or referenced in this part and listed with approved methods of analysis in Table 1B at 40 CFR §136.3 are defined as follows:

(1) *Ammonia (as N)* means ammonia reported as nitrogen.

(2) BOD_5 means 5-day biochemical oxygen demand.

(3) *Chloride* means total chloride.

(4) *Nitrate (as N)* means nitrate reported as nitrogen.

(5) *Total dissolved solids* means non-filterable residue.

(r) The parameters that are regulated or referenced in this part and listed with approved methods of analysis in Table 1A at 40 CFR §136.3 are defined as follows:

(1) *Fecal coliform* means fecal coliform bacteria.

(2) *Total coliform* means all coliform bacteria.

§ 412.3 General pretreatment standards.

Any source subject to this part that introduces process wastewater pollutants into a publicly owned treatment works (POTW) must comply with 40 CFR part 403.

Subpart A - Horses and Sheep

§ 412.10 Applicability.

This subpart applies to discharges resulting from the production areas at CAFOs where sheep are confined in open or housed lots; and horses are confined in stables such as at racetracks. This subpart does not apply to such CAFOs with less than the following capacities:

Applicable CAFOs

Livestock	Minimum capacity
Sheep	10,000
Horses	500

§ 412.11 Special definitions.

For the purpose of this subpart:

(a) *Housed lot* means totally roofed buildings, which may be open or completely enclosed on the sides, wherein animals are housed over floors of solid concrete or dirt and slotted (partially open) floors over pits or manure collection areas, in pens, stalls or cages, with or without bedding materials and mechanical ventilation.

(b) *Open lot* means pens or similar confinement areas with dirt, concrete paved or hard surfaces, wherein animals are substantially or entirely exposed to the outside environment, except where some protection is afforded by windbreaks or small shed-type shaded areas.

§ 412.12 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).

(a) Except as provided in 40 CFR '125.30 through '125.32 and when the provisions of paragraph (b) of this section apply, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BPT:
There must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 10-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the *overflow* may be allowed to be discharged into U.S. waters.

§ 412.13 Effluent limitations attainable by the application of the best available technology economically achievable (BAT).

(a) Except as provided in 40 CFR '125.30 through '125.32 and when the provisions of paragraph (b) of this section apply, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BAT:

There must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the *overflow* may be allowed to be discharged into U.S. waters.

§ 412.15 New source performance standards (NSPS).

(a) Except as provided in paragraph (b) of this section, any new point source subject to this subpart must achieve the following performance standards:

There must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the *overflow* may be allowed to be discharged into U.S. waters.

Subpart B - Ducks

§ 412.20 Applicability.

This subpart applies to discharges resulting from dry and wet duck feedlots with a capacity of at least 5000 ducks.

§ 412.21 Special definitions.

For the purpose of this subpart:

(a) *Dry lot* means a facility for growing ducks in confinement with a dry litter floor cover and no access to swimming areas.

(b) *Wet lot* means a confinement facility for raising ducks which is open to the environment, has a small number of sheltered areas, and with open water runs and swimming areas to which ducks have free access.

§ 412.22 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in 40 CFR '125.30 through '125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the application of BPT:

Effluent Limitations

Regulated parameter	Maximum daily[1]	Maximum monthly avg.[1]	Maximum daily[2]	Maximum monthly avg.[2]
BOD_5	3.66	2.0	1.66	0.91
Fecal coliform	([3])	([3])	([3])	([3])

[1] Pounds per 1000 ducks.
[2] Kilograms per 1000 ducks
[3] Not to exceed MPN of 400 per 100 ml at any time.

§ 412.25 New source performance standards (NSPS).

Any new source subject to this subpart must achieve the following standards:

(a) Except as provided in paragraph (b) of this section, there must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the *overflow* may be allowed to be discharged into U.S. waters.

§ 412.26 Pretreatment standards for new sources (PSNS).

(a) Except as provided in 40 CFR §403.7 and in paragraph (b) of this section, any new source subject to this subpart must achieve the following pretreatment standards:
There must be no discharge of process wastewater pollutants into a POTW.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the new source, the discharge of any process wastewater pollutants in the *overflow* may be allowed.

Subpart C - Beef and Dairy

§ 412.30 Applicability.

This subpart applies to concentrated animal feeding operations (CAFOs), as defined in 40 CFR §122.23, and includes the following types of animals: Mature dairy cows, either milking or dry; and cattle other than mature dairy or veal

§ 412.31 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in 40 CFR §125.30 through §125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BPT:

(a) For CAFO production areas:

(1) Except as provided in paragraph (a)(2) of this section, there must be no discharge of process wastewater pollutants into U.S. waters.

(2) Whenever rainfall causes an overflow of process wastewater, pollutants in the overflow may be discharged into U.S. waters during those periods subject to following conditions:

(i) The production area is designed and constructed to contain all process wastewaters including the runoff from a 25 year, 24 hour rainfall event; and

(ii) The production area is operated in accordance with the requirements of §412.37(a)(1) through (3) .

(b) For CAFO land application areas:

(1) Discharges resulting from the application of manure or process wastewater to land owned or under the control of the CAFO must achieve the following:

(i) Develop and implement a Permit Nutrient Plan (PNP) that includes the requirements specified at §412.37; and establishes land application rates for manure in accordance with §412.31 (b)(1)(iv).

(ii) The PNP must be developed or approved by a certified specialist.

(iii) The PNP must be written taking into account realistic yield goals based on historic yields from the CAFO, or county average data when historic yields are not appropriate. County average data may be used when a facility plants a crop that no yield data for that CAFO land application area has been obtained within the previous 10 years. CAFOs shall review the PNP annually and revise as necessary, and must rewrite the PNP at least once every five years.

(iv) Apply manure and process wastewater at a rate established in accordance with one of the three methods defined below. State approved indices, thresholds, and soil test limits shall be utilized such that application does not exceed the crop and soil requirements for nutrients:

Table 1 Phosphorus Index

Phosphorus Index Rating	Manure and Wastewater Application Rate
Low Risk	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
Medium Risk	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
High Risk	Application of phosphorus in manure and wastewater may not exceed the amount of phosphorus removed from the field with crop harvest.
Very High Risk	No land application of manure or wastewater.

Table 2 Phosphorus Threshold

Soil Phosphorus Threshold Level	Manure and Wastewater Application Rate
< 3/4 TH application	Manure and wastewater may not exceed the nitrogen requirements of the crop.
> 3/4 TH, < 2 TH application	Phosphorus in manure and wastewater may not exceed the amount of phosphorus removed from the field with crop harvest.
> 2 TH application	No land application of manure or wastewater

Table 3 Soil Test Phosphorus

Soil Test Phosphorus Level	Manure and Wastewater Application Rate
Low	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
Medium	Application of manure and wastewater may not exceed the nitrogen requirements of the crop
High	Application of phosphorus in manure and wastewater may not exceed the amount of phosphorus removed from the field with crop harvest.
Very High	No land application of manure and wastewater.

(2) Multi-year phosphorus applications are prohibited when either the P-Index is rated high, the soil phosphorus threshold is between 3/4 and 2 times the TH value, or the soil test phosphorus level is high as determined in paragraph (1) (iv) unless:

(i) Manure application equipment designed for dry poultry manure or litter cannot obtain an application rate low enough to meet a phosphorus based application rate as determined by the PNP In the event a phosphorus application occurs during one given year which exceeds the crop removal rate for that given year, no additional manure or process wastewater shall be applied to the same land in subsequent years until all applied phosphorus has been removed from the field via harvest and crop removal.

§ 412.32 Effluent limitations attainable by the application of the best control technology for conventional pollutants (BCT).

Except as provided in 40 CFR §125.30 through §125.32 and §412.41(2), any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BCT:

(a) For CAFO production areas:
Discharges must achieve the same requirements as specified in §412.31(a).

(b) For CAFO land application areas:
Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in §412.31(b) and §412.37.

§ 412.33 Effluent limitations attainable by the application of the best available technology economically achievable (BAT).

Except as provided in 40 CFR §125.30 through §125.32 and §412.33(a)(2), any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BAT:

(a) For CAFO production areas:

(1) There must be no discharge of process wastewater pollutants into U.S. waters, including any pollutants discharged to ground water which has a direct hydrologic connection to surface waters.

(2) Whenever rainfall causes an overflow of process wastewater, pollutants in the overflow may be discharged into U.S. waters during those periods when the following conditions are met:

(i) The production area is designed and constructed to contain all process wastewaters including the runoff from a 25 year, 24 hour rainfall event; and

(ii) The production area is operated in accordance with the requirements of §412.37(a).

(3) (i) The ground water beneath the production area must be sampled twice annually to demonstrate compliance with the no discharge requirement unless the CAFO has determined to the satisfaction of the permitting authority that the ground water beneath the production area is not connected to surface waters through a direct hydrologic connection.

(ii) Ground water samples shall be collected up-gradient and down-gradient of the production area and analyzed for:

Total coliforms.
Fecal coliform.
Total dissolved solids.
Nitrates.
Ammonia.
Chloride

(b) For CAFO land application areas:

Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in §412.31(b) and §412.37.

§ 412.35 New source performance standards (NSPS).

Any new source subject to this subpart must achieve the following standards:

(a) For CAFO production areas:

Subject to the provisions of paragraph (c) of this section, discharges must achieve the same requirements as specified in §412.33(a).

(b) For CAFO land application areas:

Subject to the provisions of paragraph (c) of this section, discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in §412.31(b) and §412.37.

(c) Any new source subject to the provisions of this section that commenced discharging after *[insert date 10 years prior to the date that is 60 days from the publication date of the final rule]* and before *[insert date that is 60 days from the publication date of the final rule]* must continue to achieve the standards specified in the 2000 version of §412.15, provided that the new source was constructed to meet those standards. For toxic and nonconventional pollutants, those standards shall not apply after the expiration of the applicable time period specified in 40 CFR 122.29(d)(1); thereafter, the source must achieve the standards specified in paragraphs (a) and (b) of this section.

