Chapter 5

5. Nutrient Management Planning

An NMP helps a CAFO owner or operator to ensure that crop needs are met while minimizing impacts on water quality. Most commonly, NMPs are used to develop appropriate rates for the application of manure and fertilizer. However, they can also include an array of other management and conservation practices to optimize the productivity of the operation while conserving nutrients and protecting the environment. Those include practices such as appropriate manure and fertilizer storage and handling methods, managing the diet of the animals, or irrigation practices. The CAFO regulations specify nine minimum requirements that must be included in an NMP, to the extent that they are applicable, for any CAFO seeking permit coverage. 40 CFR § 122.42(e)(1). The permit writer must incorporate conditions that address those NMP requirements into the permit as enforceable permit terms. The permit terms must include the information, protocols, BMPs and other conditions identified in a CAFO's NMP that are necessary to meet the nine minimum requirements. 40 CFR § 122.42(e)(5). For permitted Large CAFOs, the permit terms must also include the requirements of the ELG. 40 CFR §§ 122.42(e)(5), 412.4.

This chapter discusses each of the required nine minimum requirements that CAFOs must address in an NMP and how to develop enforceable permit terms for each minimum requirements (with the exception of land application protocols, which is addressed in Chapter 6). In addition, this chapter discusses the ELG requirements applicable to permitted Large CAFOs. Where applicable, the chapter also includes technical information to provide the permit writer with background information and understanding that will help support development of site-specific terms for certain minimum NMP requirements.

5.1. EPA's Nine Minimum Requirements for Nutrient Management

Any permit issued to a CAFO of any size must include a requirement to implement an NMP that contains, at a minimum, BMPs that meet the requirements specified in 40 CFR part 122.42(e)(1). Those consist of the following:

1. Ensuring adequate storage of manure, including procedures to ensure proper O&M of the storage facility.
2. Managing mortalities to ensure that they are not disposed of in a liquid manure, stormwater, or process wastewater storage or treatment system that is not specifically designed to treat animal mortalities.
3. Ensuring that clean water is diverted, as appropriate, from the production area.
4. Preventing direct contact of confined animals with waters of the U.S.
5. Ensuring that chemicals and other contaminants handled on-site are not disposed of in any manure, litter, process wastewater, or stormwater storage or treatment system unless specifically designed to treat such chemicals and other contaminants.
6. Identifying appropriate site-specific conservation practices to be implemented, including as appropriate buffers or equivalent practices, that control runoff of pollutants to waters of the U.S.
7. Identifying protocols for appropriate testing of manure, litter, process wastewater, and soil.
8. Establishing protocols to land apply manure, litter, or process wastewater in accordance with site-specific nutrient management practices that ensure appropriate agricultural utilization of the nutrients in the manure, litter or process wastewater.
9. Identifying specific records that will be maintained to document the implementation and management of the minimum elements described above.

NRCS and landowner on dairy farm discuss NMP requirements. (Photo courtesy of USDA/NRCS)

The ways in which permitted CAFOs must address those requirements in their NMPs differ and are discussed in more detail in the sections below.

5.1.1. Permitted Large CAFOs

Permitted Large CAFOs must implement NMPs as a condition of their permits. 40 CFR § 122.42(e)(1). At a minimum, the NMPs must address the requirements of 40 CFR part 122.42(e)(1). Additionally, permitted Large CAFOs are subject to the ELG defined at 40 CFR part 412. The ELG require specific standards for implementing land application rates, manure and soil sampling, and conservation practices, among other requirements. For an introduction of the ELG requirements, see Chapter 4.1.1. The ELG requirements relevant to land application are discussed in detail in the appropriate sections below.

A permitted Large CAFO in California that must implement an NMP as a condition of their permit. (Photo courtesy of USDA/NRCS)

5.1.2. Permitted Small and Medium CAFOs

Like all permitted CAFOs, Small and Medium CAFOs must develop and implement NMPs that address the requirements of 40 CFR part 122.42(e)(1). However, Small and Medium CAFOs are not subject to the ELG of 40 CFR part 412. Effluent limitations that build on part 122.42(e)(1) for Medium and Small CAFOs are based on the BPJ of the permit writer. Permit writers might find that it is appropriate to include BPJ effluent limitations that are the same as or similar to the effluent limitations established in the ELG for Large CAFOs. (See Chapter 4.1.4.)

5.1.3. Unpermitted Large CAFOs

Unpermitted Large CAFOs are not required to implement an NMP. However, for precipitation-related discharges from the land application area to qualify as agricultural stormwater exempt from permit requirements, unpermitted CAFOs must develop and implement the nutrient management practices specified by 40 CFR part 122.42(e)(vi)–(ix) to ensure appropriate agricultural utilization of the nutrients in the manure being land applied. That means that the CAFO's nutrient management planning must account for appropriate site-specific conservation practices, protocols for appropriate manure and soil testing, appropriate protocols for land application, and maintenance of records to document the implementation of those BMPs. EPA recommends that unpermitted Large CAFOs with precipitation-related land application area discharges develop and implement NMPs similar to permitted operations. By doing so, the operator can ensure that proper practices are implemented and documented to demonstrate that any discharge from the land application area is agricultural stormwater. For a more detailed discussion on the requirements for meeting the agricultural stormwater exemption, see Chapter 4.1.8.

5.2. Developing Permit Terms

Section 4.1.7 includes a discussion of options for capturing the nine minimum requirements as broadly applicable permit terms, site-specific terms, or some combination of both in which a broadly applicable permit term can be supplemented with a site-specific term. To the extent that the NMP provides site-specific information about practices that are necessary to comply with one of the minimum requirements, that information can be included as all or part of each permit term. Ultimately though, it is up to the permitting authority to determine the extent to which site-specific information from the NMP is necessary or sufficient to adequately capture each of the nine minimum requirements as permit terms. The exception is the requirement to establish protocols for land application, which can be captured as a site-specific term only. 40 CFR § 122.42(e)(5). Note that the public can comment on the sufficiency or applicability of the terms of the NMP.

NRCS staff discuss conservation planning with a landowner next to a stream livestock exclusion fence in Van Buren County, Michigan. (Photo courtesy of USDA/NRCS)

There could be cases where no site-specific information is provided in the NMP for several of the NMP requirements. For example, diversion of clean water from the production area might not be applicable to some CAFO's operation. Another example is where the permit simply prohibits direct contact of animals with waters of the U.S. Where site-specific information on a requirement is not necessary to include in an NMP, a broadly applicable term, rather than a site-specific term, will be sufficient. In other cases, a broadly applicable term may be used in the general permit and more specific information will be needed in the NMP submitted with the NOI to explain how the facility will meet the general permit conditions. The issue is discussed in greater detail under each of the NMP requirements where it is appropriate.

NMP requirements may be addressed through the use of one or more of USDA's conservation practice standards where the standards meet applicable state requirements, as long as they are identified in the operation's site-specific NMP and appropriate O&M activities are identified. A USDA conservation practice standard may be captured as a site-specific term, or when appropriate, it may be identified as a broadly applicable term. NRCS's standards are identified in USDA's *Comprehensive Nutrient Management Plans and National Instruction* (USDA-NRCS 2009). The practice standards are also included in each state NRCS Field Office Technical Guides. The sections below identify

NRCS Conservation Practice Standards associated with the technical basis for each of the minimum NMP requirements. Appendix K, NRCS Conservation Practice Standards, provides a description of each of the practice standards included in this chapter.

The remainder of this chapter discusses the components of seven of the nine minimum requirements. The requirements for maintaining records and protocols for land application are discussed in detail, respectively, in Chapters 4.2 and 6.5. This chapter includes basic technical guidance as to how each requirement can be implemented. The guidance is further illustrated with examples of site-specific information that is likely to be found in an NMP. Permit writers should consider such examples to be a starting point for identifying the information in an NMP that constitute the permit terms necessary to capture the nine minimum requirements. For cases where the basis for the applicable permit term is a source other than a CAFO's NMP, this chapter also provides sample permit language that could be used for writing a broadly applicable term.

5.3. Adequate Manure, Litter, and Wastewater Storage, Including Procedures to Ensure Proper Operation and Maintenance of the Storage Facility 40 CFR Part 122.42(e)(i)

Permitted CAFOs must have an NMP that ensures adequate storage of manure, litter, and process wastewater. The term adequate storage means that, at a minimum, the NMP must demonstrate that the CAFO has sufficient storage capacity to ensure compliance with the effluent limitations of the permit. For many permitted CAFOs, that requirement means that the CAFO must have, at a minimum, sufficient storage capacity to ensure that the production area is designed constructed, operated, and maintained to contain all manure, litter, and process wastewater including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event. 40 CFR §§ 412.13, 412.15, 412.26, and 412.31(a). For a detailed discussion of the applicable requirements for each animal subpart, see Chapter 4.1.2. The terms of the permit must address all the conditions necessary to ensure that the CAFO meets the requirements for adequate storage.

All manure, litter, and process wastewater storage structures must be properly designed, constructed, operated, and maintained, regardless of where they are in relation to the animal confinement area. That would include, for example, manure storage sites, such as litter stockpiles, that are near fields where the manure or litter is to be spread. In addition, a well-designed and constructed manure storage facility must be operated and maintained to prevent the development of conditions that could lead to a discharge. Management decisions relative to startup and loading (especially for anaerobic lagoons), manure removal, monitoring of structural integrity, and maintenance of appearance and aesthetics play critical roles in well-managed storage facilities.

5.3.1. Permit Terms for Adequate Storage of Manure, Litter, and Wastewater

The practices and information required by the permit, including any applicable standard by which wastewater and manure storage structures are to be designed, constructed, operated, and maintained need to be identified by the permitting authority and should be included in the permit term as either a site-specific term or a broadly applicable permit term. The principle site-specific terms for adequate storage capacity typically include the following:

- The structures used to provide adequate manure storage and the storage capacity of each structure.
- The facility's critical storage period—the time that would result in maximum production of manure and wastewater anticipated between emptying events—and emptying schedules (see the Agitation text box on page 5-15).
- The total design volume—for example, for facilities subject to the 25-year, 24-hour storm standard, the volume generated during the critical storage period plus the 25-year, 24-hour storm event volume plus the storage structure freeboard and other required design components (see more detailed explanation in Section 5.3.2).
- Off-site transport practices, including frequency and amount of off-site transfers, to the extent that the practices are critical to ensuring adequate storage.

For adequate storage, O&M requirements should also be included as part of the site-specific permit term 40 CFR parts 122.42(e)(1)(i) and (e)(5). Section 5.3.2 discusses O&M procedures for storage structures in greater detail. Typical O&M activities that might be included as site-specific terms include the following:

- Frequency of inspections of storage structures to confirm they are maintaining adequate storage capacity. Regulations at 40 CFR part 412 require weekly inspections for Large permitted subpart C and D CAFOs.
- Removal of solids from storage structures as needed to maintain the design storage capacity.
- Removing manure or wastewater or both in accordance with the NMP and the structure's design storage capacity (see the discussions of storage structure design and critical storage period above).
- Maintaining storage capacity for the design storm event (25-year, 24-hour storm event for most permitted Large CAFOs and the storm event dictated by site-specific management practices for open containment systems to meet the no discharge standard for new permitted Large swine, poultry, and veal calf CAFOs). The regulations at 40 CFR parts 412.37 and 412.47 require that all open surface liquid

impoundments must have a depth marker that clearly indicates the minimum capacity necessary to contain the runoff and direct precipitation of the 25-year, 24-hour rainfall event.

- Maintenance of any controls that are used to prevent plants and burrowing animals from eroding storage structure berms, embankments, liners, and sidewalls.
- Maintenance of vegetation, rock, or other materials used to prevent erosion and stabilize berms and embankments.
- Maintenance of any structures necessary (i.e., fencing) that is used to prevent animal access to the storage area.
- Inspections to ensure that all inlets and outlets to the storage structure are not blocked by debris or ice.
- Inspections of the perimeter of any storage structure to ensure any runoff or process wastewater is contained and repairing any deficiencies identified.

While some elements of adequate storage can be broadly applicable to all facilities, EPA believes that some elements need to be site-specific to fully meet the requirements of 40 CFR part 122.42(e)(1)(i).

Proper O&M standard permit condition

Proper O&M is a standard condition required to be included in all NPDES permits. 40 CFR § 122.41(e). Proper O&M of storage structures includes activities such as periodic solids removal to maintain storage capacity, maintenance of berms and sidewalls, prompt repair of any deficiencies, and, for liquid manure storage structures, appropriate dewatering activities. The standard condition does not provide enough specificity to detail the extent of O&M that should be conducted at a CAFO.

As discussed, in some instances NRCS practices standards can be included (as either a broadly applicable term, a site-specific term or a site-specific term that is used to supplement a broadly applicable term) as part of the permit terms and conditions. Table 5-1 identifies the technical basis for the NMP minimum practice to ensure adequate storage and some related NRCS conservation practice standards that might be included in NMPs to address the minimum requirement. Where references are made to NRCS standards, permit writers should ensure that necessary O&M actions are also included as permit terms. Appendix K, NRCS Conservation Practice Standards, includes a description of those conservation practice standards.

