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Agency

NPDES Permit Writers' Manual for Concentrated Animal Feeding Operations

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U.S. Environmental Protection Agency | Office of Water | Office of Wastewater Management

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NPDES CAFO Permitting Glossary

25-year, 24-hour rainfall event – Mean precipitation event with a probable recurrence interval of once in twenty-five years, as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May, 1961, or equivalent regional or State rainfall probability information developed from this source.

100-year, 24-hour rainfall event – Mean precipitation event with a probable recurrence interval of once in one hundred years, as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May, 1961, or equivalent regional or State rainfall probability information developed from this source.

303(d) water body – Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

Aboveground storage tank – Aboveground storage tanks are used as an alternative to under building pit storage and earthen basins. Current assembly practices for aboveground storage facilities are primarily circular silo types and round concrete designs, but the structures may also be rectangular. Such tanks are suitable for operations handling slurry (semisolid) or liquid manure; this generally excludes open-lot waste which is inconsistent in composition and has a higher percentage of solids. Below and aboveground storage tanks are appropriate in situations where the production site has karst terrain, space constraints, or aesthetics issues associated with earthen basins. Storing manure in prefabricated or formed storage tanks is especially advantageous on sites with porous soils or fragmented bedrock. Such locations may be unfit for earthen basins and lagoons because seepage and ground water contamination may occur.

Acre – 1 acre = 43,560 sq. ft. = 208.7 ft.; 2 = 0.405 hectares; or 640 acres = 1 sq. mile (called a section).

Acre-foot – The volume of water that would cover one acre of land (43,560 square feet) to a depth of one foot, equivalent to 325,851 gallons of water.

Aerobic – Living, active, or occurring only in the presence of free oxygen.

Air Quality Standards – Federal and state government-prescribed levels of a pollutant in the outside air that cannot be exceeded during a specified period of time in a specified geographical area.

Agronomy – The science of crop production and soil management.

Anaerobic (anoxic) – In the absence of oxygen.

Anaerobic digestion – A biological process that occurs in the absence of oxygen. In very large animal production operation, it is sometimes used to produce biogas (a low energy gas which is a combination of methane and carbon dioxide) from the biodegradable organic portion of manure. This gas can be used as an energy source. After anaerobic digestion, the remaining semi-solid (which is relatively odor free but still contains most of its nutrients) can be used as a fertilizer.

Apatite rock – A group of phosphate minerals, usually referring to hydroxyapatite, flouroapatite, chloroapatite and bromapatite, named for the high concentrations of OH^-, F^-, Cl^-, or Br^- ions, respectively, in the crystal. The formula of the admixture of the four most common endmembers is written as $Ca_{10}(PO_4)_6(OH, F, Cl, Br)_2$, and the crystal unit cell formulae of the individual minerals are written as $Ca_{10}(PO_4)_6(OH)_2$, $Ca_{10}(PO_4)_6(F)_2$, $Ca_{10}(PO_4)_6(Cl)_2$ and $Ca_{10}(PO_4)_6(Br)_2$.

Backgrounding – Growing program for feeder cattle from time calves are weaned until they are on a finishing ration in the feedlot.

Basin – A tract of land in which the ground is broadly tilted toward a common point. Water that falls onto any portion of the basin is carried toward the common point by a single river system.

Bedding – Material such as straw, sawdust, wood shavings, shredded newspaper, sand or other similar material used in animal confinement areas for the comfort of the animal or to absorb excess moisture. Bedding can drastically affect the characteristics of the manure, and must be taken into consideration in the design of the storage facility.

Belowground storage tanks – Belowground storage tanks are used as an alternative to under building pit storage and earthen basins. Belowground storage can be located totally or partially below grade and should be surrounded by fences or guardrails to prevent people, livestock, or equipment from accidently entering the tank. Such tanks are suitable for operations handling slurry (semisolid) or liquid manure; this generally excludes open-lot waste which is inconsistent in composition and has a higher percentage of solids. Below and aboveground storage tanks are appropriate in situations where the production site has karst terrain, space constraints, or aesthetics issues associated with earthen basins. Storing manure in prefabricated or formed storage tanks is especially advantageous on sites with porous soils or fragmented bedrock. Such locations may be unfit for earthen basins and lagoons because seepage and ground water contamination may occur.

Best Available Technology Economically Achievable (BAT) – Technology-based standard established by the Clean Water Act (CWA) as the most appropriate means available on a national basis for controlling the direct discharge of toxic and nonconventional pollutants to navigable waters. BAT effluent limitations guidelines, in general, represent the best existing performance of treatment technologies that are economically achievable within an industrial point source category or subcategory.

Best Conventional Pollutant Control Technology (BCT) – Technology-based standard for the discharge from existing industrial point sources of conventional pollutants including BOD, TSS, fecal coliform, pH, oil and grease. The BCT is established in light of a two-part "cost reasonableness" test which compares the cost for an industry to reduce its pollutant discharge with the cost to a POTW for similar levels of reduction of a pollutant loading. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find limits which are reasonable under both tests before establishing them as BCT.

Best management practice (BMP) – Permit condition used in place of or in conjunction with effluent limitations to prevent or control the discharge of pollutants. May include schedule of activities, prohibition of practices, maintenance procedure, or other management practice. BMPs may include, but are not limited to, treatment requirements, operating procedures, or practices to control runoff, spillage, leaks, or drainage from raw material storage.

Best professional judgment (BPJ) – The method used by permit writers to develop technology-based NPDES permit conditions, in those circumstances where there is no applicable effluent limitation guideline, on a case-by-case basis using all reasonably available and relevant data.

Biochemical Oxygen Demand (BOD) – Laboratory measurement of the amount of oxygen consumed by microorganisms while decomposing organic matter in a product. BOD levels are indicative of the effect of the waste on fish or other aquatic life which require oxygen to live, and though not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

BOD5 – The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter.

Boar – An uncastrated male hog.

Breeding stock – Sexually mature male and female livestock that are retained to produce offspring.

Broiler – Meat-type chicken typically marketed at 6.5 weeks of age. Live weight at market generally averages 4 to 4.5 pounds per bird.

Buffer Zone – The region near the border of a protected area; a transition zone between areas managed for different objectives.

Buck – Male goat. Male goats are at times disparagingly called "Billy goats".

Bull – Bovine male, uncastrated of breeding age.

Bushel – A dry volume measure of varying weight for grain, fruit, etc., equal to four pecks or eight gallons (2150.42 cubic inches). A bushel of wheat, soybeans, and white potatoes each weighs 60 pounds. A bushel of corn, rye, grain sorghum, and flaxseed each weighs 56 pounds. A bushel of barley, buckwheat, and apples each weighs 48 pounds.

By-product – Product of considerably less value than the major product. For example, the hide and offal are by-products while beef is the major product.

Bypass – The intentional diversion of waste streams from any portion of a treatment (or pretreatment) facility.

Calf – Young male or female bovine animal under 1 year of age.

Calve – Giving birth to a calf.

Capon – Castrated male chicken.

Coliform Bacteria – Microorganisms which typically inhabit the intestines of warm-blooded animals. They are commonly measured in drinking water analyses to indicate pollution by human or animal waste.

Compost – Decomposed organic material resulting from the composting process. Used to enrich or improve the consistency of soil.

Conservation district – Any unit of local government formed to carry out a local soil and water conservation program.

Conservation plan – A combination of land uses and farming practices to protect and improve soil productivity and water quality, and to prevent deterioration of natural resources on all or part of a farm. Plans may be prepared by staff working in conservation districts and must meet technical standards. For some purposes, such as conservation compliance, the plan must be approved by the local conservation district. Under the 1996 FAIR Act, conservation plans for conservation compliance must be both technically and economically feasible.

Conservation practice (NRCS) – Any technique or measure used to protect soil and water resources for which standards and specifications for installation, operation, or maintenance have been developed. Practices approved by USDA's Natural Resources Conservation Service are compiled at each conservation district in its field office technical guide.

Conservation Reserve Enhancement Program (CREP) – A sub program of the Conservation Reserve Program, CREP is a state-federal multi-year land retirement program developed by states and targeted to specific state and nationally significant water quality, soil erosion, and wildlife habitat problems. The CREP offers higher payments per acre to participants than the CRP, and perhaps other benefits as well. States with approved programs include Maryland, Minnesota, Illinois, New York, Oregon, Washington, and North Carolina.

Conservation Reserve Program (CRP) – A USDA program, created in the Food Security Act of 1985, to retire from production up to 45 million acres of highly erodible and environmentally sensitive farmland. Landowners who sign contracts agree to keep retired lands in approved conserving uses for 10-15 years. In exchange, the landowner receives an annual rental payment, cost-share payments to establish permanent vegetative cover and technical assistance.

Conservation tillage – Any tillage and planting system that leaves at least 30% of the soil surface covered by residue after planting. Conservation tillage maintains a ground cover with less soil disturbance than traditional cultivation, thereby reducing soil loss and energy use while maintaining crop yields and quality. Conservation tillage techniques include minimum tillage, mulch tillage, ridge tillage, and no- till.

Confinement area – The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milk rooms, milking centers, cowards, barnyards, medication pens, walkers, animal walkways, and stables.

Containment – Structures used to control runoff of precipitation that comes into contact with manure, feed and other wastes on open feedlots. Examples of containment structures are lagoons and holding ponds.

Contour farming – Field operations such as plowing, planting, cultivating, and harvesting on the contour, or at right angles to the natural slope to reduce soil erosion, protect soil fertility, and use water more efficiently.

Cover crop – A close-growing crop grown to protect and improve soils between periods of regular crops.

Cow – Sexually mature female bovine animal that has usually produced a calf.

Cow-calf operation – A ranch or farm where cows are raised and bred mainly to produce calves usually destined for the beef market. The cows produce a calf crop each year, and the operation keeps some heifer calves from each calf crop for breeding herd replacements. The rest of the calf crop is sold between the ages of 6 and 12 months along with old or nonproductive cows and bulls. Such calves often are sold to producers who raise them as feeder cattle.

Critical Storage Period – The number of continuous days manure and wastewater cannot be land applied or otherwise used. This occurs during the winter months or during the crop growing season when application cannot be made.

Crop rotation – The growing of different crops, in recurring succession, on the same land in contrast to monoculture cropping. Rotation usually is done to replenish soil fertility and to reduce pest populations in order to increase the potential for high levels of production in future years.

Crop Year – The period of time it takes to go from one harvest to the next harvest. A crop year can approximate a calendar year in length, if crops are only planted once per year. However, in some climates there can be two crop years within a calendar year.

Dewatering – The removal of the liquid fraction from manure slurries. This is often done to maximize storage by increasing the solids concentration or to facilitate the transportation of the manure. Dewatering is often accomplished by mechanical separation (screen separator, belt-press, centrifuge) or gravity separation (settling basin).

Director – The Regional Administrator or State Director, as the context requires, or an authorized representative. When there is no approved state program, and there is an EPA administered program, Director means the Regional Administrator. When there is an approved state program, "Director" normally means the State Director.

Digester – A vessel used for the biological, physical, or chemical break-down of livestock and poultry manure.

Discharge – Discharge when used without qualification means the discharge of a pollutant. Discharge of a pollutant means: (a) Any addition of any pollutant or combination of pollutants to waters of the United States from any point source, or (b) Any addition of any pollutant or combination of pollutants to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft which is being used as a means of transportation. This definition includes additions of pollutants into waters of the United States from: surface runoff which is collected or channeled by man; discharges through pipes, sewers, or other conveyances owned by a State, municipality, or other person which do not lead to a treatment works; and discharges through pipes, sewers, or other conveyances, leading into privately owned treatment works. This term does not include an addition of pollutants by any indirect discharger.

Dry cow – A cow that is not lactating.

Dry lot (dry operation) – An operation using confinement buildings and handling manure and bedding exclusively as dry material, an operation using a building with a mesh or slatted floor over a concrete pit, or an operation scraping manure to a covered waste storage facility is referred to as a "dry" operation. When such practices are used, and are not combined with liquid manure handling systems such as flushing to lagoons or storage ponds, these operations are referred to as "other than liquid manure handling systems" or "dry" manure systems, or "dry" operations.

Duck – Term used to connote both sexes but is also used to refer to the female gender. Ducks are typically marketed at 35 days of age at an average live weight of 7 pounds per bird.

Effluent – Water mixed with waste matter.

Effluent Limitations Guidelines (ELG) –Regulations issued by the EPA Administrator under Section 304(b) of the Clean Water Act that establish national technology-based effluent requirements for a specific industrial category.

Erosion – The wearing away of land surfaces by the action of wind or water.

Ephemeral stream – A stream that flows only sporadically, such as after storms.

EQIP – The Federal Environmental Quality Incentive Program (EQIP) provides financial assistance to producers to implement better conservation practices.

Ewe – A female sheep.

Evaporation pond – Used in regions where evaporation exceeds rainfall to separate manure solids from liquids. Constructed to remove moisture from livestock manure.

Farm Service Agency – A division of the USDA that oversees the administration of all federal farm programs. Programs include farm commodities, crop insurance, conservation programs and farm loans. Offices are located in strategic counties in every state in the U.S. Formerly known as ASCS, Agricultural Stabilization and Conservation Services.

Farrow-to-finish – Typically, a confinement operation where pigs are bred and raised to their slaughter weight, usually 200–250 pounds.

Farrowing – Stage during which the pigs are born, and kept until they are weaned from the sow.

Fecal coliform bacteria – A group of bacteria found in the intestinal tract of humans and animals, and also found in soil. While harmless in themselves, coliform bacteria are commonly used as indicators of the presence of pathogenic organisms.

Feeder cattle – Cattle past the calf stage that have weight increased making them salable as feedlot replacements.

Feedlot – Lot or building or a group of lots or buildings used for the confined feeding, breeding or holding of animals. This definition includes areas specifically designed for confinement in which manure may accumulate or any area where the concentration of animals is such that a vegetative cover cannot be maintained. Lots used to feed and raise poultry are considered to be feedlots. Pastures are not animal feedlots.

Fertilizer – Any organic or inorganic material, either natural or synthetic, used to supply elements (such as nitrogen (N), phosphate (P_2O_5), and potash (K_2O)) essential for plant growth.

Filly – A female horse less than three years old.

Filter backwash – Reversing the flow of water back through the filter media to remove entrapped solids.

Filter strips – An area of vegetation, generally narrow and long, that slows the rate of runoff, allowing sediments, organic matter, and other pollutants that are being conveyed by the water to be removed.

Finish pig – To feed a pig until it reaches market weight, 250–260 pounds.

Finishing stage – Stage leading to and including full adulthood for swine is called the finishing stage. The pigs remain here until they reach market weight, 240 to 260 pounds.

Flush system – In flush systems, large volumes of water flow down a sloped surface, scour manure from the concrete, and carry it to a manure storage facility. There are three basic types of flush systems: (1) under slat gutters, used primarily in beef confinement buildings and swine facilities; (2) narrow-open gutters, used predominately in hog finishing buildings; and (3) wide-open gutters or alleys, most often seen in dairy free stall barns, holding pens, and milking parlors.

Forage Growth – All browse and non-woody plants that are eaten by wildlife and livestock. Roughage of high feeding value. Grasses and legumes cut at the proper stage of maturity and stored to preserve quality are forage. A crop that is high in fiber and grown especially to feed ruminant animals.

Freeboard – The distance between the highest possible wastewater level in a manure storage/ treatment structure and the top edge of the structure.

Gelding – A castrated male horse.

Grassed waterway – Grassed waterways are areas planted with grass or other permanent vegetative cover where water usually concentrates as it runs off a field. They can be either natural or man-made channels. Grass in the waterway slows the water and can reduce gully erosion and aid in trapping sediment.

Grazing land – Pasture, meadow, rangeland, or other similar area where livestock are put to feed on the vegetation.

Ground water – The supply of fresh water found beneath the Earth's surface, usually in aquifers, which supply wells and springs.

Growing stage – Occurs after the piglets leave the nursery. Pigs are larger and better able to take care of themselves at this stage, so larger group pens and a less controlled environment is needed. They are kept here until they reach 120 to 140 pounds.

Gully erosion – Also called ephemeral gully erosion, this process occurs when water flows in small channels and larger swales. Most gully erosion occurs on highly erodible soils, where there is little or no crop residue cover, or where crop harvest disturbs the soil.

Heifer – Young female bovine cow prior to the time that she has produced her first calf.

Hen – Adult female chicken or turkey.

Herd – Group of cattle (usually cows) that are in a similar management program.

Highly erodible land (HEL) – Land that is very susceptible to erosion, including fields that have at least 1/3 or 50 acres of soils with a natural erosion potential of at least 8 times their T value.

Holding pond – A pond, usually made of earthen material, that is used to store manure wastewater, or polluted runoff generally for a limited time.

Immobilization – When organic matter decomposes in soil and is absorbed by microorganisms therefore, preventing it being accessible to plants.

Intermittent stream – Has flowing water only during certain periods of time, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall or snowmelt is a supplemental source of water for the stream flow.

Irrigation – Applying water (or wastewater) to land areas to supply the water (and sometimes nutrient) needs of plants. Techniques for irrigating include furrow irrigation, sprinkler irrigation, trickle (or drip) irrigation, and flooding.

Irrigation return flow – Part of artificially applied water that is not consumed by plants or evaporation, and that eventually 'returns' to an aquifer or surface water body, such as a lake or stream.

Karst topography – An irregular limestone region with sinks, underground streams, and caverns. Karst areas can provide direct channels for contaminants to reach the groundwater.

Kid – A young goat.

Lactation – Is the secretion of milk from the mammary glands and the period of time that a female lactates to feed her young.

Lamb – A young sheep. An ewe lamb or ram lamb, depending upon the sex.

Land application – The removal of wastewater and waste solids from a control facility and distribution to, or incorporation into the soil mantle primarily for beneficial reuse purposes.

Land application area – Land application area means land under the control of an AFO owner or operator, whether it is owned, rented, or leased, to which manure, litter, or process wastewater from the production area is or maybe applied.

Land-grant universities – State colleges and universities started from Federal government grants of land to each state to encourage further practical education in agriculture, home economics, and the mechanical arts.

Layer – Mature egg-type chicken over 32 weeks of age.

Legumes – A family of plants, including many valuable food, forage and cover species, such as peas, beans, soybeans, peanuts, clovers, alfalfas, sweet clovers, lespedezas, vetches, and kudzu. Sometimes referred to as nitrogen-fixing plants, they can convert nitrogen from the air to build up nitrogen in the soil. Legumes are an important rotation crop because of their nitrogen-fixing property.

Liner – Any barrier in the form of a layer, membrane or blanket, naturally existing, constructed or installed to prevent a significant hydrologic connection between liquids contained in retention structures and waters of the United States.

Litter – A combination of manure and the bedding material placed in dry chicken production facilities. The bedding material alone may also be referred to as litter.

Liquid manure – Usually less than 8.0% solids. Wash water, runoff, precipitation, and so forth are added, if needed, to dilute the manure and lower the solids content.

Liquid manure handling system – An operation were animals are raised outside with swimming areas or ponds, or with a stream running through an open lot, or in confinement buildings where water is used to flush the manure to a lagoon, pond, or some other liquid storage structure.

Load allocation – Portions of a TMDL assigned to existing and future nonpoint sources, including background loads.

Maintained – Animals are confined in the same area where waste is generated and/or concentrated. Maintained can also mean that the animals in the confined area are watered, cleaned, groomed, or medicated.

Manure – Fecal and urinary defecations of livestock and poultry; may include spilled feed, bedding, or soil.

Manure storage area – The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles.

Mare – A mature female horse or pony.

Milking parlor – The area of a dairy where milking takes place.

Milking parlor wash water – Is water used to rinse the animals and equipment during the milking process to improve sanitation. The wash water typically includes manure, feed solids, hoof dirt along with detergents and disinfectants that are being used at the operation. The amount of wash water used each day depends upon the number of animals milked and the management practices followed.

Mineralization – When the chemical compounds in organic matter in soil decomposes or are oxidized into plant-accessible forms.

Molt – A process during which hens stop laying and shed their feathers. Occurs naturally every 12 months or may be artificially induced.

Multi-year phosphorus application (phosphorus banking) – A practice that allows manure application in a single year at rates in excess of the phosphorus requirements of the crops. In subsequent years, no phosphorus would be applied until the amount applied in the single year has been removed through plant uptake and harvest.

National Institute of Food and Agriculture (NIFA) – NIFA's unique mission is to advance knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations. NIFA does not perform actual research, education, and extension but rather helps fund it at the state and local level and provides program leadership in these areas

New discharger – Any building, structure, facility, or installation: (a) From which there is or may be a discharge of pollutants; (b) That did not commence the discharge of pollutants at a particular site prior to April 14, 2003; (c) Which is not a new source; and (d) Which has never received a finally effective NDPES permit for discharges at that site.

New source – Any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced:

a. After promulgation of standards of performance under Section 306 of the CWA which are applicable to such source (i.e., February 12, 2003 for CAFOs); or

b. After proposal of standards of performance in accordance with Section 306 of the CWA which are applicable to such source, but only if the standards are promulgated in accordance with Section 306 of the CWA within 120 days of their proposal.

c. Except as otherwise provided in an applicable new source performance standard, a source is a new source if it meets the definition in 40 CFR part 122.2; and
   i. It is constructed at a site at which no other source is located; or
   ii. It totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or
   iii. Its processes are substantially independent of an existing source at the same site. In determining whether these processes are substantially independent, the Director shall consider such factors as the extent to which the new facility is integrated with the existing plant; and the extent to which the new facility is engaged in the same general type of activity as the existing source.

New source performance standards (NSPS) – Technology-based standards for facilities that qualify as new sources under 40 CFR parts 122.2, 122.29. Standards consider that the new source facility has an opportunity to design operations to more effectively control pollutant discharges.

Nonpoint source – Diffuse pollution source (i.e. without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

No-Till farming – The soil is left undisturbed from harvest to planting except for nutrient and seed injection. Weed control is accomplished primarily with herbicides.

Normal growing season – The time period, usually measured in days, between the last freeze in the spring and the first frost in the fall. Growing seasons vary depending on local climate and geography. It can also vary by crop as different plants have different freezing thresholds.

Nursery building – Used for the piglets after they are weaned. Pigs are kept in small groups in this heated, well-insulated enclosure until they reach 60 to 80 pounds. A wire or other very porous floor is used to maintain sanitary conditions. The nursery slotted phase is often broken up into two growth stages, called, respectively, a "hot" and "cold" nursery, reflecting the room temperatures used.

Nutrient – A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and nonpoint source pollution.

Open lot – Pens or similar confinement areas with dirt, concrete, or other paved or hard surfaces wherein animals or poultry are substantially or entirely exposed to the outside environment except for small portions of the total confinement area affording protection by windbreaks or small shed-type shade areas.

Other than a liquid manure handling system – An operation using confinement buildings with a mesh or slatted floor over a concrete pit, where the manure is scraped into a waste storage facility, or an operation using dry bedding on a solid floor. In this case the manure and bedding are not combined with water for flushing to a storage structure.

Overflow – the discharge of manure or process wastewater resulting from the filling of wastewater or manure storage structures beyond the point at which no more manure, process wastewater, or storm water can be contained by the structure.

Pasture – Land used primarily for the production of domesticated forage plants, usually grasses and legumes, for livestock (in contrast to rangeland, where vegetation is naturally-occurring and is dominated by grasses and perhaps shrubs).

Permitting authority – The NPDES permit issuance authority that has been authorized under part 123 of the Clean Water Act.

Pesticide – A chemical substance used to kill or control pests, such as weeds, insects, fungus, mites, algae, rodents and other undesirable agents.

Phosphorus banking – See multi-year phosphorus application.

Pit system (deep) – Has a concrete floor and masonry or concrete side walls, is constructed 2–6 feet below the ground. The animal cages are then built 8 feet or more above the pit floor. Because the pit is built below ground level, care must be taken to insure that surface and groundwater are not contaminated. Foundation drains and external grading to direct surface water away help to keep manure dry, so that natural composting might occur. The most important benefit of the deep-pit is that manure can be stored for several months or more.

Pit (shallow) – The most frequently used pit system. The concrete pit is 4–8 inches deep and is located 3-6 feet below the cages. The manure and other waste is mechanically scraped or flushed out with water to a storage area, or directly loaded into a spreader for direct field application.

Plate chiller water – Are used to cool milk being stored at the dairy. Condensation is formed on the plates and drains from the chiller.

Point source – Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fixture, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged.

Pollutant – Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

Pollution prevention – Identifying areas, processes, and activities which create excessive waste products or pollutants in order to reduce or prevent them through, alteration, or eliminating a process.

Poult – Young turkey, either male or female.

Process wastewater – Water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other CAFO facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process wastewater also includes any water which comes into contact with any raw materials, products, or byproducts including manure, litter, feed, milk, eggs, or bedding.

Process generated wastewater – See process wastewater.

Production area – That part of an AFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milk rooms, milking centers, cow yards, barn yards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms and diversions which separate uncontaminated storm water. Also included in the definition of production area is any egg washing or egg processing facility, and any area used in the storage, handling, treatment, or disposal of mortalities.

Post-harvest residue – That portion of a plant, such as a corn stalk, left in the field after harvest.

Pullet – Young female chicken between 10 and 32 weeks of age, usually this term denotes egg-type birds.

Ram – A male sheep which has not been castrated.

Rangeland – An open region over which livestock may roam and feed. The plant cover is principally native grasses, grass like plants, and shrubs. It includes natural grasslands, savannahs, certain shrubs and grass like lands, most deserts, tundra, alpine communities, coastal marshlands, and wet meadows. It also includes lands that are re-vegetated naturally or artificially and are managed like native vegetation.

Raw materials storage area – Includes but is not limited to feed silos, silage bunkers, and bedding materials.

Retention facility or retention structure – All collection ditches, conduits and swales for the collection of runoff and wastewater, and all basins, ponds, pits, tanks and lagoons used to store wastes, wastewaters and manures.

Return flow – Surface and subsurface water that leaves the field following application of irrigation water.

Rill erosion – An erosion process in which numerous small channels, typically a few inches deep, are formed. It occurs mainly on recently cultivated soils or on recent cuts and fills.

Riparian – Pertaining to or situated on or along the bank of a stream or other body of water.

Riparian buffer – A strip of vegetation planted along the bank of a body of water which slows the rate of flow of runoff from adjoining uplands, causing sediment and other materials to fall out onto the land before the runoff enters and pollutes the body of water.

Roaster – Meat-type chicken marketed at 9 weeks for males and 11 weeks for females. Live weight at market ranges between 6 and 8 pounds per bird.

Root zone – The depth of soil penetrated by plant roots.

Rotational grazing – Grazing two or more pastures in regular sequence, with rest periods for the recovery of herbage.

Ruminants – Hoofed animals with four-chambered stomachs (i.e. cattle, sheep, goats).Ruminants have a complex digestive system with a complex biological system that is capable of generating much of their own protein needs.

Runoff – That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface-water. It can carry pollutants from the air and land into receiving waters.

Sediment – Solid material that is in suspension, is being transported, or has been moved from its original location by air, water, gravity or ice.

Sedimentation – The addition of soils to lakes, a part of the natural aging process, making lakes shallower. The process can be greatly accelerated by human activities.

Semi-solid manure – Contains little bedding and usually no extra water added. In most cases, little drying occurs before handling. During wet weather the manure scraped from open lots can also be semi-solid in nature.

Settling basin – A basin, often concrete lined, that is a holding area for wastewater and runoff where the heavier particles sink to the bottom. The remaining fraction is then moved to another storage structure or utilized by the operation.

Silage – Forage, corn fodder, or sorghum preserved by partial fermentation. Silage is stored in air-tight stacks, pits, bags or silos. It is generally used as a feed for cattle.

Sinkhole – A depression in the landscape where limestone has been dissolved.

Soil loss tolerance ('T' value) – For a specific soil, the maximum average annual soil loss expressed as tons per acre per year that will permit current production levels to be maintained economically and indefinitely. T values range from 2 to 5 tons per acre per year.

Soil survey – A program of the Natural Resource Conservation Service to inventory soil resources as a basis for determining land capabilities and conservation treatments that are needed, provide soil information to the public (primarily through maps), and provide technical support to those who use soils information. About 90% of the private lands have been mapped.

Solid manure – Combination of urine, bedding, and feces with little or no extra water added. It is usually found in loafing barns, calving pens, and open lots with good drainage.

Source-water protection area – The area delineated by a state for a Public Water Supply or including numerous such suppliers, whether the source is ground water or surface water or both.

Sow – Female that has farrowed at least one litter.

Stallion – An unaltered (uncastrated) male horse.

Steer – Bovine male castrated prior to puberty.

Stocker cattle – Heifers and/or steers that are being grown on pasture or other forage for later sale as feedlot replacements.

Storage – Refers to the structures used to hold manure, litter, or process wastewater to reduce the need for frequent hauling and land spreading, to allow land spreading at a time when soil and climatic conditions are suitable, or to allow nutrient application at or near the crop's growing season.

Storage pond – A liquid impoundment used to hold manure and wastewater.

Stripcropping – Growing crops in a systematic arrangement of strips or bands, usually parallel to the land's contour, that serve as barriers to wind and water erosion.

T value (or T level) – For a specific soil, the maximum average annual soil loss expressed as tons per acre per year that will permit current production levels to be maintained economically and indefinitely; the soil loss tolerance level.

Technology-based effluent limit – A permit limit for a pollutant that is based on the capability of a treatment method to reduce the pollutant to a certain concentration.

Terrace – An embankment, ridge, or leveled strip constructed across sloping soils on the contour, or at right angle to the slope. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet, decreasing rates of soil erosion.

Tile drain – Lines of concrete, clay, fiber, plastic or other suitable material pipe placed in the subsoil to collect and drain water from the soil to an outlet. Infiltrated water that is captured by drain tiles is usually diverted to surface water.

Tom – Male turkey.

Total Suspended Solids – A measure of the material suspended in wastewater. Total suspended solids (TSS) cause: (1) interference with light penetration, (2) buildup of sediment and (3) potential reduction in aquatic habitat. Solids also carry nutrients that cause algal blooms and other toxic pollutants that are harmful to fish.

Treatment pond/lagoon – An impoundment made by excavating or earth fill to biologically treat manure and wastewater.

Upset – An exceptional incident in which there is unintentional and temporary noncompliance with the permit limit because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Veal – Meat from very young cattle (under 3 months of age). Veal typically comes from dairy bull calves.

Wasteload allocation – The proportion of a receiving water's total maximum daily load that is allocated to one of its existing or future point sources of pollution.

Wastewater – Water containing waste or contaminated by waste contact, including process-generated and contaminated rainfall runoff.

Water quality standard (WQS) – A law or regulation that consists of the beneficial use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

Water quality-based effluent limit – A value determined by selecting the most stringent of the effluent limits calculated using all applicable water quality criteria (e.g., aquatic life, human health, and wildlife) for a specific point source to a specific receiving water for a given pollutant.

Water table – The top surface of the aquifer nearest ground level.

Waters of the United States – Waters of the United States or waters of the U.S. means:

(a) All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(b) All interstate waters, including interstate wetlands;

(c) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

(1) Which are or could be used by interstate or foreign travelers for recreational or other purposes;

(2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

(3) Which are used or could be used for industrial purposes by industries in interstate commerce;

(d) All impoundments of waters otherwise defined as waters of the United States under this definition;

(e) Tributaries of waters identified in paragraphs (a) through (d) of this definition;

(f) The territorial sea; and

(g) Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) through (f) of this definition.

Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR part 423.11(m) which also meet the criteria of this definition) are not waters of the United States. This exclusion applies only to manmade bodies of water which neither were originally created in waters of the United States (such as disposal area in wetlands) nor resulted from the impoundment of waters of the United States. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA.

Watershed – The surrounding land area that drains into a lake, river or river system.

Wet lot – Wet system, or liquid manure handling system.

Wetlands – A lowland area, such as a marsh, bog, swamp, or similar saturated with water. Wetlands are crucial wildlife habitat, and important for flood control and maintaining the health of surrounding ecosystems.

Yield – The number of bushels (or pounds or hundred weight) that a farmer harvests per acre.

Chapter 1

1. Introduction

1.1. Overview

The *NPDES Permit Writers' Manual for Concentrated Animal Feeding Operations* provides information to National Pollutant Discharge Elimination System (NPDES) permit writers on permitting requirements for Concentrated Animal Feeding Operations (CAFOs). The information in the Manual may also be useful for inspectors, facility operators, and the general public. The Manual replaces the 2003 *Permit Writers' Guidance Manual and Example NPDES Permit for Concentrated Animal Feeding Operations*. The new version reflects the current NPDES regulations and Effluent Limitation Guidelines (ELGs) applicable to CAFOs under the Clean Water Act (CWA), including revisions to the regulations that the U.S. Environmental Protection Agency (EPA) finalized and published in the *Federal Register* (FR) in 2008.[1] Those requirements are collectively referred to in this Manual as *the CAFO regulations*.


Federal Register

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Part II

Environmental Protection Agency

40 CFR Parts 9, 122, and 412
Revised National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines for Concentrated Animal Feeding Operations in Response to the Waterkeeper Decision; Final Rule

The Manual does not cover types of discharges from CAFOs that trigger the requirement for a CAFO to apply for a NPDES permit. This requirement commonly referred to as the "Duty-to-Apply" requirement, will be covered in a stand-alone document. The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and setting quality standards for surface waters. Under the CWA, it is unlawful to discharge any pollutant from a point source without an NPDES permit. The CWA defines *point source* to include "any discernible, confined, and discrete conveyance, including but not limited to any … concentrated animal feeding operation … from which pollutants are or may be discharged."[2] Under the NPDES CAFO regulations, a CAFO that discharges must seek NPDES permit coverage.[3]

1.2. Background

EPA began regulating the discharges of wastewater and manure from CAFOs in the 1970s. In 2003, the Agency updated the original CAFO regulations to address changes in the animal agriculture industry sectors. 68 FR 7176 (Feb. 12, 2003). EPA subsequently published revisions to the CAFO Rule in 2008 to address a 2005 decision by the U.S. Court of Appeals for the Second Circuit in litigation challenging the 2003 regulatory updates.[4] 73 FR 70418 (Nov. 20, 2008).

At the time of the 2003 revised regulations, EPA estimated that animal feeding operations (AFOs) annually produce more than 500 million tons of animal manure.[5] This manure can pose substantial risks to the environment and public health if managed improperly. EPA projected in 2003 that the revised rule would result in annual pollutant reductions of 56 million pounds of phosphorus (P), 110 million pounds of nitrogen (N), and two billion pounds of sediment.

Today, there are slightly more than one million farms with livestock in the United States.[6] EPA estimates that about 212,000 of those farms are likely to be AFOs—operations where animals are kept and raised in confinement. Although the number of AFOs has declined since 2003, the total number of animals housed at AFOs has continued to grow because of expansion and consolidation in the industry. As Figure 1-1 shows, EPA's NPDES CAFO program tracking indicates that 20,000 of those AFOs are CAFOs—AFOs that meet certain numeric thresholds or other criteria—and that 8,000 of these CAFOs have NPDES permit coverage.[7]

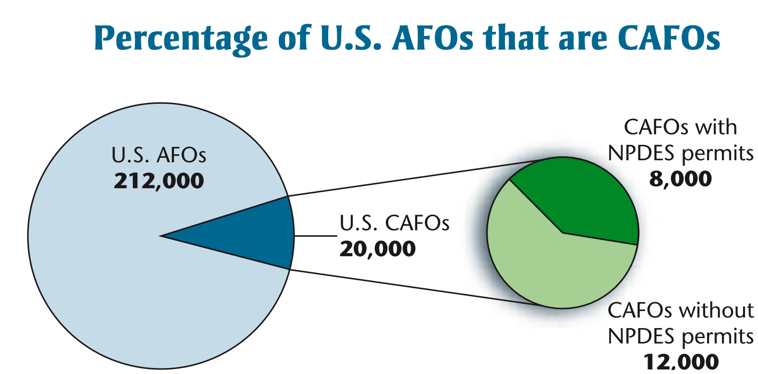


Figure 1-1. U.S. AFOs, CAFOs

The CAFO regulations identify NPDES permitting requirements for AFOs that are classified as CAFOs and that discharge. If CAFOs do not seek NPDES permit coverage, discharges from their land application areas only qualify for the agricultural stormwater exemption if the CAFOs implement and document basic nutrient management practices. EPA generally expects that the nutrient management requirements are being followed when a CAFO has developed and is implementing a comprehensive nutrient management plan (CNMP) in accordance with the U.S. Department of Agriculture (USDA) guidance. For permitted CAFOs, nutrient management plans developed and implemented as a condition of an NPDES permit must be based on applicable technical standards for nutrient management established by the NPDES permitting authority.[8]

The federal CAFO program is designed to support and complement an array of voluntary and regulatory programs administered by USDA, EPA, and states (e.g., EQIP, Idaho One Plan, New York's AEM program). The CAFO regulations are an integral part of an overall federal strategy to support a vibrant agricultural economy while simultaneously ensuring that all AFOs manage their manure in a manner that is protective of the environment. EPA and USDA have worked collaboratively to ensure that USDA's voluntary programs and EPA's regulatory and voluntary programs complement each other and support effective nutrient management by all AFOs. EPA and USDA will continue to coordinate the development and implementation of regulatory and non-regulatory tools (e.g., software, guidance, conservation practices) to support both agricultural and environmental protection goals.

1.3. Purpose and Organization of this Manual

This Manual provides information to NPDES permitting authorities on how to implement the CWA NPDES regulations for CAFOs:

- **Chapter 2** describes livestock operations that are regulated under the NPDES CAFO program. This description covers how EPA which livestock operations are AFOs and how, once an operation is defined as an AFO, it is then determined to be a CAFO. As mentioned above, the manual does not cover when CAFOs need NPDES permit coverage as this topic is covered in a separate EPA document.

- **Chapter 3** discusses the two options NPDES permitting authorities have for issuing NPDES permits for CAFOs: individual permits and general permits. It describes the administrative process for both options and provides examples of situations in which each option is most appropriate.

- **Chapter 4** discusses the critical elements of an NPDES permit for a CAFO. Those elements include effluent limitations and standards, monitoring, reporting and record-keeping requirements, special conditions, and standard conditions. It provides a detailed description of the requirements for each element and how to write a permit with enforceable terms and conditions.

- **Chapter 5** provides technical information on the nine basic components of a nutrient management plan (NMP) as required by the NPDES CAFO regulations. It also provides examples of permit terms reflecting the nine minimum measures.

- **Chapter 6** focuses specifically on the portion of the NMP that establishes protocols for land applying manure, litter, and process wastewater. It explains how to write permit terms using the two approaches—linear and narrative—outlined in the NPDES CAFO regulations.

The Manual assumes that the reader has a working knowledge of how NPDES permits are developed. Permit writers should also be familiar with applicable state voluntary and regulatory programs, and how those programs relate to the federal or state NPDES programs. The appendices contain supplementary information that is relevant to CAFOs and CAFO permitting. That information will also be of interest to CAFO owner/operators, the general public, and permit writers.

1.4. Limitations of the Manual

Although the Manual provides clarification of NPDES CAFO regulatory requirements, it does not alter or substitute for any of the NPDES CAFO regulations. The Manual, including the example permit and example NMP, is not a rule, is not legally enforceable, and does not confer legal rights or impose legal obligations on any federal or state agency or on any member of the public. If a conflict is apparent between the Manual and any statute or regulation, the Manual is not controlling. EPA has made every effort to ensure the accuracy of information in the Manual, but obligations of the regulated community are determined by the relevant statutes, regulations, or other legally binding requirements.

It is important to note that the Manual does not cover a CAFO's "Duty-to-Apply" for NPDES permit coverage. That topic was covered separately in prior EPA guidance, and EPA is at present updating both the NPDES CAFO regulations as well as the related guidance to reflect the 2011 legal decision in litigation on this topic. See *Nat'l Pork Producers Council v. EPA*, 635 F.3d 738 (5th Cir. 2011). In that decision, the court vacated the requirement that CAFOs that *propose to* discharge must apply for an NPDES permit, but upheld the duty to apply for discharging CAFOs.

Permit writers should be aware that other NPDES requirements besides CAFO requirements may apply to CAFOs. For example, Chapter 4 discusses the need for NPDES stormwater permits. In addition, states authorized to implement the NPDES permitting program have the option of establishing more stringent NPDES requirements than those laid out in the federal regulations.[9]

The Manual does not cover NPDES requirements for live animal receiving and holding areas at Meat and Poultry Processing (MPP) facilities. Those facilities are engaged in the slaughtering, dressing, and packing of meat and poultry products and are not included in EPA's definition of an AFO. That industry is considered a different point source category and is covered by a separate set of NPDES requirements connected with the ELG for the sector as laid out in 40 CFR part 432.

The word *should* as used in the Manual, including the example permit and example NMP, does not connote a requirement, but it does indicate EPA's recommendation for effective implementation of legal requirements and protection of the environment. The Manual might not apply in a situation according to the circumstances, and EPA, states and tribes have the discretion to adopt approaches on a case-by-case basis that differ from the Manual. Permitting authorities will make each permitting decision on a case-by-case basis and will be guided by the applicable requirements of the CWA and implementing regulations, taking into account comments and information presented at appropriate times by interested persons.

EPA may decide to revise the Manual without public notice. The public may offer suggestions to EPA for clarifications at any time.

Endnotes

1 Title 40 of the *Code of Federal Regulations* (CFR) 122.23 *et seq.*, as published in 73 *Federal Register* (FR) 70418.

2 CWA section 502(14)

3 40 CFR § 122.23(d)(1)

4 *Waterkeeper Alliance et al. v. EPA*, 399 F.3d 486 (2d Cir. 2005)

5 The term manure as used here and throughout the Manual refers to manure, litter, and process wastewater.

6 2007 U.S. Department of Agriculture Census of Agriculture

7 NPDES CAFO Rule Implementation Status—National Summary, Midyear 2011

8 See 40 CFR part 412.4(c)(2)

9 40 CFR § 123.25(a)

Chapter 2

2. AFOs and CAFOs

2.1. Animal Feeding Operations (AFOs)

When Congress passed the CWA in 1972, it specifically included the term *concentrated animal feeding operation* in the definition of *point source*. CWA § 502(14). Before EPA defined the CWA term *concentrated animal feeding operations* in the 1976 CAFO regulations, the 1974 ELGs for the Feedlots Point Source Category, formerly 40 CFR part 412.11(b), defined a *feedlot* to mean "a concentrated, confined animal or poultry growing operation for meat, milk or egg production, or stabling, in pens or houses wherein the animals or poultry are fed at the place of confinement and crop or forage growth or production is not sustained in the area of confinement." Similarly, the support documentation for the ELG [see, for example, EPA's *Development Document for the Final Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operation*, EPA-821-R-03-001 (2002)] distinguished between animals grown in feedlots and those grown in non-feedlot situations. The development document defines feedlot using the following three conditions:

1. A high concentration of animals held in a small area for periods in conjunction with one of the following purposes:
    a. Production of meat.
    b. Production of milk.
    c. Production of eggs.
    d. Production of breeding stock.
    e. Stabling of horses.
2. The transportation of feed to animals for consumption.
3. By virtue of the confinement of animals or poultry, the land or area will neither sustain vegetation nor be available for crop or forage.

In 1976 EPA revised its regulations in response to a court case holding that EPA could not exempt certain categories of point sources from NPDES permit requirements. *NRDC v. Train*, 396 F. Supp. 1393 (D.D.C. 1975), *aff'd NRDC v. Costle*, 586 F.2d 1369 (D.C. Cir. 1977).The revised regulations refer to *CAFOs* rather than *feedlots*. 41 FR 11458 (March 18, 1976). The 1976 rule defined which facilities were CAFOs, and therefore point sources under the CWA, and established permitting requirements for CAFOs. *Id*. EPA's 1976 definition of CAFO draws on the definition of a CAFO from the 1974 feedlot definition. Although the definition of the term CAFO was further revised in the 2003 CAFO regulations, the types of facilities covered by the definition are nearly identical to those in the original definition of a feedlot.

A facility must first meet the definition of an AFO before it can be considered a CAFO. AFOs are defined as, "operations where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period and where vegetation is not sustained in the confinement area during the normal growing season." 40 CFR § 122.23(b)(1). EPA interprets *maintained* to mean that the animals are confined in the same area where waste is generated or concentrated. Areas where animals are maintained can include areas where animals are fed and areas where they are watered, cleaned, groomed, milked, or medicated. For an overview of the livestock industry, see *Chapter 4 of the Technical Development Document for the 2003 CAFO regulations*.

Regulatory Citation

Animal feeding operation (AFO) means a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

Animals have been, are or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period.

AND

Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

40 CFR § 122.23(b)(1)

The first part of the regulatory definition of an AFO means that animals must be kept on the lot or facility for a minimum of 45 days in a 12-month period. If an animal is confined for any portion of a day, it is considered to be on the facility for a full day. For example, dairy cows that are brought in from pasture for less than an hour to be milked are counted as being confined (i.e., on the lot or facility) for the day. In addition, the same animals are not required to remain on the lot for 45 days or more for the operation to be defined as an AFO. Rather, the first part of the regulatory definition is met if some animals are fed or maintained on the lot or facility for 45 days out of any 12-month period. The 45 days do not have to be consecutive, and the 12-month period does not have to correspond to the calendar year. For example, June 1 to the following May 31 would constitute a 12-month period. Therefore, animal operations such as stockyards, fairgrounds, and auction houses where animals may not be fed, but are confined temporarily, may be AFOs.

The second part of the regulatory definition of an AFO distinguishes confinement areas from pasture or grazing land. That part of the definition relates to the portion of the facility where animals are confined and where natural forage or planted vegetation does not occur during the normal growing season. Confinement areas might have some vegetative growth along the edges while animals are present or during months when animals are kept elsewhere. If a facility maintains animals in an area without vegetation, such as dirt lots with incidental vegetative growth, the facility meets the second part of the AFO definition.

True pasture and rangeland operations are not considered AFOs because animals at those operations are generally maintained in areas that sustain crops or forage growth during the normal growing season. In some pasture-based operations, animals can freely wander in and out of areas for food or shelter; that is not considered confinement. In general, an area is a pasture if vegetation is maintained during the normal growing season. However, pasture and grazing-based operations can also have confinement areas (e.g., feedlots, barns, milking parlors, pens) that meet the definition of an AFO.

Incidental vegetation in a clear area of confinement would not exclude an operation from meeting the definition of an AFO. In the case of a winter feedlot, the second part of the AFO definition (i.e., no vegetation) is meant to be evaluated during the winter, when the animals are confined. Animals from a grazing operation can be confined during winter months in a confinement area that had vegetation during other parts of the year. If the animals are confined for more than 45 days but not year-round and vegetation emerges in the spring when animals are removed, the presence of vegetation does not prevent that feedlot from being defined as an AFO because the vegetation is growing when animals are not present. In that example, the feedlot will not sustain the vegetation that had emerged in spring once the animals are moved back into the feedlot. Therefore, the facility in the example meets the definition of an AFO.

Winter feeding of cattle. (Photo courtesy of USDA/NRCS)

Is this animal production operation an AFO?

Example A: An operation confines its animals for 10-day intervals every month for 5 months. The animals are kept in an enclosure with slot floors.

> ***Answer:*** The operation meets the AFO definition because it confines animals for a total of 50 days (i.e. more than 45 days) in a 12-month period, and the confinement area has slot floors and therefore sustains no vegetation.

Example B: An operation confines mature animals in pens of five each. It has 200 pens per building and five buildings. The animals are confined year-round.

> ***Answer:*** The operation is an AFO because it confines animals for 45 days or more and does not sustain vegetation in the confinement area.

Example C: An operation raises beef cattle in a 5,000-acre pasture from April 1 through November 30 each year. From December 1 through March 3, the cattle are confined by a fence to a 10-acre area. The animals are not free to move between the temporary confinement area and the pasture area. The growing season for the area in which the operation is located is from May 1 through October 15. A site visit is made to the operation during January, and the 10-acre area where the animals are confined has vegetation on less than 5 percent of the ground; the other areas are barren soil or packed manure. The confinement area was completely covered by vegetation during a prior visit to the operation during August.

> ***Answer:*** While the operation is pasture-based for most of the year, it meets the definition of an AFO. The animals are held in confinement for more than 45 days, and the vegetation has been denuded to the point that it is incidental while the animals are in confinement. The fact that the vegetation reestablishes itself some time after the animals have been released from confinement does not change the fact that the winter confinement results in the operation meeting the definition of an AFO.

Example D: A beef cattle operation maintains the herd on pastures from March 15 through November 15. From November 16 through March 14, the herd is moved to a fenced field where crops were grown during the spring and summer. During the winter, while the animals are confined to the field, the animals eat all the post-harvest residue and other vegetation that remained in the field after the crops were harvested. Additional feed is also brought to the field to sustain the herd throughout the winter.

> ***Answer:*** The operation meets the AFO definition. The animals are confined and fed for more than 45 days in a 12-month period (November through March). Although the confinement area is used for crop production during times when the animals are grazing on pasture, the vegetation is not sustained during the period when the animals are confined there.

Example E: An operation raises beef cattle in a 10,000-acre pasture rangeland. In the winter, food is brought to various locations in the pasture rangeland to sustain the animals. The area immediately around the food supply is rendered barren of vegetation. However, the animals have full access to the pasture area.

> ***Answer:*** The operation is not an AFO because the animals are free to move within the entire pasture, and the vegetation is sustained in pasture areas.

Is this animal production operation an AFO? *(continued)*

Example F: An operation raises beef cattle in a 2,000-acre pasture. In the winter, the animals congregate in a smaller area (e.g., 100 acres), and have access to a creek as their primary source of water. The area immediately around the creek is rendered barren of vegetation when the animals are present. The barren area constitutes approximately 10 percent of the 100-acre wintering area. The remainder of the 100 acres retains vegetative cover.

Answer: The operation is not an AFO because vegetation is sustained in the confinement area while the animals are present. While the practices at the operation do not result in it meeting the definition of an AFO, the practices are not protective of water quality. EPA would encourage such an operation to provide an alternative water source to keep the animals out of the creek to reduce potential water quality impacts.

Example G: An operation raises cattle on pasture; however, a number of the cattle are confined for birthing each spring. The confinement area is a dirt-floored pen that has only incidental vegetation along the edges and in some small areas in the pen. The animals are in the pen for 90 days each spring.

Answer: The operation meets the AFO definition. The animals are confined and fed for more than 45 days, and the vegetation in the confinement area is only incidental.

Example H: An operation raises cattle on pasture; however, as part of the rotational grazing program the cattle frequently are moved between smaller, fenced pasture areas. Cattle move between pastures in narrow laneways that are largely devoid of vegetation. The barren area constitutes less than 10 percent of the pasture areas, and the remainder of the acres retains vegetative cover year-round. The animals are not fed or watered in the laneways and are prevented from congregating in the laneways by gates and fencing.

Answer: The operation does not meet the AFO definition. The animals are not confined in the laneways that are devoid of vegetation.

2.2. Concentrated Animal Feeding Operations (CAFOs)

This section provides information to help identify which AFOs are CAFOs. An AFO is a CAFO if it meets the regulatory definition of a Large or Medium CAFO, 40 CFR parts 122.23 (b)(4) or (6), or has been designated as a CAFO, 40 CFR part 122.23(c), by the NPDES permitting authority or by EPA (see Section 2.2.8). Note that some authorized states have adopted regulatory definitions for CAFOs that are more inclusive and, therefore, broader in scope than EPA's regulations. Those facilities are subject to requirements under state law but not under federal law.

2.2.1. Types of Animal Operations Covered by CAFO Regulations

The CAFO regulations define a Large CAFO on the basis of the number of animals confined. Medium CAFOs are defined as meeting specific criteria in addition to the number of animals confined, and those criteria are discussed in Section 2.2.5. The animal types with specific threshold numbers for the Large and Medium size categories identified in the regulations are cattle, dairy cows, veal calves, swine, chickens, turkeys, ducks, horses, and sheep. *Chapter 4 of the Technical Development Document for the 2003 CAFO rule* provides descriptions of those animal types and their associated operations. An AFO that meets the small or medium size thresholds can be designated as a CAFO by the permitting authority if certain criteria are met, including that the AFO is determined to be "a significant contributor of pollutants to waters of the United States." 40 CFR § 122.23(c). For further discussion, see Section 2.2.8.

2.2.2. Animal Types Not Listed in CAFO Regulations

An operation confining any animal type (e.g., geese, emus, ostriches, bison, mink, alligators) not explicitly mentioned in the NPDES regulations and for which there are no ELGs is subject to NPDES permitting requirements for CAFOs if (1) it meets the definition of an AFO, and (2) if the permitting authority designates it as a CAFO. For a discussion of designation, see Section 2.2.8.

2.2.3. AFOs Defined as Large CAFOs

An AFO is a Large CAFO if it stables or confines equal to or more than the number of animals specified in Table 2-1 for 45 days or more in a 12-month period. The definition of a Large CAFO is based solely on the number of animals confined.

Table 2-1. Large CAFOs

Number of animals	Type of animal
700	Mature dairy cows, whether milked or dry
1,000	Veal calves
1,000	Cattle, other than mature dairy cows or veal calves (Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs.)
2,500	Swine, each weighing 55 pounds or more
10,000	Swine, each weighing less than 55 pounds
500	Horses
10,000	Sheep or lambs
55,000	Turkeys
30,000	Laying hens or broilers, if the AFO uses a liquid-manure handling system
125,000	Chickens (other than laying hens), if the AFO uses other than a liquid-manure handling system
82,000	Laying hens, if the AFO uses other than a liquid-manure handling system
30,000	Ducks, if the AFO uses other than a liquid-manure handling system
5,000	Ducks, if the AFO uses a liquid-manure handling system

Source: 40 CFR § 122.23(b)(4)

In determining whether the applicable Large CAFO threshold is satisfied, the number of animals actually maintained is considered, not the capacity of the operation.

Is this operation a Large CAFO?

Example A: An operation confines 2,800 mature swine (more than 55 pounds each) in six houses. The houses have concrete floors with conveyances to capture manure.

Answer: The operation meets the definition of an AFO; it confines animals for more than 45 days over a 12-month period and the confinement area does not sustain vegetation. The operation is a Large CAFO because it confines more than 2,500 mature swine, a number that exceeds the regulatory threshold for a Large CAFO.

Example B: A 1,000-head cow/calf operation evenly splits its calving between fall and spring. The animals are generally pastured with the exception of two 60-day periods when the cow/calf pairs are confined for weaning. Because the calving is split, only 500 cow/calves are confined in any one weaning session.

Answer: The operation meets the definition of an AFO because animals are confined for 45 days in a 12-month period. Because the operation does not confine 1,000 or more animals or cow/calf pairs for more than 45 days, the operation is not defined as a Large CAFO. The operation could be a Medium CAFO if it meets one of the two discharge criteria for the Medium CAFO category, or is designated as a CAFO by the permitting authority.

Example C: A background yard (raises feeder cattle from the time calves are weaned until they are on a finishing ration in the feedlot) has the capacity to hold 1,100 head of cattle. The facility operates year-round (animals are confined 365 days a year) and has never confined more than 800 head at any time.

Answer: The operation meets the definition of an AFO because animals are confined for 45 days in a 12-month period on a feedlot where vegetation is not sustained. Because the operation does not confine 1,000 or more animals at any one time, the operation is not defined as a Large CAFO. The operation could be a Medium CAFO if it meets one of the two discharge criteria for the Medium CAFO category, or is designated as a CAFO by the permitting authority.

2.2.4. Practices Constituting Poultry Operation Liquid-Manure Handling

The thresholds for chicken and duck AFOs in the CAFO definitions are based on the type of litter or manure handling system being used. The two systems are either a *liquid-manure handling system* or *other-than-a-liquid-manure handling system*. The animal number thresholds that determine whether the system is a CAFO for chicken or duck AFO using a liquid-manure handling system are lower than the thresholds for CAFOs that use other-than-liquid-manure handling systems.

An AFO is considered to have a liquid-manure handling system if it uses pits, lagoons, flush systems (usually combined with lagoons), or holding ponds, or has systems such as continuous overflow watering, where the water comes into contact with manure and litter. In addition, operations that stack or pile manure in areas exposed to precipitation are considered to have liquid-manure handling systems. That includes operations that remove litter from the confinement area and stockpile or store it uncovered in remote locations for even one day.

However, permitting authorities may authorize some limited period of temporary storage of litter of no more than 15 days that would not result in the facility meeting the definition of a liquid-manure handling system (e.g., where time is needed to allow for contract hauling arrangements and precipitation does not occur) (USEPA 2003, 3-6). If litter is stockpiled beyond that temporary period, the uncovered stockpile would constitute a liquid-manure handling system, and the lower CAFO thresholds for chickens and ducks would apply (see Tables 2-1 and 2-2).

Wet Lot and Dry Lot Duck Operations

Duck operations are considered to use a liquid-manure handling system if (1) the ducks are raised outside with swimming areas or ponds or with a stream running through an open lot, or (2) the ducks are raised in confinement buildings where fresh or recycled water is used to flush the manure to a lagoon, pond, or other storage structure. In addition, a duck operation that stacks manure or litter as described above for other dry poultry operations is considered to have a liquid-manure handling system.

Dry-lot duck operations include those that (1) use confinement buildings and handle manure and litter exclusively as dry material; (2) use a building with a mesh or slatted floor over a concrete pit from which manure is scraped into a solid manure storage structure; or (3) use dry bedding on a solid floor. Dry-lot duck operations are generally considered to be "operations that use other than a liquid-manure handling system."

2.2.5. AFOs that Are Medium CAFOs

An AFO is a Medium CAFO if it meets both parts of a two-part definition. The first part addresses the number of animals confined, and the second part includes specific discharge criteria. In addition, a medium-sized AFO can be designated a CAFO by the permitting authority or EPA (see Section 2.2.8). Table 2-2 lists the animal number ranges associated with the Medium CAFO definition. If an AFO confines the number of animals listed in Table 2-2 for 45 days or more in a 12-month period, it meets the first part of the definition of a Medium CAFO.

An AFO meets the discharge criteria for the second part of the Medium CAFO definition if pollutants are discharged in one of the following ways:

- Into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device.

- Directly into waters of the U.S. that originate outside the facility and pass over, across, or through the facility or otherwise come into direct contact with the confined animals.

40 CFR § 122.23(b)(6).

Table 2-2. Medium CAFOs

Number of animals	Type of animal
200–699	Mature dairy cows, whether milked or dry
300–999	Veal calves
300–999	Cattle, other than mature dairy cows or veal calves (Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs.)
750–2,499	Swine, each weighing 55 pounds or more
3,000–9,999	Swine, each weighing less than 55 pounds
150–499	Horses
3,000–9,999	Sheep or lambs
16,500–54,999	Turkeys
9,000–29,999	Laying hens or broilers, if the AFO uses a liquid-manure handling system
37,500–124,999	Chickens (other than laying hens), if the AFO uses other than a liquid-manure handling system
25,000–81,999	Laying hens, if the AFO uses other than a liquid-manure handling system
10,000–29,999	Ducks, if the AFO uses other than a liquid-manure handling system
1,500–4,999	Ducks, if the AFO uses a liquid-manure handling system

Source: 40 CFR § 122.23(b)(6)

The term *man-made device* means a conveyance constructed or caused by humans that transports wastes (manure, litter, or process wastewater) to waters of the U.S. (USEPA 1995, 8). Man-made devices include, for example, pipes, ditches, and channels. If human action was involved in creating the conveyance, it is man-made even if natural materials were used to form it. A man-made channel or ditch that was not created specifically to carry animal wastes but nonetheless does so is considered a man-made device. To be defined as a Medium CAFO, there must be an actual discharge of pollutants to waters of the U.S. However, it is not necessary for the man-made device to extend the entire distance to waters of the U.S. It is sufficient that the wastes being discharged flow through the man-made device. For example, a culvert could simply facilitate the flow of waste¬water from one side of a road to another (and subsequently into a water of the U.S.) and is a man-made device for the purposes of this provision. Also, a flushing system is a man-made device that uses fresh or recycled water to move manure from the point of deposition or collection to another location.

Definition of Production Area

Production area means that part of an AFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cow yards, barnyards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms and diversions, which separate uncontaminated stormwater. Also included in the definition of production area is any egg-washing or egg-processing facility, and any area used in the storage, handling, treatment, or disposal of mortalities.

40 CFR § 122.23(b)(8)

Tile drains in the production area are another example of a man-made device. Tile drains are underground pipes that collect subsurface water for transport away from the site. If tile drains discharge manure to waters of the U.S. from the production area of a medium-sized AFO, the facility meets discharge criterion for the Medium CAFO definition and is a Medium CAFO. An additional example would be the discharge to waters of the U.S. from a continuous-flow-through water trough system.

The Medium CAFO definition addresses discharges directly into a water of the U.S., which originate outside the facility and pass over, across, or through the facility or otherwise come into direct contact with the confined animals. The discharge criterion is met if animals in confinement at an AFO can come into direct contact with waters of the U.S. Thus, a stream running through the area where animals are confined indicates that there is a direct discharge of pollutants unless animals are prevented from any direct contact with waters of the U.S.

Is this operation a Medium CAFO?

Example A: Runoff from an earthen lot with 850 beef cattle, confined for 6 months a year, passes through a settling basin, riser pipe, concrete channel, junction box, and distribution manifold before flowing by gravity to an area where it infiltrates into the soil and does not reach waters of the U.S.

Answer: No. While the system described includes several man-made devices, the operation does not meet the definition of a Medium CAFO because the runoff does not enter waters of the U.S.

Example B: A 400-head beef cattle AFO, operated year-round, has a grassed waterway installed adjacent to the production area that transports contaminated runoff to an open field. There is no surface water in the area where the runoff is transported.

Answer: No. While a properly designed grassed waterway is a man-made device, the discharge does not reach a water of the U.S. If the discharge reached a water of the U.S., the facility would be a CAFO.

2.2.6. Operations under Common Ownership

Under the CAFO regulations, two or more AFOs under common ownership are considered one operation if, among other things, they adjoin each other (including facilities that are separated only by a right-of-way or a public road) or if they use a common area or system for managing wastes. 40 CFR § 122.23(b)(2). For example, operations generally meet the criterion where manure, litter, or process wastewater are commingled (e.g., stored in the same pond, lagoon, or pile) or are applied to the same cropland.

In determining whether two or more AFOs are under common ownership, the number of managers is not important. Two AFOs could be managed by different people but have a common owner (e.g., the same family or business entity owns both). For facilities under common ownership that either adjoin each other or use a common area or system for waste disposal, the cumulative number of animals confined is used to determine if the combined operation is a Large CAFO and is used in conjunction with the discharge criteria in Section 2.2.5 to determine if the combined operation is a Medium CAFO.

Is this operation under Common Ownership?

Example: If a single farm has six chicken houses with a total of 125,000 birds, and the houses are managed by two people, is the farm considered a CAFO?

> ***Answer:*** Yes. The chicken houses are part of a single operation and presumably use a common area or system for the disposal of wastes; therefore, the entire operation is a Large CAFO. The number of managers is not relevant.

2.2.7. Operations with Multiple Animal Types

Under the CAFO regulations, multiple types of animals are not counted together to determine the type and size of a CAFO. However, once an operation is defined as a CAFO on the basis of a single animal type, all the manure generated by all animals confined at the operation are subject to NPDES requirements. If wastestreams from multiple livestock species subject to different regulatory requirements are commingled at a CAFO, any NPDES permit for the facility must include the more stringent ELG requirements. 2003 CAFO Rule, 68 FR 7176, 7,195 (Feb. 12, 2003). See Appendix N, References for NPDES Permit Writers.

In situations where immature animals (e.g., heifers and swine weighing less than 55 lbs) are confined along with mature animals, the determination of whether the operation is defined as a CAFO depends on whether the mature or immature animals separately meet the applicable threshold. Operations that specialize in raising only immature animals (heifers, swine weighing less than 55 lbs, and veal calves) have specific thresholds under the regulations. However, once an AFO is defined as a CAFO, manure generated by all the animals in confinement would be addressed by the CAFO's NPDES permit if it is a permitted CAFO.

Is this AFO a CAFO?

Example A: A dairy operation confines year-round 275 dry mature dairy cows, 500 lactating mature dairy cows, and 800 heifers.

Answer: The operation meets the definition of a Large CAFO because it confines more than 700 (in this case 775) mature dairy cows, milked or dry for more than 45 days. The 800 heifers alone would not meet the threshold for a Large CAFO. If the CAFO obtains permit coverage, the manure from all the animals confined, including the heifers, would be subject to the ELG and would need to be addressed in the CAFO's NMP.

Example B: A swine nursery operation has 15,000 piglets that range in weight from 40 to 60 pounds. The operation also has a farrowing house with 2,200 sows and approximately 13,000 piglets that are not weaned. The operation maintains that number of animals year-round.

Answer: The operation would meet the definition of a Large CAFO if it has at least 10,000 piglets that weigh under 55 pounds confined for more than 45 days. If the CAFO obtains permit coverage, the manure from all the animals confined would be subject to the ELG and would need to be addressed in the CAFO's NMP.

Example C: An operation confines for more than 45 days 250 beef cattle, 20 horses, and 22,000 chickens (does not use a liquid-manure handling system).

Answer: The operation does not meet the definition of a CAFO. The number of animals of any one animal type that are confined for 45 days in a 12-month period does not exceed the thresholds for a Large or Medium CAFO. Because sufficient animals are not confined, there is no need to determine whether the AFO meets one of the two discharges criteria to be defined as Medium CAFO. However, the operation could still be designated as a CAFO if the appropriate authority determines that the operation is a significant contributor of pollutants to waters of the U.S.

An operation that confines multiple animals types, where no one type meets the Large or Medium CAFO threshold, can be designated as a CAFO if it is found to be a significant contributor of pollutants to waters of the U.S. For additional discussion of designated CAFOs, see Section 2.2.8.

2.2.8. AFOs Designated as CAFOs

The CAFO regulations set the standards for the Director (either the Regional Administrator or the NPDES permitting authority) to designate any AFO as a CAFO if the AFO is a significant contributor of pollutants to waters of the U.S.[1] Designation provides for protection of surface water quality while maintaining flexibility for states or other entities to assist small and medium AFOs to mitigate the conditions that could subject the AFO to NPDES requirements.[2]

The Director may designate any AFO as a CAFO on a case-by-case basis if he determines that the AFO is a significant contributor of pollutants to waters of the U.S. as specified in 40 CFR part 122.23(c). AFO operations that may be considered for designation include the following:

- A medium-sized AFO that is not defined as a CAFO and is determined to be a significant contributor of pollutants to waters of the U.S. The definition of a Medium CAFO is in the text box provided.
- A small AFO (i.e., confines fewer than the number of animals defined in Table 2-2) that meets one of the methods of discharge criteria in 40 CFR sections 122.23(c)(3)(i), (ii) and is determined to be a significant contributor of pollutants to waters of the U.S.
- An AFO that raises animals other than species identified in the regulatory definitions of Large and Medium CAFOs and is determined to be a significant contributor of pollutants to waters of the U.S. Examples of such AFOs include geese, emus, ostriches, llamas, minks, bison, and alligators.

Medium CAFO Definition Discharge

- Pollutants are discharged into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device; or
- Pollutants are discharged directly into waters of the U.S. that originate outside and pass over, across, or through the facility or otherwise come into direct contact with animals confined in the operation.

40 CFR §§ 122.23(b)(6)(ii)(A), (B)

2.2.9. Process for Designating an AFO as a CAFO

For an AFO to be designated as a CAFO, the Director must determine that the AFO is a significant contributor of pollutants to waters of the U.S. 40 CFR part 122.23(c). Once an operation is designated as a CAFO, it must seek coverage under an NPDES permit and, among other things, develop and implement an NMP.

Under 40 CFR part 122.23(c)(3), an AFO may not be designated as a CAFO until the NPDES permitting authority or EPA has determined that the operation should and could be regulated under the permit program and conducted an inspection of the operation. In addition, a small AFO may not be designated as a CAFO unless it also meets the small AFO discharge criteria, 40 CFR parts 122.23(c)(3)(i), (ii), and is determined to be a significant contributor of pollutants to waters of the U.S. EPA recommends that the designation process be conducted as soon as possible following the inspection. Regardless of when an inspection takes place, the designation should be based on current information.

In determining whether an AFO is a significant contributor of pollutants to waters of the U.S., the permitting authority or EPA Regional Administrator (see Section 2.2.10) will consider the factors specified in 40 CFR part 122.23(c)(2), which are listed in the left-hand column of Table 2-3, below. The right-hand column in Table 2-3 gives examples of case-by-case designation factors that can be assessed during the designation inspection. The assessment of regulatory factors may be based on visual observations and water quality monitoring and other sources of relevant information.

Table 2-3. Example factors for case-by-case CAFO designation

Designation factor	Example factors for inspection focus
Size of the operation and amount of wastes reaching waters of the U.S.	• Number of animals • Type of feedlot surface • Feedlot design capacity • Waste handling/storage system design capacity
Location of the operation relative to waters of the U.S.	• Location of waterbodies • Location of floodplain • Proximity of production area and land application area to waters of the U.S. • Depth to groundwater, direct hydrologic connection to waters of the U.S. • Located in an impaired watershed
Means of conveyance of animal wastes and process wastewaters into waters of the U.S.	• Identify existing or potential man-made (includes natural and artificial materials) structures that could convey waste • Direct contact between animals and waters of the U.S.
Slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of manure into waters of the U.S.	• Slope of feedlot and surrounding land • Type of feedlot (concrete, soil) • Climate (e.g., arid or wet) • Type and condition of soils (e.g., sand, karst) • Drainage controls • Storage structures • Amount of rainfall • Volume and quantity of runoff • High water table • Buffers
Other relevant factors	• History of noncompliance • Use of conservation practices to minimize nutrient transport to waters of the U.S. • Working with USDA or Soil and Water Conservation District to improve operation

Following the on-site inspection for designation, the NPDES permitting authority should prepare a brief report that (1) identifies findings and any follow-up actions, (2) determines whether the facility should or should not be designated as a CAFO, and (3) documents the reasons for that determination. Regardless of the outcome, the permitting authority should prepare a letter to inform the facility of the results of the inspection and, if appropriate, propose that the facility be designated as a CAFO. The letter should explain that EPA regulations would require the operation to seek coverage under an NPDES permit if it is designated. After providing the CAFO a reasonable opportunity to respond with any questions or concerns, the permitting authority may then send the CAFO a final designation letter. The letter should indicate whether a general permit is available or whether an individual permit application should be submitted by a specific date.

In those cases where a facility has not been designated as a CAFO but the NPDES permitting authority has identified areas of concern, the authority should note those areas in the letter. The letter should state that if the concerns are not corrected, the facility could be designated as a CAFO in the future. The letter should also include a date for a follow-up inspection to determine whether the concerns have been adequately addressed. Samples of letters that would be used at the conclusion of a designation inspection are in Appendix B, Example Letters to Owners/Operators after a Site Visit.

The following are examples of situations that might warrant CAFO designation.

- An AFO that maintains 350 cattle is adjacent to a river that is impaired as a result of nutrient loading. The operator routinely piles the waste next to the enclosure where it remains until a contract hauler picks it up. The waste is removed monthly, but precipitation occurs several times a month; runoff from the stockpiled manure flows through naturally occurring channels in the ground to the river. The facility would be a candidate for inspection and designation as a CAFO (the permitting authority also could recommend site modification). Note that an AFO that confines the number of animals specified in 40 CFR part 122.23(b)(6) (Medium CAFO) does not need to meet the discharge criteria specified in parts 122.23(c)(3)(i) or (ii) to be designated as a CAFO. For a discussion of Medium CAFOs, see Section 2.2.5.
- An AFO with 650 swine is crossed by a stream that originates outside the facility. The stream flows through an open lot where the animals are confined and continues on to connect with other waters of the U.S. beyond the facility. The facility would be a candidate for inspection and designation as a CAFO. Because the facility is a small AFO, meeting one of the discharge criteria in 40 CFR parts 122.23(c)(3)(i) or (ii) is a necessary condition for designation.

2.2.10. EPA Designation in NPDES Authorized States

The CAFO regulations authorize the EPA Regional Administrator to designate AFOs as CAFOs in NPDES-authorized states and tribal areas where the Regional Administrator has determined that one or more pollutants in an AFO's discharge contribute to an impairment in a downstream or adjacent state or Indian country water that is impaired for that pollutant or pollutants.

Such designation is based on assessment of the factors in §122.23(c)(2) and requires an on-site inspection. Upon designation by EPA, the operation would be required to apply to the permitting authority for permit coverage. EPA designation in NPDES-authorized states is intended to ensure consistent implementation of designation requirements across state or tribal boundaries where serious water quality concerns exist. If EPA decides that the AFO does not need to be designated as a CAFO, EPA may work with the state permitting authority to identify other appropriate actions.

References

USEPA (U.S. Environmental Protection Agency). 1995. *Guide Manual on NPDES Regulations for Concentrated Animal Feeding Operations*. EPA-833-B-95-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002. *Development Document for the Final Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operation*. EPA-821-R-03-001. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2003. *NPDES Permit Writers' Guidance Manual and Example Permit for Concentrated Animal Feeding Operations*. EPA-833-B-04-001. U.S. Environmental Protection Agency, Washington, DC.

Endnotes

[1] 40 CFR part 122.23(c); for more information about EPA designation in authorized states, see Section 2.2.10.

[2] The Manual does not address how the CWA applies to discharges from AFOs that are not defined or designated as CAFOs.

Chapter 3

3. Appropriate Permitting Strategies for CAFOs

NPDES permitting authorities have two options for issuing NPDES permits to CAFOs: individual permits and general permits. This chapter describes the administrative process for both permitting options and situations in which one or the other might be more appropriate.

3.1. NPDES CAFO Permit Applications and Notice of Intent

CAFO owners and operators who are required to seek permit coverage must either submit an application for an individual permit or submit a Notice of Intent (NOI) (or permitting authority's comparable form) for coverage under a general permit, if a general permit is available. 40 CFR § 122.23(d)(1).

The 2008 CAFO regulations amend the information requirements for seeking coverage under an NPDES permit for CAFOs. The regulations revised the NPDES individual permit application and general permit NOI form for CAFOs (Form 2B); specifically, the information required to be submitted for coverage under either type of CAFO permit. 40 CFR §§ 122.21(i)(1), 122.23(h). The permitting authority can use Form 2B for both NPDES CAFO permit applications and NOIs. The NOI/Permit Application for CAFOs is located at *http://www.epa.gov/npdes/pubs/cafo_fedregstr_form2b.pdf*. EPA requires applicants who seek coverage under either individual or general CAFO permits to provide, at a minimum, the information listed in Table 3-1.

To the extent that a permitting authority needs additional information to review a permit application, the NPDES permitting authority may request additional information from the applicant and use other Clean Water Act (CWA) information-gathering authorities, such as CWA part 308, to obtain such information.

Table 3-1. Information required on NPDES application forms 1 and 2B

Form 1 (all NPDES individual permit applicants) 40 CFR § 122.21 (f)	Activities conducted by the applicant that require an NPDES permit
	Name, mailing address, and location of facility
	Up to four Standard Industrial Classification codes that best reflect the principal products or services provided
	Operator's name, address, and telephone number and ownership status
	Whether the facility is on Indian lands
	List of all other state or federal permits or construction approvals received or applied for under CWA, Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), etc.
	Brief description of the nature of the business
Form 2B (CAFOs) 40 CFR § 122.21 (i)	The name, address, and telephone number of the owner or operator
	Whether the application is for an existing or proposed facility
	Facility name, address, and telephone number
	Latitude and longitude of the production area
	Name and address of integrator for contract operations
	Specific information about the number and type of animals, whether in open confinement or housed under roof
	Total number of acres under control of the applicant available for land application of manure, litter, or process wastewater
	Estimated amounts of manure, litter, and process wastewater generated per year
	Estimated amounts of manure, litter, and process wastewater transferred to other persons per year
	Topographic map of the geographic area in which the CAFO is located showing the specific location of the production area
	Containment and storage type and storage capacity for manure, litter, and process wastewater
	A nutrient management plan that satisfies the requirements specified in 40 CFR part 122.42(e), including, for all CAFOs subject to 40 CFR part 412, subpart C or subpart B, the requirements of 40 CFR part 412.4(c), as applicable
	Indication of whether a nutrient management plan is being implemented
	Date of last nutrient management plan review or revision
	Description of alternative uses of manure, litter, and process wastewater
	Identification of land application best management practices implemented

3.1.1. CAFO Permit Application or Notice of Intent Requirements for Nutrient Management Plans

Any CAFO seeking NPDES permit coverage must submit an NMP as part of its permit application to be covered by an individual permit or an NOI to be covered by a general permit. 40 CFR §§ 122.23(h), 122.42(e)(1). The NMP must meet the requirements of 40 CFR part 122.42(e). NMPs for Large CAFOs subject to subparts C or D of 40 CFR part 412 must also meet the requirements of part 412.4(c), as applicable. 40 CFR §§ 122.21(i)(1)(x), 122.23(h). EPA's application Form 2B reflects those changes. The NOI/Permit Application for CAFOs is located at *http://www.epa.gov/npdes/pubs/cafo_fedregstr_form2b.pdf*.

An NMP is a manure and wastewater management tool that every permitted CAFO must use to properly manage discharges from the production or land application areas. The requirements for an NMP are discussed in Section 4.1.7 and Chapters 5 and 6 of this Manual.

3.2. Individual NPDES Permits for CAFOs

An individual permit is a permit specifically tailored for an individual facility. Upon receiving a permit application from a facility seeking permit coverage, the permitting authority must make a determination whether to issue a permit or request additional information from the facility seeking permit coverage. After determining that a facility is eligible for permit coverage, the permitting authority develops a permit for the facility on the basis of the information in the permit application (e.g., type of activity, nature of discharge, receiving water quality). Following notice and the opportunity for public comment, the permit is then issued to the facility for a specific period (not to exceed 5 years) with a requirement to reapply before the expiration date.

The permitting authority may decide to use individual permits for some of or all the CAFOs within the jurisdiction of the permitting authority. Those include circumstances in which the permitting authority prefers, for administrative reasons, to use individual permits for all permitted CAFOs and situations in which an individual permit is the appropriate permit mechanism for a facility.

Following are reasons why a permitting authority might use individual permits for all permitted CAFOs:

- A small number of CAFOs are in the permitting authority's jurisdiction.
- Historical use of individual CAFO permits by the permitting authority.
- Preference to stagger review of site-specific information in determining appropriate permit conditions.

Alternatively, a permitting authority may elect to use a general permit for some CAFOs and individual permits for other CAFOs. For example, the permitting authority might prefer to use an individual permit for a CAFO that presents unique circumstances best addressed through the individual permitting process, or the permitting authority may require a CAFO that discharges, but is not eligible for coverage under a general permit, to apply for and obtain an individual NPDES permit. In addition, the permitting authority may require any CAFO authorized by a general permit to apply for coverage under an individual NPDES permit. 40 CFR §§ 122.23(h)(3), (b)(3). Further, any interested person may petition the permitting authority to require a CAFO to apply for coverage under an individual permit. 40 CFR § 122.28(b)(3).

Whether a CAFO should be required to obtain an individual NPDES permit, even where the CAFO might be eligible for or covered by a general permit, is a determination that remains within the discretion of the permitting authority. 40 CFR § 122.28(b)(3). In making such a determination, the permitting authority might wish to consider the following factors, such as whether the CAFO

- Is exceptionally large (existing and new operations).
- Has historical compliance problems.
- Has significant site-specific environmental concerns (e.g., proximity to a water of the U.S., discharges of stormwater from outside the production area, or other discharges that are not specifically addressed by the general permit).
- Is in an area of significant environmental concern or with particular water quality impairment (may also be addressed in a watershed permit).

Individual permits may be appropriate for CAFOs that have significant site-specific environmental concerns (e.g., proximity to a water of the U.S., discharges of stormwater from outside the production area, or other discharges that are not specifically addressed by the general permit). (Source: New Mexico Environment Department *(left)*; USDA/NRCS *(right)*)

- Is subject to voluntary alternative performance standards for the production area (see Appendix F, Voluntary Alternative Performance Standards for CAFOs).
- Is subject to additional state requirements that apply to specific areas or operations (may also be addressed in a watershed permit).
- Have operations subject to other NPDES permits (e.g., slaughterhouses, ethanol plants), the complexity of which warrants consolidation of multiple types of permit conditions into a single, comprehensive, individual permit.

Proximity of production areas to waters of the U.S. is a consideration for requiring an individual permit. (Photo courtesy of USDA/NRCS)

3.2.1. Developing Individual NPDES Permits for CAFOs

An individual NPDES permit for a CAFO is developed in the same manner as an NPDES permit for a facility in any other sector. After receiving the permit application, the permit writer develops a draft permit and fact sheet for a facility on the basis of the information in the facility's submitted application.[1] In addition, where facility inspection report(s) are available to the permitting authority, they may be used to supplement the development of permit conditions. Appendix N, References for NPDES Permit Writers, contains a list of possible references for the permit writer in support of NPDES permit development.

The permit application (including the facility-specific NMP), draft permit, and fact sheet must be made available for public review and comment. 40 CFR § 124.10(d)(iv). EPA expects that the additional information in the application and public notice together will provide the public with a meaningful opportunity to review the CAFO's NMP and the detailed requirements of the draft permit, including the terms of the NMP to be included in the permit, and provide the public with the opportunity to comment on the adequacy of both the NMP and the terms and conditions of the permit. After reviewing the draft permit and the permit

A location with historical compliance problems may need an individual permit. (Photo courtesy of USDA/NRCS)

An individual permit can be used for facilities subject to voluntary alternative performance standards, such as this CAFO with a settling basin and filter strip. (Photo courtesy of USDA/NRCS)

application, including the facility-specific NMP, and any other documentation requested by the permitting authority (e.g., plans and specifications for waste storage structures), the public would have an opportunity to seek more information, to raise concerns, or to request a hearing. The public notification and review process is discussed in more detail below in Section 3.4.