§ 412.37 Additional measures

(a) Each CAFO subject to this subpart must implement the following requirements:

(1) There must be routine visual inspections of the CAFO production area to check the following:

(i) Weekly inspections of all stormwater diversion devices, such as roof gutters, to ensure they are free of debris that could interfere with the diversion of clean stormwater;

(ii) Weekly inspections of all stormwater diversion devices which channel contaminated stormwater to the wastewater and manure storage and containment structure, to ensure that they are free of debris that could interfere with ensuring this contaminated stormwater reaches the storage or containment structure;

(iii) Daily inspections of all water lines providing drinking water to the animals to ensure there are no leaks in these lines that could contribute unnecessary volume to liquid storage systems or cause dry manure to become too wet;

(iv) Runoff diversion structures and animal waste storage structures must be visually inspected for: seepage, erosion, vegetation, animal access, reduced freeboard, and functioning rain gauges and irrigation equipment, on a weekly basis manure storage area to ensure integrity of the structure. All surface impoundments must have a depth marker which indicates the design volume and clearly indicates the minimum freeboard necessary to allow for the 25 year 24 hour rainfall event. The inspection shall also note the depth of the manure and process wastewater in the impoundment as indicated by this depth marker.

(2) Any deficiencies found as a result of these inspections shall be corrected as soon as possible. Deficiencies and corrective action taken shall be documented.

(3) Mortalities may not be disposed of in any liquid manure or stormwater storage or treatment system, and must be handled in such a way as to prevent discharge of pollutants to surface water.

(4) Land application of manure generated by the CAFO to land owned or controlled by the CAFO must be done in accordance with the following practices:

(i) Manure may not be applied closer than 100 feet to any surface water, tile line intake structure, sinkhole or agricultural well head.

(ii) The CAFO must take manure samples at least once per year and analyzed for nitrogen, phosphorus and potassium. Samples must be collected from all manure storage areas, both liquid and dry storage, as well as any wastewater or storm water storage. The CAFO must take soil samples once every three years if they apply manure to crop or pasture land under their control, and analyze the soil sample for phosphorus. Samples shall be collected in accordance with accepted Extension protocols and the analyses must be conducted in accordance with the state nutrient management standard. These protocols shall be documented in the PNP.

(iii) Manure that is transported off-site must be sampled at least once a year for nitrogen, phosphorus and potassium. The results of these analyses must be provided to the recipient of the manure.

(iv) Manure application equipment must be calibrated prior to land application of manure and/or process wastewaters at a minimum of once per year.

(b) Record keeping requirements:

Each CAFO must maintain on its premises a complete copy of the current PNP and the records specified in paragraphs (b)(1) through (12) of this section. The CAFO must make the PNP available to the permitting authority and the Regional Administrator, or his or her designee, for review upon request. Records must be maintained for 5 years from the date they are created.

(1) Cover Sheet which includes the following information:

(i) the name and location of the CAFO,

(ii) name and title of the owner or operator

(iii) name and title of the person who prepared the plan,

(iv) date the plan was prepared,

(v) date the plan was amended

(2) Executive Summary which includes the following information:

(i) Total average herd or flock size

(ii) Identification of manure collection, handling, storage, and treatment practices

(iii) Amount of manure generated annually

(iv) Identification of planned crops (rotation)

(v) Realistic yield goal as described in §412.31(b)(1)(iii)

(vi) Field condition as determined by the phosphorus index, soil test phosphorus, or phosphorus threshold (for each field unit that will receive manure)

(vii) number of acres that will receive manure

(viii) amount of manure transported off-site

(ix) animal waste application rate (gallons or tons/acre)

(x) identification of watershed or nearest surface water body

(3) Records documenting the inspections required under paragraph (a)(1) of this section.

(4) Records tracking the repairs performed on drinking water lines, automated feeding equipment, feed storage and silos, manure storage, manure treatment facilities, as well as maintenance of berms and diversions that direct clean stormwater away from any manure and other process wastewater.

(5) Records documenting the following information about manure application and crop production

(i) Expected crop yield based on historical data for the CAFO for its land application area, or county average yield data when the CAFO does not have a prior history of crop yields

(ii) The date(s) manure is applied,

(iii) Weather conditions at time of application and for 24 hours prior to and following application,

(iv) Results from manure and soil sampling,

(v) Test methods used to sample and analyze manure and soil,

(vi) Whether the manure application rate is limited to nitrogen, phosphorus, or some other parameter,

(vii) The amount of manure and manure nutrients applied,

(viii) The amount of any other nutrients applied to the field reported in terms of nitrogen, phosphorus and potassium (including commercial fertilizer, legume credits, and biosolids),

(ix) Calculations showing the total nutrients applied to land,

(x) Calibration of manure application equipment,

(xi) The rate of application of manure,

(xii) The method used to apply the manure, estimated nitrogen losses based on application method used, and the route of nitrogen loss,

(xiii) The field(s) to which manure was applied and total acreage receiving manure,

(xiv) What crop(s) was planted,

(xv) The date that crops were planted in the field, and

(xvi) The crop yields obtained.

(6) Records of the total volume or amount of manure and process wastewater generated by all animals at the facility during each 12 month period. This must include milk parlor washwater and egg washwater. The volume or amount may be determined through direct measurements or an estimated value provided all factors are documented.

(7) Records of rainfall duration, amount of rainfall, and the estimated volume of any overflow that occurs as the result of any catastrophic or chronic rainfall event.

(10) A copy of the emergency response plan for the CAFO.

(11) Records of how mortalities are handled by the CAFO.

(12) Name of state approved specialist that prepared or approved the PNP, or record and documentation of training and certification for owners or operator writing their own PNP.

Subpart D - Swine, Poultry and Veal

§ 412.40 Applicability.

This subpart applies to operations defined as concentrated animal feeding operations (CAFOs) under 40 CFR §122.23 and includes the following animals: Swine, each weighing 55 lbs. or more; swine, each weighing less than 55 lbs.; veal cattle; chickens; and turkeys.

§ 412.41 Effluent limitation attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in 40 CFR §125.30 through §125.32 , any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BPT:

(a) For CAFO production areas:

Discharges must achieve the same requirements as specified in §412.31(a).

(b) For CAFO land application areas:

Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in §412.31(b) and §412.37.

§ 412.42 Effluent limitations attainable by the application of the best control technology for conventional pollutants (BCT).

Except as provided in 40 CFR §125.30 through §125.32 , any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BCT:

(a) For CAFO production areas:

The limitations are the same as specified in §412.41(a).

(b) For CAFO land application areas:

The limitations are the same as specified in §412.41(b).

§ 412.43 Effluent limitations attainable by the application of the best available technology economically achievable (BAT).

Except as provided in 40 CFR §125.30 through §125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BAT:

(a) For CAFO production areas:

(1) There must be no discharge of process wastewater pollutants into U.S. waters.

(2) Any CAFO subject to this subpart must also comply with the requirements specified in §412.37(a)(1) through (3).

(b) For CAFO land application areas:

The limitations are the same as specified in §412.41(b).

§ 412.45 New source performance standards (NSPS).

Any new source subject to this subpart must achieve the following standards:

(a) For CAFO production areas:

(1) There must be no discharge of process wastewater pollutants into U.S. waters, including any pollutants discharged to ground water which have a direct hydrological connection to surface waters.

(2) The ground water beneath the production area must be sampled twice annually to demonstrate compliance with the provisions of paragraph (a)(1) of this section, unless the CAFO has determined to the satisfaction of the permitting authority that the ground water beneath the production area is not connected to surface waters through a direct hydrologic connection.

Ground water samples must be collected up-gradient and down-gradient of the production area. and analyzed for:

Total coliforms
Fecal coliform
Total dissolved solids
Nitrates
Ammonia
Chloride

(3) Any CAFO subject to this subpart must also comply with the requirements specified in §412.37(a)(1) through (3).

(b) For CAFO land application areas:

Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in §412.31(b) and §412.37.

(c) Any new source subject to the provisions of this section that commenced discharging after *[insert date 10 years prior to the date that is 60 days from the publication date of the final rule]* and before *[insert date that is 60 days from the publication date of the final rule]* must continue to achieve the standards specified in ' 412.15, provided that the new source was constructed to meet those standards. For "toxic" and nonconventional pollutants, those standards shall not apply after the expiration of the applicable time period specified in 40 CFR §122.29(d)(1); thereafter, the source must achieve the standards specified in paragraphs (a) and (b) of this section.

APPENDIX C - MEASURING THE AMOUNT OF ANIMAL WASTE

Determining the amount of animal waste produced and collected at your farm is essential to successful nutrient management. You can estimate the amount of animal waste that is available for land application based on the quantity of animal waste collected at cleaning time or by calculating your volume in storage. Include animal waste from all sources (e.g., scraped barns, drylots, lagoons, animal waste pits, solid separators, calf huts) in your calculation.

Description

Estimating the total amount of animal waste in storage is a primary element to determine the amount of nutrients you have available, and by extension, the total number of acres that can be fertilized at your calibration rate (see Appendix G). To determine your total amount of animal waste, you will need to estimate the volume of animal waste in each pile or container. This procedure is described below.

Instructions for Calculating Animal Waste in Above-Ground Piles

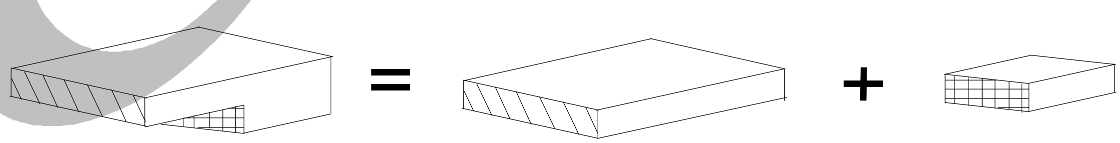
The volume of your animal waste pile can be calculated by transforming the pile's shape into a common geometric shape, such as a cube or a pyramid. To calculate volume, all you will need to know is the formula for the simple shape (see the common volume equations at the end of this appendix) and the dimensions of your pile. For example, if you store your animal waste in a rectangular box, then the formula to use is:

Volume = Length * Width * Height

Next, you will need to measure the box's length, width, and height (also called depth) and plug these numbers into the volume equation. Make sure your measurement units for all dimensions (i.e., sides) are consistent. For example, when measuring sides of your container, make sure you consistently measure in feet, yards, meters, etc.