Table 5-1. EPA minimum practice/NRCS conservation practice comparison

NPDES NMP minimum practice	Technical basis	Associated NRCS conservation practice standards
Ensure adequate storage	Maintaining sufficient storage capacity is critical for a CAFO to be able to properly store manure, wastewater, and stormwater for those periods when land application is not appropriate. A CAFO's ability to meet the applicable nutrient management technical standard depends on proper storage practices. Insufficient storage capacity increases the risk of runoff from manure piles and spills from lagoons and other containment structures. It also increases the possibility that an operation will have to land apply during periods of increased risk to surface water (e.g., during rainfall events).	Waste Storage Facility - NRCS Practice Standard Code 313 Composting Facility - NRCS Practice Standard Code 317 Waste Treatment Lagoon - NRCS Practice Standard Code 359 Anaerobic Digester - NRCS Practice Standard Code 366 Roofs and Covers - NRCS Practice Standard Code 367 Solid/Liquid Waste Separation Facility - NRCS Practice Standard Code 632

5.3.2. Technical Information on Storage Structure Design, Construction, Operation and Maintenance

Design and Construction of Storage Structures

Liquid Manure Storage Structures

Liquid manure storage structures have unique requirements that must be addressed to ensure adequate storage of liquid waste. Such structures must have adequate capacity to contain the volume accumulated as a result of contributions from all sources.

The total design volume for a liquid manure storage structure from a facility subject to the 25-year, 24-hour size storm standard required in Part 412 must include an allowance for each of the following:

- The volume of manure, process wastewater, and other wastes accumulated during the storage period (see the discussion of *critical storage period* below).
- The volume of normal precipitation minus evaporation on the storage structure surface during the entire storage period.
- The volume of runoff from the facility's drainage area from normal rainfall events during the storage period.

CAFO waste lagoon—a liquid manure storage structure. (Photo courtesy of USDA/MO NRCS)

- The volume of precipitation from the 25-year, 24-hour rainfall event on the storage structure surface.
- The volume of runoff from the facility's drainage area from the 25-year, 24-hour rainfall event.
- The volume of any leachate from bunk silos or other silage storage areas.
- In the case of anaerobic waste treatment lagoons, the minimum treatment volume.
- The minimum volume to maintain the integrity of the lagoon bottom.
- The volume of solids remaining in a storage structure after liquids are removed.
- Any necessary freeboard required to maintain structural integrity, although that is not considered to be a component of the structure's storage volume.

The volume of normal precipitation for the storage period should reflect the maximum amount of rainfall to be expected between emptying events. For example, if a storage structure is dewatered once every 6 months, the volume of normal precipitation should reflect the precipitation that is expected during the wetter of the two 6-month storage periods.

When a series of rainfall events precludes dewatering, the remaining capacity of the storage structure is reduced. When dewatering is not possible, a rainfall event of any size, both smaller or larger than the 25-year, 24-hour storm event, could result in an overflow that complies with effluent limitations based on 40 CFR part 412. CAFOs that do not actively maintain the capacity of the storage structure, such as CAFOs that start dewatering only when the storage structure is completely full, are not entitled to such discharge authorization (see the discussion of proper O&M below). It is unlikely that any given series of storms would result in an overflow from a properly developed liquid storage structure, unless the series of storms occurs so close to the end of the design storage period that the storage structure is already filled close to capacity at the beginning of the chronic rainfall event.

The volume needed for solids accumulation in a liquid manure storage structure varies with the presence and efficiency of solids separation equipment or processes and the extent to which the storage structure provides treatment. The total volume needed for solids accumulation also depends on the length of time between solids removal. Operational practices can also affect the volume needed for solids accumulation. For example, facilities that completely agitate a manure pit before pumping are likely to need less long-term solids storage volume than facilities that only pump liquid from the top of the storage structure, although it is generally advisable to agitate. (See the Agitation text box on page 5-15.) Facilities that do not intend to remove solids for many years at a time will need to provide solids storage volume for that entire period.

Terminology for Storage Structures

These terms are not defined by EPA in the NPDES regulations, but the following definitions are useful for understanding and properly implementing the regulations.

Freeboard

EPA encourages the use of NRCS and American Society of Agricultural and Biological Engineers (ASABE) standards that use the term freeboard to describe a safety feature for an open liquid storage system, to protect the integrity of the berm. ***Freeboard*** should not be treated as volume for additional storage capacity but as a structural feature necessary to the proper design of a liquid storage system.

Critical Storage Period

The minimum design volume for liquid manure storage structures is based on the expected length of time between emptying events that result in maximum production of process wastewater, including runoff from the production area. That period is the ***critical storage period***.

The critical storage period might not necessarily be the maximum period between emptying events. For example, in an area that receives most of its annual rainfall over 3 months, more process wastewater might be generated over a 4-month storage period that includes the rainy season than over an 8-month dry period.

Chronic Rainfall

Chronic rainfall is considered to be a series of wet-weather conditions that could preclude dewatering of liquid retention structures. A permitted CAFO's storage structure needs to have capacity for the critical storage period, thus accommodating all wastes, precipitation, and runoff that might accumulate during that period. Therefore, properly designed systems need to account for periods of heavy rainfall that might occur during periods when a state's technical standard prohibits land application or when the CAFO is otherwise unable to land apply. When, however, excessive rainfall causes discharges from storage structures that are properly designed, constructed, operated, and maintained to meet the requirements of a CAFO's permit, such discharges may be allowable discharges under the permit, or may qualify under the upset/bypass provisions of the regulations.

Additional standards and criteria for storage structures might also be required to meet management goals or other regulatory and state requirements. For example, a state could require CAFOs to follow recommendations from the NRCS National Engineering Handbook Part 651 Agricultural Waste Management Field Handbook (USDA-NRCS 1999) or NRCS conservation practice standards 313 Waste Storage Facility and 359 Waste Treatment Lagoon (USDA-NRCS 2003). Those practice standards include information on the foundation of the storage pond or lagoon, maximum operating levels, structural loadings for fabricated structures, slab designs, and considerations for minimizing the potential for and effects of sudden breach of embankment or accidental release. Large dairy, beef, poultry, swine, and veal calf CAFOs must identify the site-specific design basis in their records and maintain a copy of the records on-site (as required by 40 CFR part 412.37(b)(5), discussed in Section 4.2.2). All CAFOs should maintain similar records to ensure adequate storage and prevent discharges.

Treatment Lagoon Design

One reference for design of an anaerobic lagoon is the ANSI/ASAE standard EP403.3 entitled ***Design of Anaerobic Lagoons for Animal Waste Management***. ASAE's standard on the design of anaerobic lagoons states that the lagoon depth should provide for a 6.6-foot minimum depth when the lagoon is filled to its treatment volume elevation, which should be at least 1 foot above the highest groundwater table elevation. ASAE also recommends making the lagoon as deep as practical to reduce surface area and convection heat loss, enhance internal mixing, reduce odor emissions, promote anaerobic conditions, minimize shoreline weed growth problems, and reduce mosquito production. This standard also provides equations for calculating the total lagoon volume and a listing of recommended maximum loading rates for anaerobic lagoons for animal waste in mass of volatile solids per day per unit of lagoon volume. The treatment volume is sized on the basis of waste load (volatile solids or VS) added per unit of volume and climatic region. Maximum lagoon loading rates are usually based on average monthly temperature and corresponding biological activity. If odors are of concern, consideration is also given to reducing the VS loading.

The NRCS Standard Practice 359 ***Waste Treatment Lagoon*** provides information on minimum top widths, operating levels, embankment elevations, and considerations for minimizing the potential of lagoon liner seepage.

Other frequently used references are ***NRCS' Agricultural Waste Management Field Handbook***, Part 651, National Engineering Handbook, ASAE Engineering Practice standard ASAE EP393.3 Manure Storages, and Midwest Plan Service publication MWPS-18.

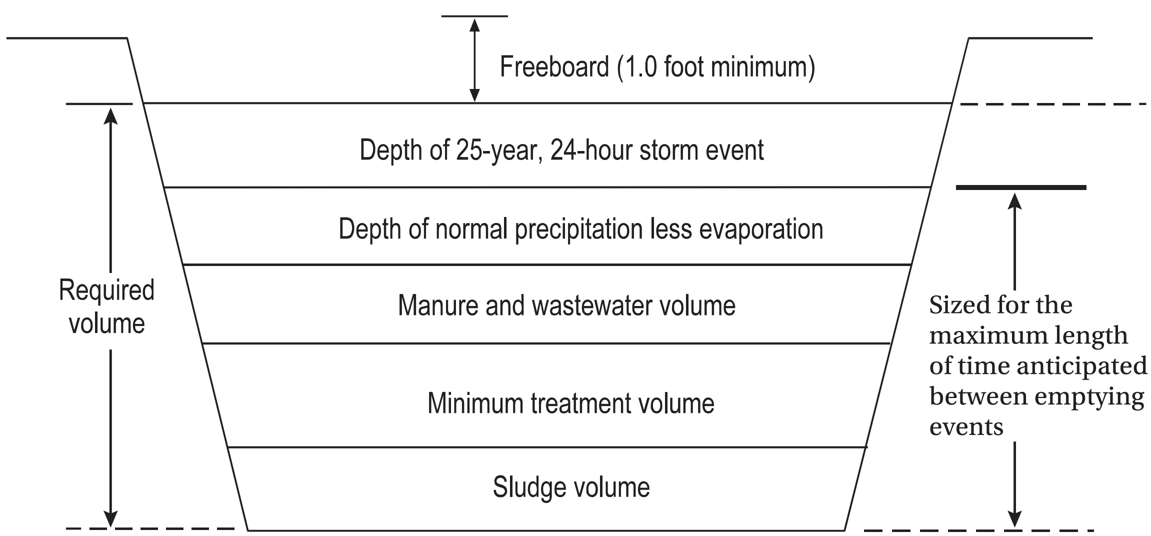

Figure 5-1. Cross section of properly designed lagoon

Solid Manure Storage Structures

Solid manure storage structures include storage areas such as the lower level of high-rise poultry houses, sheds for poultry litter, pits, stockpiles, mounds in dry lots, compost piles, and pads. The storage capacity of a solid manure storage structure should consider the frequency at which manure is moved from confinement areas to the storage structure and frequency at which manure will be removed from the storage structure for land application or off-site transfer.

Because all water that contacts raw materials, products, or by-products, including manure and litter, is considered to be process wastewater, CAFOs must manage runoff from any solid manure storage areas that are exposed to precipitation. CAFOs should consider storing stockpiles of solid manure and litter under a roof to exclude precipitation whenever possible to reduce or eliminate the need to collect all runoff from the stockpile. Solid manure and litter stockpiles that are not stored under a roof should be covered to exclude precipitation whenever possible. Where it is not possible to cover stockpiles that are stored for more than 15 days, the stockpile constitutes a liquid manure handling system. For chickens and duck sectors, a lower CAFO threshold would apply (see Section 2.2.4).

Solid manure structures include composter piles. (Photo courtesy of USDA/MO NRCS)

Inspecting compost from turkey manure and woodchips storage structure. (Photo courtesy of USDA/NRCS)

Permit authorities may also require CAFOs to manage seepage to groundwater from solid manure storage areas. The floor of a solid manure storage area should be constructed of compacted clay, concrete, or other material designed to minimize the leaching of wastes beneath the storage area. The floor should be sloped toward a collection area or sump so that runoff or leachate can be collected and transferred to a liquid manure storage structure or treatment system.

O&M of Storage Structures

All manure storage structures must be operated and maintained to prevent the discharge of pollutants into waters of the U.S. Frequent overflows are a potential indicator that a CAFO is not meeting its permit obligations to ensure adequate storage and to properly operate and maintain the facility.

In general, the records maintained by the operator help determine whether proper O&M has been performed. For Large subpart C and D CAFOs, the ELG specifies some of the records that must be maintained. NPDES permits for all CAFOs should specifically identify any records necessary to document implementation of the O&M practices required by the permit.

This section highlights activities at CAFOs that are related to O&M of manure storage and handling structures and the types of records that can be maintained to document implementation of such practices.

Storage facility maintenance is essential. (Source: EPA Region 10)

Manure Removal

The most important consideration in operating and maintaining a liquid manure storage structure is to ensure that the structure does not overflow and that the manure and wastewater is removed when it is appropriate to do so. Many discharge problems have occurred because producers were unable to manage the activities necessary to remove manure from storage in a timely manner. The appropriate frequency of emptying events could be based on factors such as the following:

- Storage structure size (i.e., if it contains more than the minimum required storage capacity).
- Hydraulic limitations of a land application site.
- Typical precipitation for the area.
- Nutrient concentrations in the stored manure or wastewater.
- Allowable timing of land application such as winter applications as specified in an NMP.
- The extent to which the liquid in the storage structure is used for irrigation water.
- The cropping system included in a CAFO's NMP.

Storage capacity should be sufficient to allow the CAFO to land apply at the times specified by the land application schedule in the NMP. Low manure storage capacity might require frequent applications and, possibly, year-round cropping systems, while larger storage volumes could allow less frequent applications or less intensive cropping. For existing facilities, the storage volume should be known or calculated, and the NMP should plan for land application (or other manure use or disposal) frequently enough to ensure that the storage capacity is not exceeded. The storage capacity for new facilities should be calculated to accommodate the planned cropping system.

Manure Removal Methods[1]

Solid Manure

Solid manure is usually removed from storage using front-end loaders, scrapers, or other bulk-handling equipment. The size of the equipment influences the time required to load hauling equipment. Hauling equipment includes a truck-mounted beater, flail or spinner-type spreader boxes, and pull-type spreaders. The size or volume of the hauling equipment used influences the number of trips required to empty manure storage facilities. The hauling distance determines the time necessary to complete a trip.

Litter

Litter is usually removed from storage using the same type of equipment as used for solid manure. Care should be taken to minimize the amount of litter that is spilled on the ground when removing litter from a poultry house. Construction of concrete pads at the entrance to poultry houses can provide for easy cleanup and reduce the potential for runoff and infiltration.