Water quality-based effluent requirements must also be included in permits where technology-based requirements are not sufficient to ensure compliance with state water quality standards or where required to implement a Total Maximum Daily Load (TMDL). If water quality concerns are associated with discharges from a CAFO seeking coverage under an individual NPDES permit, the permitting authority should take special steps to ensure that it has the necessary information needed to prepare the draft permit and fact sheet. Such information might include information on receiving water impairments, ambient water quality data, TMDL wasteload allocations, or facility-specific discharge data, design specifications, or operational plans. The permitting authority may use its CWA section 308 authority or corresponding state authorities to obtain additional information or conduct a site inspection while developing the draft permit. For CAFOs that are covered under an existing NPDES permit, the standard permit condition for Inspection and Entry, at 40 CFR part 122.41(i) also provides authority to obtain additional information or conduct a site visit to support draft permit development.

3.3. NPDES General Permits for CAFOs

An NPDES general permit covers a category of point sources with similar characteristics for a specific geographic area (e.g., watershed, county, region, state). The scope of the permit may include all CAFOs in a geographic area, or it may be limited to particular animal sectors or sizes of operations. CAFOs may appropriately be covered under an NPDES general permit because CAFOs generally involve similar types of operations, require the same kinds of effluent limitations, permit conditions, and discharge the same types of pollutants. As discussed in Section 3.2 above, there are circumstances where an individual NPDES permit might be more appropriate for a CAFO even though a general permit is available.

General permits offer a cost-effective approach for NPDES permitting authorities because they can cover a large number of facilities under one permit. CAFO general permits can be developed to cover one or several animal livestock sectors. EPA anticipates that states will use various approaches for establishing their NPDES general CAFO permit program. In some cases, a single general permit covering all the CAFOs in a state might be appropriate. In other situations, a specific permit for each animal sector might be the best approach. States may also elect to issue different general permits for existing and new sources. NPDES general permits should contain special provisions that identify facilities that are more appropriately covered under individual NPDES permits (see Section 3.2). For example, states may develop their NPDES general permits in a way that limits coverage to facilities of a certain size, thereby requiring CAFOs above a certain threshold to apply for an individual NPDES permit. Alternatively, states may choose to develop their NPDES general permits so that they identify certain facilities as a separate class of CAFOs (e.g., very large, impaired waters) that need to meet additional permit conditions identified in the general permit. The sample permit in Appendix J, NPDES General Permit Template for CAFOs, of this Manual has been set up to address all existing CAFOs that are subject to subparts C and D of the ELG.

States may require additional practices such as terraces, conservation tillage, and conservation buffers for CAFOs in environmentally sensitive areas. (Photo courtesy of USDA/NRCS)

3.3.1. Developing NPDES General Permit for CAFOs

The CAFO regulations include unique requirements that must be met when issuing a general permit for CAFOs. 40 CFR § 122.23(h). NPDES general permits for CAFOs are required to be developed and issued through a two-stage process. 40 CFR § 122.23(h). Permit requirements applicable to all permittees are developed in the first stage, following the requirements of 40 CFR part 122.28. In the second stage, following submission of a CAFO's NOI and NMP, the permitting authority must include additional, site-specific requirements in the general permit pursuant to the requirements of 40 CFR part 122.23(h).

In developing and issuing an NPDES general permit, following the procedural requirements of 40 CFR part 122.28, the NPDES permitting authority develops a draft permit and a fact sheet that defines the following: the scope of the permit, the facilities that qualify for coverage under the permit, and the specific terms and conditions that apply to the permittees. 40 CFR § 122.23(h). The permitting authority must then make the draft permit and fact sheet available for review through public notice and comment.

Given the significant public interest in animal waste management and CAFO permitting, EPA strongly encourages effective public outreach when providing public notice of draft NPDES

Some states have additional requirements for certain types of facilities, such as covering temporary litter stockpiles at poultry operations. (Source: Alabama Department of Environmental Management.

general permits for CAFOs. Permitting authorities are encouraged to schedule public outreach meetings to explain permit requirements and seek public input. After comments have been considered and, when appropriate, a public hearing has been held, the final permit is issued, usually for a 5-year term. That completes the first stage of development of a general permit for CAFOs.

To obtain coverage under a general permit, CAFO owners and operators must submit an NOI to be covered by the permit. As with other NPDES general permits, NPDES general permits for CAFOs must specify the deadlines for submitting NOIs to be covered and the date(s) when a permittee may be covered by the NPDES general permit. 40 CFR § 122.28(b)(2).

A complete and timely NOI fulfills the requirements of a permit application and indicates the owner or operator's intent to abide by all the conditions of the permit. The contents of the NOI must be clearly specified in the general permit and must include, at a minimum, requirements specified in 40 CFR part 122.21(i)(1). The information requirements for an NPDES CAFO general permit NOI and an NPDES CAFO individual permit application form are the same (see Table 3-1). The NOI/Permit Application for CAFOs is located at *http://www.epa.gov/npdes/pubs/cafo_fedregstr_form2b.pdf*. The form contains the minimum federal requirements. Additional, state-specific requirements might need to be addressed.

An owner or operator of a CAFO eligible to seek coverage under an NPDES general permit may request to be excluded from coverage under that general permit by applying for an NPDES individual permit. 40 CFR § 122.28(b)(3)(iii). Consistent with provisions in the NPDES regulations 40 CFR part 122.28(b)(3), any interested party may petition the Director of the NPDES permitting authority to require any specific facility to be covered under an individual permit.

Once an NOI (including a facility-specific NMP) is received by the permitting authority from a CAFO seeking coverage under the general permit, the second stage of the NPDES general permitting process for CAFOs is initiated pursuant to 40 CFR part 122.23(h). The permitting authority must notify the public as to which CAFOs are seeking coverage under the general permit before coverage takes effect for those facilities. After reviewing the NOI, including the facility-specific NMP and any other documentation requested by the permitting authority (e.g., plans and specifications for waste storage structures), as well as the draft terms of the NMP to be incorporated into the permit, the public has an opportunity to seek more information, raise concerns, petition the permitting authority for individual permit coverage, or request a hearing concerning CAFOs seeking coverage under the general permit. 40 CFR § 122.23(h). The process for the second stage of the general permitting process for CAFOs is discussed in greater detail in Section 3.4.

Because the NOI also provides essential compliance information, the permitting authority should ensure that the information is entered into EPA's NPDES data system (either the Permit Compliance System or the Integrated Compliance Information System).

3.3.2. Watershed-Based NPDES Permits

Watershed-based permits are NPDES permits that are issued to point sources on a geographic or watershed basis. They focus on watershed goals and consider the impact of multiple pollutant sources and stressors, including those from nonpoint sources. A watershed approach provides a framework for addressing all stressors in a hydrologically defined drainage basin instead of viewing individual pollutant sources in isolation. More than 20 states have implemented some form of the watershed approach and manage their resources on a rotating basin cycle. Because of the recent emphasis on watershed-based permits and development of TMDLs that focus on water quality impacts, EPA is looking at ways to use watershed-based permits to achieve watershed goals. The watershed-based permit is a tool that can assist with implementing a watershed approach. The utility of the tool relies heavily on a detailed, integrated, and inclusive watershed planning process. That process and data needs for developing a watershed-based permit are very similar to those needed for developing a TMDL and, therefore, they are most commonly used in situations where there is a TMDL or similar watershed analysis that provides the basis for permit requirements. For example, North Carolina's nutrient management strategy for the Neuse River Basin includes a watershed-based permit approach for TMDL implementation. The strategy recognizes the need for all groups to work together and includes an approach for permitted dischargers to work collectively to meet a combined nitrogen allocation, rather than be subject to individual allocations. Connecticut followed a similar approach to permit publicly owned treatment works discharging nutrients to Long Island Sound using a general permit that addresses only nutrients to supplement the facilities' individual permits.

A watershed-based permitting approach could be useful for CAFO permitting where a TMDL or other watershed analysis for nutrients has been completed and CAFOs are identified as a significant source of nutrients in the watershed. The TMDL or watershed analysis could allocate nutrient loadings to CAFOs in the watershed as a category or as individual sources. For example, to achieve the overall nutrient loading requirements for the watershed, CAFOs in an impaired watershed might be required to implement enhanced management practices for land application that are demonstrated to provide greater reduction of nutrient loadings than the requirements imposed on CAFOs in a non-impaired watershed.

Where a permitting authority uses a watershed-based permitting approach, the permitting authority might develop a set of individual permits and coordinate the timing of permit issuance on a watershed basis. Alternatively, the permitting authority might issue a watershed-based general permit that covers multiple sources (similar to the watershed-based permits in North Carolina and Connecticut). If the permitting authority chooses to issue a general permit, the permit must include provisions that specifically address the requirements applicable to CAFO general permits set forth in 40 CFR part 122.23(h). The general permit can include requirements that apply to all covered CAFOs and specific requirements that apply to individual CAFOs to assure attainment of water quality standards.

3.4. Procedures for Permitting Authority Review and Public Participation Before Permit Coverage

When a permitting authority receives an application or an NOI from a CAFO, it is the permitting authority's responsibility to review the application or NOI to ensure that it meets the requirements of the regulations, and for general permits, the requirements set forth in the general permit. 40 CFR § 122.23(h). In both instances, the permitting authority must determine whether the NMP submitted by the CAFO meets the requirements in 40 CFR parts 122.21(f) and (i). As part of that process, the permit writer must review the NMP for both completeness and sufficiency. Also, because the terms of the NMP are to be incorporated as permit terms, the permitting authority must provide for adequate public participation in the process of establishing permit terms on the basis of each CAFO's NMP. 40 CFR § 122.23(h).

As noted above, the general permit issuance process and the individual permitting process differ in how a permit is developed and the means by which individual facilities obtain authorization to discharge.

3.4.1. Individual Permit

For individual permits, the NMP will be submitted and reviewed as part of the permit application. The decision-making procedures in 40 CFR part 124 apply to the Director's review of the application, which includes the NMP. Part 124 requires review of the completeness and sufficiency of the permit application, including a requirement for the CAFO to modify the plan or provide additional information to the permitting authority as necessary, and requires a final decision by the Director after an opportunity for the public to comment and request a hearing.

3.4.2. General Permit

The 2008 CAFO regulations establishes public participation requirements that ensure adequate opportunity for public review of both a CAFO's NMP and the terms of the NMP to be incorporated into the permit before any CAFO obtaining authorization to discharge under an NPDES general permit. 40 CFR § 122.23. Thus, a second round of public notice and comment is necessary when providing coverage for CAFOs under a general permit, and it is then that the public is provided an opportunity to review the CAFO's site-specific NMP and comment on terms of the NMP to be incorporated into the permit. 40 CFR § 122.23(h).

As in the case of individual permit coverage, the Director must review the NOI submitted by a CAFO owner or operator to ensure that the NOI includes the information required by 40 CFR part 122.21(i)(1), including an NMP that meets the requirements of 40 CFR part 122.42(e) and applicable effluent limitations and standards, including those specified in 40 CFR part 412. Part 122.23(h)(1) also provides that if, on review, the permitting authority determines that additional information is necessary to complete the NOI or clarify, modify, or supplement previously submitted material, the Director will notify the CAFO owner or operator and request that the appropriate information be provided. When the NOI is complete, the Director must then proceed with the public notification process required by the rule and discussed below.

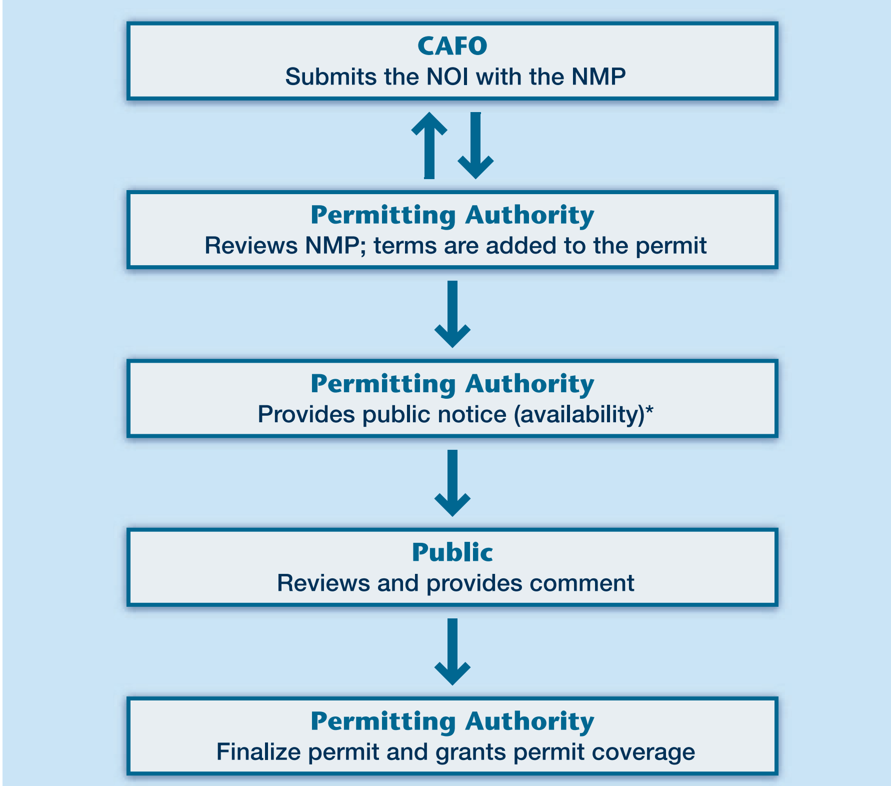
To provide permitting authorities flexibility to review NMPs of varying complexity, there is no specific time frame required for completion of the permitting authority review process. This approach is consistent with the existing NPDES regulations in Part 124 for other industries, which do not specify a time frame for automatic authorization to discharge or for the completion of the permitting authority and public review processes.

The permitting authority is responsible for reviewing NMPs and for ensuring that the terms of the NMP meet the applicable requirements of the NPDES process. There is no reason why a state cannot obtain assistance and advice from technical experts such as state-certified nutrient management planners. However, it is the permitting authority's responsibility to ensure that comments are properly addressed and the final permit terms are incorporated into the permit (see the discussion below in this section).

After making a preliminary determination that the NOI meets the requirements of 40 CFR parts 122.21(i)(1) and 122.42(e), the Director has discretion as to how best to provide the requisite public notification in the general permit context. For example, public notification could be provided on the permitting authority's website or through other electronic means. Another alternative is to use the notice or fact sheet for the general permit to establish a procedure allowing any person to electronically or by mail request notice of the receipt of an NOI, the permitting authority's proposed action, and the terms of the NMP proposed to be incorporated into the permit. Those are appropriate ways to balance the competing concerns of providing adequate notification to the public, providing flexibility to the permitting authority, and ensuring the practicality of general permits. The permitting authority may provide notice of multiple NMPs at one time provided that all applicable procedural and substantive permitting requirements are satisfied. However, if the permitting authority chooses to provide notice, that notice must be adequate, and the opportunity to comment must be meaningful.

Although the permit writer has broad discretion regarding how to write the minimum measures as permit terms, to facilitate public review of the NMP the permit writer should decide how he can clearly write the permit terms so they are easy to locate and are readily understood by the permittee, permitting authority, and the public.

Under the regulations, the Director also has discretion to establish an appropriate period for public review of the NOI and draft terms of the NMP proposed to be incorporated into the permit. Under 40 CFR part 122.23(h)(1), the Director may establish by regulation or in the general permit an appropriate period for the public to comment and request an appropriate period for the public to comment and request an individual permit or a hearing. That differs from the specifications in 40 CFR part 124.10, which sets a 30-day public notice period for proposed coverage under individual permits. Having the Director set the period for public review by regulation or in the general permit process allows the public and other interested parties an opportunity to comment on the sufficiency of that period. Factors the permitting authority might consider when



NMPs: Adding NMP Provisions to General Permits

*Process and time frame for public notice (availability) of the NMP is established by the permitting authority

establishing an appropriate period include the number of NOIs for which public notice is being given at a time, the complexity of the material made available for public review, the expected level of public interest based on prior notices of CAFOs seeking coverage, the opportunity for the public to request an extension of the comment period for one or more facilities, and whether individuals can request and receive individual notification of CAFOs seeking authorization to discharge under the permit in a timely fashion.

As noted above, the Director must also provide an opportunity for the public to request a hearing. 40 CFR § 122.23(h)(1). The procedures for requesting and holding a hearing on the terms of the NMP to be incorporated into the general permit are the same as those for draft individual permits, which are provided in 40 CFR parts 124.11 through 124.13.

Once the processes for publicly reviewing the NMP and the terms of the NMP have been completed, the Director must respond to all significant comments received during the comment period. 40 CFR § 124.17. As necessary, the Director will require a CAFO owner or operator to revise the NMP to address issues raised during the review process. Once the Director determines the CAFO's NMP is complete, the Director must make the final decision whether to grant permit coverage to the CAFO under the general permit. If coverage is granted, the Director must incorporate the relevant terms of the NMP into the general permit and inform the CAFO owner or operator and the public that coverage has been authorized and of the permit's applicable terms and conditions. 40 CFR § 122.23(h). Notification is necessary to ensure that the applicant and interested individuals are aware of the Director's final decision on granting authorization to discharge under the general permit and incorporating site-specific NMP terms into the general permit. Once a CAFO obtains authorization to discharge under an NPDES permit, it must implement the terms and conditions of the NMP as incorporated in the permit, as of the date of permit coverage authorization. 40 CFR § 122.42(e)(5).

Additional procedures are in place for EPA-issued general permits. For example, 40 CFR part 122.42(h)(2) requires the EPA Regional Administrator to notify each person who has submitted written comments on the proposal of the decision to grant permit coverage and the draft terms of the NMP of the final permit decision. A person affected by the general permit can either challenge the general permit in court or apply for an individual permit as authorized in 40 CFR part 122.28.

The public notice process described above also includes providing notice to other affected states, as required by the CWA. CWA section 402(b)(3) provides that the Administrator, in approving a state program, should make sure that the state has adequate authority to ensure notice to "any other state the waters of which may be affected." Section 402(b)(5) provides that the Administrator must ensure that any state "whose waters may be affected by the issuance of a permit may submit written recommendations to the permitting state," and that if those recommendations are rejected, the permitting state must notify the affected state in writing of the reasons for the rejection.

Any information submitted to the permitting authority as part of a permit application or NOI must be made available for public review and comment, unless it is confidential business information. 40 CFR § 122.7.

Endnotes

[1] Table 3-1 lists the information that must be provided in permit application Forms 1 and 2B. B includes a copy of Form 2B.

Chapter 4

4. Elements of an NPDES Permit for a CAFO

The elements of an NPDES permit for a CAFO are the same as for those issued to other point sources. The elements consist of a cover page, effluent limitations, monitoring and reporting requirements, record-keeping requirements, special conditions, and standard conditions (see Table 4-1). Each of those elements, other than the cover page, will be addressed in turn below as each specifically relates to CAFOs. For additional details on the elements of an NPDES permit, see EPA's *NPDES Permit Writers' Manual* (EPA-833-B-96-003).

Table 4-1. Elements of an NPDES Permit for a CAFO

Element	Section	Description
Cover Page		Serves as the legal notice of the applicability of the permit, identifies the authority under which the permit is issued, and contains applicable dates and signature(s).
Effluent Limitations and Standards	4.1	Serves as the primary mechanism for controlling discharges of pollutants to receiving waters by identifying the specific narrative or numeric limitations applied to the facility and the point of application of these limits.
Monitoring and Reporting Requirements	4.2	Describes the types of monitoring to be performed, the frequencies for collecting samples or data, how to record and maintain the data and information, and how to transmit the required information to the permitting authority.
Record-Keeping Requirements	4.2	Specifies the types of records to be kept on-site at the permitted facility (e.g., inspection and monitoring records; waste and soil sampling results; time, amount, and duration of land application activities; precipitation records; records of recipients of waste intended for application on land outside the operational control of the CAFO facility, etc.).

Table 4-1. Elements of an NPDES Permit for a CAFO *(continued)*

Element	Section	Description
Special Conditions	4.3	In NPDES permits for CAFOs, special conditions must include (1) the requirement to develop and fully implement an NMP, and (2) the requirement that the NMP address nine minimum practices defined in the regulation. In addition, NPDES permits for CAFOs may include other special conditions as determined necessary by the permitting authority.
Standard Conditions	4.4	Conditions that are included in all NPDES permits, such as the requirement to properly operate and maintain all facilities and systems of treatment and control, as specified in 40 CFR part 122.41.

4.1. NPDES Effluent Limitations and Standards

Section 301(a) of the Clean Water Act (CWA) prohibits the discharge of pollutants from a point source into waters of the U.S. unless the discharge complies with other provisions of the Act, including the requirement for a discharge to be authorized under an NPDES permit. Effluent limitations serve as the primary mechanism in NPDES permits for minimizing discharges of pollutants to receiving waters. When developing effluent limitations for an NPDES permit, a permit writer must include applicable technology-based effluent limits to control the pollutants. CWA § 302(a). Technology-based effluent limits are included in NPDES permits to achieve a level of treatment of pollutants for point source discharges on the basis of the applicable level of control according to technologies specific to that industry. If technology-based limits are insufficient to meet applicable water quality standards, the permit writer must include more stringent water quality-based effluent limitations in the permit. CWA § 301(b)(1)(C).

This section addresses each type of limitation in turn.

4.1.1. Overview of Applicable Technology-Based Effluent Limitations and Standards

Technology-based effluent limitations and standards for CAFOs must address all discharges from a CAFO. 40 CFR § 122.42(e). As discussed below, technology-based standards are established through a national ELG for some CAFO discharges. All other discharges must be addressed through technology-based effluent limitations developed on a case-by-case basis by the permit writer using her best professional judgement, or a combination of the two methods. 40 CFR § 125.3. (See the definition of best professional judgment [BPJ] in Section 4.1.4.) In general, CAFO permits will include limits for process wastewater discharges from the CAFO's production area and land application area.

The production area at a CAFO includes the animal confinement areas and other parts of the facility, including manure storage areas, raw materials storage areas, and waste containment areas. 40 CFR § 122.23(b)(8). The land application area means all land under the control of the CAFO owner or operator, including where the CAFO owns, rents, or leases the land to which manure from the production area is applied. 40 CFR § 122.23(e)(3). It includes situations where a CAFO determines when and how much manure is applied to fields not owned, rented, or leased by the CAFO.

The regulation at 40 CFR part 412 contains the ELG applicable to CAFOs. The CAFO ELG establishes the technology-based effluent limitations and new source performance standards (NSPS) for those operations that meet the regulatory definition of a Large CAFO.[1]

Construction of a storage pond at a farm in Lonoke County, Arkansas. (Photo courtesy of USDA/NRCS)

ELG Animal Sectors

Because the technology-based limits are developed on the basis of information concerning different sectors in the industry, the ELGs for CAFOs are broken into the following subparts addressing specific animal sectors:

- Subpart A: Horses and Sheep
- Subpart B: Ducks
- Subpart C: Dairy Cows and Cattle other than Veal
- Subpart D: Swine, Poultry, and Veal Calves

Table 4-2 provides a summary of the ELG applicable to each animal sector.

Table 4-2. Effluent limitation summary

Animal sector	ELG technology-based limits
Large CAFOs	**40 CFR § 412**
Subpart A—Horses and sheep	40 CFR § 412.13
Subpart B—Ducks	40 CFR § 412.22
Subpart C—Dairy cows and cattle other than veal calves	40 CFR §§ 412.33, 412.37
Subpart D—Swine, poultry, and veal calves	40 CFR §§ 412.45, 412.47

All four subparts include specific discharge limitations. Subparts A and B contain technology-based requirements for the production area only. Subparts C and D include technology-based requirements for both production areas and land application areas under the control of the CAFO owner or operator. (For a discussion on the technology-based effluent limitations for Small CAFOs, Medium CAFOs, and exotic animal species, see the discussion on BPJ in Section 4.1.4)

CAFOs That Are New Sources

The term *new source* is defined in 40 CFR part 122.2, and the criteria for determining a new source is identified at 40 CFR part 122.29(b). Only Large CAFOs can be new sources subject to NSPS requirements promulgated in accordance with CWA section 306 (as provided in 40 CFR part 412). The new source criteria in 40 CFR part 122.29(b) are used to determine which Large CAFOs are defined as new sources.

Regulatory Citation

New source means any building, structure, facility, or installation from which there is or could be a ***discharge of pollutants***, the construction of which began

(a) After promulgation of standards of performance under CWA section 306 that are applicable to such a source, or

(b) After proposal of standards of performance in accordance with CWA section 306 that are applicable to such a source, but only if the standards are promulgated in accordance with section 306 within 120 days of their proposal. 40 CFR § 122.2.

Criteria for new source determination:

(a) Except as otherwise provided in an applicable NSPS, a source is a new source if it meets the definition of new source in 40 CFR part 122.2, and

- (i) It is constructed at a site at which no other source is located; or
- (ii) It totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or
- (iii) Its processes are substantially independent of an existing source at the same site. In determining whether those processes are substantially independent, the Director shall consider such factors as the extent to which the new facility is integrated with the existing plant; and the extent to which the new facility is engaged in the same general type of activity as the existing source. 40 CFR § 122.29(b).

The first criterion for identifying a new source is construction of a new facility at a location where no other source exists. Any Large CAFO that is newly built at a site where no other source exists would be a new source CAFO subject to NSPS. In addition, an AFO that is constructed after the establishment of the NSPS requirements that later expands to become a CAFO would be considered a new source if it meets the criteria of 40 CFR part 122.29(b)(4).

The second criterion for defining a new source is where new construction at the facility replaces the process or production equipment that causes the discharge of pollutants at an existing source.

For CAFOs, that can include replacement of animal housing, an overhaul of the facility's production process, or a substantial replacement of production equipment or waste-handling system that causes the discharge of pollutants. Confinement housing and barns at CAFOs are periodically replaced, allowing the opportunity to install improved systems that provide increased environmental protection. Modern confinement housing used at many swine, dairy, veal, and poultry farms is designed so the waste handling and storage generates little or no process water. Such systems negate the need for traditional flush systems and storage lagoons, reduce the risks of uncontrollable spills, and decrease the costs of transporting manure. Similarly, the replacement of an old dairy parlor with a new one would likely result in the facility being considered a new source, particularly where it is accompanied by a change in the size of the dairy herd.

Regulatory Citation

Construction of a new source as defined under 40 CFR part 122.2 has commenced if the owner or operator has

(a) Begun, or caused to begin as part of a continuous on-site construction program:

(i) Any placement, assembly, or installation of facilities or equipment; or

(ii) Significant site preparation work including clearing, excavation or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or

(b) Entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation with a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility engineering, and design studies do not constitute a contractual obligation under the paragraph.

40 CFR § 122.29(b)(4).

Third, a CAFO would be a new source if, when built, its production area and processes are substantially independent of an existing source at the same site. For example, CAFOs could construct new or additional production areas that are on one contiguous property, without sharing waste management systems or commingling waste streams. Separate production areas could also be constructed for biosecurity reasons. New production areas could also be constructed for entirely different animal types, in which case, the more stringent NSPS requirements for that animal subpart would apply to the separate and newly constructed production area for any other subparts of animals. For example, a dairy could add a poultry production facility that is, in fact, substantially independent of the dairy operation. In such a case, the poultry operation would be a new source. In determining whether production processes and waste-handling systems are substantially independent, the permitting authority should consider factors such as the extent to which the new production areas are integrated with the existing production areas, and the extent to which the new operation is engaging in the same general type of activity as the existing source.

In some instances, such as the construction of a new Large CAFO, it is clear that the facility is a new source. In other instances, such as where new equipment or a new waste handling system is installed, the determination is a site-specific one that could turn on a number of factors. In such cases, the permitting authority should provide clear guidance to the facility concerning its status if it is determined to be a new source.

Any new source CAFO is subject to the NSPS requirements applicable to the appropriate subpart of part 412. 40 CFR § 412. The NSPS requirements for subparts A and B were not revised in the 2003 or 2008 CAFO rules. The NSPS requirements for subpart C were revised in 2003, and the NSPS requirements for subpart D were revised in 2003 and again in 2008. The regulation at 40 CFR part 122.29(d) allows a 10-year *protection period* for new sources. That protection period determines which facilities are subject to BAT and which are subject to NSPS depending on the date of construction of the operation and for how long they may be subject to NSPS after the promulgation of new NSPS standards. Table 4-3 describes the applicability of BAT and NSPS requirements for operations under subparts C and D relative to when the facility was constructed or defined as a CAFO.

Table 4-3. Applicability of NSPS for NPDES permits issued to CAFOs in subparts C and D after promulgation of the revised CAFO regulations

Period that the Large CAFO began construction [consistent with the new source criteria in 40 CFR part 122.29(b)]	Do the BAT requirements of subparts C or D apply to those facilities?	Do the NSPS requirements of subparts C or D apply to those facilities?
(1) Large CAFOs that were defined as CAFOs prior to the 2003 regulatory revisions and that began construction before April 1993	Yes	No
(2) Large CAFOs that were defined as CAFOs prior to the 2003 regulatory revisions and that began construction between April 1993 and April 14, 2003 [note that actual dates of the protection period vary for each CAFO—as of July 2010, most are no longer in the protection period]	Once the protection period established by 40 CFR part 122.29(d) expires, such CAFOs are subject to the BAT requirements of the ELGs.	Pre-2003 NSPS requirements apply until the end of the protection period established by 40 CFR part 122.29(d). Once the period expires, the CAFO is subject to the BAT requirements of the ELGs.
(3) Existing AFOs that began construction prior to April 14, 2003, and were newly defined as Large CAFOs after the 2003 NPDES regulatory revisions	Yes	No
(4) Large CAFOs subject to subpart C that began construction after April 14, 2003	No	Yes

Table 4-3. Applicability of NSPS for NPDES permits issued to CAFOs in subparts C and D after promulgation of the revised CAFO regulations *(continued)*

Period that the Large CAFO began construction [consistent with the new source criteria in 40 CFR part 122.29(b)]	Do the BAT requirements of subparts C or D apply to those facilities?	Do the NSPS requirements of subparts C or D apply to those facilities?
(5) Large CAFOs subject to subpart D that began construction after April 14, 2003, and before December 4, 2008 [note that actual dates of the protection period vary for each CAFO]	Once the protection period established by 40 CFR part 122.29(d) expires, the CAFOs are subject to the BAT requirements of the ELGs.	2003 NSPS requirements apply until the end of the protection period established by 40 CFR part 122.29(d). Permitting Authority may establish more stringent requirements. Once the period expires, the CAFO is subject to BAT under the newly promulgated guideline.
(6) Large CAFOs subject to subpart D that began construction after 12/04/08	No	Yes

For a detailed discussion of NSPS requirements by subpart see, Section 4.1.2. New Source Performance Standards – Subpart C and D.

Where EPA is the permitting authority, a new source permit for a CAFO subject to NSPS (as identified in Table 4-3) is subject to review under the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq*. Depending on the circumstances associated with the facility or facilities covered by the permit and the requirements of the permit, NEPA requirements may be satisfied by completing an environmental impact statement (EIS) or an environmental assessment (EA). An EA may be used where there is a finding of no significant impact (FONSI). Federal permit writers should coordinate efforts with the Office of Federal Activities and document all NEPA activities in the permit file and fact sheet.

CAFOs That Are New Dischargers

An AFO that is (1) newly constructed; (2) implements changes so that it meets the definition of a CAFO; or (3) that is designated as a CAFO is a *new discharger* if it is not a new source. A new discharger is an AFO that becomes a CAFO either through definition or designation and is not a new source (i.e., subject to NSPS). Such operations could be a CAFO for one of the following reasons: (1) the facility is newly constructed (but not subject to NSPS and therefore not a *new source*); (2) the facility has changed some aspect of its operations such that it becomes defined as a Medium CAFO or designated as a Small or Medium CAFO. The following are examples of such operations:

- A newly constructed Medium CAFO operation. Because the CAFO NSPS apply only to Large CAFOs, such a facility would not be subject to NSPS but would be subject to BPJ/BCT and BAT requirements. However, if the facility later expands to become a Large CAFO, the facility would likely be considered a new source, because construction began after the applicable NSPS requirements were established.
- An existing operation that increases the number of animals confined and thus meets the threshold numbers to be defined as a Large CAFO but is determined to not meet any of the new source criteria. It is subject to the ELGs requirements applicable to its subcategory.
- An existing operation that increases the number of animals confined and thus meets the threshold capacity to be defined as a Large CAFO.

4.1.2. Technology-Based Requirements for the Production Area of Large CAFOs

Flock of sheep near Dubois, Idaho. (Photo courtesy of USDA/NRCS)

Operations Covered by Subpart A—Horses and Sheep

The ELG requirements for subpart A, 40 CFR subparts 412.10-15, address the production area only. Any additional technology-based requirements for discharges from the CAFO must be developed using BPJ.

Existing and new Large CAFOs that confine horses and sheep may not discharge manure or process wastewater (which includes horse washdown water) pollutants to waters of the U.S. from the CAFO (i.e., *no-discharge* standard). The only exception to the no-discharge standard is an overflow that occurs because of a rainfall event from a facility that is designed, constructed, operated, and maintained to contain all process wastewater plus the runoff from a 25-year, 24-hour rainfall event for the location of the CAFO. 40 CFR §§ 412.13, 412.15.

To ensure that a facility meets the no-discharge standard, the CAFO must ensure that the production area has adequate storage structures that are designed, constructed, operated, and maintained to contain all manure including the runoff and direct precipitation from a 25-year, 24-hour rainfall event. An important consideration as to whether the CAFO meets the ELG requirements is whether it has adequate storage or treatment structures capable of containing all manure, litter, and process wastewater that accumulates during the critical storage period. 40 CFR § 412.13. To comply with the ELG, the storage volume in the production area must contain all those wastes. For a detailed discussion on adequate storage of manure, see Section 5.3.

Regulatory Citation

Overflow means the discharge of manure or process wastewater resulting from the filling of wastewater or manure storage structures beyond the point at which no more manure, process wastewater, or stormwater can be contained by the structure.

40 CFR § 412.2(g)

Operations Covered by Subpart B—Ducks

The ELG requirements for subpart B, 40 CFR part 412.20-26, address the production area only. The ELG distinguishes between two types of manure handling systems in the production area of duck operations (*wet lot* and *dry lot*). Chapter 2.2.4. explains the difference between wet lot and dry lot manure handling systems. Any additional technology-based requirements for discharges from the CAFO must be developed on a BPJ basis. 40 CFR § 125.3(a).

All duck operations constructed before 1974 subject to the ELG must meet specific discharge limitations established by 40 CFR part 412.22. Those are the only numeric limitations in the CAFO ELGs. The limitations are shown in Table 4-4.

Table 4-4. Numeric effluent limitations for subpart B—Ducks

Regulated parameter	Maximum daily[a]	Maximum monthly average[a]	Maximum daily[b]	Maximum monthly average[b]
BOD_5	3.66	2.0	1.66	0.91
Fecal coliform	([c])	([c])	([c])	([c])

Notes:
a. Pounds per 1,000 ducks
b. Kilograms per 1,000 ducks
c. Not to exceed MPN of 400 per 100 mL at any time

All duck CAFOs constructed after 1974 are new sources subject to a no-discharge standard that is identical to the BAT standard for subpart A (Horses and Sheep). 40 CFR § 412.25. Subpart B CAFOs may not discharge process wastewater pollutants into waters of the U.S., except for an overflow of process wastewater caused by rainfall events from a facility that was designed, constructed, operated, and maintained to contain all process generated wastewater plus the runoff from a 25-year, 24-hour rainfall event. 40 CFR §§ 412.25(b), 26(b).

To ensure that a facility meets the no-discharge standard, the CAFO must ensure that the production area has adequate storage structures that are designed, constructed, operated, and maintained to contain all manure, litter, and process wastewater including the runoff and direct precipitation from a 25-year, 24-hour rainfall event. An important consideration as to whether the

CAFO meets the ELG requirements is if it has adequate storage or treatment structures capable of containing all manure, litter, and process wastewater that accumulate during the critical storage period. To comply with the ELG, the storage volume in the production area must contain all those wastes. For a detailed discussion on adequate storage of manure, see Section 5.3.

Operations Covered by Subpart C—Dairy Cows and Cattle Other than Veal Calves and by Subpart D—Swine, Poultry and Veal Calves

Existing Sources—Subparts C and D

The ELG requirements for subparts C and D, 40 CFR subparts 412.30-37, 412.40-47, address both the production area and the land application area. This section addresses the technology-based requirements associated with the production area. Subpart C includes requirements for Large CAFOs that confine dairy cattle and cattle other than veal calves, and subpart D includes Large CAFOs that confine swine, poultry and veal calves. The requirements in subpart C are identical for existing sources and new sources. The requirements in subpart D differ for existing and new sources. The new source requirements for subpart D are addressed below.

Existing sources subject to subparts C and D and new sources subject to subpart C are subject to a no-discharge requirement. Those operations may not discharge manure into waters of the U.S. from the production area. 40 CFR §§ 412.31(a), 412.32(a), 412.33(a) (subpart C), 40 CFR §§ 412.43(a), 412.44(a), 412.45(a) (subpart D). The only exception to that no-discharge standard is when precipitation causes an overflow, provided that the production area is designed, constructed, operated, and maintained to contain all manure, litter, and process wastewater including the runoff and direct precipitation from a 25-year, 24-hour rainfall event (see the definition of overflow).

To ensure that a facility meets the no-discharge standard, the CAFO must ensure that the production area has adequate storage structures that are designed, constructed, operated, and maintained to contain all manure, litter, and process wastewater including the runoff and direct precipitation from a 25-year, 24-hour rainfall event. An important consideration of whether the CAFO meets the ELG requirements is whether it has adequate storage or treatment structure capable of containing all manure, litter, and process wastewater that accumulate during the critical storage period. To comply with the ELG, the storage volume in the production area must contain all those wastes. For a detailed discussion on adequate storage of manure, see Section 5.3.

To meet the no-discharge requirement, the CAFO must operate the production area in accordance with additional measures and record-keeping requirements specified in 40 CFR parts 412.37(a)-(b), 412.47(a)-(b). Those include requirements for routine visual inspections of the production area, the use of depth markers for liquid impoundments, corrective action when deficiencies are identified, and mortality handling. Records must be maintained on-site, including records for each of the above measures, and records documenting the design of storage structures and any overflows that occur.

Voluntary Performance Standards

Holstein dairy cows. (Photo courtesy of USDA/ARS)

The voluntary alternative performance standards provisions in 40 CFR part 412.31(a)(2) also apply to existing sources subject to subpart C and D and new sources subject to subpart C. (See Appendix F, Voluntary Alternative Performance Standards for CAFOs, of this Manual.)[2]

This provision applies only to discharges from the production area. The provision for alternative performance standards allows a CAFO owner or operator to request from the Director NPDES permit effluent limitations according to site-specific alternative technologies where the CAFO can establish that the alternative technologies will achieve a quantity of pollutants discharged from the production area equal to or less than the quantity of pollutants that would be discharged under applicable baseline effluent guidelines performance standards.

The production area baseline for existing sources subject to subparts C and D and new sources subject to subpart C prohibits the discharge of manure except when rainfall events cause an overflow from a storage structure designed, constructed, operated, and maintained to contain all manure plus the runoff and direct precipitation from a 25-year, 24-hour rainfall event. 40 CFR §§ 412.31(a), 412.32(a), 412.33(a) (subpart C), 412.43(a), 412.44(a), 412.45(a) (subpart D). Thus, a Large CAFO seeking permit conditions according to a voluntary alternative performance standard would have to first establish the predicted discharge on the basis of the baseline effluent guidelines and second, establish that its alternative technologies and management practices result in equivalent or improved pollutant reductions for the production area. In meeting each of those requirements, the CAFO must submit technical analyses and other relevant information and data specified in the regulation. Because the production area baseline provides for no discharge except in specified circumstances, the alternative standard must take into account those circumstances where discharges do occur under the baseline (i.e., extreme rainfall events). When meeting those requirements, the regulations require calculation of the median annual overflow volume on the basis of an extended period (25 years) of actual rainfall data (and then calculating a predicted average annual discharge of pollutants).

Large CAFOs seeking permit conditions that are based on the voluntary performance standards must still meet any other applicable federal, state, and local requirements (see Appendix F, Voluntary Alternative Performance Standards for CAFOs). Because using voluntary alternative performance standards is typically contemplated for discharging systems, it is important to keep in mind that any allowable discharges might be subject to other requirements, notably water quality-based standards, and more stringent state requirements. (For a discussion on water quality-based effluent limitations, see Section 4.1.9)

The permit writer must determine which ELG requirements the alternative standard replaces and which remain intact and applicable to all CAFOs. Under the alternative standard, the management practices and additional measures specified in the effluent guidelines that apply to the production area and land application area remain applicable to all Large CAFOs. 40 CFR §§ 412.4, 412.37, 412.47. Conversely, other requirements might no longer be applicable because of the alternative performance standard. For example, if under an alternative performance standard the operation does not have a liquid storage structure, the depth marker requirement would no longer be applicable.

New Source Performance Standards—Subparts C and D

As discussed in the previous section, Large subpart C beef and dairy CAFOs that are new sources have the same production area requirements as existing subpart C operations.[3] Large subpart D swine, poultry, and veal calf CAFOs that are new sources are subject to the NSPS. 40 CFR § 412.46. Like existing sources subject to subpart D, new sources under subpart D may not discharge manure, litter, or process wastewater into waters of the U.S. from the production area and are required to comply with the additional measures and record-keeping requirements at 40 CFR parts 412.47(a), (b).

Unlike the requirements for existing sources, 40 CFR part 412.46 does not allow an exception for new sources to the no discharge requirement. Rather, a CAFO subject to the requirements of 40 CFR part 412.46 must either (1) have an absolute prohibition of any discharge from its production area as a condition of its permit, or (2) request the permitting authority to "establish NPDES best management practice effluent limitations designed to ensure no discharge…" whereby the facility can satisfy the no discharge effluent limitation. 40 CFR § 412.46(a)(1).

A site-specific effluent limitation established in accordance with 40 CFR part 412.46(a)(1) must address the CAFO's entire production area. For any CAFO using an open surface manure storage structure, the no-discharge standard used in 40 CFR part 412.46 "means that the storage structure is designed, operated, and maintained in accordance with best management practices established by the Director on a site-specific basis after a technical evaluation of the storage structure." 40 CFR § 412.46(a)(1). The technical evaluation must be based on information used in the design of the storage structure necessary to meet the NSPS requirements, including minimum storage periods for rainy seasons; additional minimum capacity for chronic rainfalls; applicable technical standards that prohibit or otherwise limit land application to frozen, saturated, or snow-covered ground; planned emptying and dewatering schedules consistent with the CAFO's NMP; additional storage capacity for manure intended to be transferred to another recipient later; and any other factors that would affect the sizing of the open manure storage structure. 40 CFR § 412.46(a)(1)(i). (For further discussion of adequate storage, see Section 5.3.)

Part 412.46(a)(1)(ii) requires that the technical evaluation include an evaluation of the adequacy of the design of the open manure storage structure using the most recent version of the Natural Resources Conservation Service's (NRCS's) AWM tool and an evaluation of the overall water budgets using SPAW Field and Pond Hydrology Tool, or equivalent analytic tools (see Appendix N, References for NPDES Permit Writers). 40 CFR § 412.46(a)(1)(i). Where 100 years of continuous rainfall data are not available for all CAFOs, models can be run using actual rainfall data where available, and then simulated with a confidence interval analysis over a period of 100 years.

AWM tracks gross nutrients, but it does not track the mass or concentration of nutrients. Further, the storage period or drawdown schedule is usually determined by the individual CAFO. Accordingly, in conducting the technical evaluation, the CAFO's NMP must be used as an input to confirm both a water balance and a nutrient balance has been achieved by the CAFO. The NSPS provisions require that each CAFO use the SPAW model (or equivalent approved by the permitting authority) to assess daily hydrologic budgets for each field. The complete modeling demonstration shows not only that the storage facility does not discharge, but also that there is no runoff of process wastewater from fields during land application activities consistent with the CAFO's NMP. Those calculations are necessary to ensure that the open containment system is operated in a way to meet land application requirements of 40 CFR part 412.46(b). The requirement to use the SPAW model (or equivalent tool) ensures that CAFOs will rely on appropriate operational measures to achieve no discharge standards.

The CAFO NSPS provisions require certain specified information regarding design, construction, and operation and maintenance (O&M) of the system to be included in the CAFO's NMP. That includes the key user-defined inputs and model system parameters. CAFOs must submit a site-specific analysis to the Director. 40 CFR § 412.46(a)(1). The site-specific design, construction, and O&M measures are enforceable requirements of the CAFO's permit. As long as the CAFO complies with the requirements, the CAFO is presumed to meet the no-discharge requirement, such that, if a discharge occurs, the CAFO may rely, to the extent they are applicable, on the NPDES upset and bypass provisions of 40 CFR parts 122.41(m), (n).

Under NSPS, the Director has the discretion to require additional information from a new source subpart D CAFO owner or operator to support site-specific BMP effluent limitations. The burden is on the CAFO to demonstrate that any proposed system it employs, including an open system, meets the new source standard. CAFOs are encouraged to use the most current version of AWM and SPAW when submitting their demonstration to the permitting authority. However, EPA is aware that other peer-reviewed models and programs have been or could be developed that the permitting authority could determine are equivalent to AWM and SPAW. The Director may approve design software or procedures that are equivalent to AWM and SPAW. Once approved by the Director, the public still would have the opportunity to comment on the CAFO's modeling.

The design parameters and evaluation process required of all CAFOs wishing to avail themselves of the alternative is intended to allow CAFOs the flexibility to demonstrate compliance with the no-discharge requirements for any type of open storage facility. As a practical consideration, it is expected that most CAFOs selecting the compliance alternative will submit designs for open manure storage structures accompanied by a narrow range of acceptable operation and management practices. However, for a given type of storage facility design (for example, an integrator with several company-owned CAFOs, each designed and constructed in an essentially identical manner within the same county), an operator may conduct a series of assessments that together fully encompass the range of operational and management measures that would be used across multiple CAFOs with the specific storage facility design (i.e., types of crops, soil types and other field parameters, land application and other equipment, timing and land application schedules). In such a case, SPAW could be run to validate a wide range of NMP and storage pond management. This alternative does not affect the requirement for a CAFO to develop a site-specific NMP. The NSPS requirements allow the permitting authority to determine that CAFOs that have a specified facility type and submit an NMP that falls within the preapproved range of operational and management practices would not need to conduct an individualized assessment (i.e., the validation using SPAW).

The availability and use of such a geographical and categorical approach would require that the permit writer determine that a number of conditions are met. First, the assessment would need to fully account for all pertinent factors relevant to determining the potential for a discharge from an open storage system. The assessment would also need to include all parameters that mirror the range of soil, plant, climatic, and hydrological conditions in the representative geographical area. Finally, the assessment would need to reflect the operational and management practices to be employed by each CAFO at each individual site. Each CAFO must have a site-specific NMP that includes the operational and management measures used in the geographical assessment.

New sources subject to subpart D using an open storage structure must have a depth marker to indicate the maximum volume of manure and process wastewater the structure is designed to contain (whereas existing sources and new sources subject to subpart C must use a depth marker that indicates the 25-year, 24-hour storm event).

An important consideration of whether a CAFO meets the NSPS alternative is if it has an adequate storage or treatment structure capable of containing all manure that accumulates during the critical storage period. To comply with the NSPS, the storage volume in the production area must contain all wastes. For a detailed discussion on adequate storage of manure, see Section 5.3.

4.1.3. Technology-Based Requirements for the Land Application Area of Large CAFOs

Each CAFO subject to the ELG requirements in subparts C and D that land applies manure must do so in accordance with certain practices that constitute the technology-based effluent limitations for the land application area. 40 CFR §§ 412.4, 412.37(c).

A general description of the practices required by 40 CFR part 412.4 follows (for additional discussion of the requirements for nutrient management practices see Chapters 5 and 6):

- Develop and implement a field-specific NMP that fully incorporates the other requirements of 40 CFR part 412.4 concerning land application.

- Land apply manure at application rates that minimize nitrogen and phosphorus transport from the field to waters of the U.S. in compliance with the technical standards for nutrient management established by the permitting authority. The technical standard for nutrient management must include a field-specific assessment of the potential for nitrogen and phosphorus transport from the field to waters of the U.S. and address the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals while minimizing nitrogen and phosphorus movement to waters of the U.S. The standard must also include appropriate flexibility for any CAFO to implement nutrient management practices to comply with the standard such as consideration of multiyear phosphorus applications to fields that do not have a high potential for phosphorus runoff to waters of the U.S. and phased implementation of phosphorus-based nutrient management, as determined appropriate by the Director.

Landowner and an NRCS staff member discuss management options for the land application area. (Photo courtesy of USDA/NRCS)

- Analyze manure at least once a year for nitrogen and phosphorus content, and analyze soil at least once every 5 years for phosphorus content. The results of the analyses are to be used in determining application rates for manure, litter, and other process wastewater.
- Periodically inspect equipment used for land application of manure for leaks (before each application is recommended to ensure the manure is delivered at the proper rate of application).
- Implement a minimum setback for manure application of 100 feet from surface waters and conduits to surface waters; or substitute with a 35-foot vegetated buffer, or other alternatives where the CAFO demonstrates equivalent pollutant reductions.
- Complete on-site records documenting implementation of all required best management practices (BMPs) and any additional records specified by the permitting authority (for additional information, see Section 4.2).

Many states have unique requirements for developing an NMP. The requirements of EPA regulations establish the minimum requirements for permitted CAFOs. States may require more stringent requirements, and in many instances states have established additional requirements to address land application. For example, many states require more frequent soil analysis than is required by 40 CFR part 412.4(c)(3). In recognition of that, 40 CFR part 412.4(c)(2) requires application rates for land application of manure, litter, and process wastewater to be in compliance with technical standards for nutrient management established by the Director. Part 123.36 requires that the state's technical standards be a part of every approved state's NPDES program. 40 CFR § 123.36. EPA strongly encourages states, when establishing their technical standards for nutrient management, to address water quality protection issues when determining appropriate land application practices. At a minimum, the permitting authority must include in the technical standard the following components:

- A field-specific assessment of the potential for nitrogen and phosphorus transport from the field to waters of the U.S.
- The form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen and phosphorus movement to waters of the U.S.
- Appropriate flexibility for CAFOs to implement the standard (e.g., multiyear phosphorus banking.)

40 CFR § 412.4(c).

The state technical standards will provide additional specificity to key nutrient management provisions in the ELG. The standards should include additional information, such as soil and manure sampling and analysis protocols, application methods, and plan content requirements.

State and tribal technical standards for nutrient management are typically developed collectively among the agencies responsible for various aspects of the nutrient management planning in a state, including the respective NPDES permitting authorities, state departments of agriculture, tribes, state land grant universities, NRCS state conservationists, and EPA Regions. Many technical standards for nutrient management have already been developed as part of implementing U.S. Department of Agriculture's (USDA's) National Nutrient Management policy. NRCS developed a national nutrient management conservation practice standard (Code 590) that serves as the basis for each state NRCS office to develop its owned tailored standard. In many cases, the NRCS state standards have formed the basis for the standard established by the permitting authority. However, state technical standards established by the Director to meet NPDES requirements must address the criteria specified in 40 CFR part 412.4(c)(2). State technical standards are subject to review and approval by EPA under 40 CFR part 123.62. When establishing the technical standards, the Director may use discretion regarding the means of expressing and documenting the standards (i.e., as law, regulations, or policy) for use by CAFOs and technical standard providers in developing NMPs, for permit writers and the public in reviewing NMPs, and for submission to EPA as part of the state authorized NPDES program pursuant to the requirements of 40 CFR part 123.36. (For a detailed discussion on state technical standards, see Section 6.3.1)

The ELG also specifies that manure must be analyzed at a minimum once every year for nitrogen and phosphorus, and the soil must be analyzed at a minimum once every 5 years for phosphorus. 40 CFR § 412.4(c)(3). The analytical results are to be used in determining application rates for manure. More frequent analyses than required by the ELG might be needed to ensure appropriate agricultural utilization of the applied nutrients. The actual sample collection process and frequency should be established in the CAFO's NMP in accordance with the technical standards for nutrient management.

Finally, the ELG specifies that the site-specific conservation practices for a permitted Large CAFO must include maintaining a 100-foot setback or establishing a 35-foot vegetated buffer between land application areas and any downgradient surface waters, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to surface waters. 40 CFR § 412.4(c)(5). The ELG allows for compliance alternatives in place of the setback or buffer under certain scenarios. Those and other requirements applicable to permitted Large CAFO requirements are described in greater detail in Chapters 5 and 6.

4.1.4. Best Professional Judgment (BPJ)

NPDES permit limitations are based on BPJ when national ELGs have not been issued pertaining to an industrial category or process. Specifically, the NPDES regulations require a permit writer to establish permit limitations on a case-by-case BPJ basis when ELGs are inapplicable, or in combination with the effluent guidelines, where the ELG apply to only certain aspects of the operation or certain pollutants. CWA § 402(a)(1); 40 CFR § 122.44(k).

Alpaca farm. (Photo courtesy of USDA/MO NRCS)

As explained in Section 4.1.1, ELGs have been promulgated for only those operations that meet the regulatory definition of a Large CAFO, and apply to the production area for subparts A, B, C, and D, and land application area for subparts C and D. For example, there is no ELG for Small or Medium CAFOs or for exotic animal species. Exotic animal species are those not specifically identified in the ELG, for example: llamas, geese, or ostriches. Nonetheless, just as for any other permitted facility, the CWA requires that an NPDES permit for small, medium, and exotic animal CAFOs include technology-based effluent limitations. Therefore, the technology-based limits in the permit must be determined by the permit writer using BPJ (see Table 4-5).

Table 4-5. Facilities where the technology-based limits must be developed using BPJ

Animal Sector
Medium CAFOs—Horses, sheep, duck, dairy cows, cattle, swine, poultry, and veal calves
Small CAFOs—Horses, sheep, duck, dairy cows, cattle, swine, poultry, and veal calves
Other CAFOs—Alligators, geese, emus, ostriches, mink, bison, etc.

Similarly, for any part of a permitted facility from which there could be an authorized discharge, but for which there is no applicable ELG, technology-based limits must be set using BPJ. That includes any part of a CAFO not addressed by the land application or production area requirements of the ELG, even where the ELG address some parts of the CAFO operation. For example, land application areas at large horse, sheep, or duck CAFOs, which are not subject to the ELG requirements of 40 CFR part 412.4 but are required to have an NMP that meets the requirements of 40 CFR part 122.42(e)(1). It also includes any other discharges from CAFOs subject to subparts C and D that are not addressed by the ELG.

For all Small and Medium CAFOs, exotic animal species, and areas of Large CAFOs not addressed by the ELG, the permit writer can develop effluent limits on a case-by-case basis using the permit writer's BPJ. The term *case-by-case* has been understood to mean on a permit-by-permit basis so as to allow the use of general permits that include BPJ limits. It is important to note in such a context that a CAFO is not required to seek coverage under a general permit and always has the option to apply for an individual permit. The authority to issue case-by-case permit limitations comes from CWA section 402(a)(1) and 40 CFR parts 122.44(a), 125.3.

Given the similarity in the operational characteristics of CAFOs, in many cases, permit writers might find that it is appropriate to develop BPJ effluent limitations that are the same as, or similar to, the effluent limitations established in the ELG. See 40 CFR part 125.3. For example, a permit writer might decide that the most appropriate limitations for Medium and Small CAFO permits are the same as some of or all the requirements established for Large CAFOs in the ELG. On the other hand, a permit writer may establish different technology-based limitations for Medium and Small CAFOs using his or her BPJ, such as the site-specific circumstances that resulted in the small or medium-size AFO being defined or designated a CAFO. BPJ requirements based on the ELG should include requirements for the production area and the land application area and should include specific record-keeping requirements.

For all CAFOs, there are other circumstances where a permit writer must use BPJ or special permit conditions to address specific discharges at a CAFO that are not included in the ELG. For example, the CAFO ELG does not address plate chiller water, filter backwash water, chemicals used in the production area (for disinfection), or pollutants (such as manure, feathers, and feed) that have fallen to the ground immediately downward from confinement building exhaust ducts and ventilation fans and are carried by precipitation-related or other runoff to waters of the U.S. The permit must address technology-based limitations for those discharges on a BPJ determination, and more stringent water quality-based limits where necessary to ensure compliance with water quality standards. CWA § 402(a)(1). The same requirements apply to discharges that constitute stormwater discharges associated with industrial activities subject to 40 CFR part 122.26(b)(14) (see discussion on other discharges in Section 4.1.5).

40 CFR part 125.3(c): *Methods of imposing technology-based treatment requirements in permits.* Technology-based treatment requirements may be imposed through one of the following three methods:

(1) * * * * *

(2) On a case-by-case basis under section 402(a)(1) of the Act, to the extent that EPA-promulgated effluent limitations are inapplicable. The permit writer shall apply the appropriate factors listed in 40 CFR part 125.3(d) and shall consider: (i) The appropriate technology for the category or class of point sources of which the applicant is a member, based upon all available information; and (ii) Any unique factors relating to the applicant.

[Comment: These factors must be considered in all cases, regardless of whether the permit is being issued by EPA or an approved State.]

(d) In setting case-by-case limitations pursuant to 40 CFR part 125.3(c), the permit writer must consider the following factors:

(1) ***For BPT requirements:*** * * * * *

(2) ***For BCT requirements:*** (i) The reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits derived; (ii) The comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources; (iii) The age of equipment and facilities involved; (iv) The process employed; (v) The engineering aspects of the application of various types of control techniques; (vi) Process changes; and (vii) Non-water quality environmental impact (including energy requirements).

(3) ***For BAT requirements:*** (i) The age of equipment and facilities involved; (ii) The process employed; (iii) The engineering aspects of the application of various types of control techniques; (iv) Process changes; (v) The cost of achieving such effluent reduction; and (vi) Non-water quality environmental impact (including energy requirements).

4.1.5. Industrial Stormwater Discharges[4]

CAFOs are subject to industrial stormwater permitting requirements of 40 CFR part 122.26. Large CAFOs, as defined in 40 CFR parts 122.23 and 412 are included in category (i) of facilities considered to be engaging in *industrial activity* under part 122.26 (b)(14), which defines 15 categories of "storm water discharge associated with industrial activity." See 40 CFR part 122.26(b)(14)(i); *NPDES Storm Water Program Question and Answer Document Volume 1* (USEPA 1992). As a result, Large CAFOs are subject to the requirements of part 122.26 regardless of whether they are a permitted facility under part 122.23. The requirements of

NRCS District Conservationist suggests filter strip as one option to protect the land and improve water quality. (Photo courtesy of USDA/NRCS)

part 122.26 apply to any stormwater discharge associated with industrial activity at a Large CAFO that is not otherwise regulated under parts 122.23 and 412.

CAFOs that are permitted to discharge pursuant to 40 CFR parts 122.23 and 122.26 may have both sets of requirements included in a single permit or in separate wastewater and stormwater permits. CAFOs subject to part 122.26 requirements may qualify for the conditional exclusion provided in part 122.26(g) for *no exposure* certifications for stormwater discharges.

CAFOs may also be subject to stormwater permitting requirements for construction activity under 40 CFR parts 122.26(b)(14)(x) or 122.26(b)(15).

4.1.6. Other Technology-Based Limitations that Apply to Discharges from CAFOs

CAFOs may have additional discharges not specifically addressed in the ELG or CAFO regulations, either from the production area or from outside the production area. Those include but are not limited to the following:

- Process wastewater discharges from outside the production area, such as washdown of equipment that has been in contact with manure, raw materials, products or by-products that occurs outside the area.
- Discharges that do not meet the definition of process wastewater, such as domestic wastewater discharges; chiller water; discharges associated with feed, fuel, chemical, or oil spills, and equipment repair.
- Discharges of pollutants from poultry, swine, and veal calf animal confinement houses that are not covered by the ELG. Those include removal of animals and cleaning out houses, and runoff associated with fan exhaust deposits outside the houses.

**Where appropriate, permit writers should consider writing technology-based limitations for runoff associated with fan exhaust deposits outside a poultry house.
(Photo courtesy of USDA/NRCS)**

A properly written CAFO permit will address discharges such as those and establish BAT/BCT limits developed on a BPJ basis (as discussed in Section 4.1.4). The determination of whether to apply the no-discharge standard to areas other than those that are covered by the ELG (animal confinement area, manure storage area, waste containment area, and so on) is a site-specific determination that must be made by the permitting authority. EPA and states can begin the BPJ analysis with an evaluation based on the no-discharge standard, because that is the applicable standard most closely related to those facilities (see discussion of BPJ-based limits in Section 4.1.4). (For an example of limitations on other discharges from CAFOs, see the example general permit in Appendix J, NPDES General Permit Template for CAFOs.) If other measures are appropriate, they may be identified in the permit and subject either to conditions applicable to all permittees or addressed on a site-specific basis, perhaps in conjunction with the CAFO's NMP. It should be noted that any such discharges are also subject to applicable water quality standards.

4.1.7. Nutrient Management Plan (NMP)

An NMP is a detailed planning document that identifies conservation practices and management activities that, when implemented, help to ensure that both production and natural resource protection goals are achieved. The objective of an NMP is to document those practices and activities that will help achieve the goals of the producer and protect or improve water quality.

An NMP that is part of a CAFO permit must include, at a minimum, BMPs necessary to achieve the nine minimum requirements of 40 CFR parts 122.42(e)(1)(i)-(ix) (minimum measures) and other effluent limitations and standards, to the extent applicable, which are described in greater detail in Chapters 5 and 6. 40 CFR § 122.42(e)(1). The minimum measures include requirements applicable to both the production area and the land application area. See Appendix H, NPDES CAFO Nutrient Management Plan Review Checklist.

Creating a nutrient management plan. (Photo courtesy of USDA/MO NRCS)

As discussed in Chapter 3.2, CAFOs must submit a site-specific NMP to the permitting authority as part of their permit application or NOI when they are seeking permit coverage. The permitting authority may require the CAFO operator to make changes to its NMP before permit coverage is granted. 40 CFR § 122.23(h). Once coverage is granted, the permittee must implement the NMP approved by the Director.

Minimum Measures that Must be Terms and Conditions of the NPDES Permit

Every NPDES permit issued to a CAFO must require that the CAFO implement the terms of a site-specific NMP approved by the Director. 40 CFR § 122.42(e)(5). Those site-specific *terms of the NMP* are defined as "the information, protocols, [BMPs], and other conditions" identified in a CAFO's NMP and determined by the permitting authority to be necessary to meet the requirements of 40 CFR part 122.42(e)(1). 40 CFR § 122.42(e)(5). To meet those requirements,

Discussion is an important part of the permit writing process. (Photo courtesy of USDA/MO NRCS)

the information, protocols, BMPs, and other conditions in the plan must, at a minimum, address the following: manure storage, mortality management, clean water diversions, prevention of direct animal contact with water, chemical handling, conservation practices to control runoff, manure and soil testing protocols, land application protocols and record keeping requirements. 40 CFR § 122.42(e)(1). For a detailed discussion of each of the minimum measures, see Chapters 5 and 6.

For Large CAFOs subject to the land application requirements of the ELG, in addition to the requirements of 40 CFR part 122, the *terms of the NMP* must also include the BMPs necessary to meet the requirements of 40 CFR part 412.4(c). Part 412.4 requires that the NMP address the form, source, amount, timing and method of application and include a field-specific assessment of the potential for nitrogen and phosphorus transport from the field to surface waters. The Director may also allow appropriate flexibilities to implement nutrient management practices.

Part 122.42(e)(5) further elaborates on the terms of the NMP associated with *protocols for land application*. Those must include the fields available for land application, field-specific rates of application, and any timing limitations on when manure can be land applied. The terms for rates of application must follow one of two approaches that the regulation identifies as the linear approach and the narrative rate approach. The terms for each of those approaches are discussed in detail in Chapter 6 .

While 40 CFR part 122.42(e)(5) specifies the minimum terms of the NMP that must be included in NPDES CAFO permits, states may adopt additional or more stringent requirements. CWA section 510.

It is important for permit writers to understand that where the Director incorporates the terms of a CAFO's NMP into a general permit, the procedures established in 40 CFR part 122.62 for permit modification do not apply to CAFO permits. Instead, the regulations include procedures for incorporation of the terms of the NMP as part of the CAFO general permitting process itself, as required by 40 CFR part 122.23(h), which establishes the procedures for permit coverage under a CAFO general permit (see Chapter 3.2).

Including the Terms of the NMP as NPDES Permit Terms

As previously mentioned, the *terms of the NMP* are the information, protocols, BMPs and other conditions determined by the Director as necessary to meet the requirements of

40 CFR part 122.42(e)(1), and must be included by the permit writer in a CAFO's NPDES permit as enforceable terms and conditions of the permit. The terms of the NMP must specify what the CAFO operator is required to do relating to each of the nine minimum measures when implementing its NMP and include the specific conditions on which such actions must be based.

There is no requirement concerning where the terms of the NMP must appear in the permit, so a permit writer has discretion as to how to write the terms into the permit. Because the terms of the NMP are effluent limits, it is advisable for the permit writer to include all the conditions associated with the terms of the NMP in a section of the permit dedicated to effluent limitations, even where the terms are generally applicable to all permitted CAFOs. Where that is done, it is also a good idea for the permit writer to cross-reference in the site-specific section any generally applicable conditions of the permit relating to the minimum measures that may be included elsewhere in the permit.

Given the unique inter-relationship between the NMP and the permit, the permit writer may choose to establish permit conditions associated with the NMP in a separate part of the permit from other effluent limitations. For example, in the Example Permit included in this Manual document, Appendix J, NPDES General Permit Template for CAFOs, multiple sections are dedicated to effluent limitations; one of which is dedicated to the terms of the NMP.

Establishing the Minimum Measures as NPDES Permit Terms

As discussed in this section and elsewhere in this Manual, depending on the type of permit and the attributes of the various terms of the NMP, a permit writer may establish the terms of the NMP as broadly applicable permit conditions that are identical for multiple CAFOs (e.g., all CAFOs covered by a general permit); as site-specific permit terms based on the facility-specific NMP; or some combination of both, whereby a broadly applicable permit condition is supplemented with a site-specific term. Regardless of how the minimum measures are captured as permit terms, it is important that all permits establish clear and objective requirements. Using site-specific information from an NMP where available, helps to provide clear and objective requirements for an operation to satisfy 40 CFR part 122.42(e)(5).

How the permit writer chooses to capture the terms of the NMP in the permit is primarily up to the permit writer, except to the extent that the CAFO regulations necessitate that certain terms be site-specific. Moreover, the permit writer's discretion may be limited by applicable state-specific requirements for certain BMPs. Further, because the public must have an opportunity to review the NMP and comment on the terms of the NMP to be included in the permit, the extent of discretion allotted to the permit writer might vary.

Although the permit writer has broad discretion regarding how to write the minimum measures as permit terms, to facilitate public review of the NMP the permit writer should decide how he can clearly write the permit terms so that they are easy to locate and are readily understood by the permitee, permitting authority, and the public. The following section describes different ways that a permit writer can write permit terms.

Terms of the NMP may be written as broadly applicable permit terms for the following minimum measures: mortality management; clean water diversion; prevention of direct animal contact with water; proper chemical handling; protocols for manure and soil testing; and record-keeping requirements as long as they provide sufficient clarity for implementation of the terms by the CAFO. Where broadly applicable terms alone are sufficient to comply with 40 CFR part 122.42(e)(5), and are established in a general permit, CAFOs may submit NMPs to the Director that do not duplicate those requirements.

However, when an NMP provides site-specific measures for those terms, the permit writer should consider whether it is beneficial for clarity to include the site-specific measures to supplement the generally applicable term. As part of that evaluation, the permit writer should also determine if the NMP is missing any site-specific information that is necessary to comply with 40 CFR part 122.42(e)(5). Where site-specific information is missing, the permitting authority may require that the CAFO provide supplemental site-specific information for those terms. To the extent that the CAFO is required to provide supplemental site-specific information in its NMP to comply with 40 CFR part 122.42(e)(5), that information should be included as part of the terms of the permit. Examples of both broadly applicable terms and site-specific terms for each of the minimum measures are in Chapter 5.

Sample permit language for a general permit referencing generally applicable terms:

The terms of the NMP also include sections [***identify section(s)***] of this permit concerning [for example—no direct contact of animals with water of the U.S. or waters that are discharged to waters of the U.S.; handling and disposal of chemicals and other contaminants; limitations on the timing of application of manure, litter, and process wastewater] that are applicable to all CAFOs authorized under this permit and are included as terms of the NMP for every CAFO covered by this permit.

From time to time, situations can arise where generally applicable permit terms conflict with site-specific provisions in the NMP. In such instances, the permit writer should include provisions in the permit that clarifies which of the conflicting (or potentially conflicting) requirements must be followed by the CAFO when implementing the terms of the NMP.

EPA believes that the requirements for *waste storage*, 40 CFR part 122.42(e)(1)(i), and *conservation practices to control runoff,* 40 CFR part 122.42(e)(1)(vi), have site-specific components; therefore, it would not be sufficient to write those as generally applicable permit terms. However, because some elements of those two terms may apply to multiple facilities, EPA encourages permit writers to write the permit terms for those two measures as a hybrid of broadly applicable permit terms that are supplemented by site-specific information derived from the permitted CAFO's NMP. Examples of those approaches are provided in Chapter 5.

Sample permit language—generally applicable terms with clarifying language

The terms of the NMP also include [***identify section(s)***] of this permit concerning [for example—waste storage and conservation practices to control runoff]. Such terms are applicable to all CAFOs authorized under this permit, except where the NMP explicitly includes site-specific alternatives that meet all the requirements of this permit and are included as terms of the NMP, as follows: [Here list those terms from the NMP to be incorporated into the permit.]

Finally, the terms of the permit that are conditions that ensure compliance with the requirement to establish *protocols for land application* can be written only as site-specific permit terms. 40 CFR § 122.42(e)(5). Those are described in detail in 40 CFR part 122.42(e)(5). The terms for land application are discussed extensively in Chapter 6.5.

Approaches for Writing Site-Specific Permit Terms of the NMP

When incorporating the site-specific terms of the NMP into the permit, a permit writer may take a variety of approaches, depending on the type of permit, the complexity and length of the NMP, and—for rates of application—whether the permittee intends to follow the linear approach or the narrative rate approach. Those approaches may include (1) incorporation by reference of the NMP in its entirety; (2) incorporation of only the terms of the NMP by reference, using language that parallels the regulatory provisions for the terms of the NMP; and (3) a specific, detailed identification of each of the terms of the NMP in the text of the permit. The discussion that follows focuses on terms for rates of application but can be used by permit writers when considering how to incorporate site-specific terms for all the minimum measures.

The first approach for identifying the terms of the NMP in the permit is to incorporate the entire NMP by reference (blanket incorporation) and attach the NMP to the permit. That would be an appropriate approach to use when the terms of the NMP are clearly identifiable in the NMP, and where the NMP does not contain a lot of extraneous information that could be confused with parts of the NMP that constitute the permit terms. If a permit writer chooses to use that approach, it is generally not sufficient to merely attach the NMP to the permit. A reference to the attached NMP and a statement that it is incorporated into the permit is generally necessary to make the terms of the NMP enforceable as permit conditions. States may have specific legal requirements or standard text for incorporation by reference.

Sample permit language—*blanket incorporation* method

The [attached NMP: specify facility, responsible parties, and date of the NMP, as well as in what manner the NMP is ***attached*** to the permit, its location if not physically attached, etc.] is incorporated by reference and constitutes in its entirety the terms of the NMP, which are included as terms and conditions of this permit, as determined by the Director to constitute the information, protocols, BMPs, and other conditions necessary to meet the requirements of 40 CFR part 122.42(e)(1).

For rates of application, this method of incorporation by reference is most suitable where the permittee is using the linear approach for rates of application, where the only factor of the NMP that is variable is the amount of manure to be applied. (For a detailed discussion of the linear approach, see Chapter 6.5.1 and 6.5.2). The conditions that determine the actual amount of manure to be land applied can be specifically articulated either in the permit or in the NMP itself. It is not necessary to filter out elements of the NMP that are not actually conditions of the permit, unless there is a specific concern that there could be confusion as to whether some of the content of the NMP is considered a term of the NMP. If the concern is limited to only a few issues, this form of incorporation by reference can be used effectively, as long as clarification is provided.

Incorporation of the NMP in its entirety may also be used where the permittee follows the narrative rate approach, as long as any factors that can vary during the period of permit coverage are explicitly discussed in the NMP and the conditions, range, and other appropriate limitations concerning such variables are clearly described in the NMP. Where a permittee chooses to use the narrative rate approach, it could be problematic if the permit incorporates the NMP in its entirety, because the permittee believes that the plan is intended to allow changes to occur at the facility during the period of permit coverage and that adjustments can be made in the implementation of the plan, which will be allowed by the permit. If the NMP is incorporated as written, it must be clear to anyone reviewing the NMP what the terms are that will apply to the CAFO throughout the period of permit coverage. An NMP incorporated in this fashion will need to specifically describe the variations that may occur during the period of permit coverage and the conditions and implications associated with such variations so that changes to the NMP will not require reopening the plan for review. In those situations, EPA strongly recommends that the NMP itself clearly describe to the extent possible the array of variables that are anticipated during the period of permit coverage. Given the complexity of factors associated with rates of application, however, it might be difficult to specifically identify all the conditions that could vary within the allowable framework of the narrative rate approach.

When incorporation by reference is done using the blanket incorporation approach, it is important to keep in mind that the NMP may address more nutrient management practices than are specifically required by the CAFO regulations. If the permit incorporates the entire NMP by reference, the permittee will be expected to implement everything as described in the plan, to the extent that it pertains to the regulatory requirements, whether or not intended by the permit writer.

The second approach by which a permit writer may establish site-specific terms of the NMP in a permit is through a more detailed form of incorporation by reference. Such a detailed form of incorporation by reference specifically refers to each portion of the NMP that is incorporated as a permit term. That would be an appropriate approach to use where the NMP has delineated sections that relate to the nine minimum measures. Under this approach, it is necessary to ensure that the permit includes a reference to the NMP and make clear that the terms of the incorporated NMP are themselves terms and conditions of the permit. See 40 CFR part 122.23(h). Although it is similar to the blanket incorporation method, this approach has the advantage of providing some of the nuances identified in the NPDES regulations, thereby avoiding some of the pitfalls of blanket incorporation of the NMP. Of course, changes that exceed the bounds of the narrative rate approach may be made if the procedures for changes to the NMP are followed (see Changes to a Permitted CAFO's NMP, below). The text box below includes sample language for incorporating the terms for rates of application for a CAFO using the narrative rate approach.

Sample language—incorporation method for rates of application for a CAFO using the narrative rate approach

The terms of the NMP with respect to rates of application of manure, litter, and process wastewater include the following:

- The outcome of the field-specific assessment of the potential for nitrogen and phosphorus transport from each field.
- The crops to be planted in each field or any other uses such as pasture or fallow fields (including alternative crops identified in accordance with 40 CFR part 122.42(e)(5)(ii)(B).
- The realistic yield goal for each crop or use identified for each field.
- The nitrogen and phosphorus recommendations from sources specified by the Director for each crop or use identified for each field.
- The methodology by which the NMP accounts for the following factors when calculating the amounts of manure, litter, and process wastewater to be land applied:
    - Results of soil tests conducted in accordance with protocols identified in the NMP, as required by 40 CFR part 122.42(e)(1)(vii).
    - Credits for all nitrogen in the field that will be plant available.
    - The amount of nitrogen and phosphorus in the manure, litter, and process wastewater to be applied.
    - Consideration of multiyear phosphorus application.
    - Accounting for all other additions of plant-available nitrogen and phosphorus to the field.
    - The form and source of manure, litter, and process wastewater.
    - The timing and method of land application.
    - Volatilization of nitrogen and mineralization of organic nitrogen.
- Alternative crops that are not in the planned crop rotation but that are listed, by field, where the plan includes the realistic crop yield goals and the nitrogen and phosphorus recommendations for each such crop.

The following projections in the NMP are not terms of the NMP:

- The planned crop rotations for each field for the period of permit coverage.
- The projected amount of manure, litter, or process wastewater to be applied.
- Projected credits for all nitrogen in the field that will be plant available.
- Consideration of multiyear phosphorus application.
- Accounting for all other additions of plant-available nitrogen and phosphorus to the field.
- The predicted form, source, and method of application of manure, litter, and process wastewater for each crop.
- Timing of application for each field, as far as it concerns the calculation of rates of application.

To ensure clarity, in many instances, the best method of incorporating the terms into the permit might be to specifically delineate the terms of the NMP with site-specific conditions in the permit. Although that might be resource-intensive from the perspective of the permit writer, it can help to avoid confusion when the terms of the NMP are established by the permitting authority and when they are implemented by a CAFO during the period of permit coverage. A permit writer taking that approach would include all the terms of the NMP in the body of the permit, including all the terms associated with rates of application. When following that approach, the permit writer is advised to include a catch-all provision in the permit that ensures that the terms of the NMP fully encompass all the requirements established in the CAFO regulations. Chapter 6.6 provides a detailed example of this method for rates of application and illustrates how a permit writer can identify and extract information from an NMP and use the information to write permit terms for the *protocols for land application* minimum measure.

It is worth noting that plan writers can help the permit writer by highlighting the key information in the plan that identifies the terms of the plan. Similarly, some of that information may be included in software used in developing the NMP. Permitting authorities may allow plans to rely on such default information, as long as there is a means of clearly identifying the information used to develop the NMP and that serves as the basis for the terms of the NMP.

Regardless of the method of incorporation used by the permit writer, it is the permit writer's responsibility to ensure that the permit clearly delineates the terms of the NMP so that the CAFO operator, the public, state and federal inspectors, and others understand what is expected of the permitted CAFO when it implements its NMP. Some combination of the methods discussed above may be used to address concerns that might be raised by one or more of the parties when the draft terms of the NMP are made available for review by the permitting authority. EPA's expectations concerning specific terms of the NMP are discussed in detail in Chapters 5 and 6 and are intended to foster effective permit writing and be helpful in avoiding ambiguities in an NPDES permit. Chapter 5 includes examples of terminology that may be used for including site-specific terms for each of the minimum measures in a permit. Chapter 6 includes a detailed example of terms of the NMP for rates of application.

Changes to a Permitted CAFO's NMP

Agricultural operations modify their nutrient management and farming practices during the normal course of their operations. Such alterations might require changes to a permitted CAFO's NMP during the period of permit coverage.

Because of the way NMPs are developed and the flexibility provided by the two options for developing the terms of the NMP at 40 CFR part 122.42(e)(5), most routine changes at a facility should not require changes to the permit itself. For example, a CAFO using the narrative rate approach would not ordinarily need to change any permit terms when it makes changes to the factors that are not themselves terms but are accounted for in the methodology (such as the timing, method, form, or source of manure to be applied, which are all described in detail in Chapter 6.5.3). To minimize the need for revision, NMPs should account for and accommodate routine variations inherent in agricultural operations such as anticipated changes in crop rotation, and changes in numbers of animals and volume of manure resulting from normal fluctuations or a facility's planned expansion.

Typically, an NMP is developed to reflect the maximum number of animals confined at the facility; the maximum capacity for manure storage; the total number of fields available for land application and their maximum capacity for nutrient applications. Fluctuations under those maximum amounts would not necessitate changes to NMPs. EPA encourages operators to develop an NMP that includes reasonably predictable alternatives that a CAFO may implement during the period of permit coverage. However, unanticipated changes to an NMP and in some cases, permit terms, might nevertheless be necessary.

The regulation at 40 CFR part 122.42(e)(6)(i) requires a CAFO to notify the Director of changes to the CAFO's NMP, and 40 CFR part 122.42(e)(6) excludes the results of calculations made to calculate the maximum amount of manure. See 40 CFR parts 122.42(e)(5)(i)(B), 122.42(e)(5)(ii)(D). The results of the calculations, which are required of Large CAFOs using the linear approach and all CAFOs using the narrative rate approach, must be reported in the CAFO's annual report. Thus, there is no need to notify the Director of such types of changes, as long as they are within the scope of the terms of the NMP applicable to the permitted CAFO.

The regulations at 40 CFR part 122.42(e)(6)(iii) identify a list of changes to the NMP that would constitute a substantial change to the terms of a facility's NMP, thus triggering requirements for public notice and permit modification. Substantial changes include the following:

1. Addition of new land application areas not previously included in the CAFO's NMP.
2. Any changes to the maximum field-specific annual rates of application or to the maximum amounts of nitrogen and phosphorus derived from all sources for each crop, as expressed in accordance with the linear approach or the narrative rate approach.
3. Addition of any crop not included in the terms of the CAFO's NMP and corresponding field-specific rates of application.
4. Changes to field-specific components of the CAFO's NMP, where such changes are likely to increase the risk of nitrogen and phosphorus transport from the field to waters of the U.S.

The regulations allow a specific exception to the first type of substantial change (a land application area being added to the NMP), where additional land is already included in the terms of another existing NMP that is incorporated into an existing NPDES permit. If, under the revised NMP, the CAFO owner or operator applies manure on the land application area in accordance with the existing field-specific terms of the existing permit, addition of new land would under the revised NMP not be a substantial change to the terms of the CAFO owner or operator's NMP.

The second substantial change is any change to the field-specific maximum rates of application. The regulations clarify that, for the narrative rate approach, a substantial change is triggered by a change in the field-specific maximum amount of nitrogen and phosphorus derived from all sources.