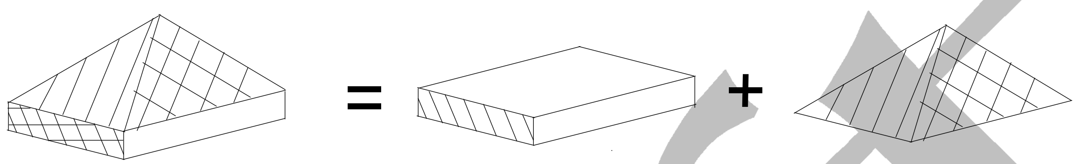
Your animal waste pile will most likely be a complex shape for which a volume formula is not readily available; therefore, you cannot use a simple formula to calculate your amount of animal waste. Instead, contour and break down the complex pile shape into an imaginary group of simple shapes (e.g., cones, rectangular boxes). The volume of each simple shape can then be computed by adding the volumes of all of the simple shapes (see the common volume equations at the end of this appendix). Make sure your measurement units for all simple shapes are consistent. Two examples of how to simplify a complex shape are provided below.

In Example 1, an animal waste container with an annex becomes two rectangular prisms, each with different heights, lengths, and widths. Each volume is calculated separately (length * width * height), and then added together to get a total volume.



Example 1

In Example 2, a heaped load on a wagon becomes a rectangular prism and a rectangular pyramid, with the top of the rectangular prism in common with the bottom of the pyramid. Each volume is calculated separately (see volume equations at the end of this appendix), and then added together to get a total volume.



Example 2

When prism ends do not form a perfect shape, or where the dimension is not uniform along the end, take an average for the dimension when calculating volumes. Sometimes it is necessary to imagine moving animal waste around to form a measurable shape. Although this decreases the accuracy of the volume calculation, it makes it easier to compute the volume.

You will probably need to convert your estimated volume of animal waste (in cubic feet or gallons) to units that match your animal waste application rates (in gallons or tons per acre). Converting animal waste volume to weight requires you to know the bulk density of the animal waste, which you can determine by weighing a unit volume of animal waste and dividing the weight by the volume (see Appendix H for more details on determining the bulk density of your animal waste).

Using Example 1 above, you measure your container and find one section of its inside dimensions to be 12 feet long, 5 feet wide, and 1 feet deep, while the other section is 3 feet long, 5 feet wide, and 0.5 feet deep. The total volume is:

$$\text{Volume (ft}^3\text{)} = [(12\text{ ft}) \times (5\text{ ft}) \times (1\text{ ft})] + [(3\text{ ft}) \times (5\text{ ft}) \times (0.5\text{ ft})] = 67.5\text{ ft}^3$$

Next, determine the bulk density of your animal waste. If your 5-gallon bucket (which has a volume of 2/3 cubic foot) weighs 5 pounds empty and 37 pounds filled, your density is:

$$\text{Density} = (37\text{ lb} - 5\text{ lb}) / (2/3\text{ ft}^3) = 48\text{ lb/ft}^3$$

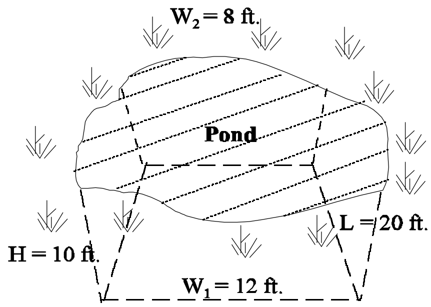
Therefore, your total animal waste in tons is:

$$\text{Total Animal Waste (tons)} = (67.5\text{ ft}^3 \times 48\text{ lb/ft}^3)/(2{,}000\text{ lbs/ton}) = 1.62\text{ tons}$$

Instructions for Calculating Liquid Animal Waste

Ponds, basins, and pits can be considered inverted piles, and you can therefore use the same techniques to estimate volume in above-ground piles. You can also compute the volume using the dimensions of your basin or by estimating the amount of animal waste removed after emptying your basin. The following example shows how to calculate volume in a basin, assuming the basin is a trapezoidal prism:

$$\text{Volume} = (H \times [W_1 + W_2]/2) \times L$$



Volume = (10 x 20/2) x 20 = 100 x 20 = 2,000 ft^3

If you store your animal waste in a constructed tank, use the dimensions of the tank to calculate volume. If the tank is not full, you will need to estimate your "new" height for the tank, that is, how high waste comes to in the tank. Use this new height in your volume calculation.

References

Cooperative Extension Service, University of Maryland System, Agricultural Engineering Department.

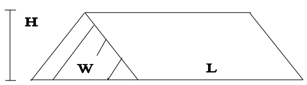
Manure Management. Outreach & Extension, University of Missouri/Lincoln University.

Who To Contact For More Information

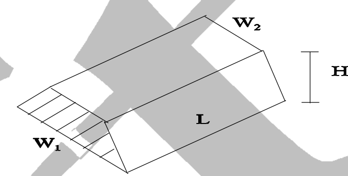
Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

Common Equations for Calculating Volume

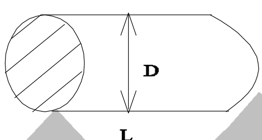
W = Width   H = Height   L = Length   D = Diameter



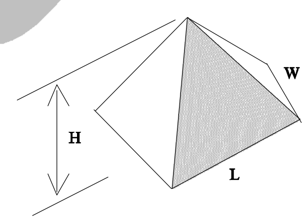
Triangular Prism = (W * H) ÷ 2 * L



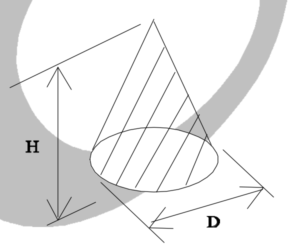
Trapezoid Prism = $(H * [W_1 + W_2] \div 2) * L$



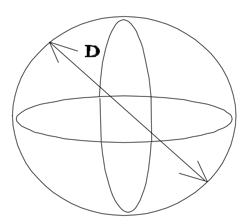
Circular Prism = $0.785 * D^2 * L$



Pyramid = W * L * H ÷ 3



Cone = $0.785 \times D^2 * H \div 3$



Sphere = $0.524 * D^3$

APPENDIX D - ANIMAL WASTE SAMPLING

Animal waste analysis is a key component of nutrient management. Complete analyses provide critical information about the animal waste composition, including pH and nutrient content. Actual nutrient content of animal waste varies with the type of animal, feed, storage system, and method of animal waste application. You should sample animal waste stored on site each time it is to be removed (for land application on or off site). Sample daily spread operations (if you land-apply daily) several times throughout the year to obtain a good estimate of nutrient content.

Description

Animal waste sampling is relatively simple, but must be done properly for reliable results. The sampling method differs based on the type of animal waste you generate at your farm (e.g., liquid, semi-solid, solid). Animal waste sampling generally consists of two to seven steps, depending on the type of animal waste. Although the number of steps varies based on the physical state of the animal waste, all of the methods rely on collecting a representative animal waste sample for analysis. Where bedding is collected with the animal waste, include both bedding and animal waste in the sample. Also, conduct sampling as close to the time of land application as possible. Specific techniques for gathering poultry litter, liquid animal waste, semi-solid animal waste, and solid animal waste samples are described below; you can use these to help develop sampling procedures at your farm. Remember that you should sample and analyze all animal waste at your farm. Work with your state and local agricultural Cooperative Extension Offices to ensure that you develop the proper procedures for your conditions and animal waste management methods.

Before sampling, know where the samples are to be shipped, how to pack and ship the sample, and what to use as sample containers. Many laboratories will furnish the proper sample containers for a small charge. Samples should never be collected and shipped in glass bottles, and they should be shipped on wet ice unless otherwise instructed by the laboratory. Contact your state or local agricultural Cooperative Extension Office for a list of laboratories that can perform your analyses. You should also wear gloves at all times, to protect yourself and the sample from contamination.

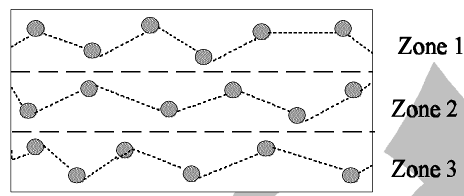
The test should analyze for such parameters as percentage of dry matter, ammonium-nitrogen, total-nitrogen, phosphorus (P or P_2O_5), and potassium (K or K_2O). Request results in the same units as your calibrated animal waste application system (see Appendix H for more information about calibrating animal waste spreaders and irrigators). For example, if your animal waste application is measured in tons per acre, request that your analysis be reported as pounds of nutrient per ton of animal waste.

Instructions for Collecting Poultry Litter Samples

Poultry litter is a mixture of poultry animal waste and the bedding (e.g., sawdust or rice hull) from houses used to raise broilers, turkeys, and other birds. You will need a clean 5-gallon bucket, a narrow, square-ended spade (or a soil spade), and a 1-quart plastic freezer bag to collect and store your sample. The five steps to collecting a representative poultry litter sample are described below.

Step 1: Mentally divide the poultry house into three zones of equal size. Within each zone, you'll take six cores (i.e., samples) as shown in the diagram below.

Feed line Water line



Sampling Pattern for Poultry Houses

Step 2: Take the first core within 1 foot of the feed line using your spade. Clear a small trench the width of the spade to the depth of the litter and remove a 1-inch slice, making sure to get equal amounts of litter from all depths. Empty the sample into your bucket.