Slurry Manure

Slurry manure should be agitated before and during pumping of the manure from storage. Agitation equipment should be selected to provide sufficient homogenization of the slurry in an acceptable time. Agitation is usually begun several hours before hauling and continued during the hauling operation. Heavy-duty chopper pumps are generally used to load slurry-hauling equipment. Hauling equipment includes conventional tank wagons and some box-type spreaders designed to haul slurry. The flow rate capability of the loading pump determines the time required to load, and the size or volume of the hauling equipment determines the number of trips that must be made. Hauling distance is an important factor in total trip time.

Umbilical or *drag-hose* systems are also used in spreading slurry manure. The method offers the advantage of continuous flow, and the slurry manure is injected or incorporated into the soil during spreading. Soil compaction is reduced because a fully loaded manure spreader is not pulled across the field. Emptying time with this method depends primarily on the pumping rate through the drag hose. The use of a flow meter is recommended with the systems to ensure that the manure is applied at the proper rate.

Liquid Manure

Liquid storage systems can be agitated. If they are not agitated, considerable nutrient buildup in the sludge will occur and will be a factor when the sludge is agitated and removed. Because solids in a liquid storage system tend to settle, nutrient concentrations vary at the surface, in the sludge, or when agitated. If liquid storages are not agitated, their capacity will be reduced over time because of solids buildup. Reduced capacity might not be obvious in treatment lagoons where pump-down does not progress beyond the top liquid layer. Liquid storage system effluent is usually removed by pumping equipment that might be similar to irrigation equipment. Hand carry, solid set, stationary big gun, traveling gun, and center pivot equipment have all been used to land apply lagoon effluent. Drag-hose systems are sometimes used as well. The pumping flow rate of the system is the primary determining factor in the time required to pump down a liquid storage system.

> **Agitation** during manure removal is critical to maintaining available storage in many liquid manure systems other than lagoons. Some facilities have designed storage structures equipped with pumps to allow wastewater application without additional agitation. Failure to properly agitate can result in a continued buildup of settled solids that are not removed. The result is less and less available storage over time. Agitation of manure re-suspends settled solids and ensures that most of or all the manure will flow to the inlet of the pump or removal device. Additionally, agitation homogenizes the manure mixture and provides more consistent nutrient content as the manure is being removed. Manure samples for nutrient analysis should be obtained after the liquid or slurry storage is well agitated. Agitation of manure storage facilities releases gases that can increase odor levels and present a health hazard in enclosed spaces. Consideration should be given to weather and wind conditions, time of day, and day of the week to minimize the possibility of odor conflicts while agitating.

Monitoring and Recordkeeping

The regulations require all permitted CAFOs to identify in the NMP the specific records that will be necessary to document proper implementation and management of the minimum required elements for an NMP, which are discussed in Section 5.11. That includes the records necessary to document the proper O&M of manure storage structures. 40 CFR § 122.42(e)(1)(ix). Records of monitoring activities are a good indication that a CAFO is implementing proper O&M practices.

Regular Visual Inspections

All CAFO operators should regularly inspect the manure storage structures to identify and correct problems with structural integrity and storage capacity before a discharge occurs. The frequency of inspections can vary, but a regular inspection schedule should be developed and followed for each handling and storage system. Inspection frequency might depend on factors such as the system size and complexity, the types of mechanical devices used (e.g., recycle pumps, float switches in reception pits), the flow rate of the recycle system, the proximity to a sensitive water source, and the type of storage facility. The ELG regulations require that permitted Large CAFOs conduct weekly inspections of all manure, litter, and process wastewater impoundments. 40 CFR § 412.37(a)(1).

In addition to periodic inspections, manure levels in a storage structure must be monitored and recorded weekly. The data can illustrate the effects of excessive rainfall and lot runoff and help in planning pump-down or other land application

> **Visual Inspections**
>
> ***§ 412.37(a)(1)*** There must be routine visual inspections of the CAFO production area. At a minimum, the following must be visually inspected: (i) Weekly inspections of all storm water diversion devices, runoff diversion structures, and devices channeling contaminated storm water to the wastewater and manure storage and containment structure; (ii) Daily inspection of water lines, including drinking water or cooling water lines; (iii) Weekly inspections of the manure, litter, and process wastewater impoundments; the inspection will note the level in liquid impoundments as indicated by the depth marker.

activities. Manure levels should be observed and recorded frequently enough to provide a *feel* for the rate of accumulation, and pumping activities should be scheduled accordingly. For Large CAFOs, the ELG requires, at a minimum, weekly recording of manure and wastewater levels in all liquid impoundments. 40 CFR § 412.37(b)(2). The permit writer can specify more frequent monitoring of lagoon levels, if appropriate. 40 CFR § 122.41(j).

Depth Markers

A depth marker is a tool that allows CAFOs to manage the liquid level in an impoundment to ensure that the impoundment has adequate capacity to contain direct precipitation and runoff from the design rainfall event. Without a depth marker, impoundments could fill to a level above their capacity, leading to overflows. The CAFO ELG requires Large CAFOs to install a depth marker in all open surface liquid impoundments but level indicators are useful management tools for all types of liquid impoundments. 40 CFR § 412.37(a)(2).

It is also a good practice to indicate the maximum drawdown level on the depth marker in a treatment lagoon to ensure that the lagoon has the volume needed for biological treatment and capacity for all solids accumulating between solids removal events. Figure 5-2 provides an illustration of an open surface liquid impoundment with a depth marker.

CAFOs may use remote sensors to measure the liquid levels in an impoundment. Sensors can be programmed to trigger an alarm when the liquid level changes rapidly or when the liquid level reaches a critical level. The sensor can transmit to a wireless receiver to alert the CAFO about an impending problem. One advantage of a remote sensor is that it can provide CAFOs with a real-time warning that the impoundment is in danger of overflowing. CAFOs may use remote sensors to track liquid levels to supplement the weekly required inspections of all manure and process wastewater structures. Even though remote sensors are more expansive, the price may be offset by the additional assurance they can provide in preventing accidental discharge and circumventing catastrophic failures.

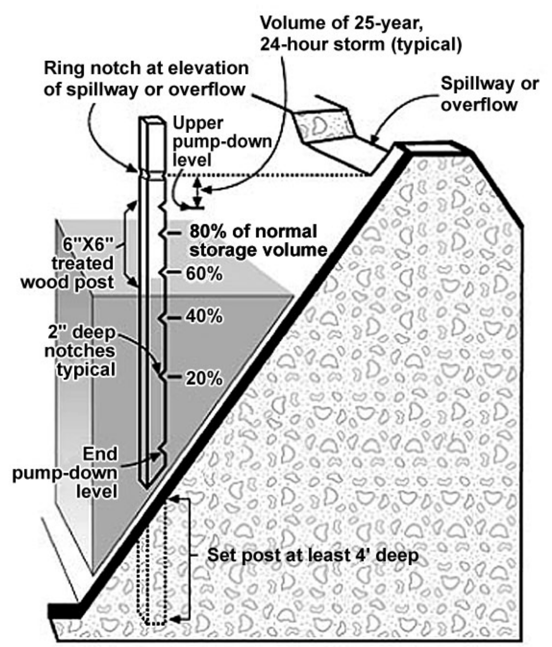

Figure 5-2. Schematic of Lagoon Depth Marker

Rain Gauge

A simple rain gauge that indicates or records rainfall can be a useful tool in maintaining and managing a manure storage structure. Rainfall has a significant impact on open storage structures and structures serving open lots, so knowledge of rainfall amounts can be very useful. A rain gauge can help with documenting such events without resorting to *off-site* data from stations that might not be descriptive of conditions at the storage facility. Recorded rainfall data are also evidence of good stewardship. While a rain gauge is not a regulatory requirement for CAFOs, it can be a useful tool for the operator to provide documentation as to the intensity of a storm event that resulted in a discharge.

Pumping Activities

"Experience has shown that unplanned discharges and spills sometimes occur with pumping activities. Sources of such unplanned discharges include burst or ruptured piping, leaking joints, operation of loading pumps past the full point of hauling equipment, and other factors. Thus, pumping activities should be closely monitored, especially in the *startup* phase, to ensure that no spills or discharges occur. Continuous pumping systems such as drag-hose or irrigation systems can be equipped with automatic shutoff devices (which usually sense pressure) to minimize the risk of discharge if pipe failure occurs." (Harrison and Smith 2004b)

Liners

No NPDES or ELG regulatory requirements specifically concern the use of liners at CAFOs. However, the permitting authority has the discretion to include additional special conditions in NPDES permits for CAFOs beyond those required by the NPDES CAFO regulations where it has determined that they are necessary to achieve effluent limitations and standards or carry out the intent and purpose of the Clean Water Act (CWA). Such additional requirements might address, for example, the use of liners in areas where there is the potential to discharge to groundwater that has a direct hydrologic connection to waters of the U.S. Also, some states have permeability or liner requirements that are based on state authorities other than the CWA.

"Liners in earthen manure storage impoundments are designed and constructed to provide an additional barrier between the potential contaminants in the impoundment and groundwater. Thus, liner integrity is extremely important in maintaining an environmentally sound manure storage facility. Liners are constructed of compacted clay, geotextiles, or a combination of both." (Harrison and Smith 2004b)

5.4. Mortality Management 40 CFR 122.42(e)(ii)

Every permitted CAFO's NMP must contain BMPs and protocols to ensure that mortalities are not disposed of in a liquid manure, stormwater, or process wastewater storage or treatment system that is not specifically designed to treat animal mortalities. In addition, Large CAFOs (except horse, sheep, and duck CAFOs) must ensure that mortalities are handled in such a way as to prevent the discharge of pollutants to waters of the U.S. 40 CFR 412.37(a)(4). Although that ELG requirement does not apply to all permitted CAFOs, all CAFOs must ensure proper mortality handling.

5.4.1. Permit Terms for Mortality Management

The permit should require that the plan address both typical and catastrophic mortality. At a minimum, the plan should identify the disposal method (which should account for the expected mortality rate at the operation as discussed below), the location if applicable (which can include sites for burial or sites of temporary storage until mortalities are removed off-site), and the actions that are to be taken if a catastrophic mortality situation occurs. Site-specific terms could be the specific structures or practices identified in the NMP and associated O&M practices including the following:

- Schedules for collecting, storing, and disposing of carcasses.
- Description of on-site storage before disposal.
- Description of the final disposal method.
- Additional management practices to protect waters of the U.S. for on-site disposal including composting or burial.
- Contingency plans for things such as mass mortality or loss of contract transporter for rendering.

To the extent that broadly applicable permit terms meet the requirements above for ensuring proper mortality management (including any necessary O&M), additional requirements might

Proper mortality management should preclude improper disposal of animal carcasses as shown above. (Photo courtesy of USDA/MO NRCS)

not be necessary. However, when it is necessary to ensure compliance with the requirements of 40 CFR part 122.42(e)(5), EPA encourages supplementing a broadly applicable term with permit terms that are based on site-specific information that is provided in the NMP. (For approaches on writing the minimum NMP requirements as permit terms, see Section 4.1.7.)

As discussed, in some instances, NRCS practice standards can be included as part of this permit term. Table 5-2 identifies the technical basis for ensuring proper mortality management and the NRCS conservation practice that might address the relevant activity. Where references are made to NRCS standards, permit writers should ensure that necessary O&M actions are also included as permit terms. (See Appendix K, NRCS Conservation Practice Standards.)

Sample broadly applicable permit language

Properly dispose of dead animals within 3 days unless otherwise provided for by the Director. Mortalities must not be disposed of in any liquid manure or process wastewater system that is not specifically designed to treat animal mortalities. Dead animals shall be disposed of in a manner to prevent contamination of waters of the U.S. or creation of a public health hazard.

Table 5-2. EPA minimum practice/NRCS Conservation practice comparison

NPDES NMP minimum practice	Technical basis	Associated NRCS conservation practice standard
Ensure proper management of mortalities	Improper disposal of dead animals can result in contamination of waters of the U.S. Nutrients and other contaminants released from decomposing animals can be transported to waters of the U.S. in runoff.	Animal Mortality Facility - NRCS Practice Code 316

5.4.2. Technical Information on Mortality Management and Disposal

In confined livestock and poultry operations, animals routinely die as a result of disease, injury, or other causes. USDA has determined typical mortality rates at livestock operations. The actual mortality rate at an operation will depend on weather and other variables. The mortality rate will also vary according to the age of the animal. Mortality rates are generally higher in newborn animals. For example, a typical mortality rate for newborn pigs is 10 percent, but for older finishing hogs, it is only 2 percent (USEPA n.d.). Table 5-3 presents typical livestock and poultry mortality rates. The capacity for mortality storage or disposal addressed in the plan should be consistent with those or other values typical for the CAFO's location and operational characteristics.