District Conservationist reviewing a conservation plan with a farmer in Orange County, Virginia. (Photo courtesy of USDA/NRCS)

The third substantial change is the addition to the NMP of crops or other uses not previously included in the CAFO's NMP, together with the corresponding maximum field-specific rates of application for those crops or other uses. Because rates of application are based on the yield goals for each specific crop, any crops or other uses that are added to the plan will require corresponding newly calculated rates of application. In addition, because the maximum rates of application must be made available to the public for review before incorporation as terms of the permit, the addition of new crops or other uses and their corresponding rates of application is considered a substantial change.

Finally, any change to site-specific components of the CAFO's NMP that is likely to increase the risk of nitrogen and phosphorus transport to waters of the U.S. is a substantial change. The actual crop planted, timing and method of land application, and conservation practices used with respect to the land application areas are all key factors that affect nitrogen and phosphorus runoff from the land application area. Changes to any of the planning considerations listed above can alter the outcome of the decisions made in an NMP and the efficacy of that plan in ensuring appropriate agricultural utilization of those nutrients that are land applied.

Whether a change to any of those factors would be considered a substantial change for purposes of 40 CFR part 122.42(e)(6)(iii) is linked to the *outcome of the field-specific risk assessment*, which is a permit term for both the linear and narrative rate approaches. The *outcome of the field-specific risk assessment* evaluates the risk of nutrient runoff from a field to surface waters, and establishes the baseline risk parameters for both nitrogen and phosphorus. Chapter 6.5.1 discusses that permit term in detail.

The risk of nitrogen runoff is minimized as long as a crop's nitrogen need is not exceeded and as long as the crops' nitrogen need is based on the realistic crop yield goal and all contributing credits of available nitrogen. This permit term is crop specific, so any changes to the crop such as a change in the yield goal or a change in the type of crop would change the amount of nitrogen that would be land applied. The risk of nitrogen transport increases when the amount of nitrogen that is applied exceeds the amount identified in the permit for the planned crops. That increase in risk would result in a substantial permit change under 40 CFR part 122.42(e)(6)(iii).

There are various methods for assessing the risk of phosphorus transport from fields, such as soil test, soil phosphorus threshold, and the phosphorus index. As discussed in Chapter 6.5.1, the method for assessing the risk of phosphorus transport should be identified in a state's technical standard, and the outcome of the assessment is the permit term. The linear and narrative rate approaches for writing this permit term affect whether a change in risk would rise to be a substantial change under 40 CFR part 122.42(e)(6)(iii). (For further discussion, see Chapter 6.5.4.)

The four substantial changes identified in the regulations are applicable to both the linear and narrative rate approaches for expressing rates of application. For example, proper implementation of the narrative rate approach depends on identifying the fields to be used for land application, so use of a new field for land application that had not been previously covered in the facility's (or another facility's) permit terms would constitute a substantial change. In addition, under the narrative rate approach, a change to the field-specific maximum amounts of nitrogen and phosphorus derived from all sources is a substantial change to the NMP because it defines the upper bounds on nutrient additions.

Finally, NPDES permits for all types of dischargers, including CAFOs, typically include reopener provisions under which the Director may revise the permit during the permit term on the basis of factors such as changes to the status of the receiving waterbody. Such standard NPDES provisions are sufficient to allow permit revisions necessary to support the criteria and standards established for receiving waters.

An advantage of the narrative rate approach is that it reduces the likelihood that changes to a CAFO's operation would result in a substantial change to the terms of the CAFO's NMP. For example, a change to the method or timing of application would be a substantial change to the terms of the NMP for CAFOs using the linear approach if the Director determines that it is likely to increase the risk of nutrient transport to surface waters. For a CAFO using the narrative rate approach, a change in the method or timing of application would not be a change to the terms of the NMP, and therefore not a substantial change, as long as the methodology in the NMP (itself a permit term) accounts for the change in method or timing.

Because changes to the NMP could result in a change to a permit term, the owner or operator is required to provide the Director with the revised NMP and identify the changes from the previous version submitted. Of course, any change to the CAFO's implementation of its NMP that does not constitute a change to the NMP itself would not be submitted to the Director. For example, for CAFOs following the narrative rate approach, any change in crop rotation or substitution of crops in a given rotation with alternative crops identified in the NMP for a given field would not be a change and, thus, would not need to be submitted to the Director before implementation.

Process for Review and Modification of the NMP

When a permitted CAFO operator revises its NMP, the CAFO regulations require the owner or operator to submit the revised NMP to the permitting authority for review and for the permitting authority to incorporate any revised terms of the NMP into the permit. The regulation at 40 CFR part 122.42(e)(6) includes provisions that enable the Director to determine whether revisions to the CAFO's NMP necessitate revisions to the terms of the NMP incorporated into the permit, and if so, whether such changes are substantial or nonsubstantial. Figures 4-1 and 4-2 illustrate the NMP review process as well as necessary steps for determining and making revisions to the

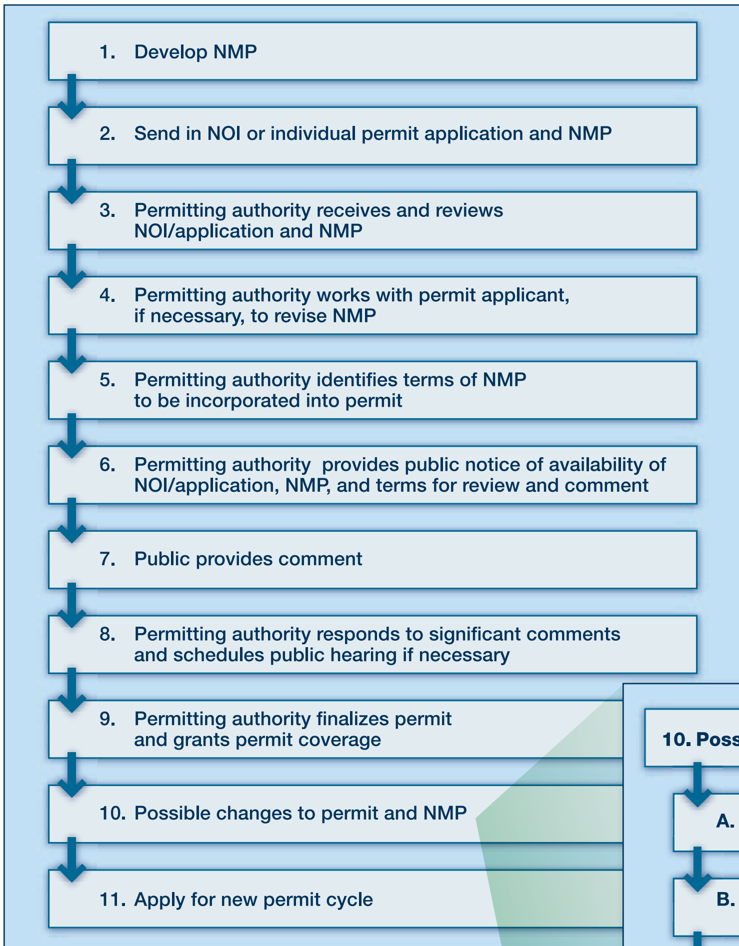


Figure 4-1. Process for Review and Modification of the Nutrient Management Plan

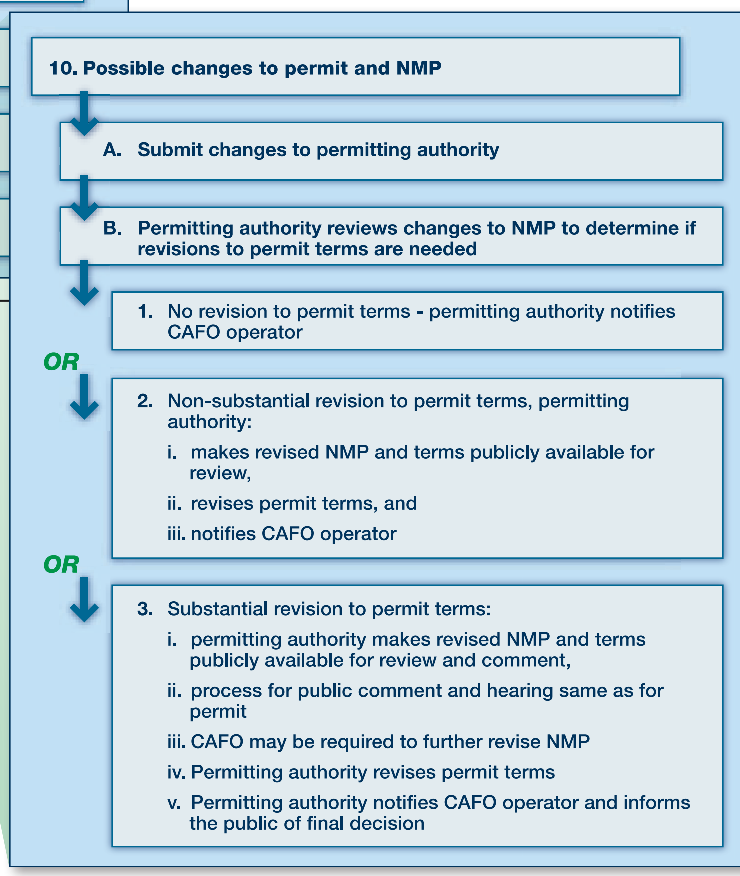


Figure 4-2. Process for Review and Modification of the Nutrient Management Plan (detail)

permit terms. The regulation identifies several specific types of changes that must be considered substantial changes to the NMP It also establishes a streamlined process for formal public notice and comment that the permitting authority must follow for permit modification when a CAFO is seeking to make substantial changes to the terms of its NMP. Nonsubstantial changes to the terms of the NMP are not subject to public notice and comment before the permit is revised. Those procedures apply to all permitted CAFOs, regardless of whether they are covered under an individual permit or under a general permit.

When a Director receives a revised plan, 40 CFR part 122.24(e)(6)(ii) requires the Director to then review the revised plan to ensure that it still meets the requirements of 40 CFR part 122.42(e) and applicable effluent limitations and standards, including those specified in 40 CFR part 412. The Director must also determine whether the changes necessitate revision to the terms of the NMP that were incorporated into the permit issued to the CAFO. If not, the Director must notify the CAFO that the permit does not need to be modified. On such notification, the CAFO may implement the revised NMP.

If, on the other hand, the Director determines that the changes to the NMP do require that the terms of the NMP that were incorporated into the permit be revised, the Director must next decide whether the change is substantial. The Director must evaluate the change on the basis of the provisions in 40 CFR part 122.42(e)(6)(iii) discussed above. Pursuant to 40 CFR part 122.42(e)(6)(ii)(A), for nonsubstantial changes, the Director must make the revised NMP publicly available and include it in the permit record, revise the terms of the NMP incorporated into the permit, and notify the owner or operator and inform the public of any changes to the terms of the NMP that are incorporated into the permit. On such notification the CAFO, may implement the revised NMP.

If the changes to the terms of the NMP are substantial, the regulations provide for a public review and comment period before the Director modifies the permit by incorporating revised terms of the NMP. 40 CFR § 122.42(e)(6)(ii)(B). The process for public comments, hearing requests, and the hearing process if a hearing is granted must follow the procedures for draft permits set forth in 40 CFR parts 124.11–124.13. The Director must respond to all significant comments received during the comment period as provided in 40 CFR part 124.17 and require the CAFO owner or operator to further revise the NMP if necessary. Once the Director incorporates the revised terms of the NMP into the permit, the Director must notify the owner or operator and inform the public. Such a type of permit modification may be appealed in the same manner as the initial, final permit decision.

The Director may establish by regulation or in the general permit for CAFOs an appropriate period that differs from the period specified in 40 CFR part 124.10 for the public to comment and request a hearing on the proposed substantial changes to the terms of the NMP incorporated into the permit. Allowing the Director to establish a different period from 40 CFR part 124.10 provides the Director the discretion to allow CAFOs to implement revised nutrient management practices in accordance with growing seasons and other time-sensitive circumstances. When proposing the period that differs from 40 CFR part 124.10, the public must have an opportunity to comment on the sufficiency of the proposed period.

Because the process in 40 CFR part 122.42(e)(6)(ii) allows for public review of substantial changes to the terms of NMPs and the underlying data and calculations, the incorporation of changes to the permit through the process is a minor permit modification under 40 CFR part 122.63(h), and no additional review of the permit modification is required.

The process and timing of modifying a permit will vary. A CAFO owner or operator must remain in compliance with his or her permit and, thus, should work closely with the permitting authority and should initiate the coordination as early as possible.

The regulations do not provide a permitting authority with the discretion to preapprove certain substantial changes, unless they are specified in an NMP that encompasses normal fluctuations or variations. That is because the *Waterkeeper* decision held that the terms of the NMPs must be subject to permitting authority review and be available for public comment.

4.1.8. Agricultural Stormwater Exemption for Permitted CAFOs

All permits issued to CAFOs that land apply manure must contain terms and conditions that, when implemented, ensure that all precipitation-related discharges from land application are composed entirely of agricultural stormwater. Section 502(14) of the CWA excludes from the definition of a point source *agricultural stormwater discharges*. The CAFO regulations establish when a discharge from a land application area under the control of a CAFO is considered to be exempt agricultural stormwater, as opposed to a point source discharge from the CAFO.[5] A precipitation-related discharge from a CAFO's land application areas is considered agricultural stormwater only when the manure was applied in accordance with site-specific nutrient management practices that "ensure appropriate agricultural utilization of the nutrients" in the manure to be applied. 40 CFR § 122.23(e). For CAFOs, the agricultural stormwater exemption applies only to discharges from land application areas.[6] Furthermore, discharges occurring during dry weather can never be discharges of agricultural stormwater.

Criteria for site-specific nutrient management practices for land application are specified in 40 CFR parts 122.42(e)(1)(vi)-(ix). Those are discussed in greater detail in Chapter 6. For permitted CAFOs, the permit must set forth the, "site-specific nutrient management practices" that will be implemented for each requirement of 40 CFR parts 122.42(e)(1)(vi)-(ix). Under 40 CFR part 122.42(e)(1)(vii), all permitted CAFOs must establish field-specific application rates for manure. The site-specific land application rates must be established as enforceable terms in the facility's NPDES permit following either the linear approach described in 40 CFR part 122.42(e)(5)(i), or the narrative rate approach described in 40 CFR part 122.42(e)(5)(ii) (see Section 6.5).

Permitted Large CAFOs

In addition to the requirements described above, permitted Large CAFOs subject to the requirements of subpart C and D of Part 412 must also meet the requirement of 40 CFR part 412.4(c) to qualify for the agricultural stormwater exemption. 40 CFR §§ 122.23(e)(1), 122.42(e)(1). The ELG specifies requirements for implementing site-specific application rates, manure and soil sampling, and setback requirements. Additionally, it provides protocols for inspecting the land application equipment. See discussion in Section 4.1.3.

The site-specific application rates for manure must be developed in accordance with technical standards established by the Director. 40 CFR § 412.4(c)(2). The rates must also be identified in the facility's NPDES permit as enforceable terms following either the linear approach or narrative rate approach (73 FR 70420). The technical standards are discussed in Chapter 6.3.1, and site-specific rates of application are discussed in Chapter 6.5.

Precipitation related runoff from a land application area where manure has been applied in accordance with an NMP is exempt as agricultural stormwater. (Photo courtesy of USDA/NRCS)

Permitted Small and Medium CAFOs

For precipitation-related discharges from the land application area of a Medium or Small CAFO to qualify for the agricultural stormwater exemption, the owner or operator of the CAFO must implement an NMP that includes the practices and protocols specified in 40 CFR part 122.42(e)(1)(vii)-(ix).

Effluent limitations for Medium and Small CAFOs are based on the BPJ of the permit writer. As discussed in Section 4.1.4, permit writers could find that it is appropriate to develop BPJ effluent limitations that are the same as, or similar to, the effluent limitations established in the ELG for Large CAFOs. Thus, a Medium or Small CAFO might be required to develop protocols for land application in accordance with the state technical standards for nutrient management and comply with the requirement for a 100-foot setback or a 35-foot vegetated buffer between land application areas and any downgradient surface waters or conduits to surface waters. Because the practices for ensuring appropriate agricultural utilization of the nutrients in land-applied manure at Large CAFOs do not differ significantly for Medium and Small CAFOs, the permit writer might find it appropriate to apply the requirements established in the state technical standards equally to land application sites at all permitted CAFOs.

4.1.9. Water Quality-Based Effluent Limitations and Standards

As discussed in Section 4.1.1, all NPDES permits must include technology-based effluent limitations. However, a permit must also include more stringent water quality-based limitations when such limitations are necessary to meet water quality standards. CWA sections 402(a), 301(b)(1)(C).

A water quality-based effluent limitation is designed to ensure that state or tribal water quality standards are met. Federal regulations require permit limitations to control all pollutants that could be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard. 40 CFR §§ 122.4(d), 122.44(d). That includes, where appropriate, water quality-based effluent limitations for the production area, land application area, and all other discharges covered by the permit.

Requirements for the Production Area of Large CAFOs

The permit writer may determine the need to establish more restrictive requirements for the production area. Even for CAFOs subject to a no-discharge, technology-based standard for the production area, situations could arise where the permitting authority needs to impose more stringent requirement for allowable discharges. Specifically, more stringent discharge limitations are necessary in instances where CAFOs discharge from a production area to a waterbody listed under CWA section 303(d) as impaired due to nutrients, dissolved oxygen or bacteria, or where an analysis of frequency, duration and magnitude of the anticipated discharge (consisting of potential overflows of manure, litter, or process wastewater) indicates the reasonable potential to violate applicable water quality standards.

The imposition of a water quality-based effluent limitation could necessitate a more stringent standard or the inclusion of additional management practices. Examples of such practices include additional storage capacity beyond that required by technology-based limits, monitoring the water quality of the waterbody and monitoring the extent of impairment where a discharge occurs, and installing an impermeable lining in a lagoon or storage pond.

Requirements for the Land Application Area of Large CAFOs

As discussed in Section 4.1.7, all permitted CAFOs are required to develop and implement an NMP. When a permitted CAFO implements an NMP in accordance with its permit requirements, any remaining precipitation related discharges of manure are considered agricultural stormwater, as discussed in Section 4.1.8. For Large CAFOs subject to the ELG, that also means that the NMP must comply with permit requirements that implement the ELG, including technical standards established by the Director for nutrient management. For facilities not subject to the ELG, it means that the NMP must comply with permit requirements that implement 40 CFR part 122.42(e) and any additional nutrient management requirements developed by BPJ. As previously mentioned, by definition, the agricultural stormwater exemption applies only to precipitation-related discharges. Any other discharges from the land application area allowed by the permit may be subject to more stringent water-quality based requirements (unless they are exempted irrigation return flows), as appropriate, to protect water quality. Those may be included in the permit as water-quality based effluent limits. They might also be addressed through the development of more protective technical standards for land application.

In addition, where there are water quality impacts associated with precipitation-related discharges from CAFO land application areas, permitting authorities are encouraged to update their technical standards to include requirements that are more protective of water quality. 68 FR 7,198 (Feb. 12, 2003).

Appropriate land application practices might include requiring phosphorus-based application rates for all manure application, additional timing restrictions such as prohibiting manure application on frozen ground, additional mandatory setbacks or buffers, groundwater monitoring requirements, or prohibiting multiyear application of phosphorus.

4.2. Monitoring, Record-Keeping, and Reporting Requirements of NPDES Permits for CAFOs

The NPDES regulations identify record-keeping, monitoring, and reporting requirements that are applicable to all CAFOs. 40 CFR §§ 122.41, 122.42(e)(2)-(4). The CAFO ELG identify additional record-keeping and monitoring requirements that are applicable only to Large CAFOs. The record-keeping requirements associated with the off-site transfer of manure are applicable to Large CAFOs. For CAFOs not subject to the ELG, additional monitoring and record-keeping requirements may be established as technology-based limits by the permitting authority on a case-by-case basis using BPJ (see Section 4.1.4).

4.2.1. Monitoring Requirements

When developing the monitoring requirements for NPDES permits, the permit writer should address the routine operational characteristics of the facility and the minimum reporting requirements at 40 CFR part 122.41(l). The ELG includes specific monitoring requirements for daily and weekly visual inspections of specific aspects of the production area and monitoring requirements associated with land application, including manure and soil analysis and land application equipment inspection. 40 CFR §§ 412.37, 412.47. Although the ELG requirements apply only to Large CAFOs subject to Part 412 subparts C and D, the permit writer should consider those as a starting point when establishing BPJ requirements for other permitted CAFOs. The permit should also include monitoring requirements that address nonroutine activities. For example, discharges at a CAFO can occur because of an overflow during a catastrophic storm event (which may be an allowable discharge under the terms of the permit) or a leak, breach, overflow, or

Sampling of wastewater from a lagoon on a hog farm. (Photo courtesy of USDA/NRCS) other structural failure of a storage facility because of improper operation, design, or maintenance (which would be an unauthorized discharge). Unauthorized discharges could also occur because of manure releases related to the improper storage or handling of liquid or solid manure, or improper land application. The permit must require specific data collection activities (as well as notification and reporting activities as described in Section 4.2.3, *Reporting Requirements*). 40 CFR § 122.41(l)(6). As explained in Section 4.1.8 where there is a discharge from the production area to an impaired water, a permit writer may impose more restrictive water quality-based effluent limitations that could include additional monitoring requirements.

The monitoring requirements include an analysis of the discharge, if needed to determine compliance by the permitting authority. 40 CFR § 122.44(g). At a minimum, the analysis should include total nitrogen, ammonia nitrogen, P, pH, temperature, *Escherichia coli* or fecal coliform, 5-day biochemical oxygen demand (BOD_5), and total suspended solids. 40 CFR § 122.44(g). The analysis is to be performed in accordance with approved EPA methods for wastewater analysis listed in 40 CFR part 136. The permitting authority might wish to specify additional parameters at its discretion.

4.2.2. Recordkeeping Requirements

CAFO operators should maintain in their records a copy of the current NPDES permit and any supplemental documents identified by the permitting authority. Permits should specify that all CAFOs must retain copies of all required documentation. In addition, permits should require that the records be organized in a manner that inspectors can easily review during a compliance inspection, such as the use of a dedicated logbook. The required records for Large CAFOs are listed in Table 4-6 and for Small and Medium CAFOs in Table 4-7. Records must be maintained for 5 years.

Recordkeeping is an important part of the permitting process. (Photo courtesy of USDA/ARS)

Table 4-6. Required records for permitted Large CAFOs

Regulatory requirement for recordkeeping	Records required
Requirements to maintain records for the nine minimum terms of the NMP. 40 CFR § 122.42(e)(2)	
Adequate storage capacity	Satisfied by requirements of 40 CFR part 412.37(b) (below)
Mortality management	Satisfied by requirements of 40 CFR part 412.37(b) (below)
Divert clean water	Satisfied by requirements of 40 CFR part 412.37(b) (below)
Prevent direct contact with waters of U.S.	Identify what waters of the U.S., if any, exist within the animal confinement areas and the measures, including operation, and maintenance procedures and associated records, that are implemented to prevent animals from contacting waters of the U.S.
Chemical disposal	Identify chemicals used or stored (or both) on-site and document appropriate disposal methods
Conservation practices to control runoff to waters of the U.S.	Identify the conservation practices used to control pollutant runoff, including location, and the protocols and procedures, including installation, operation, and maintenance, and associated records, that are implemented to ensure the practices function to control pollutant runoff
Manure and soil testing	Satisfied by requirements of 40 CFR part 412.37(c) (below)
Protocols for land application	Satisfied by requirement of 40 CFR parts 122.42(e)(2)(ii) and 412.37(c) requirement to maintain on-site a site-specific NMP
Requirements to maintain records for the production area. 40 CFR § 412.37(b)	
A complete copy of the information required by 40 CFR part 122.21(i)(1)	The name and owner or operator
	The facility location and mailing address
	Latitude and longitude of the entrance of the production area
	A topographic map of the geographic area in which the CAFO is located showing the location of the production area
	Specific information about the number and type of animals
	Type of confinement animals are in (open confinement or housed under a roof)

Table 4-6. Required records for permitted Large CAFOs *(continued)*

Regulatory requirement for recordkeeping	Records required
A complete copy of the information required by 40 CFR part 122.21(i)(1) (continued)	The type of containment and storage (anaerobic lagoon, roofed storage shed, storage ponds, under floor pits, aboveground storage tanks, belowground storage tanks, concrete pad, impervious soil pad, other)
	The total capacity for manure, litter, and process wastewater storage (tons/gallons)
	The total number of acres under control of the applicant available for land application of manure, litter, or process wastewater
	Estimated amounts of manure, litter, and process wastewater generated per year (tons/gallons)
	Estimated amounts of manure, litter, and process wastewater transferred to other persons per year (tons/gallons)
	The site-specific NMP
Requirements to maintain records for the production area. 40 CFR § 412.37(b)	
Records documenting the inspections 40 CFR § 412.37(a)(1)	Necessary documentation for inspections of the production area
	Records documenting weekly inspections of all stormwater diversion devices, runoff diversion structures, and devices channeling contaminated stormwater to the wastewater and manure storage and containment structure
	Records documenting daily inspection of water lines, including drinking water or cooling water lines
	Records documenting weekly inspections of the manure, litter, and process wastewater impoundments
Wastewater levels 40 CFR § 412.37(b)(2)	Weekly records of the manure and wastewater level in liquid impoundments as indicated by the required depth marker
Corrective actions 40 CFR § 412.37(b)(3)	Records of any actions taken to correct deficiencies found in the visual inspections of the production area
	An explanation of the factors preventing immediate correction of any deficiencies identified in the visual inspections of the production area that are not corrected within 30 days

Table 4-6. Required records for permitted Large CAFOs *(continued)*

Regulatory requirement for recordkeeping	Records required
Mortality management required 40 CFR §§ 412.37(b)(4), (a)(4)	Records must identify that mortalities were not disposed of in any liquid manure or process wastewater system. They must also identify that mortalities were handled in such a way as to prevent the discharge of pollutants to surface water, unless alternative technologies pursuant to 40 CFR part 412.31(a)(2) and approved by the Director are designed to handle mortalities.
Storage structure design 40 CFR § 412.37(b)(5)	Current design of any manure or litter storage structures, including volume for solids accumulation, design treatment volume, total design volume, and approximate number of days of storage capacity
Overflows 40 CFR § 412.37(b)(6)	The date, time, and estimated volume of any overflow
Requirements to maintain records for the land application area. 40 CFR § 412.37(c)	
	Expected crop yields
	Weather conditions 24 hours before application, at time of application, and 24 hours after application
	Explanation of the basis for determining manure application rates, as provided in the technical standards established by the Director
	Calculations showing the total nitrogen and phosphorus to be applied to each field, including sources other than manure, litter, or process wastewater
	Total amount of nitrogen and phosphorus actually applied to each field, including documentation of calculations for the total amount applied
	The method used to apply the manure, litter, or process wastewater
	Test methods used to sample and analyze manure, litter, process wastewater, and soil. 40 CFR §§ 412.37(c), 47(c)
	Results from manure, litter, process wastewater, and soil sampling. 40 CFR § 412.37(c)
	Date(s) of manure application equipment inspection
Additional recordkeeping requirements	**Records required**
40 CFR § 412.37(c)	At the discretion of the permitting authority

For Medium and Small CAFOs, the monitoring and record-keeping requirement for the effluent limitations are established by the permitting authority on a case-by-case basis. The inclusion of additional record-keeping requirements in the permit for Large CAFOs would be at the discretion of the permitting authority. The specific record-keeping requirements for other CAFOs would be established by the permitting authority.

Table 4-7. Required records for permitted Small and Medium CAFOs

Regulatory requirement for recordkeeping	Responsive records or documentation
Requirements to maintain records for nine minimum terms of the NMP. 40 CFR §122.42(e)(1)(ix)	
Adequate storage capacity	Documentation of the storage capacity required to meet permit requirements and the storage capacity available
Mortality management	Records of practices implemented to meet the mortality disposal or management practices (or both) of the permit
Divert clean water	Document implementation of any operation and maintenance practices used to ensure that clean water is diverted as appropriate
Prevent direct contact with waters of the U.S.	Identify what waters of the U.S., if any, exist within the animal confinement areas and the measures, including operation and maintenance procedures and associated records, that are implemented to prevent animals from contacting waters of the U.S.
Chemical disposal	Identify chemicals used or stored (or both) on-site and document appropriate disposal methods
Conservation practices to control runoff to waters of the U.S.	Identify the conservation practices used to control pollutant runoff, including location, and the protocols and procedures, including installation, operation, and maintenance, and associated records, that are implemented to ensure the practices function to control pollutant runoff
Manure and soil testing	Results of manure and soil tests taken to meet the requirements of the permit and NMP
Protocols for land application	Satisfied by requirement of 40 CFR part 122.42(e)(2)(ii) requirement to maintain on-site a site-specific NMP
Additional record-keeping requirement to satisfy the effluent limitations	
Determined by the permitting authority on a case-by-case basis	

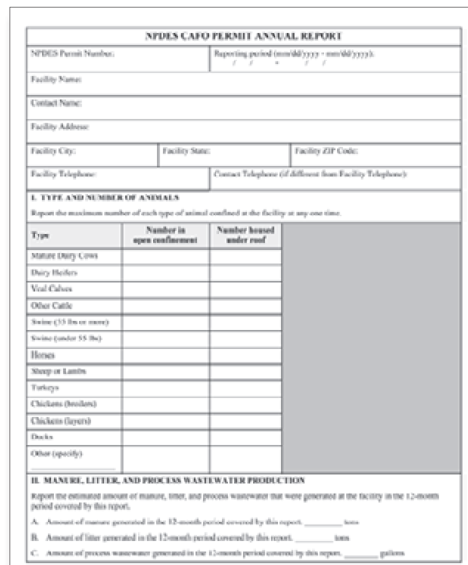
Appendix D, Example Nutrient Management Plan Record Keeping Forms, and Appendix M, Nutrient Management Recordkeeping Calendar, include some examples of record-keeping forms. Those forms can help the operation meet some of the record-keeping requirements specified in the regulations.

4.2.3. Reporting Requirements

Reporting requirements are generally linked to monitoring requirements and can include periodic reports, emergency reports for overflow events, and special reports. When developing the reporting requirements for an NPDES permit, the permit writer should consider monitoring requirements for routine operational characteristics of the facility, including the required annual report, and the minimum reporting requirements at 40 CFR part 122.41(l). The permit also should include reporting requirements that address nonroutine activities such as discharge notification (for both authorized and unauthorized discharges). The permit must require immediate notification of the permitting authority and a follow-up report describing the specific data collection activities required for discharges. 40 CFR § 122.41(l)(6). The reporting requirements must ensure that the permittee provides a description of the discharge, describes the time and duration of the event, identifies the cause(s) of the discharge, and provides the result of any required an analysis(es) to the permitting authority. 40 CFR §§ 122.41(l)(6), 122.44(g).

Annual Reports

All NPDES permits for CAFOs must include a requirement that the permittee submit an annual report with specific information defined in the regulation. 40 CFR § 122.42(e)(4). In addition to the information required by the NPDES regulations, state permitting authorities can require additional information to be included with the annual report. As with NOIs, EPA will promote electronic submission of annual reports and immediate posting on publicly available locations. Appendix C, Example NPDES CAFO Permit Annual Report Form includes all the information specified in the NPDES CAFO regulation.



NPDES CAFO PERMIT ANNUAL REPORT

NPDES Permit Number: | Reporting period (mm/dd/yyyy - mm/dd/yyyy):

Facility Name:

Contact Name:

Facility Address:

Facility City: | Facility State: | Facility ZIP Code:

Facility Telephone: | Contact Telephone (if different from Facility Telephone):

I. TYPE AND NUMBER OF ANIMALS

Report the maximum number of each type of animal confined at the facility at any one time.

Type	Number in open confinement	Number housed under roof
Mature Dairy Cows		
Dairy Heifers		
Veal Calves		
Other Cattle		
Swine (55 lbs or more)		
Swine (under 55 lbs)		
Horses		
Sheep or Lambs		
Turkeys		
Chickens (broilers)		
Chickens (layers)		
Ducks		
Other (specify)		

II. MANURE, LITTER, AND PROCESS WASTEWATER PRODUCTION

Report the estimated amount of manure, litter, and process wastewater that were generated at the facility in the 12-month period covered by this report.

A. Amount of manure generated in the 12-month period covered by this report. ________ tons

B. Amount of litter generated in the 12-month period covered by this report. ________ tons

C. Amount of process wastewater generated in the 12-month period covered by this report. ________ gallons

The annual report must include the following.
40 CFR § 122.42(e)(4)

- The number and type of animals confined at the CAFO.
- Estimated total amount of manure, litter, and process wastewater generated by the CAFO in the previous 12 months (tons/gallons).
- Estimated total amount of manure, litter, and process wastewater transferred to other persons by the CAFO in the previous 12 months (tons/gallons).
- Total number of acres for land application covered by the NMP.
- Total number of acres under control of the CAFO that were used for land application of manure, litter, and process wastewater in the previous 12 months.

- Summary of all manure, litter, and process wastewater discharges from the production area that have occurred in the previous 12 months, including the date, time, and approximate volume of the discharge.
- A statement indicating whether the current version of the CAFO's NMP was developed or approved by a certified nutrient management planner.
- The actual crop(s) planted and actual yield(s) for each field.
- The nitrogen and phosphorus content of the manure, litter, and process wastewater as reported on the laboratory report for the required analyses (lbs/ton, g/Kg, pounds/1,000 gallons, mg/L, ppm).
- The results of calculations conducted in accordance with the approved NMP to determine the amount of manure, litter, or process wastewater to apply.
- The amount of manure, litter, and process wastewater applied to each field during the previous 12 months.
- For any CAFO that implements an NMP that addresses rates of application in accordance with the narrative rate approach:
  - The results of any soil testing for nitrogen and phosphorus conducted during the previous 12 months.
  - The data used in calculations conducted in accordance with the methodology in the approved NMP to determine rates of nitrogen and phosphorus application from manure, litter, and process wastewater.
  - The amount of any supplemental fertilizer applied during the previous 12 months.

Part 122.42(e)(4)(viii) requires all permitted CAFOs to include in their annual reports the actual crop(s) planted and actual yield(s) for each field, the actual nitrogen and phosphorus content of the manure, litter, and process wastewater, and the amount of manure, litter, or process wastewater applied to each field during the previous 12 months. It is important for the permitting authority to obtain that information annually to ensure that the CAFO has been operating in compliance with the terms of its permit. The annual report will inform the Director and the public how the CAFO has operated, given the flexibility for the terms of the NMP incorporated into the permit.

CAFOs that follow the narrative rate approach for describing rates of application in the NMP must also submit as part of their annual report the results of all soil testing and concurrent calculations to account for residual nitrogen and phosphorus in the soil, all recalculations, and the new data from which they are derived. 40 CFR § 122.42(e)(5)(ii). The CAFO is required to report the amounts of manure and the amount of chemical fertilizer applied to each field during the preceding 12 months. Together with the total amount of plant-available nitrogen and phosphorus from all sources, the information that is required to be included in the annual report provides the information necessary to determine that the CAFO was adhering to the terms of its permit when calculating amounts of manure to apply.

The narrative rate approach requires the CAFO to recalculate the projected amount of manure, to be land applied, using the methodology in the NMP, at least once a year, throughout the period of permit coverage. 40 CFR § 122.42(e)(5)(ii). To ensure that such recalculations are made available to the Director and the public, the recalculations and the new data from which they are derived are required to be reported in the CAFO's annual report, in which the recalculations and data for the previous 12 months must be reported.

The annual report requirements are for use only in addressing implementation of existing NMP provisions and changes to the NMP contemplated through flexibilities built into the NMP during the initial planning process or later modifications in accordance with 40 CFR part 122.42(e)(6). Because the terms of the NMP are incorporated as enforceable terms and conditions of the permit, any change that results in a change to the terms of the NMP constitutes a change to the permit and therefore must be processed in accordance with 40 CFR part 122.42(e)(6).

4.3. Special Conditions for All NPDES Permits for CAFOs

The NPDES regulations require every CAFO permittee to maintain permit coverage until the CAFO no longer discharges or is properly closed. 40 CFR § 122.22(g). In addition, NPDES permits issued to Large CAFOs must include a special condition that requires the operator to collect and maintain information concerning the transfer of manure to other persons (see Section 4.3.3). Permitting authorities have the discretion to add special conditions to NPDES permits to address site-specific conditions at the CAFO to minimize the discharge of nutrients to waters of the U.S. 40 CFR § 122.44(k).

4.3.1. Additional Special Conditions as Determined by the Permitting Authority

NPDES permits for CAFOs may include additional special conditions as determined necessary by the permitting authority.

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 under the CWA. 40 CFR § 22.44(k). For example, such additional requirements could address emergency discharge impact abatement, extended storage periods, irrigation control, spills, discharges from field drain tiles, measurement of rainfall, protection for endangered species and migratory birds, employee training, and groundwater that has a direct hydrologic connection to waters of the U.S. In addition, states concerned with groundwater may require monitoring, liners, or other requirements in accordance with appropriate state authority. CWA § 510.

4.3.2. Duty to Maintain Permit Coverage until the CAFO is Properly Closed

Under the revised regulations, permit coverage must be maintained until the facility has ceased operation or is no longer a CAFO or that the facility no longer discharges manure that was generated while the operation was a CAFO, other than agricultural stormwater from land application areas. 40 CFR § 122.23(g).

Once an operation is issued an NPDES permit, that permit remains in place for the entire life of the permit term, independent of the specific number of animals confined at any time. For example, a beef operation with 1,200 cattle meets the definition of a Large CAFO and is subject to regulation. It applies for and is issued an NPDES permit. After issuance of the permit, 400 cows are transported off the operation, leaving 800 cattle at the operation. The permit remains in place, and the operation must continue to comply with its requirements. If the operation has taken the steps to permanently reduce the number of animals confined to a number less than the regulatory threshold and it would not meet the definition of a Medium CAFO, it can request that the permitting authority terminate the permit, as long as the operation no longer discharges manure that was generated while the facility was operated as a CAFO.

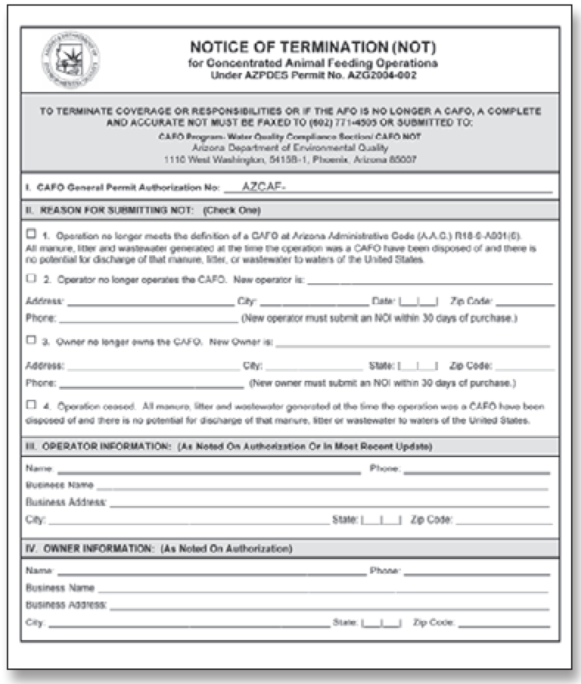
The sun goes down over a farm. (Photo courtesy of USDA/NRCS)

Closure Documentation

Specific information to be submitted to document proper closure would be established at the discretion of the permitting authority. Because of the variation in site management practices, it is unlikely that there will be a standard package of documentation that addresses whether an operation has been properly closed or no longer meets the definition of a CAFO and has no potential to discharge to waters of the U.S. any manure generated while it was a CAFO. The key information to be submitted by the permittee to document such change should focus on that which establishes a permanent change to the number of animals held in confinement and the necessary changes to the manure and wastewater storage and use practices. In those cases where a permitted CAFO has ceased operation, the documentation may include records of sale for the animals confined specifying the date at which no animals remained in confinement. In addition, the land application or transfer records should document the disposition of all the manure and wastewater associated with those animals, either in accordance with a site-specific NMP or transferred off-site, for the period up to and including the date at which the operation no longer met the definition of a CAFO.

That information could include the submission of a certification, prepared by a professional engineer licensed in the state, that any liquid storage structure has been properly closed and that pollutants associated with manure will not migrate from the closed structure to waters of the U.S. Permitting authorities should also be aware that NRCS has established a Conservation Practice Standard addressing the closure of such facilities. The standard is titled *Closure of Waste Impoundments* and is identified as Practice Code 360.

In cases where a permitted CAFO claims that it no longer meets the definition of a CAFO or has addressed the factors that resulted in its being designated as a CAFO, the permitting authority should request information that documents the permanent reduction in the number of animals confined and that the amount of wastewater being generated and stored at the operation is consistent with the reduction. Permitting authorities might wish to conduct an inspection of the operation to confirm that it has been properly closed. With respect to designated operations, the CAFO should submit documentation as to how the conditions were addressed and why the operation is no longer a significant contributor of pollutants to waters of the U.S. In those cases where there is a significant reduction in the number of animals being confined, the permitting authority should request records that document the proper disposition of any stored manure and wastewater on the basis of the permitted capacity of the operation.


NOTICE OF TERMINATION (NOT)
for Concentrated Animal Feeding Operations
Under AZPDES Permit No. AZG2004-002

TO TERMINATE COVERAGE OR RESPONSIBILITIES OR IF THE AFO IS NO LONGER A CAFO, A COMPLETE AND ACCURATE NOT MUST BE FAXED TO (602) 771-4505 OR SUBMITTED TO:
CAFO Program- Water Quality Compliance Section/ CAFO NOT
Arizona Department of Environmental Quality
1110 West Washington, 5415B-1, Phoenix, Arizona 85007

I. CAFO General Permit Authorization No: AZCAF-

II. REASON FOR SUBMITTING NOT: (Check One)

☐ 1. Operation no longer meets the definition of a CAFO at Arizona Administrative Code (A.A.C.) R18-9-A901(6). All manure, litter and wastewater generated at the time the operation was a CAFO have been disposed of and there is no potential for discharge of that manure, litter, or wastewater to waters of the United States.

☐ 2. Operator no longer operates the CAFO. New operator is: ______
Address: ______ City: ______ Date: |__|__| Zip Code: ______
Phone: ______ (New operator must submit an NOI within 30 days of purchase.)

☐ 3. Owner no longer owns the CAFO. New Owner is: ______
Address: ______ City: ______ State: |__|__| Zip Code: ______
Phone: ______ (New owner must submit an NOI within 30 days of purchase.)

☐ 4. Operation ceased. All manure, litter and wastewater generated at the time the operation was a CAFO have been disposed of and there is no potential for discharge of that manure, litter or wastewater to waters of the United States.

III. OPERATOR INFORMATION: (As Noted On Authorization Or In Most Recent Update)
Name: ______ Phone: ______
Business Name ______
Business Address: ______
City: ______ State: |__|__| Zip Code: ______

IV. OWNER INFORMATION: (As Noted On Authorization)
Name: ______ Phone: ______
Business Name ______
Business Address: ______
City: ______ State: |__|__| Zip Code: ______

4.3.3. Manure Transfer Requirements for Large CAFOs

NPDES permits for Large CAFOs must include specific requirements concerning the transfer of manure to other persons. The permit must require the operator to provide all recipients of manure and wastewater generated by the CAFO with the most current manure nutrient analysis. 40 CFR § 122.42(e)(3). The nutrient analysis must be consistent with the CAFO ELG. 40 CFR § 412. The ELG for Large CAFOs requires that manure be sampled for nitrogen and phosphorus at least annually. In addition, the permit must require Large CAFOs to retain records of the date of the transfer, the name and address of the recipient, and the approximate amount of manure, litter, or process wastewater transferred (tons/gallons). Those records are to be maintained for 5 years from the date the manure, litter, or process wastewater is transferred. As a result of the negative environmental impact of the improper use and disposal of manure, NPDES permit writers should use PBJ in determining whether to include these requirements in an NPDES permit issued to a small or medium CAFO. For examples of a manure, litter, and wastewater transfer record form, see Appendix P, Sample Nutrient Management Plan Section 7 and Appendix D, Example Nutrient Management Plan Recordkeeping Forms.

4.4. Standard Conditions of a CAFO NPDES Permit

Standard conditions must be included in all NPDES permits. Standard conditions specified in 40 CFR parts 122.41 and 122.42 play an important supporting role to effluent limitations, monitoring and reporting requirements, and special conditions because they delineate various legal, administrative, and procedural requirements of the permit. Standard conditions cover various topics, including definitions, testing procedures, records retention, notification requirements, penalties for noncompliance, and other permittee responsibilities. The conditions provided in 40 CFR part 122.41 apply to all types and categories of NPDES permits and must be included in all permits (for applicability to state NPDES permits, see 40 CFR part 123.25). The conditions provided in 40 CFR part 122.42 apply to only certain categories of NPDES facilities. Any permit issued to a facility in one of the categories listed in 40 CFR part 122.42 must contain the additional conditions, as applicable.

The use of standard conditions helps ensure uniformity and consistency of NPDES permits issued by authorized states or the EPA Regional offices. Permit writers need to be aware of the contents of the standard conditions because it might be necessary to explain portions of the conditions to a discharger. The permit writer should keep abreast of any changes in EPA's standard conditions set out in 40 CFR parts 122.41 and 122.42. According to 40 CFR part 122.41, standard conditions may be incorporated into a permit either expressly (verbatim from the regulations) or by reference to the regulations. It generally is preferable for permit writers to attach the standard conditions expressly because permittees might not have easy access to the regulations. Some states have developed an attachment for NPDES permits that includes the federal standard conditions.

4.4.1. Types of Standard Conditions

A brief summary of the 40 CFR part 122.41 standard conditions that must be included in all types of NPDES permits follows:

- **Duty to Comply** 40 CFR part 122.41(a): The permittee must comply with all conditions of the permit. Noncompliance is a violation of the CWA and is grounds for enforcement action, changes to or termination of the permit, or denial of a permit renewal application.

- **Duty to Reapply** 40 CFR part 122.41(b): A permittee wishing to continue permitted activities after the permit expiration date must reapply for and obtain a new permit.

- **Need to Halt or Reduce Activity not a Defense** 40 CFR part 122.41(c): The permittee may not use as a defense in an enforcement action the reasoning that halting or reducing the permitted activity is the only way to maintain compliance.

- **Duty to Mitigate** 40 CFR part 122.41(d): The permittee is required to take all reasonable steps to prevent any discharge or sludge use or disposal in violation of the permit that has a reasonable likelihood of adversely affecting human health or the environment.
- **Proper Operation and Maintenance** 40 CFR part 122.41(e): The permittee must properly operate and maintain all equipment and treatment systems used for compliance with the terms of the permit. The permittee must provide appropriate laboratory controls and quality assurance procedures. Operation of backup systems is required only when needed to ensure compliance.
- **Permit Actions** 40 CFR part 122.41(f): The permit may be modified, revoked and reissued, or terminated for cause. A request by the permittee for a permit modification, revocation or reissuance, termination, or a notification of planned changes or anticipated noncompliance does not suspend the permittee's obligation to comply with all permit conditions.
- **Property Rights** 40 CFR part 122.41(g): The permit does not convey any property rights of any sort, or any exclusive privilege.
- **Duty to Provide Information** 40 CFR part 122.41(h): The permittee must furnish, within a reasonable time, any information needed to determine compliance with the permit or to determine whether there is cause to modify, revoke and reissue, or terminate the permit. The permittee also must furnish, on request, copies of records that must be kept as required by the permit.
- **Inspection and Entry** 40 CFR part 122.41(i): The permittee must, on presentation of valid credentials by the Director or his or her representative, allow entry into the premises where the regulated activity or records are present. The Director must have access to and be able to make copies of any required records; inspect facilities, practices, operations, and equipment; and sample or monitor at reasonable times.
- **Monitoring and Records** 40 CFR part 122.41(j): Samples must be representative of the monitored activity. The permittee must retain records for 3 years (5 years for sewage sludge activities) subject to extension by the Director. Monitoring records must identify the sampling dates and personnel, the sample location and time, and the analytical techniques used and corresponding results. Wastewater and sludge measurements must be conducted in accordance with Parts 136 or 503 or other specified procedures. Falsification of results is a violation under the CWA.
- **Signatory Requirement** 40 CFR part 122.41(k): The permittee must sign and certify applications, reports, or information submitted to the Director in accordance with the requirements in 40 CFR § 122.22. Knowingly making false statements, representations, or certifications is punishable by fines or imprisonment.
- **Planned Changes** 40 CFR part 122.41(l)(1): Notice must be given to the Director as soon as possible of planned physical alterations or additions to the facility (or both)

that could meet the criteria for determining whether the facility is a new source under 40 CFR part 122.29(b); result in changes in the nature or quantity of pollutants discharged; or significantly change sludge use or disposal practices.

- **Anticipated Noncompliance** 40 CFR part 122.41(l)(2): The permittee must give advance notice of any planned changes that could result in noncompliance.
- **Permit Transfers** 40 CFR part 122.41(l)(3): The permit is not transferable except after written notice to the Director. The Director may require modification or revocation and reissuance, as necessary.
- **Monitoring Reports** 40 CFR part 122.41(l)(4): [This standard condition is not applicable to CAFOs because CAFOs are not required to maintain and submit discharge monitoring reports (DMRs).]
- **Twenty-Four Hour Reporting** 40 CFR part 22.41(l)(6): The permittee must orally report any noncompliance that might endanger human health or the environment within 24 hours after becoming aware of the circumstances. Within 5 days of becoming aware of the circumstances, the permittee must provide a written submission including a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the anticipated time the noncompliance is expected to continue (if not already corrected); and steps taken to reduce, eliminate, or prevent reoccurrence unless the Director waives the requirement. In addition, 24-hour reporting is required for an unanticipated bypass exceeding effluent limits; an upset exceeding effluent limits; and a violation of a maximum daily effluent limitation for pollutants listed in the permit for 24-hour reporting.
- **Other Noncompliance** 40 CFR part 122.41(l)(7): The permittee must report all instances of noncompliance not reported under other specific reporting requirements at the time monitoring reports are submitted.
- **Other Information** 40 CFR part 122.41(l)(8): If the permittee becomes aware that it failed to submit any relevant facts in its application, or submitted incorrect information in its application or other reports, it must promptly submit such facts or information.
- **Bypass** 40 CFR part 122.41(m): The intentional diversion of wastestreams from any portion of a treatment facility. Bypass is prohibited unless the bypass does not cause the effluent to exceed limits and is for essential maintenance to ensure efficient operation (no notice or 24-hour reporting is required in such a case). All other bypasses are prohibited, and the Director of the NPDES program may take enforcement action against a permittee for a bypass, unless the bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; there was no feasible alternative; and the proper notification was submitted.
- **Upset** 40 CFR part 122.41(n): An upset (i.e., an exceptional incident in which there is unintentional and temporary noncompliance with technology-based effluent limits

because of factors beyond the permittee's control) can be used as an affirmative defense in actions brought against the permittee for noncompliance. An upset does not include noncompliance to the extent caused by operational error, improperly designed or inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation. The permittee (who has the burden of proof to demonstrate that an upset has occurred) must have operational logs or other evidence that shows

- When the upset occurred and its causes.
- The facility was being operated properly.
- Proper notification was made.
- Remedial measures were taken.

Reference

USEPA (U.S. Environmental Protection Agency). 1992. *NPDES Storm Water Program Question and Answer Document Volume 1*. EPA 833-F-93-002. U.S. Environmental Protection Agency, Washington, DC.

Endnotes

1 Except that subpart B applies to operations with 5,000 or more ducks, and does not distinguish between dry and liquid manure handling systems.

2 Appendix F, Voluntary Alternative Performance Standards for CAFOs presents an overview of the baseline requirements and the *voluntary performance* standards program, which includes a description of who can participate in the program and how participation in the program will affect existing NPDES CAFO permits, as well as a step-by-step description of the requirements associated with participation in the program.

3 Including the additional measures and record-keeping requirements specified in 40 CFR parts 412.37(a) and (b).

4 The discussion in this section does not address discharges that qualify as exempt agricultural stormwater. For a discussion of the agricultural stormwater exemption, see Section 4.1.8.

5 See 40 CFR part 122.23(e), 68 FR 7176 at 7196 (February 12, 2003) and Revised NPDES Regulation and ELGs for CAFOs in Response to the Waterkeeper Decision, 73 FR 70418, 70434 (November 20, 2008).

6 73 FR 70434.

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.

- 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.

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

- 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.

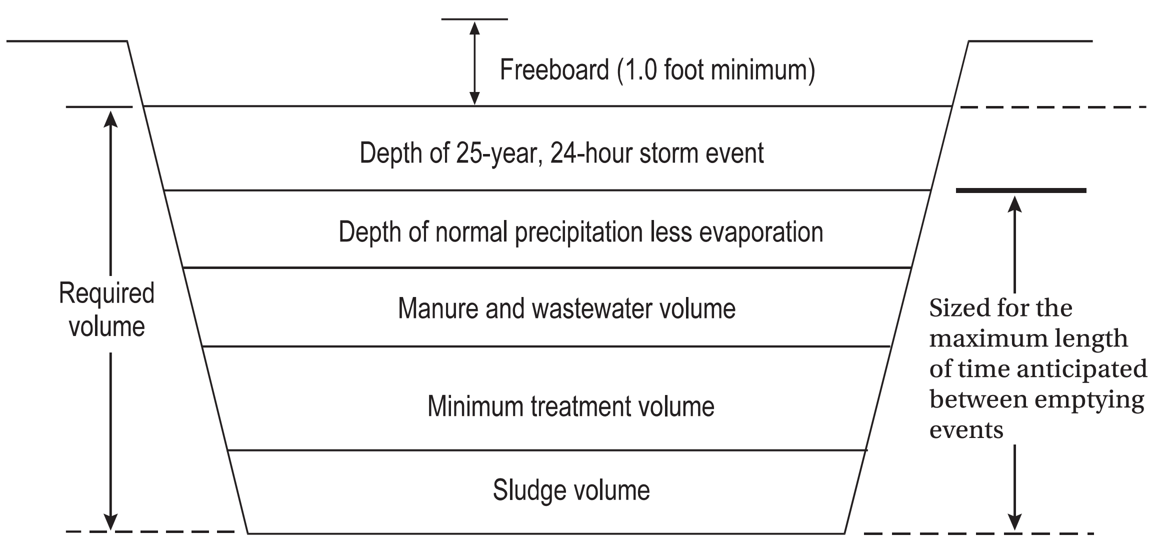


Figure 5-1. Cross section of properly designed lagoon

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.

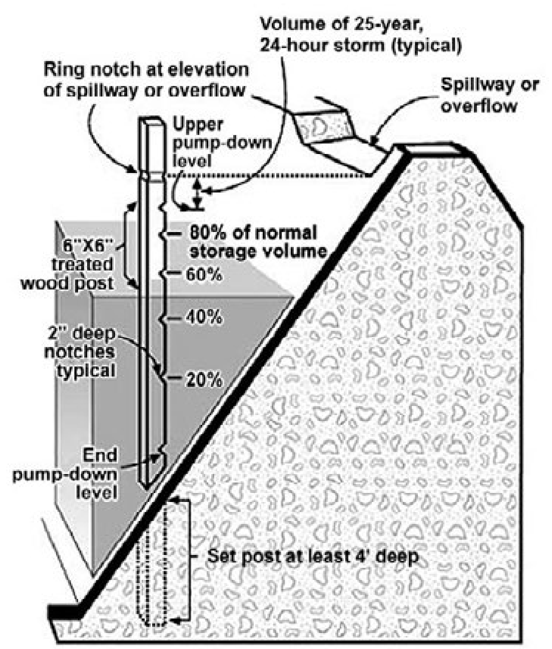


Figure 5-2. Schematic of Lagoon Depth Marker

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.

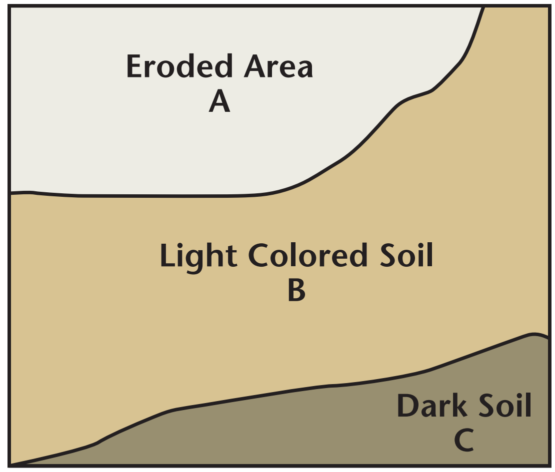


Figure 5-3. Sampling soil by type or condition. Within each field, collect a separate sample from each area that has a different type of soil or different management history.

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	Zn	Cu	Moisture
%	%	%	%	%	%	%	ppm	ppm	ppm	%
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

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

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.

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/*).

Chapter 6

6. Protocols for Land Application of Manure Nutrients

As explained in Chapter 4.1.7, any permit issued to a CAFO must include a requirement to implement an NMP that includes the BMPs necessary to meet the requirements of 40 CFR part 122.42(e)(1) and for Large CAFOs the ELG of 40 CFR part 412. The relevant content in the NMP must be integrated into the permit as enforceable terms of the permit. The *terms of the NMP* are the content of the NMP that implements the regulatory requirements in part 122.42(e)(1). One of the nine requirements in part 122.42(e)(1) are *protocols for land application*.[1] Terms of the NMP relevant to the *protocols for land application* must be incorporated as enforceable terms of any CAFO permit.

NMPs contain the technical information operations use to develop a plan that allows for maximum utilization of the nutrients in manure while minimizing the runoff of nutrients and pollutants. The maximum utilization of nutrients in manure depends on the amount of manure that the operation will have, the characteristics of that manure, the amount of land the operation will have available, and the type of crops and nutrient needs of the crops that the operation plans to grow. Although this chapter explains in more detail the specific components of the NMP that are the *protocols for land application* of manure, 40 CFR part 122.42(e)(1)(ix), it is important for a permit writer to understand the source of the information in the NMP itself and the way it is used in the NMP to develop rates of application and terms of the NMP.

Land application of manure slurry. (Photo courtesy of USDA/NRCS)

This chapter provides background information on soil fertility and plant availability of nutrients, state technical standards for nutrient management, EPA's regulatory requirements for land application of manure, the permit term *protocols for land application*, and this chapter demonstrates how to derive the permit terms for *protocols for land application* from a sample NMP.

6.1. Soil and Plant Availability of Nutrients

Soil is a pathway for nutrient flow to surface and ground water, and it is a medium for nutrient transformations. Nutrient compounds are generally dynamic, undergoing various transformations depending on the properties of the soil they are in. Because those transformations affect the amount and form of nitrogen and phosphorus available to the plant, appropriate manure and fertilizer applications in an NMP will account for many of the transformations as discussed below. Additionally, the CAFO rule requires accounting for some of those nutrient transformations as permit terms. 40 CFR §§ 122.42(e)(5)(i)(A), (e)(5)(ii)(A). Therefore, it is important for a permit writer to understand the behavior of nitrogen and phosphorus in the soil. For further supporting information regarding soil science, see Appendix A, Basic Soil Science and Soil Fertility.

6.1.1. Nitrogen Cycle

Although nitrogen in soil is essential for plant growth, it is not always available in a form for plant uptake. The largest pool of nitrogen is found in the atmosphere as an inert gas (N_2). Plants are not able to absorb gaseous nitrogen. Nitrogen must first have its form changed by biological or industrial processes. The process that converts nitrogen gas into plant available forms of nitrogen is called nitrogen fixation and is a part of the nitrogen cycle (Figure 6-1). In nature, nitrogen becomes plant available when specialized bacteria (and to a lesser extent, lightning) fix nitrogen gas. Leguminous plants, such as alfalfa and soybeans, have a symbiotic relationship with nitrogen-fixing bacteria, in which the bacteria supply sufficient nitrogen to the plant and the plant supplies carbohydrates to the bacteria. Because of that relationship, a legume crop is able to supply its own nitrogen need and enrich a soil with nitrogen for crops that follow in the rotation and therefore is considered an nitrogen credit.

The forms of nitrogen that plants typically use are ammonium (NH_4^+) and nitrate (NO_3^-). Ammonium is used less by plants because it is extremely toxic in large concentrations. Ammonium can oxidize in the soil to form nitrate through a two-step process that requires two types of soil bacteria (*Nitrosomonas* and *Nitrobacter*). Nitrate is highly mobile and easily leached as water moves through the soil profile, and can be a source of nitrogen pollution in surface and ground water if it is not utilized by growing crops.

The majority of the nitrogen in the soil (95 to 99 percent) is locked up as organic compounds (mostly as proteins) that are generally unavailable to plants. Organic nitrogen compounds become plant available through a microbial process called mineralization. While mineralization converts organic compounds into inorganic compounds, inorganic nitrogen can also be converted to organic forms through a process called immobilization. Microbes require nitrogen, as all living

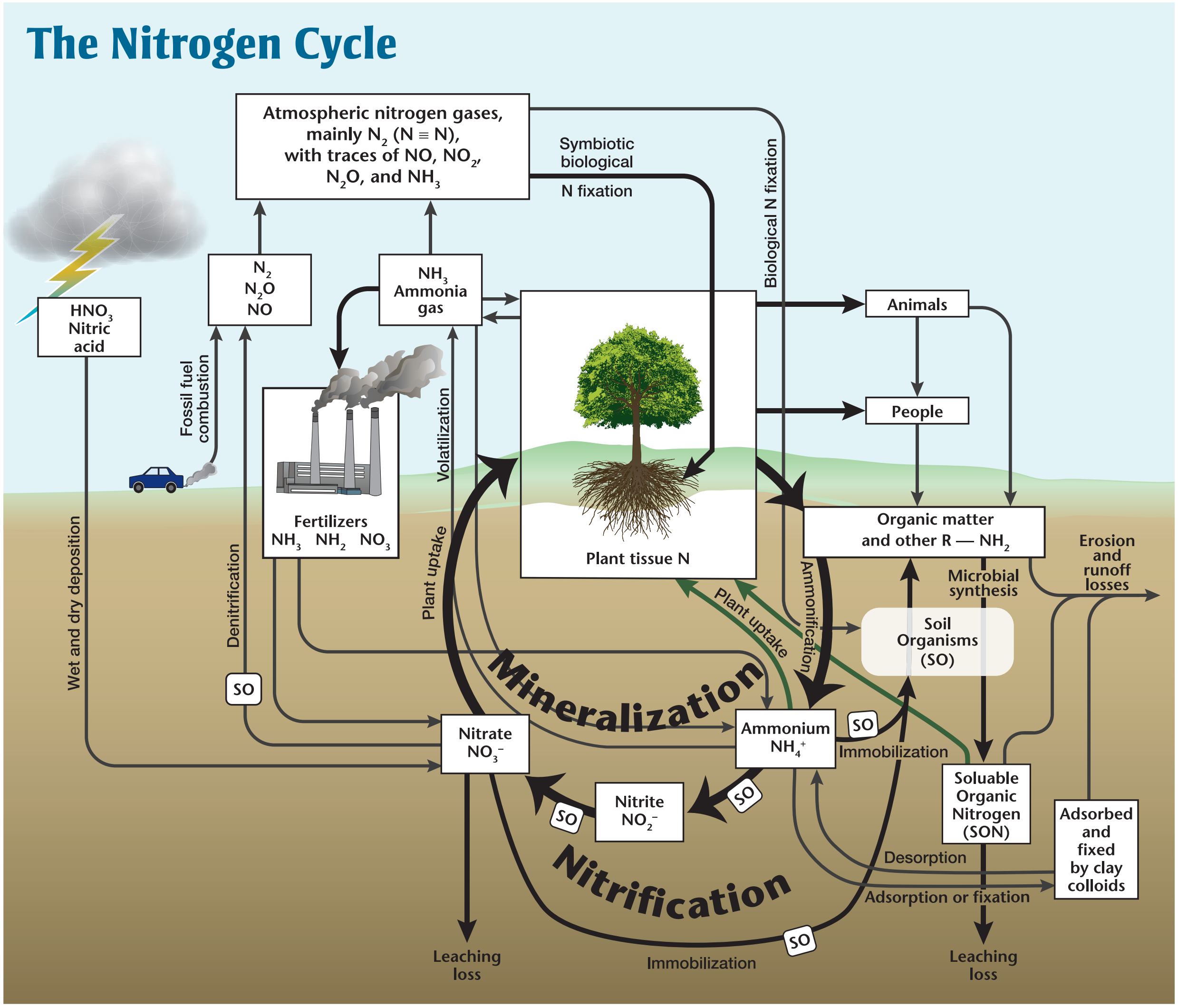

Figure 6-1. The Nitrogen Cycle.

organisms do, for basic cellular function. Nitrogen is required for microbial decomposition of organic residues. Microbes use available inorganic nitrogen from the soil, which becomes incorporated into their microbial cellular structure. That nitrogen is unavailable until the organisms die and decompose, releasing plant available inorganic nitrogen back to the soil.

Nitrogen compounds can also be released to the atmosphere as ammonia gas (NH_3) through a process called volatilization. Warm, moist soils and surface application of manure and wastewater accelerates volatilization. While ammonia can be lost to the atmosphere, it can also be removed from the atmosphere via absorption through plants. The other significant pathway for gaseous loss of nitrogen is denitrification. Denitrification is a series of bacteria-driven reduction reactions that reduce nitrate ultimately to nitrogen gas. Because denitrification is a reduction reaction, it requires an anaerobic environment, such as saturated soils. Only when soil oxygen levels are low enough will nitrate be fully reduced resulting in the formation of nitrogen gas.

6.1.2. Phosphorus Cycle

Phosphorus in soil mostly comes from weathered apatite rock. Other sources of soil phosphorus include decomposing organic matter and humus. Plant available forms of phosphorus include hydrogen phosphate (HPO_4^{-2}) and dihydrogen phosphate ($H_2PO_4^-$). Phosphorus's tendency to bond with other compounds and with the clay fraction in the soil can reduce the mobility of the nutrient. Soil pH also has a strong influence on the availability of phosphorus. The phosphorus cycle is shown in Figure 6-2.

Both the inorganic and organic phosphorus forms are distributed among three major soil pools: solution phosphorus, active phosphorus, and fixed phosphorus. The solution pool contains dissolved, soluble phosphorus that is readily available for plant uptake. While that pool is generally small, relative to the total amount of phosphorus, it is important because it is the only pool from which plants can draw nutrients. Because plants are continuously removing nutrients from this pool, it must be replenished.

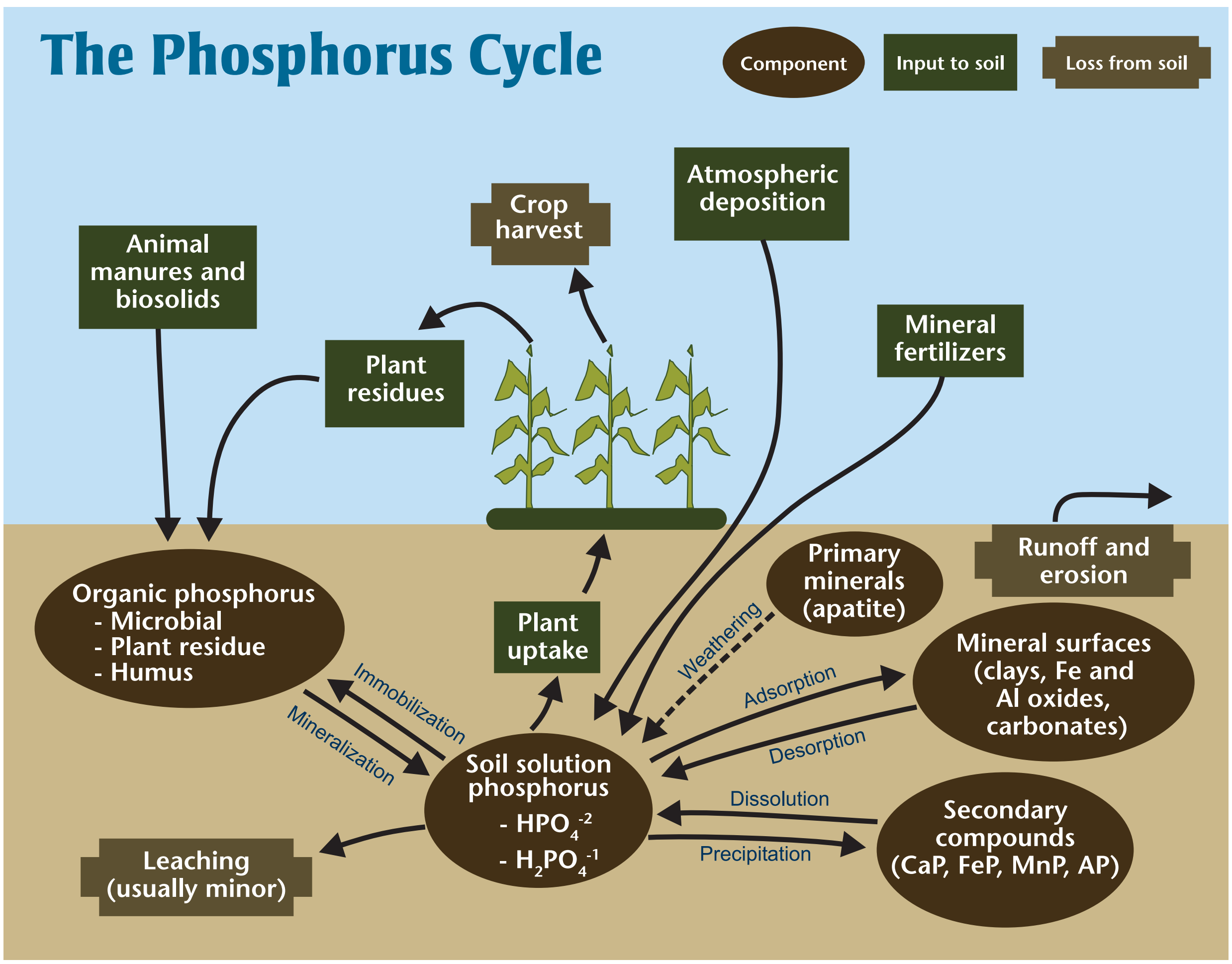

Figure 6-2. The Phosphorus Cycle.

The active pool is capable of replenishing the solution pool. The active pool contains phosphorus that is somewhat less available than the solution pool. This pool contains phosphorus in several different forms:

- Phosphorus that is loosely adsorbed to mineral surfaces, on active mineral sites.
- Phosphorus that has reacted with other elements to form somewhat insoluble compounds.
- Organic phosphorus that is easily mineralized.

While the active pool does not contain soluble phosphorus, the active pool can easily release phosphorus to the solution pool. The relationship between the solution and active pools can be described by the cycle shown in Figure 6-3. As phosphorus is added to the solution pool, more phosphorus is adsorbed to mineral surfaces and as the solution pool is depleted, the active pool will release additional phosphorus to replenish it.

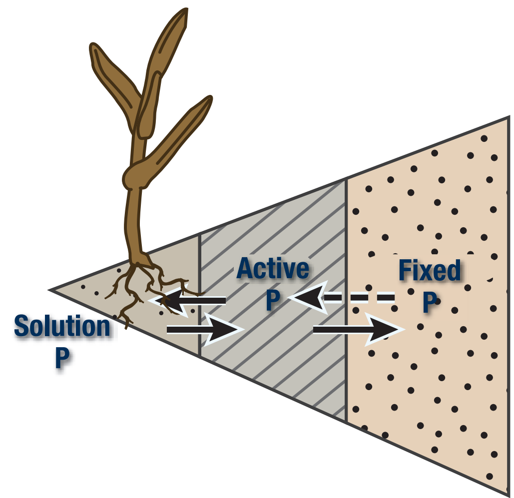

Figure 6-3. The relationship between the phosphorus solution and the active pool.

Some exchange occurs between the solution and active pools. When phosphorus is initially added to a soil, it can first be held in complexes of low solubility or by temporary bonds, as part of the active pool, that can be released back to the solution pool and be made plant available. However, with time, the compounds will become more and more insoluble and contribute to the third pool—fixed phosphorus. Fixed phosphorus is extremely insoluble and can remain there for many years without becoming available to a plant and contributing minimally to a soil's fertility.

Soils have a phosphorus fixation capacity that is defined by the sites on a mineral surface that are available to react with phosphorus. Historically, there has been very little plant available phosphorus in many soils because of that fixation capacity. If enough soluble phosphorus is added to a soil, the reactive sites become occupied so that any further phosphorus that is applied will remain in the solution pool. Soils that have been regularly over-applied with phosphorus might have relatively high levels of soluble phosphorus because the soil's capacity to fix phosphorus has been overwhelmed. In those cases, dissolved phosphorus can be leached from soils and lost to groundwater through the soil profile or to surface water in runoff.

Regardless of the potential for dissolved phosphorus leaching or runoff, there is always a potential for losses of phosphorus to surface waters from erosion. Because phosphorus binds to soil particles, if soil particles are eroded from a landscape, the attached phosphorus (and any other nutrients, metals, or contaminants) are lost as well. Phosphorus can be released from the soil particle it is bound to if the chemical bond holding it together is broken. For example, the oxidized form of iron forms a strong bond with phosphorus. However, if iron is reduced, the bond will break and release phosphorus. When phosphorus is bound to soil sediments by iron and the soil is eroded to surface waters such as an anaerobic lake or pond, iron will be reduced and release iron-bound phosphorus from the soil particle to the waterbody. Agricultural management practices must consider the potential for this type of phosphorus loss. 40 CFR §§ 122.42(e)(1)(vi), 412.4(c)(2)(i).

Many factors must be considered when applying phosphate fertilizer, including soil fertility levels, crops to be grown, tillage methods, equipment, timing, slope, climate, and other management factors so that both dissolved and particulate phosphorus are adequately controlled while supplying the necessary crop nutrient requirements.

6.1.3. Soil Fertility

Soil fertility is the ability of a soil to provide nutrients for plant growth. Although soils contain most of the nutritional elements plants require, only a small percentage is available for plant uptake. Plants generally derive nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur from soil. Many factors affect the availability of nutrients in soil, including the forms of the nutrient in the soil, pH, soil aeration, soil compaction, soil temperature, and soil moisture. The essential nutrients for plant growth move through the soil profile at various rates, depending on their chemical properties. An understanding of the chemical properties of those elements and the amounts available to plants is necessary when determining the amount of fertilizer or manure to be added to a soil to prevent over application, which in time could result in surface and ground water contamination.

The ability of a soil to retain nutrients is related to its cation exchange capacity (CEC). CEC is a measure of the soil's ability to retain cations (positively charged ions) and is indicative of the soil's fertility. Soil minerals have a net surface charge, which is usually negative, that allows them to hold and retain cations against leaching. The net negative charge of a soil is largely attributed to the clay and organic matter contained in the soil. Negatively charged soil particles will naturally attract positively charged ions and repel negatively charged ions. That explains why positively charged nutrients such as ammonium, will remain adsorbed to clay particles in the soil, while negatively charged nutrients such as nitrate are easily leached out of the soil. The CEC of a soil directly affects the soil's nutrient storage capacity and, therefore, the amount of fertilizer or manure that should be used and the frequency with which fertilizer or manure should be applied.

Water runoff eroding a field. (Photo courtesy of USDA/MO NRCS)

The movement of nutrients in soil is largely controlled by the movement of water through and over a soil. Two pathways are (1) the infiltration and percolation or drainage of water through the soil profile; and (2) runoff water over the soil surface.

Percolation results in the loss of soluble compounds (leaching), thus depleting soils of needed plant nutrients. Runoff losses generally include water, appreciable amounts of soil (erosion) and any nutrients, chemicals, or compounds that are attached to the displaced soil particles.

6.2. Using Manure Nutrients

Manure is land applied because it contains nutrients (i.e., nitrogen, phosphorus and potassium) and acts as a fertilizer by supplying crop nutrient needs; it also contains organic matter, which improves the quality of the soil by decreasing compaction, increasing water-holding capacity, and, increasing the CEC, among other benefits. Typically, manure is applied so that it supplies either the nitrogen or phosphorus requirements of the crop to which it is applied. Manure is typically excreted at an nitrogen to phosphorus ratio of 2 or 3 to 1, while the typical crop's nutrient need of nitrogen and phosphorus is in a ratio ranging from 4 to 9 pounds of nitrogen per pound of phosphorus. That means that up to 3 times the needed amount of phosphorus is applied when manure is applied to meet the nitrogen requirements (disregarding nutrient losses). Table 6-1 shows typical nutrient concentrations for various types of manure. Table 6-2 shows typical nutrient requirements for some common crops. The values shown in these tables are generalized and might not be typical of all locations. When developing an NMP, site-specific values should be used where available. State-specific book values should be used where site-specific data are not available. Because of the 2 or 3 to 1 nitrogen to phosphorus ratio of manure, meeting nitrogen requirements through manure application alone can lead to a buildup of phosphorus in the soil and correspondingly high or very high soil test phosphorus levels.

Land application of dairy waste via "big gun" effluent distribution system. (Photo courtesy of USDA/NRCS)

Table 6-1. Manure nutrient content factors

Animal type	Manure nutrient content (pounds per ton of manure)			
	Nitrogen		Phosphorus*	
	As excreted	After losses	As excreted	After losses
Beef cows	10.95	3.30	3.79	3.23
Milk cows	10.69	4.30	1.92	1.65
Heifer and heifer calves	6.06	1.82	1.30	1.10
Steers, calves, bulls, and bull calves	10.98	3.30	3.37	2.86
Breeding hog and pig	13.26	3.32	4.28	3.62
Other hog and pig	11.30	2.82	3.29	2.80
Hens and pullets of laying age	26.93	18.64	9.98	8.50
Pullets over 3 months but not laying	27.20	13.60	10.53	8.95
Pullets under months	27.20	13.60	10.53	8.95
Broilers	26.83	16.10	7.80	6.61
Turkeys for slaughter	30.36	16.18	11.83	10.06
Turkeys for breeding	22.41	11.20	13.21	11.23

* Phosphorus presented here is elemental phosphorus. To convert to the orthophosphate (P_2O_5) form, multiply the elemental phosphorus by 2.29.

Table 6-2. Nutrient uptake parameters for selected crops used to estimate the assimilative capacity of cropland. *These values are for the harvested portion of the crop that is removed from the field at harvest.*

Crop	Yield unit	Pounds per yield unit	Nutrient content - pounds per yield unit	
			Nitrogen	Phosphorus
Field corn, for grain	Bushel	56	0.80	0.15
Field corn, for silage	Ton	2,000	7.09	1.05
Oats	Bushel	32	0.59	0.11
Barley	Bushel	48	0.90	0.18
Soybeans	Bushel	60	3.55	0.36
Alfalfa hay	Ton	2,000	50.40	4.72
Bermuda grass seed	Pound	1	0.040	0.005
Winter wheat harvested (soft)	Bushel	60	1.02	0.20
Winter wheat harvested (hard)	Bushel	60	1.23	0.23
Canola	Pound	1	0.035	0.006
Rice	Bag	100	1.25	0.29
Rice for grain	Bushel	56	1.07	0.18
Sorghum hay	Ton	2,000	2.39	1.01
Sugar beets for seed	Pound	1	0.024	0.020
Sugar beets for sugar (w/o crown)	Ton	2,000	4.76	0.94
Triticale	Bushel	56	1.50	0.17
Wild rice	Pound	1	0.013	0.003

In some areas, animal waste application rates might need to be based on parameters other than nitrogen or phosphorus. For example, trace metals present in animal wastes, when applied at either nitrogen- or phosphorus-based rates, provide many of the micronutrients necessary for plant growth. Excessively high levels of the trace metals, however, can inhibit plant growth. By limiting manure applications to the nitrogen- and phosphorus-based rate, CAFOs will also be limiting the rate at which metals are applied to fields and thus reduce the potential for applying excessive amounts of the trace metals. In other regions of the country where farmlands are overloaded with salt, the salt content of animal waste, often measured as electrical conductivity, might be the appropriate parameter for limiting land application rates. When using any of those alternative application rates, CAFOs must ensure appropriate agricultural use of the nutrients in the manure. In no case may manure be applied at rates greater than the annual nitrogen needs of the crop(s).

NRCS staff and landowner use the soil probe to take a soil sample on farm. (Photo courtesy of USDA/NRCS)

The animal agricultural industry has seen the consolidation of many smaller operations into a smaller number of larger operations (Kellogg et al. 2000). Many livestock and poultry producers do not have adequate land to utilize the manure nutrients generated on-site in a manner that does not exceed crops needs. Figures 6-4 and 6-5 illustrate that in some counties, the production of recoverable manure nutrients exceeds the assimilative capacity of all the cropland and pastureland available for manure application in that county.

Consolidation in the animal agriculture industry has created regional surpluses of phosphorus and a buildup of soil phosphorus levels, as indicated by Figure 6-6. Phosphorus buildup is one variable that can contribute to phosphorus loss. However, other factors can result in high phosphorus loss even when the soil test phosphorus is low. Unfortunately, problems associated with high soil phosphorus levels are aggravated by the fact that many of these agricultural soils are in states with sensitive waterbodies, such as the Great Lakes, Lake Champlain, the Chesapeake Bay and Delaware Bay, Lake Okeechobee, and the Everglades.