Step 3: Repeat the process, gathering six cores from each zone, taking your last core within each zone within 1 foot of the water line. Walk the length of the building in each zone in a zigzag pattern taking cores with the spade at random points along your path (as shown in the diagram above). Take a representative number of cores under feeders and waterers. If the bucket becomes full before all 18 samples are taken, dump the contents onto a plastic sheet and continue sampling.

Step 4: After collecting samples from all three zones, crumble and thoroughly mix all of the litter in the bucket. It may be easier to pour the material onto a piece of plastic, or plywood, or into a wheelbarrow to facilitate mixing. Thorough mixing is critical to ensure that the analyzed sample is representative of the entire house.

Step 5: After the litter is well mixed, fill your plastic freezer bag with a subsample (i.e., a small sample) from your composite. Fill the bag only two-thirds full and squeeze the air out before sealing. Keep the sample cool (on ice if possible) until it is shipped.

Instructions for Collecting Liquid Animal Waste Samples

Liquid animal waste is typically stored in tanks, lagoons, or ponds. For tanks, collect only one sample, but collect several subsamples of liquid animal waste to get a representative sample from lagoons and ponds. You will need a clean 5-gallon bucket, a plastic cup, wire, and a long pole to collect liquid animal waste samples from lagoons and ponds. Sample containers are required to collect liquid animal waste samples from all sources. The two steps to collect a representative liquid animal waste sample are described below.

Step 1: For lagoons and ponds, collect several samples from around the shore of the lagoon or pond and mix them together in a clean 5-gallon bucket. You can collect the samples by wiring a plastic cup to the end of a long pole. When taking the sample, turn the cup upside down and push it a few feet below the surface. Then turn the cup right side up and pull out the sample.

If you store your liquid waste in tanks, your tanks must be well agitated before sampling. Often the only practical time to do this is as you are pumping the animal waste into your spreader.

Step 2: Fill a sample container with your sample, making sure to leave 2 inches of air space. Tightly seal the container and keep cool (on ice if possible) until it is shipped.

Instructions for Collecting Semi-Solid Animal Waste Samples

Collecting a representative sample of semi-solid animal waste is best done using a simple sampling device. You will need a 2-inch PVC pipe, nylon rope, a rubber ball, a dowel, a clean 5-gallon bucket, and sample containers. The seven steps to collecting a representative semi-solid animal waste sample are described below.

Step 1: Get a length of 2-inch PVC pipe long enough to reach well into your animal waste storage facility. Cut a notch 2 inches long and 1/4 inch wide at one end of the pipe. Cut a length of nylon rope 2 feet longer than the PVC pipe and tie a knot at one end. Drill a hole through a 2.5 inch rubber ball. Thread the rope through the ball until it is snug against the end knot. Tie a second knot to hold the ball at the end of the rope. Thread the rope through the PVC pipe and pull it until the ball plugs the end of the pipe. Slip your end of the rope into the notch and tie a knot; this will create a “latch” to keep the pipe sealed after you collect the sample. Tie a short dowel to the free end of the rope to serve as a hand grip. Cut a length of 1-inch PVC pipe and seal one end. Use this pipe to push samples out of the tube.

Step 2: With the ball sealing the end of the pipe, push the pipe through the top layer of animal waste to form a sample hole.

Step 3: Release the rope from the notch so that the ball dangles freely from the end of the pipe. Push the pipe into the sample hole in the animal waste crust. Make sure the ball does not block the pipe opening.

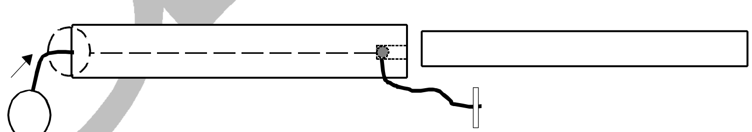
Step 4: Ease the pipe back slightly and pull the rope until the ball seals the end of the pipe. Slip the rope in the notch to anchor the ball in place and withdraw the pipe.

Step 5: Pour the sample into a clean 5-gallon bucket. You may need the 1-inch PVC pipe to force the sample from the pipe. Two people will need to operate a long pipe. To avoid backwash, keep the bottom of the pipe lower than your end.

Step 6: Repeat this process at several locations around the pit.

Step 7: Mix samples thoroughly in the bucket, then fill your sample container with the mix, leaving 2 inches of air space. Tightly seal the container and keep the sample cool (on ice if possible) until it is shipped.

A diagram of the sampling apparatus is shown below.



Sample Apparatus for Semi-Solid Animal Waste

Instructions for Collecting Solid Animal waste

Collecting a representative sample of solid animal waste is best done using a simple sampling device. You will need thin-walled metal tubing (1-inch diameter), a drill, a dowel or short metal rod, a clean 5-gallon bucket, and sample containers. The four steps to collecting a representative solid animal waste sample are described below.

Step 1: Cut a 3-foot length of thin-walled metal tubing and sharpen the bottom edge. Near one end, drill through the tubing and slide in a dowel or short metal rod to make a handle. Cut a 4-foot length of broomstick to force samples from the tube.

Step 2: Push and twist the tubing all of the way into the animal waste pile. Use the broomstick to push the animal waste into a clean 5-gallon bucket.

Step 3: Repeat Step 2 at several random locations around the pile. It is recommended that the more samples the better, so try to get at least 20 samples.

Step 4: Mix samples in the 5-gallon bucket, and fill the sample container with the mix, leaving 2 inches of air space. Tightly seal the container and keep the sample cool (on ice if possible) until it is shipped.

Animal Waste Sample Analyses

Contact your state or local agricultural Cooperative Extension Office for a list of available laboratories that can analyze your animal waste samples. Some Cooperative Extension Offices may even provide free analysis (e.g., in Maryland).
Label, package, and ship your samples to your contracted laboratory. The laboratory should be able to provide their proper protocol for packaging and shipping samples.

Your animal waste sample is typically analyzed for the following constituents:

- Nitrogen;
- Phosphorus;
- Potassium;
- pH;
- Moisture content;
- Calcium;
- Manganese;
- Magnesium;
- Sulfur;
- Zinc; and
- Copper.

Note that the first four constituents are required to be analyzed by a CAFO.

The first step in interpreting analytical results of an animal waste test is to check the units used to report the results. They may be reported as percent nutrient (%) or parts per million (ppm), or, on rare occasions, on a dry-weight basis. (Most animal waste is measured on a wet-weight [i.e., as-is] basis.) The phosphorus and potassium may be reported on an elemental basis (P and K) rather than the phosphate (P_2O_5) and potash (K_2O) basis, which is typical of fertilizers. You will need to convert your animal waste test results into the proper fertilizer units for calculating your animal waste application rate.

Animal waste is an excellent fertilizer if it is spread uniformly on a field and at the proper rate. A pound of animal waste phosphate or potash has a nutrient value equivalent to that of commercial fertilizer. Although it has a value as a fertilizer, typically 50 to 80% of the total nitrogen applied is available to crops. See Appendix H for more information on calculating your agronomic nutrient application rate.

References

MU Extension, University of Missouri-Columbia. Sampling Poultry Litter for Nutrient Testing.

Cooperative Extension Service, University of Maryland System. Manure Analysis Instruction Sheets.

Who to Contact For More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

APPENDIX E - SOIL SAMPLING AND TESTING

The nutrient status of the soil is one of the most important components of a permit nutrient plan (PNP). A soil test is a laboratory procedure that measures the plant-available portion of soil nutrients. This measurement is used to predict the amount of nutrient or nutrients that will be available during the growing season. Soil test results form the basis for nutrient recommendations. Traditional soil tests include tests for pH, phosphorus, potassium, nitrogen, soil organic matter, and electrical conductivity. (Note that pH, phosphorus, and potassium are required to be included in a soil analysis by a CAFO.) You should sample each field area where animal waste nutrients are to be applied. If different field areas have different soil types, past cropping histories, or different production potentials, you should sample and manage these areas separately. You can use soil test results to characterize soil conditions and to determine the agronomic nutrient application rate (see Appendix H) for animal waste application.

Description

Soil sampling determines the average nutrient concentration in a field, and allows you to measure nutrient variability in the field. When you know the variability, you can adjust the fertilizer application rates to more closely meet the supplemental nutrient needs of a crop, which can increase crop yield, reduce commercial fertilizer costs, and reduce environmental risk.

Send all samples to an accredited laboratory for analyses. An accredited laboratory is one that has been accepted in one or more of the following programs:

- State-certified programs;
- The North American Proficiency Testing Program (Soil Science Society of America); and
- Laboratories participating in other programs whose tests are accepted by the Land Grant University in the state in which the tests are used as the basis for nutrient application.

The analytical results from a soil test extraction are relatively meaningless by themselves. You and your Certified Nutrient Management Specialist must interpret soil nutrient levels in terms of the soil's ability to supply the nutrients to crops. Most soil test laboratories use qualitative terms such as "low," "medium or optimum," and "high or very high," which are related to quantities of nutrients extracted, to label the results.

Soil testing is a chemical evaluation of the nutrient-supplying capability of a soil at the time of sampling. Poor soil-sampling procedures account for more than 90% of all errors in fertilizer recommendations based on soil tests. The test is only as good as the sample, so you must handle the sample properly for it to remain a good sample. A testing program can be divided into four steps: 1) taking the sample, 2) analyzing the sample, 3) interpreting the sample analyses, and 4) making the fertilizer recommendations.

Take samples as close as possible to planting or to the time of crop need for the nutrient, approximately two to four weeks before planting or fertilizing the crop. It usually takes one to three weeks from the time you sample for you to receive the results. Very wet, very dry, or frozen soils will not affect results, but obtaining samples during these climatic conditions is very difficult. Do not sample snow-covered fields because the snow makes it difficult to recognize. Avoid unusual areas in the field because your sample may not be representative.