Table 5-3. Poultry and livestock mortality rates

Poultry type	Average weight (lbs)	Mortality rate (%)			Flock life (days)	Design weight (lbs)
Broiler	4.2	4.5%–5%			42–49	4.5
Layers	4.5	14%			440	4.5
Breeding hens	7–8	10%–12%			440	8
Turkey, females	14	5%–6%			95	14
Turkey, males	24	9%			112	24
Swine growth stage	**Average weight (lbs)**	**Mortality rate (%)**				**Design weight (lbs)**
		Low	**Average**	**High**		
Birth to weaning	6	< 10%	10%–12%	> 12%		10
Nursery	24	< 2%	2%–4%	> 4%		35
Growing-finishing	140	< 2%	2%–4%	> 4%		210
Breeding herd	350	< 2%	2%–5%	> 5%		350
Cattle/horses growth stage	**Average weight (lbs)**	**Mortality rate (%)**				**Design weight, (lbs)**
		Low	**Average**	**High**		
Birth	70–130	< 8%	8–10%	> 12%		130
Weaning	600	< 2%	2%–3%	> 3%		600
Yearling	900	< 1%	1%	> 1%		900
Mature	1,400	< 0.5%	0.5%–1%	> 1%		1,400
Sheep/goats growth stage	**Average weight (lbs)**	**Mortality rate (%)**				**Design weight (lbs)**
		Low	**Average**	**High**		
Birth	8	< 8%	8%–10%	> 10%		10
Lambs	50–80	< 4%	4%–6%	> 6%		80
Mature	170	< 2%	3%–5%	> 8%		170

Source: Ohio State University Extension 1999.

Catastrophic mortality can occur when an epidemic infects and destroys the majority of a herd or flock in a short time or when a natural disaster, such as a flood, blizzard, or tornado, strikes. Catastrophic mortality management plans are typically expected for swine and poultry operations because the animals confined at those operations are more susceptible to disease outbreaks and more sensitive to extreme weather conditions than the animals confined at beef and dairy operations. Heat waves are a particular concern for the broiler industry and are that sector's most common cause of catastrophic mortality.

Animal Mortality Disposal Practices

Historically, dead animals were often taken to a remote area, where the carcasses were allowed to decompose and be eaten by scavengers. The practice is now illegal in virtually the entire United States because it facilitates the spread of disease from one operation to another, and it presents a significant risk of surface and groundwater contamination. Mortality handling should be practiced in accordance with all applicable state and local regulations. CAFOs could also be required to manage mortalities consistent with NRCS Conservation Practice Standard—Animal Mortality Facility (Code 316). The standard establishes the minimum NRCS requirements for the on-farm treatment or disposal of livestock and poultry carcasses. In many cases, state or local laws and ordinances may prohibit the use of specific animal mortality practices, which should be reflected in the plan. Such regulations can often be found at the state department of agriculture or the state or county health department.

Catastrophic cattle mortality as a result of a blizzard. (Source: US EPA)

The number of livestock mortality practices being used in the industry today is limited. The following practices might be commonly encountered in a mortality management plan. For a more detailed discussion on how each of the practices is implemented, see the Livestock and Poultry Environmental Stewardship Program—Lesson 51 - Mortality Management at *http://www.extension.org/pages/8964/livestock-and-poultry-environmental-stewardship-curriculum-lessons.*

- **Rendering**—If rendering is identified in the NMP as the method for addressing animal mortality, the NMP should specify the location on the operation where the dead animals are to be stored for pickup and practices to ensure runoff or leachate from the storage area is managed properly. The location of the rendering facility should be identified, which the permit writer should verify along with the facility's operational status. The pickup schedule should be included. The on-site storage capabilities should be consistent with the schedule.

- **Composting**—If composting is the method identified in an NMP to address animal mortality, the plan should address the following:
  - Frequency with which mortalities are removed from the confinement facilities (typically that should be daily).
  - How precipitation that comes into contact with the compost pile is collected or diverted to prevent a discharge.
  - Operational parameters that should be from a documented source (e.g., USDA, land grant university).

— How compost is stored until it can be applied in accordance with the timing prescribed by the NMP or prepared for sale to others.

- **Incineration—**If incineration is the method identified in the NMP to address animal mortality, all necessary state and local permits should be identified in the plan.
- **Sanitary landfills**—If a sanitary landfill is identified as the method for addressing animal mortality the plan should address the following:
  - — Name and location of the landfill.
  - — Operator of the landfill.
  - — The plan might also have to address specific transportation issues, as some states require special licenses to transport dead animals.

  Additionally, the permit writer should verify whether the landfill accepts dead animals.
- **Burial**—If burial is the method to address animal mortality, review of the plan should include the following:
  - — Documentation of any state and local siting requirements.
  - — An alternative method for addressing mortality when the weather precludes burial (e.g., frozen ground).

  Additionally, the permit writer should verify that burial is allowed by the operation's state and confirm that the location of the burial area is consistent with all siting requirements. If a plan identifies burial as the method for addressing animal mortality, a more comprehensive review of the plan or inspection of the facility should be performed for the purpose of protecting against discharges to groundwater that has a direct hydrologic connection to waters of the U.S. or to verify compliance with other state requirements beyond NPDES if appropriate.
- **Disposal pits**—If a disposal pit is the identified method to address animal mortality, the permit writer should take the following steps:
  - — Verify that the state and locality where the operation is located allow the practice.
  - — If there are state or local siting requirements, confirm that they have been addressed in the NMP.
  - — Determine whether there are any areas of high risk to groundwater and confirm that the disposal pit is not in those areas.

    Additionally, if an NMP identifies disposal pits as the method for addressing animal mortality, a more complete review of the plan or inspection of the facility should be performed to ensure that no groundwater or surface water contamination is taking place.

With proper siting, construction, operation, and management, all those practices can be used without significant risk to water quality. In general, however, rendering and composting when properly implemented would be the most environmentally responsible practices. In addition, those practices allow nutrients to be recycled. Although incineration, sanitary landfills, burial, and disposal pits might be acceptable from a regulatory perspective, the nutrients are generally not recycled, and each carries a greater risk to the environment. Table 5-4 identifies some of the risks posed by those practices.

Table 5-4. Environmental risks of common mortality disposal practices

Practice	Potential environmental risks
Incineration	Incineration can release of particulates and other contaminants to the atmosphere. Ash that remains must be properly handled and disposed of to avoid surface and groundwater contamination.
Sanitary landfills	Disposal in sanitary landfills can result in groundwater contamination if the facility does not have the proper leachate control mechanisms in place.
Burial	Burial can result in groundwater contamination.
Disposal pits	Disposal pits can result in groundwater contamination.

5.5. Clean Water Diversion 40 CFR Part 122.42(e)(1)(iii)

Clean water and floodwaters that come into contact with manure have the potential to contaminate surface water. Clean water must be diverted, as appropriate, from the production area. Any clean water that is not diverted and comes into contact with raw materials, products, or by-products including manure, litter, process wastewater, feed, milk, eggs, or bedding is, by definition, process wastewater and thus is subject to the effluent limitations specified in the permit. Where clean water is not diverted the permittee must document that it will be collected and has been accounted for to ensure adequate storage capacity as a condition of the permit (see Section 5.3.2). Diverting clean water from upslope areas and directing runoff away from the production area can reduce waste volume and storage requirements. In most cases diverting clean water is more cost-effective than providing additional storage capacity. Clean water includes, but is not limited to, rain falling on the roofs of facilities and runoff from adjacent land.

5.5.1. Permit Terms for Clean Water Diversion

To the extent that broadly applicable permit terms meet the requirements above for ensuring that clean water is diverted from the production area (including any necessary O&M), additional requirements may not be necessary. However, when it is necessary to ensure compliance with the requirements of 40 CFR part 122.42(e)(5), EPA encourages supplementing a broadly applicable term with permit terms that are based on site-specific information that is provided in the NMP. (For approaches on writing the minimum NMP requirements as permit terms, see Chapter 4.1.7.)

Water run-off control with the use of a gutter system at a dairy in Tillamook, Oregon. (Photo courtesy of USDA/NRCS)

Site-specific terms would identify and require implementation of conservation practices, BMPs or engineering controls needed to exclude clean water from production areas such as the following:

- The construction and maintenance of perimeter controls (e.g., berms, dikes, or channels).
- Installation of roof runoff management techniques (e.g., gutters, downspouts, above- and below-ground piping).
- O&M procedures required to maintain the identified practices, BMPs or engineering controls. Depending on which practices are identified and used in the NMP site-specific O&M, terms could include the following:
  - Frequency of inspection of stormwater management facilities.
  - Maintenance of berm, dike or channel height.
  - Removal of sediment and vegetation from channels.
  - Cleaning and inspection of roof runoff controls.

Sample broadly applicable permit language

Ensure that clean water is diverted, as appropriate, from the production area. Any clean water that is not diverted and comes into contact with raw materials, products, or by-products including manure, litter, process wastewater, feed, milk, eggs, or bedding is subject to the effluent limitations specified in this permit. Where clean water is not diverted from the production area, the retention structures shall include adequate storage capacity* for the additional clean water. Clean water includes, but is not limited to, rain falling on the roofs of facilities and runoff from adjacent land.

* Specifically addressed in terms for adequate storage capacity

Table 5-5 identifies the technical basis for diversion of clean water and the NRCS conservation practices that could address the relevant activity and could be included as part of this permit term. Where references are made to NRCS standards, permit writers should ensure that necessary O&M actions are also included as permit terms.

Table 5-5. EPA minimum practice/NRCS conservation practice comparison

NPDES NMP minimum practice	Technical basis	Associated NRCS conservation practice standards
Diversion of clean water	Clean water that comes into contact with manure and wastewater has the potential to contaminate waters of the U.S. Water that is not diverted is to be collected and properly handled and stored.	Diversion - NRCS Practice Standard Code 362 Roof Runoff Structure - NRCS Practice Standard Code 558

5.6. Prevention of Direct Animal Contact with Waters of the U.S. 40 CFR Part 122.42(e)(1)(iv)

BMPs must be in place to prevent the direct contact of animals confined or stabled at the facility with waters of the U.S. in the production area. The NMP must describe how the operator will prevent animals in the production area from coming into direct contact with waters of the U.S., including standing in, crossing, or drinking from such waters.

5.6.1. Permit Terms for Prevention of Direct Animal Contact with Waters of the U.S.

To the extent that broadly applicable permit terms meet the requirements above for ensuring that animals do not have direct contact with waters of the U.S. while in the production area (including any necessary O&M), additional requirements may not be necessary. However, when it is necessary to ensure compliance with the requirements of 40 CFR part 122.42(e)(5), EPA encourages supplementing a broadly applicable term with permit terms that are based on site-specific information that is provided in the NMP. For example, if fencing is used in the production area to prevent confined animals from contacting a water of the U.S., the practice, fencing, the location and any necessary O&M for the fencing could also be included as part of the site-specific permit term. For approaches on writing the minimum NMP requirements as permit terms, see Section 4.1.7.

Sample broadly applicable permit language

Animals confined at the CAFO must not come into direct contact with waters of the U.S.

Table 5-6 identifies the technical basis for preventing animals from directly contacting waters of the U.S. and the NRCS conservation practice standards that might address the relevant activity and could be included as part of this permit term. If a reference to an NRCS practice standard is used, the permit writer should ensure that necessary required O&M requirements are also included as permit terms. Appendix K, NRCS Conservation Practice Standards, includes descriptions of the conservation practice standards.

Table 5-6. EPA minimum practice/NRCS conservation practice comparison

NPDES NMP minimum practice	Technical basis	Associated NRCS conservation practice standards
Prevention of direct contact of animals with waters of the U.S.	The installation of fences, barriers, or other control devices in the production area to prevent animals from entering waters of the U.S. reduces erosion and prevents the direct deposition of manure into waters of the U.S.	Fence - NRCS Practice Standard Code 382 Access Control - NRCS Practice Standard Code 472

5.7. Chemical Disposal 40 CFR Part 122.42(e)(1)(v)

BMPs must be in place to ensure that chemicals and other contaminants handled on-site are not disposed of in any manure or stormwater storage or treatment system unless specifically designed to treat such chemicals or contaminants. CAFOs commonly use chemicals including pesticides, hazardous and toxic chemicals, and petroleum products/by-products. Pesticides and other agrichemicals are often used in agricultural production. However, when used or disposed of improperly or indiscriminately, they can create a hazard and be harmful to water and land resources, people, and animals.

Disposing of chemicals. (Photo courtesy of USDA/NRCS)

5.7.1. Permit Terms for Chemical Disposal

To the extent that broadly applicable permit terms meet the requirements above for ensuring that chemicals are properly contained (including any necessary O&M), additional requirements might not be necessary. However, when it is necessary to ensure compliance with the requirements of 40 CFR part 122.42(e)(5), EPA encourages supplementing a broadly applicable term with permit terms that are based on site-specific information that is provided in the NMP, particularly in circumstances where large quantities of chemicals or particularly toxic or dangerous chemicals are used on-site. For approaches on writing the minimum NMP requirements as permit terms, see Chapter 4.1.7. A list of provisions that an operator can follow is presented in Table 5-7, which could be incorporated into the permit as a site-specific term. The permit writer should place additional restrictions in the permit where necessary.

Table 5-7. Example NMP provisions for chemical handling and disposal

All chemicals are stored in proper containers. Expired chemicals and empty containers are properly disposed of in accordance with state and federal regulations. Pesticides and associated refuse are disposed of in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) label.
Chemical storage areas are self-contained with no drains or other pathways that will allow spilled chemicals to exit the storage area.
Chemical storage areas are covered to prevent chemical contact with rain or snow.
Emergency procedures and equipment are in place to contain and clean up chemical spills.
Chemical handling and equipment wash areas are designed and constructed to prevent contamination of surface waters, wastewater, and stormwater storage and treatment systems.
All chemicals are custom applied, and no chemicals are stored at the operation. Equipment wash areas are designed and constructed to prevent contamination of surface waters, wastewater, and stormwater storage and treatment systems.