The overall goal of efforts to reduce phosphorus loss to water should be to balance phosphorus inputs and outputs at the farm and watershed levels while managing soil and phosphorus in ways that maintain productivity. Management strategies that minimize phosphorus loss to water can involve one or more of the following approaches: optimizing phosphorus use efficiency, refining animal feed rations, using feed additives to increase animal absorption of phosphorus, transporting manure from surplus areas to deficit areas, increasing the number of acres available

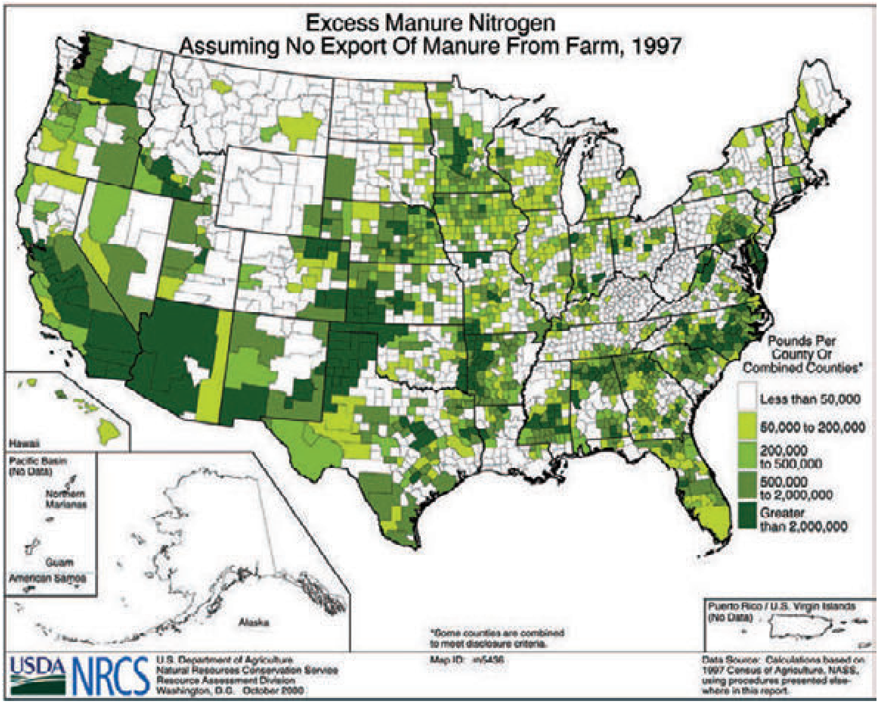

Figure 6-4. Excess manure nitrogen.

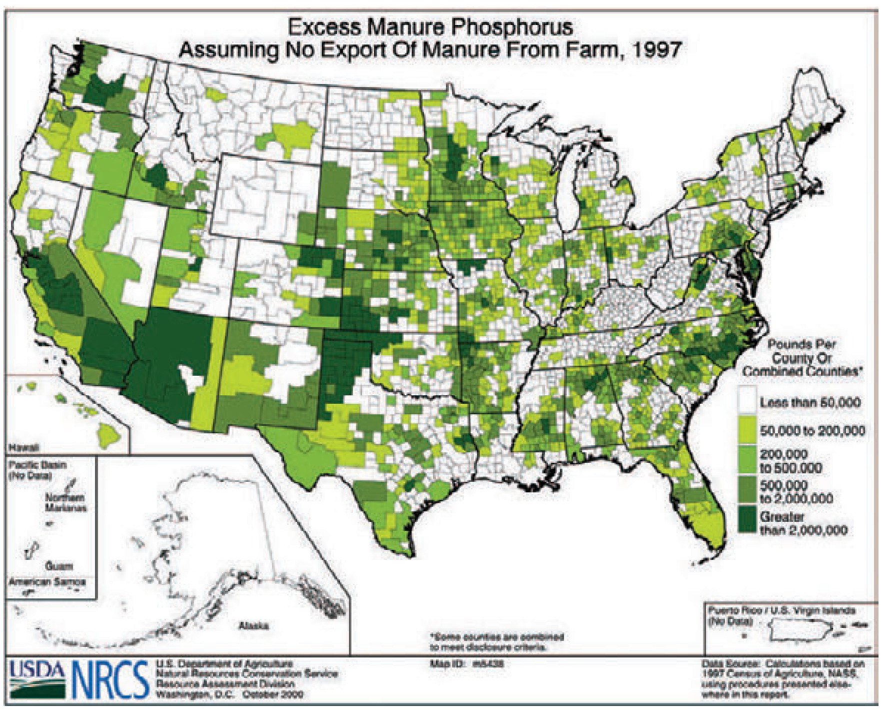

Figure 6-5. Excess manure phosphorus.

to an operation for land application, and applying conservation practices like reduced tillage, buffer strips, and cover crops in critical areas of phosphorus export from a watershed.

Because of the potential for phosphorus buildup where manure utilization plans are based on nitrogen, soils in fields receiving livestock manure should be tested regularly with close monitoring of phosphorus levels as well as the risk for phosphorus transport from the field.

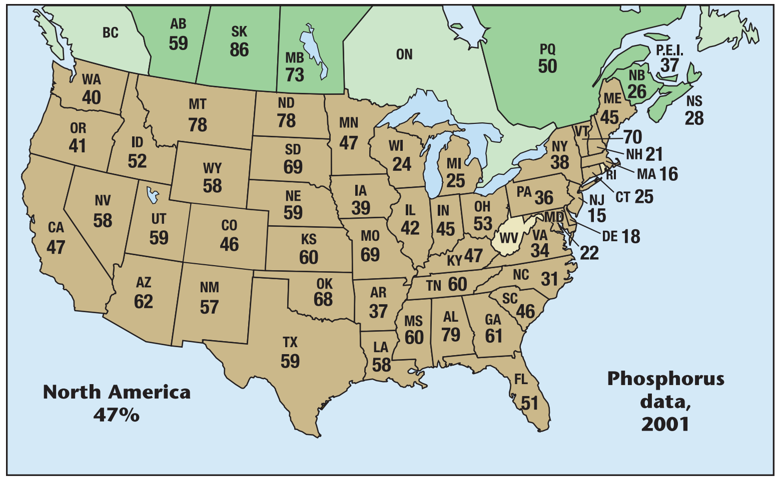

Figure 6-6. Percent of soils testing medium or low in phosphorus. (Source: USDA/NRCS)

6.3. Standards for Nutrient Management

Utilizing manure nutrients can be a beneficial practice that improves the health of the soil and replaces the use of purchased commercial fertilizer. However, that requires proper management of the amount, form, source, timing, and placement of the nutrients. Various standards exist for the management of nutrients. USDA-NRCS develops national conservation practice standards for nutrient management. Each state's NRCS office adopts and may modify those practices that are applicable in that state. Some state NRCS offices also develop state-specific standards that are not found in the national handbook. For standards to which NPDES permit writers and inspectors can refer, see Appendix K, NRCS Conservation Practice Standards. NRCS Conservation Practice Standard Code 590,[2] Nutrient Management, is intended to guide the proper land application of nutrients. The standard states that nutrient application rates are to be established that consider current soil tests, realistic yield goals and management capabilities. In cases where manure is the source of applied nutrients, the rate also must be based on an analysis of the nutrient content of the manure, NRCS book values, or historical documented records.

NRCS conservation practice standards often rely on guidelines established by the state's land grant university. Land grant universities establish guidelines for many procedures involved with nutrient management. Some examples can include

- Crop yield goals.
- Fertilizer recommendations.
- Manure excretion rates.
- Field risk assessment tools for nitrogen, phosphorus, and erosion.
- How to calibrate equipment.

Chicken litter spreading. (Photo courtesy of USDA/NRCS)

- Nutrient use efficiency strategies.
- Emerging technologies.

Private industries also develop some of their own standards. For instance, many private soil and manure testing labs develop their own nutrient recommendations on the basis of soil test analyses. Those private standards might or might not be recognized by the land grant university in a state.

6.3.1. EPA's State Requirements for Land Application

The CAFO regulations require states to establish technical standards for nutrient management that are consistent with 40 CFR part 412.4(c)(2). 40 CFR § 123.36. The regulation at 40 CFR part 412.4(c)(2) requires that those technical standards include a field-specific assessment of the potential for nitrogen and phosphorus transport from the field to waters of the U.S. In addition, the standards must address the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals while minimizing nitrogen and phosphorus movement to waters of the U.S. Id.

40 CFR § 412.4(c)(2)
Best Management Practices (BMPs) for Land Application of Manure, Litter, and Process Wastewater

Determination of application rates

Application rates for manure, litter, and other process wastewater applied to land under the ownership or operational control of the CAFO must minimize phosphorus and nitrogen transport from the field to surface waters in compliance with the technical standards for nutrient management established by the Director. Such technical standards for nutrient management shall:

(i) Include a field-specific assessment of the potential for nitrogen and phosphorus transport from the field to surface waters, and address the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen and phosphorus movement to surface waters; and

(ii) Include appropriate flexibilities for any CAFO to implement nutrient management practices to comply with the technical standards, including *consideration of multi-year phosphorus application* on fields that do not have a high potential for phosphorus runoff to surface water, phased implementation of phosphorus-based nutrient management, and other components, as determined appropriate by the Director.

Requirements for State Technical Standards

All technical standards must identify an appropriate field-specific assessment method for determining nutrient transport to be used when developing rates for land application. Technical standards for nutrient management also establish methods and criteria for determining application rates that must appropriately balance the nutrient needs of crops and potential adverse water quality impacts, in accordance with the risk of nutrient transport. 40 CFR § 412.4(c)(1). To achieve that objective, technical standards must address the source, amount, timing and method of application for each form of manure nutrients. 40 CFR § 412.4(c)(2)(i).

Nutrient Transport Risk Assessment

The field-specific assessment provides CAFOs with the information needed to determine whether manure nutrients should be applied at an nitrogen- or phosphorus-based rate, or if manure application is not appropriate. CAFOs may apply a combination of conservation practices, BMPs, and management activities, which in aggregate can reduce a field's vulnerability of phosphorus transport to waters of the U.S. Regardless of what assessment method is required by a state, it must at least include an analysis of soil phosphorus. 40 CFR §§ 122.42(e)(5), 412.4(c)(3). As discussed in Chapter 5, sample handling can affect soil test results and extraction procedures used for different analysis are typically tailored to a region. Therefore, technical standards need to also address how soil samples are to be collected, the extraction procedures, methods or laboratories that are to be used for analyzing different nutrients and the frequency with which the analyses should occur.

Form and Source

The form and source of the manure must be identified for all manure that is planned for land application. 40 CFR § 412.4(c)(2)(i). The term *form* of manure may be identified as solid, liquid, semi-solid, or slurry. The term *source* refers to the specific storage structure or location at which manure is held until it is land applied. The manure's form will directly determine the type of storage needed. Liquid and semi-solid or slurry manures are typically stored in a type of lagoon or holding pond. Solid manures are typically stored in sheds or stockpiles, which can be on a concrete pad or other impervious material. For further discussion of manure types and storage, see Chapter 4 of EPA's development document for the 2003 CAFO rule revisions (EPA-821-R-03-001) (USEPA 2003).

Turkey litter stockpile. (Photo courtesy of USDA/NRCS)

Amount

Because the amount of manure to be applied relies on the amount of nutrients in the manure, technical standards need to ensure that manure nutrient analyses represent the manure that is applied. Similar to soil testing, the handling of a sample can affect the outcome of the test results. For example, some manure nitrogen is lost through volatilization during the handling and storage of the manure. The manure nutrient analysis accounts for volatilization losses that have occurred up to the time at which the samples for the analysis are taken. Therefore, technical standards need to address appropriate sampling methods and acceptable methods or laboratories that should be used for performing the analyses to ensure the results represent the nutrient content of the material that will be applied to a field.

A separate manure analysis needs to be provided for each form (e.g., stockpiled solids, separated solids, lagoon or pond liquid, lagoon or pond sludge) of animal manure stored on-site where the manure nutrient content is expected to vary to have test results that accurately reflect the nutrients in the manure that is land applied. See 40 CFR parts 412.4(c)(1) and (c)(3). Not only will the composition of the forms be different, they often are applied to the land separately from each other. For example, liquids from a holding pond could be irrigated weekly to a field, whereas the solids might be land applied just once or twice per year to remotely located fields. There could be circumstances where sampling of every single source might be less important. For example it could be reasonable to expect a dairy with multiple barns that are each designed, operated, and managed under the same set of variables would generate manure with similar nutrient content. When each barn houses the same number of cows, the cows are fed the same diet and are on the same milking schedule, and each barn is designed to handle and store manure in the same manner (e.g., freestall barns with push pits at the end of each barn), sampling of both pits is probably not necessary. For more information on manure testing protocols, see Chapter 5.9.

The amount of nutrients to be applied, from both organic and inorganic sources also depends on the realistic production goals, and the nutrient needs for a given crop to meet the realistic yield goal. The criteria for deriving realistic yield goals including criteria for adjusting yield goals on the basis of actual crop yields should be provided by the technical standard as that will affect the amount of nitrogen and phosphorus that will be applied to the land. It might be insufficient for the technical standard to simply require development of realistic yield goals; the specific basis(es) for the yield goals should be described. Unrealistic yield goals will result in an over-application of nutrients.

Residual plant available nitrogen (PAN) in the soil affects the amount of additional nutrients that should be applied to meet crop nitrogen needs. Because organic forms of nitrogen typically become plant available when they are converted to inorganic forms, such as nitrate and ammonium, crediting generally identifies the amount of organic nitrogen likely to be converted to inorganic forms that will be plant available. Crediting for all residual nitrogen in the field that will be plant available, as a result of prior additions, should be done in accordance with the directions provided in the technical standards. That will include appropriate mineralization rates to be used in determining the amount of available nitrogen that has slowly become available from previous manure applications and the amount of PAN from a prior legume crop.

The amount of available nutrients will also fluctuate with the method of land application (e.g., spray irrigation, surface application, with or without incorporation). The method of land application will affect the amount of nitrogen that will volatilize, thus affecting the amount of manure that needs to be applied to meet realistic yield goals. Therefore, volatilization rates to be applied to various application methods should be provided by the technical standards.

Timing

Heavy frost on a stream buffer. (Photo courtesy of USDA/NRCS)

Under certain circumstances, usually related to seasonal conditions, CAFO land application areas might be more likely to generate runoff that reaches waters of the U.S. Accordingly, technical standards must address *timing* considerations as to when land application should be delayed and/or prohibited to minimize nutrient movement to surface waters. 40 CFR § 412.4(c)(2)(i). To minimize movement of nutrients to waters of the U.S., technical standards for nutrient management should prohibit application of manure and process wastewater to saturated ground where appropriate. The technical standards should prohibit surface application of manure and process wastewater during rainfall and when rainfall is expected soon after a planned application, if the rainfall might produce runoff and the runoff might enter waters of the U.S. The standards should either prohibit application of manure and process wastewater on snow, ice, and frozen ground, or include specific protocols that CAFO owners or operators, nutrient management planners, and inspectors will use to conclude whether application to a frozen or snow- or ice-covered field (or a portion thereof) poses a reasonable risk of runoff. Where there is a reasonable risk, the standards should prohibit application to the field or relevant portion thereof during times when the risk exists or could arise. Manure storage structures need to include adequate capacity to store material that accumulates during those times when, under the technical standards for nutrient management, land application would be prohibited. 40 CFR § 122.42(e)(1)(i).

For example, in Michigan, the technical standard for nutrient management includes an explicit prohibition of manure application under certain conditions :

1. CAFO waste shall not be applied on land that is flooded or saturated with water at the time of land application.
2. CAFO waste shall not be applied during rainfall events.
3. CAFO waste shall not be surface applied without incorporation to frozen or snow-covered ground, except in accordance with the Department 2005 Technical Standard for the Surface Application of CAFO Waste on Frozen or Snow-Covered Ground without Incorporation or Injection.
4. CAFO waste application shall be delayed if rainfall exceeding one-half inch, or less if a lesser rainfall event is capable of producing an unauthorized discharge, is forecasted by the National Weather Service (NWS) during the planned time of application and within 24 hours after the time of the planned application. Forecast models to be used are at *http://www.weather.gov/mdl/synop/products.php*.

The ELG does not establish national requirements prohibiting manure application to frozen, snow-covered, or saturated ground, or before forecasted rain. Runoff associated with such application could depend on a number of site-specific variables, including soil type, topographic variability (i.e., slope of the land), and distance to waters of the U.S. States are better able to tailor their technical standards to reflect the site-specific conditions that warrant prohibitions or limitations on manure applications to frozen, snow-covered, or saturated ground, or before forecasted rain. In general, EPA strongly encourages states to prohibit application to frozen, snow-covered, or saturated ground, and when the forecast calls for rain in an amount that is likely to produce runoff because crops are unable to utilize the nutrients during such conditions and, therefore, typically results in runoff of nutrients. For additional guidance on addressing winter spreading, see Appendix G, Winter Spreading Technical Guidance and Appendix E, Minimum Depth of Rain at Which Runoff Begins.

If technical standards for nutrient management do not prohibit manure application on frozen, saturated, or snow covered ground, the *protocols for land application* under those circumstances should account for the form of the manure to be applied (e.g., liquid, semi-solid, or dry manure), the time at which the manure would be applied relative to periods when runoff may occur, the fraction of precipitation that runs off the land in melt water and in response to winter rains (as affected, in part, by whether soil is frozen), the time it takes runoff to travel to waters of the U.S. (as affected by the slope of the land, distance to waters, roughness of the land surface, and whether runoff is in contact with land surface), and other relevant factors, as appropriate.

Flexibility to Implement Nutrient Management Practices

Technical standards for nutrient management can allow certain flexibilities for implementing nutrient management practices. 40 CFR § 412.4(c)(2)(i). The CAFO regulations specifically allow for the *consideration of multi-year phosphorus application* on fields that do not have a high risk for phosphorus runoff to waters of the U.S. Id. Multi-year phosphorus application is an approach that allows a single application of manure phosphorus to be applied at a rate equal to the recommended phosphorus application rate or phosphorus removal in harvested plant biomass for the crop rotation for multiple years in the crop sequence. However, under any multi-year phosphorus application, the rate at which manure nutrients are applied cannot exceed the annual nitrogen recommendation of the year of application. 68 FR 7,210 (Feb. 12, 2003). The field must also not receive additional phosphorus until the amount applied in the single year has been removed through plant uptake and harvest. 40 CFR § 412.4(b)(3).

Additional Standards

While the state's technical standards need to be detailed in addressing the form, source, amount, timing and method of application for the use of each form of manure nutrients, they may also contain additional requirements that the state chooses to address. Those could include specific requirements that address animal feed management, additional soil testing (i.e., nitrogen testing requirements), implementing specific BMPs (i.e., cover crops), or any other practices the state deems necessary to minimize nitrogen and phosphorus transport to surface waters. Additional considerations necessary for protecting surface waters are left to the discretion of the state Director when establishing technical standards. 68 FR 7,198 (Feb. 12, 2003).

6.4. EPA's CAFO Requirements for Land Application

Any permit issued to a CAFO must include the requirement to implement a nutrient management plan that includes *protocols for land application*. 40 CFR § 122.42(e)(1). As discussed in Chapter 4.1.3 of this Manual, permitted Large CAFOs subject to ELG subparts C and D must land apply manure nutrients in accordance with certain practices defined by the ELG. 40 CFR § 412.4. Those include following the state's technical standards for nutrient management[3] as discussed in Section 6.3.1. Id.; at § 4(c). Briefly the ELG require the following:

- A field-specific assessment of the potential for nitrogen and phosphorus transport from each field where manure is to be applied and using the results in developing application rates. 40 CFR § 412.4(c)(2)(i).
- Land application of manure, litter, and process wastewater at application rates that minimize phosphorus and nitrogen transport from the field to waters of the U.S. in compliance with the technical standards for nutrient management. 40 CFR § 412.4(c)(2).
- Consideration of the manure and soil analyses in the development of the application rates. 40 CFR § 412.4(c)(3).
- Inspections of equipment used for land application. 40 CFR § 412.4(c)(4).
- Development of appropriate setbacks and buffers. 40 CFR § 412.4(c)(5).
- Documentation of appropriate BMPs as well as other necessary record keeping requirements. 40 CFR § 412.37(c).

As discussed throughout this chapter, numerous variables, including those listed above, are considered when developing appropriate land application rates for manure, litter and process wastewater. Technical standards, as discussed above, form the foundation for determining the appropriate rates of application.

A nutrient management planner reviews field conditions and implementation of BMPs to conduct a field risk assessment and calculate appropriate land application rates. (Photo courtesy of USDA/NRCS)

A Note on the Orientation of Chapter 6:

Section 6.5 of this chapter provides an in-depth discussion of *protocols for land application* and discusses how a permit writer can derive permit terms for *protocols for land application* from an NMP, as required in 40 CFR part 122.42(e)(1). As discussed in Chapter 4.1.7, a permit writer may identify the *protocols for land application* as a permit term by using one of three methods. Section 6.6 illustrates how a permit writer can derive terms for *protocols for land application* from an NMP, using the third method discussed in Chapter 4, which specifically describes each term of the NMP in detail. A permit writer taking that approach would extract from the NMP all the relevant values for all the components that together encompass the term *protocols for land application*.

6.5. Protocols for Land Application

The CAFO regulations require site-specific terms of an NMP to be included in a CAFO's NPDES permit. Technical standards form the basis for critical elements of the site-specific terms of the NMP because they are the foundation from which an NMP is developed. EPA has clarified what a technical standard should include to adequately meet the requirements of 40 CFR part 412.4(c)(2) when used to develop an NMP that contains all the required terms of the NMP (See Appendix I, NPDES CAFO Technical Standard Review Checklist).

Land application of manure using lay-flat hose system. (Photo courtesy of USDA/NRCS)

Land application rates in NMPs are uniquely developed for each field and must be included in the permit as site specific permit terms. 40 CFR § 122.42(e)(5). Fields and field-specific rates of application of manure cannot be captured with broadly applicable permit conditions. (For an introduction of the concepts of broadly applicable versus site-specific terms, see Section 4.1.7.) The remainder of this chapter discusses and provides example permit terms that should be used as guidance for understanding what in the NMP should be identified as a permit term under both the linear and narrative rate approach.

With respect to rates of application, a CAFO permit must be written to express the terms of the NMP for *protocols for land application* using either the linear or narrative rate approach. 40 CFR § 122.42(e)(5). Many NMPs are developed such that the permit terms may be written to meet either the linear or narrative rate approach. In essence, both approaches require the same information. However, the linear and narrative rate approaches differ in the way the site-specific land application rates and the information used to develop them are expressed in the NMP and incorporated as terms of the permit. Under the linear approach, certain required information is captured as permit terms, while

Cover crop BMPs can reduce the risk of phosphorus transport by minimizing soil erosion. (Photo courtesy of USDA/NRCS)

under the narrative rate, much of the same information is captured as part of a complex term, identified in the CAFO regulations as the *methodology*. Under the linear approach, the NMP as submitted with the NOI is the NMP that is to be implemented over the 5 years of permit coverage. The rates, methods, timing, and source of manure nutrients (among other items) are to be applied as predicted by the NMP. The linear approach is for operators who do not anticipate that the NMP will change once it is developed. The narrative rate approach allows the NMP the flexibility for some changes to occur as it is implemented over 5 years of permit coverage. The source of manure and the rates, methods, and timing of application are some of the elements that may change over the life of the permit without requiring changes to the terms of the NMP.

For each approach, the CAFO rule identifies the required, minimum terms of the NMP specific to that approach. The linear approach expresses field-specific maximum application rates in terms of the amount (in pounds) of nitrogen and phosphorus from manure allowed to be applied. 40 CFR § 122.42(e)(5)(i). The narrative rate approach expresses the field-specific application rates by identifying the way in which the site-specific NMP determines how to calculate the amount of manure allowed to be applied while including limits on the maximum amounts of nitrogen and phosphorus derived from all sources of nutrients. Id at (e)(5)(ii). Under either approach, the projected amount of manure to be land applied is not a permit term because it depends on the concentration of nutrients in the manure. However, specifying the actual amount of manure applied must be reported in the annual report. Id. Under both approaches, the amount of manure to be land applied is a projected amount that must be recalculated at least once a year. 40 CFR §§ 122.42(e)(5)(i)(B), (5)(ii)(D).

There is more than one way for the permit writer to adequately express the terms of the NMP as permit requirements, particularly given the flexibilities provided by the narrative rate approach. As discussed, state-specific requirements for nutrient management vary from one state to another. Field risk assessment tools differ in the site characteristics they include and the frequency with which they are run. Some states' risk assessment tools factor in current and previous manure applications while others do not. Some states require nitrogen soil testing in addition to phosphorus soil testing, and soil testing frequency can range from 1 to 5 years. Those types of variation affect how agronomic rates are developed in an NMP. Section 6.5 provides one approach for writing narrative rate permit term requirements. Permit writers need to understand their state's regulatory requirements and technical standards for nutrient management, as well as the minimum requirements of the linear and narrative rate approaches, so they can develop site-specific permit terms that meet the requirements of their state-specific CAFO programs.

6.5.1. Site-Specific Terms: Linear and Narrative Rate Approaches

Table 6-3 outlines the terms associated with *protocols for land application* for each approach. As shown in Table 6-3, six site-specific terms apply to both the linear and narrative rate approaches for expressing land application rates in NMPs. 40 CFR §§ 122.42(e)(5)(i)(A), 122.42(e)(5)(ii)(A). Six additional permit terms apply when using the linear approach. 40 CFR § 122.42(e)(5(i)(A). Those additional linear approach permit terms address site-specific information that is also addressed under the narrative rate approach. The difference is that, in the narrative rate approach, the linear approach permit terms are factors of the *methodology*, rather than terms of the NMP. The factors are not themselves required to be terms in the narrative rate approach, but the *methodology* used to account for them in the CAFO's NMP is a term. Under the narrative rate approach, the *methodology* is the enforceable permit term, rather than the factors that it must encompass. Sections 6.5.1, as follows, 6.5.2, and 6.5.3 discuss in depth the elements listed in Table 6-3 and the important role each plays in the NMP, regardless of whether they are captured under the linear or narrative rate approach.

Table 6-3. Field-specific land application protocol terms

NMP Components	Term linear approach	Term narrative rate
Fields available for land application	X	X
Timing limitations for land application	X	X
Outcome of the field-specific assessment of the potential for nitrogen and phosphorus transport from each field	X	X
Planned crops or other use	X	X
Realistic annual crop yield goal	X	X
Total nitrogen and phosphorus recommendations per crop	X	X
Credits for plant available nitrogen	X	
Consideration of multi-year phosphorus application	X	
Accounting for all other additions of plant available nitrogen and phosphorus to the field	X	
Method and timing of land application	X	
Form and source of manure, litter, and process wastewater	X	
Maximum pounds of nitrogen and phosphorus from manure, litter, and process wastewater	X	
Methodology to account for the amount of nitrogen and phosphorus in the manure to be applied	X	
Maximum amount of nitrogen and phosphorus from all sources		X
Alternative crops		X

Table 6-3. Site-specific and field-specific land application protocol terms *(continued)*

NMP Components	Term linear approach	Term narrative rate
Methodology to account for • Soil test results • Credits for plant available nitrogen in the field • The amount of nitrogen and phosphorus in the manure, litter, and process wastewater to be applied • Consideration of multi-year phosphorus application • Accounting for all other additions of plant available nitrogen and phosphorus to the field • Form and source of manure, litter, and process wastewater • Timing and method of land application • Volatilization of nitrogen and mineralization of organic nitrogen		X

Fields Available for Land Application

The NMP must identify each field where land application will occur. The CAFO regulations require each field included in the NMP to be a site-specific term of the permit. 40 CFR § 122.42(e)(5). Each field should have a unique name or code and include the number of acres making up the field. Field maps that are appropriately labeled should also be included in the NMP. The labels from the field maps should be easily matched to all fields listed through the NMP. Otherwise, it might be difficult to correlate other terms associated with each field, thus making it difficult for the permit writer to correctly establish the terms of the NMP.

Technical standards may limit the allowable size of a field by setting limits on the acres that a soil sample can represent. Many standards set limits ranging from 10 to 30 acres. For example, if the soil sample shows that a 30-acre portion of a 100-acre field has significantly different soil nutrient content than the rest of the field, that 30-acre portion should be managed separately to meet the objective of nutrient management planning. Conversely, many standards allow fields with similar allowable application rates to be combined. For example, Missouri's technical standard requires the average field area represented by a soil sample to be approximately 20 acres or less. The Missouri standard allows adjoining 20-acre field areas to be combined, to a limit

Implementing the nutrient management plan. (Photo courtesy of USDA/NRCS)

of 80 acres, when recommendations are within 10 percent (or 10 pounds per acre, whichever is greater). A permit writer needs to be aware of such limitations and conditions in a technical standard to ensure that field sizes are set appropriately in an NMP.

Timing Limitations for Land Application

The term *timing limitations* requires the permit writer to establish permit restrictions for land applying manure under certain conditions. State technical standards need to identify when applications should be prohibited or delayed. These could include, for example, times when fields are saturated or frozen, or when other conditions prevent the use of appropriate land application practices. Such timing limitations may be seasonal; for example, restrictions barring winter application such as between November and February. EPA encourages CAFOs to ensure adequate storage so that manure is never applied to frozen ground.

> The term *timing limitations* should be distinguished from the term *timing and method of land application. Timing and method of land application* refers to the availability of nutrients for crop uptake because that can vary with the timing and the method of land application. Under the linear approach, *timing and method of land application* is a term in addition to *timing limitation*. Under the narrative rate approach, *timing and method of land application* is a factor of the term, *methodology. Timing and method of land application* is further discussed in Section 6.5.2.

Outcome of the Field-Specific Assessment of the Potential for Nitrogen and Phosphorus Transport from Each Field

Application rates for manure applied to land under the ownership or operational control of a permitted CAFO must minimize phosphorus and nitrogen transport from the field to surface waters using a field-specific risk assessment. 40 CFR § 412.4(c)(2)(i). Therefore, the *outcome of the field-specific assessment of the potential for nitrogen and phosphorus transport from each field* (from here forward, the term will be referred to as *outcome of the field-specific risk assessment*) is a term.

As previously discussed, the field-specific risk assessment should be identified in the state's technical standard. EPA provides examples of the different types of field-specific risk assessment methods. Those examples are based on the risk assessment methods that were included in USDA's NRCS Nutrient Management Conservation Practice Standard, Code 590 (August 2006) which EPA referenced in the 2003 CAFO rule. That NRCS practice standard describes three methods: (1) Soil Test Phosphorus Level; (2) Soil Phosphorus Threshold Level; and (3) P-Index. Those three tools assess the risk of phosphorus loss.[4]

The *outcome of the field-specific risk assessment* reflects the terminology typically associated with the use of the P-Index, which reflects the risk assessment method described by the January 2012 NRCS conservation practice standards 590 and the supporting National Instruction Document NI-190-302. NRCS conservation practice standard 590 (and elaborated on below). However, in the CAFO rule and this Manual this phrase is to reflect the results of whichever method is required by the technical standards established by the Director, including the soil test phosphorus method and the phosphorus threshold method.

Terraces, buffers, and conservation tillage are among the practices being used in water quality improvement projects. (Photo courtesy of USDA/NRCS)

The field-specific risk assessment for nitrogen evaluates whether the manure application rate supplies excess nitrogen that could be lost to the environment. An nitrogen loss risk assessment should consider the nitrogen requirement of the crop to be grown according to the operation's soil type, crop, and realistic crop yields. Once the nitrogen requirement for the crop is established, the manure application rate is generally determined by subtracting any other sources of nitrogen available to the crop from the crop's nitrogen requirement. The other sources of nitrogen can include residual nitrogen in the soil from previous applications of organic nitrogen, nitrogen credits from previous crops of legumes, crop residues, or applications of commercial fertilizer, irrigation water, and biosolids. Application rates are based on the nitrogen content in the manure and should also account for application timing and methods, such as incorporation, and other site-specific practices. 68 FR 7,211 (Feb. 12, 2003). As long as nitrogen needs are not exceeded, the risk is assumed to be minimized.

USDA's NRCS Nutrient Management Conservation Practice Standard, Code 590, also recommends utilizing a leaching index to assess the risk of NO_3^- leaching from a field. Nitrate is a highly mobile nutrient. As water moves through the soil profile, NO_3^- is not utilized by the crop may readily leach to groundwater. ELG have not been developed for discharges to groundwater, and therefore permit authorities are not required to write a permit term to address groundwater contamination; however, state permitting authorities may impose NPDES permit conditions for these discharges. 68 FR 7,216 (Feb. 12, 2003). Where surface waters have a direct hydrological link to groundwater, a nitrogen leaching index would be an appropriate tool for the permitting authority to include as part of the permit term. Additionally, while a nitrogen leaching index is not a requirement under this CAFO rule, many states have chosen to make the index a state-specific requirement in their technical standards.

If a state's technical standard for nutrient management incorporates a version of the NRCS 590 practice standard that allows more than one assessment method, the permitting authority has the discretion to determine which method or other state-approved alternative method may be used. Additionally, when a standard identifies more than one allowable method, the method used at the time of permit coverage must be used throughout the 5 years of permit coverage (unless the CAFO permit is revised). If a CAFO operator decided to change assessment methods in the middle of permit coverage, the operator would be subject to the requirements associated with a substantial permit modification. 40 CFR § 122.42(e)(6)(iii). The field risk assessment provides CAFOs with the information needed to determine if manure nutrients should be applied at an nitrogen or phosphorus based application rate, or if no manure application is appropriate. Changing the tool that is the basis for determining appropriate manure application rates is a change to the term of the NMP and should be considered a substantial permit modification (see Chapter 4.1.7).

Soil Test

In this option, manure application rates are based on the soil test recommendations for optimum crop production. In other words, the amount of phosphorus in the soil based on the phosphorus soil test dictates whether the application of manure can be made to meet the nitrogen needs of the crop, the phosphorus needs of the crop, or whether no manure nutrients should be applied.

Soil Test Example—Indiana

Indiana includes the soil test method as an option for determining application rates for manure, biosolids, and other phosphorus-containing material, as shown in the table below.

Soil test method P risk assessment for Indiana

Soil test phosphorus level (Bray P1/Mehlich 3ppm)	Basis for nutrient application
≤50	Nitrogen based
51–100	Not to exceed 1.5 × crop P_2O_5 removal
101–200	Not to exceed crop P_2O5 removal
>200	No phosphorus application

Source: Indiana NRCS. 2001. Conservation Practice Standard, Nutrient Management, Code 590. Indiana Natural Resources Conservation Service Field Office Technical Guide—July 2001.

The soil sampling depth will impact the outcome of the phosphorus soil test. According to USDA-ARS publication, *Agricultural Phosphorus and Eutrophication*, it is the top few centimeters of soil with which surface runoff interacts. Therefore, when using soil test results for environmental purposes, the soil sampling depth should always be considered. For more discussion on soil sampling, see Chapter 5.

Soil Phosphorus Threshold

Many states have considered developing recommendations for phosphorus applications based on the potential for phosphorus loss in agricultural runoff to address environmental concerns. What makes such a determination challenging is the identification of a phosphorus soil test that estimates when soil phosphorus concentrations becomes high enough to result in unacceptable concentration of phosphorus enrichment of agricultural runoff. The phosphorus threshold approach recommends nitrogen-based manure application on sites on which the soil phosphorus test levels are below a set threshold value and phosphorus-based rates or no manure application on sites on which soil phosphorus test levels meet or exceed the set threshold value.

Soil Phosphorus Threshold Example—Idaho Phosphorus Threshold (IDPTH)

The 590 conservation practice standard adopted by Idaho NRCS establishes thresholds for determining application rates to

- Determine the method for developing the nutrient budget. This could be either crop uptake or recommended application rate cited in the University of Idaho Crop Specific Fertilizer Guide.
- Track trends in soil phosphorus concentrations over time and to assess environmental risk.

Soil samples taken soon after manure, biosolids or other organic by-product application could produce erroneous soil test results for phosphorus. Soil samples taken for the Idaho Phosphorus Threshold (IDPTH) should be delayed for 9 to 12 months after organic amendment applications. The on-site surface or ground water resource concern will determine the appropriate depth of the soil sample taken (Table A) for comparison to the IDPTH:

- Surface water concerns exist when surface runoff leaves the field(s) from average annual precipitation, rain on snow or frozen ground, or irrigation.
- Groundwater concerns exist when surface water (from any source) does not leave the field. A high water table, fractured bedrock, poor irrigation water management, cobbles, gravel, or coarse-textured soils can contribute to downward movement of water and nutrients.*

**Note: EPA's NPDES CAFO program does not regulate discharges to groundwater.*

Table A. Required soil sample depth for the IDPTH

Primary resource concern	IDPTH soil sample depth (inches)
Surface Water	0–12
Ground Water	18–24

When both a surface and ground water concern exist, the surface water concern governs NMP development. If neither concern exists, the NMP is developed on the basis of the IDPTH for the groundwater concern to maintain soil quality and long-term sustainability.

IDPTH concentrations by resource concern are listed in Table B. The primary resource concern identified and site characteristics are used to determine the appropriate IDPTH for the site.

Table B. IDPTH concentration by resource concern

Primary resource concern	IDPTH concentration (ppm)		
	Olsen	Bray-1	Morgan
Surface Water	40	60	6
Ground Water			
Water <5 feet	20	25	2.5
Water >5 feet	30	45	4.5

Soil Phosphorus Threshold Example—Idaho Phosphorus Threshold (IDPTH) *(continued)*

Table C. Phosphorus application rates based on the IDPTH

Soil test phosphorus (ppm)	Phosphorus application rate
< IDPTH	Fertilizer Guide or Crop Rotational Phosphorus uptake
≥ IDPTH	Crop Rotational Phosphorus uptake

Nitrogen-based manure applications are allowed on sites where the soil test phosphorus levels are below the IDPTH (Tables B and C). The nitrogen availability of the planned application must match plant uptake characteristics as closely as possible, taking into consideration the timing of nutrient application(s) to minimize leaching and atmospheric losses. The management activities and technologies used must effectively utilize mineralized nitrogen and minimize nitrogen losses through denitrification and ammonia volatilization.

Phosphorus-based applications are allowed on sites where soil phosphorus levels equal or exceed threshold values. Where phosphorus-based applications are made, the application rate must

- Not exceed the recommended nitrogen application rate for the current crop during the year of application.
- Not be made on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices, BMPs, or management activities are used to reduce the vulnerability.

Source: Information taken from Idaho NRCS Conservation Practice Standard, Nutrient Management, Code 590 (June 2007 version).

The Phosphorus Index[5]

Another approach advocated by researchers is to link critical areas of surface runoff and high phosphorus content in a watershed. When environmental sources of phosphorus (e.g., high soil concentrations, manure or fertilizer applications) are transported to a sensitive location (through processes such as leaching, runoff, and erosion) water quality can be heavily impacted. A field with high soil phosphorus levels but little opportunity for transport may not always constitute an environmental threat, even though there is no agronomic need for additional phosphorus. Likewise, a field where there is a high potential for transport but no source of phosphorus to move might be of little threat. The concern and emphasis on management practices should be focused on areas where these two conditions—phosphorus sources and transport mechanisms—coincide. Such areas are called critical source areas.

The Concept of a Phosphorus Site Index

The purpose of the Phosphorus Site Index (P-Index) is to provide field personnel, watershed planners, and land users with a tool to assess various landforms and management practices for potential risk of phosphorus movement to waterbodies. The P-Index ranking identifies sites where the risk of phosphorus movement might be higher than that of other sites. When the parameters of the index are analyzed, it should become apparent that an individual parameter or parameters could be influencing the index disproportionately. Those identified parameters can be the basis for planning corrective soil and water conservation practices and management techniques. If successful in reducing the movement of phosphorus, the potential for phosphorus enrichment of surface waters will also be reduced.

The Procedures for Making an Assessment

The site characteristics addressed by the P-Index are weighted by the reasoning that some characteristics might be more influential than others in allowing phosphorus movement from the site. There is scientific basis for concluding that these relative differences exist; however, the absolute weighting factors given are based on professional judgment. Examples of weighted site characteristic factors are

- Soil erosion (1.5).
- Irrigation erosion (1.5).
- Runoff class (0.5).
- Soil phosphorus test (1.0).
- Phosphorus fertilizer application rate (0.75).
- Phosphorus fertilizer application method (0.5).
- Organic phosphorus source application rate (1.0).
- Organic phosphorus source application method (1.0).

The value categories are rated using a log base of 2. The greater the ratings, the proportionally higher are the values. The higher the value, the higher potential for significant problems related to phosphorus movement. Examples of value ratings are as follows:

- None = 0.
- Low = 1.
- Medium = 2.
- High = 4.
- Very high = 8.

To make an assessment using the P-Index, a rating value is selected for each site characteristic using the categories NONE, LOW, MEDIUM, HIGH, or VERY HIGH. The site characteristic weight factor is multiplied by the rating value to get the weighted value for each characteristic. The sum of the weighted values for all eight characteristics is compared with the site vulnerability chart.

Note that each state has the ability to adopt the P-Index and make state-specific adaptations. Some states might not consider all factors listed above, and they could weight each factor differently. Therefore, ratings in each state might not follow the 0 through 8, *none* to *very high* risk rating system. Some states might have more or fewer rating categories and use alternative numbering systems for describing each category.

An example using the P-Index	
Soil erosion (weight = 1.5) is 7.5 ton/ac/yr (= MEDIUM, value = 2)	1.5 x 2 = 3.0
Irrigation erosion (weight = 1.5) is not applicable (= NONE, value = 0)	1.5 x 0 = 0
Runoff class (weight = 0.5) is LOW (value = 1)	0.5 x 1 = 0.5
Soil phosphorus test (weight = 1.0) is 82 lb P (= HIGH, value = 4)	1.0 x 4 = 4.0
Phosphorus fertilizer application rate (weight = 0.75) is 25 lb/ac (= LOW, value = 1)	0.75 x 1 = 0.75
Phosphorus fertilizer application method (weight = 0.5) is placed with planter (= LOW, value = 1)	0.5 x 1 = 0.5
Organic phosphorus source application rate is 95 lb/ac (= VERY HIGH, value = 8)	1.0 x 8 = 8.0
Organic phosphorus source application method (weight = 1.0) is surface applied a month before no-till planting (= HIGH, value = 4)	1.0 x 4 = 4.0

Sum total of all weighted values = 20.75
Site vulnerability is HIGH

Total of weighted rating values site vulnerability

<8 LOW
8–14 MEDIUM
15–32 HIGH
>32 VERY HIGH

Using the Phosphorus Index as a Permit Term

The phosphorus site index is the most commonly used field-specific risk assessment tool. Because many state technical standards require the use of a P-Index for nutrient management, an extended discussion on this risk assessment tool and its use as a permit term, is provided below.

States that use a P-Index adapt the tool to accommodate local conditions, thereby creating variation among state phosphorus site indices (Osmond et al. 2006)].[6] Some state P-Indices use a specific risk loss category, such as low, medium or high risk, to describe the quantitative weighted value of the risk. In others, only the quantitative weighted value is used to describe the risk. In many states, an appropriate application rate basis (such as nitrogen-based, phosphorus-based, or no application) is also applied to each risk. When a state's P-Index is used as the field-specific risk assessment tool, it is important that the permit term include the risk and the recommended nutrient basis for land application.

Scientist notes excellent corn growth on manured soil treated with alum residue, which cuts phosphorus losses in runoff water. (Photo courtesy of USDA/ARS)

Two different risk categories may have the same recommendation for land application. For instance a state could recommend nitrogen-based manure application for fields that have low risk and medium risk for phosphorus transport. Even if the application rate basis for a field does not change with a change in the risk rating, the operator (or planner) needs to know when the risk for a field is increasing. The reason for this is that any increase to the *outcome of the field-specific risk assessment* is a substantial change to a term that necessitates a permit modification. Even though both low and medium risk ratings might recommend an nitrogen-based application rate, the change from low to medium is indicative of some other change in the current management or conditions on the field, which is resulting in an increased risk of phosphorus runoff. Therefore, the permit term needs to capture the risk category or other rating in addition to specifying the recommended application rate basis.

The factors that are considered in calculating a P-Index often include variables that fluctuate over time, such as application rates and methods of application for inorganic and organic nutrient sources, the timing of each application, conservation practices implemented or the actual crops planted (among others). Those variables can fluctuate with each crop grown on a field and also depend on how and how often manure is applied. Over the course of a 5-year permit cycle, a P-Index risk rating could theoretically fluctuate from a low to high risk on a single field. The linear approach inherently accommodates the variation in risk over the life of the permit because the NMP reflects the actual crops and associated manure application rates that will be used. The narrative rate approach allows that implementation of the NMP could differ from what was anticipated when the plan was written. Methods of nutrient applications might fluctuate or nutrient applications might occur at different times than when they were originally planned, particularly if crop rotations change (as is accommodated under the narrative rate approach). Given those anticipated changes, a field's actual risk for an individual crop year might change during the period of permit coverage and might not reflect the risk that was calculated at the beginning of the permit cycle. That situation could require permit modifications during the 5-year permit term, depending on how the *outcome of the field-specific risk assessment* is written as a permit term.

The *outcome of the field-specific risk assessment* is required to be reported by field, but not for each individual crop grown in the field. Nevertheless, even though the permit term is not crop-specific, the outcome of the assessment depends on the management of each specific crop (i.e., accounting for the manure application rate and method for each crop) and, thus, is indirectly crop specific.

This Manual describes two possible methods for developing the term *outcome of the field-specific risk assessment*. In the first method, the term reflects the field risk for each crop-year in the plan. This method is described as *multiple risk levels* over the planning period. That method meets the CAFO rule requirement for reporting the risk for each field for each year covered by the NMP but restricts the operator in the sense that any management changes during the planning period must maintain the risk identified for each crop-year. This method aligns with the requirements of the linear approach.

In the second method, the term is described as a *single risk level* for a field over the entire planning period. It is based on the highest risk calculated for any individual crop year. This method accounts for the inherent relationship between the P-Index and the management of each crop and allows each individual year's risk to fluctuate as long as the highest risk over the planning period is not exceeded. This second approach reconciles inconsistencies between the multiple risk level method and the flexibility intended by the narrative rate approach.

It is important to note that, while EPA has determined that the two methods described below are consistent with the requirements of the CAFO rule, they are not necessarily the only valid methods for capturing the term *outcome of the field-specific risk assessment*. Permitting authorities may identify other approaches consistent with the regulatory requirements.

As mentioned above, the single risk level approach accommodates the flexibilities provided under the narrative rate approach. Unlike the linear approach, the narrative rate approach allows CAFOs to adjust their manure nutrient application rates without requiring the permit to be modified. 73 FR 70,449 (Nov. 20, 2008). The predicted form, source, amount, timing and method of application of manure, litter and process wastewater set forth in the NMP are not permit terms under the narrative rate approach so the actual inputs may differ from what was projected in the NMP. Additionally, the narrative rate approach allows the flexibility to include alternative crops that might be planted over the course of the permit. Because changing any of those inputs could result in a change to the risk in an individual crop year, the single risk level approach sets the permit term as the highest risk (i.e., the risk that results in the most stringent nutrient basis for land application) anticipated over the course of permit coverage. Actual inputs for factors such as the crop planted or the form, source, timing and method of nutrient application can fluctuate, as anticipated under the narrative rate approach, as long as the field's risk for any individual crop year does not increase above this highest predicted rating. That avoids the requirement for a permit modification based on a substantial change to the NMP that might otherwise be needed if the permittee is restricted to the risk predicted in the NMP for each individual crop year. The implications of this approach with respect to the allowable land application rates are discussed in Section 6.5.3 under the discussion on the *maximum amount of nitrogen and phosphorus from all sources*.

Example of two approaches to expressing the term *outcome of the field-specific risk assessment for nitrogen and phosphorus transport*

In a CAFO's NMP, Field A results in the following risk ratings and associated nutrient basis for land application for a corn-soybean rotation.

Crop Year 1: Medium—Nitrogen-based application

Crop Year 2: Medium—Nitrogen-based application

Crop Year 3: High—Application at 1.0 x crop phosphorus removal rate

Crop Year 5: Medium—Nitrogen-based application

Method 1 (Multiple Risk Levels)

The permit term could be reported for every year on every field. Under this approach, the field will have multiple risks, each corresponding to a particular crop year.

Field	Year	Crop	Risk	Recommended rate basis
1	2010	Corn	Medium	Nitrogen-based Application
	2011	Soybean	Medium	Nitrogen-based Application
	2012	Corn	High	1 times crop phosphorus removal
	2013	Soybean	High	1 times crop phosphorus removal
	2014	Corn	Medium	Nitrogen-based Application

Under the multiple risk method, where the permit term includes the individual risk for each crop year under permit coverage, the operator must not exceed a medium risk in crop years 1, 2 and 5 and a high risk in crop years 3 and 4. For example, the operator could substitute an alternative crop in Year 1, which allows a higher manure application rate as long as the change does not cause the risk rating to increase to high in year 1 year 2, or year 5.

Method 2 (Single Risk Level)

The permit term could be reported as a single risk for the field. In this case, the highest risk rating for the field for the planning period (usually corresponding to a 5-year permit period) would be reported as the permit term.

Field	Risk	Recommended rate basis
1	High	1 times crop phosphorus removal

Under the single risk method, the term would reflect the high risk rating for the entire permit period. The operator would have more flexibility to make changes in years 1, 2, and 5 that might increase the risk rating as long as the change does not cause the risk rating to exceed the high risk in any year.

Additional Considerations for Implementing the *Outcome of the Field-Specific Risk Assessment* when Utilizing a Phosphorus Site Index

In many states, an appropriate application rate for manure (e.g., nitrogen-based, phosphorus-based, or no application) is associated with the risk estimated by a state-specific P-Index. Additionally, many state P-Indices include the planned application rate of manure as a variable in calculating the risk in the P-Index. A CAFO's planned application rate could result in a risk rating that would not recommend the planned rate to be applied. Planned rates of manure application must always align with the recommended rate associated with the estimated risk. Therefore, determining the appropriate land application rate is an iterative process because it is necessary to analyze the planned rate of manure application in the calculation of the P-Index until the planned rate aligns with the recommend rate as defined by the P-Index. An example is given below.

A state-specific P-Index is as follows:

P-Index rating	Risk	Recommended nitrogen and phosphorus application rates
0–5	Low	Nitrogen-based
6–10	Medium	Crop phosphorus removal
11–15	High	No application

An operator may plan to apply manure at an nitrogen-based rate on his field the first year of operation. When the P-Index is calculated, which takes the nitrogen-based rate into consideration, the P-Index rating is 7, and the risk for runoff is medium. The recommended application rate for manure, when the risk is 7 should not exceed the crop phosphorus removal rate. The planned nitrogen-based rate does not align with the recommended rate. The P-Index indicates that an nitrogen-based manure application increases the risk for phosphorus runoff on this particular field and therefore should not be applied. The rate needs to be adjusted to lower the risk. (Another variable influencing the risk could also be adjusted or conservation practices could be implemented that would also reduce the risk to low, and then the planned nitrogen-based rate could be applied because it would align with the recommended rate, but this example assumes that other factors are held constant.)

No matter how the term for the *outcome of the field-specific risk assessment* is identified in the permit, planned rates of application should not exceed the recommended rates based on the P-Index or other risk assessment method used.

Planned Crop or Other Use

An NMP is predicated on the use of manure as a source of nutrients for a crop. Land application of manure that is not intended for crop uptake is simply waste disposal. Without a crop to actively utilize nutrients and prevent erosion, nutrients applied in manure can be washed directly into surface streams or leached into the groundwater. The vegetative cover that a crop provides reduces the potential for runoff and erosion from an area. The root system of a crop holds soil together and provides a network of openings, or pores, for water to infiltrate soil rather than run off. When selecting a crop, the operator should consider factors including:

- Adaptation to the local climate.
- Ability to use nutrients when manure applications are made.
- Harvest requirements.
- Marketability and profitability.
- Yield.
- Suitability to soil conditions.
- Pest management.

Crops growing in a Missouri field. (Photo courtesy of USDA/MO NRCS)

Among the most common cropping practices that receive manure applications are a corn/soybean rotation (i.e., corn is grown in one year and soybeans the next year), continuous corn (i.e., corn is grown every year), a corn/soybean/wheat rotation (i.e., three crops are grown in 2 years), and forage (i.e., hay or grass). Yet depending on the region, manure application is commonly used for many different crops. Specific data about the appropriateness of manure application and local application rates should always be outlined in the state's technical standards and often follow the guidance of local agronomists, NRCS experts, a Cooperative Extension Service, or land grant university. Those experts help operators select sustainable cropping practices, and they make nutrient application recommendations.

A CAFO's NMP must identify the crop or crops that are planned for each field for every year of permit coverage. Alternate crops may be specified for NMPs developed using the narrative rate approach, as described in Section 6.5.3.

Crop Rotations and Crop Nutrient Requirements

To develop appropriate land application practices, CAFOs should identify planned crop rotations. A rotation is the growing of a sequence of crops to optimize yield and crop quality, minimize the cost of production, and maintain or improve soil productivity. CAFOs should describe their planned sequence of crops (e.g., corn for silage, soybeans) preferably for 5 years. That should include planting and harvesting dates and residue management practices. Crop rotation is important in calculating total nutrient needs over the period of the rotation, nutrient buildup, and nutrient removal via harvesting.

Benefits of Crop Rotations

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

Realistic Annual Yield Goals

The realistic yield goal is the estimated potential for crop yield for a given field. The total nutrient requirements for fields are largely based on the CAFOs expected crop yields; generally, the higher the yield expectation, the higher the nutrient requirement. An unrealistic estimate can result in either a deficiency or an excess of nutrients being applied. In addition to crop variety and climate, crop yields are influenced by field-specific factors including, among others, soil fertility, soil type, crop management and, pest control. Thus, estimated yields can be expected to vary for different fields. State technical standards for nutrient management need to identify acceptable methods and data sources for establishing realistic yield goals.

The best way to estimate yield potential is to consider production practices given the relationship between crop yields and site-specific management and field conditions. For example, the average of the three highest yields of the five most recent years that the specific crop was grown in the field could be used. Increased yields from the use of improved varieties and hybrids should be considered when yield goals are set for a specific field.

Where records are not available, as is the case with most new operations, another method of estimating yield is needed. NRCS, in conjunction with state agricultural and Cooperative Extension Service specialists, establish realistic yields for specific crops on different agricultural soils. Those values are based on inherent soil properties and long-term observations. They should be viewed only as estimates because they might not reflect irrigation, new cultivars, and improved management tools. That information is available through county NRCS field offices. Local farmers, fertilizer dealers, and custom harvest companies might also be able to provide yield data. Field-to-field and farm-to-farm differences can easily result in a ±20 percent difference in realistic yield expectations from those published by state and Cooperative Extension Service specialists and should be considered normal. Further differences might also exist because of practices such as supplemental irrigation or no-till planting although local specialists might have information to document those differences.

States should establish in their technical standards criteria for deriving realistic yield goals including criteria for adjusting yield goals according to actual crop yields. CAFO operators of Large CAFOs subject to subparts C and D should follow the criteria established in the technical standards for deriving a realistic yield goal for a given crop. CAFO operators must follow the criteria in the technical standards and should have sufficient data and records to demonstrate that the yield goals used as the basis for developing application rates are realistic. 40 CFR § 412.4(c)(2). The permit term for *realistic annual yield goal* is the yield goal identified in the NMP for each crop grown in each field for each year of the planning period. See 40 CFR sections 122.42(e)(5)(i)(A) and 122.42(e)(5)(ii)(A).

While the basis for establishing the yield goal is not part of the permit term, EPA recommends that the basis (e.g., historical records, data source for book values) be identified in the NMP. In any event, the permitting authority has the authority to request the basis for the yield goal that was used. 40 CFR § 122.23(h). Additionally, upon subsequent permit issuance, the public will have the opportunity to review yield goals in light of actual yields reported by the CAFO in its annual reports. Id.; § 122.42(e)(4)(viii).

Once a realistic yield expectation is determined for a crop, the amount of nutrients required to achieve that yield can be determined.

Total Nitrogen and Phosphorus Recommendations for Each Crop

A key factor in determining the amount of manure to apply to a crop is the amount of nitrogen and phosphorus required for a crop to achieve a given yield. The *total nitrogen and phosphorus recommendation* for specific crops should be identified by each state's technical standards for nutrient management.

While the total amount of nutrients required to achieve a given yield may be met by drawing from all available sources, recommendations for a crop might or might not account for available nutrients already present in the soil. State recommendations may be based solely on quantity of nutrients needed to achieve the given yield goal or may be based on the amount of nutrients needed in addition to those available to a crop from the soil needed to achieve the given yield goal. The latter is commonly referred to as the crop's fertilizer recommendation. Fertilizer recommendations can account for the availability of existing nutrients and how nutrients (existing and added) will behave with time, management practices, and other environmental conditions that affect their availability to a plant. Phosphorus fertilizer recommendations account for existing available nutrients and, therefore, must always consider the results of a soil analysis. That is less common for nitrogen fertilizer recommendations because nitrogen compounds are highly mobile and undergo rapid transformations in soil (see Section 6.1.1 on the nitrogen cycle). Providing an accurate and representative soil analysis of plant available nitrogen is more difficult than for phosphorus because the samples need to be taken close to the time when nutrients will be land applied. Therefore, nitrogen fertilizer recommendations often represent the entire quantity of plant available nitrogen needed from all sources to achieve the yield goal.[7]

Cropland fertilized with hog manure. (Photo courtesy of USDA/NRCS)

Instead of using a fertilizer recommendation to quantify the nutrients needed to achieve a certain yield, some technical standards express the *total nitrogen and phosphorus recommendation* in terms of the crop's nutrient removal rate. When a crop is harvested, the nutrients in the harvested portion of the plant that the crop extracted from the soil, are removed from the field. Standard values have been calculated for specific crops to quantify the amount of nutrients removed on the basis of the yield unit that is harvested. Crop yield units for the most common grain and forage crops are bushels/acre and tons/acre, respectively. The nutrient content of common crops is shown in Table 6-2 . The values in Table 6-2 are generalized national data. Local crop nutrient content is not expected to differ greatly from that shown in Table 6-2 but should be based on local NRCS, Cooperative Extension Service, or land grant university data. Such local data should be used for planning purposes. A crop's nutrient removal rate is determined by multiplying the nitrogen or phosphorus per yield unit by the expected yield.

Nitrogen

Total nitrogen recommendation is almost always based on the fertilizer recommendation. The recommendation defines the amount of nitrogen needed by the crop and application rates are derived considering the various sources of nitrogen available to meet the total nitrogen need.

The exception to that approach is when the crop is a legume. Legumes can supply and meet their own nitrogen needs through nitrogen fixation. However, some states' technical standards allow for manure to be applied to legumes, because legumes will use nitrogen that has been supplied externally to the extent that it meets the plant's needs, rather than fixing nitrogen to meet that need. In states that allow manure application to legumes, typically it is allowed at the crop's removal rate. The nitrogen removal rate will determine the amount of nitrogen expected in harvested biomass for a given crop and yield. Where states allow that, the nitrogen removal rate can be reported for legume crops as the crop nitrogen recommendation. In all other cases, the crop nitrogen fertilizer recommendation should be used.

Phosphorus

Total phosphorus recommendations can follow either the phosphorus removal rate or the phosphorus fertilizer recommendation (based on the soil phosphorus test level). When the soil test for phosphorus is low, operators will most likely follow the phosphorus fertilizer recommendation, rather than the removal rate, because it allows a higher phosphorus application rate, which will build up the soil phosphorus level to improve the fertility of the field. When the phosphorus fertilizer recommendation is followed, the soil test level increases with time, and subsequently the phosphorus recommendation should decrease.

The phosphorus fertilizer recommendation is based on the amount of phosphorus that is needed beyond what is already available in the soil to grow a given yield of a specific crop. A soil sample is analyzed to determine the amount of phosphorus that can be removed from the sample; the ability to remove phosphorus from the sample represents the plant availability of phosphorus.

Fertilizer recommendations based on soil test phosphorus levels are designed to achieve an *optimum* available soil phosphorus level (see Figure 6-7 and Section 5.9.3 Soil Test Protocols). When the soil test is low, the recommendation is to apply more than what the crop will remove with the intention to build up the soil test level so that the soil can supply the crop and subsequent crop's phosphorus need. Conversely, when the soil test level is high, the recommendation is less than the removal rate because the intention is to draw down the phosphorus level in the soil to achieve an optimum level. When the phosphorus fertilizer recommendation is used as the term for *total phosphorus recommendation*, the term will inevitably change because the intent of the recommendation is to increase the amount of phosphorus in the soil (or to decrease the amount of phosphorus in soil when soil tests are high) to achieve an optimum level of phosphorus soil fertility.

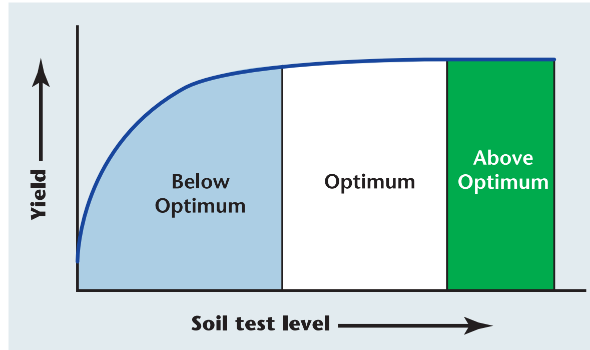

Figure 6-7. Yield response curve illustrating the soil test interpretation levels.

An application based on a crop phosphorus removal rate will maintain the current soil phosphorus test level because the removal rate supplies only enough phosphorus to replace the phosphorus that is removed with harvest. The amount of plant available soil phosphorus will have no bearing on the amount of additional nutrients to apply. When the crop phosphorus removal rate is used as the term for *total phosphorus recommendation*, the term will be consistent over time for a specific crop unless the crop yield goal is adjusted.

Figure 6-8 provides an example of how the recommended pounds of P_2O_5 to apply can differ when following either a soil test fertilizer recommendation or a crop phosphorus removal rate.

The site-specific information captured for the term, *total nitrogen and phosphorus recommendations for each crop*, will depend on what the state's technical standards require. In many cases, the state's technical standards will allow for either the fertilizer recommendation or the crop removal rates, in which case, the higher rate will typically be used to calculate manure nutrients to be applied.

Removal Rates vs. Fertilizer Recommendations

Nutrients removed in harvested portions of corn silage.

Crop	Unit of yield	Nutrient removed per unit of yield	
		P_2O_5	K_2O
		lb/unit	
Corn			
Silage	ton	3.30	8.00

Phosphate (P_2O_5) recommendations for corn silage.

Soil test	Yield potential—tons per acre				
	20	22	24	26	28
ppm (lb/acre)	lb P_2O_5 per acre				
5 (10)[1]	115	125	130	135	140
10 (20)	90	100	105	110	115
15-30 (30-60)[2]	65	75	80	85	90
35 (70)	35	40	40	45	45
40 (80)	0	0	0	0	0

[1] Values in parentheses are lb/acre.
[2] Maintenance recommendations are given for this soil test range.

Figure 6-8. Removal rates versus fertilizer recommendations. (Source: TriState Fertilizer Recommendations)

Understanding Substantial Changes with Low Phosphorus Soil Test Results

Various applications for the result of the soil phosphorus analysis are discussed throughout this chapter, which include how they are applied in deriving:

- *Outcome of the field-specific risk assessment*.
- *The total phosphorus recommendation for each crop*.
- *The maximum amount of phosphorus to be applied*.
- *The methodology* (under the narrative rate approach).

With respect to the above terms, any changes to the field-specific maximum amounts of phosphorus and any changes that are likely to increase the risk of nitrogen and phosphorus transport to waters of the U.S. as determined by the *outcome of the field-specific risk assessments* are substantial changes to the terms of an NMP.

As just discussed, when soil tests are low, the operator will likely follow the phosphorus fertilizer recommendation over the removal rate if given a choice. Following the fertilizer recommendation will increase the soil test value and subsequently decrease the corresponding fertilizer recommendation.* Thus, over a period the permit term, *total phosphorus recommendation,* is likely to change.

In many cases, when the phosphorus soil test is low, the risk for runoff will also be low and manure will most likely be applied at an nitrogen-based rate. As a result, the phosphorus recommendation is likely to be become obsolete. The phosphorus fertilizer recommendation is not followed when land applying using an nitrogen-based rate. While the fluctuating term, *total phosphorus recommendation* would be considered a permit modification, it has no bearing on the *maximum amount of phosphorus that can be applied* and thus it would not be a **substantial** permit modification.

However, it is possible for a field to have a high risk for runoff (generally limiting application to a phosphorus-based rate) and a low phosphorus soil test. In this case, the fertilizer recommendation is most likely followed. In this case, the *maximum amount of phosphorus* will be the amount directly determined by the fertilizer recommendation. Over time, the phosphorus soil test will increase and subsequently the fertilizer recommendation will decrease. Because that field has a high risk for runoff, as the recommendation declines, less phosphorus should be applied, thereby decreasing the *maximum amount of phosphorus* that can be applied. With every change to the *total phosphorus recommendation* (in this case the fertilizer recommendation), *the maximum amount of phosphorus* changes triggering a **substantial** permit modification. EPA believes that is necessary to ensure that phosphorus is not over-applied as the soil phosphorus levels build on such high-risk sites.

***Note:**
There are many ways to read a soil test analysis, which could lead to confusion when discussing the change to the fertilizer recommendation. Phosphorus fertilizer recommendations are typically given as the pounds of phosphorus to be applied to a crop for a given soil test range. Therefore, for a range of soil test results, the recommendation will be the same. For example, a quantitative range of soil test results (i.e., 0–50, 50–100, 100–150 ppm) will be qualitatively described (0–50 = low, 50–100 = optimum, 100–150 = high). Different phosphorus recommendations for the amount of additional phosphorus to be applied will be provided for each qualitative soil test range. If a soil test is taken more than once over the course of a 5-five year permit term, a change to the crop recommendation term would occur only if a new soil test recommendation is applied.

6.5.2. Additional Site-Specific Terms: Linear Approach

Because the linear approach specifies the maximum amount of nutrients that will be supplied from manure, the permit must include terms for the variables and data that are used to derive that value. In addition to the terms that apply to both approaches, which are discussed in Section 6.5.1 above, the CAFO regulations require the terms described in this section for application rates expressed using the linear approach.

Credits for Plant Available Nitrogen in the Field

Once the nitrogen recommendation for a crop is known, the manure application rates can be determined by subtracting from the total nitrogen recommendation the amount of nitrogen that will be available to the crop from all other sources. One of these sources is nitrogen that is already in the field. These in-field nitrogen sources of PAN are referred to as nitrogen credits. Two common credits for PAN are organic nitrogen from prior manure applications that mineralizes to available nitrogen compounds over the course of the planning period and nitrogen supplied from legume crops. Quantifying these sources of PAN is part of the methodology for calculating application rates for the narrative rate approach and a permit writer should ensure this is specified in the NMP. Under the linear approach, the credits themselves are a term.

Nitrogen Credits from Mineralization

Not all nitrogen in manure that CAFOs apply is available to the crop during the year of application. Some nutrients require organic material decomposition before they are available for plants. An accurate estimate of the amount of organic nitrogen that will become available in the years after a manure application event is considered a part of the credits for PAN in the field. The availability of organic nitrogen from manure application will vary according to the degradability of organic nitrogen compounds in the manure and other environmental conditions. Organic nitrogen in different types of manure (e.g., dairy, poultry, beef) mineralizes at different rates. Varying environmental conditions associated with the timing of application (fall versus spring), such as soil temperature and moisture, affect the ability of microorganisms to mineralize organic nitrogen compounds in the manure into plant available forms. Availability coefficients are applied to the amount of organic nitrogen, as determined from the manure analysis. Coefficients typically are used for calculating nitrogen availability in the first, second and third year after application. (See section 6.1.1 and Appendix A, Basic Soil Science and Soil Fertility, for more details on the nitrogen cycle and nitrogen mineralization.)

State technical standards should provide mineralization coefficients that are based on the type of manure being applied and the time of year that application is occurring. Most states consider nutrients to be 50 to 75 percent available in the first year. Typical rates are provided in Table 6-4, but state-specific rates should be reflected in a CAFO's NMP.

Table 6-4. General mineralization rates for nitrogen[a]

Waste and management	Years after initial application		
	1	2	3
	Percent available (accumulative)		
Fresh poultry manure	90%	92%	93%
Fresh swine or cattle manure	75%	79%	81%
Layer manure from pit storage	80%	82%	83%
Swine or cattle manure stored in covered storage	65%	70%	73%
Swine or cattle manure stored in open structure or pond (undiluted)	60%	66%	68%
Cattle manure with bedding stored in roofed area	60%	66%	68%
Effluent from lagoon or diluted waste storage pond	40%	46%	49%
Manure stored on open lot, cool-humid	50%	55%	57%
Manure stored on open lot, hot-arid	45%	50%	53%

Source: Table 11-9, USDA-NRCS, 1999

a. Table assumes annual applications on the same site. If a one-time application, the decay series can be estimated by subtracting year 1 from year 2 and year 2 from year 3. For example, the decay series for fresh poultry manure would be 0.90, 0.02, 0.01. The decay rate becomes essentially constant after 3 years.

The permit writer should be aware that the estimate for residual manure nitrogen in the field, which, in the linear approach, contributes to the permit term, *credits for PAN in the field* is estimated from the manure analysis used to develop the NMP. Therefore, the requirement for Large CAFOs to sample and analyze their manure annually could result in changes in the value of PAN in the field. Medium and Small CAFOs are subject to BPJ requirements and might be able to account for the nutrient content of manure using standard book value estimates. Standard estimates will not reflect fluctuations of the manure analysis and associated changes to the PAN credits in the field. The narrative rate approach accommodates for those types of fluctuations.

Temporal fluctuations in the manure nutrient content can be great for uncovered lagoons and pits because seasonal variations in temperature and precipitation can alter nutrient content through dilution, evaporation, and volatilization. Manure analyses from under-barn concrete pits or covered aboveground tanks will not vary as much because there is limited exposure to the environment.

Nitrogen Credits from Legumes

As described in the discussion above on *total nitrogen recommendations*, legumes can fix atmospheric nitrogen to supply their own nitrogen need and add nitrogen to the soil. The state's technical standards for nutrient management need to describe how to account for nitrogen credits from a previous legume crop so the NMP can properly account for them. Two examples from Montana and Iowa are provided below. Montana's technical standard provides legume credits that vary with plant species and growing conditions (Table 6-5):

Iowa's technical standard sets an upper limit of total nitrogen credits that can be derived from a soybean crop. Credits for nitrogen that are to be carried over into the following year are calculated as follows:

- Last year's soybean crop: 1 lb nitrogen per bushel of yield, maximum of 50 lb nitrogen per acre credit.
- Legume forage crop:
  - Last year's crop with 50 to 100 percent alfalfa or other legume in stand: 100 to 140 lbs nitrogen per acre.
  - Last year's crop with 20 to 50 percent alfalfa or other legume in legume/grass mixture: 50 to 80 lbs nitrogen per acre.
  - Two years ago crop with 50 to 100 percent alfalfa or other legume in stand: 30 lbs nitrogen per acre.
- Last year's legume green manure crop: 100 lbs nitrogen per acre.

Nitrogen credits are a term even for a field with a phosphorus-based rate because the nitrogen credit is needed to calculate the appropriate amount of supplemental nitrogen to be added to the field to ensure that the crop's nitrogen requirement is not exceeded.

Consideration of Multi-Year Phosphorus Application

A multi-year phosphorus application consists of applying a single application of manure at a rate equal to the recommended phosphorus application rate (whether based on soil test levels or crop removal) for multiple years in the crop sequence. In some situations a multi-year phosphorus application is used because the application equipment might not be able

Table 6-5. Legume nitrogen credits for Montana

Legume	Nitrogen fixation (lbs/acre)*
Alfalfa (after harvest)	40–80
Alfalfa (green manure)	80–90
Spring Pea	40–90
Winter Pea	70–100
Lentil	30–100
Chickpea	30–90
Fababean	50–125
Lupin	50–55
Hairy Vetch	90–100
Sweetclover (annual)	15–20
Sweetclover (biennial)	80–150
Red Clover	50–125
Black Medic	15–25

*The maximum nitrogen fixation in lbs/acre should be used unless appropriate justification is given showing lower nitrogen fixation is appropriate. In all cases, the nitrogen fixation used must be within the ranges specified above.

An example of no till farming where young soybean plants thrive in the residue of a wheat crop. (Photo courtesy of USDA/NRCS) to apply manure at the recommended phosphorus application rate because that rate is lower than the spreading capability of the equipment. In other cases, it might be more practical and economical to *bank* phosphorus by applying manure at rates higher than the crop's phosphorus needs for that year.

The use of multi-year phosphorus application is a flexibility that the Director can provide to CAFOs when establishing the state's technical standards for nutrient management. 40 CFR § 412.4(c)(2)(ii). However, that flexibility is allowed only on fields that do not have a high potential for phosphorus runoff to surface waters. Id. Such flexibility is not needed when the *outcome of the field-specific risk assessment* permits an nitrogen-based application rate because an nitrogen-based application rate already provides 2 to 4 times the amount of phosphorus that a crop typically needs. Therefore, *consideration of multi-year phosphorus application* will never be a term for any field with an nitrogen-based limit. It is a flexibility to be considered once the *outcome of the field-specific risk assessment* restricts application to a phosphorus-based rate.

The term for *consideration of multi-year phosphorus application* should identify the field, crop, and year that the multi-year phosphorus application will occur. Because a multi-year phosphorus application should never exceed the annual nitrogen rate for the year of application, the plan should demonstrate that the amount of nitrogen being applied does not exceed the allowable nitrogen recommendation for that crop during the year that the multi-year phosphorus application is made.

When a multi-year phosphorus application is allowed, CAFOs must not apply additional phosphorus to those fields until the amount applied in the single year has been removed through plant uptake and harvest. 40 CFR § 412.4(c)(1). Therefore, the permit writer should ensure that no manure application is planned for the number of years covered by the multi-year application. The number of years will depend on how many years' worth of phosphorus was applied in a single application [68 FR 7,210 (Feb. 12, 2003)].

Accounting for All Other Additions of Plant Available Nitrogen and Phosphorus

For many fields where manure is land applied, other sources of nutrients are also land applied. The term, *accounting for all other additions of plant available nitrogen and phosphorus*, is to capture those sources of nutrients. The nutrient sources can include chemical fertilizers, biosolids, nutrients in water used for irrigation, or any other additions to the field but would not include mineralization of nitrogen from previous land application events or legume nitrogen credits.

Pound for pound, animal manure does not have the same nutrient value as commercial fertilizer, and commercial fertilizer can be customized and blended to meet specific nutrient requirements. Farmers often supplement animal manure applications with commercial fertilizer or biosolids. Furthermore, because animal manure contains relatively high concentrations of phosphorus, crops are generally not supplied with enough nitrogen when manure is applied on a phosphorus basis. Therefore, CAFOs might need commercial nitrogen fertilizer to meet the crop's total nitrogen requirements when manure is applied at less than the nitrogen rate.

Irrigation water, especially from shallow aquifers, contains some nitrogen in the form of NO_3-N. Also, water from runoff ponds and storage lagoons contains nutrients. CAFOs must include those nutrient sources in the NMP. To calculate the amount of nitrogen applied with irrigation water, CAFOs must conduct a nutrient analysis to determine the concentration of nitrogen and phosphorus in the water, typically reported as NO_3-N and soluble phosphorus in ppm or mg/L.

The permit term is not the actual amount of the nutrient source to be applied the field. The CAFO rule describes the term as accounting for additions of plant available nutrients to indicate how those other nutrient sources are included as additions for meeting crop needs. That is to say that they must be identified in the NMP, and the amount of nutrients they contribute must be included in the calculation of the total nutrients to meet the nutrient recommendation. Therefore, while the permit term could be captured in the permit as a specific type of fertilizer, the actual amount of fertilizer applied can fluctuate year to year. The plan should include the nutrient content of the sources that are accounted for (e.g., the N-P-K value of supplemental fertilizer or the nitrogen and phosphorus concentration in biosolids or irrigation water).

Example term *accounting for all other additions of plant available nitrogen and phosphorus*

A Large permitted CAFO plans to apply 100 lbs/acre of nitrogen from manure and 50 lbs/acre of nitrogen from a 25-0-0 commercial fertilizer to Field A in each year of the permit.

The permit term for *accounting for all other additions of plant available nitrogen and phosphorus* means that the plan includes the additions of commercial fertilizer to field A. (For an illustration, see the example provided in section 6.6.2 under *Accounting for all other additions of plant available nitrogen and phosphorus*.) In year 2 of the permit, the manure test indicates the concentration of nitrogen in the manure has decreased because of a change in the feed ration. Using all the manure generated at the CAFO supplies only 90 lbs/acre of nitrogen, and the amount of commercial fertilizer used must be increased. That is an acceptable change to make because the actual amount of fertilizer being applied is not the permit term. However, if the CAFO operator wanted to use biosolids to supplement the nitrogen supplied by manure this would be considered a change to the NMP and would need to be submitted to the Director because that source was not accounted for in the NMP.

Form and Source of Manure that Is Land Applied

The form and source of manure are closely related. The form of manure will dictate the type of storage structure or source. The *form and source of manure* are required terms for the linear approach because they relate to the method of application, which is also a term and is discussed in more detail below. 40 CFR § 122.42(e)(5)(i)(A).

An automated lagoon waste management system for a 900-head hog farm. (Photo courtesy of USDA/NRCS)

Manure handled as a solid, such as broiler and turkey manure, is typically surface applied to cropland using either tractor-drawn or truck-mounted, box-type manure spreaders. Manure handled as a semi-solid or slurry, such as dairy cow manure removed from free-stall barns by scraping, is typically applied to cropland using tractor-drawn or truck-mounted tanks. That type of manure typically can be surface applied and incorporated into the soil by disking or plowing, or can be directly injected into the soil. Manure handled as a liquid, such as lagoon wastewater, could be applied to cropland using tractor-drawn or truck-mounted tanks or irrigation systems. Because of the volume of manure when handled as a liquid, irrigation is a fairly common method for land application of this form of manure because it reduces labor requirements. Liquid manure is either applied on the soil surface and incorporated shortly after application or can be directly injected into the soil. Incorporation or injection helps to control loss of volatile ammonia and odors. Incorporation is very effective at controlling runoff of manure nutrients from land application if done within a few hours after application. A soil injector applies liquid manure directly into the soil to a depth of 6 to 9 inches as the tanker passes over the field.

The term *form* refers to the form of the manure (solid, semi-solid, slurry, and liquid) and the term source refers to the storage structure containing the manure. Multiple applications of manure can be made to a single field in one season. Each application could come from a different source and be of a different form. For example, in March solid manure from a manure stack might be land applied to a field. That same field could receive an additional manure application the next month in the form of an injection of liquid manure from a lagoon. Each form and source of manure application should be identified in the NMP and as the permit term for *form and source of manure* in the linear rate approach.

Timing and Method of Land Application

The timing and method of land application of manure have a direct impact on the amount of nutrients that will be available to the growing crop. Therefore, the CAFO regulations specify that those are required site-specific terms when using the linear approach.

The time of year that manure is applied can influence nitrogen availability because of seasonal changes in conditions that influence mineralization rates. As a term of the NMP, *timing* depends on the specific way in which timing affects nutrient availability in the application rate calculation.

For example, *spring* or *fall* would be sufficient if the nitrogen value for that application is the same no matter when during the spring or fall manure is applied. On the other hand, the term might be as specific as "within two weeks before planting" if that is critical to determining the availability of nitrogen to the growing crop. An operator might prefer to specify the timing of an application relative to a seasonal time frame for use as a permit term, even if the plan specifies a specific day or month. (Note that most nutrient management planning software requires identification of a specific date of application; EPA does not expect that permit terms would dictate a specific date for manure application). EPA believes that capturing application timing over the course of a season would be appropriate even if the NMP is more specific, as long as the specific timing is not critical to determining nutrient availability.

The term *method* refers to the equipment used (e.g., big gun, injector, sprinkler, broadcast spreader) to apply the manure. The method of application can affect nutrient availability, the efficiency of crop use, and the likelihood of nutrient loss from the soil. Surface-applied nutrients are more likely to be lost with erosion, particularly during heavy rains, if adequate erosion controls are not in place. Phosphorus loss can also occur in the absence of soil erosion with runoff of dissolved, soluble phosphorus. Nitrogen loss can also occur in the absence of soil erosion because of volatilization and/or leaching losses. Fresh or stored manure contains nitrogen in the form of ammonium, which is subject to loss because it volatilizes as ammonia gas. Incorporation into the soil reduces volatilization; however, there can be a tradeoff because erosion potential increases after disturbing the soil surface. Solid manures like feedlot pen manure contain very little ammonium, making incorporation less critical for conserving nitrogen lost from volatilization (although still desirable for controlling manure nutrients that can be lost from runoff and erosion). Nevertheless, incorporation within the root zone increases plant availability of nutrients. Uniformity of nutrient applications and distance from the root system can also influence crop response to nutrient applications. Manure and wastewater should also be applied at rates and with methods that consider and account for all pathways for loss.

The land application method used at a CAFO often depends on the type of application equipment available or the method that is most cost- or time-effective. Many growers choose to broadcast nutrient application because of fewer time constraints and lower cost. The handling system and therefore the form of manure might also dictate the application method that is used. For example, solid or semi-solid materials cannot be effectively injected into the soil or applied through an irrigation system, while lagoon liquids are most economically applied through an irrigation system.

Land application of manure by injection. (Photo courtesy of USDA)

If the rates associated with a method rely on incorporating the manure after a certain number of days, the number of days should be captured with the method and as part of the timing requirement because the timing, as it specifically relates to the method of application, will affect the amount of nitrogen that will volatilize after manure is land applied.