You may need to sample once every year and fertilize for the potential yield of the intended crop, especially for mobile nutrients. Whether you need an analysis of a nutrient depends on such things as mobility in the soil and the nutrient requirements of the crop. Having an analysis performed for every nutrient each year is not necessary, although EPA requires that, at a minimum, you should sample soil at least once every three years, or more if conditions change.

Collect soil samples from each field at least once during each crop rotation cycle, keeping a record of the results for each field to evaluate long-term trends in nutrient levels. Work with your state and local agricultural Cooperative Extension Office to ensure that you develop the best procedures for your conditions and animal waste management methods.

Instructions for Collecting Soil Samples

Below is a set of sampling instructions that you can use to help you develop sampling procedures at your farm. You will need a soil auger or probe (a shovel or spade can be used for shallow samples), a ruler, several 5-gallon buckets for compositing samples, some plastic sheeting, and soil collection bags. Be sure all of your equipment is clean so as not to contaminate any of your samples.

Avoid unusual areas such as eroded sections, dead furrows, and fence lines when sampling. If your sample area contains various topography, subdivide it into relatively uniform areas (i.e., sampling units). Omit small units from sampling since they are probably not treated differently from adjacent units. Sampling units should be approximately 20 acres in area, though some units may be bigger and some smaller.

<u>Number of Subsamples</u>

Collect one sample for each sample unit. (Note that if you collect samples at different depths, such as for nitrogen samples, you will have more than one sample per unit; you will have one sample, per depth, per unit.) Within each sampling unit, take soil samples from several different locations (at the same depth) and mix these subsamples into one composite sample for the unit for a given depth. The number of subsamples you take depends on the size of the unit. You can use the chart below as guidance.

Field Size (acres)	Number of Subsamples
Fewer than 5	15
5 to 10	18
10 to 25	20
25 to 50	25
More than 50	30

Source: Soil Sampling, University of Idaho.

If you sample several units, this guidance may be impractical and unrealistic because of the time required to take the recommended samples. You need to collect a minimum of 10 subsamples from each unit to obtain a representative sample. Your composite sample for the unit should be at least 1 pint in size (approximately 1 pound).

This guidance is also more applicable to surface (i.e., tillage layer) samples. If you take samples at greater depths, take at least 10 or more subsamples at a given depth at random within the sampling unit.

Sampling Depth

The depth at which you should sample depends on your crop, cultural practices, tillage depth, and nutrients to be analyzed. You need surface soil samples for all crops because fertilizer recommendation for all nutrients (except nitrogen) are based on the crop and soil tests from the surface samples. Typically, surface samples are used for determining pH, lime need, organic matter, phosphorus, potassium, sulfur, and zinc. The tillage layer is considered to be the 0-to-6- or 0-to-8-inch depth. Sampling deeper than the tillage layer for these parameters can result in inaccurate results.

When sampling for mobile nutrients such as nitrogen and boron, take samples by 1-foot increments to the effective rooting depth of the crop, which may be 5 to 6 feet for some crops. Therefore, you will have five or six composite samples for the sampling unit (not including your surface sample). Effective rooting depth for some common crops are listed below. You will need subsurface soil samples for these nutrients because they leach into the subsoil. Collect these samples separately from your surface samples.

Crop	Depth (feet)
Cereals (wheat, barley, oats)	5 to 6
Corn	5 to 6
Alfalfa, rapeseed	4 to 5
Hops, grapes, tree fruits	4 to 5
Sugarbeets	2 to 3
Peas, beans, lentils, onions, potatoes, mint	2
Vegetable seed	1 to 1.5

Source: Soil Sampling, University of Idaho.

Sample Collection

Collect the appropriate number (at the appropriate depth) of samples in your bucket, one unit at a time. Take all subsamples randomly from the unit, ensuring that you are getting a representative distribution of samples. Zig-zag through the unit, staying away from the unusual areas as described above. Scrape away any surface residues and mix the sample to break up the soil aggregates. After you have collected all of your subsamples, stir your composite at least 50 times and spread out the sample on a piece of plastic or plywood. Fill your soil bag with 1 pint of soil per unit, discarding the rest of the soil from the unit. Repeat the collection process for each unit and for each depth.

Sampling Handling

Keep moist soil samples cool at all times during and after sampling. Samples can be refrigerated or frozen for extended periods of time. If samples cannot be refrigerated or frozen soon after collection, air-dry them or take them directly to the testing laboratory. Air-dry by spreading the entire sample from a given unit in a thin layer on a plastic sheet, breaking up any clumps, and spreading the soil in a layer about 0.25 inch deep. Dry at room temperature, using a fan (if available) for more rapid drying. When the soil samples are dry, again mix the soil thoroughly, breaking up any large clumps. Take about 1 pint of well-mixed soil from the sample and place it in a soil sample bag or other container. When sending samples to your laboratory, be sure to include which nutrients you want to have analyzed, your last crop grown, and future cropping plans.

Interpreting results

Soil-testing laboratories use different test methods, which may influence results and subsequent recommended agronomic nutrient application rates. Adequate soil nutrient levels vary depending on plant species. Soil test results can be grouped into broad categories that describe the relative crop availability for a given nutrient: low, medium, optimum, and excessive. These categories are described below.

- Low: The nutrient content in the soil is inadequate for optimum growth. Additional nutrients are needed for optimal crop growth.
- Medium: The nutrient content in the soil may or may not be optimum for growth. Additional nutrients may be needed for optimal crop growth.
- Optimum: The nutrient content in the soil is adequate for optimum growth of most crops. Additional nutrients may not be needed for optimal crop growth.
- Excessive: The nutrient content in the soil is more than adequate for optimum growth of most crops. No additional nutrients should added. Additional nutrients may cause excess nutrient leaching or eroding from crop fields into water bodies.

References

Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. Guidelines for Soil Sampling. G91-1000-A, February 1991.

Mahler, R.L., and T.A. Tindall. “Soil Sampling,” Bulletin 704 (Revised). University of Idaho, Cooperative Extension System, August 1997.

Maryland Cooperative Extension, University of Maryland College Park/Eastern Shore. Soil Sampling Procedures for Nutrient Management. March 1999.

Oregon State University Extension Service. Soil Test Interpretation Guide, EC 1478, August 1999.

Who to Contact for More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

APPENDIX F - LEACHING INDEX AND PHOSPHORUS INDEX

Tools such as the Soil Nitrogen Leaching Index and Phosphorus Index have been developed to assist field staff, watershed planners, and land users in evaluating various land forms and management practices for potential risk of nitrogen and phosphorus movement to water bodies. The vulnerability ratings of the Leaching Index (i.e., inches of water infiltrating below the 1- meter root zone) address the ability of soluble nitrogen to move below the crop root zone and into groundwater. The site rating of the Phosphorus Index (i.e., low, medium, high, very high) identifies sites where the risk of phosphorus movement may be relatively high when compared to other sites.

The material contained in this appendix should be used for your informational purposes only. Specific leaching index and phosphorus index calculations should be done by NRCS, your local extension, or a certified nutrient management planner.

Description

The Leaching Index (LI) is a simple index of potential leaching based on average annual percolation and seasonal rainfall distribution. It is important in determining the amount of nitrate nitrogen leached. The LI considers the saturated hydraulic conductivity and storage capacity of individual soils (based on various regions of the country), the average annual rainfall, and the seasonal distribution of that rainfall. It does not look at the leaching potential of specific nutrients, but rather the intrinsic probability of leaching occurring if nutrients are present and available to leach.

The Phosphorus Index (PI) is a simple assessment tool that examines the potential risk of phosphorus movement to waterbodies based on various landforms and management practices. The PI identifies sites where the risk of phosphorus movement may be relatively higher or lower than other sites. It considers soil erosion rate, runoff, available phosphorus soil test levels, fertilizer and organic phosphorus application rates, and methods to assess the degree of vulnerability of phosphorus movement from the site. A weighting procedure includes the various contributions each site characteristic may have.

Instructions for Calculating Your Leaching Index

The LI for local areas is in the USDA/NRCS Field Office Technical Guide (FOTG), Section II-3, or you can calculate it using the following equations:

$$LI = P \times SI$$

where:

$$P = \frac{(p - 0.4s)^2}{p + 0.6s}$$

where:

p = annual precipitation

s = (1,000/curve number) - 10

$$SI = \left(\frac{2PW}{p} \right)^{1/3}$$

where:

PW = fall and winter precipitation when crop growth is minimal, usually the sum of precipitation during October, November, December, January, and February

An LI below 2 inches would indicate that soluble nitrogen would likely not leach below the root zone, whereas an LI between 2 and 10 inches indicates that soluble nitrogen may leach below that zone. You should consider nutrient management practices and techniques, such as pre-sidedress nitrate nitrogen testing (which measures soil nitrate during the growing season rather than prior to it) and use of a nitrification inhibitor.

An LI greater than 10 inches indicates that soluble nitrogen leaches below the root zone. You should use an intense nitrogen management plan to minimize nitrate nitrogen movement. This would include careful management of applied nitrogen, precise timing to match crop utilization, conservation practices that restrict water percolation and leaching, and covering crops to capture and retain nutrients in the upper soil profile.

Instructions for Calculating Your Phosphorus Index

The PI uses eight characteristics, as presented in the following table, to obtain an overall rating for a site. Each characteristic is assigned an interpretive rating with a corresponding numerical value: LOW (1), MEDIUM (2), HIGH (4), or VERY HIGH (8), based on the relationship between the characteristic and the potential for phosphorus loss from a site. Suggested ranges appropriate to each rating for a site characteristic are then assigned. Each of the characteristics in the PI has also been given a weighting factor that reflects its relative importance to phosphorus loss. For example, erosion (weighting factor=1.5) is generally more important to phosphorus loss than phosphorus fertilizer application method (weighting factor = 0.5). The weighting factors used are currently based on the professional judgment of the scientists that developed the PI; they are not derived directly from field research with the PI. Contact your state or local conservation agency for modified weighting factors, which are based on local soil properties, hydrologic conditions, and agricultural management practices.