Sample broadly applicable permit language

Ensure that chemicals and other contaminants handled on-site are not disposed of in any manure, litter, process wastewater, or stormwater storage or treatment system unless specifically designed to treat such chemicals or contaminants. All wastes from dipping vats, pest and parasite control units, and other facilities used for managing potentially hazardous or toxic chemicals must be handled and disposed of in a manner sufficient to prevent pollutants from entering the manure, litter, or process wastewater retention structures or waters of the U.S.

Other, non-NPDES, requirements might also apply to chemical handling and disposal at CAFOs, including the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Under FIFRA, pesticide labels contain information on requirements for proper chemical disposal. In addition, some CAFOs could be required to develop Spill Prevention, Control and Countermeasure (SPCC) plans for oil spill prevention, preparedness, and response. Such requirements might or might not be included in a CAFO's NMP; however, the term for chemical disposal does not include spill response or prevention plans. Additionally, certain chemicals will enter the waste stream during the normal course of operation at a CAFO, such as disinfectants used to wash milking parlors or animals (e.g., foot baths), and this permit term is not intended to prohibit such practices. Rather, it is to prohibit the dumping and disposal of chemicals in the wastewater retention structures.

Table 5-8 identifies the technical basis for proper chemical disposal and the NRCS conservation practice standards that might address the relevant activity and could be included as part of this permit term. If a reference to an NRCS practice standard is used, permit writers should ensure that necessary O&M actions are also included as permit terms. Appendix K, NRCS Conservation Practice Standards, includes descriptions of the conservation practice standards.

Table 5-8. EPA minimum practice/NRCS conservation practice comparison

NPDES NMP minimum practice	Technical basis	Associated NRCS conservation practice standards
Chemical handling	The improper handling, storage, or disposal of chemicals at the CAFO can result in their inappropriate introduction into the manure, litter, or process wastewater handling and storage system. The land application or accidental release of manure and wastewater can result in contamination of waters of the U.S. Proper handling practices incorporated into the NMP demonstrate that the CAFO is taking the necessary actions to prevent contamination and protect water resources.	Agrichemical Handling Facility - NRCS Practice Standard Code 309 Also, chemical handling is addressed in the O&M section of the Nutrient Management (Code 590) practice standard.

5.7.2. Technical Information on Chemical Disposal

Improper chemical storage and handling presents a high potential risk for polluting surface water and groundwater, and it creates potential for chemicals to enter and contaminate manure wastewater storage structures. Chemicals that enter manure, litter, and wastewater storage structures can enter surface waters during land application of the manure and wastewater or during spills or other accidental releases. Furthermore, introduction of some types of chemicals could interfere with treatment processes in certain lagoon systems.

A CAFO's NMP must incorporate specific actions to be taken to prevent the improper introduction of chemicals and other contaminants into manure and wastewater storage structures or treatment systems unless specifically designed to treat such chemicals and other contaminants. All wastes from dipping vats, pest and parasite control units, fuels and other petroleum products, pharmaceuticals, and facilities used to manage other potentially hazardous or toxic chemicals should be handled and disposed of in a manner sufficient to prevent pollutants from entering the wastewater retention structures or waters of the U.S. Although the NMP requirement addresses only the disposal of chemicals, EPA encourages CAFOs to minimize the use of potentially harmful chemicals and contaminants and to address in their NMPs all areas where chemicals are stored, mixed, and loaded as well as disposal of empty chemical containers to ensure that wastes and runoff are controlled. Chemical handling plans should consider protection of wells, water supplies, and drainage ways that might be in or close to chemical storage and handling areas.

5.8. Site-Specific Conservation Practices 40 CFR Part 122.42(e)(1)(vi)

All permitted CAFOs must implement appropriate site-specific conservation practices to control and minimize the runoff of nitrogen and phosphorus to waters of the U.S. For permitted Large CAFOs (except horse, sheep, and duck CAFOs), the ELG specifically requires implementation of land application setbacks or alternative practices as described below. The CAFO regulations also require all permitted CAFOs to include in their NMPs any additional conservation practices that are necessary to control nutrient runoff.

Restored riparian forest buffers provide protection from manure nutrients running off into ponds and the downstream watershed. (Photo courtesy of USDA/ARS)

In addition to the required setback(s) or buffer(s), the NMP may identify practices that are implemented for purposes other than controlling nutrient runoff. That could include anaerobic digesters (code 366) heavy use area protection (code 561), or livestock shade structures (code 717), to name a few. To ensure that those practices are not identified as permit terms for site-specific conservation practices, NMPs should clearly identify which conservation practices are included for the purpose of controlling nutrient runoff to surface waters.

To the extent that conservation practices that are implemented by a CAFO are necessary to ensure proper implementation of other practices identified in 40 CFR part 122.42(e)(1), those practices constitute a term of the NMP. That would include, for example, practices necessary to ensure adequate storage or to satisfy protocols for land application.

5.8.1. Permit Terms for Conservation Practices

While it is common for a number of conservation practices to be included in an NMP, Large CAFOs (except horse, sheep, and duck CAFOs) must (at a minimum) implement the 100-foot setback or the 35-foot vegetated buffer required by the ELG, or demonstrate that the setback or the 35-foot vegetated buffer is not necessary because of the implementation of an alternative practice. Those ELG requirements are described in more detail, in Section 5.8.2, below. Large CAFOs must include that practice in the NMP because it is a necessary term of the permit required to meet 40 CFR part 122.42(e)(1)(vi). While the 100-foot setback, 35-foot buffer, or other alternative is required only of Large dairy, beef, poultry, swine, and veal calf CAFOs, it might be a helpful starting point for the permit writer when determining appropriate BPJ conservation practice limits for Small and Medium CAFOs and horse, sheep, and duck CAFOs. The requirement for conservation practices at 40 CFR part 122.42(e)(1)(viii) specifically identifies setbacks and buffers as conservation practices that are expected be included in an NMP. In addition to not applying manure in the required setback, CAFOs should also not apply manure in the following areas or under the following conditions:

- Near or in wetlands, riparian buffer areas, water resources, wells, drinking water supplies, high slope areas, and high erosion areas.
- Within concentrated water flow areas (vegetated or non-vegetated) 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.

The permit authority may include these types of requirements as technology-based standards.

Any other conservation practice included in the NMP should be identified as a site-specific permit term if the practice is necessary to meet any of the requirements associated with 40 CFR part 122.42(e)(1) or if the practice influences the *outcome of the field-specific risk assessment of the potential for nitrogen and phosphorus transport from each field* and, consequently, the application rate (for a detailed discussion on the *outcome of the field-specific risk assessment of the potential for nitrogen and phosphorus transport from each field,* see Chapter 6.5.1). If the NMP includes other conservation practices that do not control the risk of nutrient runoff and do not affect nutrient runoff, permit writers should not include those conservation practices as a term of the permit. In general, non-nutrient control practices should be considered enhancements, rather than provisions required for compliance with the applicable regulations, unless they actually do affect nutrient runoff. Conversely, such practices should not be allowed if they impermissibly facilitate runoff that is not accounted for in the NMP. Other types of conservation practices that might be included in a CAFO's NMP are discussed in Section 5.8.3 below.

Site-specific permit terms for this requirement should include the identification of the specific practice(s) that are used and the location in the production area and/or land application area (as identified in the NMP map(s) or other sources) where the conservation practice(s) are implemented to control nutrient runoff. Where applicable, O&M should also be included as part of the site-specific terms. Specific O&M procedures are often required for a practice to function efficiently throughout its expected life span. NRCS conservation practice standards may include specific O&M requirements for certain practices. For example, O&M requirements for filter strips (code 393) include harvesting, weed control, inspection and repair after storm events, and other procedures to maintain species composition, stand density, and functionality of the filter strip. Where the NRCS standard does not include specific O&M requirements, the permit writer should add these as permit terms where appropriate to do so.

Permit writers should also be aware of the expected life span of conservation practices that are incorporated as site-specific terms to ensure that the critical nutrient control practices remain functional and effective. Table 5-9 shows the practice life span, established by NRCS at a national level, for conservation practices that permit writers are likely to encounter in NMPs. A conservation practice life span is the minimum time (in years) the implemented practice is expected to be fully functional for its intended purpose(s). The established conservation practice life spans are based on following an O&M plan developed for the practice making it a critical part of the permit term. A one-year application life span is established for those management type conservation practices, where practices are reapplied (other than normal O&M) annually or more than one time on the same land to achieve its purpose(s). Each state can establish practice life spans for its state-specific conservation practice standards.

Table 5-9. Life spans for selected NRCS conservation practice standards

Conservation practice	Code	Life span (years)
Conservation Crop Rotation	328	1
Contour Buffer Strip	332	5
Cover Crop	340	1
Filter Strip	393	10
Grassed Waterway	412	10
Irrigation Water Management	449	1
Residue and Tillage Management	329 345 346	1
Riparian Forest Buffer	346	15
Stripcropping	585	5
Terrace	600	10

Source: NRCS eDirectives, National Bulletin 450-9-8, July 28, 2009.
http://policy.nrcs.usda.gov/viewerFS.aspx?hid=25215

While some elements of conversation practices can be broadly applicable to all facilities, such as the requirements of the ELG, EPA believes that some elements need to be site-specific to fully meet the requirements of 40 CFR part 122.42(e)(5). That is particularly true given the importance that many conservation practices play in determining the outcome of the risk assessment and therefore the amount of nutrients that are to be land applied. For approaches on writing the minimum NMP requirements as permit terms, see Chapter 4.1.5.

Table 5-10 identifies the technical basis for conservation practices to control nutrient runoff and the NRCS conservation practice standards that might address the relevant activity and could be included as part of this permit term. If a reference to an NRCS practice standard is used, permit writers should ensure that necessary O&M actions are also included as permit terms. Appendix K, NRCS Conservation Practice Standards, includes descriptions of those and other related conservation practices.

Table 5-10. EPA minimum practice/NRCS conservation practice comparison

NPDES NMP minimum practice	Technical basis	Associated NRCS conservation practice standards
Site-specific conservation practices	The implementation of conservation practices reduces the velocity of runoff, traps sediment, absorbs nutrients and promotes infiltration of runoff to prevent it from entering waters of the U.S.	Conservation Crop Rotation – NRCS Practice Standard Code 328 Contour Buffer Strips – NRCS Practice Standard Code 332 Cover Crop – NRCS Practice Standard Code 340 Filter Strip – NRCS Practice Standard Code 393 Grassed Waterway – NRCS Practice Standard Code 412 Irrigation Water Management – NRCS Practice Standard Code 449 Residue and Tillage Management – NRCS Practice Standard Codes 329, 345, 346 Riparian Forest Buffer – NRCS Practice Standard Code 391 Stripcropping – NRCS Practice Standard Code 585 Terrace – NRCS Practice Standard Code 600

5.8.2. Required Land Application Setback and Alternatives for Large CAFOs 40 CFR Part 412.4(c)(5)

At a minimum, the ELG prohibits Large dairy, beef, poultry, swine, and veal calf CAFOs from applying manure, litter, or process wastewater closer than 100 feet to any downgradient surface water, open tile line intake structure, sinkhole, agricultural well head, or other conduit to surface waters except as allowed by the two alternatives discussed below. A setback is an area where manure, litter or process wastewater is not applied, but crops can continue to be grown. A setback reduces pollution by increasing the distance pollutants in land-applied manure, litter or process wastewater has to travel to reach surface water bodies. CAFOs can apply commercial fertilizer in the setback zone, and can grow crops in the setback zone, but CAFOs are encouraged not to apply any form of nutrients this close to surface waters and to implement conservation practices in these areas.

CAFOs can use two alternatives to the 100-foot setback requirement in the ELG. First, the CAFO can establish a 35-foot-wide vegetated buffer between the land application site and waters of the U.S. Second, the CAFO can demonstrate that the setback or the 35-foot vegetated buffer is not necessary because of implementing an alternative practice. Each of those alternatives is described below.

States can require implementation of other setbacks, such as from property lines, homes, surface waters, wells, road rights-of-way, and public use areas. Those setbacks would also be included in a CAFO's NMP; however, it would be up to the permit writer as to whether such setbacks are included as part of the permit term for this requirement.

Setbacks that include multiple rows of trees and shrubs, a grass strip, combined with terraces protect Bear Creek in Story County, Iowa. (Photo courtesy of USDA/NRCS)

35-Foot Vegetated Buffer

A vegetated buffer is a permanent strip of dense, perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the land application field. NRCS standards such as practice code 393 (Filter Strip) recommend appropriate species for cover, generally native species. If the native species include hay or alfalfa, CAFOs can choose such species in the vegetated buffer; however, for the area to continue to be considered vegetated, CAFOs should not harvest it. The purpose of a vegetated buffer is to slow the runoff from a land application site, enhance the filtration of the runoff, and minimize the risk of nutrients and other pollutants leaving the land application site and reaching surface waters. CAFOs may not grow crops in the buffer or apply manure, litter, or process wastewater to the buffer. NRCS standards recommend appropriate maintenance of the buffer, such as periodic sediment removal, nutrient removal, and vegetation trimming.

Demonstration That the Setback is Not Necessary

CAFOs can demonstrate that the setback is not necessary because it is implementing alternative conservation practices or field-specific conditions. If an alternative practice for compliance with the 100-foot setback is proposed, aside from the 35-foot vegetated buffer, it should be identified in the NMP, and the CAFO must demonstrate in its permit application or NOI that the alternative is equivalent to the 100-foot setback. Pollutant reductions of nitrogen, phosphorus, five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) equal to or greater than the reductions achieved by the 100-foot setback should be demonstrated. It is the CAFO that must ultimately make the demonstration, even if the CAFO uses information generated by others. The regulations do not prescribe how the CAFO should make the demonstration; however, in general, CAFOs should not be allowed to use a setback less than 100 feet or a buffer smaller than 35 feet without implementing some additional controls. A smaller setback or buffer implemented without additional controls, or the total absence of any setback or buffer, might be insufficient to meet the requirement in 40 CFR part 122.42(e)(1)(vi) to "control runoff of pollutants to waters of the United States."