Volatilization coefficients, which correspond with different methods and timing of application, can be applied to the appropriate nitrogen compounds from the manure analysis where technical standards account for this type of nitrogen loss. Typical rates are provided in Table 6-6.

Table 6-6. Percentage of nitrogen in applied manure still potentially available to the soil (ammonia volatilization causes the predicted losses)

Application method	Percentage remaining/delivered		
Injection	95%		
Sprinkling	75%		
Broadcast (fresh solids)	*Soil Conditions*		
Days between application and incorporation:	*Warm dry*	*Warm wet*	*Cool wet*
1	70%	90%	100%
4	60%	80%	95%
7 or more	50%	70%	90%

Source: Table 11-6, USDA-NRCS Agricultural Waste Management Field Handbook, (after Willrich et al. 1974)

Manure spreading or spraying activities should be planned and managed to prevent nuisances and an adverse impact on groundwater, surface water, public health, and plants. Degradation of any aspect of the environment could warrant reevaluation of the use of a selected manure application system.

Method

CAFOs should always apply manure uniformly and at the approved application rates. Under the effluent guidelines, CAFOs must record the data (day, month, year) and method of each manure application. 40 CFR § 412.37(c). Although many equipment options exist, there are basically two methods of application: subsurface application and surface application. CAFOs must record weather conditions (e.g., rainfall amounts) at the time of application and for the 24-hour period before and after application. 40 CFR § 412.37(c)(3). The operator must also periodically inspect equipment used for land application of manure, litter, or process wastewater. 40 CFR § 412.4(c)(4). Though the CAFO rules do not specify the frequency of the inspections, EPA recommends inspections every time the equipment is used. This allows CAFOs to detect and then correct any potential problems before they cause adverse environmental impacts.

- **Subsurface Application.** Solid, semisolid, and liquid manure can all be applied using this method. When feasible, this is the preferred method of manure application.

Equipment Calibration

Once the method of land application is determined, the manure-spreading equipment needs to be calibrated to ensure that the actual manure application rate matches the planned manure application rate. Equipment calibration is determining the appropriate setting and speed necessary for a piece of land application equipment to apply a calculated rate of manure per acre. Calibration helps a producer to ensure that application at appropriate rates by determining appropriate overlaps, evaluating application uniformity, monitoring usage and *wear and tear* in equipment, and determining application settings based on manure consistency. At a minimum, equipment used to apply manure, litter, or process wastewater should be calibrated annually.

During calibration, the required or appropriate overlap can be determined. Overlap distances and travel lane widths are best determined by measuring the distribution of applied material across the spread pattern. Rain gauges, tarps, or disposable baking pans can be used to collect the applied manure before it is weighed or measured. Many times, visual estimates of desired overlap can be misleading. Because of variations in spreader volume and changes in manure moisture content and density, this is especially true when calibrating litter or solid manure spreaders. Sprinkler overlaps, typically calculated to be the points where an area is receiving less than half of the average volume across the spread width, generally vary between 50 to 80 percent, depending on sprinkler type and wind conditions.

Application equipment should be maintained and operated so it applies a given application rate as evenly as possible across a field. *Hot spots* or areas of over-application due to operator error, non-calibrated or worn equipment can increase the occurrence of runoff or ponding, accumulation of nutrients, or excessive nutrients moving into shallow groundwater. Areas of low application might not produce the realistic yield that could be achieved on the site, potentially leaving unused nutrients that accumulate or are lost to the environment.

As equipment is used and becomes older, it loses efficiency, increasing the need for calibration. That is compounded by the solids, acidity, and salts found in manure, litter, and wastewater that can accumulate in equipment with use. To monitor system performance, irrigation systems that pump liquids with high solids or with significant crystal (iron or calcium carbonate/lime) buildup should be calibrated regularly.

Finally, equipment should be calibrated in response to changes in manure consistency and nutrient content. When a manure storage structure is emptied, a higher amount of solids will be removed and applied to fields than when only wastewater from the surface of the storage structure is applied. As the manure density increases, the equipment should be recalibrated to ensure that the application rate is within acceptable limits. Spreaders should also be recalibrated when a material that is wetter or drier than the litter or manure spread during the previous calibration is applied. Different manure sources will require equipment calibration to account for changes in nutrient content.

Manure spreader calibration. (Photo courtesy of USDA/NRCS)

CAFOs use this method by mechanically incorporating or injecting the manure into the soil. Mechanical incorporation can be performed using moldboard plows, chisel plows, or heavy discs. To reduce nutrient losses, CAFOs should incorporate wastes applied to the land surface before it dries, usually within 2 days of application. Injection requires a liquid manure spreader and equipment to inject manure below the soil surface. To prevent nutrient losses, CAFOs should close the openings made by the injectors following application.

Immediately incorporating manure in the spring will increase the amount of PAN by reducing ammonia loss. Incorporation in soils with low runoff potential can help prevent the movement of nutrients and pathogens from animal manure to surface waters. Where soil erosion is a problem, however, tillage might result in unacceptable losses of soil and nutrients.

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

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

  Irrigation can save considerable amounts of time and labor when applying large volumes of wastewater or liquid animal manure. Sometimes, CAFOs might need to dilute animal manure with fresh water for salinity or other plant requirements, or to facilitate application via irrigation. Irrigation provides flexibility in applying animal manure during the growing season and has the added advantage of supplying water during the growing season's drier periods. Infiltrating liquid can carry much of the easily volatilized ammonia into the soil, although some ammonia will still be lost from the spray before it reaches the soil.

  The irrigation system should, however, be matched to the topography, cropping program, nutrient and water needs of the crops, as well as infiltration, percolation rate, and water holding capacity of the soil. CAFOs should not use irrigation to apply animal wastes unless solids have been removed or chopped very fine. If solids are present, the nozzles will clog and the system will not operate properly. Irrigation also can produce aerosol sprays that can cause odor problems.

- **Surface Application of Dry, Solid Manure.** This application method is very effective at applying dry, bulky animal wastes such as poultry litter. Box spreaders with a chain-drag delivery to a fan or spreader mechanism, or tank wagons equipped with splash plates typically are used for surface applications.

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

CAFOs can reduce nutrient losses when using surface application by implementing soil conservation practices such as contour strip cropping, crop residue management, cover crops, diversion terraces, vegetative buffer strips, and grass waterways. More information about conservation practices is available from the local soil and water conservation district and USDA's NRCS.

- **Irrigation Technologies.** Irrigation application systems can be grouped under two broad system types: gravity flow and pressurized. Gravity-flow systems are particularly predominant in the arid west. Many irrigation systems rely on gravity to distribute water across the field. Land treatments (such as soil borders and furrows) are used to help control lateral water movement and channel water flow down the field. Water losses are comparatively high under traditional gravity-flow systems due to percolation losses below the crop-root zone and water runoff at the end of the field.

  Pressurized systems—including sprinkler and low-flow irrigation systems—use pressure to distribute water. Sprinkler system use is highest in the Pacific Northwest, northern plains, and in eastern states. Center-pivot technology serves as the foundation for many technological innovations—such as low-pressure center pivot, linear-move, and low-energy precision application systems—that combine high application efficiencies with reduced energy and labor requirements. For more detail on irrigation water management, see ARS' Irrigation Water Management in Agricultural Resources and Environmental Indicators at *http://www.ers.usda.gov/publications/ah712/AH7124-6.pdf*.

Gravity-Flow Irrigation

Water is conveyed to the field by means of open ditches, above-ground pipe (including gated pipe) or underground pipe, and released along the upper end of the field through siphon tubes, ditch gates, or pipe valves. Such systems are generally designed for irrigation water, and many CAFOs have not traditionally accounted for the irrigated manure nutrients. Some irrigation systems may offer nutrient management challenges to CAFOs including: uneven nutrient distribution, flooding and pooling, excessive volatilization of nitrogen, excessive leaching, and other potential difficulties in meeting technical standards established in their state.

Timing

Timing of manure application is an important consideration for nutrient availability. The longer manure nutrients are in the soil before crops take up the nutrients, the more those nutrients can be lost through volatilization, denitrification, leaching, and surface runoff. CAFOs should consider the hydrological cycle and hydrological sensitivity of each field when making management decisions.

- **Spring Applications.** Applications made during this time can conserve nutrients if nutrients are applied in coordination with plant crop needs because it is just before the period of maximum crop uptake, allowing for more efficient nutrient utilization. In these cases the threat of surface runoff and leaching can be diminished. However, nutrients added in early spring can also be quite vulnerable to loss. Increased precipitation, snow melts, and warming soils contribute to saturated soils that can result in high nutrient loss unless applications are timed appropriately with crop nutrient uptake.

- **Summer Applications.** Early summer is a good time to apply manure because it is generally the time of maximum crop uptake. One consideration is that improper manure application rates and methods can damage growing crops. Options for applying manure in the early summer include side-dressing manure by injecting it between row crops, irrigating liquid manure over corn rows when the corn is 3 to 12 inches tall (taller corn stalks can suffer more leaf damage), or applying manure to forages such as hay fields and grasses after the first and second cuttings or to pastures with small stubble. CAFOs can also apply nutrients to harvested stubble fields in mid- to late-summer. Nitrogen in the manure stimulates more growth of cover crops, especially non-legume species that require nitrogen. The cover crop takes up the nutrients and holds them in an organic form in the plant, preventing them from leaching or being tied up in the soil complex. The nutrients are then more available for subsequent years' crops when the crop residue breaks down.

- **Fall Applications.** Fall application of manure generally results in greater nutrient losses, especially if manure is applied to a soil without any vegetative cover. Increased nutrient losses occur because mobile nutrients such as nitrogen leaching out of the soil. Many of the non-leachable nutrients react with the soil to form insoluble compounds that build soil fertility, but some are bound so tightly that they might not be available for the next crop. In fall, manure is best applied at low rates to fields that will be planted in winter grains or cover crops. If winter crops are not planted, CAFOs should apply manure to the fields containing the most vegetation or crop residues. Sod fields to be plowed the next spring are also acceptable, but fields where corn silage is removed and a cover crop not planted are undesirable sites.

- **Winter Applications.** The greatest nutrient losses typically occur with winter manure applications to frozen, snow-covered, or saturated soils. Research indicates that winter applications increase pollutants in runoff during spring thaw and rainfall events. Most of the seasonal runoff occurs during snowmelt in late winter or early spring. Manure applied in winter generally does not have the opportunity to dry and anchor to the soil surface or to be incorporated into the soil. CAFOs that apply manure during the winter must do so in compliance with the state's technical standards unless winter application is prohibited by the state technical standards. Such protocols must account for the form of material that would be applied (e.g., liquid, semi-solid, or dry manure). In addition, such standards should address the time at which the materials would be applied relative to periods when runoff could occur, the fraction of precipitation that runs off the land in meltwater and in response to winter rains (as affected, in part, whether the soil is frozen or not), the time it takes runoff to travel to waters of the U.S. (as affect by slope, distance to waters, roughness of the land surface, and whether runoff is in contact with the land surface), and other relevant factors, as appropriate.

Nutrient applications should be managed in a way that accounts for the right amount, the right source (manure/fertilizer), the right placement, and most important the right timing. While different seasons can be more or less favorable for crop nutrient utilization, the right timing should ultimately be coordinated with planted crop needs for efficient nutrient utilization and to minimize nutrient loss. CAFOs should check their state regulations to determine whether fall or winter land application is allowed. Manure, litter, and wastewater storage structures should include adequate capacity to store materials that accumulate during those times when, under the technical standards for nutrient management, land application would be prohibited.

The Maximum Amount of Nitrogen and Phosphorus from Manure, Litter and Process Wastewater

For the linear approach, the enforceable term for the land application rate is the *maximum amount of nitrogen and phosphorus from manure, litter, and process wastewater* in pounds per acre, per year, in chemical forms determined to acceptable to the Director. 40 CFR § 122.42(e)(5)(i)(A). That value does not include residual nutrient credits or nutrients available from other sources because under the linear approach, the nutrients from those sources are already accounted for as separate permit terms. The maximum application rate must be calculated for each crop on each field to be used for land application for each year of permit coverage.

The purpose of the term, *outcome of the field-specific risk assessment* (in both the linear and narrative rate approaches) is to determine the appropriate limiting nutrient for developing land application rates (i.e., whether phosphorus or nitrogen limits the amount of manure, litter, or process wastewater that can be applied or whether land application is to be avoided altogether). Therefore, the field-specific risk assessment plays an important role in determining the appropriate amount of both nitrogen and phosphorus to apply. Therefore, what constitutes the term, **maximum** *amount of nitrogen and phosphorus from manure, litter, and process wastewater*, depends on the term *outcome of the field-specific risk assessment.* Section 6.5.1 describes two methods for writing the permit term, outcome of the *field-specific risk assessment,* when the assessment tool is a phosphorus site index. The first method, the *multiple risk level*, lends itself to the linear approach.

The maximum amount of nitrogen from manure, litter, and process wastewater is the maximum amount of nitrogen from manure that can be applied to a field for the specified crop. The amount is calculated on the basis of the terms for the total nitrogen recommendation minus the nitrogen credits and any other additions of PAN. The amount must also account for the form, source, method, and timing of application, all of which are terms under the linear approach. Where the risk assessment allows nitrogen-based application, the maximum amount of nitrogen from manure should supply the difference between the crop's nitrogen fertilizer recommendation (or for legumes, the crop nitrogen removal or other state-specific nitrogen recommendation) and other sources of PAN.

The maximum amount of phosphorus from manure, litter, and process wastewater will be determined for every crop according to each year's field risk rating. *The maximum amount of phosphorus from manure, litter, or process wastewater* can be calculated as the quantitative value for the allowable application rate determined for a field by the field-specific risk assessment. The *maximum amount of phosphorus from manure, litter, or process wastewater* needs to be reported only for years where land application is limited to a phosphorus-based rate. For example, assuming that the operator is only using manure as a nutrient source, if the field-specific risk assessment determines that manure application should be limited to the annual crop phosphorus removal rate in year 1, the crop removal rate will define the value that constitutes the term *maximum amount of phosphorus from manure, litter, or process wastewater*. If in the second year the risk is reduced so that manure could be applied at an nitrogen-based rate, the maximum amount of phosphorus from manure that could be applied could be reported as nitrogen-based without quantitatively defining the phosphorus limit. For every field, there will be an individual nitrogen and phosphorus limit for every crop that is based on the crop(s) planned to be grown each year in the NMP and that year's risk assessment outcome.

Hog manure sampling for nutrient analysis. (Photo courtesy of USDA/NRCS)

The Methodology to Account for the Amount of Nitrogen and Phosphorus in the Manure to be Applied

Permitted CAFOs must calculate the maximum amount of manure to be land applied at least once each year on the basis of the results of the manure nutrient analysis. 40 CFR §§ 122.42(e)(5)(i)(A), (ii)(D). The tons or gallons of manure to be applied are not the enforceable permit term. The enforceable term is the *maximum number of pounds of nitrogen and phosphorus from the manure to be applied.* The operator is held to that rate when calculating the tons or gallons of manure to be land applied. Although the rate constitutes a numeric limit in the permit, the operator may apply fewer nutrients from manure but may not exceed the *maximum amount of nitrogen and phosphorus from manure, litter, and process wastewater* that is established as a term of the NMP.

Under the linear approach, the methodology that is used to account for the amount of nitrogen and phosphorus in the manure that is to be applied is a permit term. 40 CFR § 122.42(e)(5)(i)(A). As mentioned above, operators of permitted Large CAFOs must calculate the actual amount of manure to be applied annually to supply the calculated amount of nutrients to be applied from manure. The amount of nitrogen and phosphorus in the calculated amount of manure can be determined with the use of the manure test results. For more on how to read and interpret a manure analysis, see Chapter 5.9.1. Large CAFOs must use the results of the most recent representative manure tests for nitrogen and phosphorus taken within at least 12 months of the date of land application. Medium and Small CAFOs must apply manure consistent with BPJ-based requirements established in the permit for accounting for the nutrient content of the manure. The NMP must describe the calculations that will be used to translate the pounds of nitrogen and phosphorus to be applied into an application rate for manure, litter, or process wastewater.

6.5.3. Additional Site-Specific Terms: Narrative Rate Approach

The narrative rate approach allows rates of nutrient application from manure to be expressed in a narrative as long as it includes the *maximum amount of nitrogen and phosphorus derived from all sources.* The six site-specific terms described in Section 6.5.1 must be terms of the permit when using either the linear or narrative rate approach for expressing land application rates in NMPs. They are

- *The fields available for land application.*
- *Timing limitations for land application.*
- *Outcome of the field-specific risk assessment.*
- *Planned crops or other use.*
- *Realistic crop yield goals.*
- *Total nitrogen and phosphorus recommendation for each crop.*

In addition to those six permit term requirements, three additional site-specific permit term requirements apply only to the narrative rate approach.

- *The maximum amount of nitrogen and phosphorus from all sources.*
- *Alternative crops.*
- *The methodology used to derive the actual amount of manure that is applied.*

The Maximum Amounts of Nitrogen and Phosphorus from All Sources

Unlike the linear approach, where land application rates are expressed in terms of the amount of nutrients to be applied from manure, the narrative rate approach sets an upper limit on the amount of nutrients to be applied from all sources. The term is *the maximum amounts of nitrogen and phosphorus derived from all sources of nutrients* for each crop identified in the NMP in chemical forms determined to be acceptable to the Director, in pounds per acre, for each field. 40 CFR § 122.42(e)(5)(ii)(A). An additional distinction between the maximum limits required by the linear and narrative rate approach is that in the linear approach, the maximum limit must be identified for each year manure is applied; in the narrative rate approach, the maximum limit is identified only for each crop but does not need to be reported each year that crop is planted. 40 CFR §§ 122.42(e)(5)(i) and (5)(ii).

The *outcome of field-specific risk assessment* is used to determine the appropriate limiting nutrient for developing land application rates (i.e., whether phosphorus or nitrogen limits the amount of manure, litter, or process wastewater that can be applied or whether land application is to be avoided altogether). However, in the narrative rate approach, the term *maximum amount of nitrogen and phosphorus from all sources* should not be exclusively dependent on the *outcome of the field-specific risk assessment for the potential for nitrogen and phosphorus transport* as the maximum limit was described for the linear approach.

The *maximum amount of nitrogen from all sources* under the narrative rate approach is based on the maximum amount of nitrogen that can be applied to a field for the specified crop based on crop type, yield goal, and current soil test (where states rely on nitrogen soil testing). That is the crop's fertilizer recommendation or for legumes, the crop nitrogen removal rate, or other state-specific nitrogen limit for legumes. That value is the same value that is reported for the term, *total crop nitrogen recommendation*.

To preserve the flexibility of the narrative rate approach, the *maximum amount of phosphorus from all sources* can be set for each crop according to the maximum amount of phosphorus applied in any one year for any one crop as dictated by the *outcome of the field-specific risk assessment*. For example, the *maximum amount of phosphorus from all sources* applied in one given year may be the amount of phosphorus in an nitrogen-based application.

The same crop may be planted more than once over the course of a 5-year NMP. Each time the crop is planted it can receive different amounts of nitrogen and phosphorus (i.e., a legume may or may not have manure applied to it. A *maximum amount of nitrogen and phosphorus from all* *sources* does not need to be identified each time the crop is planted and associated with a specific crop year. This is illustrated in the following example.

The NMP illustrated in Figure 6-9 shows a corn-soybean rotation with varying rates of manure application and a risk that varies with each crop and management of that crop. As discussed in Section 6.5.1 under the subsection *Additional Considerations for Implementing the Outcome of the Field-Specific Risk Assessment when Utilizing a Phosphorus Site Index*, planned rates of application should not exceed the recommended rates identified by the phosphorus site index. Given that the risk fluctuates with different crops and years, different rates of manure are applied that follow the P-Index recommended rates. Therefore, in year 1, an nitrogen-based rate is applied to corn but in year 3, because the risk increases, manure is applied at the crop phosphorus removal rate as recommended by this state-specific P-Index. More phosphorus is applied in an nitrogen-based rate than in a rate that supplies the crop phosphorus removal; therefore, the maximum amount of phosphorus that is applied to a corn crop in this NMP is the amount applied under the nitrogen-based rate. The soybean crop is planted twice in this NMP. In the second year, manure is applied at the soybean phosphorus removal rate and in year 4, no phosphorus is applied. Therefore, the maximum amount of phosphorus applied to soybeans is the soybean phosphorus removal rate.

The field-specific assessment plays an important role in determining the appropriate amount of both nitrogen and phosphorus to apply each year and can result in different amounts of nutrients applied each time the same crop is planted. Disassociating the amount recommended by the risk assessment from a specific crop-year in the NMP allows flexibility to change the crop rotation or the crops grown as intended under the narrative rate approach. In addition to changing the sequence that crops are planted, the narrative rate approach also allows a change in actual crops grown as long as the nitrogen and phosphorus application rates are calculated in accordance with the approved methodology (see the section below on alternative crops).

Permitted CAFOs must comply with all limits and conditions of their permits. That includes the *outcome of the field-specific risk assessment*. Therefore, manure and other nutrient sources can be applied up to the identified *maximum amount of nitrogen and*

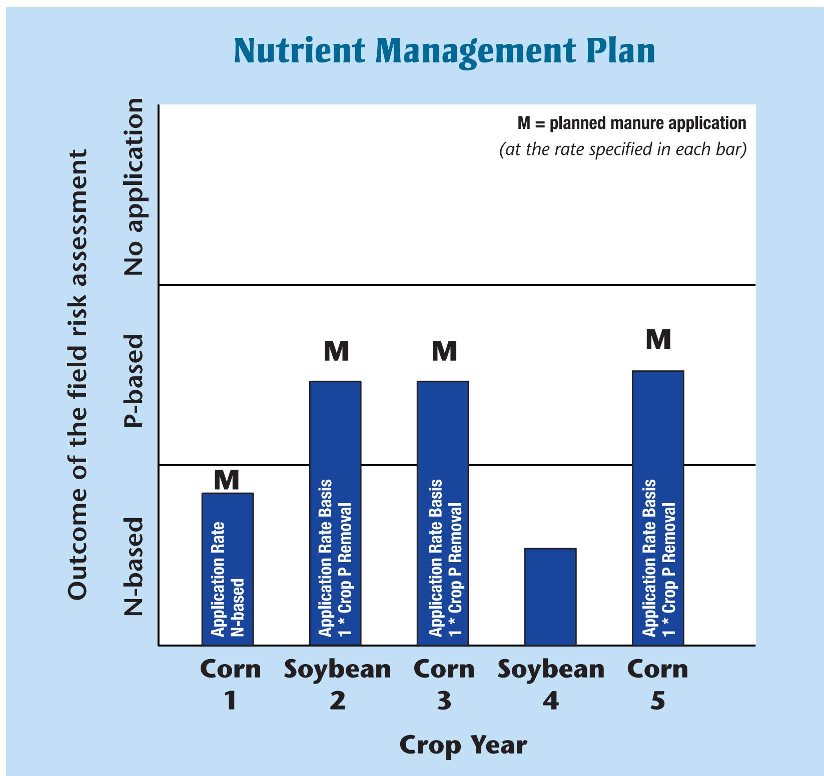

Figure 6-9. An illustration of a 5-year NMP for a corn-soybean rotation.

phosphorus from all sources limits identified in the permit so long as the field risk rating is maintained as well as all other established permit limits and conditions (For ways in which application rates can be changed without incurring a substantial permit modification, see Section 6.5.1 under the subsection *Additional Considerations for Implementing the Outcome of the Field-Specific Risk Assessment when Utilizing a Phosphorus Site Index* and Section 6.5.4).

Alternative Crops

A key difference between the linear and narrative rate approaches that allows for greater flexibility under the narrative rate approach, is that the narrative rate approach allows the NMP to include alternative crops that may be planted in lieu of those included in the planned rotation. If *alternative crops* are included, the NMP must also identify for each alternative crop realistic yield goals and nitrogen and phosphorus recommendations from sources specified by the Director. The term alternative crops includes the alternative crops listed in the NMP, along with their associated yield goals and nitrogen and phosphorus recommendations. 40 CFR § 122.42(e)(5)(ii)(B).

If an alternative crop is used, the *maximum amounts of nitrogen and phosphorus from all sources* and the amount of manure to be applied must be determined in accordance with the *methodology* that is included as an enforceable permit term (as discussed below). The terms and factors associated with *alternative crops* would be the same as the terms and factors required for the crops included in the planned rotation in the NMP.

It is important to recognize that any increase in an *outcome of the field-specific risk assessment* that results from incorporating an alternative crop into the planned crop rotation will still be considered a substantial change to the plan. 40 CFR § 122.42(e)(6)(iii)(D). The amount and timing of nutrients to be applied is likely to change with a change in the planned crop rotation. As discussed in Section 6.5.1, this type of change could affect the *outcome of the field-specific risk assessment* for an individual crop year. A CAFO operator must ensure that there is no increase the *outcome of the field-specific risk assessment* when implementing an alternative crop; otherwise, the operator must follow the substantial change procedures for revising a plan.

Sunflower crop. (Photo courtesy of USDA/ARS)

It is also important to recognize that when alternative crops are used, application rates might need to be adjusted for all years after implementing the alternative crop. That is especially important if a legume crop is added or removed from a rotation because of the change in PAN credits that are accounted for in the methodology. Additionally, if a manure application rate is adjusted because of an alternative crop, mineralization credits for future years could also change. Those changes are accommodated by the flexibility allowed to an operator when using the narrative rate approach and would not be considered substantial changes.

The Methodology by which the NMP Calculates the Amount of Manure to be Land Applied

Rates of application that are expressed using either the linear and narrative rate approach must include the *methodology* for calculating the amount of manure to be land applied; that *methodology* is captured as an enforceable term. 40 CFR §§ 122.42(e)(5)(i)(A), (ii)(A). Under, the narrative rate approach, the *methodology* must account for the following factors part 122.42(e)(5)(ii)(A):

- Credits for PAN in the field.
- The amount of nitrogen and phosphorus in the manure to be applied.
- Consideration of multi-year phosphorus application.
- Accounting for all other additions of plant available nitrogen and phosphorus to the field.
- Form and source of manure, litter, and process wastewater.
- Timing and method of land application.
- Soil test results.
- Volatilization of nitrogen and mineralization of organic nitrogen.

A Global Positioning Satellite (GPS) navigation system facilitates accurate planting, fertilization, and harvesting. (Photo courtesy of USDA/FSA)

The factors listed above are not themselves considered permit terms, but the *methodology* used to account for them in the CAFO's permit is a term. Thus, the CAFO operator will be bound by the methodology and the way in which the above factors are accounted for in calculating the rates of manure application. As long as the methodology prescribed in the NMP is followed and includes all the listed factors, the calculated amount of manure, litter, or process wastewater can change from year to year.

The first six factors listed above are terms under the linear approach. 40 CFR § 122.42(e)(5)(i)(A). Regardless of whether they are expressed as permit terms under the linear approach or as factors of the *methodology* under the narrative rate approach, the information is typically used in the same manner when calculating rates of manure application. Therefore, the discussions of these terms under the linear approach (see the discussion above in Section 6.5.2) also apply here, and the factors are not further discussed in this section. The difference is that, unlike the linear approach, where the factors are terms, the narrative rate approach allows flexibility for the factors to fluctuate from year to year without notifying the Director. As described in Chapter 4.2.3, some of this information must be included in the annual report for CAFOs that use the narrative rate approach to assure the permitting authority and the public that the CAFO is operating within the limits established by the permit given the flexibility of the narrative rate approach permit terms. 40 CFR § 122.42(e)(4).

Results of the Soil Test

The annual calculation of the amount of manure to be applied must account for the results of the most recent soil test conducted in accordance with sampling requirements approved by the Director. Soil sampling requirements should be included in the technical standards for nutrient management. The ELGs specify that Large CAFOs subject to subparts C and D must test their soil for phosphorus at least once every 5 years. Some states' technical standards require sampling to be done more frequently (e.g., annually or 2 to 3 years). Some states require more frequent sampling on fields that have reached higher soil test phosphorus levels. The annual calculation of the amount of manure to be applied must rely on the results of the most recent soil test; even if sampling is conducted more frequently than required by the Director. If a soil test is taken only once over the course of a 5-year permit term, the amount of plant available soil phosphorus indicated by that analysis is assumed on an annual basis. Some states may also require testing for soil nitrogen. The methodology for calculating the amount of manure to be land applied should take that into account.

How the soil test is factored into the methodology under the narrative rate approach may differ from state to state. Soil tests should be included as a variable in the field risk assessment method. Different assessments use the soil test differently. The examples of assessment methods provided in Section 6.5.1 show that some states use soil test thresholds while others rely on a P-Index. Soil test thresholds directly rely on the soil test value to determine if manure nutrients should be applied at an nitrogen-based rate, phosphorus-based rate, or not applied at all while P-Indices use the soil test along with many other variables to make that determination. Each state has the flexibility to determine which assessment method it uses and how that assessment incorporates the soil test results.

When states require a soil test to be taken more frequently than once over the course of a 5-year permit cycle, the CAFO operator should recalculate the field-specific risk assessment so that the outcome is based on the result of the most recent test. If soil test levels for phosphorus are increasing, the potential for phosphorus to be transported from a field could be increasing as well. The CAFO operator should be aware of such a change so that changes in manure application rates or conservation practices can be implemented and updated in the NMP to minimize losses and maintain the risk rating captured as a term for that field. EPA encourages frequent soil testing and reevaluation of the field risk assessment for all CAFO operators, regardless whether they are using the linear or narrative rate approach. The CAFO operator should always be aware of the current field conditions to ensure the minimization of nutrient transport from each field using the most recent data.

Mineralization of Organic Nitrogen and Volatilization of Nitrogen

As with the linear approach, the narrative rate approach must rely on and incorporate the results of the most recent representative manure tests taken within 12 months of the date of land application when calculating the rates of application.

The amount of manure to be land applied is determined on the basis of the amount of plant available nutrients in the manure. A manure analysis provides the amount of nitrogen (typically as total nitrogen, ammonium and phosphorus) contained in the manure samples that were submitted (see Chapter 5). The manure analysis is used to determine the amount of PAN. PAN is determined by accounting for both nitrogen losses (volatilization) and nitrogen gains (mineralization). State technical standards for nutrient management should identify appropriate volatilization and mineralization rates; those rates are a part of the *methodology* under the narrative rate approach to ensure proper calculation of appropriate manure application rates.

Losses of nitrogen from volatilization vary depending on the form, source, timing and method of application. Gains of PAN as a result of mineralization will vary depending on the timing of application and the type of manure that is being used (e.g., dairy, beef, poultry, or swine). Some organic nitrogen will be available the year it is applied, and some will become available in the years following a land application event. Approximately 50 to 75 percent of the total nutrients applied are likely to be plant available during the first year. Nitrogen not used by the crop(s) planted following an application is available for subsequent crops or they are subject to loss by erosion or leaching. It is therefore important to time manure applications to coincide with peak nutrient uptake by the crop.

The volatilization and mineralization rates identified by the state technical standards must be applied to the appropriate manure nitrogen fractions to determine the amount of PAN, supplied from the manure to be added to a field for a crop. In general, volatilization factors are applied to the ammonium result from the manure analysis. Mineralization factors are applied to the organic nitrogen results. If the manure analysis provides only total nitrogen and ammonium, the amount of organic nitrogen can be determined as the difference between the two (total N – NH_4^+).

Land application of manure by a honeywagon. (Photo courtesy of USDA/NRCS)

In practice, the narrative rate approach (and the linear approach) will require that amounts of manure to be land applied be translated from pounds of nutrients into tons or gallons of manure to be applied. The information presented to the public in the CAFO's NMP will include the projected tons or gallons of manure for the planned crop rotation for

Applying volatilization and mineralization factors to the annual manure analysis results will provide an adequate estimate for calculating the tons or gallons of manure to be applied to supply the appropriate amount of nitrogen to the crop. While this estimate is generally adequate, the volatilization and mineralization coefficients that are the basis for those values include certain assumptions about environmental conditions that affect the processes; actual conditions, and therefore actual volatilization and mineralization rates, could differ from those estimated.

Plant tissue testing and pre-sidedress nitrate testing might be effective tools for more accurately determining nitrogen deficiencies (and the need for supplemental nitrogen application) and for determining excess nitrogen. Plant tissue tests and pre-sidedress nitrate tests are typically taken after a portion of the manure or fertilizer applications have been made on a field. The tests should be used to adjust the amount of additional manure or fertilizer that needs to be applied to meet the crop needs. A CAFO's NMP may include plant tissue testing as part of the CAFO's methodology as long as it is done consistently with state technical standards.

each field. That provides the permitting authority and the public an opportunity to review, before permit issuance, the adequacy of the CAFO's methodology. Additionally, the permitting authority and public can review the way the CAFO uses the methodology to calculate the appropriate amount of manure to be applied. Again, the planned crop rotations and projected amounts are not terms, because they will need to be recalculated each year on the basis of updated information; however, the projections will allow the public to see how the *methodology* (which is a term) is applied to a projected set of facts to calculate the amounts to be land applied.

The narrative rate approach provides additional flexibility. In addition to addressing changes in the management of the operations, CAFOs can adjust their rates of application because of fluctuations in any of the factors addressed by the narrative rate methodology. For example, if the NMP projects an amount of manure to be applied according to incorporation of solid manure, the operator could instead apply process wastewater from a lagoon. Form, source, and method of application are all factors affected when an operation makes that type of change. Factors of the *methodology* can change and possibly result in a change to the projected tons of manure to be applied to gallons of wastewater to be land applied. The flexibility is allowed by the narrative rate because the new amount of manure to be applied will be predictably and accurately calculated according to the required *methodology*.

If an NMP is developed by hand or using software that either is not documented publicly or has not been determined to satisfy all the factors in accordance with the state's technical standard, the methodology must be documented in the NMP itself. The *methodology* may; however, be embedded in a software program if the permitting authority determines that the program adequately accounts for the required factors in accordance with the state's technical standards. In addition, documentation that fully expresses how the software accounts for each of the listed factors must be available to the Director and to the public to satisfy the public review requirements of the CAFO rule. Section 6.6 should serve as guidance for permitting authorities as to what EPA expects in nutrient management planning programs to ensure that it encompasses all the factors of the *methodology* listed above.

6.5.4. Substantial Changes

The *outcome of the field-specific risk assessment and the maximum amount of nitrogen and phosphorus from all sources or the maximum amount of nitrogen and phosphorus from manure, litter, or process wastewater* are site specific permit terms. Changes to these terms (any **increase** to the *outcome of the field-specific risk assessment* and **any change** to the *maximum amount of nitrogen and phosphorus*) are considered substantial changes that trigger a permit change. 40 CFR § 122.42(e)(6)(iii)(B). Given the relationship between the amount of nutrients to be applied and the field-specific risk assessment, it is necessary for CAFOs to recalculate the *outcome of field-specific risk assessment* when there are changes to any variables that are used in calculating the *outcome of the field-specific risk assessment*. That becomes more apparent when the field-specific risk assessment is a P-Index because of the numerous variables used by that tool for determining risk. Because a P-Index often includes the manure application rate as one of the variables; this would include changes to the planned rate of manure application, even if the new planned rate does not exceed the maximum limit identified in the permit. Figure 6-10, below illustrates when a phosphorus site index would need be recalculated when NMP implementation deviates from what was planned when the NMP was first developed.

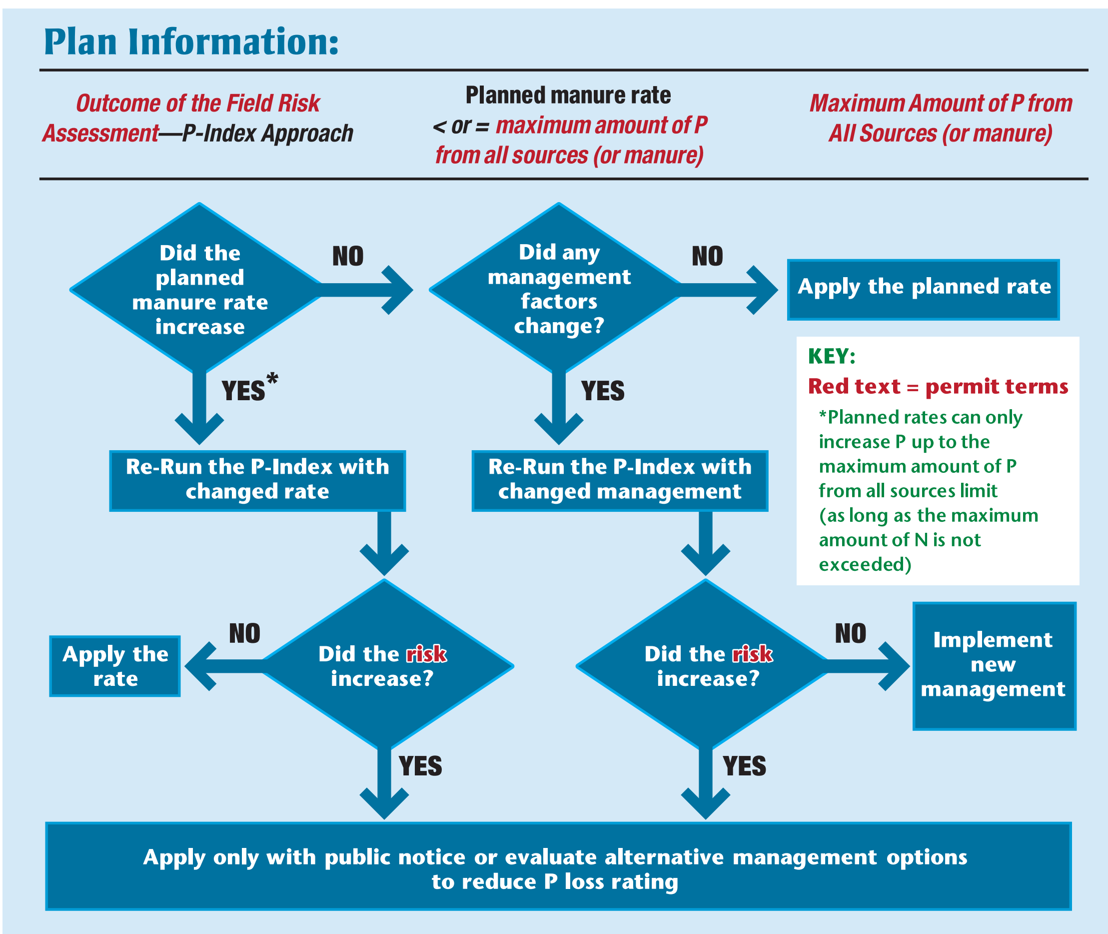

Figure 6-10.

The permit term for the *outcome of the field-specific risk assessment* can be written in various ways. Two have been discussed in this Manual. The process illustrated in Figure 6-10 is applicable regardless of how the permit term for the *outcome of the field-specific risk assessment* is written. When a single overall risk for a field is used (the highest risk), only changes that result in an exceedance of that risk are substantial. When multiple risks are used for a field (typically associated with each crop year) any change that results in an exceedance of any one risk over the course of the NMP is substantial.

The CAFO operator is responsible for ensuring that any changes in management that deviate from what was proposed in the submitted NMP do not increase the field risk rating beyond the rating included as a term in the permit. If an operator's NMP plans for the land application of nutrients at rates below the limits established by the permit term *maximum amount of nitrogen and phosphorus from all sources* (e.g., planned application of manure at the crop phosphorus removal rate when the risk assessment allows for an nitrogen-based rate), the operator can choose to apply at rates that are higher than planned without violating the permit, as long as the rates do not exceed the *maximum amount of nitrogen and phosphorus from all sources (or from manure, litter, and process wastewater* under the linear approach) and as long as the increased application rate does not increase the field risk beyond that allowed by the permit term *outcome of the field-specific risk assessment.*

6.6. Permit Terms for Land Application Protocols Using a Sample NMP

This section uses a sample NMP (Appendix P, Sample Nutrient Management Plan) to identify example permit terms under each approach. Because many permit terms are based on the technical standard for nutrient management, a sample technical standard is also provided with the sample permit (Appendix O, Sample Site-Specific NPDES General Permit). The sample technical standard that is attached to the sample permit was developed by EPA for illustrative purposes only and is not a state Director-identified and approved technical standard for any state.

The permit writer needs to be familiar with the state's technical standards to properly determine that permit terms based on information in a CAFO's NMP are developed in accordance with the state's requirements. To help illustrate the importance and relationship that technical standards play in developing permit terms, a reference to the sample technical standard is given for the example, where appropriate. Additionally, for each term, the location in the plan is identified. While the NMP contains 16 fields and is developed for 5 years, permit terms are not illustrated for each field for all 5 years because many of the terms are identical and the information is repetitive.

As described above, this section provides guidance to permitting authorities on EPA's expectations as to what needs to be addressed by automated nutrient management planning tools to ensure that they encompass all the terms and factors required by the CAFO rule. The sample plan referenced in this section was developed using Manure Management Planner (MMP). EPA recognizes that many states use different programs, which may encompass all of what is described below. Data may be contained in program files and not explicitly provided to an operator as not all the information is necessary to an operator in the day-to-day management of his operation. No matter how the data are stored or displayed, to obtain permit coverage, it is the CAFO's responsibility to ensure that the information is provided to the permit writer.

The sections below follow the order of the discussion of site-specific permit terms for land application protocols in Section 6.5. For each of the terms identified in the CAFO rule, Section 6.6 identifies the site-specific information from the sample NMP that would be captured as permit terms.

6.6.1. Site-Specific Terms: Linear and Narrative Rate Approaches

Fields Available for Land Application

Data sources:

1. Sample NMP: Table 6.1 Field Information and Field Maps
2. Technical Standards reference: Appendix A9 of the Iowa DNR, Manure Management Plan Form, 65.17(16) - *Soil sampling requirements for fields where the P-Index must be used*

Example term:

Field ID	Subfield ID	Total spreadable acres
Bob's Farm-North	8N	56.4
Bob's Farm-South	8S	79.6

A note on using the sample NMP and technical standard to develop the permit term:
As discussed in Chapter 6.5.1, technical standards may limit the allowable size of a field by setting limits on the acres that a soil sample can represent. This sample technical standard does not prohibit grouping soil test results from soil samples. Therefore, field acres represented by similar analyses have been grouped in the sample NMP.

Timing Limitations for Land Application

Data sources:

1. Sample NMP:
   - Table 6.1 Field Information and Field Maps
     - ▹ for field slopes
   - Table 6.6 Manure Application Planning Calendar
     - ▹ for timing restrictions
2. State Technical Standard reference: State NRCS Conservation Code 590 (December 2008).

Text from the state-specific NRCS code 590:

Nutrients and organic nutrient sources shall not be surface applied to frozen, snow covered ground, or saturated soil if a potential risk for runoff exists. A potential risk for runoff exists on slopes greater than 5% unless erosion is controlled to soil loss tolerance levels (T) or less. Manure may be surface applied to frozen, snow covered or saturated ground if a potential risk for runoff exists only under one of the following conditions.

- Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure.
- On an emergency basis.

Example term:

Field ID	Subfield ID	Year	Limitations
Bob's Farm South	8S	2010 2011 2012 2013 2014	The slope is 7%, therefore: Manure may only be surface applied to this field when the ground is frozen, snow covered or saturated if one of the following conditions exists: 1. Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure 2. On an emergency basis

In contrast, an example of a field with a slope of less than 5 percent, the term could be illustrated as

Example term:

Field ID	Subfield ID	Year	Limitations
Sample	*Sample-1*	2010 2011 2012 2013 2014	The slope is 3.5%, therefore: No limitations. Manure may be applied year round.

A note on using the sample NMP and technical standard to develop the permit term:
Although in emergency situations, the sample technical standards allow for application to occur on frozen, snow covered, and saturated ground, EPA encourages that no application occur by any method to any ground that is frozen, snow covered, or saturated. EPA points out that while a standard may allow for that type of application to occur, the plan writer may choose that it is not the best management practice and write a more protective limit into the permit.

Outcome of the Assessment of the Potential for Nutrient and Phosphorus Transport for Each Field

Data source:

1. Sample NMP: Table 5.3, Nitrogen and Phosphorus Risk Analysis—Iowa Phosphorus Index
2. Technical Standard:
   - Appendix A9 of the Iowa DNR, Manure Management Plan Form, Chapter 567—65.17(17)

Example term when using multiple risks for a field that are based on each crop year's risk

Field ID	Subfield ID	Year	P loss risk	Allowable manure application rate
Bob's Farm South	8S	2010	Low	Manure shall not be applied in excess of the nitrogen needs of the crop.
		2011	Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation.
		2012	Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation.
		2013	Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation.
		2014	Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation.

Or

Example term when using a single risk outcome for a field based on the highest risk for all crop years

Field ID	Subfield ID	P loss risk	Allowable manure application rate
Bob's Farm South	8S	Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation.

A note on using the sample NMP and technical standard to develop the permit term:
The allowable manure application rate associated with each risk level is not provided in the NMP output Table 5.3. The allowable manure application rate basis was pulled from the state technical standards [Appendix A9 of the Iowa DNR, Manure Management Plan Form, Chapter 567—65.17(17)] to develop the complete and appropriate permit term.

Planned Crops or Other Use (Fallow, Pasture, etc.) for Each Field and Each Year

Data source:

1. Sample NMP: Table 6.5, Planned Crops and Fertilizer Recommendation
2. Technical Standard reference: Not applicable

Example term:

Field ID	Subfield ID	Year	Crop
Bob's Farm South	8S	2010	Soybean
		2011	Corn
		2012	Soybean
		2013	Corn
		2014	Soybean

Realistic Annual Crop Yield Goal for Each Field

Data sources:

1. Sample NMP: Table 6.5, Planned Crops and Fertilizer Recommendation
2. Technical Standard Reference: Appendix A9 of the Iowa DNR, Manure Management Plan Form, Chapter 567—65.17(6) - *Optimum crop yield and crop schedule.*

Example term:

Field ID	Subfield ID	Year	Crop	Yield goal	Units
Bob's Farm South	8S	2010	Soybean	61	bu/acre
		2011	Corn	195	bu/acre
		2012	Soybean	61	bu/acre
		2013	Corn	195	bu/acre
		2014	Soybean	61	bu/acre

A note on using the sample NMP and technical standard to develop the permit term:
According to Appendix A9 of the Iowa DNR, Manure Management Plan Form, Chapter 567—65.17(6) - *Optimum crop yield and crop schedule*, optimum crop yield goals could have determined in accordance with one of the following methods:

- Soil Survey Interpretation Record
- USDA county crop yields
- Proven Yield Methods

In this case, USDA county crop yields were used. Appendix A8 of the Iowa DNR, Manure Management Plan Form, contains Agriculture Statistics on County Corn and Soybean Yield Averages.

Total Nitrogen and Phosphorus Recommendations for Each Crop by Field and Year

Data sources

1. Sample NMP: Table 6.5, Planned Crops and Fertilizer Recommendations
   - Provides fertilizer recommendations and removal rates
2. Technical Standard References:
   - Appendix A5 of the Iowa DNR, Manure Management Plan Form, Crop Nitrogen Usage Rates Factors for Various Crops
   - Appendix A6 of the Iowa DNR, Manure Management Plan Form, Nutrient Removal for Iowa Crops
   - IA NRCS 590 conservation code (December 2008), Manure and Organic By-Product Nutrient Application Rates, Section A. Nitrogen Application
     - Manure application to legumes

Example term:

Field ID	Subfield ID	Year	Crop	Total N	Total P_2O_5
Bob's Farm South	8S	2010	Soybean	232 lbs/A	49 lbs/A
		2011	Corn	210 lbs/A	73 lbs/A
		2012	Soybean	232 lbs/A	49 lbs/A
		2013	Corn	210 lbs/A	73 lbs/A
		2014	Soybean	232 lbs/A	49 lbs/A

A note on using the sample NMP and technical standard to develop the permit term:
In Table 6.5 of the sample NMP, the crop nitrogen recommendation for legumes is zero. However, the IA NRCS 590 conservation code (December 2008) allows for manure or other organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in the harvested portion of the crop that is removed from the field in that growing season. Therefore, the permit term for nitrogen for soybeans is reported according to the removal rate of 3.8 lbs N/bu of soybean harvested and the yield goal. In addition to being reported in the NMP, it is provided in Appendix A6 of the Iowa DNR, Manure Management Plan Form.

The nitrogen recommendation as reported in MMP in Table 6.5 of the sample NMP indicates that corn, following soybeans has a recommendation of only 160 lbs/acre. That is 50 lbs less than the typical, 210 lbs/acre recommendation for corn (based on the recommendation for a corn crop following a corn crop. This rotation with this recommendation is not shown in the simplified NMP of Appendix P). The recommendation is lowered to account for nitrogen credit generated from the legume crop. For this term, the 50 lbs/acre is included in the total nitrogen recommendation because the credit is accounted for in the term *credits for plant available nitrogen in the field by year* for the linear approach. See Section 6.6.2 below under, Credits for Plant Available Nitrogen and step 6 of the Methodology in Section 6.6.3 for an example of how this credit was accounted for.

The phosphorus fertilizer recommendation for all crops is 0 lbs P_2O_5/acre. This is based on the high phosphorus soil tests (Tables 6.3 of the sample NMP). Because the soil test recommendation is zero and the appropriate nutrient rate basis, as defined by *the outcome of the field specific risk assessment,* allows for phosphorus to be applied at a phosphorus removal rate, the term for the *total phosphorus recommendation* is based on removal rate for each specific crop.

6.6.2. Additional Site-Specific Terms: Linear Approach

Credits for Plant Available Nitrogen

Data sources:

1. Sample NMP:
   a. Table 6.8, Field Nutrient Balance
      i. For legume and residual credits
   b. Table 6.9, Field Nutrient Status Details
      i. Also identifies residual manure Nitrogen credits
      ii. Also can be used to identify adjustments to crop Nitrogen recommendations for legume credits
2. Technical Standard:
   a. Footnote "t" of the Iowa DNR Manure Management Plan Form
      i. For legume credit values
   b. Appendix B3 of the Iowa DNR, Manure Management Plan Form. Note Appendix B3 is the Iowa State University Extension publication PMR1033 (September 2008) - Using Manure Nutrients for Crop Production.
      i. For residual Nitrogen credit values

Example term:

Field ID	Subfield ID	Year	Crop	PAN credits(lbs/acre)
Bob's Farm South	8S	2010	Soybean	0
		2011	Corn	50†
		2012	Soybean	0
		2013	Corn	50† + 2*= 52
		2014	Soybean	0

† - Legume credits
* - Residual manure Nitrogen credits

A note on using the sample NMP and technical standard to develop the permit term:
When the first year of an NMP contains 0 lbs of PAN/acre, it is assumed that the field has not received manure or been planted in legumes in recent history. For most existing fields, the first year of the plan will include a PAN credit. For permit renewals, permit writers should check the first-year PAN credit to ensure that it is consistent with the known cropping and land application history for the field as reflected under the previous permit.

MMP accounts for legume credits by adjusting the crop nitrogen recommendation. Here, the legume nitrogen carryover from the prior legume crop is captured as part of the term, *PAN credits*.

The methodology describes in greater detail how the numeric values for both legume and residual manure nitrogen credits were derived for each year. (See Step 6 of the methodology in Section 6.6.3.)

Consideration of Multi-Year Phosphorus Application

Data sources:

1. Sample NMP: Table 6.7, Planned Nutrient Applications; Table 6.8, Field Nutrient Balance
2. Technical Standard Reference: Appendix A9 of the Iowa DNR, Manure Management Plan Form, Chapter 567—65.17(19)

Example term:

Field ID	Year	Crop	Consideration of multi-year phosphorus
Bob's Farm South – 8S	2010	Soybean	No
	2011	Corn	Yes
	2012	Soybean	N/A
	2013	Corn	N/A
	2014	Soybean	No

A note on using the sample NMP and technical standard to develop the permit term:
Manure was applied in the fall of 2010. (See Table 6.7, Planned Nutrient Applications). The application is shown here as occurring in 2011 because the fall application is nutrients for the crop planted in the spring of 2011. Table 6.8 of the sample NMP, Field Nutrient Balance, does not state that the manure application is considered a multi-year application with a yes or no as it is shown in the table above. What Table 6.8 illustrates is that phosphorus balance remains after a manure application had been made to meet the crop phosphorus removal rate. Therefore, more phosphorus has been applied than was removed by the crop. What also should be noted in Table 6.8 is that additional manure is not applied until the balance returns to zero.

The methodology describes in greater detail how this manure application meets the state requirements for applying a multi-year phosphorus application. (See Step 9 of the methodology in Section 6.6.3.)

Accounting for All Other Additions of Plant Available Nitrogen and Phosphorus to the Field

Data sources:

1. Sample NMP: Table 6.7, Planned Nutrient Applications
2. Technical Standard Reference: Not applicable

Example term:

Field ID	Subfield ID	Date	Other additions of PAN	Available N (Lbs/Acre)	Available P_2O_2 (Lbs/Acre)
Bob's Farm South	8S	2010	None	0	0
		2011	Commercial fertilizer (28-0-0)	128	0
		2012	None	0	0
		2013	Commercial fertilizer (28-0-0)	158	0
		2014	None	0	0

A note on using the sample NMP and technical standard to develop the permit term:
The only additional plant available nutrients that are applied to this field are nitrogen fertilizer. The amount of available nitrogen from nitrogen fertilizer is shown in the table below, but the value of available nitrogen is not part of the term and may fluctuate from year to year. The term is the source of additional nutrients planned for each year and the fact that it is an additional amount of nutrients necessary to ensure crop yield goals are met without exceeding maximum limits, that is taken into consideration.

Form and Source of Manure that is Applied

Data source:

1. Sample NMP:
   a. Table 6.7 Planned Nutrient Applications
      i. Nutrient source
   b. Table 2.3 Manure Storage
      i. Type of storage
2. Technical Standard Reference: Not applicable

Example term:

Field ID	Subfield ID	Timing	Form	Source
Bob's Farm South	8S	Fall 2010	Solid	E Lots Stack #1
		Fall 2014	Solid	W Lots Stack #2

A note on using the sample NMP and technical standard to develop the permit term:
Timing is not a component of the term *form and source of manure, litter, and process wastewater to be land applied*, but is included here to clarify the form and source to be applied at different times during each crop year. For example, if the facility planned to apply liquid manure in the spring of 2011 and solid manure in the fall of 2011, the terms for *timing and form* would work in conjunction to clarify the details for each manure application.

The sample NMP does not specify the form of manure to be applied; however, according to the information in Tables 2.3 (Manure Storage) and 6.7 (Planned Nutrient Applications), the permit writer is able to determine the form of manure that is stored in each source.

Method and Timing of Land Application of Manure for Each Field

Data source:

1. Sample NMP: Table 6.7, Planned Nutrient Applications
2. Technical Standard Reference: Not applicable

Example term:

Field ID	Subfield ID	Timing in NMP	Timing term	Method
Bob's Farm South	8S	Nov 2010	Fall 2010	Dry Box Spreader, Not incorporated
		Sept 2014	Fall 2014	Dry Box Spreader, Not incorporated

A note on using the sample NMP and technical standard to develop the permit term:
MMP reports timing of applications on a monthly basis. Other tools might report an exact date of application. That information can be captured more broadly as the permit term. Here, it is captured on a seasonal basis. For this example, spring is defined as March, April, and May. Summer is defined as June, July, and August. Fall is defined as September, October, and November. Winter is defined as December, January, and February.

Maximum Amount of Nitrogen and Phosphorus from Manure, Litter, and Process Wastewater

Data source:

1. Sample NMP: Table 6.7, Planned Nutrient Applications
2. Technical Standard Reference: Not applicable

Example term:

Field ID	Subfield ID	Crop year	Crop	Max N from manure applied	Max P_2O_2 from manure applied
				(lbs/acre)	
Bob's Farm South	8S	2010	Soybean	0	0
		2011	Corn	32	190
		2012	Soybean	0	0
		2013	Corn	0	0
		2014	Soybean	0	0

As indicated above, although the NMP shows the first manure application on this field in the fall of 2010, that application is made for the corn crop to be planted in the spring of 2011, so the limits are associated with the 2011 crop year. That is also true for the September 2014 manure application. (Note that the *Target Crop* indicated in Table 6.7 for the November 2010 and September 2014 manure applications are corn, whereas the crops grown in 2010 and 2014 are soybeans.)

The permit term for the linear approach is the manure nutrients predicted by the NMP to be applied expressed as pounds of nitrogen and phosphorus for each year of permit coverage. Note that this value does not include residual nitrogen from previous application(s).

The operator has chosen not to meet crop needs solely with manure nutrients. Manure could have been applied to the soybean crops, but the operator has chosen not to apply nutrients in those three crop years (additionally, this plan has utilized the flexibility of a multi-year phosphorus application which restricted any additional phosphorus from being applied until the phosphorus from the multi-year application had been utilized by the crops). Also, the NMP shows that commercial fertilizer will be applied to this field in addition to manure in 2011 and 2013. So, although the plan could have been written to allow more nutrients from manure to be applied, the operator has chosen to limit manure application on this field. As described in Section 6.5 under the linear approach, the NMP that is submitted with the NOI is the NMP that is to be implemented over the 5 years of permit coverage. The permit terms are written to reflect what is predicted by the submitted NMP. For the linear approach, the CAFO's permit will limit manure application on the basis of the amount of manure nutrients to be applied as predicted in the submitted NMP, unless the operator follows the substantial change procedures to increase this term.

Methodology to Account for the Amount of Nitrogen and Phosphorus in the Manure to be Applied

The term is the set of calculations used by the MMP software program to account for the amount of nitrogen and phosphorus in the manure that is to be applied. That is the methodology used to derive the amount of manure to be applied according to the term *maximum pounds of nitrogen and phosphorus from manure* and the manure nutrient analysis. In this specific example, for the 2011 corn crop, 1,514 tons of dry box spreader manure from E Lots Stack #1 (that was not incorporated) was able to supply 32 pounds of nitrogen and 190 pounds of phosphorus. The permitting authority has determined that this program accounts for the nitrogen and phosphorus in the tons of manure to be applied. The term that is captured in the permit would be *Use of Manure Management Planner, version 0.29*. If the result of the annual manure nutrient analysis is different from that used to develop the plan, the CAFO operator would use MMP to recalculate the amount of manure to apply in 2010 and 2014 based on the term *maximum amount of nitrogen and phosphorus from manure*.

For this example field, the methodology for the linear rate approach is encompassed within the methodology for the narrative rate approach. For a more detailed discussion on how the amount of nitrogen and phosphorus in the manure applied is calculated, see steps 7.1 through 7.3.4 of the methodology in Section 6.6.3.

Data source/Location in NMP:

1. Sample NMP: If MMP or other software is used, the methodology can be cited as use of the program, if the permitting authority determines that the program adequately accounts for the nitrogen and phosphorus in the manure to be applied.

Putting together all the terms that are applicable to the linear approach :
The *methodology* is expressed within MMP version 0.29. The permitting authority determined that the methodology used by MMP was developed in accordance with the state's technical standard. Additional site-specific permit terms for expressing protocols for land application under the linear approach are shown below. (Note that in this example, the permit term for the *outcome of the field risk assessment*, was written so that a single risk was applied to the entire field.) For this example, the terms are shown only for the field Bob's Farm South, Subfield 8S, but a permit writer for this facility would identify terms for all fields identified in the NMP.

<table>
<tr><th colspan="2">Fields available for land application</th><th rowspan="2">Crop year</th><th rowspan="2">Total acres</th><th rowspan="2">Timing limitations for a land application</th><th colspan="2">Outcome of the assessment of the potential for nutrient transport</th><th rowspan="2">Planned crops or other use</th><th rowspan="2">Realistic annual yield goal</th><th rowspan="2">Total nitrogen and phosphorus recommendations for each crop on each field</th></tr>
<tr><th>Field</th><th>Sub-field</th><th>P loss risk</th><th>Allowable manure application rate</th></tr>
<tr><td rowspan="5">Bob's Farm South</td><td rowspan="5">8S</td><td>2010</td><td rowspan="5">79.6</td><td rowspan="5">Field slope 7%. Manure may only be surface applied to this field when the ground is frozen, snow covered or saturated if one of the following conditions exists:

1. Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure

2. On an emergency basis</td><td>Low</td><td>Manure shall not be applied in excess of the nitrogen needs of the crop</td><td>Soybean</td><td>61 bu/acre</td><td rowspan="5">Soybean recommendations
232 lbs N/acre
49 lbs P_2O_5/acre

Corn recommendations
210 lbs N/acre
73 lbs P_2O_5/acre</td></tr>
<tr><td>2011</td><td>Medium</td><td rowspan="4">Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation</td><td>Corn</td><td>195 bu/acre</td></tr>
<tr><td>2012</td><td>Medium</td><td>Soybean</td><td>61 bu/acre</td></tr>
<tr><td>2013</td><td>Medium</td><td>Corn</td><td>195 bu/acre</td></tr>
<tr><td>2014</td><td>Medium</td><td>Soybean</td><td>61 bu/acre</td></tr>
</table>

Subfield	Crop year	Credits for PAN lbs/acre	Consideration of multi-year phosphorus application	Accounting for all other additions of plant available nitrogen and phosphorus to the field: PAN	Accounting for all other additions of plant available nitrogen and phosphorus to the field: P_2O_5
8S	2010	0	No	None	None
	2011	50	Yes; 3 years' worth of manure phosphorus is applied, and no additional phosphorus is applied for the next two years.	Commercial fertilizer (28-0-0)	None
	2012	0	Continued	None	None
	2013	52	Continued	Commercial fertilizer (28-0-0)	None
	2014	0	No	None	None

Subfield	Crop year	Form of manure applied	Source of manure applied	Timing of land application	Method of land application	Maximum amount of nitrogen and phosphorus from manure: N (lbs/acre)	Maximum amount of nitrogen and phosphorus from manure: P_2O_5 (lbs/acre)
8S	2010	Solid	E Lots Stack #1	Fall	Dry Box Spreader, not incorporated	0	0
	2011	No manure applied	No manure applied	No manure applied	No manure applied	32	190
	2012	No manure applied	No manure applied	No manure applied	No manure applied	0	0
	2013	No manure applied	No manure applied	No manure applied	No manure applied	0	0
	2014	Solid	W Lots Stack #2	Fall	Dry Box Spreader, not incorporated	0	0

6.6.3. Additional Site-Specific Terms: Narrative Rate Approach

As previously mentioned, six site-specific terms apply when using either the linear or narrative rate approach for expressing land application rates in NMPs. Those six terms are (1) *the fields available for land application,* (2) *timing limitations for land application,* (3) *the outcome of the nitrogen and phosphorus transport risk assessment,* (4) *planned crops or other use,* (5) *realistic annual crop yield goal,* and (6) *total nitrogen and phosphorus recommendations for each crop.* Those permit terms for this sample NMP are identified in Section 6.6.1. The only exception is for how *the outcome of the nitrogen and phosphorus transport risk assessment* would be reported. Under the narrative rate approach, a single risk method would likely be utilized by the permit writer. In addition to those six permit terms, the narrative rate approach has three additional site-specific permit term requirements that are as follow:

Maximum Amount of Nitrogen and Phosphorus from All Sources of Nutrients

Data Source:

1. Sample NMP: Table 6.7. Planned Nutrient Applications

Example term:

Field ID	Subfield ID	Year	Crop	Max N Derived from all sources (lbs/acre)	Max P_20_5 Derived from all sources (lbs/acre)
Bob's Farm South	8S	2010	Soybean	Soybeans = 0 lbs N/acre Corn = 210 lbs N/acre	Soybeans = 0 lbs P_20_5/acre Corn = 190 lbs P_20_5/acre
		2011	Corn		
		2012	Soybean		
		2013	Corn		
		2014	Soybean		

The maximum amount of phosphorus from all sources in any single year is shown in Table 6.7 as 190 lbs/acre. (There is a 2014 fall application of manure that contains 200 lbs P_2O_5/acre but that is targeted for crop in the next permit cycle.) The state's P-Index interpretation of the medium risk category is two times the crop phosphorus removed with crop harvest over the period of the crop rotation. That would be 2 × (49 lbs P_2O_5/acre for soybeans plus 73 lbs P_2O_5/acre for corn) or 244 lbs P_2O_5/acre (see step 4.4 of the methodology in Section 6.6.3 below). The NMP was not submitted with any one crop receiving an application rate with 244 lbs P_2O_5/acre being applied. Therefore, while a maximum amount of phosphorus from all sources could have been set at 244 lbs P_2O_5/acre for any one crop, the plan was submitted with a maximum application rate of phosphorus at 190 lbs P_2O_5/acre. Additionally, the state's technical standards allow manure or other organic by-products to be applied on legumes at rates equal to the estimated removal of nitrogen in the harvested portion of the crop that is removed from the field in that growing season (Iowa NRCS 590). In this case, that would be 232 lbs nitrogen/acre for the soybean crop. Therefore, a maximum amount of nitrogen could have been set at 232 lbs nitrogen/acre for soybeans. The NMP was not submitted with any soybean crop receiving an application rate with 232 lbs nitrogen/acre being applied. Therefore, while a maximum amount of nitrogen from all sources could have been set at 232 lbs nitrogen/acre for soybeans, the plan was submitted with a maximum application rate of nitrogen at 0 lbs nitrogen/acre.

As noted in Section 6.5.3, the maximum rates of nitrogen and phosphorus are not associated with a particular year. They are associated only with a particular crop. The rates could be applied in any one year as long as no other permit terms or conditions are violated.

Alternative Crops

The term is the alternative crops (in addition to the planned crops) listed in the NMP. In this plan, there are no alternative crops being grown.

Data source: N/A – The example plan does not include any alternative crops. However, if it were to include crops, the term could be reported as follows:

Example term:

Field	Subfield	Potential alternative crop(s)	Yield goal (unit/acre)	N rec. (lbs/acre)	P_2O_5 rec. (lbs/acre)
Bob's Farm South	8S	Wheat	78 bu/acre	88	41
		Alfalfa	4.1 ton/acre	205	51

Methodology

Data source: In the sample NMP, the methodology is expressed within MMP version 0.29. The permitting authority determined that the methodology used by MMP encompasses all the factors of the methodology, and the plan was developed in accordance with the state's technical standard.

The steps described below review development of the application rates for the entire permit cycle for the field Bob's Farm South, Subfield 8S from the sample NMP. The steps review the entire process of calculating land application rates to show how the methodology should account for the required narrative rate factors; therefore, the steps repeat some of the information on narrative rate approach terms described above. In addition, the methodology presented here is useful to illustrate the general process for calculating land application rates, regardless of whether the linear or narrative rate approach is used.

Several of the narrative rate factors are addressed in multiple steps in the process below, as follows:

Factor	Step(s)
Soil test results	3.1
Credits for PAN in the field	6
Total amount of nitrogen and phosphorus in the manure to be applied	7
Consideration of multi-year phosphorus application	9
Accounting for all other additions of plant available nitrogen and phosphorus to the field	5
Form and source of manure	7.1
Timing and method of land application	7.3.2
Volatilization of nitrogen and mineralization of organic nitrogen	7.3.2 and 6.2

These steps should serve as guidance for permitting authorities as to what EPA expects of various nutrient management planning programs to ensure that they encompass all the required factors of the methodology. The methodology can be rather complicated, and a step by step approach does not necessarily always need to be written out in its entirety as a permit term. As stated earlier, it is common for much of the methodology to be embedded within many state software programs. However, the process below and the type of information that it captures should be contained within all methodologies. In addition, software documentation that clearly describes the methodology should be made publicly available.

The steps below outline the process to account for the required factors of the narrative rate methodology; therefore, the term *outcome of the nitrogen and phosphorus transport risk assessment* is expressed as a single risk rating for a field according to the highest crop year's risk.

Step 1: Identify the Technical Standards Applicable to the Plan for Developing Rates of Application

The sample plan is for a facility in Sioux, Iowa. The sample technical standard that applies to this location is in Appendix O, Sample Site-Specific NPDES General Permit.

Step 2: Identify the Fields where Manure Nutrients Will be Applied

Manure is planned to be land applied in crop years 2011 and 2015, with actual application in the fall of 2010 and 2014, or permit years 1 and 5 (2010–2014) to Bob's Farm South Subfield 8S (field 8S from here onward).

Field	Subfield	Crop year	Application rate	Units
Bob's Farm South	8S	2010	0	N/A
		2011	1,514	Tons
		2012	0	N/A
		2013	0	N/A
		2014	0	N/A
		2015	1,500	Tons

These values are found in Table 6.7, Planned Nutrient Application of the sample NMP. In Table 6.7, two applications are shown to occur in November of 2010 and November of 2014. Those are considered nutrient applications for the following calendar year; spring crop 2011 and spring crop 2015. While 2015 is not part of this permit cycle and would not be captured as part of this permit's permit terms, it is shown here as it would be necessary to account for that information during the next permit cycle. The nutrient applications are not themselves a term; however, the methodology for calculating them is. The tons or gallons of manure applied should follow the basic methodology:

Manure nutrients applied ≤ Max nitrogen or phosphorus from all sources – other additions of plant available nutrients – available in field nutrients

The required factors of the narrative rate methodology can be found within those four variables. Calculating the value of each variable above takes into consideration the other required factors of the narrative rate approach. The process below illustrates how all the factors of the methodology are included in the NMP and used in calculating the tons and gallons of manure to be applied.

Step 3: Identify the Allowable Basis for Calculating an Application Rate

Because manure, litter and process wastewater contain both nitrogen and phosphorus, the application of manure to each field will be made so that the appropriate amount of nutrients are supplied to meet either the nitrogen or phosphorus requirement of the crop being grown on that field. This is determined by the outcome of field specific assessment for the potential of phosphorus transport from each field. The specific risk assessment used is provided in the sample state technical standard for nutrient management. Because the sample NMP is based on an operation that is in Iowa, the sample technical standard used for Iowa requires that the Iowa P-Index (as specified by the USDA NRCS Iowa Technical Note no. 25) be used to determine the nutrient basis for all manure applications. The Iowa P-Index calculations result in a numerical value that corresponds to one five risk assessments:

Total points from index	Interpretation of points	Basis for application rate
0–1	Very Low	Manure shall not be applied in excess of an nitrogen-based rate in accordance with 65.17(18)
> 1–2	Low	Manure shall not be applied in excess of an nitrogen-based rate in accordance with 65.17(18)
> 2–5	Medium	Manure shall not be applied in excess of two times the phosphorus removed with crop harvest over the period of the crop rotation.*
> 5–15	High	Manure shall not be applied until practices are adopted which reduce the P-Index to at least the medium risk category.
> 15	Very High	Manure shall not be applied.

* Regulations 65.17(17) describe the manure application rate requirements for fields that are assigned the P-Index site vulnerability ratings described by the Iowa P-Index. The sample technical standard does not always restrict applications on a field with a medium risk rating to 2 times the crop phosphorus removal rate. However, for this example, 2 times the phosphorus removed with crop harvest over the period of the crop rotation is set as the upper limit for all medium risk ratings.

The Iowa P-Index uses source and transport factors to approximate phosphorus loads to surface waters. The source factors are arranged in a multiplicative manner within three components that represent the main transport mechanisms: (1) Erosion Component (sediment loss), (2) Runoff Component (water loss), and (3) Subsurface Drainage Component (water movement through tile or coarse subsoil/substrata). The Iowa P-Index is calculated as follows:

Erosion component + Runoff component + Subsurface drainage component = P-Index

The three components are composed of the following variables:

1. Erosion =
   Gross erosion × (sediment trap factor or delivery ratio) × buffer factor × enrichment factor × Soil Test Phosphorus (STP) erosion factor

2. Runoff =
   Runoff factor × precipitation × (STP runoff factor + phosphorus application factor)

3. Subsurface drainage =
   Precipitation × flow factor × STP drainage factor

Step 3.1: Use the Soil Test Results to Calculate the Outcome of the Risk Assessment

STP, a required factor of the methodology, is considered in all three transport components of the Iowa P-Index.

The soil test results are shown in Table 6.3, Soil Test Data, of the sample NMP. The results are as follows:

Field	Subfield	Test year	P concentration	Units	Test analysis
Bob's Farm South	8S	2009	32	ppm	Bray P1

The outcome of the assessment is provided Table 5.3, Nitrogen and Phosphorus Risk Analysis, of the sample NMP. In this example, the P-Index is run each year for each crop on the field. The permit term is based on the highest risk for each crop over the course of the 5 years of permit coverage. In this case, the highest risk is a medium risk (for both corn and soybeans), which limits application rates to two times the phosphorus removed with crop harvest over the period of the crop rotation.

Field ID	Subfield ID	Year	Risk	Basis for application rate*
Bob's Farm South	8S	2010	Low	Nitrogen-based
		2011	Medium	2 times the phosphorus removed with crop harvest over the period of the crop rotation.
		2012	Medium	2 times the phosphorus removed with crop harvest over the period of the crop rotation.
		2013	Medium	2 times the phosphorus removed with crop harvest over the period of the crop rotation.
		2014	Medium	2 times the phosphorus removed with crop harvest over the period of the crop rotation.

* The basis for the allowable application rate is not provided in Table 5.3 of the sample NMP. The appropriate rate basis was identified from the technical standard and applied to the appropriate risk category.

Step 4: Derive the Crop Nutrient Requirements

Crop nutrient requirements are derived from the planned crops, their realistic yield goals, and the total nitrogen and phosphorus recommendation for each crop identified in the planned crop sequence. The permit terms for field 8S, for *planned crops, yield goals, and total nitrogen and phosphorus recommendations* are shown below. Table 6.5 in the sample NMP identifies the Planned Crops and Fertilizer Recommendations as well as the crop removal rates. Steps 4.1 through 4.3 illustrate how the values in total nitrogen and phosphorus recommendations were determined.

Year	Field crop	Yield goal (bushels/ acre)	Total recommended nitrogen (lbs/acre)	Total recommended phosphorus (lbs per/acre)
2010	Soybean	61	232	N/A
2011	Corn	195	210	73
2012	Soybean	61	232	49
2013	Corn	195	210	73
2014	Soybean	61	232	49

Step 4.1: Derive the Realistic Annual Yield Goals

All crop recommendations are based on a realistic yield goal for the crop. The yield goal typically represents the expected optimum yield for that crop. The example plan, as written, does not provide a specific reference for how the yield goal was determined. The regulations do not require that an NMP provide the basis for the yield goal; however, the permit writer has the authority to request the source of that information, which might be necessary if the values appear to be unrealistic. The sample technical standard provides multiple options for calculating an optimum yield goal. Those include the following:

- Soil survey interpretation record.
- USDA county crop yields.
- Proven yield methods. Proven yield methods may be used only if a minimum of the most recent three years of yield data for the crop is used. Those yields can be proven on a field-by-field or farm-by-farm basis. Crop disaster years may be excluded when there is a 30 percent or more reduction in yield for a field or farm from the average yield over the most recent five years. Excluded years shall be replaced by the most recent non-disaster years. Proven yield data used to determine application rates shall be maintained with the current manure management plan.

A review of the yield goals provided in the sample NMP shows that USDA county crop yields were used. The sample technical standard contains Iowa Ag Statistics for County Corn and Soybean Yields. The 5-year average yield, the 5-year average yield +10 percent and the average yield of the four highest years are provided. For Sioux County, the location of the facility for which the sample plan was developed, the 5-year average yield +10 percent is 195.3 bu/acre for corn and 60.7 bu/acre for soybeans, which matches the reported sample NMP yield goals for corn and soybeans.

Step 4.2: Derive the Crop Nitrogen Recommendations

The sample technical standard provides Crop Nitrogen Usage Rate Factors for Various Crops. For corn, those nitrogen usage rate factors are based on the expected yield goal and the appropriate geographic zone where corn is being grown. The standard outlines three geographic zones for different soil associations. The sample NMP is written for an operation in Sioux County, which is in both zones 1 and 2. The nitrogen usage rate factor for zone 1 is 0.9 lbs N/bu, and the nitrogen usage rate factor for zone 2 is 1.1 lbs N/bu. The estimated yield goal for corn is 195 bu/acre.

Zone 1 Nitrogen Usage Rate = 195 bu/acre × 0.9 lbs N/bu = 176 lbs N

Zone 2 Nitrogen Usage Rate = 195 bu/acre × 1.1 lbs N/bu = 215 lbs N

The NMP includes an nitrogen recommendation of 210 lbs nitrogen/acre. Because Sioux county contains both zone 1 and zone 2 nitrogen usage factors, a nitrogen recommendation of 210 appears to be appropriate. If the permit writer believes that the nitrogen or phosphorus recommendation in the NMP is significantly different than that which can be derived from the technical standard, it is a good idea to ask the operator or planner to explain the basis for the rate.

Note that Table 6.5 of the sample NMP does not show a corn nitrogen recommendation of 210 lbs nitrogen/acre. When corn follows a legume, the crop need is shown as 50 lbs less than the total nitrogen recommendation. That is because the nitrogen credits from the legume crop are directly factored into the recommendation in Table 6.5. For purposes of identifying permit terms, the *total nitrogen recommendation* will still be identified as 210 lbs nitrogen/acre. The 50 lbs of nitrogen credit from the legumes will be accounted for under the factor *all other plant available credits in the field*, shown in step 6 below.

Step 4.2.1: Derive the Crop Nitrogen Removal Rates

The sample technical standard allows for manure or other organic by-products to be applied on legumes at a rate equal to the estimated amount of nitrogen in the harvested portion of the crop that is removed from the field in that growing season (i.e., crop nitrogen removal). The nitrogen removal for soybeans is 3.8 lbs nitrogen/bushel (found in sample technical standard, Appendix A6 of the Manure Management Plan Form). MMP's Initialization File Summary Report also includes that information and could be provided with the CAFO's NMP (see Section 8.3 of the sample NMP). Given the expected yield goal of 61 bushels/acre, the allowable nitrogen application is 232 lbs/acre.

3.8 lbs N/bushel × 61 bushels/acre = 232 lbs N/acre

Table 6.5 in the sample NMP also provides that removal rate for soybeans. Although the fertilizer nitrogen recommendation for soybeans is 0 lbs of nitrogen, the permit term *Total nitrogen recommendation* is 232 lbs nitrogen/acre based on the technical standard allowance for nitrogen application on legume crops.

Step 4.3: Derive the Crop Phosphorus Recommendations

The term *total phosphorus recommendation* is based on the removal rate of each crop. Removal rates are found in the sample technical standard, Appendix A6 of the Manure Management Plan Form and in MMP's Initialization File Summary Report (see Section 8.3 of the sample NMP). For corn, the removal rate is 0.375 lbs P/yield unit, and for soybeans it is 0.8 lbs P/yield unit.

Corn
0.375 lbs P_2O_5/bushel × 195 bushels = 73 lbs P_2O_5

Soybean
0.8 lbs P_2O_5/bushel × 61 bushels = 49 lbs P_2O_5/acre

Table 6.5 of the sample NMP also provides those removal rates for corn and soybeans.

Step 4.4: Determine the Maximum Amount of Crop Nutrient from All Sources

The methodology relies on the maximum amount of crop nutrients that **could** be applied from all sources for illustrating the basic methodology:

Manure nutrients applied ≤ Max nitrogen or phosphorus from all sources—other additions of plant available nutrients—available in field nutrients

The permit term is based on what is shown in the NMP as submitted with for permit coverage. As discussed in Section 6.6.3, it was identified that for this field, nutrient application rates were not set as the maximum possible rate as allowed under the state's technical standard. The maximum amount of nutrients that **could** have been applied is used to illustrate that permit terms are in compliance with the state's technical standards for nutrient management.

The maximum amount of nitrogen that can be applied from all sources is equal to the amount of nitrogen identified for the permit term, *total nitrogen recommendation.*

The maximum amount of phosphorus from all sources that can be applied is based on the term, *outcome of the field-specific risk assessment*. For field 8S, the Iowa P-Index results in a medium risk. The state standards define the phosphorus limit for medium-risk fields as two times the crop phosphorus removed over the crop rotation. Field 8S shows a corn, soybean rotation.

Corn:
73 lbs P_2O_5 removed/acre

Soybean:
49 lbs P_2O_5 removed/acre

2 × (49+73 lbs P_2O_5/acre) = 244 lbs P_2O_5/acre

Applying those values to the basic methodology is described as

Manure nutrients applied ≤ Max nitrogen or phosphorus $_{\text{from all sources}}$ - other additions of plant available nutrients—available in field nutrients

Crop Year 2010, 2012, and 2014: Soybeans

X lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre - commercial fertilizer applied lbs N/acre - N available in field lbs/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - commercial fertilizer applied lbs P_2O_5/acre - P_2O_5 available in field lbs/acre

Crop Year 2011 and 2013: Corn

X lbs N/acre $_{\text{from manure}}$ ≤ 210 lbs N/acre - commercial fertilizer applied lbs N/acre - N available in field lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - commercial fertilizer applied lbs P_2O_5/acre - P_2O_5 available in field lbs/acre

Step 5: Determine Other Sources of Nutrients Applied

The term *accounting for all other additions of plant available nitrogen and phosphorus to the field* captures the amount of nutrients from sources other than manure. Those nutrients are applied to the total amount required to meet the crop's need. That includes nutrient sources such as commercial fertilizers, biosolids, or irrigation water. According to the sample NMP, commercial fertilizer is the only source of nutrients added besides manure. That can be found in Table 6.7 of the sample NMP. Commercial fertilizer is added to subfield 8S in years 2011 and 2013. Adding that to the basic methodology is as follows (with the amount of nutrients from sources other than manure shown as the second element of the expression):

Crop Years 2010, 2012, and 2014: Soybeans

X lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre - 0 lbs N/acre - N available in field lbs/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - P_2O_5 available in field lbs/acre

Crop Year 2011: Corn

X lbs N/acre $_{\text{from manure}}$ ≤ 210 lbs N/acre - 128 lbs N/acre - N available in field lbs/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - P_2O_5 available in field lbs/acre

Crop Year 2013: Corn

X lbs N/acre $_{\text{from manure}}$ ≤ 210 lbs N/acre - 158 lbs N/acre - N available in field lbs/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - P_2O_5 available in field lbs/acre

Step 6: Determine the Available in Nutrients in the Field

This step accounts for the PAN that is already in the soil from prior legume crops, previous manure applications, and other sources. Credits for PAN in the sample NMP come from legumes, which contribute nitrogen to the soil, and from the mineralization of organic nitrogen from previous years' manure applications.