Site Characteristic (weighting factor)	**Phosphorus Loss Rating (value)**				
	None (0)	**Low (1)**	**Medium (2)**	**High (4)**	**Very High (8)**
Soil erosion (1.5)	Not applicable	<5 tons/acre	5-10 tons/acre	10-15 tons/acre	>15 tons/acre
Irrigation erosion (1.5)	Not applicable	Infrequent irrigation on well-drained soils	Moderate irrigation on soils with slopes < 5%	Frequent irrigation on soils with slopes of 2-5%	Frequent irrigation on soils with slopes > 5%
Soil runoff class (0.5)	Not applicable	Very low or low	Medium	High	Very high
Soil test P (1.0)	Not applicable	Low	Medium	High	Excessive
P fertilizer rate (lb P2O5/acre) (0.75)	None applied	<31	31-90	91-150	>150
P fertilizer application method (0.5)	None applied	Placed with planter deeper than 5 cm	Incorporate immediately before crop	Incorporate > 3 months before crop or surface applied < 3 months before crop	Surface applied > 3 months before crop
Organic P source application rate (lb P2O5/acre) (1.0)	None applied	<31	31-90	91-150	>150
Organic P source application method (1.0)	None	Placed with planter deeper than 5 cm	Incorporate immediately before crop	Incorporate > 3 months before crop or surface applied < 3 months before crop	Surface applied > 3 months before crop

Source: Soil Testing for Phosphorus, USDA, April 1998.

For each of the eight characteristics, multiply the characteristic weighting factor by your phosphorus loss rating value, and sum the totals. For example, if your soil erosion is medium and your irrigation erosion is high, then your overall site characteristic score for soil erosion is 3 (1.5 * 3) and for irrigation erosion is 6 (1.5 * 4). Calculate your site characteristic score for the remaining six characteristics and the sum them (i.e., 3 + 6 + remaining scores).

This sum total is your phosphorus index for your site. Use the table below as guide to your phosphorus index.

Phosphorus Index for Site	Generalized Interpretation of Phosphorus Index for Site
<8	LOW potential for P movement from the site. If farming practices are maintained at the current level, the probability of an adverse impact to surface waters from P losses at this site is low.
8 - 14	MEDIUM potential for P movement from the site. The chance for an adverse impact to surface waters exists. Some remedial action should be taken to lessen the probability of P loss.
15 - 32	HIGH potential for P movement from the site and for an adverse impact on surface waters to occur unless remedial action is taken. Soil and water conservation as well as P management practices are necessary to reduce the risk of P movement and water quality degradation.
> 32	VERY HIGH potential for P movement from the site and for an adverse impact on surface waters. Remedial action is required to reduce the risk of P loss. All necessary soil and water conservation practices, plus a P management plan, must be put in place to avoid the potential for water quality degradation.

Source: Soil Testing for Phosphorus, USDA, April 1998.

References

USDA/NRCS Field Office Technical Guide.

Core4 Conservation Practices, August 1999.

U.S. Department of Agriculture. Soil Testing for Phosphorus, April 1998.

Who to Contact for More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

APPENDIX G - AGRONOMIC NUTRIENT APPLICATION RATE

Good nutrient management includes proper land application of animal wastes. To do this, determine the most appropriate rate at which your animal waste should be applied. Calculate this application rate using results from your soil and animal waste analyses, crop nutrient recommendations, and land availability. It is important to consider all of these factors when calculating your nutrient application rate to reduce commercial fertilizer costs, reduce potential for crop damage, and reduce environmental impact.

Description

Animal waste nutrient application rates should be based upon Land Grant University guidance and site-specific test results. You should consider current soil test results, nutrient credits from previous legume crops and animal waste applications, crop yield goals, and other pertinent information when determining your nutrient balance, which is used to calculate your application rate.

Base your application rate on realistic yield goals. You can calculate an appropriate application rate, or agronomic rate, using the nutrient availability of the animal waste and the crop requirement for the nutrient having the highest nutrient need (nitrogen or phosphorus). Most state guidelines/policies allow animal waste applications at rates sufficient to meet, but not to exceed the nitrogen needs of agronomic crops, which typically results in over application of phosphorus. However, in areas with high soil phosphorus levels, animal waste should be applied at rates sufficient to meet, but not to exceed the phosphorus needs of agronomic crops.

To calculate your nutrient application rate you need to perform a nutrient balance to determine whether animal waste nutrient spreading is necessary. To do this, first determine your crop nutrient needs, accounting for the nutrients currently available in your soil (as determined in your soil analyses) and from nitrogen credits. Next, determine how many gallons (or tons) of animal waste you collect between each land application (see Appendix C for more information on estimating animal waste volumes). Then, using the results of your nutrient animal waste analysis (see Appendix D), calculate the amount of nutrients available each year from your animal waste. Now you can calculate the amount of animal waste needed to meet your nutrient needs, which is done by dividing your crop nutrient need by your nutrient animal waste analysis for a few key nutrients (e.g., nitrogen and phosphorus). These steps are described in more detail below.

Performing A Nutrient Balance

To determine your agronomic nutrient application rate, you need to perform a nutrient balance for your crops. The nutrient balance accounts three components needed to calculate an application rate: 1) the nutrients your crops need, 2) the nutrients available to your crops from prior nutrient applications (i.e., nutrient credits), and 3) the nutrients available from your animal waste.

Most crop nutrient requirements and nutrient credits are calculated from many years of field research. There is no "real time" method available for calculating your crops' nutrient requirement or the nutrients available at any one time. Rather, both components are based on past performance for your climate and soil condition.

A nutrient budget is a method for matching the nutrient needs of your crop with your available nutrients. It can easily determine if there is a gross imbalance between the nutrients that are available and the amount required and can be used to calculate a nutrient addition rate.

There are two methods for calculating a nutrient budget. The first is based on a soil test analysis and crop nutrient recommendation as given by an agronomic specialist (e.g., USDA, land grant university). The nutrient requirement of your crop is determined from historical field research for your soil and climate. The nutrient credits are derived from analysis of soil and historical animal waste spreading data.

This method is EPA's preferred method because it takes into account your local climate and soil conditions. Typical crop nutrient requirements can be obtained from USDA and state agricultural Cooperative Extension Offices. Some states have even developed agronomic plant nutrient recommendations based on soil tests and yield goals for the major agronomic crops grown in that state.

The second method is based on the balance between nutrients supplied to the crop and nutrients removed by the crop. You need to know the crop for which you are planning a nutrient budget. Nutrient budgets can be calculated for a single crop or over the entire crop rotation. You need to know your expected crop yield based on realistic soil, climate, and management parameters. Yield expectations can be calculated from historical records, soil productivity tables, or local research.

Estimating the Nutrients Removed by the Crop

The nutrients removed by the crop can be used to represent your nutrient crop need when it is not available from other sources. When a crop is harvested and removed from the field, the nutrients in that crop are also removed. These removed nutrients represent a net loss to the soil. Other losses, such as erosion and runoff, and leaching can occur and must be estimated if you are trying to maintain a constant level of nutrients in your field. The USDA/NRCS Agricultural Waste Management Field Handbook, Table 6-6, can be used to estimate nutrient content in harvested crops. This handbook can be found on the Internet at **http://www.ftw.nrcs.usda.gov/awmfh.html**. Chapter 11 of this handbook can be used to estimate nitrogen nutrient losses from the field system. Use the following form to calculate the nutrients removed by your crop.

Step 1: Yield (units of measure/acre) * Unit weight (lbs) = pounds crop material harvested

______________________ * _____________ = _______________ lb/acre

Step 2: Nutrient content of harvested material (refer to Table 6-6 of the Agricultural Waste Management Field Handbook

% N = ________ % P = _________ % K = ________

Step 3: Crop nutrient Content (multiply results in Step 1 by results in Step 2)

N = _____ lb/acre * ______ %N P = _____ lb/acre * _____%P K = _____lb/acre * _____%K

N = _______lb/acre P = ________ lb/acre K = _______ lb/acre

Step 4: Convert to fertilizer equivalent units

N =N lb/acre P_2O_5 = P lb/acre * 2.29 K_2O = K lb/acre * 1.2

Source: Core4 Conservation Practices, August 1999.

Estimating Nitrogen Credits

Nitrogen is a mobile nutrient and exists in the soil and plants in many forms. It is stored in the soil's organic matter and released as the organic matter decomposes. This nitrogen is available to crops during this time and should be accounted for in performing your nutrient balance. There are at least four groups of nitrogen credits that you need to account for: 1) legume nitrogen credits from your previous crop, 2) residual nitrogen from previous manure applications, 3) irrigation water nitrate nitrogen, and 4) other sources. These are described below.

- Legume Nitrogen Credits - Legumes can produce, through atmospheric fixation, enough nitrogen to meet their nutrient requirements. When the legume is harvested, organic nitrogen is mineralized, releasing available nitrogen to the following crop. Refer to your local extension information for the legume nitrogen credits.

- Nitrogen residual from previous manure applications - Organic nitrogen mineralizes according to a decay series which is specific for each manure type and composition. This concept recognizes the gradual mineralization of organic nitrogen over several years. Refer to your local mineralization rates to determine the residual release of nitrogen.

- Irrigation Water Nitrate Nitrogen - Irrigation water, especially from shallow aquifers, contain some nitrogen in the form of nitrate nitrogen. To calculate the amount of nitrogen applied with irrigation water, determine the concentration of nitrate nitrogen in water (in mg/L). The application amount will equal the nitrate nitrogen concentration multiplied by the volume (in acre-inches) times 0.23 to calculate pounds of nitrate per acre.

- Other Nitrogen Credits - Other credits come from atmospheric deposition from dust and ammonia in rainwater. This value is recorded by weather stations and can obtained from the National Atmospheric Deposition in Fort Collins, Colorado. The atmospheric deposition can range from a few pounds per acre per year to over 30 pounds per acre per year.