CAFOs should not assume that meeting state BMP requirements or implementing commonly used conservation practices will always meet the demonstration requirement. For example, incorporation (i.e., tilling the manure into the soil) allows nutrients to make immediate contact with soil particles and therefore minimizes certain nutrient losses. Specifically, incorporation can reduce dissolved phosphorus runoff from manure nutrients versus allowing manure nutrients to remain on the surface. However, incorporation increases erosion and, therefore, increases particulate phosphorus losses. A 100-foot setback controls nutrient losses in many forms. The demonstration of equivalency for any proposed alternative must show that the alternative does the same. At a minimum the pollutant reductions should address the runoff, leaching and erosion of nutrients (nitrogen and phosphorus), BOD_5, and solids.

In some cases, a state could develop a list of alternative conservation practices that have been evaluated and demonstrated to provide pollutant reductions better than the 100-foot setback. CAFOs should check to see whether their permitting authority has collected data and information that could be used to demonstrate that certain conservation practices provide pollutant reductions equivalent to or better than the reductions that would be achieved by the 100-foot setback. A state could also provide CAFOs with information or could specify suitable methods to facilitate the CAFO's demonstration.

5.8.3. Additional Conservation Practices Identified in the NMP

In addition to the required 100-foot setback (or compliance alternative) for Large dairy, beef, poultry, swine, and veal calf CAFOs, other conservation practices that are necessary to minimize the runoff of nitrogen and phosphorus to waters of the U.S. from any CAFO could be identified as a term of the NMP. In general, any practices on which the CAFO relies for its nutrient transport risk assessment should be included in the NMP. For example, practices that ensure adequate erosion control will help control sediment-bound nutrient transport to surface waters. Soil erosion is typically a factor used to calculate the P-Index, a common nutrient transport risk assessment tool. Therefore, the elimination of any conservation practices that control erosion losses might change a CAFO's field-specific risk assessment and thereby affect the amount of additional manure that can be land applied. The use of residue management, such as no-till or mulch-till, is another example of a practice that might affect the outcome of a CAFO's nutrient transport risk assessment. Such practices minimize soil surface disturbances and, therefore, help to control erosional nutrient losses. For

Conservation filter strips are a popular practice for Illinois farmers. The strips help to keep soil and nutrients out of creeks and streams and provide quality habitat for many species of wildlife. (Photo courtesy of USDA/NRCS)

that reason, residue management is also considered a key characteristic of many P-Indices and is inextricably linked to other aspects of the NMP, specifically the risk assessment and, thereby, rates of application. Therefore, such types of practices should also be included as part of the site-specific conservation practice permit term.

NRCS staff and landowner measuring residue. (Photo courtesy of USDA/NRCS)

5.9. Manure and Soil Testing Protocols 40 CFR Part 122.42(e)(1)(vii)

The NMP must identify protocols for appropriate testing of manure and soil. Testing protocols for all CAFOs should address the sampling procedures, appropriate methods of analysis, and the required testing frequency. Large dairy, beef, swine, poultry, and veal calf CAFOs are required by the ELG to analyze manure at least once annually for nitrogen and phosphorus. Soil must be analyzed at least once every 5 years for phosphorus. 40 CFR § 412.4(c)(3).

All CAFOs must use the results of the most recent representative manure, litter, and process wastewater test for nitrogen and phosphorus taken within 12 months of the date of land application when calculating the maximum amount of manure, litter, and process wastewater to be land applied each year. 40 CFR §§ 122.42(e)(5)(i)(B), 122.42(e)(5)(ii)(D)(2). The CAFO operator may use a 5-year manure analysis average as long as the average includes a manure analysis taken within the past 12 months. Any CAFO using the narrative rate approach for calculating maximum amounts of manure, litter, or process wastewater to be land applied must also rely on the results of the most recent phosphorus soil testing requirements that are in accordance with the Director-approved protocols. 40 CFR § 122.42(e)(5)(ii)(D)(1).

5.9.1. Permit Terms for Protocols for Manure and Soil Testing

To the extent that broadly applicable permit terms meet the requirements above for identifying protocols for appropriate testing of manure and soil, additional requirements might not be necessary. Adequate technical standards should identify the necessary protocols for sampling and analyzing both manure and soil. That could include the laboratories that are to be used (e.g., laboratories listed with the Manure Testing Laboratory Certification Program (MTLCP) or those that meet the requirements of the North American Proficiency Testing Program (NAPT) for soil analyses), how samples should be collected (described in Section 5.9.2 below), and which analyses (e.g. Mehlich I, Mehlich III, Olsen, Bray, or other appropriate extractions for soil samples) are to be used. A broadly applicable permit term could require following those protocols that are established in the state Director identified technical standards.

A site-specific component is not always necessary for this permit term as long as sufficient details are included in the broadly applicable terms of the permit (or technical standards when the technical standard is used as a broadly applicable term). However, site-specific measures may be included as part of the permit term if specific information is included in the NMP that the permit writer deems necessary to ensure compliance with the regulatory requirement.

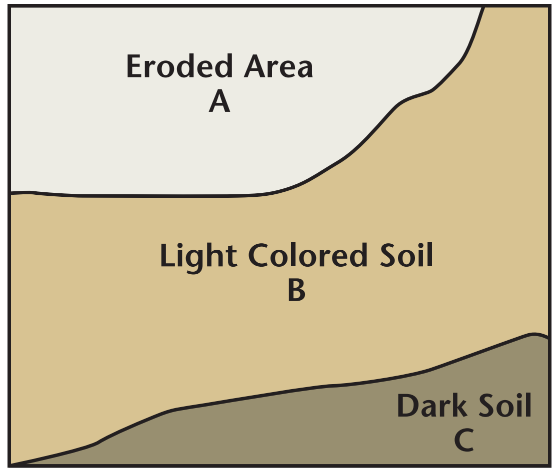

Figure 5-3. Sampling soil by type or condition. Within each field, collect a separate sample from each area that has a different type of soil or different management history.

No NRCS conservation practices address the relevant activity and could be included as part of this permit term because protocols are generally developed by each state in conjunction with land grant universities. However, it is ultimately the Director's determination as to what is required in the technical standards.

Sample broadly applicable permit language

Manure must be analyzed at least once annually for nitrogen and phosphorus content. Soil must be analyzed at least once every 5 years for phosphorus content. Protocols for sampling and analyzing the sample established in the technical standards must be followed. The results of those analyses must be used in determining application rates for manure, litter, and process wastewater.

5.9.2. Technical information for Protocols for Manure and Soil Testing

The following section provides an overview of sampling methods for manure and soil analysis. Where similar information is identified in the NMP, the information can be included as part of the permit term for identifying appropriate protocols for the manure and soil sampling.

Manure Test Protocols

Taking samples that are representative of the manure that will be land applied is critical to obtaining an accurate manure analysis. How the manure samples are collected, the specific number of samples and subsamples taken, what the samples are analyzed for, and approved laboratories or methods that are to be used to perform the analyses are all a part of the protocols for manure testing and should be identified in the technical standard for nutrient management

(Section 6.3.1). The permit writer should verify that the methods for manure analysis in the NMP are consistent with protocols identified by the applicable nutrient management technical standards.

Manure Sampling

Proper sampling is the key to obtaining reliable manure analysis results. Accurate laboratory procedures have little value if the sample fails to represent the manure that is to be land applied. This section provides a brief overview of the methods employed for different types of manure samples. Permit writers will not generally be collecting actual samples, so this section is provided for informational purposes only. However, enforcement actions might require sample collection, and inspectors could also be collecting samples.

Manure samples submitted to a laboratory should represent the average composition of the material that will be applied to the field. Reliable samples typically consist of material collected from multiple locations within a storage structure. Typically, the subsamples from different locations in a storage structure are mixed well, and a single sample is removed from the composite for analysis. Representative sampling methods vary according to the type of manure. It is important that proper containers are used and maximum holding or shipping times are also identified and followed to avoid contaminating or altering the collected samples. General sampling recommendations follow. It is always best to check with the laboratory that will analyze the samples to know how to best prepare and ship samples and when the laboratory is willing to receive them.

Liquid manure

Liquid manure samples submitted for analysis are generally placed in a sealed, clean plastic container with about a one-pint volume. Glass is not suitable because it is breakable and could contain contaminants. At least 1 inch of air space is generally left in the plastic container to allow for expansion caused by the release of gas from the manure material. Samples that cannot be shipped on the day they are collected should be refrigerated or frozen to minimize chemical reactions and pressure buildup from gases. Ideally, liquid manure should be sampled after it is thoroughly mixed, but because that is sometimes impractical, samples can also be taken in accordance with the suggestions that follow.

Water samples from filtration lagoon. (Photo courtesy of USDA/NRCS)

Liquid storage effluent

Premixing the surface liquid in the liquid storage is not needed, provided it is the only component that is being pumped. Growers with multistage systems should draw samples from the liquid storage they intend to pump for crop irrigation. Samples should be collected using a clean, plastic container. One pint of material should be taken from at least eight sites around the lagoon and then mixed in a larger clean, plastic container. Effluent should be collected at least 6 feet from the lagoon's edge at a depth of about one foot. Shallower samples from anaerobic lagoons might be less representative than deep samples because oxygen transfer near the surface sometimes alters the chemistry of the solution. Floating debris and scum should be avoided. One pint of mixed material should be sent to the laboratory. Galvanized containers should not be used for collection, mixing, or storage because of the risk of contamination from metals (e.g., zinc) in the container.

Liquid slurry

Manure materials applied as a slurry from a pit or storage pond should be mixed before sampling. Manure should be collected from several areas (approximately 8) around the pit or pond and mixed thoroughly in a clean plastic container. An 8- to 10-foot section of 0.5- to 0.75-inch plastic pipe can also be used to collect a representative sample by extending the pipe into the manure, pressing a thumb over the end of the pipe to form an air lock, removing the pipe from the manure, and releasing the air lock to deposit the manure in the plastic container.

Lagoon sludge

It is somewhat more difficult to obtain a representative sample of lagoon sludge. Two common methods are used. One method requires pumping the lagoon down to the sludge layers. Then, during sludge agitation, a liquid or slurry type of sample described above can be collected. The other method requires inserting a probe to the bottom of the lagoon to obtain a column of material. A *sludge-judge* is a device commonly used for such sampling. The sludge component of the column is released into a clean plastic bucket, and samples are likewise collected from several (12 to 20) other sampling points around the lagoon to obtain a composite, representative sample. That procedure should be performed with a boat or mobile floating dock. For analysis, most laboratories require at least one pint of material in a plastic container. The sample should not be rinsed into the container because doing so dilutes the mixture and distorts nutrient evaluations. However, if water is typically added to the manure before land application, a proportionate quantity of water should be added to the sample.

Solid manure

Solid manure samples should represent the manure's average moisture content. A one-quart sample is typically adequate for an analysis. Samples are generally taken from several different areas (approximately eight) in the manure pile, placed in a clean plastic container, and thoroughly mixed. Approximately one quart of the mixed sample should be placed in a plastic bag, sealed, and shipped directly to the laboratory. Samples stored for more than 2 days should be refrigerated.

Sampling within dry litter houses

Litter can be sampled in production houses before litter cleanouts, but one must take care to collect a representative sample. Ten to fifteen small samples are typically collected from each house and placed in a clean plastic bucket. Samples should be taken to the depth of cleanout, being careful not to dig into the dirt floor. Cake litter samples should be taken at the depth of cake removal. Litter samples from brooder breeder slat houses should be taken after the slat manure and litter are mixed during the cleanout process. Material that will be applied to the field should be sampled (e.g., cake out results should not be used to represent total cleanout). Samples should be thoroughly mixed in the bucket. Approximately one quart of material should be placed in a plastic freezer bag or wide-mouth plastic bottle before submitting for analysis.

Poultry below-house manure sampling

In a high-rise system, manure is deposited below the poultry house. If the system is properly managed, the manure should be fairly uniform in moisture and appearance. Several (approximately eight) samples should be collected throughout the storage area. If manure in certain areas differs in appearance, 10 percent of the manure samples should be taken from an area that is different from the bulk of the pile. The collected material should be combined in a plastic container and mixed thoroughly. The one-quart laboratory sample should be taken from the mixture, placed in a plastic bag, sealed, and shipped to the laboratory for analysis. If the sample cannot be shipped within one day of sampling, it should be refrigerated.

Stockpiled manure or litter

Ideally, stockpiled manure and litter should be stored under cover on an impervious surface. The weathered exterior of uncovered waste might not accurately represent the majority of the material. Rainfall generally moves water-soluble nutrients down into the pile. If an unprotected stockpile is used over an extended period, it should be sampled before each field application. Stockpiled manure should be sampled at a depth of at least 18 inches at six or more locations. The collected material should be combined in a plastic container and mixed thoroughly. The one-quart laboratory sample should be taken from the mixture, placed in a plastic bag, sealed, and shipped to the laboratory for analysis. If the sample cannot be shipped within one day of sampling, it should be refrigerated.

Surface-scraped manure

Surface-scraped and piled materials should be treated like stockpiled manure, using the same procedures for taking samples. Ideally, surface-scraped materials should be protected from the weather unless they are used immediately.