Step 6.1: Accounting for Legume Credits

Soybeans are the only legume planted in field 8S. As mentioned in step 4, MMP accounted for nitrogen credits from legumes by adjusting the recommendation for corn in years following a soybean crop. Footnote 't' of the Manure Management Plan Form in the sample technical standard contains the appropriate credits for legume crops. Credits for nitrogen carryover from prior year legume crops are calculated as follows:

- Credit 1 lb nitrogen per bushel of yield for the previous year's soybean crop.
- A maximum credit of 50 lb nitrogen per acre is allowed.

Year	Field crop	Yield goal (bushels/acre)	Total nitrogen legume credit (lbs/acre)
2010	Soybean	61	0
2011	Corn	195	50
2012	Soybean	61	0
2013	Corn	195	50
2014	Soybean	61	0

Step 6.2: Accounting for Manure Mineralization Credits

Residual manure nitrogen credits are identified in the Field Nutrient Status Detail Custom Report, provided in Section 6.9 of the sample NMP. Mineralization rates for organic nitrogen are defined in the sample technical standard under Iowa State University Extension publication PMR1033 - Using Manure Nutrients for Crop Production (September 2008). The technical standard provides mineralization rates for the year of application and two years following manure application.

Animal type	1st year nitrogen availability	2nd year nitrogen availability	3rd year nitrogen availability
Beef cattle (solid)	35%	10%	5%

The fraction of nitrogen from manure that will be available in year 1, when the manure is applied, is not captured as a part of this credit. Credits are derived from only what is carried over from a previous year's application. Mineralized nitrogen available during the year of application is accounted for in step 7 below.

On subfield 8S, manure is first applied in 2011, which provides residual manure credits for years 2012 and 2013. Manure is also applied in year 2014, which creates credits for year 2015 and 2016. Credits for year 2015 and 2016 fall under a new permit cycle and will be accounted for then.

Application		Nitrogen availability		
Application year	Total manure N* (tons/acre)	1st year availability (35%)	2nd year availability† (10%)	3rd year availability† (5%)
2010	0	2010	2011	2012
		0	0	0
2011	133	2011	2012	2013
		32	10	4
2012	0	2012	2013	2014
		0	0	0
2014	0	2013	2014	2015
		0	0	0
2015	140	2014	2015	2016
		34	10	5

* To calculate the total manure nitrogen applied, which is needed to determine residual manure credits, the manure analysis is used. Derivation of this value is described in step 7.3.2.

† The second and third year availability estimates of 10 and 5 percent cannot be applied directly to the total manure nitrogen applied to the field to determine nitrogen availability for the second and third years after land application. Volatilization losses associated with manure application in year 1 must be accounted for first. Step 7.3.2 calculates the manure nitrogen available after application, which accounts for volatilization losses and the first year manure nitrogen availability. The second and third year availability estimates of 10 and 5 percent are applied to this nitrogen value after volatilization.

Combining the total PAN credits from step 6.1 and 6.2 (legumes and 2nd and 3rd year mineralization credits) for each year as follows:

Permit year	Field crop	Total N credit (as calculated) (lbs/acre)	Total N credit (available) (lbs/acre)
2010	Soybean	0	0
2011	Corn	50	50
2012	Soybean	10*	0
2013	Corn	54*	52
2014	Soybean	0	0
2015	Unknown	0	0
2016	Unknown	10	10
2017	Unknown	5	5

* Residual credits are calculated as available in years 2012 and 2013 from the fall 2010 manure application. However, MMP assumes that if the crop does not utilize the available nitrogen in the year that it is made available, it is lost. Table 6.8, Field Nutrient Balance of the sample NMP shows a positive nitrogen balance of 2 extra lbs of nitrogen/acre in year 2013. Those two excess nitrogen credits are assumed lost because they are not necessary to meet the corn crop needs. Therefore, only the 52 lbs of nitrogen credit/acre are utilized and reported.

Years 2015–2017 are shown in the table above to capture residual manure nitrogen credits that will be available from the 2014 fall application. These values are not included as part of this permit cycle but will be important to know if this facility reapplies for a second permit cycle. Credits for PAN available in the field are shown as the third element in the expressions below.

Crop Year 2010 and 2014: Soybean

X lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre - 0 lbs N/acre - 0 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - 0 lbs P_2O_5/acre

Crop Year 2011: Corn

X lbs N/acre $_{\text{from manure}}$ ≤ 210 lbs N/acre - 128 lbs N/acre - 50 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - 0 lbs P_2O_5/acre

Crop Year 2012: Soybean

X lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre - 0 lbs N/acre - 0 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - 0 lbs P_2O_5/acre

Crop Year 2013: Corn

X lbs N/acre $_{\text{from manure}}$ ≤ 210 lbs N/acre - 158 lbs N/acre - 52 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre - 0 lbs P_2O_5/acre - 0 lbs P_2O_5/acre

Step 7: Meeting the Remaining Nutrient Need with Manure

The preceding steps have illustrated how to calculate the amount of nutrients to be applied from manure. The equations can now be simplified to

Crop Year 2010: Soybean

X lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre

Crop Year 2011: Corn

X lbs N/acre $_{\text{from manure}}$ ≤ 32 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre

Crop Year 2012: Soybean

X lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre

Crop Year 2013: Corn

$X \text{ lbs N/acre}_{\text{from manure}} \leq 0 \text{ lbs N/acre}$

$X \text{ lbs } P_2O_5\text{/acre}_{\text{from manure}} \leq 244 \text{ lbs } P_2O_5\text{/acre}$

Crop Year 2014: Soybean

$X \text{ lbs N/acre}_{\text{from manure}} \leq 232 \text{ lbs N/acre}$

$X \text{ lbs } P_2O_5\text{/acre}_{\text{from manure}} \leq 244 \text{ lbs } P_2O_5\text{/acre}$

Steps 7.1 through 7.4 use the remaining factors of the methodology to illustrate how the remaining nutrient needs can be satisfied with the nutrients from manure applications. The remaining factors include the form and source of the manure that is applied, the timing and method of manure application, the amount of nitrogen that volatilizes, and the nitrogen and phosphorus in the manure analysis.

Step 7.1: Identify the Form and Source of the Manure that is Applied

The form and source of manure to be applied to must be identified in the NMP. One reason is to ensure that the appropriate manure analysis is used. The form and source of manure is in Table 2.3, Manure Storage of the sample NMP. The results are as follows:

Source	Form
E Lots Stack #1	Solid
E SetldSolidBasin #3	Solid
E Storage Pond #1	Liquid
W Lots Stack #2	Solid
W SetdSolidBasin #4	Solid
W Storage Pond #2	Liquid

The form can be identified as a liquid or a solid depending on the rate at which it is applied, pounds or tons for solid and gallons for liquids as is indicated in the planned nutrient application table.

Field 8S has two applications, one in the fall of 2010 and one in the fall of 2014. As mentioned, both of those applications are credited toward the next year's spring crop and are therefore considered applications for the permit year 2011 and 2015. The fall 2010 application comes from the solid manure held in the E Lots Stack #1, and the fall 2014 application comes from the solid manure held in the W Lots Stack #2.

Step 7.2: Reading the Manure Analysis

The amount of nitrogen and phosphorus contained in the manure is determined by the manure analysis. The manure analysis is in Table 6.4 of the sample NMP. A manure analysis is provided for each manure source. In this sample NMP, for field 8S, manure is used from E Lots Stack #1 and W Lots Stack #2. These two manure storage structures have the same manure analysis. The manure analyses for all manure sources are as follows:

Source	Measured total nitrogen	Measured NH_4-N	Measured Total P_2O_5	Units
E Lots Stack #1	7.0	2.6	10.0	lbs/ton
W Lots Stack #2	7.0	2.6	10.0	lbs/ton

Step 7.3: Calculate the First Year Nitrogen Availability

The nitrogen content that is measured by the manure analysis is not what is available to the crops when applied to the field. Only a portion of the nitrogen will mineralize and become available in year 1 (as discussed in step 6.2). Additionally, the amount of nitrogen that is applied is subject to volatilization losses. The following steps go through each of those processes to determine the amount of nitrogen that is applied and available to the crops for uptake.

Step 7.3.1: Accounting for the Storage and Handling of Manure

Volatilization of nitrogen will occur during the handling and storage and the manure. Those losses are already accounted for in the measured manure analysis shown above. As discussed in Chapter 5, the manure analysis should be taken as close to the time of application as possible to accurately assess the nutrient content just before field application to reflect these types of losses.

Step 7.3.2: Accounting for the Timing and Method of Land Application

Different methods of land application affect the amount of nitrogen that will volatilize. This must be taken into consideration so the concentration of available nitrogen in the manure that is being land applied can be estimated accurately. It is important to remember that only the ammonium fraction of the total nitrogen value volatilizes. However, the applicable technical standard for the sample NMP applies the volatilization factor to the total nitrogen value from the manure analysis. This is not necessarily how all technical standards calculate nitrogen availability.

Year	Manure applied (tons)	Total manure nitrogen* (lbs/acre)	Method of application	Timing of application	Volatilization correction factor†	Manure nitrogen after application (lbs/acre)‡
2010	0	0	N/A	N/A	N/A	0
2011	1,514	133	Dry Box Spreader	Not incorporated	0.7	93
2012	0	0	N/A	N/A	N/A	0
2013	0	0	N/A	N/A	N/A	0
2014	0	0	N/A	N/A	N/A	0
2015	1,500	140	Dry Box Spreader	Not incorporated	0.7	98

* Total Manure Nitrogen is calculated as follows:

(Tons applied × Total Manure Nitrogen analysis)/acres manure spread

Example: Year 2011 total manure nitrogen = (1,514 tons × 7.0 lbs N/ton) / 79.7 acres = 133 lbs N/acre

† From the sample technical standard, Iowa State Extension PMR 1003 – Using Manure Nutrients for Crop Production provides volatilization rates for manure application. PMR 1003 specifies that when solid manure is broadcast and not incorporated the manure total nitrogen rate applied should be multiplied by the volatilization correction factor of 0.70 to 0.85 to determine the portion of total manure nitrogen remaining. Because manure applied in year 2011 was not incorporated, MMP applied a 0.70 volatilization correction factor.

‡ Step 7.3.2 accounts for the ammonium nitrogen that volatilizes from the total manure nitrogen because of the method of application. Step 7.3.3 shows how to calculate the portion of organic nitrogen that mineralizes in year 1 and is available for plant uptake.

Step 7.3.3: Calculating the Mineralization of Nitrogen

The nitrogen in manure is available over multiple years. The sample technical standard uses Iowa State University Extension publication PMR1033 (September 2008), Using Manure Nutrients for Crop Production, to estimate the amount of manure nitrogen, by animal source, that is available over the course of three years. This nitrogen availability must be taken into consideration when determining the tons of manure to apply to meet the crop needs.

The technical standard includes a mineralization factor of 35 percent for the first year of application. The first year mineralization estimate of 35 percent was applied the total manure nitrogen after application as derived in step 7.3.2. The year 1, total available manure nitrogen values are directly provided in the sample NMP, in Table 6.7 Planned Nutrient Applications (Manure-Spreadable Area). It is important to remember that only the organic fraction of the total nitrogen value mineralizes. (The organic nitrogen fraction can be calculated by subtracting the ammonium nitrogen value from the total nitrogen value.) However, the applicable technical standard for the sample NMP applies the mineralization rate to the total nitrogen remaining after volatilization. This is not necessarily how all technical standards calculate manure nitrogen availability.

Year	Manure nitrogen after application (lbs/acre)*	First year nitrogen availability for beef cattle manure	Year 1 plant available manure nitrogen (lbs N/acre)
2010	0	N/A	0
2011	93	35%	32
2012	0	N/A	0
2013	0	N/A	0
2014	0	N/A	0
2015	98	35%	34

* Values calculated in step 7.3.2.

Step 7.3.4: Determining the Availability of Manure Phosphorus

The sample technical standard, Iowa State University Extension publication PMR1033 (September 2008), Using Manure Nutrients for Crop Production, indicates that phosphorus from beef cattle manure is 60 to 100 percent available in the first year of application. For this example, based on the methodology used in MMP, 100 percent of the total phosphorus from the manure nutrient analysis is assumed to be plant available.

Year	Manure applied (tons)	Total manure P_2O_5 after application (lbs/acre)*	First year N availability for beef cattle manure	Year 1 plant available manure P_2O_5 (lbs/acre)
2010	0	0	N/A	0
2011	1,514	190	100%	190
2012	0	0	N/A	0
2013	0	0	N/A	0
2014	0	0	N/A	0
2015	1,500	200	100%	200

* Total Manure P_2O_5 after application is calculated as follows:
(Tons applied × Total Manure Phosphorus analysis)/acres manure spread
Example: Year 2011 total manure phosphorus = (1,514 tons ×10.0 lbs P_2O_5/ton)/79.7 acres = 190 lbs P_2O_5/acre

Step 8: Meeting the Remaining Crop Needs for Crop Years 2010 and 2011

Step 7 illustrated how to determine the actual amount of nutrients from the manure applied that would be available after land application to meet the crop nutrient needs along with nutrients available from other sources. Step 8 illustrates how the pounds of nutrients are converted to tons of manure and how the manure that is planned to be applied is in compliance with the maximum permit limits.

Step 8.1: Calculate Manure Application Rate for Crop Year 2010

As shown in Step 2, the NMP indicates that no manure will be applied in year 2010. Therefore,

$$0 \text{ Tons of manure} = 0 \text{ lbs N/acre}$$

and

$$0 \text{ Tons of manure} = 0 \text{ lbs } P_2O_5\text{/acre}$$

The NMP demonstrates compliance with the permit terms with respect to manure application because:

$$0 \text{ lbs N/acre} < 232 \text{ lbs N/acre}$$

$$0 \text{ lbs } P_2O_5\text{/acre} < 244 \text{ lbs } P_2O_5\text{/acre}$$

Step 8.2: Calculate Manure Application Rate for Crop Year 2011

As shown in Step 5, commercial fertilizer application is planned for the 2011 corn crop. At the beginning of Step 7, the equations demonstrate that manure nutrients could be used to supply up to 32 lbs[8] of nitrogen needed by the corn crop as long as the manure application is in compliance with the medium field risk assessment **and** does not contain more than 244 lbs of P_2O_5.

$$X \text{ lbs of N/acre}_{\text{from manure}} \leq 32 \text{ lbs N/acre}$$

and

$$X \text{ lbs } P_2O_5\text{/acre from manure} \leq 244 \text{ lbs } P_2O_5\text{/acre}$$

As shown step 7, the NMP indicates that the CAFO plans to apply 1,514 tons of manure which will supply 32 pounds of nitrogen per acre.

$$1{,}514 \text{ Tons of manure} = 32 \text{ lbs manure N/acre}$$
$$32 \text{ lbs manure N/acre} = 32 \text{ lbs N/acre}$$

Step 7 also shows that 1,514 tons of manure supplies 190 lbs of phosphorus therefore:

$$1{,}514 \text{ tons manure} = 190 \text{ lbs } P_2O_5\text{/acre}$$

$$190 \text{ lbs } P_2O_5\text{/acre} < 244 \text{ lbs } P_2O_5\text{/acre}$$

On the basis of that check, the 1,514 tons of manure planned for application is in compliance with the permit limits. However, the permit writer should be aware that, although the crop phosphorus removal rate for corn is 73 lbs of phosphorus, 190 lbs of phosphorus are being applied. Before moving on to the remaining years, it will be imperative to determine that this application rate is in compliance with the state's technical standards for multi-year phosphorus application.

Step 9: Accounting for Multi-Year Phosphorus Application in Crop Year 2011

The technical standards allow multi-year phosphorus application on fields that are limited to a phosphorus-based application rate. The sample technical standard establishes the following requirements for multi-year phosphorus application.

1. No single manure application shall exceed the nitrogen-based rate of the planned crop receiving the manure application.

2. No single manure application shall exceed the rate that applies to the expected amount of phosphorus removed with harvest by the next four anticipated crops in the crop schedule.

3. If the actual crop schedule differs from the planned crop schedule, any surplus or deficit of phosphorus shall be accounted for in the subsequent manure applications.

In 2011 on Subfield 8S, 1,514 tons of manure is planned to be applied to a corn crop; the manure supplies 190 lbs/acre of P_2O_5. A single year of phosphorus removal for growing 195 bushels of corn is 73 lbs/acre of P_2O_5. EPA defines multi-year phosphorus application as phosphorus applied to a field in excess of the crop needs for that year. 190 lbs/P_2O_5 is more phosphorus than the crop needs for 2011. However, this application appears to meet the state's requirements for a multi-year application based on the following:

1. The 1,514 tons of manure that is applied in November 2010 for the 2011 crop year supplies 32 lbs/acre of nitrogen which, in conjunction with other sources of PAN, does not exceed the 210 lbs/acre of nitrogen recommended for this corn crop.

2. Assuming the crop rotation of soybean–corn continues with soybeans in year 2015, the total amount of phosphorus removed by the crops for the next 4 years would total

   Years 2012 soybeans = 0.8 lbs P_2O_5/bu × 61 bu/acre = 49 lbs/acre P_2O_5

   Year 2013 corn = 0.375 lbs P_2O_5/bu × 195 bu/acre = 73 lbs/acre P_2O_5

   Years 2014 soybeans = 0.8 lbs P_2O_5/bu × 61 bu/acre = 49 lbs/acre P_2O_5

   Year 2015 corn = 0.375 lbs P_2O_5/bu × 195 bu/acre = 73 lbs/acre P_2O_5

   TOTAL = 244 lbs/acre P_2O_5 allowed

   The applied 190 lbs/acre P_2O_5 does not exceed this limit.

3. 190 lbs/acre P_2O_5 contains approximately the next 3 years' worth of phosphorus that is expected to be removed and from this NMP, it is shown that no additional phosphorus will be applied for the next two years so that 2011, 2012, and 2013 crops can use the phosphorus that was applied in 2011.

Step 10: Calculate the Manure Application Rate for Crop Years 2012 and 2013

On the basis of step 9, no additional manure should be applied for the next two years after the 2011 multi-year phosphorus application. As indicated by the sample NMP (Table 6.7, Planned Nutrient Applications), no nutrients from manure are applied in year 2012 or 2013:

Crop Year 2012: Soybean

0 lbs N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre

0 lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre

Crop Year 2013: Corn

0 lbs N/acre from manure ≤ 0 lbs N/acre

0 lbs P_2O_5/acre from manure ≤ 244 lbs P_2O_5/acre

Step 11: Calculate the Manure Application Rate for Crop Year 2014

Because no phosphorus will be applied in 2012 and 2013 because of the 3-year phosphorus application in year 2011, manure nutrients can be applied again in year 2014. As shown in steps 1–7, the sample NMP indicates that no other sources of nitrogen will be applied in crop year 2014. In steps 1 through 7, the amount of nutrients to be applied from manure was calculated as follows:

X lbs of N/acre $_{\text{from manure}}$ ≤ 232 lbs N/acre

and

X lbs P_2O_5/acre $_{\text{from manure}}$ ≤ 244 lbs P_2O_5/acre

Manure nutrients can be used to supply 232 lbs of N/acre to the soybean crop as long as the manure application is in compliance with the medium field risk **and** does not contain more than 244 lbs of P_2O_5/acre. As shown in step 7, the NMP indicates that no additional manure will be applied for crop year 2014. Therefore, the NMP demonstrates compliance with the permit terms with respect to manure application because

0 tons manure = 0 lbs N/acre

0 lbs N/acre < 232 lbs N/acre

and

0 lbs P_2O_5/acre < 244 lbs P_2O_5/acre

Table 6.7, Planned Nutrient Applications in the sample NMP shows that in September of 2014, 20 tons/acre of W Lots Stack #2 manure will be surface applied with a dry box spreader. A soybean crop is planted in year 2014, and those nutrients are not to supply the nutrient needs of the soybean crop. That is a fall application (and it is indicated in Table 6.7) that the nutrients are applied to supply the next spring's corn crop. Those nutrients should be credited to the next year's permit cycle.

Putting together all the terms that are applicable to the narrative rate approach:
The methodology is expressed within MMP version 0.29. The permitting authority has determined that the methodology used by MMP encompasses all the factors of the methodology, and the plan was developed in accordance with the state's technical standard. Additional site-specific permit terms for expressing protocols for land application under the narrative rate approach include the following:

Fields available for land application					Outcome of the assessment of the potential for nutrient transport				
Field	Sub-field	Crop year	Total acres	Timing limitations for a land application	P loss risk	Allowable manure application rate	Planned crops or other use	Realistic annual yield goal	Total nitrogen and phosphorus recommendations for each crop on each field
Bob's Farm South	8S	2010	79.6	Field slope 7%. Manure may only be surface applied to this field when the ground is frozen, snow covered or saturated if one of the following conditions exists: 1. Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure 2. On an emergency basis	Low	Manure shall not be applied in excess of the nitrogen needs of the crop	Soybean	61 bu/acre	Soybean recommendations 232 lbs N/acre 49 lbs P_2O_5/acre Corn recommendations 210 lbs N/acre 73 lbs P_2O_5/acre
		2011			Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation	Corn	195 bu/acre	
		2012			Medium		Soybean	61 bu/acre	
		2013			Medium		Corn	195 bu/acre	
		2014			Medium		Soybean	61 bu/acre	

Subfield	Crop year	Max lbs N derived from all sources	Max lbs P_2O_5 derived from all sources	Alternative crop			
				Alternative crop	Yield goal	Total N recommendation	Total P_2O_5 recommendation
8S	2010	Soybeans = 0 lbs N/acre Corn = 210 lbs N/acre	Soybeans = 0 lbs P_2O_5/acre Corn = 190 lbs P_2O_5/acre	Wheat	78 bu/acre	88	41
	2011						
	2012			Alfalfa	4.1 ton/acre	205	51
	2013						
	2014						

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Endnotes

[1] All terms of the NMP are italicized in this chapter.

[2] Notice of proposed changes to the national handbook of conservation practices (including the 590 standard) for the Natural Resources Conservation Service was published in the Federal Register on January 11, 2011. (See *http://edocket.access.gpo.gov/2011/pdf/2011-373.pdf*) Revisions to the 590 conservation standard were finalized in January 2012 and are available at *http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/npm*

[3] Land application of manure is often handled differently than land application of industrial waste or biosolids. 40 CFR part 503 subpart B provides information for land application of biosolids to agricultural land. Many states use similar regulations for other industrial wastes. Those rules often require tracking of many nutrients, metals, and other potential contaminants. They also usually require crediting for nutrient availability over multiple years. Usually, they do not require any type of phosphorus risk analysis. Animal waste is typically a much more homogenous and consistent source of nutrients. Nitrogen or phosphorus is almost always the limiting constituent for determining manure application rates. When application rates are based on those nutrients, the accumulation of metals in the soil is rarely a problem. The nutrients in manure are also more readily available than the nutrients in most industrial wastes. Given those differences, care should be taken when comparing the land application of manures to regulations on land application of other wastes.

[4] The January 2012 revised NRCS 590 conservation standard requires the use of an NRCS approved nitrogen and phosphorus risk assessment tool. An NRCS approved risk assessment tool meets the technical criteria outline in the National Instruction Document NI-190-302 (located: *http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046435.pdf*).

[5] Portions of the information in this section are extracted or adapted from NRCS, The Phosphorus Index, A Phosphorus Assessment Tool (August 1994) at *http://www.nrcs.usda.gov/technical/ecs/nutrient/pindex.html*.

[6] State indices can vary so much in fact, that P-indices should not be used in states other than that for which they were developed, and risk categories are generally not comparable state to state.

[7] An exception is for nitrogen recommendations provided with soil analysis reports. Analytical labs often make nitrogen recommendations according to the results of the soil analysis. The recommendations consider the yield goal and the soil nutrient content. Some state technical standards allow use of laboratory recommendations for nutrient management planning.

[8] Note that, because the amount of nutrients to be supplied from manure is not a term under the narrative rate approach, the operator is not limited to 32 lbs of nitrogen from manure. If the amount of commercial fertilizer is decreased, more manure could be applied as long as the total amounts of nitrogen and phosphorus applied do not exceed the term *maximum amount of nitrogen and phosphorus to be applied from all sources*.

Appendix A

Basic Soil Science and Soil Fertility

Introduction

Understanding the nutritional needs of plants can be quite complex, given the dynamic nature of plant nutrients in the soil. Nutrients can exist in organic or inorganic forms and in various phases. They can exist in solution, on mineral surfaces, or be retained in the structural framework of soils. Environmental conditions affect nutrients' transformations and movement in the soil, which determines their availability for plant uptake. In managed systems, understanding those transformations is essential for maintaining nutrient balances to properly supply a plant's nutritional requirements with minimal effect on the environment.

Soil Formation and Basic Morphology

Soil is the layer of unconsolidated material on the immediate surface of the earth that is capable of supporting plant life. Most soils contain four basic components: mineral particles, water, air, and organic matter. Organic matter can be further subdivided into roots, living organisms, and humus (a dark colored, semi-soluble organic substance formed from decomposition of other soil organic matter). A soil in good condition for plant growth will have a volume composition of approximately 50 percent solid material and 50 percent pore space. Under ideal moisture conditions for plants, the soil pore space would also consist of about half air and half water by volume (Figure A-1).

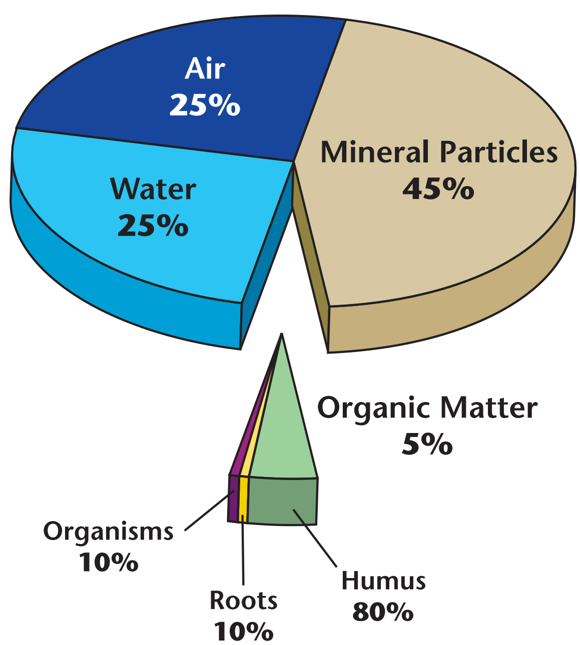


Figure A-1. Average composition of soil.
(Source: Pidwirny, M. J., *Fundamentals of Physical Geography*)

The mass of dry soil per unit of bulk volume, including the airspace, is called the soil bulk density. Bulk density is an indicator of soil quality. Soils with a high proportion of pore space to solids have lower bulk densities than those that are more compact and have less pore space. As bulk density increases, pore space is reduced, which ultimately inhibits root growth. Not only is it more difficult for roots to penetrate through the soil, fewer pores means less aeration and water infiltration both of which also deteriorate the conditions necessary for optimum crop growth. Fine-textured soils such as silt loams, clays, and clay loams generally have lower bulk densities than sandy soils. Sandy soils typically have less total pore space than finer textured soils. Sandy soils lack the micro-pore spaces that exist within soil aggregates, which finer textured soils contain in addition to the macro-pore spaces that exist between soil aggregates (Figure A-2).[1] Although finer textured soils have very low bulk densities, when they become compacted, the bulk density can be quite high.

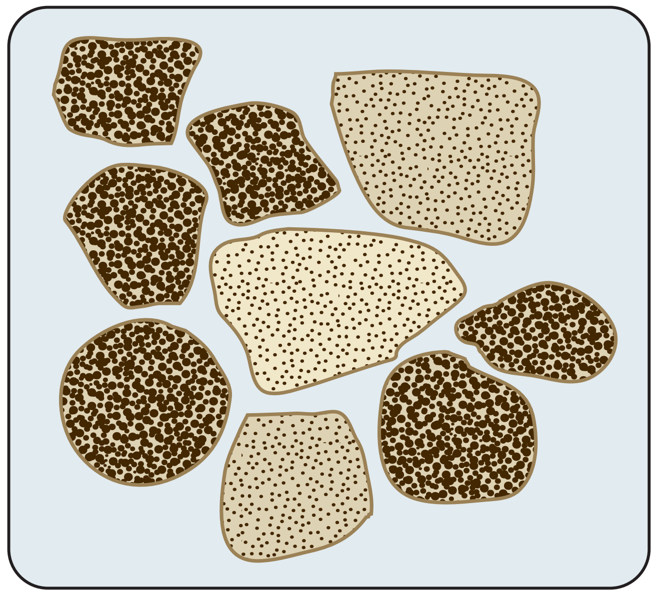


Figure A-2. Soil aggregates, aka micro & macro.

Heavy animal traffic and repeatedly driving farm equipment over fields and can compact soils, increasing the bulk density. Compaction deteriorates plant growth, and increased bulk density means a diminished capacity to infiltrate water and, therefore, greater surface runoff. It is extremely difficult to decrease the bulk density of a soil once it has been compacted. Tillage practices can initially loosen the soil surface and improve aeration and infiltration; however, over long periods those practices also lead to an overall increase in soil bulk density. The effects that different practices can have on increasing soil bulk density should be considered so that they can be minimized to improve the longevity of the soil, reduce surface runoff and help crops reach optimum yield potentials.

Soil is largely made up of mineral material from weathered rock (also called parent material), which is the product of thousands of years of physical processes. Temperature changes, water, ice and wind abrasions, and plants and animals all act to physically wear down rock and minerals. Physical weathering exposes greater amounts of surface area that can simultaneously weather through chemical processes. Many chemical reactions can take place during soil formation. Acid-producing reactions are one example that is enhanced once a soil begins supporting living organisms. Carbon dioxide is emitted through respiration and decomposition. Carbon dioxide dissolves in water held in the soil pore spaces to form carbonic acid, which dissolves minerals. Physical and chemical weathering will occur simultaneously and enhance each other, greatly speeding up the soil-forming process.

The soil-forming process produces distinct visible layers, called horizons, in the soil. The horizons are defined by the soil's color, texture, consistency, and structure. Horizons will also vary in chemical characteristics or composition. Figure A-3 shows the major horizons in a soil profile.

Some soils will have an O (organic) horizon on the surface that consists mainly of plant litter at various levels of decomposition. The O horizon is unlikely to be identified in cultivated fields because the layer is easily lost though erosion that can result from years of plowing and tilling.

Horizon A is the surface soil (also called the topsoil) and is the layer where crops are planted and grown. Typically, the layer contains more organic matter and is coarser than the lower horizons. The humus in the surface soil imparts a distinct grayish to dark-brown to black color to the horizon. Generally, the darker the color of a soil, the more humus is present. Horizon A is the zone of maximum biological activity.

Horizon B is the subsurface soil, which is also called the subsoil. There is generally more clay, which makes the horizon finer-grained than the surface horizon. Horizon B's color is usually brighter, ranging from red to brown to yellow. The layer generally accumulates all or most of the silicates, clay, iron, and aluminum in the soil.

Horizon C is formed in the parent material and has acquired some characteristics of the subsoil. The parent material can be alluvium, loess, colluvium,[2] or bedrock. If formed in bedrock, the layer will sometimes look like weathered rock, but it is soft enough to be dug into and will crumble easily.

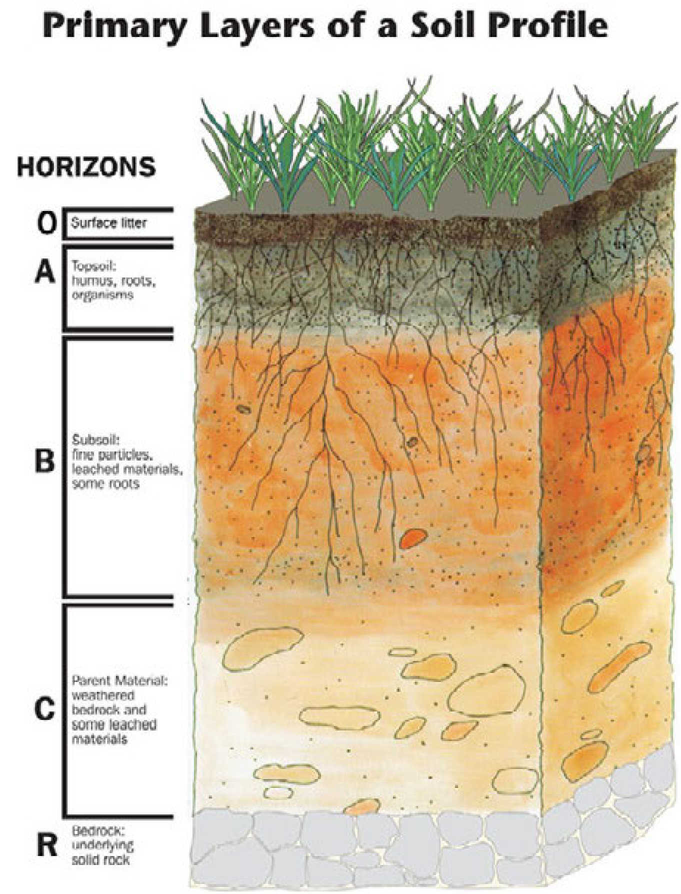


Figure A-3. **The major horizons in a soil profile. (Source: Illinois Central Core)**

The R horizon, if present, consists of unweathered bedrock.

Soil Properties

The properties of a soil result from the environmental factors and conditions that shaped the soil. The following characteristics are important factors that determine a soil's suitability for use and its management needs.

Organic Matter

Organic matter in soil is derived from decomposed plant and animal material. The amount of organic matter depends on the type of plants that are growing in the soil, how long the plants have been growing, and the water content or moisture in the soil. Humus is the most reactive and important component of soil organic matter.

An adequate level of humus provides soil with a number of benefits:

- Increased ability to hold and store moisture.
- Helps maintain porosity in fine-textured soils.
- Reduces leaching of soluble nutrients to lower soil layers.
- Important source of carbon and nitrogen (N) for plants.
- Improves soil structure for plant growth.
- Decreases erosion losses.

Texture

Texture refers to the fineness or coarseness of the mineral particles in the soil and is determined by the relative amounts of different sized mineral particles in the soil. Particles are normally grouped into three main classes: sand, silt, and clay (Table A-1).

Table A-1. Soil classification by particle size

Classification	Soil particle size
Sand	0.05 to 2 mm
Silt	0.002 to 0.05 mm
Clay	< 0.002 mm

Mineral particles that are larger than 2 mm in diameter are considered coarse fragments. Mineral particles that range from 0.05 mm to 2 mm in diameter are called sand. Sand feels rough when rubbed between the thumb and fingers. Soil particles between 0.002 mm to 0.05 mm in diameter are classified as silt. Dry silt feels smooth and silky and retains an imprint when pressed. Wet silt remains smooth and does not become slick or sticky. Clay is the finest sized particle, with each particle smaller than 0.002 mm in diameter. When dry, clay feels very smooth. When wet, clay becomes slick and sticky and holds its form when shaped.

The proportion of sand, silt, and clay form the basis for 12 primary classes of soil texture (Figure A-4 and Table A-2). The texture of a soil affects the movement of air and water, as well as plant root penetration. However, most importantly, the texture of a soil determines the amount of surface area available. The surface of a mineral is where water, nutrients, chemicals, microorganisms, and charges are held and released. That ultimately determines the soil's water-holding capacity and fertility. Coarse and sandy soils allow for more rapid infiltration rates for water as opposed to more fine-textured or clay soils. Sandy soils are also easier to till. Sandy soils are suited for producing specialty crops such as vegetables, tobacco, and peanuts. Fine-textured soils hold more water and

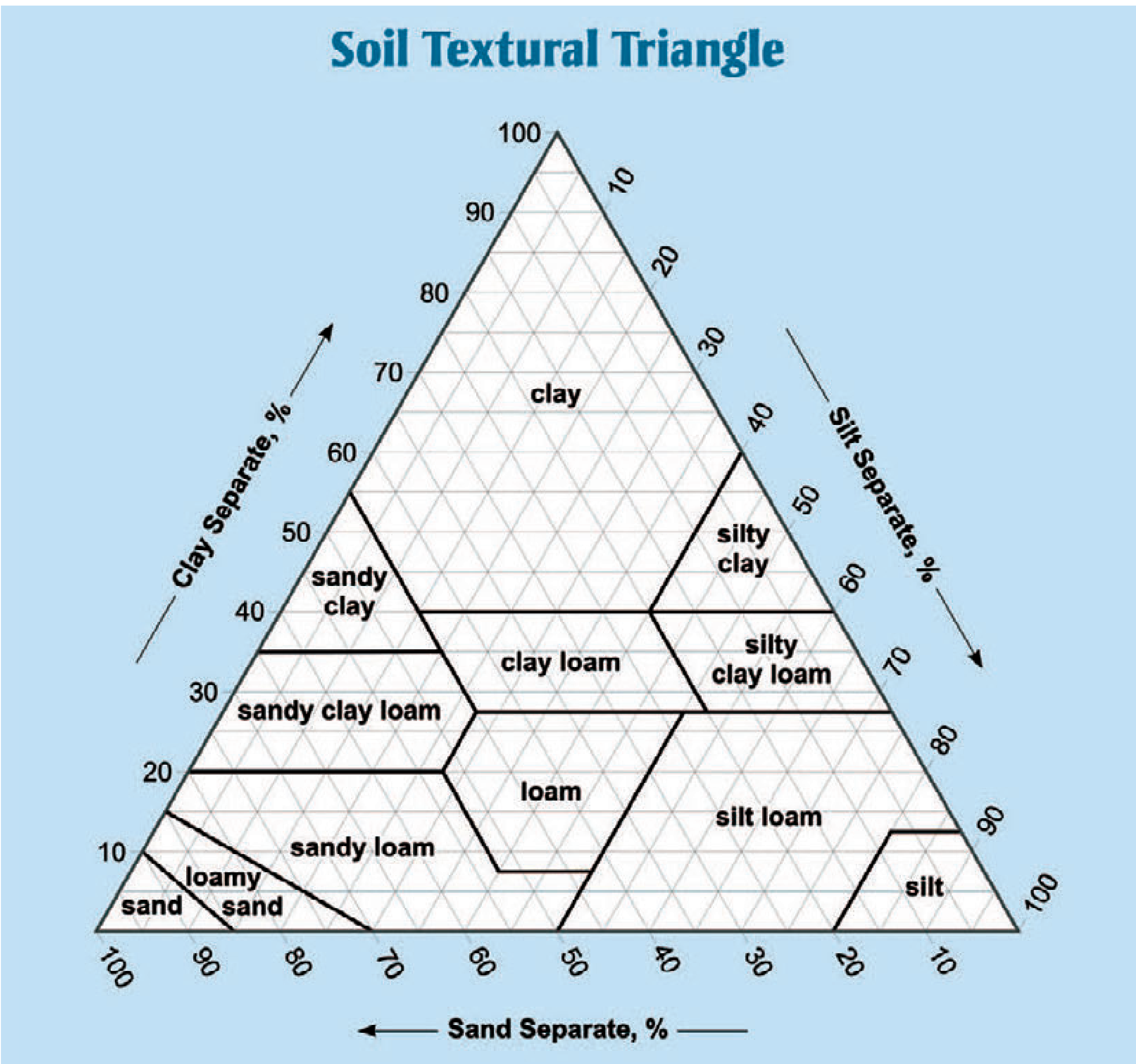


Figure A-4. Soil textural triangle. (Source: USDA/NRCS) plant nutrients and require less frequent nutrient applications. Moisture has a significant effect on the workability of fine soils. Such soils can form puddles after a rain and can develop a crust. Fine-textured soils are best suited for producing corn, small grains, hay, and forages.

Table A-2. Soil texture classes

Texture classes of soils[a]		
Common names	**Texture**	**Class names**
Sandy soils	Coarse	Sandy, loamy sands
Loamy soils	Moderately coarse	Sandy loam, loam
	Medium	Silt loam, silt, clay loam
	Moderately fine	Sandy clay loam, silty clay loam
Clayey soils	Fine	Sandy clay, silty clay, clay

a. Adapted from Smith 1990

Aggregation and Structure

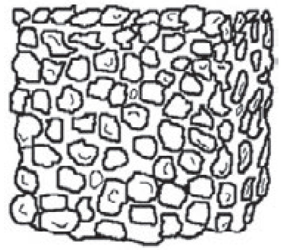
The cementing or binding together of several soil particles into a secondary unit is called soil aggregation. The soil particles are arranged or grouped together to form structural pieces (building blocks) called peds or aggregates, in various shapes and sizes. The arrangement of the aggregates determines the soil's structure (Figure A-5).

Structure is an important soil characteristic because good structure allows favorable movement of air and water and allows and encourages extensive root development.

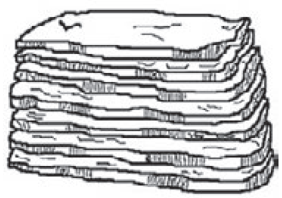
The formation of aggregates and good structure of the surface soil is promoted by a proper supply of organic matter, adequate lime, and working or tilling the soil during correct moisture conditions. On the other hand, structure is weakened or destroyed when organic matter is depleted, when inadequate lime is used, and when the soil is tilled or worked with too much or too little moisture in the soil.

Color

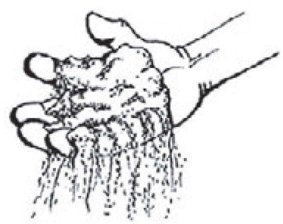
The color of a soil has little influence on a soil's function; however, it tells a great deal about the soil. Soil colors are often a result of the various oxidation states of the minerals present. Brighter colors such as yellow and reds are an indication of iron oxides. The brighter colors suggest good drainage and aeration. Grayish soils can indicate iron reduction caused by permanently saturated soil. Soils with mottled colors of various shades of yellow, brown, and gray are indicative of a fluctuating aerobic and anaerobic environment. Aside from iron, other minerals that contribute to soil color are manganese oxide, glauconite, and carbonates. Additionally, very dark browns and black soil colors can be an indication of high levels of organic matter.



Granular: Resembles cookie crumbs and is usually less than 0.5 cm in diameter. Commonly found in surface horizons where roots have been growing.



Platy: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.



Single Grained: Soil is broken into individual particles that do not stick together. Always accompanies a loose consistence. Commonly found in sandy soils.

Figure A-5. Examples of soil structure. (Source: Soil Science Education home page)

Retention/Water-Holding Capacity

The amount of water retained in a soil is dependent on the interaction of soil texture, bulk density, and aggregation. The term field capacity defines the amount of water remaining in a soil after downward gravitational flow has stopped, and it is expressed as a percent by weight. The permanent wilting percentage represents the amount of water in soil after plants are permanently wilted. Water is still in the soil, but it is held so tightly that it is unavailable for plant use. The difference between field capacity and the wilting point is the plant-available water (Figure A-6). Irrigation water is generally applied when the soil moisture is depleted by 40 to 60 percent of field capacity. Irrigation water is applied to bring the soil moisture back to near field capacity.

Sandy soils hold little water because their large pore spaces allow water to drain freely. While clay soils have greater water-holding capacities because of their small pore spaces, they also hold water more tightly than sandy soils, making a certain amount of water unavailable to plants. The amount of organic matter and stoniness in soils improves the available water capacity for plant use. Coarser soils tend to have the lowest plant available water capacity, while medium-textured soils tend to have the highest. Decreasing the bulk density of soils reduces water-holding capacity.

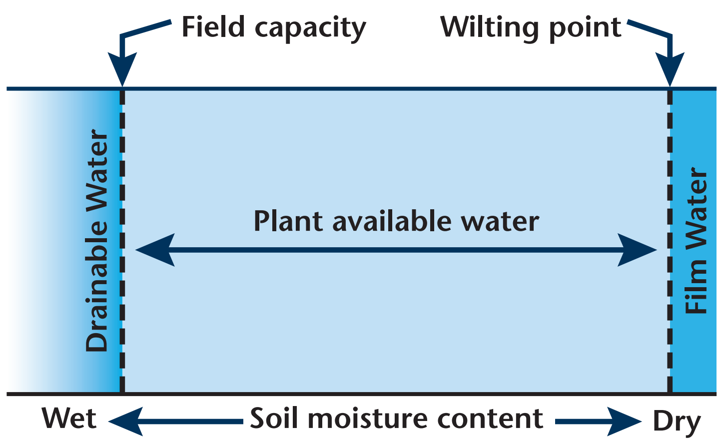


Figure A-6. Plant available water and drainable water in relation to field capacity and wilting point. (Source: University of Minnesota)

Drainage

Soil drainage is defined as the rate and extent of water removal. That includes water movement across the surface and downward through the soil. Topography is a very important factor in soil drainage. Other factors that affect drainage include the soil layers' texture and soil structure. Poor drainage is indicated by a mottled gray soil color, constantly wet soil, or water *sitting* on the soil surface for a long time after rain or irrigation. If drainage is poor, plant roots are deprived of oxygen. Thus, adequate drainage is essential to good plant growth. Conversely, excessively drained soils, such as very sandy soils or those on steep slopes, tend to hold too little water for normal plant growth.

Cation Exchange Capacity

Soil materials have a net surface charge, usually negative, that allows them to hold and retain ions (i.e., nutrients) against leaching. The net negative charge of a soil is largely attributed to the clay and organic matter in the soil and will naturally attract positively charged nutrients and repel negatively charged nutrients. That explains why cations, the positively charged nutrients (such as ammonium (NH_3^+)), remain in the soil while anions, the negatively charged nutrients (such as nitrate (NO_3^-)), are repelled and easily leached out of the soil.

The cation exchange capacity (CEC) is a measure of the soil's ability to retain cations and, therefore, is indicative of the soil's fertility. In addition to clay and organic matter, pH has an effect on CEC. Increasing soil pH increases its CEC, activating more ion exchange sites.

Soils with low CEC can have one or more of the following characteristics:

- High sand and low clay content.
- Low organic matter content.
- Low water-holding capacity.
- Low pH value.
- Lightly buffered and cannot easily resist changes in pH or other chemical changes.
- Nutrients are leached very easily.
- Productivity can be low.
- Certain types of clay such as kaolinite will have a much lower CEC than a montmorillonite or vermiculite (high shrink and swell clays).

Soils with a higher CEC can have one or more of the following characteristics:

- Low sand and high clay content.
- Moderate to high organic matter content.
- High water-holding capacity.
- Highly buffered and resist changes in pH or other chemical changes.
- Nutrients are retained and leaching losses reduced.

A soil's CEC directly affects the amount of fertilizer that should be used and the frequency with which it should be applied.

Soil Fertility

Soil fertility is the ability of a soil to provide nutrients for plant growth (Table A-3). Many factors affect the availability of elements in soil, including the form of the element found in the soil, pH, soil aeration, soil compaction, soil temperature, and soil moisture. As described, the ability of a soil to retain nutrients is related to its CEC. Many of the important plant nutrients are cations, which are retained by the soil's negative charge. Those include ammonium (NH_4^+), calcium (Ca^{2+}), potassium (K^+), sodium (Na_2^+), aluminum (Al^{3+}), hydrogen (H^+), and magnesium (Mg^{2+}). As the CEC increases, the soil's ability to retain and provide nutrients to plants increases. Therefore, the fertility and productivity of a soil can be greatly influenced by the CEC. Negatively charged ions, or anions, are leached than positively charged ions. For example, NO_3^- is not retained in the soil profile because of its negative charge. An exception occurs with phosphorus (P). Although it exists in the anionic form, the properties of phosphate anions allow them to (1) react with other minerals in the soil and form low-solubility compounds that are unavailable to the plant and (2) to become fixed on and in available sites of clay particles through a process known as phosphorus fixation. Thus, phosphorus leaching is limited unless soil concentrations become very high or in sandy soils because of limited fixation sites.

Table A-3. Essential plant nutrients

Plant-available forms of essential elements	
Primary plant nutrients	
Nitrogen	NH_4^+, NO_3^-
Phosphorus	HPO_4^{2-}, $H_2PO_4^-$
Potassium	K^+
Secondary plant nutrients	
Calcium	Ca^{2+}
Magnesium	Mg^{2+}
Sulfur	SO_4^{2-}
Carbon	CO_2
Hydrogen	H^+, OH^-

Soil pH affects plant nutrient availability because pH greatly influences the solubility of certain elements. Most crops grow best in slightly acidic soils (pH 6.0 to 6.5). Acidification is a natural and continuous process in many soils. Through chemical weathering, cations are released from parent materials and become available on the exchange complex of a clay particle. Soils become acidic when the cations are displaced by acid ions, mostly H^+ and Al^{3+}. Acid ions are prevalent in the soil because of other ongoing chemical processes in the soil that release them. When exposed to water, the non-acidic cations (K^+, Ca^{2+}, and Mg^{2+}) and anions are leached from the soil profile, leaving the exchange complex and soil solution acidic. In areas with high annual rainfall, soils tend to be acidic because of the increased leaching conditions. For that reason, soils in Eastern states are generally more acidic than those in the Midwest and Western United States.

The working of ground limestone into the soil to raise soil pH is referred to as liming. The benefits of liming are both direct and indirect. Some direct benefits include the reduction of Al^{3+} and Mn^{2+} solubility (both ions are toxic to most plants unless at very low concentrations), and the application of Ca^{2+} and/or Mg^{2+}, both of which are plant nutrients. Indirect benefits include increased microbial activity and the increased Ca^{2+} levels in the soil can improve the soil structure. The benefits of liming are generally expected to last for at least 5 and commonly up to 10 years. While liming has many beneficial effects, over liming can easily induce micronutrient deficiencies in many crops adapted to low or moderate pH conditions.

For a plant to take up nutrients, the nutrient must exist in the soil solution (water-filled pore space) and be in a soluble form. A large amount of nutrients are stored in the solid framework (mineral and organic material) of a soil; however, the nutrients are released slowly to the soil solution through chemical and biochemical processes. The soil solution usually holds insufficient quantities of nutrients for plant's nutritional needs. The larger particles (sand, silt, large clay particles, and organic matter), tightly entrap and retain certain nutrient species making them available very slowly over time. Within the colloidal size fraction, nutrients are exposed to a greater surface area and broken down faster, but they are still entrapped and, thus, are only slightly more available. Nutrient ions are also adsorbed to mineral surfaces, in what is considered an exchangeable form, but the nutrients are also only moderately available. It is only when they reach the soil solution that nutrients are free and available for plant uptake and considered *plant available*.

In addition nutrients being plant available, nutrients must be at the root surface for uptake. If nutrients are not in direct contact with the root, they must move by mass flow or diffusion. Root uptake of nutrients is an active metabolic process. Therefore, even if adequate plant-available nutrients are present, factors that deter flow and root metabolism, such as soil compaction, cold temperatures, lack of water or oxygen, can inhibit plant uptake of nutrients.

Forms and Fate of Nitrogen

Nitrogen is an essential part of amino acids, the building blocks for proteins, making it an important plant nutrient. In the soil, it exists in both organic (proteins, amino acids, urea, in living organisms and decaying plant and animal tissues) and inorganic forms [ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), and ammonia ($NH_{3(gas)}$)]. The majority of nitrogen in the soils is in an organic form (95 to 99 percent as amine groups in proteins), which is largely unavailable for plant uptake. Figure A-7 illustrates the processes responsible for converting nitrogen into plant available forms.

Microbes break down organic compounds releasing ammonium ions through a process called mineralization. Mineralization occurs as a result of decomposition. The factors that control decomposition control the rate of mineralization and, therefore, the rate at which plant available nitrogen is released to soil. Factors controlling decomposition include soil conditions that encourage microbial growth and the carbon:nitrogen (C:N) ratio of the compound that is being degraded. Adequate soil moisture and aeration, near-neutral soil pH, and warm soil temperatures are conditions that are favorable to a broad range of organisms.

Microbes need carbon, but they also require nitrogen for building cells and extracting energy. The C:N ratio of the compound being decomposed is a critical factor in determining if nitrogen is utilized by the microbes for energy and depleted from the soil or supplied to the plant available nitrogen pool in the soil. When materials with a high C:N ratio, such as corn stalks (C:N ratio is typically 55:1) are added to soil, microorganisms begin to degrade the compound as a food source. Given the limited amount of nitrogen in the source itself, the microbes will scavenge the soil for available nitrogen, which is necessary for decomposition. In such situations, the soil can be depleted of plant available nitrogen. On the other hand, when an organic compound with a low C:N ratio, such as alfalfa hay (C:N ratio is typically 13:1) is added to soil, there is sufficient nitrogen in the compound itself for decomposition. The microbes do not need to use nitrogen from the

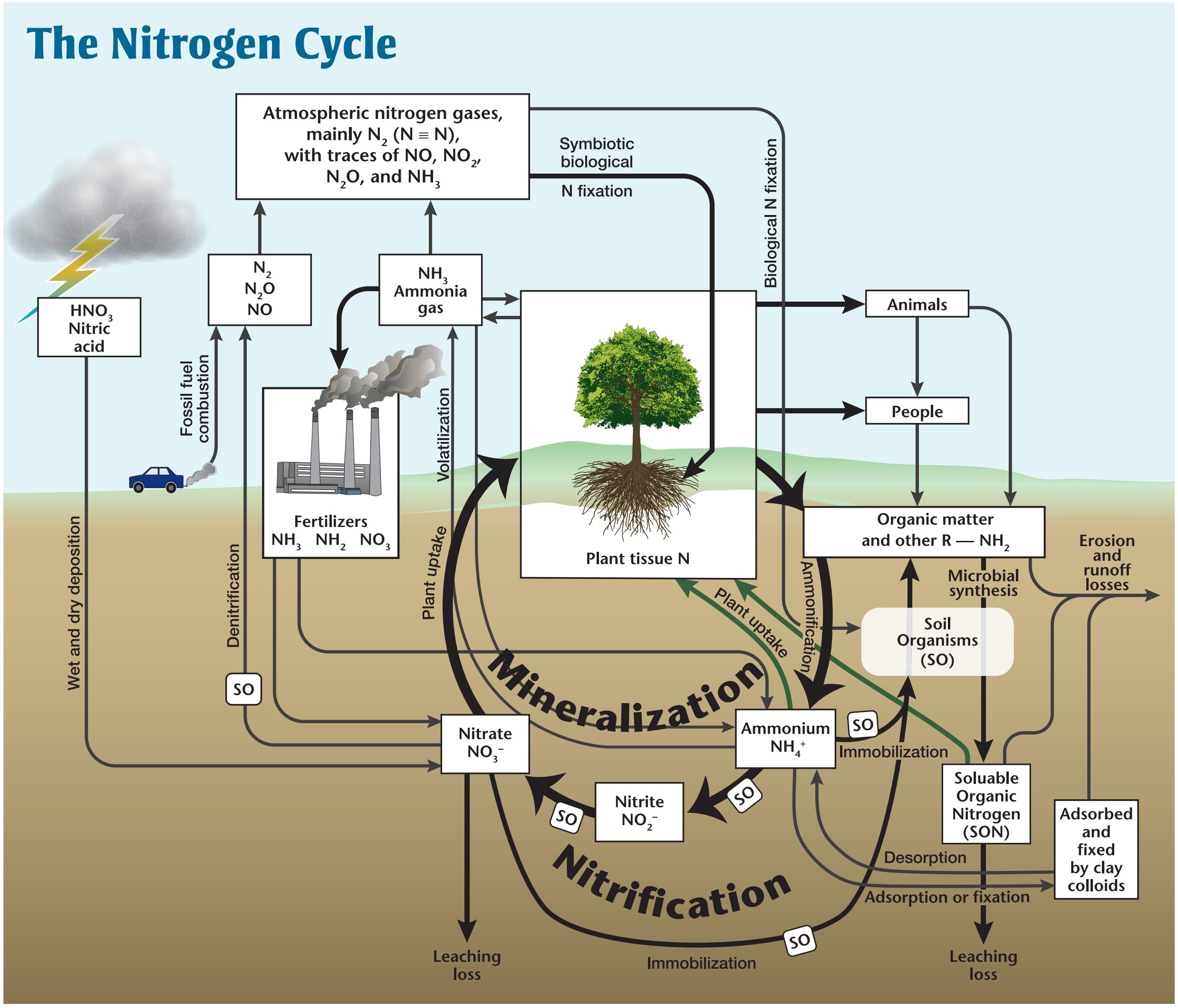


Figure A-7. The Nitrogen Cycle.

soil. Rather, decomposition of the material can release plant available nitrogen from the organic compound to the soil.

As mineralization occurs, if ammonium is released to the soil, it can be directly absorbed by a plant or it can be oxidized to nitrate and then absorbed. Because soil systems often are aerobic, ammonium does not typically persist in the soil in large quantities. Ammonium is a positively charged ion, which means, if it is present in a soil, it can be retained by the negatively charged soil particles on a soil's exchange complex. As previously mentioned, nutrients held on the mineral exchange complex are moderately plant available because, while they are retained on the mineral surface, they can be displaced by competing ions to the soil solution. Ammonium can also become fixed within the crystal structure of certain types of clay particles because of its size and the arrangement of the specific clay particles. Fixed ammonium is only slowly released to the soil solution and would not be a sufficient source of nitrogen for plants.

When manure is land applied as an organic compound, only a small fraction of the nitrogen might be soluble as ammonium and plant available. However, a larger portion of that nitrogen is mineralized by microbes and slowly released over many years. Nitrogen mineralization rates of the organic nitrogen present in the initial land application vary depending on various environmental factors such as soil type, the manure source, and climate. For example, cattle manure mixed with bedding that has been stored under cover will have approximately 60 percent of the organic nitrogen fraction mineralized in the year of application; 6 percent in the second year, and 2 percent in the third year. For many types of manure, 1 to 4 percent of organic nitrogen is still being released 4 years after the initial application. Therefore, calculations to determine annual land applications of nitrogen should account for released forms of nitrogen from previous organic nitrogen applications.

As nitrogen-containing organic compounds such as manure and fertilizers are broken down, ammonia can be released. Ammonia is most commonly found as a gas and is released from a soil system through a process called volatilization. Volatilization occurs at the liquid air interfaces and is controlled by the pH and water content of the soils, which drive nitrogen either into or out of the soil. The loss of ammonia to the atmosphere is driven by high level pH soils. The importance of incorporating manures into soils is to minimize the contact area between the manure and the ambient air to reduce ammonia volatilization. Soils and plants have the ability to sorb ammonia from the atmosphere, but fertilizer recommendations do not consider atmospheric nitrogen sources. As a result, areas that are exposed to high atmospheric ammonia concentrations (such as intensive livestock operations) could be having fertilizers applied at rates in excess of plants' needs.

Nitrate is another plant available form of nitrogen that can enter the soil system through atmospheric deposition, commercial fertilizers, and transformation of ammonium as mentioned above. Ammonium is oxidized to nitrite, which is quickly oxidized to nitrate by nitrifying bacteria as long as favorable soil conditions exist for the bacteria to survive. Nitrite is also plant available, but it can be toxic to plants and rarely persists in the soil in significant concentrations. As opposed to ammonium, nitrate is a negatively charged ion that is not adsorbed to the negatively charged soil mineral surfaces. Therefore, nitrate is readily available to plants, but if excess nitrate persists in the soil solution, the negatively charged nutrient is repelled by the soil surfaces and lost to groundwater through leaching. Factors that contribute to nitrogen leaching or runoff include over-application of nitrogen as fertilizers or manure particularly on sandy or coarse-textured soils; improperly timed applications of nitrogen, poorly designed or nonexistent soil conservation measures; and periods of exceptionally heavy rainfall.

Anaerobic bacteria can also reduce nitrate to nitrogen gas through a process called denitrification. Denitrification is a series of bacteria driven reduction reactions that reduce nitrate ultimately to nitrogen gas. Because denitrification is a reduction reaction, it requires an anaerobic environment, such as saturated soils. Only when soil oxygen levels are low enough, typically in waterlogged or poorly drained soils, will nitrate be fully reduced resulting in the formation of nitrogen gas. When oxygen levels fluctuate, as they commonly do in the field, nitrate will not be fully reduced and nitric oxide (NO) and nitrous oxide (N_2O) can be released to the atmosphere because those are intermediate by-products.

Forms and Fate of Phosphorus

Phosphorus is an important plant nutrient because it is an essential component of deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and the nucleotide adenosine 5'-triphosphate (ATP), which are necessary for intracellular energy transfer. Unlike nitrogen, gaseous forms of phosphorus seldom exist and are often not considered in the phosphorus cycle (Figure A-8).

Organic phosphorus usually occurs in microbial biomass and organic matter compounds. Inorganic phosphorus commonly appears in the form of phosphates (HPO_4^{-2} and $H_2PO_4^{-}$). Relative to other nutrients, phosphorus in soil solution is found in very low concentrations (0.001 to 1 mg/L) that rarely exceed 0.01 percent of total soil phosphorus.

When phosphate ions are added to a soil, they are quickly (within hours) removed from solution to form phosphorus containing compounds with very low solubility. Phosphate most commonly forms compounds with either calcium or iron and aluminum (sometimes manganese). Initially, some ions are retained on the exchange complex, which makes them moderately plant available but with time, they undergo sequential reactions that continually decrease their solubility.

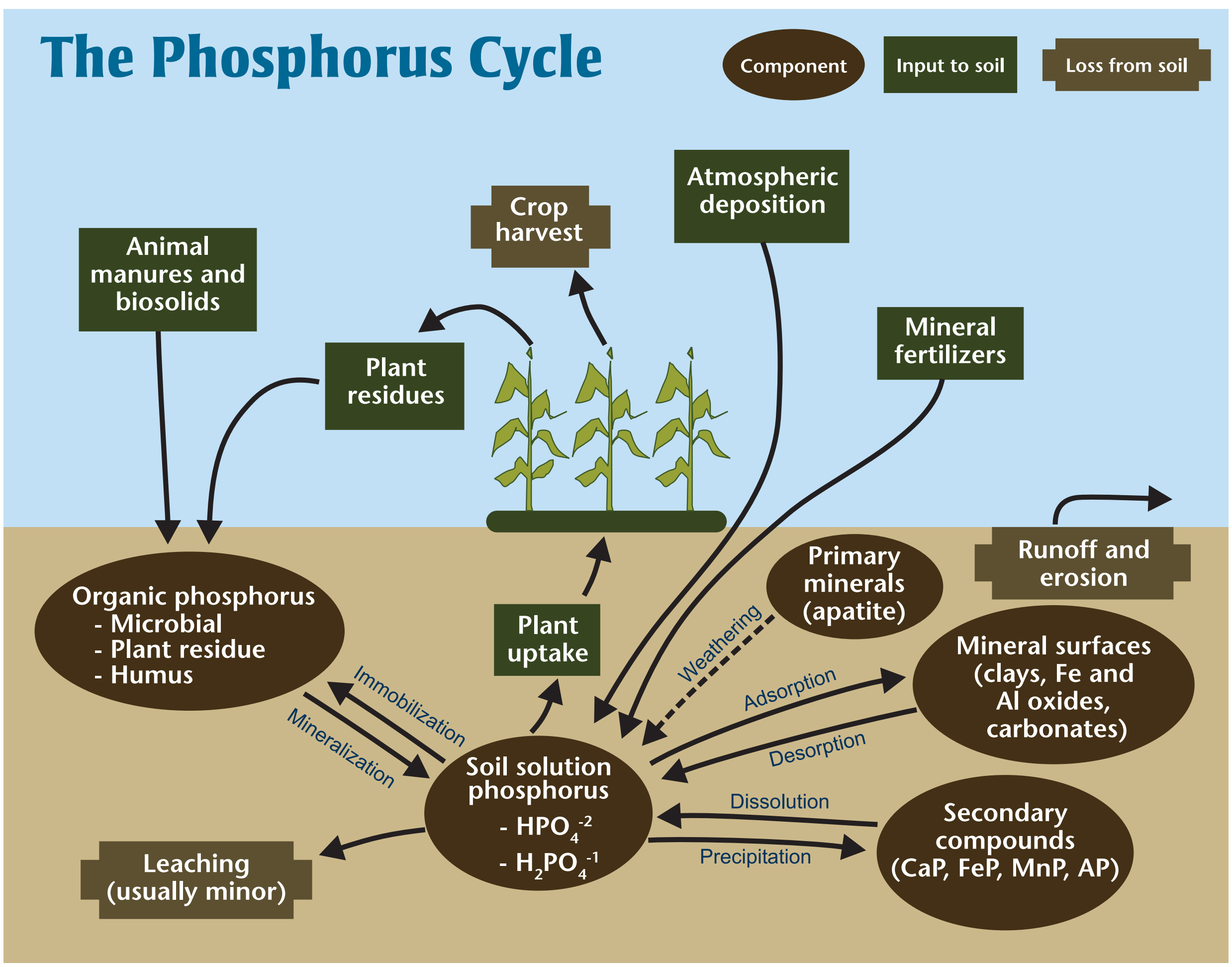


Figure A-8. The Phosphorus Cycle.

Such reactions result in phosphorus permanently bonding to the calcium or aluminum/iron/manganese ions, becoming buried under products from additional precipitation reactions. Those reactions can also entrap phosphorus within the calcium or iron/aluminum/manganese particles. That is regarded as phosphorus fixation and it is not easily reversible.

The capacity for soils to fix phosphorus depends on a number of soil factors including the mineral type, pH, and amount of organic matter. Phosphate ions are negatively charged; therefore, the minerals sorbing and fixing the ions must be positively charged. Certain types of minerals have a greater capacity for sorbing anions than others. The pH of the soil affects the solubility of the calcium and iron and aluminum phosphate compounds with the greatest fixation occurring at low and high pH values. Organic matter and by-products from its decomposition compete with phosphate ions for adsorption sites on mineral surfaces; therefore, soils with low organic matter concentrations tend to fix more phosphorus, making less available to plants. Because fixation depends on available mineral surface area and sorption sites, soils have a finite capacity to fix phosphorus.

Additions of fertilizers and manures typically allow for only 10 to 15 percent of added phosphorus to be taken up by plants because of that fixation capacity. Therefore, during the early and mid-20th century, farmers applied phosphorus in quantities far in excess of the plants' nutritional needs. In addition, manure has historically been applied at rates to meet plant nitrogen requirements, which can supply 2 to 4 times the phosphorus requirement. What was not removed in the harvest could accumulate in the soil in an insoluble, unavailable form. That became common practice and over the years, many fertilized, cultivated soils have reached their phosphorus fixation capacity. Note that that was not the case everywhere. In many developing countries where fertilizer is seldom used, phosphorus is often the limiting nutrient in food-crop production.

If not taken up by plants, phosphorus can be lost with surface runoff as dissolved phosphorus (if not incorporated into a soil) or it can be lost with soil particles through erosion or colloid leaching if sorbed to mineral surfaces. Soil particles containing fixed phosphorus that are lost through erosion might not appear to degrade water quality because of phosphorus fixation. However, in prolonged anaerobic environments (i.e., river beds) iron that is binding phosphorus will be reduced. While oxidized iron is insoluble, reduced iron is soluble allowing for the bound phosphate to be released into solution, contributing to water quality problems like eutrophication.

Water Quality

Water pollution from cropland is controlled in large part by the hydrologic cycle. Precipitation and irrigation add water, which, once at the soil surface, infiltrate, pond, or run off. Two types of losses from soils that affect water quality are (1) percolation or drainage, and (2) runoff. Percolation results in the loss of soluble elements (leaching), thus depleting soils of certain nutrients. Runoff losses generally include water and appreciable amounts of soil (erosion).

Two prime reasons raise concern over the loss of essential elements by leaching and erosion. First is the obvious concern for keeping nutrients in the soil so that they are available to crops. A second and equally significant reason is to keep the nutrients out of streams, rivers, and lakes. Nitrate contamination of ground and surface waters can cause serious environmental damage. Nitrates in drinking water are toxic because they reduce the capacity for blood to carry oxygen. That can be lethal to human infants and can alter normal body functioning in adults. Some underground sources of drinking water have become sufficiently high in nitrate causing health concerns for humans. Likewise, surface runoff waters from heavily fertilized lands can contain levels of nitrate toxic to livestock. While phosphorus is not toxic, it can degrade water quality if lost from a soil system in significant quantities. Excessive growth of algae and other aquatic species takes place in water overly enriched with nitrogen and phosphorus. That process, called eutrophication, depletes the water of its oxygen, thus harming fish, other aquatic species, and ultimately most life in the waterbody.

Infiltration, Percolation, and Leaching

As water enters a soil (infiltration) and moves down through the soil profile (percolation) it carries dissolved nutrients with it (leaching). Leaching losses occur when the amount of rainfall or irrigation water entering a soil exceeds the soil's ability to store it. The amount and rate of nutrient losses are influenced by the amount of rainfall or irrigation, the topography of the landscape, the amount of evaporation, the soil type, and the crop cover.

Soil properties have an effect on nutrient leaching losses. The physical properties of sand, silt, and clay, and the relative proportions of each have direct bearing on nutrient retention. As discussed, coarse soils (soils with a high percentage of sand) generally permit greater nutrient loss than do finer textured soils (soils with higher percentage of silt and clay). Organic matter content and type and amount of clay have significant influence on retention and nutrient storage and exchange.

The loss of nutrients through leaching is also influenced by climatic factors. In regions where water percolation is high, the potential for leaching is also high. Such conditions exist in the United States in the humid east and in the heavily irrigated sections of the west. In non-irrigated, semiarid areas, less nutrient leaching occurs because less water is added to the soil to contribute to the leaching process.

The proportion of rain or irrigation water entering the soil is enhanced by practices that keep the soil surface covered (e.g., with vegetation or mulch) to protect it from the beating action of rain drops that breaks down soil surface structure, decreasing porosity. Rain on bare soil also displaces soil particles that are easily transported by surface runoff.

Numerous best management practices are available to encourage residue management and to minimize negative consequences of soil tillage. Excessive tillage that destroys the surface roughness should be avoided. Tillage across the slope, leaving small ridges, encourages water infiltration. Likewise, terraces can help control the erosive potential of water movement and increase infiltration into the soil.

Runoff and Erosion

A primary principle of soil water management is to encourage water movement into rather than off the soil. The more water runs off the surface, the less infiltrates into the soil. Maintaining good soil structure is critical to reducing runoff; excess water that cannot infiltrate the soil accumulates on the surface and flows downgrade displacing surface soil particles along the way (erosion). Soil erosion damages productive soils and can increase nutrient transport to streams and lakes.

Two steps are recognized in the erosion process—the detachment or loosening influence and transportation by floating, rolling, dragging, and splashing. Freezing and thawing, flowing water, and rain are the major detaching agents. Those actions displace soil particles that are easily transported by surface runoff. Raindrop splash and especially running water facilitate the transport of loosened soil.

Following detachment, three types of water erosion are recognized: sheet, rill, and gully. In sheet erosion, soil is removed more or less uniformly from every part of the slope. However, sheet erosion is often accompanied by tiny channels (rills) irregularly dispersed, especially on bare land newly planted or fallow. That is called rill erosion. The rills can be obliterated by tillage, but the damage is already done—the soil quality in the field is diminished.

Where the volume of runoff water is further concentrated, downward cutting forms larger channels or gullies. That is called gully erosion. The gullies are obstacles to tillage and cannot be removed by ordinary tillage practices. While all types can be serious, the losses from sheet and rill erosion, although less noticeable, are responsible for most of the field soil deterioration.

The quantity of nutrients lost from the soil by erosion can be quite high. Such losses can be counterbalanced only in part by adding fertilizers; even still soils that are severely eroded might not respond well to fertilization. Much of the nitrogen and phosphorus lost is in eroded sediments, which include soil organic matter and finer particles.

Revised Universal Soil Loss Equation Version 2[3]

The Revised Universal Soil Loss Equation, Version 2 (RUSLE2), is designed to predict the long-term average rate of soil loss and guide conservationists on proper cropping, management, and conservation practices for a field or management unit. RUSLE2 cannot be applied to a specific storm or a specific year. Agricultural research coupled with centuries of farmers' experience has identified the major factors affecting erosion.

RUSLE2 is a computer model that uses a detailed mathematical approach for integrating multiple equations that describe how factors such as plant yield, vegetative canopy and rooting patterns, surface roughness, mechanical soil disturbance, amount of biomass on surface, and others affect soil erosion. The basic structure of the RUSLE2 equation is

$$A = RKLSCP$$

where

A = predicted average annual soil loss from rill and inter rill erosion caused by rainfall and its associated overland flow expressed in tons/acre/year.

R = climatic erosivity.

K = soil erodibility measured under a standard condition.

L = slope length.

S = slope steepness.

C = cover and management.

P = support practices (erosion control).

RUSLE2's predicted soil losses can be compared with soil loss tolerances (T) to provide guidelines for effective erosion control.

Soil Loss Tolerance

Soil loss tolerance (T) is the maximum amount of soil loss in tons per acre per year that can be tolerated and still permit a high level of crop productivity to be sustained economically and indefinitely.

A Natural Resources Conservation Service conservation plan is essentially a set of conservation practices that are designed to work in an integrated manner to accomplish an identified level of resource treatment. Developing a conservation plan involves determining the baseline erosion and other associated losses and evaluating the practices that would meet T.

RUSLE2's user interface allows a user to select from its database values to describe site-specific field conditions for climate, soil, topography, and land use. A brief description of each factor and the extent of its influence on soil erosion follows:

Rainfall erosivity, the *R* factor, is the most important climatic variable used by RUSLE2. Erosivity is related to rainfall amount and intensity, with the latter generally being more influential. A high annual precipitation received in a number of gentle rains can cause little erosion, whereas a lower yearly rainfall descending in a few torrential downpours can result in severe erosion. Temperature is also a key variable as rain and temperature affect the longevity of materials like crop residue and mulch that can prevent erosion. RUSLE2 associates erosivity, precipitation, and temperature values with the location chosen by the user.

The soil erodibility factor, *K*, indicates the inherent erodibility of a soil. The two most significant and closely related soil characteristics affecting erosion are infiltration capacity and structural stability. The infiltration capacity is influenced greatly by structural stability, especially in the upper soil horizons. In addition, organic matter content, soil texture, the kind and amount of swelling clays, soil depth, tendency to form a surface crust, and the presence of impervious soil layers all influence the infiltration capacity.

The stability of soil aggregates affects the extent of erosion damage in another way. Resistance of surface granules to the beating action of rain saves soil even though runoff does occur. The granule stability of some tropical clay soils accounts for the resistance of those soils to the action of torrential rains. Downpours of a similar magnitude on temperate region clays would be disastrous.

Values used by RUSLE2 for soil erodibility have been determined for most cropland and similar soils across the United States by the U.S. Department of Agriculture–Natural Resources Conservation Service. The user typically selects a soil-map unit name from a list of soils in the RUSLE2 database.

Site-specific values are entered for the topographic factor (*LS*), which reflects the influence of slope length, steepness, and shape characteristics. The greater the steepness of slope, other conditions being equal, the greater the erosion, partly because more water is likely to run off but also because of increased velocity of water flow. The length of the slope or flow path is important because it is directly proportional to the concentration of the flooding water.

Land use is the most important factor affecting rill and interrill erosion because it can be easily changed to reduce erosion. RUSLE2's cover-management (cultural) practices and support practices data are used to describe land use.

Soil detachment and erosive forces can be affected by cover-management practices. The cover and management factor, *C*, indicates the influence of cropping systems and management variables on soil loss. C is the factor over which the farmer has the most control. The type of crop, yield level, and tillage system used are important features to consider when land is used for crops. Forests and grass provide the best natural protection known for soil and are about equal in their effectiveness, but forage crops, both legumes and grasses, are next in protective ability because of their relatively dense cover. Small grains such as wheat and oats are intermediate and offer considerable obstruction to surface wash. Row crops such as corn and soybeans offer relatively little cover during the early growth stages and thereby encourage erosion. Most subject to erosion are fallowed areas where no crop is grown and all the residues have been incorporated into the soil. The marked differences among crops in their ability to maintain soil cover emphasize the value of appropriate crop rotation to reduce soil erosion.

RUSLE2 stores the description of any cover-management practice within its database and allows for selection of the practice that best fits site-specific field conditions. Key variables like yield level or mulch application can be changed so that the practice stored in RUSLE2 more accurately reflects the field conditions.

The support practice factor, *P*, reflects the benefits of contouring, strip cropping, terraces, diversions, small impoundments and other supporting factors. Such support practices reduce erosion primarily by reducing the erosivity of surface runoff. *P* is the ratio of soil loss with a given support practice to the corresponding loss when crop culture is up and down the slope. Like cover-management practices, support practices are selected from the RUSLE2 database and site-specific information such as the location of a practice is entered as required.

References

Brady, N.C., and R.R. Weil. 2002. *The Nature and Properties of Soils*. 13th ed. Pearson Education, Upper Saddle River, NJ.

Smith, R.L., and T.M. Smith. 1990. *Ecology and Field Biology*. Pearson Education, Upper Saddle River, NJ.

USDA-NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service). 2011. *National Soil Survey Handbook*, title 430-VI. <*http://soils.usda.gov/technical/handbook/*>. Accessed November 11, 2011.

Endnotes

1 Soil aggregrates – Groups of soil particles that bind to each other more strongly than to adjacent particles. The space between the aggregates provide pore space for retention and exchange of air and water. (Definition from USDA: *http://soils.usda.gov/sqi/publications/files/sq_eig_1.pdf*.)

2 Alluvium – A general term for all detrital material deposited or in transit by streams, including gravel, sand, silt, clay, and all variations and mixtures of these. Unless otherwise noted, alluvium is unconsolidated.
Loess – Material transported and deposited by wined and consisting of predominantly silt-sized particles.
Colluvium – A deposit of rock fragments and soil material accumulated at the base of steep slopes as a result of gravitational action (from Brady and Weil 2002).

3 Adapted from USDA-NRCS 2011.

Appendix B

Example Letters to Owners/Operators After a Site Visit

Example Letter in Follow-up to an Inspection: Facility *Not Designated* as a CAFO

[NAME & ADDRESS]

Dear Mr./Ms. _____________:

An inspection of your facility, located at [ADDRESS], was conducted on [DATE] by representatives of the [PERMITTING AUTHORITY]. The purpose of the inspection was to determine if conditions or practices on your animal feeding operation (AFO)[1] warrant designating your facility as a concentrated animal feeding operation (CAFO) and, consequently, requiring a National Pollutant Discharge Elimination System (NPDES) permit for operation.

During the inspection, no conditions or practices were observed to warrant designation of your facility as a CAFO at this time. However, the following observations were noted during the inspection.

[NOTE AREAS OF POTENTIAL CONCERN, IF ANY]

We request that you evaluate and address these areas of potential concern to ensure that they do not become problems. Technical information and assistance is available through [LOCAL NRCS OR EXTENSION OFFICE, STATE DEPARTMENT OF AGRICULTURE, OR US EPA's AGRICULTURAL ASSISTANCE CENTER (888/663-2155)].

The [PERMITTING AUTHORITY] may inspect your facility again in the future. Please be advised that any illicit discharges[2] to surface water or to surface water through a direct hydrological connection via ground water are violations of the Clean Water Act and subject to enforcement action with penalties.

Sincerely,

[1] An animal feeding operation means a "lot or facility" where animals "have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period; and crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility." 40 CFR 122.23(b)(1). **[or alternate definition established by the Permitting Authority].**

[2] In the absence of a NPDES permit, all discharges from the facility are prohibited.

Example Letter in Follow-up to an Inspection: Facility *Designated* as a CAFO

[NAME & ADDRESS]

Dear Mr./Ms. _____________:

An inspection of your facility, located at [ADDRESS], was conducted on [DATE] by representatives of the [PERMITTING AUTHORITY]. The purpose of the inspection was to determine if conditions or practices on your animal feeding operation (AFO)[1] warrant designating your facility as a concentrated animal feeding operation (CAFO) and, consequently, requiring a National Pollutant Discharge Elimination System (NPDES) permit for operation.

During the inspection, the following conditions were observed:

[NOTE THE CONDITIONS THAT SUPPORT THE CAFO DESIGNATION.[2]]

Based on these conditions, the [PERMITTING AUTHORITY] has determined that your facility is or has proposed to be a contributor of pollutants to the waters of the United States. As such, the [PERMITTING AUTHORITY] designates your operation as a CAFO, with the requirement of applying for a NPDES permit and taking immediate steps to cease existing discharges and eliminate the potential for future discharges, except as authorized by a NPDES permit.

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1 An animal feeding operation is defined as a "lot or facility" where animals "have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period and crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility" **[or alternate definition established by the Permitting Authority]**.

2 In making a designation, the Director "shall consider the following factors: the size of the AFO and amount of wastes reaching waters of the United States, the location of the AFO relative to waters of the United States, the means of conveyance of animal wastes and process waste waters into waters of the United States, the slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of animal wastes manure and process waste waters into waters of the United States; and other relevant factors." 40 CFR 122.23(c)(ii)(2).

To apply for a permit for your facility, [PROVIDE SPECIFIC INSTRUCTION AS TO WHETHER THEY ARE REQUIRED TO APPLY FOR AN INDIVIDUAL PERMIT OR SUBMIT AN NOI FOR A GENERAL PERMIT. INCLUDE STEPS AS TO HOW TO GET PERMITTED]

This letter includes web sites, hotlines, and other resources for small businesses that you may use to obtain assistance to comply with these requirements.

The [PERMITTING AUTHORITY] may inspect your facility again in the near future. Please be advised that discharges such as that observed on [DATE] are in violation of the Clean Water Act and as such can subject you to enforcement action with penalties.