Use the following chart to calculate your nitrogen credits.

A.	Legumes Credits from Previous Crop	_____ lb/acre
B.	Residual from Previous Animal Waste Applications	_____ lb/acre
C.	Irrigation Water Nitrate Nitrogen	_____ lb/acre
D.	Others (atmospheric deposition, other fertilizer applications)	_____ lb/acre
Total Nitrogen Credits (Sum of A through D)		_____ lb/acre

Calculating the Number of Pounds of Each Nutrient Available During Land Application

To calculate the number of pounds of each nutrient that is available during land application, you need to know how much animal waste you produce (see Appendix C) and the nutrients contained in it (see Appendix D). Using your animal waste sampling results, multiply the amount of animal waste in storage (or available for application) by the concentration of nutrients found in your animal waste, as shown below.

Nutrient	Amount of Animal waste Available (gal or tons)		Concentration of Nutrient in Animal waste Analysis (lb/gal or lb/ton)		Pounds of Nutrient Available
Nitrogen		x		=	
Phosphorus (P2O5)		x		=	
Potassium (K2O)		x		=	

Source: Iowa State University, 1995.

After calculating the pounds of nutrients available, you need to correct for the nitrogen that is lost to the air during application. (It is assumed that there are no losses of phosphorus or potassium during application.) The remaining amount is the amount of nitrogen that will remain after spreading. To do this, multiply your pounds of nitrogen available (from the above chart) by the correction factor below that best describes your animal waste application method, and then plug that factor into the following form.

- Direct injection - 0.95
- Broadcast and incorporate within 24 hours - 0.95
- Broadcast and incorporate after 24 hours - 0.8
- Broadcast, no incorporation - 0.7

If you use a combination of application methods, you will need to account for this difference in the total pounds of nitrogen available, using the appropriate ratio of pounds available with the appropriate correction factor.

Pounds of Nitrogen Available		Correction Factor		Nitrogen Remaining after Application Loss (lbs)
	x		=	

Source: Iowa State University, 1995

The result is the nitrogen remaining after application losses; however, only 50 to 80% of the organic nitrogen will be available to plants the first year after spreading. The percentage available depends on the type of animal waste spread. Beef and dairy animal waste has approximately 50% available, while poultry waste has approximately 80% available. Next, multiply your nitrogen amount by your factor (e.g., 0.50 or 0.80) using the following chart. The result is the net usable nitrogen in your animal waste (in pounds).

Pounds of Nitrogen Remaining after Application Loss		Percent of Nitrogen Available (as a decimal)		Net Usable Nitrogen in Animal Waste (lbs)
	x		=	

Source: Iowa State University, 1995

Account for the nitrogen credits by adding the total estimated nitrogen credits to the net usable nitrogen in animal waste to calculate the total nitrogen available sources.

To calculate the usable amount of each nutrient available during application, divide the total usable amount of nutrient in animal waste (using the adjusted amount for nitrogen) by your available volume of animal waste, to calculate a rate in pounds of nutrient per gallon of animal waste, or pounds of nutrient per ton of animal waste.

Instructions for Determining Animal Waste Volume to Apply

After calculating your nutrient needs, total pounds of nutrients available and the pounds of nutrients available to plants in each gallon (or ton) of animal waste spread, you have determined your nutrient balance and can calculate the amount of animal waste to apply to your crops. For each nutrient, divide your net nutrient needs (calculated or estimated from published rates) by the usable nutrient amount available (in pounds per gallon or pounds per ton) to calculate the amount of animal waste you need to apply. Do this for both nitrogen and phosphorus. You will base your application rate on whichever nutrient requires less animal waste. Next, divide your total volume of animal waste needed by your land area (in acres) to calculate your animal waste application rate (in gallons per acre or tons per acre).

References

U.S. Department of Agriculture. CORE4 Key Conservation Practices, August 1999.

Iowa State University, University Extension. Land Application for Effective Manure Nutrient Management, Pm-1599, October 1995.

Wolkowski, Richard P. A Step-by-Step Guide to Nutrient Management. Nutrient and Pest Management Program, A3568.

Who to Contact for More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

APPENDIX H - CALIBRATING ANIMAL WASTE SPREADERS AND IRRIGATORS

Animal waste should always be applied uniformly and at a rate consistent with nutrient demand. Although many equipment options exist, there are basically three general methods of application: subsurface application, irrigation, and surface application. The method of application, however, is generally dictated by the form of the animal waste (i.e., solid, semi-solid, liquid). For example, solid animal waste is generally best applied using a surface spreader or subsurface system. Liquid animal waste is applied by pump and liquid spreader, subsurface, or irrigation system. Semi-solid animal waste can be handled as a solid or a liquid; therefore, it can be applied with a surface spreader, liquid spreader, subsurface, or irrigation system. This appendix discusses calibration techniques for surface application, subsurface application, and irrigation.

Description

Animal waste spreader calibration is a key component of nutrient management. To properly calibrate your system, you will need to know your animal waste application rate (see Appendix G).

You can perform animal waste spreader calibration using two direct methods: load-area and weight-area. Both methods require measuring the amount of animal waste applied to the soil under different conditions. The load-area method involves measuring the amount of animal waste in a loaded spreader and then calculating the number of spreader loads required to cover a known land area. Subsurface application calibration should be done using the load-area method because soil-injected animal waste cannot be collected. The weight-area method requires weighing animal waste spread over a small surface and computing the quantity of animal waste applied per acre. You can measure the application rates for irrigation systems using the area of your liquid storage.

Animal waste should be collected after spreading, if possible. If calibrating using a large tarp or plastic sheet, then you can easily recollect the test volume. If the animal waste is spread on a known area, such as 500 or 1000 ft^3, this should be done in a field were the animal waste can be left on the surface.

Your calibration method used depends on the type of animal waste spreader used (e.g., liquid animal waste is best measured with the load-area method, while solid or semi-solid animal waste may be used with either method). Instructions for using load-area calibration and weight-area calibration, as well as for calculating irrigation rates from irrigation systems are provided below.

Instructions for Load-Area Calibration (Solid, Semi-solid, or Liquid Animal Waste)

Use this method when you know your animal waste spreader's capacity or animal waste weight. This approach works well with a liquid spreader filled to capacity, and is less accurate for box spreaders or other solid application systems where capacity is difficult to estimate.

Overview

1. **Measure the capacity of animal waste (tons or gallons) held in the spreader load.**
2. **Spread a number of identical loads at a constant speed, spreader setting, and overlap.**
3. **Measure the total area of the spread.**
4. **Compute the amount of animal waste spread per acre.**

Measure the capacity of animal waste (tons or gallons) held in the spreader load.

The capacity must be expressed in units compatible with the units used in the nutrient analysis and recommended application rate. The capacity is sometimes provided by the equipment manufacturer.

Liquid animal waste application is expressed in pounds of nutrient per gallon; the application rate is given in gallons per acre. Spreader capacity is given in gallons of animal waste.

Solid and semi-solid animal waste application is expressed in pounds of nutrient per ton; the application rate is given in tons per acre. Spreader capacity is given in tons of animal waste. Note that the moisture content in animal waste affects the weight. Therefore, the weight capacity of the spreader varies based on the animal waste held. The most accurate method of determining the weight of a load is to actually measure the load using farm scales.

If scales are not available, use the following steps to convert volumetric capacity to weight capacity:

- The manufacturer should supply the volumetric capacity of the spreader in cubic feet. Two capacities are usually provided: heaped load (animal waste piled higher than the sides of the box) and struck load (the volume contained within the box).

- The capacity of older spreaders is sometimes given in bushels; multiply the bushel capacity by 1.24 to determine capacity in cubic feet.

- Next, multiply the volumetric capacity (in cubic feet) by the bulk density of the animal waste (in pounds per cubic foot) and convert it to tons by dividing by 2,000.

- Bulk density depends on the amount of water, solids, and air in the animal waste and can be measured by weighing a known standard volume of animal waste. A 5-gallon bucket has a volume of two-thirds cubic foot and can be used as a standard volume by weighing an empty bucket and recording the weight, filling the bucket with animal waste from the loaded spreader (packed to the same density as in the spreader), weighing the full bucket, and subtracting the empty bucket weight to calculate the animal waste weight in pounds. Next, multiply the animal waste weight by 3, and then divide by 2 to calculate the animal waste bulk density in pounds per cubic foot of volume.

- Multiply the bulk density by the spreader capacity (in cubic feet) to calculate the weight of the spreader load in pounds, and then divide by 2,000 to calculate tons.

- Repeat this procedure at least three times, sampling the animal waste at different places and in different spreader loads.

- Average the results to obtain a representative composite of the animal waste.

Spread a number of identical loads at a constant speed, spreader setting, and overlap.

Spread at least three full loads of animal waste on the field, maintaining the same speed and spreader setting for each load. Try to spread in a rectangle or square for easy calculation.

Measure the total area of the spread.

Place flags at the four corners of the spread area. Measure the width and length between the flags (in feet) using a measuring tape, wheel, or consistent pace. Multiply the width by the length and divide that product by 43,560 to determine the area in acres.

Compute the amount of animal waste spread per acre.

Multiply the number of loads spread by the number of tons (or gallons) per load to determine the total amount of animal waste applied to the area. Divide the total amount of animal waste by the area of the spread (in acres) to determine the application rate in tons per acre (or gallons per acre).

Repeat this procedure for various speeds and spreader settings until the desired application rate is achieved, maintaining a record of the rates found at the different settings. This procedure needs to be repeated for each piece of equipment used to spread animal waste.

Instructions for Weight-Area Calibration (Solid or Semi-solid Animal Waste)

Use this method to estimate solid and semi-solid animal waste application rates.

Overview

1. **Select a animal waste collection surface.**
2. **Secure the collection surface in the field.**
3. **Spread animal waste over the collection area.**
4. **Collect and weigh the animal waste.**

Select a animal waste collection surface.