Fresh manure samples collected at a swine facility near Peoria, Illinois. (Photo courtesy of USDA/ARS)

Composted manure

Ideally, composted manure should be stored under cover on an impervious surface. Although nutrients are somewhat stabilized in such materials, some nutrients can leach out during rains. When compost is left unprotected, samples should be submitted to the laboratory each time the material is applied to fields. Sampling procedures are the same as those described for stockpiled waste.

Manure Analysis[2]

Both public and private laboratories analyze manure samples. Public laboratories generally operate in conjunction with either a state land grant university or a state agricultural or environmental agency. Private laboratories can be found through local Cooperative Extension Service agents, the land grant university, state regulators, or other producers. State technical standards should identify state-approved laboratories or laboratory procedures or both to properly analyze manure. The permit writer should ensure that any laboratory used by an operator and identified in a CAFO's NMP has been selected in accordance with the state's technical standards.

Manure analysis results can be presented in a number of ways. The most common way is wet, *as-is* basis in pounds of nutrient (nitrogen or phosphorus) per ton; pounds per 1,000 gallons of manure or wastewater; or pounds per acre-inch of manure or wastewater. If a laboratory reports results on a dry basis, the moisture content of the manure must be known to convert the results back to a wet basis. A laboratory might also give results as a concentration (parts per million [ppm], percent (%), or milligram per liter [mg/L]), which likewise requires conversion factors to get the results into a usable form according to how the manure will be applied. Finally, if a laboratory reports phosphorus as elemental phosphorus, it must be converted to the fertilizer basis of P_2O_5. That can be done with the following conversion:

$$P \times 2.29 = P_2O_5$$

What Forms of Nutrients Should Be Tested?

At a minimum, CAFOs should test for total Kjeldahl nitrogen (TKN), ammonia, total phosphorus, and soluble phosphorus.

Organic forms of nitrogen are converted to inorganic forms of nitrogen during a process called mineralization. The inorganic forms of nitrogen are used by plants. Inorganic nitrogen, such as ammonium N (NH_4^+), is usually attached to soil particles until used by the plants. In contrast, the nitrate form (NO_3^-) is highly susceptible to leaching and can leach before used by the plant.

Adsorbed phosphorus is considered unavailable for plant growth. Erosion and runoff are common ways in which adsorbed phosphorus can transport off-site and contaminate surface water. In contrast, highly permeable soils, low pH, and low organic matter allow phosphorus to leach.

Nitrogen is typically reported as total Kjeldahl nitrogen (TKN), ammonium N (NH_4^-N), and sometimes nitrate-nitrogen (NO_3^-N). TKN is the concentration of ammonium and organic nitrogen. NH_4^-N and NO_3^-N are directly provided by the manure analysis and are both plant available fractions of nitrogen (for information on plant-available nutrients, see Appendix A, Basic Soil Science and Soil Fertility). A fraction of the organic nitrogen will become rapidly plant available when land applied, and additional nitrogen will become available over the course of the following few years. Such a release of plant available nitrogen occurs through mineralization, which must be accounted for when calculating land application rates. From the manure analysis, organic nitrogen can be calculated as the difference between the TKN and NH_4^-N.

NH_4^-N is subject to volatilization losses. Significant volatilization losses can occur during manure storage; therefore, the manure analysis should take place as close to the time of application as possible to accurately assess the nutrient content just before field application.

Calculating the Dry Weight of Nitrogen in Manure

The CAFOs most recent manure sample analysis indicates that the nitrogen content in lb/ton wet weight is 3.3, and the moisture content is 33 percent. To calculate the amount of nitrogen in lb/ton dry weight, the CAFO uses the following equation:

Concentration N dry basis = Concentration N wet basis × (100 G % moisture content)

= 3.3 lb/ton × (100 G 33%)

= 2.2 lb/ton

NO_3^-N is not always reported in a manure analysis. Nitrate becomes available from the oxidation of ammonium (nitrification). Manure on many animal operations is stored in an anaerobic environment, and for those operations, measures of NO_3^-N are negligible. However, if manure is stored in an aerobic lagoon or sampled from a compost source, an NO_3^-N analysis should be requested.

Reports of analysis on an *as-is* basis should be in the units of measure and nutrient forms most useful to an operation for nutrient planning purposes. The most useful nutrient form reported in a manure analysis is predicted nutrients available for the first crop in a planned crop rotation. First year nutrient availability is predicted on the basis of estimates of manure breakdown and nutrient loss because of application method.

To meet a specific plant nutrient requirement, nutrients listed in the report or calculated as *available for the first crop* should be used in determining the actual application rate. For the availability prediction to be reliable, the person who collected the sample should have properly identified the type of manure and the application method on the information sheet submitted to the laboratory. All information required by the laboratory must be reported for the laboratory to do the appropriate analysis. Sampling and shipping procedures must be followed for the results to be accurate. It is important to understand that nutrient availability cannot be determined with 100 percent accuracy. Many variables, including the type of manure and environmental factors (e.g., soil type, rainfall, temperature, and general soil conditions) influence the breakdown of manure and nutrient loss.

A Sample Manure Analysis. A laboratory will generally provide findings in concentration and as a wet basis. Concentration is reported in the percent or ppm of specific constituents, while wet basis is reported in pounds per ton, pounds per 1,000 gallons of manure/wastewater, or pounds per acre-inch manure/wastewater for specific constituents. Below is an example of a typical analysis report.

Sample Manure Results

Requestor/Location: John Doe – Utopia County, USA
Lab Identification: CAFO University Lab
Sample No.: XXXXXX
Manure Type: Beef Cattle **Date:** xx/xx/xx

Results										
N %	NH_4-N %	P_2O_5 %	K_20 %	Ca %	Mg %	S %	Mn ppm	Zn ppm	Cu ppm	Moisture %
0.99	0.06	0.51	0.79	0.43	0.22	0.16	33.3	30.8	7.3	69.5

Nutrient Content Lbs/ton											
N	NH_4-N	P_2O_5	K_20	Ca	Mg	S	Mn	Zn	Cu	Available N	
										Incorp.	Not Incorp.
19.76	1.21	10.13	15.74	8.54	4.42	3.10	0.07	0.06	0.02	7.70	6.49

Soil Test Protocols

Crop nutrient requirements vary depending on factors such as soil characteristics and previous fertilization. Soil testing is used to provide agronomic and environmentally sound nutrient and lime recommendations. It provides growers a means to assess soil pH and plant-available nutrient content, to determine the need for addition of lime and nutrients, and to minimize nutrient losses to the environment from over-application.

Soil sampling - collection of a soil core. (Photo courtesy of USDA/MO NRCS)

Good animal manure management includes routine soil sampling on every field on which manure is applied. EPA generally considers soil sampling for phosphorus every 5 years as the minimum necessary to properly manage soil nutrient levels (as is required for Large dairy, beef, poultry, swine, and veal calf CAFOs under the ELG. 40 CFR § 412.4(c)(3). States should consider more frequent testing, especially for operators who are implementing nitrogen-based NMPs.

Soil Sampling

Proper sampling is the most important component of an accurate soil test. If a representative sample is not collected, the recommendations developed by the laboratory will likely be inaccurate, resulting in excessive nutrient application or deficiencies that will affect production. Permit writers and inspectors will generally not be collecting soil samples, so this section is provided for informational purposes only. However enforcement actions might require the soil sample collection in some cases.

Every soil sample submitted for testing typically consist of about 15 to 20 cores taken at random locations throughout one field or management unit. The various cores will be used to form one composite sample to be submitted for laboratory analysis. Keep in mind that each composite sample should represent only one general soil type or condition (see Soil Surveys text box). If the field contains areas that are obviously different in slope, color, drainage, and texture and if those areas can and will be managed separately, a separate sample should be submitted. Many state technical standards will establish a maximum field acreage that a soil sample can represent; it is important for a permit writer to be aware of those limits.

Soil Sampling

ANSI GELPP 0004-2002, *Manure Utilization* (ANSI 2002) standard recommends sampling soils every 3 years and analyzing them for, at minimum, nitrate content, available phosphorus content, pH, and buffer pH. EPA also recommends periodically analyzing the soil sample for nitrogen, potassium, pH, alkalinity, metals, micronutrients, and organic matter to better assess the soil conditions at a land application site.

Soil Surveys

Planners and permit writers can use published soil surveys to identify fields or sub-fields that should be sampled or managed separately on the basis of variations in soil type. The National Cooperative Soil Survey (NCSS), coordinated by NRCS, is a county-by-county scientific inventory of U.S. soils on nearly all public and private land.

Soil surveys contain soil maps and general information about the agriculture and climate of the area and descriptions of each soil type. A soil survey could also include interpretations of the soil's characteristics, and guidance for community planning, agricultural land management, engineering, and wildlife management.

Soils in the survey are classified by soil orders, suborders, great groups, subgroups, families, and series. The U.S. system of soil classification recognizes approximately 15,000 different soil series.

Soil survey reports are available from several sources.

- The state or local NRCS office, county extension office, or congressional representatives might offer free reports.
- Public libraries and conservation district offices generally have reference copies available.
- Soil surveys are available on the Web Soil Survey website: *http://websoilsurvey.nrcs.usda.gov*

When collecting soil samples, small areas where the soil conditions are obviously different from those in the rest of the field should be avoided; examples include wet spots, old manure and urine spots, places where wood piles have been burned, severely eroded areas, old building sites, fence rows, spoil banks, and the like. Samples taken from such locations are not typical of the soil in the rest of the field, and including them could produce misleading results. Areas in a field where different crops have been grown in the past should be sampled separately even if the same crop will now be planted in the entire field. Areas that have been limed and fertilized differently from the rest of the field should also be sampled separately.

To avoid contamination of the samples, samples should be collected with stainless steel or chrome plated sampling tools and plastic buckets. Brass, bronze, or galvanized tools should be avoided. Tools and buckets should be clean and free of lime and fertilizer residues. Even a small amount of lime or fertilizer transferred from the sampling tools to the soil can seriously contaminate the sample and produce inaccurate results.

For soil samples intended for analysis of phosphorus and other immobile nutrients (potassium, calcium, and magnesium), samples should be collected at the same depth to which the field is tilled (usually about 6 to 8 inches) because that is the zone in which the fertilizer has been incorporated. For fields that rely on no-till management, non-mobile nutrients such as phosphorus become stratified. Phosphorus can become concentrated within the 0- to 2-inch depth and depleted at lower soil depths. Sampling procedures should be adjusted to identify variation of nutrient availability that can change under different types of land management so that recommendations can be adjusted. For areas that use soil nitrate testing, a deeper core sample might be needed. It is important to collect soil samples from the depth specified by the permit or technical standards. Those sources might refer to recommendations provided by the approved laboratory to which the sample will be sent for analysis. Before filling the shipping container, the cores should be pulverized and mixed thoroughly in a clean, plastic bucket. The composite soil samples should be air dried and the shipping container filled about two-thirds full with the mixture. Once the soil test results are known, the final fertilizer and lime suggestions can be made. Recommendations are typically given on a per-acre basis for each nutrient.

Soil Analysis

A soil test is a laboratory procedure that measures the plant-available portion of soil nutrients. The measurement is used to predict the amount of nutrients that will be available during the growing season. In general, the soil test is an extraction procedure that has been tailored to a specific region.[3] A soil test is used to assess the fertility of a soil but does not provide a direct measure of the actual quantity of plant available soil nutrients. Therefore, a soil test is used to predict a crop response and can be used to provide a nutrient recommendation needed to achieve a given crop response.

Soil tests provide quantitative and qualitative analyses regarding the availability of nutrients in the soil. A single quantitative numeric value is provided, which is interpreted on the basis of regional crop response research. The quantitative value is typically given in ppm or pounds per acre (lbs/A) elemental phosphorus, potassium, magnesium, or any other element that is being analyzed. Interpretation of the soil test value is based on the current availability of the nutrient being analyzed in the soil. Interpretations typically range from very low to very high or excessive. Interpretations have also been described using the terminology optimum and below or above optimum. The way categories are described and the number of categories that are defined is typically determined by the land grant universities or the soil testing laboratory.

Soil samples examined in a lab.
(Photo courtesy of USDA/MO NRCS)

Nutrient levels designated optimum (or in some states medium or high) indicate sufficient levels of plant available soil nutrients for a given crop yield. Soil test levels designated very high or excessive indicate more-than-sufficient availability of soil nutrients for plant growth. The qualitative categories describing a soil test (e.g., low, medium, optimum, high, very high, excessive) can generally be compared state to state across similar geographic regions because they describe whether an increase in yield can be expected if additional nutrient is applied. However, the quantitative values defining each category will differ depending on the soil test method used for the nutrient extraction, regional growth range ratings, and numeric standards for each range which are set by each state.

Laboratories will use different extracting solutions and methods for analyzing nutrient availability. That is mainly because different extractants are more appropriate for different soil properties, which vary across regions. A good example of this is the analysis used for soil phosphorus. The Mehlich 1, Mehlich 3, Morgan, and Modified Morgan extractants are predominant in the northeastern United States. Since the chemistry of northeastern soils primarily involves factors affecting the availability of aluminum phosphates, soil tests in the northeast use a dilute acid solution to dissolve these minerals and extract phosphorus. The Mehlich III extracting solution can be used across a wider variety of soils, including calcareous soils, whereas the Mehlich I extraction solution is not as effective for such types of soils. Laboratories also report results using different units. Commonly, results are expressed as lbs/A, ppm, or as a fertility index value. Given those variations, it is very difficult to convert analyses. It is most important to follow the recommendation developed by the laboratory for the sample analyzed.