Sincerely,

Compliance Assistance Resources

If you operate a small business as defined by the Small Business Administration (defined at 13 CFR 121.201; in most cases, this means a business with 500 or fewer employees), you may find the following information helpful.

The U.S. Environmental Protection Agency (EPA) and the U.S. Small Business Administration (SBA) offer small businesses a wide variety of compliance assistance resources and tools designed to help small businesses comply with federal and state environmental laws. These resources can help businesses understand their obligations, improve compliance and find cost-effective ways to comply through the use of pollution prevention and other innovative technologies.

We encourage you to take advantage of these tools to improve your understanding of and compliance with environmental regulations and avoid the need for future enforcement actions. ***Please note that any decision to seek compliance assistance at this time does not relieve you of your obligation to respond to an EPA request, administrative or civil complaint in a timely manner, does not create any new rights or defenses, and will not affect EPA's decision to pursue this enforcement action***.

Dissemination of this information sheet does not constitute an admission or determination by EPA that your business organization is a small entity as defined by the Small Business Enforcement and Fairness Act (SBREFA) or related provisions nor does it create any new rights or defenses under law.

Web sites

EPA offers a great deal of compliance assistance information and materials for small businesses on the following Web sites:

www.epa.gov	EPA's Home Page
www.smallbiz-enviroweb.org	Small Business Environmental Home Page
www.smallbiz-enviroweb.org/contacts/sbosbeap.aspx	Small Business Environmental Assistance Program State Contacts
www.epa.gov/smallbusiness	Small Business Gateway
www.epa.gov/smallbusiness/help.htm	Small Business Assistance, Help, and Training Web Page
www.epa.gov/compliance/incentives/smallbusiness/	Small Business Compliance and Enforcement
www.epa.gov/compliance/assistance/index.html	Compliance Assistance Home Page
www.epa.gov/oecaagct/tsma.html	EPA Ag Center Small Farm/Small Business Web Page

State Agencies

Many state agencies have established compliance assistance programs that provide on-site as well as other types of assistance. Please contact your local state environmental agency for more information.

Agriculture Compliance Assistance Center

EPA has established national compliance assistance centers, in partnership with industry, academic institutions, and other federal and state agencies, that provide assistance services in sectors heavily populated with small businesses, including agriculture.

- Agriculture Compliance Assistance Center: *www.epa.gov/agriculture*
- National Agriculture Center: 1-888-663-2155 or *www.epa.gov/agriculture/agctr.html*

Hotlines

EPA sponsors more than 50 hotlines and clearinghouses that provide free and convenient avenues to obtain assistance with environmental requirements. EPA's Small Business Ombudsman Hotline can provide you with a list of all the hotlines and assist you with determining which hotline will best meet your needs. Key hotlines that may be of interest to you include:

- EPA's Small Business Ombudsman.............................. (800) 368-5888
- Superfund and EPCRA Call Center.............................. (800) 424-9346
- Safe Drinking Water Hotline ....(800) 426-4791

Small Business Compliance Policy

EPA's Small Business Compliance Policy is intended to promote environmental compliance among small businesses by providing incentives such as penalty waivers and reductions for participation in compliance assistance programs, and encouraging voluntary disclosure and prompt correction of violations. This policy can not be applied to an enforcement action that has already been initiated. Contact EPA's Compliance Assistance and Sector Programs Division (202-564-2310) for information on the Small Business Policy or review the policy online at *http://www.epa.gov/compliance/incentives/smallbusiness/*.

Small Business Administration National Ombudsman

The Small Business and Agriculture Regulatory Enforcement Ombudsman and ten Regional Fairness Boards were established to receive comments from small businesses about federal agency enforcement actions. The Ombudsman will annually rate each agency's responsiveness to small businesses. If you believe that you fall within the Small Business Administration's definition of a small business (based on your SIC designation, number of employees or annual receipts, defined at 13 CFR 121.201) and wish to comment on federal enforcement and compliance activities, contact the SBA's Office of the National Ombudsman at 1-888-734-3247 or *ombudsman@sba.gov*. ***Please note that participation in this program does not relieve you of your obligation to respond to an EPA request, administrative or civil complaint or other enforcement action in a timely manner nor create any new rights or defenses under law. In order to preserve your legal rights, you must comply with all rules governing the administrative enforcement process. The ombudsman and fairness boards do not participate in the resolution of EPA's enforcement action.***

Appendix C

Example NPDES CAFO Permit Annual Report Form

NPDES CAFO PERMIT ANNUAL REPORT

NPDES Permit Number:	Reporting period (mm/dd/yyyy - mm/dd/yyyy): / / - / /
Facility Name:	
Contact Name:	
Facility Address:	

Facility City:	Facility State:	Facility ZIP Code:

Facility Telephone:	Contact Telephone (if different from Facility Telephone):

I. TYPE AND NUMBER OF ANIMALS

Report the maximum number of each type of animal confined at the facility at any one time.

Type	Number in open confinement	Number housed under roof
Mature Dairy Cows		
Dairy Heifers		
Veal Calves		
Other Cattle		
Swine (55 lbs or more)		
Swine (under 55 lbs)		
Horses		
Sheep or Lambs		
Turkeys		
Chickens (broilers)		
Chickens (layers)		
Ducks		
Other (specify) ____________		

II. MANURE, LITTER, AND PROCESS WASTEWATER PRODUCTION

Report the estimated amount of manure, litter, and process wastewater that were generated at the facility in the 12-month period covered by this report.

A. Amount of manure generated in the 12-month period covered by this report. _________ tons

B. Amount of litter generated in the 12-month period covered by this report. _________ tons

C. Amount of process wastewater generated in the 12-month period covered by this report. ________ gallons

III. MANURE, LITTER, AND PROCESS WASTEWATER TRANSFERRED TO OTHER PERSONS

Report the estimated amounts of manure, litter, and process wastewater that were transferred to other persons in the 12-month period covered by this report.

A. Amount of manure transferred in the 12-month period covered by this report. _________ tons

B. Amount of litter transferred in the 12-month period covered by this report. _________ tons

C. Amount of process wastewater transferred in the 12-month period covered by this report. ________ gallons

IV. LAND APPLICATION—ACRES COVERED BY PLAN

Report the total number of acres of land that are covered by the facility's nutrient management plan. Include all land application acres covered by the nutrient management plan, whether or not they were used for land application during the 12-month period covered by this report.

Total number of land application acres covered by the nutrient management plan. _______ acres

V. LAND APPLICATION—ACRES USED

Report the total number of acres of land where manure, litter, or process wastewater generated at the facility was spread. Include only land application areas that are under the control of this CAFO facility.

Total number of acres under the control of the CAFO used for land application of manure, litter, or process wastewater in the 12-month period covered by this report. ________ acres

VI. SUMMARY OF DISCHARGES

Provide a summary of each discharge of manure, litter, and/or process wastewater from the production area(s) that occurred in the 12-month period covered by this report. Attach additional sheets, if needed.

Date[a]	Time[b]	Volume[c]	Location[d,f]	Description[e,f]

a. **Date:** The date of the discharge. If the discharge was detected after it happened, give an estimate of the date when the discharge occurred.
b. **Time:** The time of the discharge. If the discharge was detected after it happened, give an estimate of the time when the discharge occurred.
c. **Volume:** Give an estimate of the number of gallons or tons of manure, litter, or process wastewater discharged.
d. **Location:** The location of the discharge. Provide a specific description of where the manure, litter, or process wastewater was discharged from the production area. Include names of nearby waterbodies, landmarks or other points of reference (e.g., Three Mile Creek, at southeast corner of feedlot where creek bends to the west).
e. **Description:** Provide other relevant information about the discharge, including the source, cause, composition (e.g., emergency overflow of process wastewater from lagoon #2), and impacts observed (e.g., fish kill in waterbody).
f. This information is not required by the NPDES CAFO regulations to be included in the annual report.

VII. NUTRIENT MANAGEMENT PLAN

Indicate whether the facility's nutrient management plan was developed or approved by a certified nutrient management planner. Note: The *[permitting authority]* does not require CAFO owners or operators to use a certified nutrient management planner to prepare or approve nutrient management plans.

Was the current version of this facility's nutrient management plan prepared or approved by a certified nutrient management planner? ❑ Yes ❑ No

VIII. LAND APPLICATION SUMMARY

A. Report the nitrogen (N) and phosphorus (P) content of manure, litter, and process wastewater using the results of the most recent representative manure, litter, and process wastewater tests for N and P. Report the form of N and P used for nutrient management planning purposes in the *Nutrient form* column.

Note: Large CAFOs using the linear approach and all CAFOs using the narrative rate approach must present results taken within 12 months of the date of land application of the manure, litter, and process wastewater.

				Nutrient form
Manure N Content	______	lbs/ton	as	______
Manure P Content	______	lbs/ton	as	______
Litter N Content	______	lbs/ton	as	______
Litter P Content	______	lbs/ton	as	______
Process Wastewater N Content	______	lbs/1,000 gallons	as	______
Process Wastewater P Content	______	lbs/1,000 gallons	as	______

B. For each field, report the actual crop(s) planted, the season (for multiple crops planted in one field), the actual crop yield, and the amount of manure, litter, process wastewater, and supplemental fertilizer applied to each field during the previous 12-month period. Attach additional sheets if necessary.

Field ID	Season	Crop planted	Crop yield (specify units)	Amount to be applied as calculated according to the NMP methodology			Actual amount applied		
				Manure (tons)	Litter (tons)	Process wastewater (gallons)	Manure (tons)	Litter (tons)	Process wastewater (gallons)

C. *Comments (E.g., "Actual amounts of manure applied are greater than the planned amounts due to a drop in the amount of N analyzed in the manure test.")*

D. *For CAFOs with NMPs developed using the narrative rate approach only as described under 40 CFR 122.42(e)(5)(ii)*: For each field used for land application, report the results of the most recent soil nutrient analyses for any soil test taken in the last 12 months.

Field ID	Most recent soil test results					Supplemental fertilizer (pounds/acre)	
	Nitrogen		Phosphorus			N applied	P applied
	ppm	N form	ppm	P form	method		
		as		as			
		as		as			
		as		as			
		as		as			
		as		as			
		as		as			
		as		as			

IX. INSTANCES OF NONCOMPLIANCE NOT PREVIOUSLY REPORTED

During the past 12 months have there been any instances of noncompliance that have not been reported to the permitting authority? ❑ Yes ❑ No If yes, please provide the information requested below.

Note: This information is required to be submitted under 40 CFR 122.41(l)(7) and 40 CFR 122.44(i)(2).

If during the past 12 months instances of noncompliance have occurred that have not been reported to the permitting authority please provide the following information, for each instance, along with this annual report:

- Description of the noncompliance and its cause.
- The period that the operation was in noncompliance with permit conditions, including exact dates and times.
- In cases where the noncompliance has not been corrected, the anticipated time it is expected to continue.
- Description of the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

X. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direct supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage this system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: ____ Date: _____________________

Print Name: ____

Submit by [*insert due date/reporting schedule*]

Submit to [*permitting authority and address*]

Appendix D

Example Nutrient Management Plan Recordkeeping Forms

CAFO Weekly Storage, Containment and Treatment Structure Inspections
Log Sheet

Facility Name: ______________________ NPDES Permit No.: ______________

Storage, Containment or
Treatment Structure: ______________________________

Instructions: Use this form to keep track of weekly visual inspections of the structures that you use to store, contain or treat manure, litter, and process wastewater. Use a separate form for each structure.

Keep track of your inspections each week in the table below. Provide the following information:

- the date of the inspection
- the initials of the inspector
- for open liquid waste storage structures, record the level indicated on the depth marker
- for open liquid waste storage structures, indicate whether the wastewater level was below the level required to maintain capacity to store the runoff and precipitation from a 25-year, 24-hour storm.
- use the "Notes" column to describe problems, if you find any, and how they might be fixed
- fill in the "date corrected" column with the date when you correct the problem

	Date	**Initials**	**Depth Marker Reading**	**Wastewater Below Pumping Level?**	**Notes** (Note any problems found and possible solutions.)	**Date Corrected**
Week 1						
Week 2						
Week 3						
Week 4						
Week 5						

	Date	Initials	Depth Marker Reading	Wastewater Below Pumping Level?	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 6						
Week 7						
Week 8						
Week 9						
Week 10						
Week 11						
Week 12						
Week 13						
Week 14						
Week 15						
Week 16						

	Date	Initials	Depth Marker Reading	Wastewater Below Pumping Level?	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 17						
Week 18						
Week 19						
Week 20						
Week 21						
Week 22						
Week 23						
Week 24						
Week 25						
Week 26						
Week 27						

	Date	Initials	Depth Marker Reading	Wastewater Below Pumping Level?	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 28						
Week 29						
Week 30						
Week 31						
Week 32						
Week 33						
Week 34						
Week 35						
Week 36						
Week 37						
Week 38						

	Date	Initials	Depth Marker Reading	Wastewater Below Pumping Level?	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 39						
Week 40						
Week 41						
Week 42						
Week 43						
Week 44						
Week 45						
Week 46						
Week 47						
Week 48						
Week 49						

	Date	Initials	Depth Marker Reading	Wastewater Below Pumping Level?	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 50						
Week 51						
Week 52						

CAFO Weekly Storm Water Diversion and Channel Inspections Log Sheet

Facility Name: ______________________________ NPDES Permit No.: ______________

Instructions: Use this form to keep track of weekly visual inspections of your storm water management structure(s) (including storm water and runoff diversion devices, and devices used to channel contaminated storm water to a wastewater storage or containment structure). List the items that need to be inspected below.

______________________________ ______________________________
______________________________ ______________________________
______________________________ ______________________________
______________________________ ______________________________

Keep track of your inspections in the following table by filling out one row each week when you inspect your storm water management structures. Provide the following information:

- the date of the inspection
- the initials of the inspector
- check the "OK" box if no problems were found
- use the "Notes" column to describe problems, if you find any, and how they might be fixed
- fill in the "date corrected" column with the date when you correct the problem

	Date	**Initials**	**OK** (✓ if no problems found)	**Notes** (Note any problems found and possible solutions.)	**Date Corrected**
Week 1					
Week 2					
Week 3					
Week 4					
Week 5					

	Date	Initials	OK (✓ if no problems found)	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 6					
Week 7					
Week 8					
Week 9					
Week 10					
Week 11					
Week 12					
Week 13					
Week 14					
Week 15					
Week 16					

	Date	Initials	OK (✓ if no problems found)	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 17					
Week 18					
Week 19					
Week 20					
Week 21					
Week 22					
Week 23					
Week 24					
Week 25					
Week 26					
Week 27					

	Date	Initials	OK (✓ if no problems found)	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 28					
Week 29					
Week 30					
Week 31					
Week 32					
Week 33					
Week 34					
Week 35					
Week 36					
Week 37					
Week 38					

	Date	Initials	OK (✓ if no problems found)	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 39					
Week 40					
Week 41					
Week 42					
Week 43					
Week 44					
Week 45					
Week 46					
Week 47					
Week 48					
Week 49					

	Date	Initials	OK (✓ if no problems found)	Notes (Note any problems found and possible solutions.)	Date Corrected
Week 50					
Week 51					
Week 52					

CAFO Nutrient Land Application Log Sheet

Facility Name: ______________________ **NPDES Permit No.:** ______________

Field ID (use the same field identification as used in the NMP): ______________ **Acres:** ______________

Instructions: Use this form to keep records of your land application activities. Maintain a separate sheet for each field. For each land application event, provide the following information in the table below:

- Date: the date that you applied manure, litter, or process wastewater to the field
- Source: the source (e.g., storage structure) of the manure, litter, or process wastewater applied
- Method: the method you used to apply the manure, litter, or process wastewater
- Weather Conditions: the weather conditions 24 hours before, during, and 24 hours after the land application event
- Amount Applied: The total tons of manure or litter or gallons of process wastewater applied
- Total N: the total amount of nitrogen you applied to the field
- Total P: the total amount of phosphorus you applied to the field

The following records also must be maintained on-site along with a current copy of your site-specific NMP:

- Expected crop yield
- Test methods used to sample and analyze manure, litter, soil, and process wastewater
- Results from manure, litter, process wastewater and soil sampling
- Explanation of basis for determining application rates
- Calculations for the total N and P planned to be applied and the total N and P actually applied
- Dates of land application equipment inspections.

Date	Source	Method	Weather Conditions			Amount Applied (specify gallons or tons)	Total N	Total P
			24 hours before	during	24 hours after			

Date	Source	Method	Weather Conditions			Amount Applied (specify gallons or tons)	Total N	Total P
			24 hours before	during	24 hours after			

Daily Water Line Inspection
Log Sheet

Facility Name: ______________________________ NPDES Permit No.: ______________

Instructions: Use this form to keep track of your daily water line visual inspections (including drinking and cooling water lines). Initial the form *each day* the after the inspection is done. Mark the "✓ if leak" column if you find a leak.

Year	January		February		March		April		May		June		July		August		September		October		November		December	
20___	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak	Initials	✓ if leak
1																								
2																								
3																								
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29																								
30																								
31																								

MANURE, LITTER, AND PROCESS WASTEWATER TRANSFER RECORD FORM

Facility Name: ______________________ NPDES Permit No. ______________

Instructions: Use this form to keep track of all manure, litter, and process wastewater generated at your CAFO facility that you transfer to other persons (i.e. for use or disposal on land not owned by or under the control of your CAFO). Use additional sheets as necessary.

Date of Transfer	Name of Recipient	Address of Recipient	Nutrient Analysis Provided to Recipient	Amount Transferred		
				Manure (tons)	Litter (tons)	Wastewater (gallons)

Appendix E

Minimum Depth of Rain at Which Runoff Begins

Minimum Depth of Rain at Which Runoff Begins

This appendix provides a methodology for estimating the minimum depth of precipitation required to produce runoff for a given field with a given runoff curve number.

Step 1: Estimate the runoff curve for the field or land area of concern. Table 3 in Appendix R provides curve numbers for various combinations of land uses (e.g., row crops), cover treatment or practices (e.g., contoured), and hydrologic conditions (e.g., poor). The runoff curve numbers in this table represent Antecedent Runoff Condition III (e.g., saturated soils). To identify corresponding runoff curve numbers for Antecedent Runoff Condition II (i.e., average conditions) use either Appendix R-3 or Tables 2-2b and 2-2c in Urban Hydrology for Small Watersheds, USDA-NRCS, 1986 (see Appendix E-2).

To predict the possibility of runoff where rainfall is forecast in a season other than winter, it may be reasonable to use runoff curves for Antecedent Runoff Condition II.

Step 2: Using Table 10-1 on page 10-7 of the USDA-NRCS National Engineering Handbook Part 630, Hydrology (see Appendix E-1); select the curve number (CN) for the field being investigated.

Step 3: For the selected curve number in Table 10-1, identify the minimum depth of precipitation in inches required to produce runoff for a given runoff curve number (Column 5, designated with the column header of Curve* starts where P =).

Appendix E-1

National Engineering Handbook Table 10-1 Curve Numbers (CN) and Constants for the Case $I_a = 0.2\ S$

Table 10–1 Curve numbers (CN) and constants for the case $I_a = 0.2S$

1	2	3	4	5
CN for ARC II	-- CN for ARC -- I	III	S values* (in)	Curve* starts where P = (in)
100	100	100	0	0
99	97	100	.101	.02
98	94	99	.204	.04
97	91	99	.309	.06
96	89	99	.417	.08
95	87	98	.526	.11
94	85	98	.638	.13
93	83	98	.753	.15
92	81	97	.870	.17
91	80	97	.989	.20
90	78	96	1.11	.22
89	76	96	1.24	.25
88	75	95	1.36	.27
87	73	95	1.49	.30
86	72	94	1.63	.33
85	70	94	1.76	.35
84	68	93	1.90	.38
83	67	93	2.05	.41
82	66	92	2.20	.44
81	64	92	2.34	.47
80	63	91	2.50	.50
79	62	91	2.66	.53
78	60	90	2.82	.56
77	59	89	2.99	.60
76	58	89	3.16	.63
75	57	88	3.33	.67
74	55	88	3.51	.70
73	54	87	3.70	.74
72	53	86	3.89	.78
71	52	86	4.08	.82
70	51	85	4.28	.86
69	50	84	4.49	.90
68	48	84	4.70	.94
67	47	83	4.92	.98
66	46	82	5.15	1.03
65	45	82	5.38	1.08
64	44	81	5.62	1.12
63	43	80	5.87	1.17
62	42	79	6.13	1.23
61	41	78	6.39	1.28
60	40	78	6.67	1.33
59	39	77	6.95	1.39
58	38	76	7.24	1.45
57	37	75	7.54	1.51
56	36	75	7.86	1.57
55	35	74	8.18	1.64
54	34	73	8.52	1.70
53	33	72	8.87	1.77
52	32	71	9.23	1.85
51	31	70	9.61	1.92
50	31	70	10.0	2.00
49	30	69	10.4	2.08
48	29	68	10.8	2.16
47	28	67	11.3	2.26
46	27	66	11.7	2.34
45	26	65	12.2	2.44
44	25	64	12.7	2.54
43	25	63	13.2	2.64
42	24	62	13.8	2.76
41	23	61	14.4	2.88
40	22	60	15.0	3.00
39	21	59	15.6	3.12
38	21	58	16.3	3.26
37	20	57	17.0	3.40
36	19	56	17.8	3.56
35	18	55	18.6	3.72
34	18	54	19.4	3.88
33	17	53	20.3	4.06
32	16	52	21.2	4.24
31	16	51	22.2	4.44
30	15	50	23.3	4.66
25	12	43	30.0	6.00
20	9	37	40.0	8.00
15	6	30	56.7	11.34
10	4	22	90.0	18.00
5	2	13	190.0	38.00
0	0	0	infinity	infinity

* For CN in column 1.

Appendix E-2

USDA Urban Hydrology for Small Watersheds (TR-55)

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Appendix E-3

Instructions for Determining Precipitation Forecasts for CAFO Permits Using the National Weather Service Website

WARNING: Do not be intimidated. This is much easier then it may seem at first. Once you learn how to do this and save the results in your Favorites you can check both forecasts in less then a minute (or up to a few minutes depending on your internet connection speed). In fact, you may find these forecast models useful in planning other areas of work on your farm.

Start at this website: *www.weather.gov/mdl/synop/products.php*. Once you are there you may wish to save it in your Favorites. If the website has changed or the required forecast models are not longer available, please contact the Michigan Department of Environmental Quality Office listed on your Certificate of coverage or on the cover page of your permit

1. Click on "Forecast Graphics" in the "GFS MOS (MAV)" box (near the center of the page).
2. In the column on the left side, in the drop down box under "Precipitation", click on "24H Prob.>= 0.50 in.". Note: if it has been determined that a smaller precipitation event is capable of producing runoff or erosion then use a smaller precipitation probability such as "24H Prob. >=0.25 in.".
3. This will bring up a map of the U.S. showing precipitation probabilities as colored bands or areas for the upcoming 24 hour period. Precision is not ideal because it covers all of the U.S. but estimate the color for the proposed land application area. If the precipitation probability is 70% or greater (blue shades) then you should not land apply. You can save the map in your favorites.
4. Underneath the map are day & time boxes such as "Tuesday" and "00" and "12". That would be Tuesday midnight and noon, GMT (Greenwich Mean Time) which is 5 hours ahead of EST (Eastern Standard Time) and 4 hours ahead of EDT (Eastern Daylight Time). So "Tuesday 00" would be 7 p.m. EST or 8 p.m. EDT Monday. The map forecast is for the 24 hour period ending at the highlighted time. The first box, which will be highlighted when you bring up the map, will give the map for the upcoming 24 hour period. You can click on subsequent time periods to see future forecasts. You should always check the immediate upcoming 24 hour forecast just prior to a planned land application event.

After you have finished checking the maps use your back button or go to your Favorites to return to the above website.

1. Click on "Text Message By Station List" in the "GFS MOS (MEX)" box (toward the right side on the page).
2. In the list of states on the left side click on "Michigan".

3. In the list that comes up on the right side click in the box for the station closest to the land application location. You may need to select 2 or 3 stations if none are close to the land application area. If selecting more then one station, note the 4-letter station designation after each station name so you know which chart is for which station.

4. Once you have selected the station(s) scroll to the bottom of the Michigan station list and click on "Go to the bottom to submit now". Then click on the "Submit Query" box.

5. You will now have a very confusing chart for each selected station (you can save this page in your Favorites). Look down the left hand column for "Q24" and read across the first number. It will be one digit from 0 to 6. This is the only number you need to be concerned with. This number is the quantity precipitation forecast for the upcoming 24 to 48 hour period. 0 = no precipitation, 1 = 0.01" to 0.09", 2 = 0.1" to 0.24", 3 = 0.25" to 0.49", 4 = 0.5" to 0.99", 5 = 1.0" to 1.99" and 6 = > 2.0". If it is 4 or greater you may not land apply. Note: if it has been determined that a smaller precipitation event is capable of producing runoff or erosion then use a smaller precipitation quantity forecast number. For example, if 0.35" of precipitation in 24 hours on a particular field will produce runoff or erosion then you may not land apply if the number is 3 or greater.

6. You may need to check the charts 2 or 3 times in advance of a planned land application event to determine the precipitation amount forecasted for the land application time frame.

In the event that you are immensely curious as to what all the rest of the data on these charts mean, then go back to the website at the top on these instructions and in the left hand column click on "GFS Description" to get to an explanation page.

Once you have saved the map and charts in your Favorites, you can click on those links and get to the current map or chart(s) with just one click!

Appendix F

Voluntary Alternative Performance Standards for CAFOs

Introduction

The examples in this appendix are for informative purposes only. The examples assume, but do not guarantee, that the confined animal feeding operation (CAFO) meets all applicable federal, state, and local requirements.

The U.S. Environmental Protection Agency's (EPA's) long-term vision for CAFOs includes continuing research and progress toward environmental improvement. CAFOs, U.S. Department of Agriculture (USDA), land grant universities, state agencies, equipment vendors, and other agricultural organizations are now working to develop new technologies to reduce nutrient, pathogen, and other pollutant losses to surface water; ammonia and other air emissions; and groundwater contamination from animal manure. In the future, as those technologies are developed and improved, EPA believes that they could offer CAFOs the potential to match or surpass the pollutant reduction achieved by complying with the current requirements. EPA believes that some CAFOs will voluntarily develop and install new technologies and management practices equal to or better than the current requirements described in the CAFO rule of this manual in exchange for being allowed to discharge the treated effluent. (For the purposes of this appendix, the current technology controls required under the CAFO effluent limitation guidelines (ELG) described in the CAFO rule will be referred to hereafter as the *baseline* technology requirements.) That is why EPA has created the voluntary performance standards program for CAFOs.

This appendix presents an overview of the baseline requirements and the *voluntary performance* standards program, which includes a description of who can participate in the program, how participation in the program will affect existing CAFO National Pollutant Discharge Elimination System (NPDES) permits, and a step-by-step description of the requirements associated with program participation.

A. Overview of the Baseline Requirements

As described in the CAFO rule, the baseline production area requirements for all existing beef, dairy, heifer, veal, swine, and poultry CAFOs are the same. However, baseline requirements vary for new operations. A summary of the requirements is presented in Table F-1.

Table F-1. Summary description of baseline requirements

Existing and new large beef, dairy, heifer and existing large swine, poultry and veal CAFOs
1. Baseline requirements prohibit the discharge of manure and process wastewaters. 2. A CAFO may discharge when rainfall events cause an overflow from a storage structure designed, constructed, operated, and maintained to contain the following: • All manure, litter, and all process wastewaters including manure, wastewater, and other wastes accumulated during the storage period as reflected by the design storage volume • Direct precipitation from a 25-year, 24-hour rainfall event • Associated runoff from a 25-year, 24-hour rainfall event

B. Overview of the Voluntary Performance Standards Program

Under the voluntary performance standards program, existing and new Large beef, heifer, and dairy CAFOs and existing Large swine, poultry, and veal CAFOs are allowed to discharge process wastewater that have been treated by technologies that the CAFO demonstrates results in equivalent or better pollutant removals from the production area than would otherwise be achieved by the baseline requirements.

Program Benefits

CAFOs are expected to derive substantial benefits from participating in this program through greater flexibility in operation, increased goodwill of neighbors, reduced odor emissions, potentially lower costs, and overall improved environmental stewardship. EPA is considering other possible incentives to encourage participation in this program.

B.1. Program Participation

All CAFOs electing to participate in the program should have a good compliance history (e.g., no ongoing violations of existing permit standards or history of significant noncompliance). In most cases, participation will result in an individual NPDES permit addressing the site-specific nature of the alternative technology and establishing site-specific discharge limitations.

B.2. Pollutants of Concern

In general, all CAFOs applying for the voluntary performance standards program must design the treatment technology to achieve equal or less quantities of 5-day biochemical oxygen demand (BOD_5), total nitrogen (N) (ammonia, nitrite/nitrate, and organic N), total phosphorus (P), and total suspended solids (TSS) than the baseline system. EPA selected those parameters because of their high concentrations in manure-type wastestreams and their impact on surface water quality if not treated. In addition, many conventional wastewater treatment technologies, in the process of treating those four selected pollutants, will result in treatment and removal of other pollutants. To qualify for voluntary alternative performance standards, the CAFO may also be required to remove other specific pollutants, such as pathogens and metals, if such pollutants are present in the wastestream at concentrations that could affect surface water quality, as determined appropriate by the permitting authority.

B.3. Required Technical Analysis

CAFOs requesting site-specific effluent limitations to be included in NPDES permits must submit a supporting technical analysis and any other relevant information and data that would support such site-specific effluent limitations. For more information, see Section C of this appendix.

B.4. Validation of Equivalent Pollutant Reductions

The CAFO must attain the limitations and requirements of a permit on the basis of alternative technologies as of the date of permit coverage (Title 40 of the *Code of Federal Regulations* [CFR] section 412.31(a)(3). If those alternative limits will not be met as of the date of permit coverage, such as because of startup of certain wastewater treatment technologies, the permitting authority would need to incorporate a compliance schedule into an enforceable order that would establish milestones for implementing the alternative technologies and fully meeting the permit limitations. The permitting authority should consider whether it is appropriate to select a permit term that is less than 5 years to allow the permitting authority to evaluate whether the alternative technologies have resulted in the permit limitations being met.

If the permitting authority grants a request for voluntary alternative performance standards, the CAFO should, at a minimum, be required to take monthly effluent samples from the treatment system to verify continued permit compliance. The permitting authority may determine that the CAFO must take more frequent samples (such as during startup) or collect samples on a basis other than monthly (such as during all discharge events in the case of intermittent discharging technologies). CAFOs should be required to analyze for the following pollutants: BOD_5, total N, total P, and TSS. The permitting authority may also require a CAFO to monitor other pollutants regularly. If monthly pollutant discharges from the alternative treatment system are greater than specified in the NPDES permit, a CAFO could be subject to both state and EPA enforcement actions.

General versus Individual NPDES Permits

A general NPDES permit is written to cover a category of point sources with similar characteristics for a defined geographic area. The majority of CAFOs may appropriately be covered under NPDES general permits because CAFOs generally involve similar types of operations, require the same kinds of effluent limitations and permit conditions, and discharge the same types of pollutants.

Individual NPDES permits might be most appropriate for CAFOs that are exceptionally large operations, are undergoing significant expansion, have historical compliance problems, or have significant environmental concerns. Individual permits will generally include all the permit conditions contained in the general NPDES permit and some additional requirements specific to the permitted facility. Additional requirements could include liners and covers for manure and wastewater storage units and more frequent water quality monitoring.

B.5. Relationship to Existing NPDES Permits

EPA expects that most CAFOs will be subject to a general, rather than an individual, permit that requires compliance with the baseline effluent guidelines requirements. If a CAFO decides to pursue voluntary performance standards based on a treatment technology that allows a discharge, EPA expects the permit authority to require the CAFO prepare and submit an application for an individual NPDES permit. The application will include general information about the CAFO (e.g., ownership, responsible persons, location, receiving stream), waste characteristics, information about the treatment system including design and operational parameters, and expected effluent quality from the proposed treatment system. A CAFO may not discharge from the alternative treatment system until the permitting authority has issued an NPDES permit that allows the discharge.

C. Step-By-Step Requirements for Participation in the Voluntary Performance Standards Program

The voluntary performance standards program has two main requirements: the CAFO must estimate the pollutant discharge associated with the baseline system and must demonstrate that the alternative treatment technology achieves an equivalent or better reduction in the quantity of pollutants discharged from the production area. This section provides detailed recommendations for how such showings should be made, along with a description of the information that must be submitted to the permitting authority to obtain alternative performance standards.

C.1. Determining Baseline Pollutant

If a CAFO decides to participate in the voluntary performance standards program, the CAFO must conduct a technical analysis to estimate the pollutant discharge associated with the baseline[1] waste management system (e.g., anaerobic treatment lagoon). At a minimum, the technical analysis must include the information in the text box at right [see 40 CFR part 412.31(a)(2)].

In a limited number of circumstances, the calculated median annual overflow volume based on a 25-year period of actual rainfall data may be zero. In those instances, the permit authority may allow the CAFO to calculate an average overflow volume for the 25-year period.

One approach for estimating pollutant discharges is to use a computer simulation model, spreadsheet, or similar program. One can either develop a new model or revise an existing model that estimates pollutant discharges from waste management systems. The models can be used to evaluate site-specific climate and wastewater characterization data to project the pollutant discharge from a baseline system. The model should evaluate the daily inputs to the waste management system, including all manure, litter, all process wastewaters, direct precipitation, and runoff. The model should also evaluate the daily outputs from the waste management system, including losses due to evaporation, sludge removal, and the removal of wastewater for use on cropland at the CAFO or transported off-site. CAFOs can use the model to predict the median annual overflow from the storage system that would occur over a 25-year period. Next, the CAFO should use the overflow predictions, combined

Technical Analysis of Discharge

40 CFR part 412.31(a)(2) …The technical analysis of the discharge of pollutants must include

(A) All daily *inputs* to the storage system, including manure, litter, all process waste waters, direct precipitation, and runoff.

(B) All daily *outputs* from the storage system, including losses due to evaporation, sludge removal, and the removal of wastewater for use on cropland at the CAFO or transport off site.

(C) A calculation determining the predicted median annual overflow volume based on a 25-year period of actual rainfall data applicable to the site.

(D) Site-specific pollutant data, including N, P, BOD_5, TSS, for the CAFO from representative sampling and analysis of all sources of input to the storage system, or other appropriate pollutant data. (E) Predicted annual average discharge of pollutants, expressed where appropriate as a mass discharge on a daily basis (lbs/day), and calculated considering paragraphs (a)(2)(i)(A) through (a)(2)(i)(D) of this section.

with representative pollutant concentrations in the overflow, to predict the annual average discharge of pollutants (including nitrogen, phosphorus, BOD_5, and TSS) over the 25 years evaluated by the model. For the complete list, see 40 CFR part 412.31(a)(2)(i)(E).

Site-specific information that a CAFO should gather and input to the model to calculate the predicted annual discharge of pollutants from the baseline system includes the following [also see 40 CFR part 412.31(a)(2)]:

- Data on actual local precipitation from the past 25 years. Precipitation data are available from the National Weather Service and possibly a local airport. One can also obtain local precipitation data from EPA's Better Assessment Science Integrating point and Nonpoint Sources (BASINS) model at *http://www.epa.gov/OST/BASINS/b3webwn.htm*. State weather data are at *http://www.epa.gov/ost/ftp/basins/wdm_data/*. Historical weather can also be obtained from National Climatic Data Center.
- Soil type and permeability in drylot areas. Site-specific soil permeability data can be obtained from the local Soil Conservation District office.
- The rate of evaporation from the storage system (e.g., lagoon, pond, holding tank). Evaporation rate data are available from the National Weather Service or EPA's BASINS model website.
- The concentration of BOD_5, total N, total P, TSS, and other pollutants as required by the Director, measured in a representative sample collected from the waste management system.
- Starting volume in the waste management system based on process wastes and runoff collected since the last land application or waste management system pump-out or sludge cleanout or both.
- Projected total design storage volume to store manure, wastewater, and other wastes accumulated during the storage period as reflected by the design storage volume (see Chapter 5.3 of this document).
- Change in the waste management system's volume due to the estimated daily flow of process wastes.
- Change in the storage system volume due to direct precipitation and evaporation.
- Change in the storage system volume due to runoff from open lot areas.
- Change in volume due to waste management system pump-out or sludge cleanout and land application.

The model should calculate the net change in the volume of the liquid storage area daily and add it to the previous day's total. If the total volume is greater than the maximum design volume, the excess volume overflows. Also, CAFOs can calculate the mass pollutant discharge from the overflow by multiplying the overflow by the pollutant concentration (BOD_5, total N, total P, TSS) measured in the representative sample.

Examples 1 and 2 at the end of this appendix present the results of a technical analysis conducted for example dairy and swine CAFOs, respectively.

C.2. Demonstrating That an Alternative Control Technology Achieves Equivalent or Better Pollutant Reductions

EPA recommends that CAFOs follow the steps shown below to demonstrate that an alternative control technology will achieve equivalent or better pollutant reductions:

- Measuring volume or quantity of manure, wastewater, and runoff generation from production areas.
- Collecting samples of manure, wastewater, and runoff to determine raw or untreated pollutant concentrations for treatment system design using the same pollutant parameters as measured for a baseline.
- Preparing a conceptual design of the treatment system showing equipment sizing, operational requirements, and expected pollutant reductions by each treatment step.
- Estimating the volume and frequency of discharge from the treatment system.
- Estimating or measuring the concentration of the effluent from the treatment system.
- Results of pilot testing to verify the treatment system will achieve equivalent or better pollutant reductions than baseline for all required constituents (including BOD_5, total N, total P, and TSS) and to gather information for design of the full-scale treatment system. Any pilot testing needs to be related to representative/typical production and climate conditions expected at the CAFO. Therefore, multiple testing episodes or sites might be necessary to adequately capture the actual conditions at the CAFO. Consider on-site pilot testing to demonstrate that the proposed system will work at the CAFO.

Examples 1 and 2 summarize the methods that could be used by the example CAFOs to determine if an alternative treatment system performed equivalent to or better than the baseline system. In the examples, the permit authority would require the CAFO to continue to collect testing data until the alternative technology has been proven at the site. Thereafter, the CAFO might need to collect samples only frequently enough to demonstrate compliance with their NPDES permit limitations.

Can a CAFO Demonstrate Equivalency Using Practices Already in Existence at the Site?

Yes. If the practices already in place at the operation provide equivalent or better pollutant reductions than the predicted average annual pollutant discharge for the baseline requirements, the CAFO can apply for an alternative performance standard. Example 3 shows how data from an existing pollution prevention/treatment system were compared to the baseline system to develop site-specific permit limits for an egg production facility.

C.3. Obtaining an Alternative Performance Standard

The next step in participating in the voluntary performance standards program is to submit an application to the permitting authority along with the technical analyses, conceptual design, results of any pilot-scale testing and any other relevant data before constructing the full-scale treatment system. The permitting authority should review the application, technical analyses, and conceptual design, and then compare the pilot-scale testing results with the predicted annual average discharge of pollutants to verify that the proposed treatment system is reasonable, appropriate, and will likely achieve the predicted results. In addition, the permit authority should confirm that the quantity of pollutants discharged from the production area is equal to or less than the quantity of pollutants discharged under baseline. The Director has the discretion to request additional information to supplement the CAFO's application, including conducting an on-site inspection of the CAFO. 40 CFR § 412.31(a)(2)(E)(ii). Once an application is approved, a CAFO can proceed with detailed design and construction of the alternative control technology. After the treatment system's construction but before start-up [see 40 CFR part 412.31(a)(3)], the CAFO must obtain an NPDES permit specifying the discharge limitations. Also see Section B.4 of this appendix.

Footnotes

1 Recall a baseline system at the CAFO is a system that meets the requirements as described in the CAFO Rule [see 40 CFR part 412.31(a)(1)].

Example 1. Whole Milk Dairy, Lancaster, Pennsylvania

Background

Whole Milk Dairy (WMD) is a Large CAFO in Lancaster County, Pennsylvania. WMD milks 1,200 dairy cows per day, plus manages 400 heifers and 400 calves. Milk cows are confined in a 550,000-square-foot-area containing three free stall barns, the milking parlor, and yard. Free stall barn alleys are cleaned three times a day (every 8 hours) using a flush system. Sawdust is used for bedding in the free stall barn. Silage is kept covered. All flush water, cow wash-water, and parlor cleanup and sanitation water is directed to the existing 3,351,252-cubic-foot manure holding lagoon.

All liquids in the holding lagoon are applied to crop land four times each year consistent with the site's NMP. Thus, the lagoon has 90 days of storage capacity. To help show the storage structure has adequate capacity, WMD assumes that the storage volume is never less than the accumulated sludge volume plus the minimum treatment volume. Although solids are periodically removed and thus more volume is available to store process wastewater, runoff, and precipitation, this conservative assumption reserves the sludge volume for the maximum amount of accumulated solids over the storage period.

Approximately 40 percent of the milk cow confinement area is paved or roofed. Precipitation from roofed areas drains onto the paved portion of the milk cow confinement area before being discharged to the manure holding lagoon. All paved areas have curbing to contain manure and precipitation. Unpaved areas have reception pits to collect manure and precipitation before discharge to the manure holding lagoon. Heifers and calves are managed on a non-paved 300,000-square-foot-dry lot that discharges to the manure holding lagoon. Any overflows from the lagoon might eventually reach a receiving surface waterbody (in this case, the Susquehanna River).

Summary of baseline overflow volume and pollutant loading calculations

Process Wastewater Generation:	25,857 ft^3/day (193,400 gal/day)
Sludge Volume (constant):	870,807 ft^3
Minimum Treatment Volume (constant):	1,530,000 ft^3
Total Existing Storage Lagoon Volume:	3,351,252 ft^3 (25 million gallons)
Volume in Lagoon at Start:	2,400,807 ft^3 (Sludge Volume + Minimum Treatment Volume)
Precipitation Volume (median):	40 in/yr
Evaporation Rate (median):	57 in/yr
Runoff (median):	17,033 ft^3/yr
Liquid/Solids Removal for Crop Application:	Completely dewater all lagoon liquids four times per year

Calculated baseline overflow volume method

Daily Accumulation of Lagoon Liquids (ft^3/day) = Process Waste (ft^3/day) + Runoff (ft^3/day) + ((Precipitation-Evaporation (ft/day)) x Lagoon Surface Area (ft^2)

Volume of Lagoon Liquids (ft^3) = Previous Days' Volume (ft^3) + Daily Accumulation of Lagoon Liquids Volume (ft^3/day)

Example 1. Whole Milk Dairy, Lancaster, Pennsylvania *(continued)*

If the Volume of Lagoon Liquids (ft^3) is greater than the following:

Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)], then

Overflow Volume = Volume of Lagoon Liquids (ft^3) - [Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]; and

Volume of Lagoon Liquids (ft^3) is adjusted to the following:

[Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)] (the maximum volume of liquids the lagoon can store)

If it is a land application day:

The Volume of Lagoon Liquids (ft^3) = 0

Calculated Overflow Volume for WMD: 57,386 ft^3/yr (429,247 gal/yr)

WMD collected a representative sample of liquid from the storage lagoon to calculate the annual pollutant discharge of BOD_5, total N, total P, and TSS as a result of the overflow volume. The sample was collected from the top 12 inches of the lagoon surface because the majority of overflow will likely be attributed to that zone. The sampling results are shown below:

BOD_5:	600 mg/L	(5.0 lbs per 1,000 gallons)
Total N:	268 mg/L	(2.2 lbs per 1,000 gallons)
Total P:	208 mg/L	(1.7 lbs per 1,000 gallons)
TSS:	1,500 mg/L	(12.5 lbs per 1,000 gallons)

On the basis of the overflow and the measured concentration, the annual pollutant discharges from the lagoon were calculated by multiplying the flow by the concentration as shown in the example for BOD_5 below:

$$BOD_5\text{: 600 mg/L x 3.785 L/gal x 429,247 gal/yr x 2.2 lbs/kg x 1 kg/}10^6\text{ mg = 2,145 lbs/yr}$$

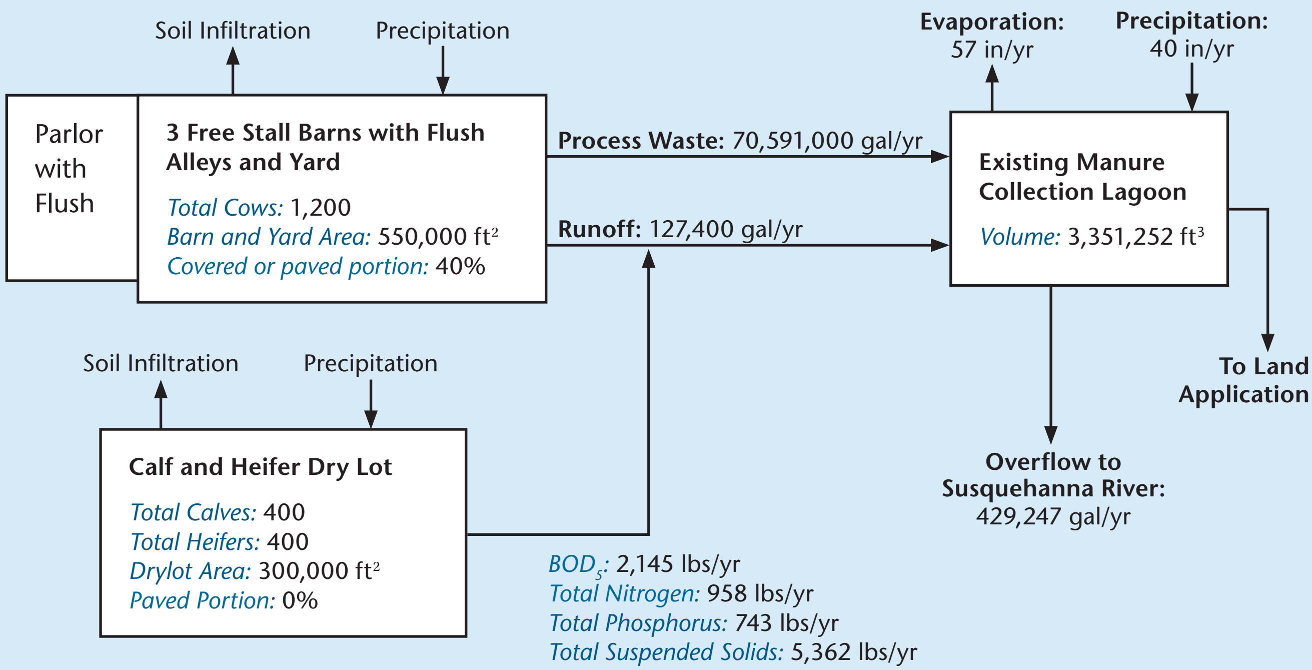
A summary of the pollutant loadings based on the overflow rate and concentration is shown below.

BOD_5:	2,145 lbs/yr
Total N:	958 lbs/yr
Total P:	743 lbs/yr
TSS:	5,362 lbs/yr

Example 1. Whole Milk Dairy, Lancaster, Pennsylvania *(continued)*

Diagram of baseline waste management system

The following figure is a block diagram of WMD summarizing the inputs and outputs from the manure storage lagoon and the overflows and pollutant loadings. Any overflows from the lagoon eventually reach a surface waterbody (in this case, the Susquehanna River).



Waste characterization and alternative treatment system evaluation

WMD in cooperation with its consultant, Tick Engineering, has decided to voluntarily pursue an alternative to its existing lagoon to have a constant discharge of treated water to the Susquehanna River. The treatment train it selected consists of primary clarification, aerobic biological treatment, and final polishing using an engineered wetland. Tick Engineering conducted pilot-scale testing of the system June 15 to November 15 at WMD using actual process wastewater. The conceptual design calculations and pilot-scale treatment test are summarized below.

Waste flow and characterization

Tick Engineering conducted a daily composite sample of manure, flush water, wash water, parlor cleanup and sanitation water and rainwater during a 7-day operational period in April 2003 to characterize the wasteload discharged to the storage lagoon. The combined volume of manure, flush water, wash water, parlor cleanup water and rainwater was also measured during the 7-day sampling period in April, 2003. The average daily flow to the lagoon, which included one day of rainfall was 176,410 gallons. Waste characterization data and calculated average daily loading to the treatment system are summarized below:

Example 1. Whole Milk Dairy, Lancaster, Pennsylvania *(continued)*

Pollutant	Concentration (mg/L)	Influent (lbs/day)
BOD_5:	1,701	2,496
Total N:	478	702
Total P:	74	109
TSS:	12,269	18,018

Daily pollutant loadings were calculated by multiplying the concentration for each constituent by the average daily flow as shown in the example below for BOD_5:

BOD_5 Loading: 1,701 mg/L x 3.785 L/gal x 1 kg/1,000,000 mg x 2.2 lbs/kg x 176,410 gal/day = 2,496 lbs/day

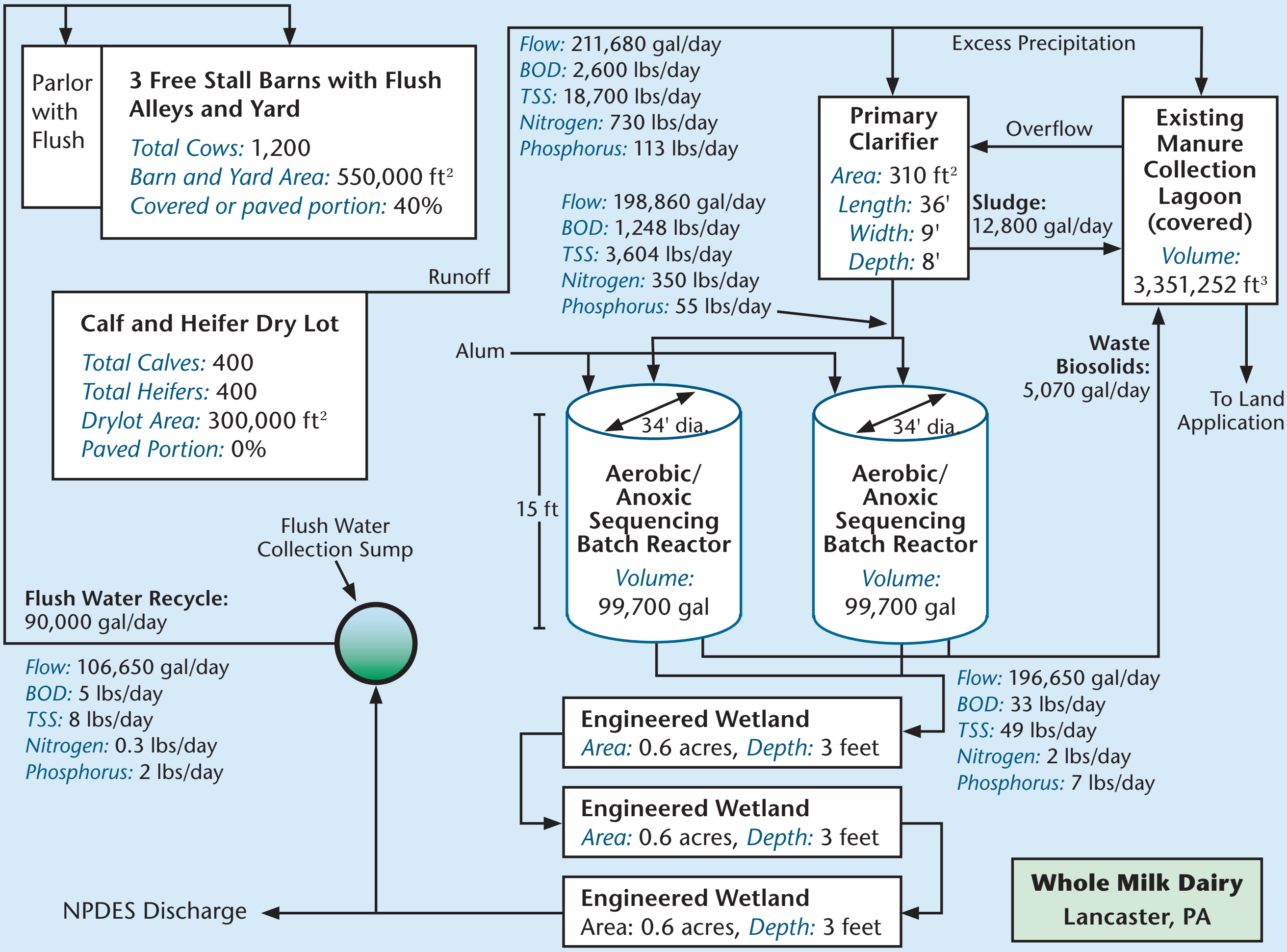
The treatment system design is based on a flow excess of 20% or 211,690 gallons per day. Flows greater than 211,690 gal/day will overflow back to the existing 3,351,252-cubic-foot lagoon. During dry-weather periods, excess water and direct precipitation from the lagoon will be pumped back to the beginning of the treatment system for processing. The following figure is a flow diagram showing the treatment equipment and sizes, flows in and out of each treatment unit, and the pollutant reductions by each treatment step. Note that WMD will have the capability of recycling nearly 90,000 gallons per day of treated effluent for manure flushing.

Alternative treatment system effectiveness

The average concentration of target pollutants measured in the effluent from the pilot-scale treatment system during the 6-month study is shown below. The calculated monthly loadings for the full-scale treatment system is based on an average daily flow of 176,410 gallons entering the treatment system minus a recycle flow of 90,000 gallons per day for manure flushing.

Example 1. Whole Milk Dairy, Lancaster, Pennsylvania *(continued)*

Diagram of alternative treatment system



Comparison of the baseline overflow to the discharge from the alternative treatment system

Pollutant	Baseline overflow (lbs/yr)	Treatment system discharge (lbs/day)
BOD_5:	2,145	1,830
Total N:	958	110
Total P:	743	730
TSS:	5,362	2,920

Conclusion: The loadings comparison clearly shows the proposed treatment system consisting of primary clarification, aerobic biological treatment and final polishing using an engineered wetland would achieve a quantity of pollutants discharged from the production area that is equal to or less than the quantity of pollutants that would be discharged using baseline treatment. Note: This analysis pertains to the technology-based requirements of the CAFO rules and does not include an assessment of whether a discharge would meet the state's water quality standards.

Example 2. KF Pork Producers, Davenport, Iowa

Background

KF Pork Producers (KFP) is a Large CAFO in Scott County, Iowa. KFP has 7,000 grower swine with an average weight of approximately 140 pounds. Swine are housed in a 57,400-square-foot-barn with 10 confinement pens. Manure is washed from pens daily using a flush system. All manure and flush water drains into storage tanks beneath the partially slotted concrete floor. Storage tanks are emptied daily by pumping the manure and flush water to an existing 3,931,800-cubic-foot manure holding lagoon.

KFP, in consultation with local residents, avoids de-watering the storage structure on weekends and holidays. Liquids in the holding lagoon are applied to crop land (to the maximum daily hydraulic loading) on the 7th, 14th, 21st, and 28th days of each month during the freeze-free period between April 21 and September 14, assuming that there has been no significant precipitation during the 3 days before the day of application. (The nutrient applications are tracked by KFP's NMP and are not further considered here.) KFP assumes that the storage volume is never less than the accumulated sludge volume plus the minimum treatment volume. Although there are times that solids are removed and more space is available for process wastewater, runoff, and precipitation, that conservative assumption reserves storage space for the maximum amount of accumulated solids over the storage period.

Summary of baseline overflow volume and pollutant loading calculations

Process waste generation:	8,356 ft^3/day (62,500 gal/day)
Sludge Volume (constant):	486,091 ft^3 (3.6 million gal)
Minimum Treatment Volume (constant):	661,500 ft^3 (4.9 million gal)
Total Existing Storage Lagoon Volume:	3,931,800 ft^3 (29.4 million gal)
Volume of Liquids and Solids in Lagoon at Start:	1,206,083 ft^3 (Sludge Volume + Minimum Treatment Volume + Accumulated Process Wastes Since Last Liquid Application)
Precipitation Volume (average):	26 in/yr
Evaporation Rate (average):	98 in/yr
Liquid/Solids Removal for Crop Application:	Land apply lagoon liquids to the maximum hydraulic loading of the crop land on days 7, 14, 21, and 28 of each month unless there has been precipitation in the past 3 days before the application day (That occurs between the freeze-free days between April 21 and September 14)

Calculated baseline overflow volume method

Daily Accumulation of Lagoon Liquids (ft^3/day) = Process Waste (ft^3/day) + [Precipitation – Evaporation] (ft/day) x Lagoon Surface Area (ft^2)

Volume of Lagoon Liquids (ft^3) = Volume of Lagoon Liquids from Previous Day (ft^3) + Daily Accumulation of Lagoon Liquids (ft^3)

Example 2. KF Pork Producers, Davenport, Iowa *(continued)*

If the Volume of Lagoon Liquids (ft^3) is greater than the following:

Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)], then

Overflow Volume = Volume of Lagoon Liquids (ft^3) - [Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]; and

Volume of Lagoon Liquids (ft^3) is adjusted to the following:

[Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]
(the maximum volume of liquids the lagoon can store)

If it is an application day (day 7, 14, 21, or 28 of the period between April 21 and September 14), the Volume of Lagoon Liquids (ft^3) = Volume of Lagoon Liquids (ft^3) - Max Hydraulic Loading (ft3)

Calculated Overflow Volume for KFP: 158,419 ft^3/yr (1,184,970 gal/yr)

KFP collected a representative sample of liquid from the storage lagoon to calculate the annual pollutant discharge of BOD_5, total N, total P, and TSS as a result of the overflow volume. The sample was collected from the top 12 inches of the lagoon surface because the majority of overflow will likely be attributed to that zone. The sampling results are shown below:

BOD_5:	1,650 mg/L
Total N:	270 mg/L
Total P:	102 mg/L
TSS:	3,000 mg/L

On the basis of the overflow and the measured concentration, the annual pollutant discharges from the lagoon were calculated by multiplying the flow by the concentration as shown in the example for BOD_5 below:

BOD_5: 1,650 mg/L x 3.785 L/gal x 1,184,970 gal/yr x 2.2 lbs/kg x 1 kg/10^6 mg = 16,280 lbs/yr

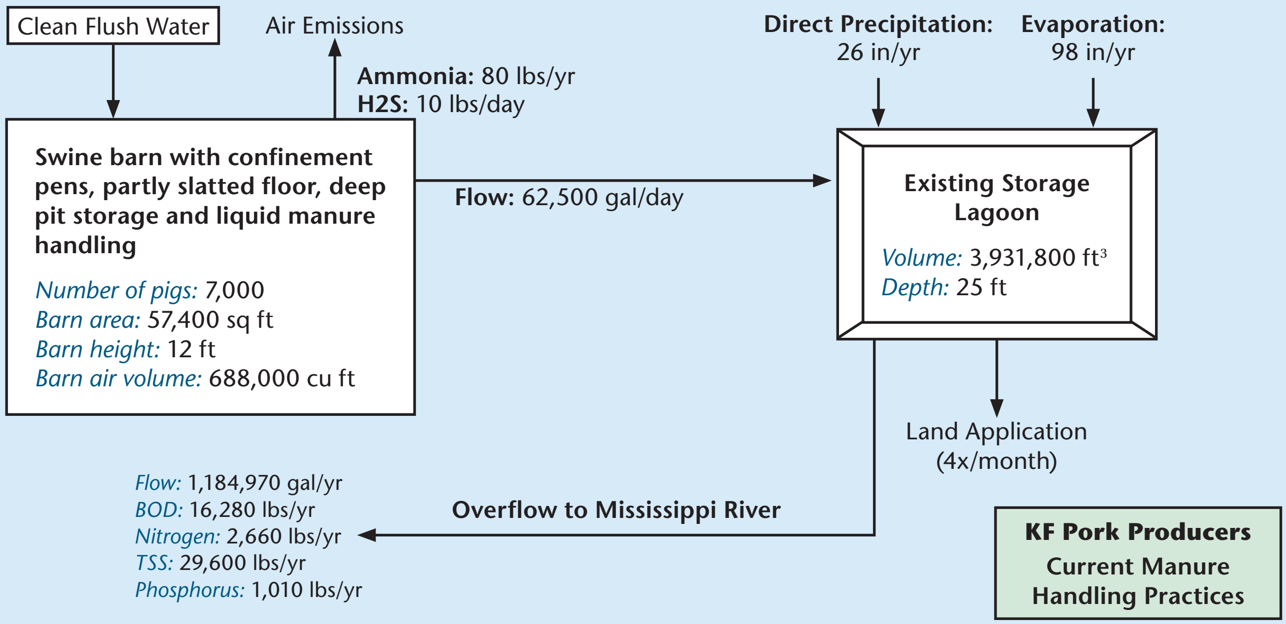
A summary of the pollutant loadings based on the overflow rate and concentration is shown below.

BOD_5:	16,280 lbs/yr
Total N:	2,660 lbs/yr
Total P:	1,010 lbs/yr
TSS:	29,600 lbs/yr

Example 2. KF Pork Producers, Davenport, Iowa *(continued)*

Diagram of baseline waste management system

The following figure is a block diagram of KFP summarizing the inputs and outputs from the manure storage lagoon and the overflows and pollutant loadings. Any overflows from the lagoon discharge to a surface waterbody (in this case, the Mississippi River).



Waste characterization and treatment system evaluation

KFP realized it was not cost-effective to haul excess nutrients in the liquid manure. KFP, in cooperation with its consultant, WB Engineering, conducted a whole-farm audit to determine if pollutant releases could be reduced at the facility by applying new technologies. WB Engineering examined discharges of pollutants from lagoon overflows, estimated air emissions of ammonia and hydrogen sulfide, and worked with KFP to determine if changes in swine feed rations could lower the amount of ammonia and P entering the manure. Finally, WB examined manure application rates to determine if more frequent removals of manure/sludge from the lagoon could provide additional storage capacity and less frequent overflows.

As a result of the whole-farm audit, KFP decided to further evaluate a new wastewater treatment system plus an off-gas treatment system for air removed from both the swine barn and manure pits. Changes in feed rations were not implemented on recommendations from both an animal nutritionist and the local agricultural extension agent, and additional application rates of manure to KFP's crop land would have exceeded nutrient requirements according to the facility's NMP.

The treatment train selected for KFP consists of primary clarification, a vibrating membrane filtration system, and final polishing using a biological trickling filter. For off-gas from the swine barn and manure pits, a biofilter using inorganic media was selected to remove ammonia and hydrogen sulfide. Pilot-scale testing of both the wastewater and air treatment system was conducted March 20 to September 20, 2003, by WB Engineering. Pilot 20 2003 by WB Engineering. A summary of the conceptual design calculations and pilot-scale treatment test results are below.

Example 2. KF Pork Producers, Davenport, Iowa *(continued)*

Waste flow and characterization

WB Engineering collected a daily composite sample of manure and flush water during a 7-day operational period in March 2003 to characterize the wasteload discharged to the storage lagoon. The volume of manure and flush water was also measured during the 7-day sampling period in April, 2003. The average daily flow to the lagoon was 62,500 gallons. Waste characterization data and calculated average daily loading to the treatment system for the target pollutants are summarized below:

Pollutant	Concentration (mg/L)	Influent (lbs/day)
BOD_5:	3,766	1,960
Total N:	753	392
Total P:	301	157
TSS:	11,863	6,174

Daily pollutant loadings were calculated by multiplying the concentration for each constituent by the average daily flow as shown in the example below for BOD_5:

BOD_5 Loading: 3,766 mg/L x 3.785 L/gal x 1 kg/1,000,000 mg x 2.2 lbs/kg x 62,500 gal/day = 1,960 lbs/day

The wastewater treatment system design is based on a flow excess of 20% or gallons per day. Flows greater than 75,000 gallons per day will overflow to the existing 1,500,000-cubic-foot lagoon. During dry-weather periods, excess water from the lagoon will be pumped back to the beginning of the treatment system for processing. Note that KFP will have the capability of recycling nearly 22,600 gallons per day of treated effluent for manure flushing.

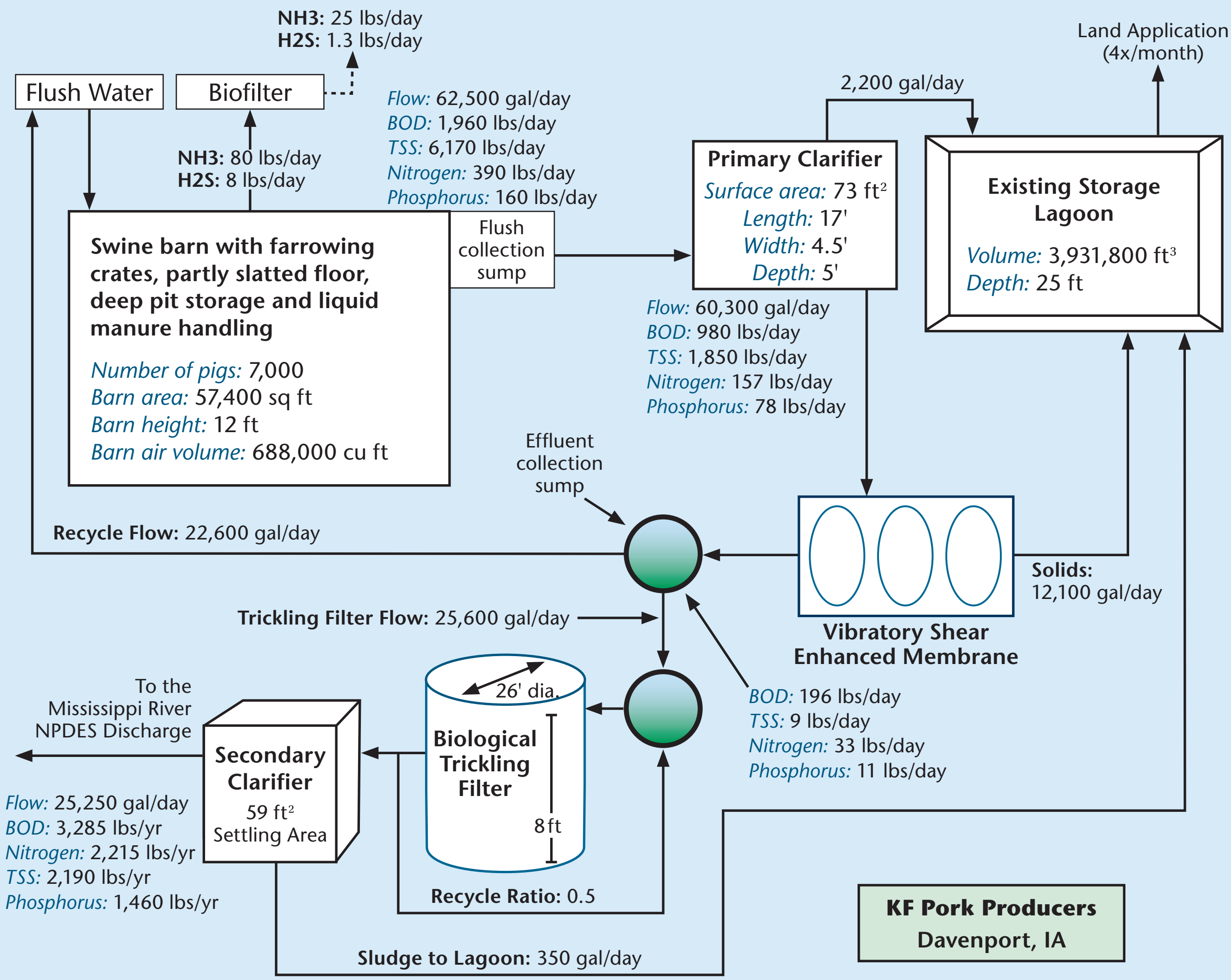
Off-gas from the swine barn and deep pit areas was characterized by collecting air samples from areas near the exit fans. The average concentration of ammonia and hydrogen sulfide measured in the off-gas was 54 ppm and 4 ppm, respectively. On the basis of a measured exhaust rate from all the exit fans for the barn and pit areas, WB Engineering estimates approximately 80 lbs/day of ammonia and approximately 10 lbs/day of hydrogen sulfide is emitted to the atmosphere. Design of the biofilter for treatment of off-gas was provided by BIOREM and consists of new fans and duct work to move air through a single discharge point and an in-ground biofilter to destroy ammonia and hydrogen sulfide.

Treatment system effectiveness

The average concentration of target pollutants measured in the effluent from the pilot-scale wastewater treatment system during the 6-month study is shown in the table below. The calculated monthly loading for the full-scale treatment system is based on an average daily flow of 25,250 gallons. The remaining 37,750 gallons of water that enter the treatment system is used for either recycle or contains concentrated treatment residuals that are discharged to the existing storage lagoon. KFP now has the additional flexibility to collect solids and concentrated nutrients from the existing sludge lagoon and haul them off-site for other uses.

Example 2. KF Pork Producers, Davenport, Iowa *(continued)*

Diagram of alternative treatment system



Comparison of the baseline overflow to the discharge from the alternative treatment system

Pollutant	Baseline overflow (lbs/yr)	Treatment system discharge (lbs/day)
BOD_5:	16,280	3,285
Total N:	2,664	2,215
Total P:	1,006	1,460
TSS:	29,602	2,190

Example 2. KF Pork Producers, Davenport, Iowa *(continued)*

The average concentration of ammonia and hydrogen sulfide measured in the off-gas from the biofilter during the 6-month pilot-scale treatment test is shown below. The biofilter removed approximately 70 percent of the ammonia and 87 percent of the hydrogen sulfide in the gas stream. The biofilter also eliminated all odors from the swine CAFO's off-gas.

Biofilter treatment results during the 6-month pilot test

Pollutant	Influent loading (lbs/day)	Gas flow (cfm)	Effluent loading (lbs/day)	Odor
Ammonia	80	23,000	25	None
Hydrogen Sulfide	10	23,000	1.3	None

Conclusion: Comparison of the pilot-scale testing results with the calculated overflow discharges indicates the proposed treatment system cannot achieve a quantity of pollutants discharged for all the targeted pollutants that is equal to or less than the quantity of pollutants that would be discharged under the baseline performance standards. Because the proposed treatment system cannot achieve the reduction for all target pollutants, the permitting authority denies the facility's request for an individual NPDES permit for operation and discharge of water from the proposed treatment system. If modifications to the treatment system can be made that lower the annual discharge of phosphorus, an individual permit might be considered.

KFP has still decided to install a new biofilter system to remove odors, ammonia, and hydrogen sulfide from its air stream to address complaints from neighbors regarding smells from the facility.

Example 3. Birvan Egg Farms, Okeechobee County, Florida

Background

Birvan Egg Farms (Birvan) is a Large CAFO in Okeechobee County, Florida. Birvan has 40,000 laying hens with an average weight of approximately 3 pounds. Birds are housed in a high-rise cage system. Manure drops from the cages to the floor below and is picked up by the wet flush system and transferred to the anaerobic digester. The anaerobic digester removes the majority of nutrients, BOD_5, and volatile solids while generating methane that is used in the facility's boiler system. Effluent from the anaerobic digester is pumped through a vibrating membrane filtration system for polishing residual solids, BOD_5, and nutrients before land application of the polished water to a small grass field. All solids are hauled and sold off-site. Birvan elected to install an anaerobic treatment system rather than a holding pond because of space constraints and the lack of crop land to apply liquids and solids. The manure treatment system has been in operation since 1996.

Birvan calculated the overflow volume and loading from a baseline system (a liquid storage structure) that could have been installed at the facility and compared the results with the loadings being obtained from the existing treatment system.

Summary of baseline overflow volume and pollutant loading calculations

Estimated Storage Lagoon Volume if Constructed:	58,200 ft^3 (435 thousand gallons)
Process Wastewater Generation:	374 ft^3/day (2,800 gal/day)
Volume of Liquids and Solids in Lagoon at Start:	635 ft^3 (Sludge Volume + Minimum Treatment Volume + Accumulated Process Wastes Since Last Liquid Application)
Precipitation Volume (average):	61 in/yr
Evaporation Rate (average):	90 in/yr
Sludge Volume (constant):	5,900 ft^3
Minimum Treatment Volume (constant):	9,200 ft^3
Assumed removal rate:	2x per month from January 21 to December 9
Daily Accumulation of Lagoon Liquids (ft^3/day) =	Process Waste (ft^3/day) + [Precipitation - Evaporation (ft/day)] x Lagoon Surface Area (ft^2)
Volume of Lagoon Liquids (ft^3) =	Previous Days' Volume (ft^3) + Accumulation Volume (ft^3/day)

Calculated baseline overflow volume method

Daily Accumulation of Lagoon Liquids (ft^3/day) = Process Waste (ft^3/day) + [Precipitation - Evaporation (ft/day)] x Lagoon Surface Area (ft^2)

Volume of Lagoon Liquids (ft^3) = Previous Days' Volume (ft^3) + Accumulation Volume (ft^3/day)

Example 3. Birvan Egg Farms, Okeechobee County, Florida *(continued)*

If the Volume of Lagoon Liquids (ft^3) is greater than the following:

Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)], then

Overflow Volume = Volume of Lagoon Liquids (ft^3) - [Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)]; and

Volume of Lagoon Liquids (ft^3) is adjusted to the following:

[Existing Storage Lagoon Volume (ft^3) - Sludge Volume (ft^3) - Minimum Treatment Volume (ft^3)] (the maximum volume of liquids the lagoon can store)

Calculated Overflow Volume for Birvan 3,162 ft^3/yr (23,651 gal/yr)

Birvan collected a representative sample of liquid from the digester to calculate the annual loading of BOD_5, total N, total P, and TSS that would be discharged as a result of the overflow volume. The sample was collected from the top 12 inches of the digester surface because the majority of overflows will likely be attributed to this zone. The sampling results are shown below:

BOD_5:	1,500 mg/L
Total N:	750 mg/L
Total P:	100 mg/L
TSS:	3,200 mg/L

On the basis of the overflow and the measured concentration, the annual pollutant discharges from the storage system was calculated by multiplying the flow by the concentration as shown in the example for BOD_5 below:

BOD_5: 1,500 mg/L x 3.785 L/gal x 23,651 gal/yr x 2.2 lbs/kg x 1 kg/10^6 mg = 295 lbs/yr

A summary of the pollutant loadings based on the overflow rate and concentration is shown below.

BOD_5:	295 lbs/yr
Total N:	148 lbs/yr
Total P:	20 lbs/yr
TSS:	433 lbs/yr

Treatment system evaluation

Birvan has been collecting monthly samples for BOD_5, total N, total P, and TSS from the existing treatment system since early 1997. The measured monthly concentrations in the treatment system effluent and the total flow through the treatment system over the past 12 months are shown below.

Example 3. Birvan Egg Farms, Okeechobee County, Florida *(continued)*

Measured treatment system effluent concentration and total influent flow during the past 12 months

Month	BOD_5 (mg/L)	N (mg/L)	P (mg/L)	TSS	Total flow (gal)
June	20	3.3	0.6	14	83,800
July	21	5.2	0.8	15	83,200
August	13	1.6	0.7	10	84,600
September	8	0.8	0.6	9	83,900
October	9	0.6	0.4	7	84,200
November	18	3.5	0.6	13	84,700
December	13	2	0.7	11	84,300
January	6	0.7	0.4	9	82,900
February	8	0.7	0.4	8	83,900
March	19	1.8	0.8	13	84,700
April	20	4.2	1.2	15	85,100
May	7	2.7	0.8	14	84,300
Median	**13**	**1.9**	**0.6**	**12**	**84,250**

As shown in the figure below, the vibrating membrane filter generates a concentrated wastestream equaling 20% of the influent flow (16,850 gal/month). That concentrated wastestream is sent to a 10,000-gallon holding tank before off-site shipment. Effluent from the vibrating membrane filter enters a lift station where submersible pumps transfer approximately 45,000 gallons per month back to the layer house for manure flushing. According to a measured average flow rate of approximately 22,400 gallons per month at Outfall 001 and the concentration of pollutants in the vibrating membrane treatment system effluent, the following annual loadings to St. Lucie Canal were calculated and compared to the baseline overflow loadings.

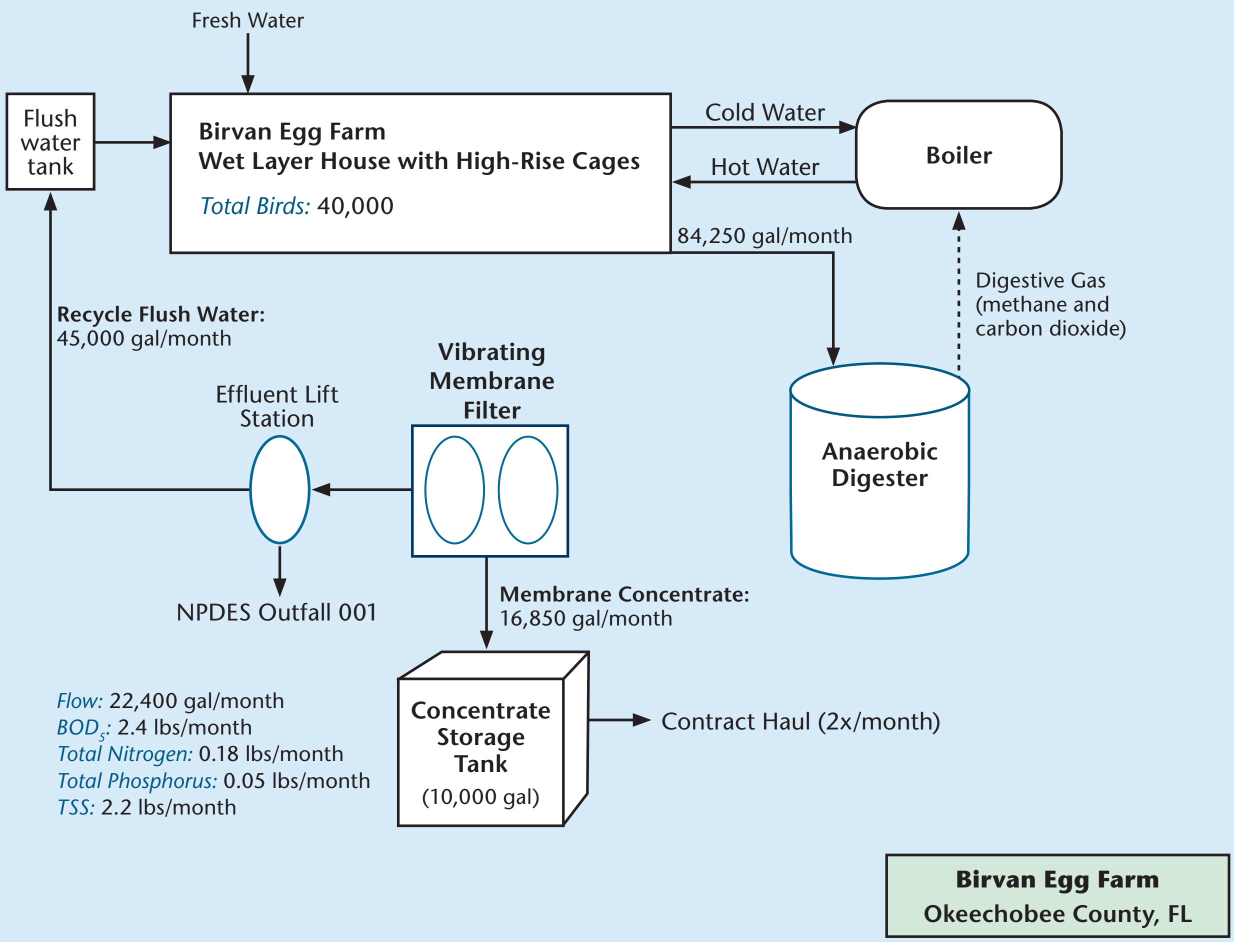
Comparison of the Calculated Baseline Overflow Discharge to the Treatment System Discharge

Pollutant	Baseline overflow (lbs/yr)	Treatment system discharge (lbs/day)
BOD_5:	295	29
Total N:	148	4.2
Total P:	20	1.3
TSS:	433	27

Conclusion: The comparison shows that the existing treatment systems consisting of an anaerobic digester and vibrating membrane filtration system achieve better performance than the baseline system for all targeted pollutants. If water quality constraints for fecal coliform in the St. Lucie Canal make additional treatment necessary, Birvan is also considering increasing the temperature of the digester to make it thermophilic, a practice known to reduce fecal coliform in the effluent.

Example 3. Birvan Egg Farms, Okeechobee County, Florida *(continued)*

Diagram of existing treatment system



Appendix G

Winter Spreading Technical Guidance

Interim Final

Technical Guidance for the Application of CAFO Manure on Land in the Winter

Water Division
Region 5
United States Environmental Protection Agency

Introduction[1]

Many owners or operators of concentrated animal feeding operations (CAFOs) use their manure, litter, and process wastewater (hereinafter *manure*) as a source of nutrients for the growth of crops or forage or to improve the tilth of soil. Others dispose of manure on land. The longer manure remains in the soil before plants take the nutrients up, the more likely those nutrients will be lost through volatilization, denitrification, leaching to subsurface drainage tile lines or ground water, and runoff to surface water. To use the greatest fraction of the nutrients in manure, late spring and early summer are the best times for land application. Some CAFO owners or operators apply manure on land in the late fall or winter because crops are not growing, labor is available, and, when it is frozen, the soil is able to handle the weight of manure hauling equipment without excessive compaction. Application in the late fall or winter also enables the owner or operator to avoid the cost of the structures that would be needed to store manure through the winter months. From the dual perspectives of nutrient utilization and pollution prevention, however, winter is the least desirable time for land application. Appendix G-1 contains an excerpt from the U.S. Environmental Protection Agency (EPA) (2002 p. 177–78) summarizing the literature on the risk that land application in the winter poses to water quality.