Select a ground cover that can be used to collect the animal waste. The ground cover can be a cloth or plastic sheet of at least 100 square feet in area. Multiply the length of the sheet by the width to determine the area in square feet. If the animal waste is too liquid, use shallow plastic or metal pans on top of the ground cover, with a minimum area of 1 square foot each. Multiply the pan length by the width to calculate the area of one pan. Multiply the area of the one pan by the number of pans to determine the total collection area in square feet. For handling and cleaning convenience, place a plastic garbage bag inside the pan for each field test so that the bag and animal waste can be discarded, leaving the pan clean. Six or more pans are necessary for a test.

Weigh the ground cover or one pan and record the weights for use as a tare weight in calculations. You can use dirty sheets and pans for multiple tests only after removing major animal waste deposits. Weight dirty sheets and pans before each test so that any animal waste residue is included in the new tare weight.

Secure the collection surface in the field.

Lay out the ground cover, fully extended. Lay the sheet on the ground so that, as the sheet is removed from the field, the animal waste applied over the surface can be collected easily in its folds. If dirty sheets are being used for additional test, turn the dirty side up so that any animal waste residue included in the tare weight is not lost. Use stone, metal, or earth clods to hold down the cover so that the wind does not disturb it. Evenly space pans in a row perpendicular to the spreader's path. Be mindful of tires, as they can easily crush the pans. Place flags at designated wheel tracks to help avoid pan damage.

<u>Spread animal waste over collection area.</u>

Spread animal waste over and near the ground cover or pans in a pattern similar to that practiced during spreading. With rear outlet spreaders, make three passes: the first directly over the center of the collection area and the second two on each side of and overlapping the first pass. With side outlet spreaders, locate a first pass off of but along one edge of the collection area. Continue with subsequent passes farther away from the collection area and at the intended overlap until animal waste no longer reaches the surface.

In all cases, start spreading animal waste far enough before the collection area to ensure that the spreader is functioning. If a ground cover is folded or a pan is moved during a spread pass, investigate its condition before continuing with the test. Folded edges can be straightened without major loss of accuracy. If more than one-fourth of the surface has moved and did not receive animal waste, conduct the test again with a newly weighed sheet.

<u>Collect and weigh the animal waste.</u>

Remove the weights holding the ground cover in place. Fold the cover and animal waste in short sections from all sides and corners inward, avoiding animal waste loss. A 100-square-foot sheet folded with wet animal waste may weigh as much as 150 pounds and can be difficult to handle; place the folded cover in a feed tub or other container for easier handling. Pans typically weigh less than 5 pounds each and are usually easier to handle.

Select scales that can accurately weigh the type and quantity of animal waste collected (e.g., kitchen scales for pans, spring-tension milk scales, or platform balances for ground covers). The weight indicated on the scale includes the tare weight of the cover or pans. Subtract the tare weight from the indicated weight to determine the net weight of the animal waste collected.

<u>Compute the application rate.</u>

The application rate is based on the method of collection and the units per acre.

Using a ground cover: Divide the net pounds of animal waste collected by the ground cover area to obtain the animal waste application rate in pounds of animal waste per square foot. Multiply that result by 43,560 and then divide by 2,000 to convert to tons per acre.

Using pans: Add the net weights of the animal waste collected in the individual pans to calculate the total animal waste weight collected. Divide the total animal waste weight by the total collection area to obtain pounds of animal waste per square foot. Multiply that result by 43,560 and then divide by 2,000 to convert to tons per acre.

If working with liquid animal waste, make an additional measurement to calculate the weight per gallon of animal waste. Fill a 5-gallon bucket with liquid animal waste similar to that tested. Weigh the bucket of animal waste and subtract the tare weight of the bucket to determine the net weight of 5 gallons of animal waste. Divide the result by 5 to determine the weight in pounds per gallon. Multiply this weight by the number of pans collected. Divide the total animal waste weight by the total collection area to obtain pounds of animal waste per square foot. Multiply that result by 43,560 and then divide by pounds per gallon to convert to gallons per acre.

Instructions for Irrigation System Calibration

Use this method when a direct measure of volume is not available when pumping from a lagoon or animal waste storage. Different methods are used depending on whether you use a traveling gun irrigation system or center pivot irrigation system. Both methods are described below.

Measure surface area of lagoon or storage

Calculate the area (assumed to be a rectangle) by multiplying length (in feet) by width (in feet) to calculate the surface area in square feet. Take these measures at the liquid level and not at the top of the storage. Secure a yardstick or other measuring tool to a wooden stake, and plant the stake in the storage where the wastewater is several feet deep. Start your irrigation system.

If using a traveling gun irrigation system:

Note the starting location of the towed irrigation system and at the same time the liquid level in the storage tank on the yardstick (to the nearest quarter inch). Mark the irrigation nozzle location with a stake; this is considered Depth 1. Record results in inches.

Measure the diameter of the wetted circle from the irrigation nozzle (in feet). It is best if this measure is perpendicular to the direction of travel.

At some later time (at least an hour), note the liquid level in the storage tank again, generally after more than one foot change in depth has occurred. (The greater the change in depth, the more accurate the estimated application rate will be.) This is considered Depth 2. Record results in inches.

Note the location of irrigation nozzle with a second stake at the same time of the second depth measure. Measure the distance between the two stakes (in feet).

Calculate the application rate by multiplying the area by the difference between Depth 1 and Depth 2 (i.e., Depth 1 - Depth 2). Multiply this result by 27,200 (conversion factor). Divide this number by the distance between the two stakes, and divide this result by the diameter of the wetted circle. Your application rate will be given in gallons per acre. Note that this test assumes that your irrigation sprinklers do not overlap when applying. If your sprinklers do overlap, you need to ensure that you account for the overlap when calculating your rate. You can use the spacing between sprinkler pulls or run when calculating your rate.

If using a center pivot irrigation system:

Note the location of the pivot irrigation system and at the same time the liquid level in the storage tank on the yardstick. If possible, measure depth to the nearest quarter inch. Mark the irrigation nozzle location with a stake; this is considered Depth 1. Record results in inches.

When the pivot has completed an entire circle, note the wastewater depth again. This is considered Depth 2. Record results in inches.

Calculate the application rate by multiplying the area by the difference between Depth 1 and Depth 2 (i.e., Depth 1 - Depth 2). Multiply this result by 0.62 (conversion factor). Divide this number by the acres under the pivot, and divide this result by the fraction of the circle your pivot was able to complete. For example, if your pivot completes an entire circle, the fraction is 1. If it only completes 2/3 of the circle, the fraction is 0.667. Your application rate will be given in gallons per acre.

A center pivot is designed for a uniform pumping rate (GPM) and pressure. If this rate and pressure are used for animal waste, you already know how many gallons are applied per time unit and you know how long it take the unit to complete a circle (the ground drive is usually electric). Therefore, you can calculate total gallons without running the system. Then divide by the acres under the system and you have the rate per acre. It is useful to check this periodically, though your rate should not change unless the pump is damaged or worn. If you add fresh water to the mix, then the total gallons of animal waste is reduced by a like amount, but the fact remains that a sprinkler will only put out a set volume at a given pressure.

References

Northeast Regional Agricultural Engineering Service. Fertilizer and Manure Application Equipment, NRAES-57, April 1994.

Maryland Institute for Agricultural and Natural Resources. Fact Sheet: Calibrating Manure Spreaders, Fact Sheet 419.

Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. Manure Applicator Calibration, G95-1267A.

Who to Contact for More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

APPENDIX I - RECOMMENDED BEST MANAGEMENT PRACTICES (BMPS)/CONSERVATION PRACTICE STANDARDS

There are several BMPs and conservation practices to consider when planning and implementing a Permit nutrient plan (PNP). This appendix contains some of USDA's published practices, though many other practices exist. The practices you see here represent those that EPA believes will be the most helpful when planning your PNP. Consult your state or local Cooperative Extension Office for more information and other standard practices.

Description

The Natural Resources Conservation Service (NRCS) is a division of USDA that provides leadership in a partnership effort to help people conserve, improve, and sustain our natural resources and the environment. NRCS relies on many partners to help set conservation goals, work with people on the land, and provide assistance. Its partners include conservation districts, state and federal agencies, NRCS Earth Team volunteers, agricultural and environmental groups, and professional societies.

NRCS has published the National Handbook of Conservation Practices (NHCP), which includes conservation practice standards guidance for applying technology on the land, and sets the minimum level for acceptable application of the technology. The most commonly considered conservation practice standards that may be used are shown in the table below:

Practice	Practice
Composting Facility (a)	Pond Sealing or Lining - Flexible Membranes (a)
Conservation Crop Rotation (a)	Pond Sealing or Lining - Bentonite Sealant (a)
Contour Buffer Strips (a)	Residue Management, no-till and Strip Till
Cover and Green Manure Crop	Residue Management, Mulch Till
Cross Wind Trap Strips	Roof Runoff Management
Diversions	Spring Development
Fences	Strip cropping, Contour
Filter Strips (a)	Terraces
Grade Stabilization Structure	Trough or Tank
Grassed Waterways	Use Exclusion
Irrigation Water Management	Waste Management Systems (a)
Nutrient Management (a)	Waste Storage Facility (a)
Pest Management	Waste Treatment Lagoon (a)
Pipelines	Waste Utilization (a)

National standards for each practice are available at the NRCS web site at **http://www.ncg.nrcs.usda.gov/nhcp_2.html**. State conservationists determine the national standards to apply on a state-wide level, and add detail to effectively implement the standards on a local level, including more restrictive levels, if warranted. Local standards cannot be less restrictive than the national standards.

[Copies of individual standards could be included in this appendix.]

References

Natural Resources Conservation Service, Department of Agriculture. Notice of Technical Guidance for Developing Comprehensive Nutrient Management Plans (CNMPs).

Who to Contact for More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)