Nitrogen

Not all laboratories test for soil nitrogen. It is a very mobile nutrient in the environment, and soil levels can change rapidly in a short period. For laboratories that do nitrogen testing, it is important to remember that the sampling depth for nitrogen might be different from that for other analyzed components (phosphorus, potassium, or pH) and that the nitrogen test is only relevant if a sample can be obtained, analyzed, and reported back to the producer in a short period. Nitrogen sampling in this mode is very valuable and saves money by reducing fertilizer costs and environmental risks.

Pre-Sidedress Soil Nitrate Test (PSNT)

The PSNT is a widely used tool for optimizing nitrogen fertilizer use efficiency for corn production. The test relies on timely measurement of mineralized soil nitrate in the top layer of soil just before corn's period of rapid nitrogen uptake. The PSNT is highly recommended for corn fields where manure (and other organic sources of nitrogen) has been applied recently. The PSNT may be less reliable when total nitrogen application before sidedress exceeds 50 pounds nitrogen per acre. CAFOs should consult their local Extension Service for more information.

Phosphorus

Phosphorus is an essential nutrient for crop and animal production, but it can accelerate freshwater eutrophication—one of the most common water quality impairments. Because phosphorus is relatively stable in soils, soil testing is useful for determining the relative levels of phosphorus available to crops, monitoring phosphorus accumulation over time, and determining when soil phosphorus levels are high enough that no additional land application is necessary.

Soil Phosphorus Test

A soil sample from the site is necessary to assess the level of available phosphorus in the surface layer of the soil. The available phosphorus is the level customarily given in a soil test analysis by the Cooperative Extension Service or commercial soil test laboratories. These ranges of soil test phosphorus values will vary by soil test method and region. The soil test level for available phosphorus does not ascertain the total phosphorus in the surface soil. It does, however, give an indication of the amount of total phosphorus that might be present because of the general relationship between the forms of phosphorus (organic, adsorbed, and labile phosphorus) and the solution phosphorus available for crop uptake.

5.10. Protocols for Land Application 40 CFR Part 122.42(e)(1)(viii)

The requirements for addressing the protocols for land application are discussed in depth in Chapter 6.

5.11. Recordkeeping 40 CFR Parts 122.42(e)(1)(ix) and (e)(2)

The NMP must identify the records that will be kept to document implementation of all NMP minimum requirements, including the records specified for O&M. The records must be maintained on-site. 40 CFR § 122.42(e)(2). Section 4.2.2 describes the record-keeping requirements included in the CAFO rule, including the ELG record-keeping requirements for Large CAFOs. Table 5-11 includes examples of the types of site-specific records that a CAFO might include in its NMP to document implementation of the nine minimum NMP requirements.

Table 5-11. Example site-specific records to document NMP implementation

NMP minimum requirement	Example site-specific records
Ensure adequate storage	• Dates of weekly visual inspections of Ponds A, B, and C, including the exposed portion of the pond liners; the south swale to Pond A; the east swale to Pond C; and Pumps 1 and 2 (Weekly Records form) • Description of deficiencies and corrective actions associated with weekly inspections (Weekly Records form) • Weekly records of the wastewater level in Ponds A, B, and C (Weekly Records form) • Daily precipitation records (Rain Gauge log form) • Document daily inspections of the east and west drinking water lines, the central cooling line, and the piping from the well to the barn (Weekly Records form) • Monitor Pumps 1 and 2 hourly during all wastewater applications (Wastewater Application Log form) • Dates of solids/sludge removal from Ponds A, B, and C
Ensure proper management of mortalities	• Monthly documentation (initial) that all dead animals were handled and disposed of as described in the NMP (Monthly Records form) • Renderer invoices (electronic copies stored on computer) • For catastrophic mortality, document the number, average weight, cause, and date of animal deaths and the method of disposal.
Diversion of clean water	• Dates of weekly visual inspections of the north and west berms (Weekly Records form) • Dates of weekly visual inspections and cleaning/repair as needed of gutters, downspouts, and underground piping for roof runoff (Weekly Records form)

Table 5-11. Example site-specific records to document NMP implementation *(continued)*

NMP minimum requirement	Example site-specific records
Prevention of direct contact of animals with waters of the U.S.	• Records of visual inspections of the east perimeter fencing along Spring Creek, at a minimum monthly and after storms and other disturbance events (Monthly Records form) • Description of deficiencies and corrective actions associated with visual inspections (Monthly Records form)
Chemical disposal	• Maintain inventory of chemicals stored or handled at the facility. • Date of monthly inspections of the chemical storage shed, including a description of conditions that would cause concern, and required actions as appropriate (Monthly Records form) • Monthly documentation (initial) that all chemicals were handled and disposed of as described in the NMP (Monthly Records form) • Dates of employee training and names of employees trained on proper chemical handling and disposal
Conservation practices to control nutrient loss	• Document implementation of mowing and maintenance schedule for Field 15 and 15a buffer strip including monitoring of vegetative density, reseeding, and redistribution of sediment as needed (Monthly Records form) • Document inspections of the Field 24 filter strip at a minimum monthly and after storm events, including repair of any gullies that have formed, removal of unevenly deposited sediment accumulation that will disrupt sheet flow, reseeding of disturbed areas and other measures necessary to prevent concentrated flow through the filter strip (Monthly Records form)
Protocols for manure and soil testing	• Sampling dates and results of soil analyses for all fields (ensure laboratory reports identify methods of analysis) • Sampling dates and results of irrigation water nutrient analyses • Sampling dates and results of manure analyses, east and west stockpiles (ensure laboratory reports identify methods of analysis) • Sampling dates and results of wastewater analyses, Ponds B and C (ensure laboratory reports identify methods of analysis)
Protocols for land application of manure and wastewater	• Complete Wastewater Application Log form for each land application event on each field, including • Calculations showing the total N (PAN) and P (P_2O_5) to be applied (complete before land application) • Total amount of PAN and P_2O_5 actually applied, including calculations • Weather conditions 24 hours before application, at the time of application, and 24 hours after application • Document dates of inspections of Pumps 1 and 2 and all piping used to transfer wastewater from Ponds B and C to each field, and the center pivots irrigators on each field (minimum once annually and daily during application)

The requirement for record keeping can be established in the general permit as a broadly applicable permit condition by specifically identifying all the records required to be maintained by all CAFOs covered under the permit. A site-specific component is not required as part of the permit term; however, site-specific measures may be implemented if necessary and included in the NMP. A permit writer could determine that some of the site-specific records identified in the NMP are necessary to ensure implementation of the minimum NMP requirements and include them as site-specific terms in the permit. Moreover, the permit writer might determine that certain site-specific measures require site-specific records, even if those records are not identified in the NMP. The specific record-keeping requirements of the CAFO rule are described in Chapter 4.2.2.

5.12. Developing an NMP

5.12.1. USDA's Comprehensive Nutrient Management Plan

A comprehensive nutrient management plan (CNMP) is a plan developed according to standards established by USDA's NRCS to manage manure and organic by-products by combining conservation practices and management activities into a conservation system that, when implemented, will protect or improve air, soil, and water quality. The CNMP need not be a document separate from the NMP required by the CAFO regulations. The NMP minimum requirements in the CAFO regulations were developed to be consistent with the content of a CNMP as defined by USDA policy and CNMP Technical Criteria. The NMP minimum requirements represent a subset of the management practices and activities that would generally be included in a USDA-defined CNMP. The content of a USDA-defined CNMP is described in the USDA policy and CNMP Technical Criteria (for website links, see Appendix N, References for NPDES Permit Writers). Table 5-12 identifies each of the 10 elements of a CNMP and indicates which of the NMP minimum requirements for CAFOs would typically be addressed under each element during the development and implementation of a CNMP.

There are some situations where the CNMP might not fully address all the EPA NPDES minimum requirements. For example, the CNMP technical guidance does not specifically include the prevention of direct contact of animals with waters of the U.S. within the elements of a CNMP. However, the prevention of direct contact is strongly recommended through the CNMP technical criteria and in the Nutrient Management 590 conservation practice standard (USDA-NRCS 2006) and is generally considered to be a component of the conservation planning process. The CNMP is defined by USDA as a part of the conservation planning process focused on AFOs. If the CNMP does not fully address the minimum requirements required by the CAFO regulation, it cannot qualify as a valid NMP for use with an NPDES CAFO permit. It is important to bear in mind that an NMP must meet all the requirements established by the Director (and discussed in this manual). For a CNMP to qualify as an NMP for NPDES permitting, it will need to satisfy those conditions.

EPA's NPDES NMP minimum requirements do not address two of the ten elements of USDA's CNMP—Feed Management and Other Utilization Options. Although those are important and should be considered in the development of a site-specific CNMP or NMP for CAFOs, they do not have to be addressed, as regulatory requirements, in NMPs developed as condition of a CAFO's NPDES permit.

Table 5-12. USDA CNMP elements/NPDES NMP minimum practices comparison

USDA CNMP elements	NPDES NMP minimum practices
Background and Site Information	
Manure and Wastewater Handling and Storage	Adequate storage capacity Diversion of clean water
Farmstead Safety and Security	Chemical handling Prevention of direct contact of animals with waters of the U.S. Mortality management
Land Treatment Practices	Conservation practices to control nutrient loss
Soil and Risk Assessment Analysis	Protocols for the land application of manure and wastewater
Nutrient Management	Protocols for the land application of manure and wastewater Protocols for manure and soil testing
Record Keeping	Record keeping
Feed Management	
Other Utilization Options	
References	

5.12.2. Technical Assistance for Preparing NMPs

EPA anticipates that permitting authorities will coordinate with their state agricultural agency partners to prepare guidance on implementing the established state nutrient management technical standard when developing the site-specific NMP required by the permit. (For additional information on the requirements of a technical standard, see Chapter 6.3.1.) In addition, a CNMP prepared in accordance with the CNMP Technical Criteria issued by USDA's NRCS should meet most of the NMP and minimum practice requirements of the permit. (To review NRCS's CNMP Technical Criteria, see *NRCS National Instruction 190-304*.)

Nutrient Management Planning Tools

Many states, universities, and private sector companies have developed nutrient management tools that can be used (generally within a specific state) to assist livestock and poultry producers develop site-specific NMPs. One example of such tools follows:

Manure Management Planner (MMP): Developed at Purdue University; a manure utilization planning tool to help develop NMPs. You can access MMP at *http://www.agry.purdue.edu/mmp/*

Appendix L, Nutrient Management Planning Software, provides additional information on other state software programs available for generating NMPs.

CAFO owners and operators should seek technical assistance for developing NMPs. Federal agencies, such as the NRCS, and state and tribal agricultural and conservation agency staff, Cooperative Extension Service agents and specialists, Soil and Water Conservation Districts, and land grant universities might be able to provide technical assistance. Producers might also be able to obtain information from industry associations, integrators and private consultants.[4] A number of computer-based tools are being developed to facilitate the development and implementation of NMPs. (For a discussion on available software programs, see Appendix L, Nutrient Management Planning Software.)

5.12.3. NMPs Developed by Certified Specialists

Although EPA's CAFO regulations do not require CAFOs to use a certified specialist or technical service provider to develop the required site-specific NMP, permitting authorities should encourage and support the use of the specialists. If a CNMP is used to meet the nutrient management requirements when seeking NPDES permit coverage, the CNMP would have to be signed by a certified specialist because that is a requirement for all CNMPs. A certified specialist is a person who has demonstrated capability to develop NMPs in accordance with applicable USDA or state standards and is certified by USDA or a USDA-sanctioned organization. Certified specialists include qualified persons who have received certifications through a state or local agency, personnel from NRCS, and persons who have completed technical service provider certification programs recognized by NRCS or other programs recognized by states. In addition, USDA has developed agreements with technical service providers to provide certified NMP development services. Third-party vendor certification programs could include (1) American Society of Agronomy's

A producer and NRCS staff members work together. (Photo courtesy of USDA/NRCS) certification programs, including Certified Crop Advisors and Certified Professional Agronomists, Certified Professional Crop Scientists, and Certified Professional Soil Scientists; (2) land grant university certification programs; (3) National Alliance of Independent Crop Consultants; and (4) state certification programs.

An NMP preparer certification program is one mechanism that a state can use to ensure that plans are prepared in accordance with the nutrient management technical standard established by the Director. Many states have the discretion to require their use to prepare or approve plans. EPA recognizes that some states could require NMPs to be certified under state requirements. The value of using certified specialists is to ensure that NMPs are developed, reviewed, and approved by persons who have the appropriate knowledge and expertise to ensure that plans fully and effectively address the applicable ELG requirements, the minimum practices, and the applicable state nutrient management technical standard and are appropriately tailored to the site-specific needs and conditions of the CAFO. Because of the multidisciplinary nature of NMPs, it is likely that a range of expertise will be needed to develop an effective NMP (e.g., professional engineer, crop specialist, soil specialist).

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Endnotes

[1] Portions of the information in this section are extracted or adapted from Harrison and Smith 2004a.

[2] Portions of the information in this section are extracted or adapted from Fulhage 2000.

[3] The typical content of a laboratory soil analysis report varies significantly from state to state. Typically, nitrogen, phosphorus, and pH are reported. Micronutrients are rarely reported unless requested.

[4] A list of consultants that are certified by NRCS to develop CNMPs in each state is available through USDA's Technical Service Providers (TSP) Registry (*http://techreg.usda.gov/*).