Under regulations that EPA promulgated in 2003, agencies that are authorized to issue National Pollutant Discharge Elimination System permits (hereinafter *states*) need to have technical standards for nutrient management that address, among other factors, the times at which CAFOs may apply manure on land (see Title 40 of the *Code of Federal Regulations* [CFR]part 123.36). Technical standards are to achieve realistic crop or forage production goals while minimizing movement of nitrogen and phosphorus to waters of the United States. They will form the basis for the nutrient management plans that CAFO owners and operators will implement under 40 CFR parts 122.42, 412.4.

EPA recognizes certain times during which there could be an increased likelihood that runoff from CAFO land application areas could reach waters of the United States. The times include, among others, when the soil is frozen or covered with ice or snow. Frozen soil will occur in areas where snow or other ground cover is shallow and where prolonged periods of subfreezing air temperatures prevail (U.S. Army Corps of Engineers 1998). The January normal daily minimum air temperature in EPA Region 5 ranges from minus 8 degrees Fahrenheit (°F) in the northwest to 22 °F in the south. Thus, all areas in the region are subject to air temperatures that can cause soil to freeze. For December through March, the mean precipitation in the region ranges from 3 inches of water in the northwest to 14.6 inches of water in the south. The mean snowfall in those months ranges from 13 inches in the south to 108 inches in the coastal north. The above normals notwithstanding, the only reliable way to predict temperature and precipitation before any winter is through statistical analysis of historical data for the location of interest.

To ensure effective implementation of the regulations, EPA (2003) has expressed its strong preference that states prohibit the discharge of manure from land application. That is applicable unless the discharge is an agricultural stormwater discharge (i.e., a precipitation-related discharge from land where manure was applied in accordance with a nutrient management plan). EPA has also expressed its strong preference for the way in which states in their technical standards should address the timing of land application. With regard to the winter months, EPA strongly prefers that technical standards either prohibit surface application on snow, ice, and frozen soil or include specific protocols that CAFO owners or operators, nutrient management planners, and inspectors will use to conclude whether application to a frozen or snow- or ice-covered field, or a portion thereof, poses a reasonable risk of runoff. Where there is a reasonable risk, EPA strongly prefers that technical standards prohibit application on the field or the pertinent portion thereof during times when the risk exists or could arise.

Technical Guidance

This paper presents technical guidance to which EPA Region 5 will refer as we work together with those states that plan to allow CAFO owners or operators to apply manure on land in the winter where a crop will not be grown in that season or nutrients need not be applied in the winter to grow the crop. For that purpose, Region 5 assumes that the risk of runoff will be minimized if a state requires injection or timely incorporation of manure in the winter, provided that the CAFO owner or operator adheres to the setback requirements in 40 CFR part 412.4(c)(5). Further, we assume that the risk of runoff will be minimized if waters of the United States, sinkholes, open tile line intake structures, and other conduits to waters of the United States are upslope from the land on which manure would be surface applied. Thus, the balance of this technical guidance is intended to provide a basis for the region to evaluate the adequacy of preliminary technical standards that would allow surface application without timely incorporation where waters of the United States, sinkholes, open tile line intake structures, or other conduits to waters of the United States are downslope from the land on which the manure would be applied.[2]

Potential Discharges That Are Not Precipitation Related

When liquid manure is applied on frozen soil in the absence of snow cover, Region 5 has concluded that the manure will run off and potentially discharge if it is applied in excess of the pertinent rate specified in Table G-1a or G-1b.[3] For an example that shows how the region came to this conclusion, see Appendix G-2. In as much as the discharge of manure is not an agricultural stormwater discharge when it is not related to precipitation, technical standards need to prohibit the application of liquid manure on frozen soil, in excess of the rates provided in the following tables, when the soil is not covered with snow.

Liquid Manure Maximum Rates of Application onto Frozen Soil

Table G-1a. Harvested Crops were row crops planted in straight rows with land in good hydrologic condition

Hydrologic Soil Group*	Maximum rate of application (gallons per acre)
A	3,000
B	1,600
C	1,100
D	1,100

Table G-1b. Harvested crops were close-seeded legumes planted in straight rows with land in good hydrologic condition

Hydrologic Soil Group	Maximum rate of application (gallons per acre)
A	4,100
B	2,200
C	1,100
D	1,100

*See Appendix A of U.S. Department of Agriculture, Soil Conservation Service (1986) for information on the Hydrologic Soil Group within which a given soil is classified. The appendix is at *ftp://ftp.wcc.nrcs.usda.gov/wntsc/H&H/other/TR55documentation.pdf*.

Discharges That Are Precipitation Related

When manure is applied on land in the winter, Region 5 assumes that nutrients and manure pollutants will dissolve or become suspended in any precipitation that comes into contact with the manure. That assumption is consistent with the findings reported in Appendix G-1 and Table G-2. The technical guidance that follows is intended to provide a basis for the region to evaluate the adequacy of preliminary technical standards as such standards affect the movement of nutrients and manure pollutants in precipitation runoff during the winter or early spring. Six substantive steps are presented below. The first three involve the formulation of state policy for nutrient management. As contemplated in ***Step 1***, the policy should include a standard for the concentration or mass of biochemical oxygen demand (BOD) in precipitation-related discharges. Nutrients, including ammonia and nitrite, contribute to that demand. The final three involve engineering analysis to determine whether the BOD standard will be met.

Step 1: In collaboration with Region 5, the state establishes a standard for the concentration or mass of BOD that will be permitted in precipitation-related discharges from land on which manure has been surface applied in the winter.

Table G-2. **Assumed initial concentration of bod in runoff from land on which manure or process wastewater has been surface applied**

Type of material	Initial total BOD in runoff (mg/L)
Broiler manure[a]	708
Cattle (other than manure dairy cow) manure	Reserved
Cattle open lot process wastewater	Reserved
Egg wash process wastewater	Reserved
Feed storage process wastewater	Reserved
Layer manure[b]	809
Mature dairy cow manure[c]	924
Swine manure[d]	204
Turkey manure	Reserved

[a] Daniel et al. 1995
[b] Ibid.
[c] Thompson et al. 1979
[d] Daniel et al. 1995

Step 2: ***A.*** The state establishes preliminary technical standards for the setback[4] and the type, form, and maximum quantity of manure that could be surface applied on land in the winter. Standards for the setback should be expressed in terms of distance and slope. The minimum distance is that required under 40 CFR part 412.4(c)(5). As required to use equations 2 or 3, below, standards for the setback should also be expressed in terms of the land cover and treatment practice and the crop residue rate (in the case of equation 2) or the Hydrologic Soil Group (in the case of equation 3). For information on various residue rates and land cover and treatment practices, see Tables G-3 and G-4.

B. If the standard established in ***Step 1*** is expressed as a mass, the state establishes additional preliminary technical standards for the land cover and treatment practice and Hydrologic Soil Group applicable to land that is upslope from the setback.

Step 3: So that Region 5 can perform the engineering analysis, the state establishes appropriate design conditions for the land use, form of precipitation (rain or ripe snow), depth of precipitation, and the temperature and moisture content of soil. At a minimum, the design condition for the moisture content of soil should be antecedent moisture condition III (i.e., saturated soil) (Wright 2004; Linsley et al. 1982). States should carefully review climate data to determine whether the design temperature of soil should be 0 degrees Celsius (°C) or less. In no case should the design temperature of soil exceed 3 °C.

Table G-3. Recommended Manning's roughness coefficients for overland flow

Cover or treatment	Residue rate (ton/acre)*	Recommended coefficient	Range
Bare clay-loam (eroded)		0.02	0.012 to 0.033
Fallow - no residue		0.05	0.006 to 0.16
Chisel plow	< 0.25	0.07	0.006 to 0.17
	0.25 to 1	0.18	0.07 to 0.34
	1 to 3	0.3	0.19 to 0.47
	> 3	0.4	0.34 to 0.46
Disk/harrow	< 0.25	0.08	0.008 to 0.41
	0.25 to 1	0.16	0.1 to 0.25
	1 to 3	0.25	0.14 to 0.53
	> 3	0.3	--
No till	< 0.25	0.04	0.03 to 0.07
	0.25 to 1	0.07	0.01 to 0.13
	1 to 3	0.3	0.16 to 0.47
Moldboard plow (fall)		0.06	0.02 to 0.1
Coulter		0.1	0.05 to 0.13
Range (natural)		0.13	0.02 to 0.32
Range (clipped)		0.1	0.02 to 0.24
Short grass prairie		0.15	0.1 to 0.2
Dense grass		0.24	0.17 to 0.3

Source: Engman 1986

* See Figure G-2 to convert residue cover from a percent to a mass.

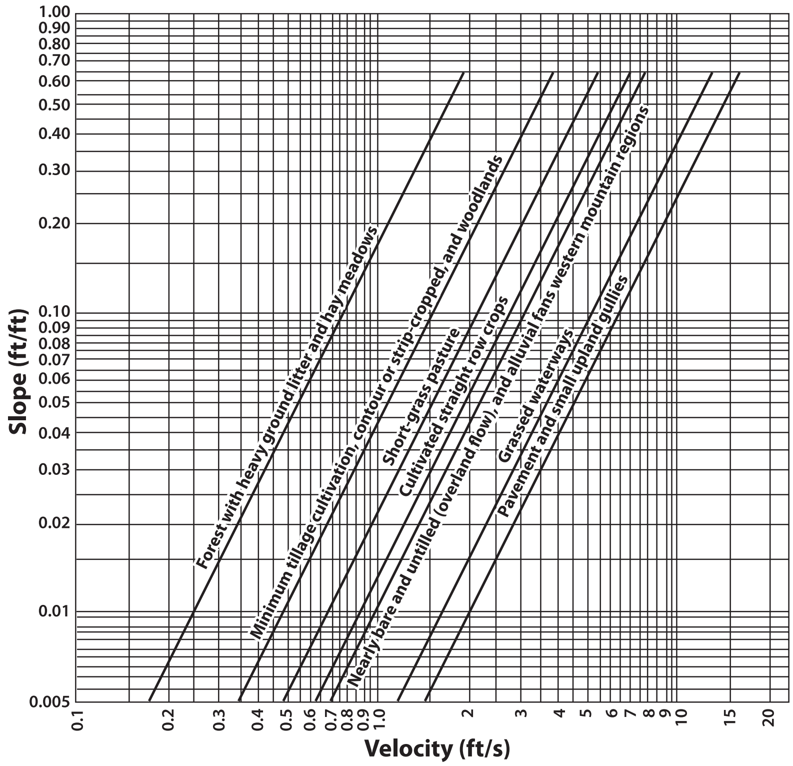


Figure G-1. Average velocity of shallow concentrated flow. (Source: USDA NRCS 1993)

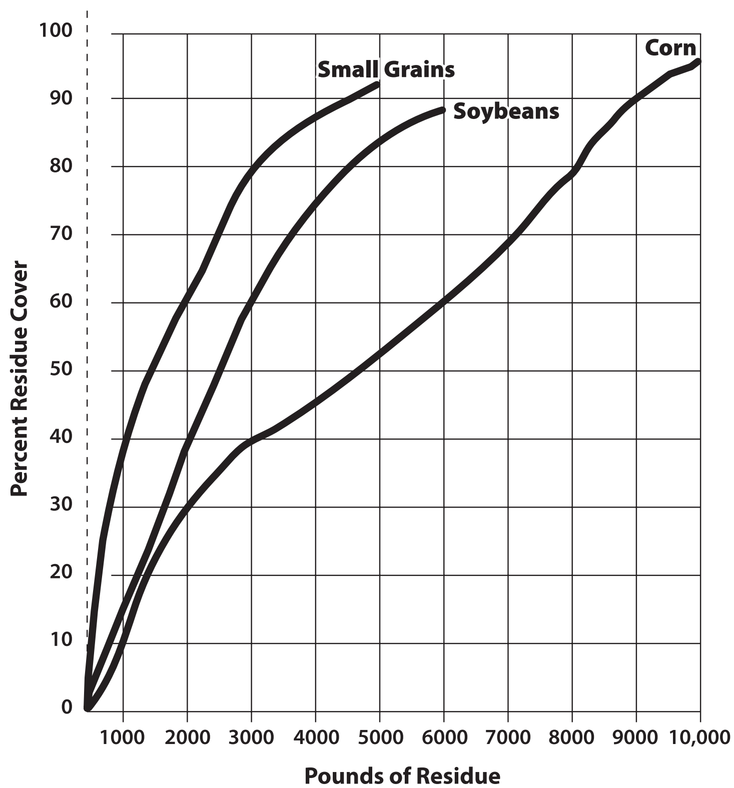


Figure G-2. Pounds of residue vs. percent ground cover. (Source: USDA NRCS 2002b)

Table G-4. Runoff curve numbers for hydrologic soil-cover complexes[a]

Land use	Treatment or practice	Hydrologic condition[b]	Hydrologic soil group			
			A	B	C	D
Fallow	Bare soil		89	94	97	98
	Crop residue cover	Poor	89	94	96	98
	"	Good	88	93	95	96
Row crops	Straight row	Poor	86	92	95	97
	"	Good	83	90	94	96
	Straight row and cop residue cover	Poor	86	91	95	96
	"	Good	81	88	92	94
	Contoured	Poor	85	91	93	95
	"	Good	82	88	92	94
	Contoured and crop residue	Poor	84	90	93	95
	"	Good	81	88	92	94
	Contoured and terraced	Poor	82	88	91	92
	"	Good	79	86	90	92
	Contoured, terraced, and crop residue	Poor	82	87	91	92
	"	Good	78	85	89	91
Small grain	Straight row	Poor	82	89	93	95
	Contoured	Poor	80	88	92	94
	"	Good	78	87	92	93
	Contoured and crop residue	Poor	79	87	92	93
	"	Good	78	86	91	93
	Contoured and terraced	Poor	78	86	91	92
	"	Good	77	85	90	92
	Contoured, terraced, and crop residue	Poor	78	86	90	92
	"	Good	76	84	89	91
Close-seeded legumes[c] or rotation meadow	Straight row	Poor	82	89	94	96
	"	Good	76	86	92	94

Table G-4. Runoff curve numbers for hydrologic soil-cover complexes[a] *(continued)*

Land use	Treatment or practice	Hydrologic condition[b]	Hydrologic soil group			
			A	B	C	D
	Contoured	Poor	81	88	93	94
	"	Good	74	84	90	93
Close-seeded legumes[d] or rotation meadow	Contoured and terraced	Poor	80	87	91	93
	"	Good	70	83	89	91
Pasture or range		Poor	84	91	94	96
		Fair	69	84	91	93
		Good	59	78	88	91
	Contoured	Poor	67	83	92	95
	"	Fair	43	77	88	93
	"	Good	13	55	85	91
Meadow		Good	50	76	86	90

Source: USDA NRCS 1993; USDA SCS 1986

[a] The runoff curve numbers in this table apply to saturated soil conditions (i.e., antecedent moisture condition III). For runoff curve numbers applicable to average soil moisture conditions, see Appendix G-3.

[b] According to USDA SCS (1986), hydrologic condition is based on a combination of factors, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotation, (d) percent of residue cover on the land surface (good ≥ percent), and (e) degree of surface roughness.

[c] Close-drilled or broadcast

[d] Close-drilled or broadcast

Step 4: The region calculates the percent removal of BOD that will occur in the setback, given the design conditions and preliminary technical standards. Calculating the percent removal is a two-step process, as shown in **A** and **B** below.

A. Calculate the amount of time it takes water to travel or *concentrate* (T_c) across the setback distance. Two equations are provided below as options for calculating T_c. In general, use equation 1 (USDA NRCS 2002a) when the design condition consists of rain on frozen soil or rain on ripe snow or when the preliminary technical standards specify a residue rate equal to or greater than 20 percent. Use equation 3 (USDA NRCS 1993) when the design condition consists of ripe snow, the preliminary technical standards do not specify a residue rate, or the rate is less than 20 percent.

Eq. 1 $T_c\,(\text{hr}) = T_{t\,(overland)} + T_{t\,(shallow\ concentrated)}$

where

Eq. 2 $$T_{t\,(overland)} = \frac{0.007 \times (N \times L)^{0.8}}{(P^{0.5}) \times (x^{0.4})}$$

N = Manning's roughness coefficient for overland flow. To select a coefficient that is appropriate in light of the preliminary technical standards, see Table G-3.

L = overland flow portion of the setback distance (maximum of 100 feet) (ft).

P = precipitation design depth (in).

s = preliminary technical standard for the slope over the distance L (ft/ft).

$T_{t\,(shallow\ concentrated)}$ applies to the shallow concentrated flow portion of the setback distance. In other words, it applies to the portion that is between points (a) and (b) as described below.

Point (a): 100 feet downslope from the furthest downslope point at which manure would be applied under the preliminary technical standards.

Point (b): the nearest waters of the United States, sinkhole, open tile line intake structure, or other conduit to waters of the United States. $T_{t\,(shallow\ concentrated)}$ is determined by multiplying the above distance times a velocity of runoff that is appropriate in light of the preliminary technical standards. See Figure G-1.

Eq. 3 $$T_c\,(hr) = \frac{5}{3} \times \frac{(L^{0.8}) \times (S+1)^{0.7}}{1900 \times (s^{0.5})}$$

where

L = preliminary technical standard for the setback distance (ft).

S = potential maximum retention after runoff begins

= (1,000 / CN) – 10

CN= runoff curve number. To select a number that is appropriate in light of the design condition for the land use and the preliminary technical standards, see Table G-3.

s = preliminary technical standard for the slope over the distance L (percent).

B. Calculate the percent removal of BOD in the setback. The equation for percent removal is as follows (modified from Martel et al. 1980):

Eq. 4 $E = (1 - A \times e^{-(k_T) \times t}) \times 100$

where

E = percent removal of BOD

A = nonsettleable fraction of BOD in manure

= 0.5 to 0.6 for animals other than mature dairy cows (Zhu 2003)

= 0.9 for mature dairy cows (Wright 2004)

k_T = first-order reaction rate constant at the design temperature of soil (T) (°C)

= $k \times (\Theta)^{T-20}$

Θ = 1.135 (Schroepfer et al. 1964)

k = 0.03/min[5]

t = detention time

= $T_c \times 60$

Step 5: Region 5 multiplies the percent removal calculated in ***Step 4. B.*** times the initial concentration of BOD in runoff from land where manure has been surface applied (i.e., the concentration before treatment of the runoff by land in the setback). If state-specific data are not available, use the values from Table G-2 as the basis for assumptions about the initial concentration. Subtract from the initial concentration the product of the percent removal times the initial concentration. If the standard established in ***Step 1*** is expressed as a mass, proceed to ***Step 6.*** If it is expressed as a concentration, compare the final concentration to the standard. If the final concentration is less than or equal to the standard, the region will conclude that there is no reasonable risk of runoff. The region will neither object to nor disapprove the state's preliminary technical standards. However, for the analysis to hold, the technical standards need to require the CAFO owner or operator to verify that conditions in the setback at the beginning of any application are consistent with the values assigned to *N* or *S*. In other words, the standards need to prohibit surface application when ice reduces the surface roughness or occupies the surface storage in the setback. If the concentration is greater than the standard established in ***Step 1***, the region will conclude that there is a reasonable risk of runoff. Therefore, the final technical standards need to prohibit surface application of manure in the winter (or on frozen or snow-covered soil) or the state needs to otherwise strengthen the preliminary technical standards so there is no reasonable risk of runoff.

Step 6: If the standard is expressed as a mass, Region 5 calculates the mass of BOD that will run off the land given the design conditions for the land use, depth of precipitation, soil temperature, and soil moisture content and the preliminary technical standards for the Hydrologic Soil Group, land cover and treatment practice, and the type and maximum quantity of liquid manure. Calculating the mass is a three-step process as shown below.

A. Use the following equation (USDA NRCS 1993) to calculate the inches of runoff.

Eq. 5 $$Q = \frac{(P - 0.2 \times S)^2}{(P + 0.8 \times S)}$$

where

Q = runoff (in)

P = precipitation design depth plus the depth of water that could be applied in the winter as liquid manure given the preliminary technical standards (in).

S = the same as defined for equation 3 except that, if the design temperature of soil is 0 °C or less, substitute S_f for S where $S_f = (0.1 \times S)$ (Mitchell et al. 1997).

B. Use the following equation to convert the runoff from inches to a volume per acre.

Eq. 6 $$Q\ (gal/ac) = Q\ (in) \times ft/12\ in \times 43{,}560\ ft^2/ac \times 7.48\ gal/ft^3$$

C. Calculate the mass of BOD in runoff by multiplying the volume of runoff times the final concentration of BOD calculated in ***Step 5.*** The equation is as follows:

Eq. 7 $$BOD\ (lb/ac) = BOD\ (mg/l) \times Q\ (gal/ac) \times 3.7854\ L/gal \times g/1000\ mg \times 0.0022\ lb/g$$

Compare the mass with the standard established in ***Step 1***. If the mass is less than or equal to the standard, Region 5 will conclude that there is no reasonable risk of runoff. The region will neither object to nor disapprove the preliminary technical standards. However, for the analysis to hold, the technical standards need to require the CAFO owner or operator to verify that conditions in the setback at the beginning of any application are consistent with the values assigned to *N* or *S*. In other words, the standards need to prohibit surface application when ice reduces the surface roughness or occupies the surface storage in the setback. If the mass is greater than the standard established in ***Step 1***, Region 5 will conclude that there is a reasonable risk of runoff. Therefore, the final technical standards need to prohibit surface application of manure in the winter (or on frozen or snow-covered soil) or the state needs to otherwise strengthen the preliminary technical standards so there is no reasonable risk of runoff.

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Endnotes

1 In accordance with the U.S. Environmental Protection Agency (2000), Region 5 asked three professional engineers to review a February 2004 draft of this document. The peer review record includes responses to the comments that those individuals provided pursuant to the request.

2 For the purpose of this technical guidance, "other conduits to waters of the United States" means any area wherein water is or could be conveyed to waters of the United States via channelized flow.

3 Region 5 developed the tables for the corn and soybean crops commonly grown in the region. On request, the region can supply tables for other land uses and land cover and treatment practices.

4 The term *setback* is defined in 40 CFR part 412.4 to mean a specified distance from surface waters (i.e., waters of the United States) or potential conduits to surface waters where manure may not be land applied.

5 The k value of 0.03 per minute is as reported by Martel et al. (1980) for treatment of municipal wastewater by the overland flow process. The region assumes that Martel et al., reported the constant at 20 °C consistent with standard engineering practice.

Appendix G-1

The following is an excerpt from EPA (2002 p. 177–78):

> [C]onsiderable research has demonstrated that runoff from manure application on frozen or snow-covered ground has a high risk of water quality impact. Extremely high concentrations of nitrogen and phosphorus in runoff have been reported from plot studies of winter-applied manure: 23.5 to 1,086 milligrams (mg) of total Kjeldahl nitrogen (TKN) per liter (L) and 1.6 to 15.4 mg/L of phosphorus (P) (Thompson, et al. 1979; Melvin and Lorimor 1996). In two Vermont field studies, Clausen (1990, 1991) reported 165 to 224 percent increases in total P concentrations, 246 to 1,480 percent increases in soluble P concentrations, 114 percent increases in TKN concentrations, and up to 576 percent increases in ammonia-nitrogen (NH_3^-N) following winter application of dairy manure. Mass losses of up to 22 percent of applied nitrogen and up to 27 percent of applied P from winter-applied manure have been reported (Midgeley and Dunklee 1945; Hensler et al. 1970; Phillips et al. 1975; Converse et al. 1976; Klausner et al. 1976; Young and Mutchler 1976; Clausen 1990, 1991; Melvin and Lorimor 1996). Much of this loss can occur in a single storm event (Klausner et al. 1976). Such losses could represent a significant portion of annual crop needs.
>
> On a watershed basis, runoff from winter-applied manure can be an important source of annual nutrient loadings to waterbodies. In a Wisconsin lake, 25 percent of annual P load from animal waste sources was estimated to arise from winter spreading (Moore and Madison 1985). In New York, snowmelt runoff from winter-manured cropland contributed more P to Cannonsville Reservoir than did runoff from poorly managed barnyards (Brown et al. 1989). Clausen and Meals (1989) estimated that 40 percent of Vermont streams and lakes would experience significant water quality impairments from the addition of just two winter-spread fields in their watersheds.
>
> Winter application of manure can increase microorganism losses in runoff from agricultural land compared to applications in other seasons (Reddy et al. 1981). Cool temperatures enhance survival of fecal bacteria (Reddy et al., 1981; Kibby et al. 1978). Although some researchers have reported that freezing conditions are lethal to fecal bacteria (Kibby et al. 1978; Stoddard et al. 1998), research results are conflicting. Kudva et al. (1998) found that Escherichia coli can survive more than 100 days in manure frozen at minus 20 degrees Celsius. Vansteelant (2000) observed that freeze/thaw of soil/slurry mix only reduced E. coli levels by about 90 percent. Studies have found that winter spreading of manure does not guarantee die-off of Cryptosporidium oocysts (Carrington and Ransome 1994; Fayer and Nerad 1996). Although several studies have reported little water quality impact from winter-spread manure (Klausner 1976; Young and Mutchler 1976; Young and Holt 1977), such findings typically result from fortuitous circumstances of weather, soil properties, and timing/position of manure in the snowpack. The spatial and temporal variability and unpredictability of such factors makes the possibility of ideal conditions both unlikely and impossible to predict.

Appendix G-2. Example Derivation of the Maximum Rates for Liquid Manure Application on Frozen Soil

Givens

According to USDA NRCS (1993), the following are givens:

Potential maximum retention after runoff begins (S) $= \frac{1,000}{CN} - 10$

Runoff curve number (CN) $= \frac{1,000}{S + 10}$

According to Mitchell et al. (1997), the following is a given for frozen soil:

$$S_f = 0.1 \times S$$

For *CN* in the range from zero to 100, Table 10.1 in USDA NRCS (1993), identifies the minimum depth of precipitation (*P*) at which the runoff curve begins under dry, average, and saturated antecedent soil moisture conditions. For example, for a *CN* of 91 and average antecedent soil moisture, the runoff curve begins when *P* equals 0.2 inch.

Example

Hydrologic Soil Group A.

Harvested crop was corn planted in straight rows.

The land is in good hydrologic condition.

The antecedent soil moisture is average.

$$S_f = (1,000 / 64 - 10) \times 0.1 = 0.56$$

$$CN_f = (1,000 / (0.56 + 10) = 94.7 \cong 95$$

According to Table 10.1 in USDA NRCS (1993), for a CN of 95, 0.11 inch is the minimum depth of precipitation (or other liquid) at which the runoff curve begins. Converting that depth to a volume per acre,

$$Q \text{ (gal/ac)} = 0.11 \text{ in} \times \text{ft}/12 \text{ in} \times 43,560 \text{ ft}^2/\text{ac} \times 7.48 \text{ gal/ft}^3$$

results in 2,987 gallons per acre as the maximum quantity of liquid that can be applied on frozen soils in Hydrologic Soil Group A while precluding runoff.

Appendix G-3. Runoff Curve Numbers for Antecedent Moisture Condition II

If the curve number for AMC III is …	then the curve number for AMC II is …
100	99
99	96
98	93
97	91
96	89
95	87
94	85
93	83
92	81
91	79
90	78
89	76
88	74
87	73
86	71
85	70
84	68
83	67
82	65
81	64
80	63
79	62
78	60
77	59
76	58
75	57
74	55
73	54
72	53
71	52
70	50
69	49
68	48
67	47
66	46
65	45
64	44
63	43
62	42
61	41

Appendix H

NPDES CAFO Nutrient Management Plan Review Checklist

Introduction

This checklist is a tool to guide the review of a nutrient management plan (NMP) submitted with a National Pollutant Discharge Elimination System (NPDES) permit application or notice of intent (NOI). The checklist supports the permit writer's determination of whether the NMP adequately addresses each of the nine minimum practices required in the regulations. That determination should be based on an assessment of the following for each minimum practice:

1. Are the practices and procedures identified in the NMP sufficient to prevent discharges to surface water?
2. Are the practices and procedures adequate to support identification of NMP terms for the permit?

The checklist is focused on the fundamental concepts necessary to evaluate whether an NMP addresses the regulatory requirements (e.g., NPDES minimum standards and effluent limitations guideline (ELG) requirements). The checklist is organized into three parts: (1) Part A – Basic Facility Information, (2) Part B – Nine Minimum Practices and Associated Information, and (3) Part C – Plan Adequacy. Associated information in Part B includes information associated with each minimum practice and is used to help to determine if the plan meets the requirements of the minimum practices. For example, crop information is necessary to review the protocols for land application of manure and wastewater minimum practice.

Using the Checklist

The checklist has been designed to serve as a tool for use in determining whether an NMP addresses the ELG requirements (where applicable) and NPDES NMP minimum practices. It also addresses the information needed to identify the terms of an NMP as defined by EPA. The checklist was designed to cover a variety of NMPs and operations; as such, it should cover most common situations a permit writer will encounter. However, specific operational characteristics can vary widely depending on animal sector, climate, state requirements, and other factors. Permit writers should be aware of the characteristics of a typical CAFO in their area and, if needed, revise the checklist to improve its utility in evaluating NMPs for a specific state or region.

Although the checklist is intended for use by permit writers in evaluating NMPs, the completed checklist for a facility should be saved in the permit file and be made available as a reference for the CAFO inspector to review before conducting a compliance inspection. The checklist information would enable the inspector to document changes that have occurred at the operation since the permit was issued and verify that they are reflected in the current NMP.

The determination of whether an NMP addresses the nine minimum practices often will be based on best professional judgment. Even where a plan appears to address each of the nine minimum practices, a poorly developed plan could be an indicator of a potential future permit violation. Further, as described in Chapter 4 of this Manual, broadly applicable permit could be captured as terms and conditions of the permit and therefore might not necessarily be addressed in the operation's NMP.

NPDES CAFO NMP Nine Minimum Practices Review Checklist

Part A **Basic Facility Information**
Documents location information and basic information about the type and size of the operation.

Part B **Nine Minimum Practices**
Documents critical information and terms specific to each of the NMP nine minimum practices, including information associated with or necessary to review how the plan addresses each practice.

Part C **Plan Adequacy**
For use by the plan reviewer to document an overall determination of plan adequacy.

Note: Some of the information in the checklist might apply to Large CAFOs only. For additional details, consult the regulations.

Part A – Basic Facility Information

1. Facility Identification

- Operation Name:____
- NPDES permit number:______________________________________

2. Plan Preparer Certification

- Did the plan preparation involve certified technical specialists? .... ☐ Yes ☐ No
- Are the name and certification credentials of the plan preparer identified in the plan?............. ☐ Yes ☐ No

3. Type of Operation

- Is the operation ☐ Large CAFO ☐ Medium or Small CAFO ☐ Other (non-CAFO)
- Is the operation ☐ Open lot ☐ Partially enclosed ☐ Fully enclosed

  Notes: ____
  ____
  ____

- Does the description of the facility in the plan reflect the description of the facility in the application/NOI/fact sheet/permit? .... ☐ Yes ☐ No

4. Facility Location

- Street Address (mailing):______________________________________
- City, State, ZIP:____
- Does the plan include maps that identify
  - (1) The location of the production area, including confinement areas, manure and wastewater handling and storage areas, and raw material handling and storage areas)?... ☐ Yes ☐ No
  - (2) All land application areas owned or under the ownership, rental, lease, other legal arrangement of the CAFO operator, including topography and soil types?................ ☐ Yes ☐ No
  - (3) Environmentally sensitive areas (sinkholes, wells, drinking water sources, tile drain outlets, etc.) for the production and land application areas? .... ☐ Yes ☐ No
- Does the plan identify the latitude and longitude to the entrance of the production area? .... ☐ Yes ☐ No
- Does the plan identify the watershed(s) in which the operation is located? .... ☐ Yes ☐ No

- Is the watershed listed on the state's list of impaired watersheds? .... ☐ Yes ☐ No

  *If yes, what impairments are identified?*____

  ____

  ____

- Is this facility within a state-designated source water protection area? .... ☐ Yes ☐ No
  Are there any other water quality concerns in this watershed? .... ☐ Yes ☐ No

  Explain: ____

  ____

  ____

5. Animals

- What type(s) of animals are confined at the facility?

☐ Beef (slaughter/feeder)	☐ Chicken – Layer
☐ Dairy	☐ Chicken – Broiler
☐ Swine	☐ Sheep/Lambs
☐ Turkey	☐ Horse
☐ Duck	☐ Other ________________________

- What is the maximum number of animals confined, by animal type?

☐ Beef (slaughter/feeder) __________	☐ Chicken – Layer ____________________
☐ Dairy ____________________	☐ Chicken – Broiler ____________________
☐ Swine ____________________	☐ Sheep/Lambs ____________________
☐ Turkey ____________________	☐ Horse ____________________
☐ Duck ____________________	☐ Other ____________________

- Is the plan based on the animal numbers listed above? .... ☐ Yes ☐ No

  *If no, on what capacity is the plan based?*____

  ____

  ____

Part B – Nine Minimum Practices

Minimum Practice: Ensure Adequate Storage Capacity

Manure/Litter/Process Wastewater Generation

- What are the manure generation rates identified in the plan?
  - Animal Type 1:________________________ ____________ lbs/year
  - Animal Type 2:________________________ ____________ lbs/year
  - Animal Type 3:________________________ ____________ lbs/year
- Are the manure generation rates generally consistent with the USDA's *Agricultural Waste Management Field Handbook*? .... ☐ Yes ☐ No

  If no, are other practices in place that account for the rates included in the plan? .... ☐ Yes ☐ No

  If yes, what are the practices identified in the plan?.............................. ☐ Feed Management ☐ Other

  Explain: ____

  ____
- Does the plan identify all sources of process wastewater and appropriate generation rates? .. ☐ Yes ☐ No

Storage Capacity

- Does the plan identify the volume and number of days of storage required for the facility?...... ☐ Yes ☐ No
- Does the plan identify the size (in acres) of the production area? ....☐ Yes ________acres ☐ No
- Does the plan identify the number and type of storage structures?... ☐ Yes ☐ No
- Does the plan document the source of the information to calculate available storage volume? ☐ Yes ☐ No
- Does the storage volume in the plan account for manure and process wastewater generation (including silage leachate and other wastes) during the storage period in addition to the collection of runoff and direct precipitation on the surface of the storage structure from normal precipitation and the design storm event (25-year, 24-hour storm or other as required/appropriate for new source swine, poultry, and veal calf operations) for the CAFO location, a minimum treatment volume for anaerobic lagoons, and volume for solids accumulation?....................... ☐ Yes ☐ No
- Does the plan use the correct 25-year, 24-hour rainfall amount for the location of this operation to determine storage requirements (or other storm event as required/appropriate for new source swine, poultry, and veal calf operations)?..................... ☐ Yes ☐ No

  *Note source of information:*____
- Are the evaporation rates used in the plan consistent with local data/guidance and appropriately applied? .... ☐ Yes ☐ No
- Does the plan include a schedule for cleaning out the storage structures or solids removal for liquid storage structures? .... ☐ Yes ☐ No
- Does the plan document that available storage volume is consistent with the plan's specified land application schedule? .... ☐ Yes ☐ No
- Does the plan require maintenance for all storage structures? .... ☐ Yes ☐ No
- Does the plan identify the specific maintenance actions and a frequency/schedule for those actions? .... ☐ Yes ☐ No

Terms for Minimum Practice: Ensure Adequate Storage Capacity (identify below or reference NMP section(s)):

____

____

____

____

Minimum Practice: Ensure Proper Management of Mortalities

- Is the animal mortality addressed in the plan? .... ☐ Yes ☐ No
  If yes, what methods are identified in the plan to address animal mortality?
  ☐ Rendering ☐ Incineration ☐ Composting ☐ Disposal pits
  ☐ Landfill ☐ Other____
- Does the plan include a schedule for collecting, storing, and disposing of animal carcasses? . ☐ Yes ☐ No
- Does the plan address mortality storage before final disposition?.. ☐ Yes ☐ No
- Is the mortality rate used in the plan consistent with USDA expected values for the animals confined at the operation?.. ☐ Yes ☐ No
- Does the plan include contingency plans for unexpected but possible occurrences such as mass mortality or the loss of a rendering contractor?... ☐ Yes ☐ No
- Does the animal mortality plan meet state and local requirements? .... ☐ N/A ☐ Yes ☐ No

Terms for Minimum Practice: Ensure Proper Management of Mortalities (identify below or reference NMP section(s)):

____

____

____

Minimum Practice: Divert Clean Water from Production Area

- Does the plan address the diversion of clean water from the production areas?....................... ☐ Yes ☐ No
  If no, why?____

  ____

  If no, is the runoff being collected and is storage of runoff adequate?
  (See the Minimum Practice: Ensure Adequate Storage Capacity section)................. ☐ Yes ☐ No
- Does the plan require periodic visual inspection to verify proper and functional diversion?...... ☐ Yes ☐ No
- Does the plan address the maintenance of diversion structures? .... ☐ Yes ☐ No

Terms for Minimum Practice: Divert Clean Water from Production Area (identify below or reference NMP section(s)):

____

____

____

Minimum Practice: Prevent Direct Contact

- Does the facility or topographic map identify any surface water in the production area? .... ☐ Yes ☐ No
- If yes, are measures in the plan to prevent direct contact? .... ☐ Yes ☐ No
- What are the measures identified in the plan?... ☐ Fences ☐ Other
- Does the plan address maintenance of the identified practices?.. ☐ Yes ☐ No

Terms for Minimum Practice: Prevent Direct Contact (identify below or reference NMP section(s)):

____

____

____

Minimum Practice: Chemical Disposal

- Does the plan include practices that ensure chemicals (including pesticides, hazardous and toxic chemicals, and petroleum products/by-products) are not disposed of in any storage or treatment system that is not specifically designed to treat those chemicals? .... ☐ Yes ☐ No
- Has the facility incorporated measures (in accordance with applicable laws and regulations) to prevent mishandling of pesticides, hazardous and toxic chemicals, and petroleum products/by-products? .... ☐ Yes ☐ No

  *If no, explain:*____

  ____

Terms for Minimum Practice: Chemical Disposal (identify below or reference NMP section(s)):

____

____

____

Minimum Practice: Conservation Practices to Reduce Nutrient Loss

- Does the plan specify a 100-foot setback or a 35-foot vegetated buffer or alternative setback for land application from downgradient surface waters and conduits in accordance with the Effluent Limitations Guideline? .... ☐ N/A ☐ Yes ☐ No

  If an alternative setback has been specified, what is the basis for the use of an alternative

  setback? ____

  ____

  ____

- Does the plan include the use of best management practices (BMPs) to control nutrient loss from the:
  - Production area .... ☐ N/A ☐ Yes ☐ No
  - Land application area(s) .... ☐ N/A ☐ Yes ☐ No

  If yes, identify:

  Land Application Areas
  - ☐ Vegetated Buffers (Type of vegetation__________)
  - ☐ Diversion
  - ☐ Grassed Waterway (Type of vegetation__________)
  - ☐ Strip Cropping
  - ☐ Residue Management
  - ☐ Terracing
  - ☐ Conservation Tillage

  Production Area
  - ☐ Vegetated Buffers (Type of vegetation__________)
  - ☐ Other ______________________________

- If BMPs are being used to control nutrient loss, does the plan specify how they are to be implemented? .... ☐ Yes ☐ No

  If yes, what does the plan require? ____

  ____

- What references are cited for the practices? ☐ USDA Practice Standards ☐ State Standards ☐ Other ______________________ (*Note: To be used to verify proper implementation*)
- Does the plan include Operation & Maintenance requirements for practices used to reduce nutrient loss? .... ☐ Yes ☐ No
- Do the plan and facility maps identify the specific locations where the BMPs and setbacks are to be used? .... ☐ N/A ☐ Yes ☐ No

Terms for Minimum Practice: Conservation Practices to Reduce Nutrient Loss (identify below or reference NMP section(s)):

____

____

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____

Minimum Practice: Protocols for Manure and Soil Testing

- Does the plan include specific protocols for the representative *sampling* of manure, wastewater, and soil for determining nutrient content? ☐ Yes ☐ No
- Does the plan include appropriate frequencies for the *sampling* of manure, wastewater, and soil for determining nutrient content? ☐ Yes ☐ No
- Does the plan include specific protocols for the *analysis* of manure, wastewater, and soil for determining nutrient content? ☐ Yes ☐ No
- Are the soil test results used to develop the plan less than 5 years old? ☐ Yes ☐ No
- Are the manure nutrient analysis results used to develop the plan less than 12 months old? ☐ Yes ☐ No
  [Note: book values may be used for the first year of operation.]

Terms for Minimum Practice: Protocols for Manure and Soil Testing (identify below or reference NMP section(s)):

____

____

____

____

____

Minimum Practice: Protocols for Land Application of Manure and Wastewater

Manure, Litter, and Process Wastewater Use and Disposal

- What manure utilization options are identified in the plan? (If more than one option is identified in the plan, indicate the relative amount of the manure used or disposed of under this option.)

  ☐ Land Application ______%

  ☐ Composting ______%

  ☐ Incineration ______%

  Does the plan address what is done with the remaining ash? ____________________

  ____

  ☐ Other ______%

  *Describe:*____

  ____

- Is manure, litter, or wastewater to be transferred off-site? ☐ Yes ☐ No

  If yes:

  How much will be transferred annually? __________________ tons ______________________ gallons

  Does the plan include the necessary arrangements for that transfer? ☐ Yes ☐ No

  Does the plan identify the recipients? ☐ Yes ☐ No

- If the plan includes land application of manure, litter, or process wastewater:

  Do the facility maps identify the fields or conservation management units (CMU) used to develop the plan? (Field boundaries, field number, acreage)........................ ☐ Yes ☐ No

  Does the plan address rates of application using the ☐ linear approach or the ☐ narrative rate approach?

  [Note: The linear and narrative rate approaches primarily influence identification of terms based on the NMP and generally do not dictate the content of the NMP, with a few specific exceptions. The questions in the sections below identify specific information that is required to support development of terms under a particular approach.]

- How many acres under control of the CAFO (e.g., owned, leased, subject to an access agreement) are identified in the plan for land application use?

  _________ acres owned _________acres leased _________ total acres applied

- Does the CAFO own or control sufficient land to properly use all manure and wastewater generated by the operation?.. ☐ Yes ☐ No

  If no:

  Does the plan identify the quantity of excess manure being generated? ________tons/year or gallons/year
  Does the plan identify how the excess manure is to be used? .... ☐ Yes ☐ No
  If yes, how?____

Terms for Minimum Practice: Protocols for Land Application of Manure and Wastewater, Manure, Litter, and Process Wastewater Use and Disposal (identify below or reference NMP section(s)):

____

____

____

____

____

Crop Production Information
For use where the NMP includes land application of manure, litter, or process wastewater

- Does the plan identify what crops are produced for each field? .... ☐ Yes ☐ No

  *What are they?*____

  ____

- Does the plan identify the crop rotations? .... ☐ Yes ☐ No

  *What is the crop rotation?*____

  ____

  Does the plan identify cropping practices? .... ☐ Yes ☐ No

  If yes, what are they? ☐ Ridge Till ☐ Conservation Tillage ☐ Contour Farming
  ☐ Other ________________________________

- Does the cropping system use irrigation?.. ☐ Yes ☐ No

  If yes, what type: ☐ Traveling Gun ☐ Center Pivot
  ☐ Flood ☐ Other Sprinkler
  ☐ Ridge and furrow ☐ Other___________________________

- For plans using the narrative rate approach, does the plan identify alternative crops for specific fields? .... ☐ Yes ☐ No
  [Note: Inclusion of alternative crops is optional.]

- Are realistic crop yield goals identified in the plan (including for alternative crops, if included in plans using the narrative rate approach)? ☐ Yes ☐ No
- What source of information was used to determine the realistic yield goals for this operation?
  - ☐ Farm records (*Circle one:* last year's crop production, 3-year average, 5- year average, Other: ____________________)
  - ☐ USDA
  - ☐ State databases (VALUES, MASCAP)
  - ☐ County averages
  - ☐ Previous crop insurance records
- Is adequate justification provided to support the yield goal? ☐ Yes ☐ No

Terms for Minimum Practice: Protocols for Land Application of Manure and Wastewater, Crop Production Information (identify below or reference NMP section(s)):

____

____

____

____

____

Rate Determination/Nutrient Application Information

For use where the NMP includes land application of manure, litter, or process wastewater

- Does the plan clearly identify field-specific maximum application rates, as follows:

  For plans using the linear approach, the maximum pounds of N and P from manure, litter, and process wastewater per crop, per year? ☐ Yes ☐ No

  For plans using the narrative rate approach, the maximum pounds of N and P from all nutrient sources per crop, per year? ☐ Yes ☐ No
- Does the plan include the outcome of a field-specific N and P transport risk assessment? ☐ Yes ☐ No
- Does the plan identify the basis/rationale for determining an N-based or P-based application rate for each field? ☐ Yes ☐ No

  What is the basis?

  - ☐ Soil test method
  - ☐ Soil phosphorus threshold
  - ☐ Phosphorus Index
  - ☐ Other ____________________
- Does the plan identify fields where land application is N-based and where it is P-based? ☐ Yes ☐ No
- For P-based fields, does the plan include the use of multi-year P application? ☐ Yes ☐ No

  If yes,

  Is multi-year P application limited to fields that do not have a high potential for P runoff to surface water? ☐ Yes ☐ No

  Is the application rate limited to the annual crop N requirement? ☐ Yes ☐ No

  Is additional P application planned only after the amount applied in the multi-year application has been removed through crop uptake and harvest? ☐ Yes ☐ No
- Does the plan identify the appropriate crop N and P removal rates or nutrient recommendations (including for alternative crops, if included in plans using the narrative rate approach)? ☐ Yes ☐ No
- Does the plan take into account other sources of nutrients used at the operation ☐ Yes ☐ No

  If yes, what other sources of nutrients have been accounted for?

  - ☐ Commercial fertilizer
  - ☐ Biosolids
  - ☐ Bedding
  - ☐ Legume credits
  - ☐ Wastewater
  - ☐ Previous manure application
  - ☐ Compost
  - ☐ Irrigation water
  - ☐ Other ____________________

- For plans using the linear approach, does the plan clearly articulate the methodology used to account for the amount of N and P in the manure to be applied? ☐ Yes ☐ No
- For plans using the narrative rate approach, does the plan clearly articulate the methodology used to account for the following? ☐ Yes ☐ No
  (check each that is addressed in the NMP methodology)

  ☐ Soil test results
  ☐ Credits for all plant available N in the field
  ☐ The amount of N and P in the manure to be applied
  ☐ Consideration of multi-year P application
  ☐ Accounting for all other additions of plant available N and P to the field
  ☐ The form and source of manure
  ☐ The timing and method of land application
  ☐ Volatilization of N
  ☐ Mineralization of organic N

- Does the plan identify the application method? ☐ Yes ☐ No
  If yes, what method is used: ☐ Surface applied ☐ Injected ☐ Incorporated
- Does the plan identify appropriate volatilization rates based on the method of application? ☐ Yes ☐ No
- Does the plan include the application of wastewater to fields via an irrigation system? ☐ Yes ☐ No

  If yes:

  Does the plan identify the type of irrigation system? ☐ Yes ☐ No

  Does the plan include provisions to minimize ponding or puddling of wastewater on land application fields? ☐ Yes ☐ No

  Does the plan address the management of drainage water to prevent surface or groundwater contamination? ☐ Yes ☐ No

- Does the plan include specific restrictions or adequate management practices to prevent water pollution from the application of manure/wastewater to flooded, saturated, frozen, or snow-covered ground? ☐ Yes ☐ No
- Does the plan address inspection and maintenance of land application equipment? ☐Yes ☐ No
- Does the plan require periodic calibration of manure application equipment? ☐Yes ☐ No
- Are the application rates identified in the plan appropriate? ☐Yes ☐ No

  Notes: ______________________________

  ____

  ____

Terms for Minimum Practice: Protocols for Land Application of Manure and Wastewater, Rate Determination/Nutrient Application Information (identify below or reference NMP section(s)):

____

____

____

____

____

Minimum Practice: Record Keeping

- Identify the records that the plan indicates will be maintained at the facility.
  - ☐ Production Area Records
    - ✓ Weekly inspections of stormwater and runoff diversion devices and devices for channeling contaminated stormwater to wastewater containment structures.................. ☐ Yes ☐ No
    - ✓ Weekly inspections of manure, litter, and process wastewater impoundments................ ☐ Yes ☐ No
    - ✓ Weekly storage facility wastewater level, as indicated on a depth marker .... ☐ Yes ☐ No
    - ✓ Daily water line inspections .... ☐ Yes ☐ No
    - ✓ Actions taken to correct deficiencies identified as a result of daily and weekly inspections .... ☐ Yes ☐ No
    - ✓ Manure/wastewater storage—date of emptying, level before emptying, and level after emptying, or quantity removed (dry manure) .... ☐ Yes ☐ No
    - ✓ The date, time, and volume of any overflow.. ☐ Yes ☐ No
    - ✓ Records documenting that mortalities were not disposed of in any liquid manure or process wastewater system and that mortalities were handled to prevent the discharge of pollutants to surface water .... ☐ Yes ☐ No
    - ✓ On-site precipitation .... ☐ Yes ☐ No
    - ✓ Animal Inventory .... ☐ Yes ☐ No
  - ☐ Land Application Records
    - ✓ Manure and wastewater sample nutrient analysis test methods and results that will be used to calculate land application rates... ☐ Yes ☐ No
    - ✓ Soil sample analysis test methods and results that will be used to calculate land application rates .... ☐ Yes ☐ No
    - ✓ Manure and wastewater application equipment inspection log .... ☐ Yes ☐ No
    - ✓ Maintenance log of all equipment necessary to control discharge and meet permit requirements (e.g., maintenance of land application equipment) .... ☐ Yes ☐ No
    - ✓ Annual calculation of the maximum amount of manure or wastewater to be land applied, before application .... ☐ Yes ☐ No
    - ✓ Crop planting/harvest dates by field or CMU .... ☐ Yes ☐ No
    - ✓ Crop type and yield by field or CMU – bushels/acre (seasonally) .... ☐ Yes ☐ No
    - ✓ For each land application event, the date, rate (tons of manure or gallons of wastewater/acre or pounds of N and P per acre), weather conditions during and for 24 hours before and after application, application method, and equipment used by field or CMU (daily during application)... ☐ Yes ☐ No
    - ✓ The total amount of N and P applied to each field, including calculations........................ ☐ Yes ☐ No
    - ✓ Lease/Rental/Access Agreements for all land not owned by the operator .... ☐ Yes ☐ No
  - ☐ Off-site Transfer of Manure and Wastewater Records
    - ✓ Date of each transfer... ☐ Yes ☐ No
    - ✓ The name and address of the recipient (for each transfer).. ☐ Yes ☐ No
    - ✓ Quantity transferred (for each transfer) .... ☐ Yes ☐ No
    - ✓ Documentation that the most current nutrient analysis was provided to the recipient ...... ☐ Yes ☐ No
- Does the plan require that any additional records be maintained at the facility? .... ☐ Yes ☐ No

  If yes, what are those records? ____

  ____

- Does the plan include an emergency action plan to address spills and catastrophic events? .. ☐ Yes ☐ No

Terms for Minimum Practice: Record Keeping (identify below or reference NMP section(s)):

____

____

____

____

____

Part C – Determination of Plan Adequacy

[Note: This section is to be used by the NMP reviewer to evaluate the overall adequacy of the plan based on the information in Parts A and B and does not necessarily reflect information expected to be contained in the NMP.]

- Does the plan adequately address the storage, handling, and application of manure and wastewater to prevent the discharge of pollutants to waters of the United States? .... ☐ Yes ☐ No
- Is the plan consistent with the technical standards for nutrient management established by the Director with regard to protocols for manure and soil testing and land application protocols including nutrient transport risk assessment methods and methods and data used to determine application rates? .... ☐ Yes ☐ No
- Have there been past discharges to waters of the United States from the facility? .... ☐ Yes ☐ No

  If yes, does the plan include sufficient measures to address the cause of the past discharge and prevent future discharges? .... ☐ Yes ☐ No
- Does the plan require revision? .... ☐ Yes ☐ No

  If yes, what specific components of the plan require revision?

  ____

  ____

  ____

  ____

  ____

  ____

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  ____

  ____

Additional Review Comments:

____

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Appendix I

NPDES CAFO Technical Standard Review Checklist

Under the Clean Water Act, all authorized states were required to adopt technical standards by February 12, 2005, pursuant to Title 40 of the *Code of Federal Regulations* (CFR) part 123.36. Part 123.36 requires that technical standards meet the requirements of 40 CFR part 412.4(c)(2) to minimize phosphorus (P) and nitrogen (N) transport to surface waters. Additionally, the 2008 confined animal feeding operation (CAFO) rule requires site-specific *terms of a nutrient management plan* (NMP) to be included in a CAFO's National Pollutant Discharge Elimination System (NPDES) permit. Technical standards provide the basis for critical elements of the site-specific terms of the NMP required by 40 CFR parts 122.42(e)(5)(i) and (ii). The criteria outlined in the attached checklist identifies the information needed in a technical standard to meet the requirements ofpart 412.4(c)(2) to develop an NMP that contains all the required *terms of the NMP.*

ESTABLISHMENT AND APPLICABILITY OF TECHNICAL STANDARDS (TS)			
1	Has the Director verified or provided (or both) the state's TS?		
2	What mechanism did the state Director use to establish the TS? (*check item(s) to right*)		Standalone document
			Permit attachment
			Permit referenced documents
			Written into the regulations
			Regulation reference documents
			Other
3	How is the specific standard included as a requirement of the CAFO program?	Describe how it is made known that the CAFO NMP must be developed in accordance with the document(s) identified above. For example, does the permit or regulation provide a reference to the listed document(s)? Or does the document itself identify that it is the TS for CAFO operations that meets the requirement of part 412.4(c)(2)?	
APPLICATION RATES			
Field-specific risk assessment			
Criteria		**Specify**	**Reference**
4	Does the TS contain a clearly outlined, field-specific assessment tool for N or P or both transport from the field to surface waters?	Answer Y or N; Describe what the assessment tool is	Provide a reference to where in the TS this is stated
5	Does the assessment tool (above) provide quantitative or qualitative (or both) criteria for determining whether manure application rates can be N-based, P-based, or prohibited?	Answer Y or N; Provide the quantitative criteria and corresponding rate (e.g., 1.5xP removal, 2xP removal, 3xP removal)	Provide a reference to where in the TS this is stated
6	Where the assessment tool requires a P-based application rate, is it constrained to a 1-year P removal rate?	Answer Y or N; If no, provide under what criteria this is allowed and what rate is allowed	Provide a reference to where in the TS this is stated
Amount			
Criteria		**Specify**	**Reference**
7	Does the TS provide the basis for determining expected crop yields?	Answer Y or N; Explain how realistic yield goals are to be calculated or determined and provide any necessary sources of information that are to be used.	Provide a reference to where in the TS this is stated
8	Does the TS provide crop recommendations that are to be used on which to base applications rates?	Answer Y or N; Provide the recommendations that are to be used for different crops and their source	Provide a reference to where in the TS this is stated
9	Does the TS define what a P-based application rate is? (e.g., crop removal rate, soil test, or the choice of either)?	Answer Y or N; Provide what it is	Provide a reference to where in the TS this is stated
10	Does the TS provide the actual removal rates, soil test recommendations or both for crops, depending on the answer to item 9?	Answer Y or N; Provide what the removal rate is or the soil test recommendation	Provide a reference to where in the TS this is stated

Amount *(continued)*			
Criteria		**Specify**	**Reference**
11	Does the TS provide a value for N credits to be given when legume crops are planted?	Answer Y or N; Provide what N credits are applied for different legumes	Provide a reference to where in the TS this is stated
12	Are N mineralization rates provided for different type (dairy, beef, poultry, swine, etc.) of manure?	Answer Y or N; Provide rates with corresponding manure types	Provide a reference to where in the TS this is stated
13	Does the TS address the requirement for a manure[†] analysis?	Answer Y or N	Provide a reference to where in the TS this is stated
14	Does the TS address the frequency of a manure[†] analysis	Answer Y or N; Provide frequency for analysis to be performed	Provide a reference to where in the TS this is stated
15	Does the TS address methods for collecting manure[†] samples?	Answer Y or N; Provide methods to be used	Provide a reference to where in the TS this is stated
16	Does the TS address the components for which the manure[†] is to be analyzed?	Answer Y or N; List components to be analyzed	Provide a reference to where in the TS this is stated
17	Does the TS address acceptable method(s) or laboratories or both for conducting the manure[†] analysis?	Answer Y or N; Provide methods or appropriate laboratories to be used	Provide a reference to where in the TS this is stated
18	Does the TS address the requirement for a soil test?	Answer Y or N	Provide a reference to where in the TS this is stated
19	Do the TS address the frequency of the soil test?	Answer Y or N; Provide frequency for analysis to be performed	Provide a reference to where in the TS this is stated
20	Does the TS address the methods for collecting soil samples?	Answer Y or N; Provide methods to be used	Provide a reference to where in the TS this is stated
21	Does the TS address which components to include in the soil analysis?	Answer Y or N; List components to be analyzed	Provide a reference to where in the TS this is stated
22	Does the TS address acceptable method(s) or laboratories or both for conducting the soil analysis?	Answer Y or N; Provide methods or laboratories to be used	Provide a reference to where in the TS this is stated
Form and Source			
Criteria		**Specify**	**Reference**
23	Does the amount, timing, and method address how it is to be applied to each form (solid, semisolid, or liquid) and source of manure?	The *form and source* of manure can be addressed separately under the amount, timing, or method of land application as it applies.	
Timing—The criteria below are not required to adequately address the timing of manure application. The criteria identified below may be addressed in a TS, although alternative criteria that address the timing of manure application would also be appropriate.			
Criteria		**Specify**	**Reference**
24	Does the TS address when manure application should be prohibited or delayed? If yes, do these limitations apply only to certain forms (solid, semisolid, or liquid) of manure?	Answer Y or N; If yes, provide when it is to be delayed	Provide a reference to where in the TS this is stated
25	Does the TS adjust mineralization rates for applications made at different times during the year?	Answer Y or N; Provide rate to be used for different times of land application	Provide a reference to where in the TS this is stated

Method of Application—The criteria below are not required to adequately address the method of manure application. The criteria identified below may be addressed in a TS, although alternative criteria that address the method of manure application would also be appropriate.			
Criteria		Specify	Reference
26	Does the TS provide volatilization rates to apply to different types of land application methods? (*e.g., if manure is incorporated after X number of days, a different volatilization rate is applied*)?	Answer Y or N; Provide rate and corresponding land-application method	Provide a reference to where in the TS this is stated
27	Are there any specifications provided for applying different forms (solid, semisolid, or liquid) of manure?	Answer Y or N; Provide any specifications that must be met when land applying different forms of manure (e.g., application of liquid waste through surface or sprinkler irrigation will be timed to prevent deep percolation or runoff. The application rate must not exceed the soil intake/ infiltration rate.)	Provide a reference to where in the TS this is stated
Appropriate Flexibilities			
Criteria		Specify	Reference
28	Does the TS allow multi-year P application?	Answer Y or N; If yes, define what multi-year application means for this standard	Provide a reference to where in the TS this is stated. This flexibility does not have to be provided for by the state Director. If it is not provided for, the remaining criteria (29 – 31) are not applicable.
29	If yes, does it provide restrictions on when or where (or both) this can occur?	Answer Y or N; provide restrictions that apply	Provide a reference to where in the TS this is stated
30	If yes, is there a restriction that additional P to these fields may not be applied until the amount applied in the single year has been removed through plant uptake and harvest?	Answer Y or N	Provide a reference to where in the TS this is stated
31	If yes, does the standard set N limits that must be met?	Answer Y or N; Provide N limits that must be met	Provide a reference to where in the TS this is stated

[1] *Manure* in this checklist means manure, litter, or process wastewater.

Appendix J

NPDES General Permit Template for CAFOs

NOTE: This NPDES General Permit template for CAFOs has been developed to address existing large CAFOs subject to the effluent limitation guidelines subparts C (dairy cows and cattle other than veal calves) and D (swine, poultry, and veal calves). This example permit has not been developed for new sources or for CAFOs subject to subparts A (horses and sheep) and B (ducks).

Example NPDES CAFO Permit Text Key:
[BOLD/SMALL CAPITALS] defines areas where the permitting authority needs to insert specific text.

[Bold/Italic] provides notes to the permitting authority designed to help it develop an NPDES CAFO permit and should be deleted when using this template.

TEMPLATE
NPDES GENERAL PERMIT
FOR
CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFOs)

[AUTHORIZED NPDES PERMITTING AUTHORITY]

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

[The intent of this NPDES General Permit template for CAFOs is to provide an outline for specific permit requirements that are consistent with the NPDES CAFO regulations, CAFO ELG, and the NPDES CAFO Permit Writers' Guidance (to be updated in accordance with the 2008 final rule). EPA encourages permitting authorities to use the recommendations of the guidance manual and this template as appropriate. Minimum NPDES permitting requirements for CAFOs are defined at 40 CFR parts 122, 123, and 412 and all other applicable CWA regulations.]

In compliance with provisions of the Clean Water Act, 33 United States Code (U.S.C.) 1251 *et seq.* (the Act), **[INSERT STATE REGULATORY CITATION AS APPROPRIATE]**, owners and operators of concentrated animal feeding operations (CAFOs), except those CAFOs excluded from coverage in Part I of this permit, are authorized to discharge and must operate their facility in accordance with effluent limitations, monitoring requirements, and other provisions set forth herein.

A copy of this permit must be kept by the permittee at the site of the permitted activity.

This permit will become effective **[DATE 30 DAYS AFTER: DATE OF PUBLICATION (GENERAL PERMIT) OR SIGNATURE (INDIVIDUAL PERMIT)]**

This permit and the authorization to discharge under the NPDES shall expire at midnight **[DATE 5 YEARS AFTER THE DATE ABOVE]**.

Signed this **[DAY]** of **[MONTH]** and **[YEAR]** .

____

[PERMITTING AUTHORITY—OFFICIAL]

Contents

Part I. Permit Area and Coverage

A. Permit Area

[The permitting authority should insert language that identifies the scope of the permit. In the case of a general permit, the permit should identify the type of facilities and/or the geographic area covered (e.g., watershed, statewide) by the permit. If the general permit is restricted to specific animal types and/or to certain size facilities, those limitations should be identified here. When issuing individual permits, this section of the permit should identify the specific facility covered by the permit. Only facilities that discharge or propose to discharge are required to apply for an NPDES permit. Other CAFOs may seek permit coverage if desired.]

B. Permit Coverage

This permit covers any operation that meets the following criteria:

1. Is located in the permit area as defined by Part I.A. of this permit.
2. That meets the definition of a CAFO at 40 CFR part 122.23(b)(4) (see Part VIII, Definitions, *large CAFO* of this permit) **[Insert State Regulatory Citation as Appropriate].**
3. Discharges pollutants to waters of the United States. Once an operation is defined as a CAFO, the NPDES requirements for CAFOs apply with respect to all animals in confinement at the operation and all manure, litter and process wastewater generated by those animals or the production of those animals, regardless of the type of animal.
4. Is eligible for permit coverage as defined in Part I.C .of this permit.
5. Is authorized for permit coverage by the permitting authority as specified in Part I.F. of this permit.

C. Eligibility for Coverage

Unless excluded from coverage in accordance with Paragraph D or F below, owners/operators of existing, operating animal feeding operations that are defined as CAFOs or designated as CAFOs by the permitting authority (see Part VIII Definitions, *CAFOs* of this permit) and that are subject to 40 CFR Part 412, subparts C (Dairy Cows and Cattle Other than Veal Calves) and D (Swine, Poultry, and Veal Calves) are eligible for coverage under this permit. Eligible CAFOs may apply for authorization, under the terms and conditions of this permit, by submitting a Notice of Intent (NOI) to be covered by this permit (see Appendix A of this permit). ***[The permitting authority should provide a copy of the NOI as an appendix to this permit.]***

CAFO owners/operators may also seek to be excluded from coverage under this permit by (1) submitting to the permitting authority a Notice of Termination form (see Appendix D of this permit). ***[The permitting authority should specify the information to be included in such a request or, if available, the form to be used and include a copy of the form as an appendix to the permit.]*** or (2) by applying for an individual NPDES Permit in accordance with Part I.F of this permit.

[The permitting authority should specify an overall approach that defines how CAFOs are to be permitted. That requires determining those types of CAFOs that will be addressed under either general (statewide or watershed) or individual permits. The approach should be modified, as necessary, to reflect specific permitting authority programmatic priorities and constraints.]

D. Limitations on Coverage

The following CAFOs are not eligible for coverage under this NPDES general permit and must apply for an individual permit: ***[Specific eligibility limitations for the general permit should be determined by the NPDES permitting authority.]***

E. Application for Coverage

[The permitting authority should insert the appropriate text in this section. Two alternatives are provided for E.1 providing different levels of detail.]

1. Owners/operators of CAFOs seeking to be covered by this permit must perform the following:
   a. For facilities covered by an expiring or expired permit that wish to have continuous permit coverage, submit an NOI to the permitting authority within ***[The permitting authority may establish a time frame for submitting the NOI, which may extend to the expiration date of the permit or some time before the expiration date.]*** days of the effective date of this permit.
   b. Submit a Nutrient Management Plan (NMP) with the NOI that meets the requirements of 40 CFR Parts 122 and 412, where applicable.
   c. Submit an NOI after the applicable date in Part I. E.1.a. above. Regardless of when the NOI is submitted, the CAFO's authorization under this permit is only for discharges that occur after permit coverage is granted. The permitting authority reserves the right to take appropriate enforcement actions for any unpermitted discharges.

      [Where a CAFO has submitted an application for coverage under an individual permit before issuance of the general permit, the CAFO must (1) submit an NOI for coverage under the general permit, or (2) submit an updated application for coverage under an individual permit if the application requirements have been revised or if the information in the existing application is not current.]

2. Contents of the NOI: The NOI submitted for coverage under this permit must include the following information:
   a. Name of the owner or operator.
   b. Facility location and mailing addresses.
   c. Latitude and longitude of the production area (entrance to production area).
   d. Topographic map of the geographic area in which the CAFO is located showing the specific locations of the production area, land application area, and the name and location of the nearest surface waters.
   e. A diagram of the production area.
   f. Number and type of animals, whether in open confinement or housed under roof (beef cattle, broilers, layers, swine weighing 55 pounds or more, swine weighing less than 55 pounds, mature dairy cows, dairy heifers, veal calves, sheep and lambs, horses, ducks, turkeys, other).
   g. Type of containment and storage (anaerobic lagoon, roofed storage shed, storage ponds, underfloor pits, aboveground storage tanks, belowground storage tanks, concrete pad, impervious soil pad, other) and total capacity for manure, litter, and process wastewater storage (tons/gallons). ***[Note: Total design storage volume includes all wastes accumulated during the storage period, and as applicable; normal precipitation less evaporation on the surface of the structure during the storage period; normal runoff from the production area for the storage period; the direct precipitation from a 25-year, 24-hour storm on the surface of the structure; the runoff from the 25-year, 24-hour storm from the production area; residual solids; and necessary freeboard to maintain structural integrity.]***
   h. Total number of acres under control of the applicant available for land application of manure, litter, or process wastewater.
   i. Estimated amounts of manure, litter, and process wastewater generated per year (tons/gallons).
   j. Estimated amounts of manure, litter and process wastewater transferred to other persons per year (tons/gallons).
   k. An NMP that meets the requirements of the provisions of 40 CFR part 122.42(e) (including, for all CAFOs subject to 40 CFR part 412, subpart C or subpart D, the requirements of 40 CFR part 412.4(c), as applicable) and Part III of this permit.
3. Signature Requirements: The NOI must be signed by the owner/operator or other authorized person in accordance with Part VII.E of this permit.
4. Where to Submit: Signed copies of the NOI or individual permit application must be sent to: **[Permitting Authority Mailing Address]**.

5. Upon receipt, the permitting authority will review the NOI and NMP to ensure that the NOI and NMP are complete. The permitting authority may request additional information from the CAFO owner or operator if additional information is necessary to complete the NOI and NMP or to clarify, modify, or supplement previously submitted material. If the permitting authority makes a preliminary determination that the NOI is complete, the NOI, NMP and draft terms for the NMP to be incorporated into the permit will be made available for a thirty (30) day public review and comment period. The process for submitting public comments and requests of hearing will follow the procedures applicable to draft permits as specified by 40 CFR parts 124.11 through 124.13. The permitting authority will respond to comments received during the comment period as specified in 40 CFR part 124.17 and, if necessary, require the CAFO owner or operator to revise the NMP in order to granted permit coverage. If determined appropriate by the permitting authority, CAFOs will be granted coverage under this general permit upon written notification by EPA. The permitting authority will identify the terms of the NMP to be incorporated into the permit in the written notification.

F. Requiring an Individual Permit

1. **The [PERMITTING AUTHORITY], may at any time require any facility authorized by this permit to apply for and obtain an individual NPDES permit. [PERMITTING AUTHORITY] will notify the operator, in writing, that an application for an individual permit is required within [TIME FRAME FOR APPLICATION SUBMISSION]. Coverage of the facility under this general NPDES permit is automatically terminated when (1) the operator fails to submit the required individual NPDES permit application within the defined time frame or (2) the individual NPDES permit is issued by [PERMITTING AUTHORITY].**

2. Any owner/operator covered under this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner/operator shall submit an application for an individual permit (Form 1 and Form 2B) with the reasons supporting the application to the **[Permitting Authority]**. If a final, individual NPDES permit is issued to an owner/operator otherwise subject to this general permit, the applicability of this NPDES CAFO general permit to the facility is automatically terminated on the effective date of the individual NPDES permit. Otherwise, the applicability of this general permit to the facility remains in full force and effect (for example, if an individual NPDES permit is denied to an owner/operator otherwise subject to this general permit).

G. Permit Expiration

This permit will expire 5 years from the effective date. The permittee must reapply for permit coverage 180 days before the expiration of this permit unless the permit has been terminated consistent with 40 CFR part 122.64(b) or the CAFO will not discharge or propose to discharge upon expiration of the permit. If this permit is not reissued or replaced before the expiration date, it will be administratively continued in accordance with the Administrative Procedures Act and remain in force and effect. Any permittee who is granted permit coverage before the expiration date will automatically remain covered by the continued permit until the earlier of any of the following:

1. Reissuance or replacement of this permit, at which time the permittee must comply with the NOI conditions of the new permit to maintain authorization to discharge.
2. Issuance of an individual permit for the permittee's discharges.
3. A formal decision by the permitting authority not to reissue this general permit, at which time the permittee must seek coverage under an individual permit.
4. The permitting authority grants the permittee's request for termination of permit coverage.

H. Change in Ownership

If a change in the ownership of a facility whose discharge is authorized under this permit occurs, coverage under the permit will automatically transfer if (1) the current permittee notifies the permitting authority at least 30 days prior to the proposed transfer date; (2) the notice includes a written agreement between the existing and new permittees containing a specific transfer date for permit responsibility, coverage, and liability; and (3) the permitting authority does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If the new CAFO owner or operator modifies any part of the NMP, the NMP shall be submitted to the permitting authority in accordance with Part III.A of this permit and 40 CFR part 122.42(e)(6).

I. Termination of Permit Coverage

1. Coverage under this permit may be terminated in accordance with 40 CFR part 122.64 and if EPA determines in writing that one of the following three conditions are met:
   a. The facility has ceased all operations and all wastewater or manure storage structures have been properly closed in accordance with ***[The appropriate standard for closure for example, Natural Resource Conservation Service (NRCS) Conservation Practice Standard No. 360, Closure of Waste Impoundments, as contained in the Natural Resources Conservation Service Field Office Technical Guide]*** and all other remaining stockpiles of manure, litter, or process wastewater not contained in a wastewater or manure storage structure are properly disposed.
   b. The facility is no longer a CAFO that discharges manure, litter, or process wastewater to waters of the United States.
   c. In accordance with 40 CFR part 122.64, the entire discharge is permanently terminated by elimination of the flow or by connection to a publicly owned treatment works (POTW).

Part II. Effluent Limitations and Standards and Other Legal Requirements

A. Effluent Limitations and Standards

[The permit writer will include (1) technology-based effluent limitations, and (2) any more stringent water quality-based effluent limitations where necessary to prevent discharges from the production area that would cause or contribute to an exceedance of water quality standards.]

The following effluent limitations apply to facilities covered under this permit:

[These provisions apply to all existing facilities that are subject to the CAFO ELG specified in 40 CFR part 412 parts C and D. In other cases, the permit writer establishes technology-based limitations on the basis of the specific requirements defined in the CAFO ELG or through the application of best professional judgment (BPJ), whichever is determined to be applicable.]

1. **Technology-based Effluent Limitations and Standards—Production Area.** The CAFO must implement the terms of an NMP, as specified below and in Part III.B of this permit.
   a. There may be no discharge of manure, litter, or process wastewater pollutants into waters of the United States from the production area except as provided below:

      Whenever precipitation causes an overflow of manure, litter, or process wastewater, pollutants in the overflow may be discharged into waters of the United States provided:

      i. The production area is properly designed, constructed, operated and maintained to contain all manure, litter, process wastewater and the runoff and direct precipitation from the 25-year, 24-hour storm event for the location of the CAFO.

      ii. The design storage volume is adequate to contain all manure, litter, and process wastewater accumulated during the storage period including, at a minimum, the following:

         a) The volume of manure, litter, process wastewater, and other wastes accumulated during the storage period.

         b) Normal precipitation less evaporation during the storage period.

         c) Normal runoff during the storage period.

         d) The direct precipitation from the 25-year, 24-hour storm.

         e) The runoff from the 25-year, 24-hour storm event from the production area.

         f) Residuals solids after liquid has been removed.

         g) Necessary freeboard to maintain structural integrity.

         h) A minimum treatment volume, in the case of treatment lagoons.

b. Installation of a depth marker in all open surface liquid impoundments. The depth marker must clearly indicate the minimum capacity necessary to contain the runoff and direct precipitation of the 25-year, 24-hour rainfall event. The marker shall be visible from the top of the levee.

c. Weekly visual inspections of all stormwater diversion devices, runoff diversion structures, and devices channeling contaminated stormwater to the wastewater and manure storage and containment structures.

d. Weekly inspections of the manure, litter, and process wastewater impoundments noting the level as indicated by the depth marker installed in accordance with Part II.A.1.b of this permit.

e. Daily visual inspections of all water lines, including drinking water and cooling water lines.

f. Timely correction of any deficiencies that are identified in daily and weekly inspections.

g. Proper disposal of dead animals ***[may specify a timeframe for example, within 3 days]*** unless otherwise provided for by the permitting authority. Mortalities must not be disposed of in any liquid manure or process wastewater system that is not specifically designed to treat animal mortalities. Animals shall be disposed of in a manner to prevent contamination of waters of the United States or creation of a public health hazard.

h. The maintenance of complete, on-site records documenting implementation of all required additional measures for a period of 5 years, including the records specified for Operation and Maintenance in Part V.C, Table V-A of this permit.

i. The production area must be operated in accordance with the additional measures and records specific in Part II.A.2 of this permit.

2. Additional Measures–Applicable to the Production Area.
In addition to meeting the requirements in Part II.B of this permit, the permittee must implement the following additional measures:

a. Ensure adequate storage of manure, litter, and process wastewater, including procedures to ensure proper operation and maintenance of the storage facilities.

b. Mortality handling practices shall be in accordance with all applicable state and local regulatory requirements. Any such state/local requirements should be consistent with NRCS Practice Standard 316 as applicable.

c. Ensure that clean water is diverted, as appropriate, from the production area in accordance with Part III.A.3.c of this permit.

d. Prevent direct contact of confined animals with waters of the United States.

e. Ensure that chemicals and other contaminants handled on-site are not disposed of in any manure, litter, process wastewater, or storm water storage or treatment system unless specifically designed to treat such chemicals and other contaminants.

f. Identify specific records that will be maintained to document the implementation and management of Part II.A.2. a through c of this permit.

g. In cases where CAFO-generated manure, litter, or process wastewater is sold or given away, the permittee must comply with the following conditions:

   i. Maintain records showing the date and amount of manure, litter, and/or process wastewater that leaves the permitted operation.

   ii. Record the name and address of the recipient.

   iii. Provide the recipient(s) with representative information on the nutrient content of the manure, litter, and/or process wastewater.

   iv. The records must be retained on-site, for a period of 5 years, and be submitted to the permitting authority on request.

3. Water Quality-based Effluent Limitations and Standards—Production Area.

[Permitting authority to specify applicable water quality-based effluent limitations.] ***[The permit writer must ensure that the permit includes effluent limitations developed from applicable technology-based requirements and any more stringent effluent limitations necessary to meet water quality standards. A water quality-based effluent limitation is designed to protect the quality of the receiving water by ensuring state or tribal water quality standards are met. Federal regulations, 40 CFR part 122.44(d), require permit limitations to control all pollutants that may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard. Where water-quality based effluent limitations apply (i.e., are more stringent), technology-based effluent limitations do not apply.***

The permit writer determines the need to establish more restrictive requirements for the production area, particularly for instances where the discharge is to 303(d) waterbodies listed for nutrients, dissolved oxygen, or bacteria, or where an analysis of frequency, duration and magnitude of the anticipated discharge (consisting of potential overflows of manure, litter, or process wastewater) indicates the reasonable potential to violate applicable water quality standards. With respect to the production area, the imposition of a more restrictive water quality-based effluent limitation can include the establishment of more restrictive requirements, such as the imposition of a higher design standard (e.g., 100 year, 24-hour storm in the case of existing sources under subpart C and D of the CAFO ELG) or the inclusion of additional management practices.]

4. **Technology-based Effluent Limitations and Standard—Land Application Areas under the Control of the CAFO Owner/Operator.**

Permittees that apply manure, litter, or process wastewater to land under the permitted CAFO's ownership or operational control must implement the terms of an NMP, as specified below and in Part III.B of this permit. The NMP must be developed in accordance with the requirements of this section and Part III.A of this permit.

a. Determination of application rates. Application rates for manure, litter, or process wastewater must minimize phosphorus and nitrogen transport from the field to surface waters in compliance with the technical standards for nutrient management established by the permitting authority. **[Insert or Reference Technical Standards for Nutrient Management established by the Permitting Authority in Accordance with 40 CFR 123.36. The Technical standard must (1) specify the field-specific assessment of the potential for nitrogen and phosphorus transport form the field to surface waters, (2) address the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals, and (3) include appropriate flexibilities for the implementation of specific nutrient management practices to comply with the standard.]** ***[It is recommended that a complete copy of the standard established by the permitting authority be included as an appendix to the permit.]***

b. Manure and soil sampling. Manure must be analyzed at least once annually for nitrogen and phosphorus content. Soil must be analyzed at least once every 5 years **[or replace with more stringent state-specific soil sampling frequencies for phosphorus and nitrogen]**. The results of the analyses must be used in determining application rates for manure, litter, and process wastewater.

c. Inspection of land application equipment for leaks. Equipment used for land application of manure, litter, or process wastewater must be inspected periodically for leaks.

d. Land application setback requirements. Manure, litter, or process wastewater must not be applied closer than 100 feet to any downgradient waters of the United States, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to waters of the United States. The permittee may elect to use a 35-foot vegetated buffer where applications of manure, litter, or process wastewater are prohibited as an alternative to the 100-foot setback to meet the requirement.

e. Record Keeping requirements. Complete, on-site records including the site-specific NMP must be maintained to document implementation of all required land application practices. Such documentation must include the records specified for Soil and Manure/Wastewater Nutrient Analyses and Land Application in Part V.C, Table V-A of this permit.

[Site-specific conservation practices (other than the setback requirements in 40 CFR part 412.4(c)(5) which apply to all Large CAFOs) and protocols to land

apply manure, litter and process wastewater are site-specific and must be included in Part IV of this permit.]

5. **Additional Measures–Applicable to the Land Application under the Control of the CAFO Owner/Operator.**

[Permitting authorities should consider the applicability of the following types of additional limitations for land application under the control of the CAFO. Options are not limited to the examples presented below.]

a. Additional BMPs to control discharges from land application areas. ***[Insert BMPs to control discharges from land application areas, such as limiting discharges from tile drains, areas where there is significant soil erosion, and/or runoff associated with irrigation.]***

b. Prohibitions.

i. There shall be no discharge of manure, litter, or process wastewater to waters of the United States from a CAFO as a result of the application of manure, litter or process wastewater to land areas under the control of the CAFO, except where it is an agricultural stormwater discharge. Where manure, litter, or process wastewater has been applied in accordance with the terms of the NMP as set forth in Part II.A and III.B of this permit, a precipitation related discharge of manure, litter, or process wastewater from land areas under the control of the CAFO is considered to be an agricultural stormwater discharge.

ii. ***[Any state-specific prohibition or other limitations such as timing of land application, (e.g., no application on frozen or snow-covered land), minimum storage capacity, or specific BMPs required (e.g., stockpiles, prevention of the direct contact of animals with waters of the United States).]***

6. **Water Quality-based Effluent Limitations and Standards–Applicable to the Land Application under the Control of the CAFO Owner/Operator.**

[PERMITTING AUTHORITY TO SPECIFY OTHER/ALTERNATE APPLICABLE WATER QUALITY-BASED EFFLUENT LIMITATIONS.] ***[Discharges from CAFOs that are not exempt from CWA permitting requirements (i.e., agricultural stormwater discharges) are subject to NPDES requirements, including water quality-based effluent limitations. The permit writer may determine the need to establish effluent limitations necessary to meet water quality standards. A water quality-based effluent limitation is designed to protect the quality of the receiving water by ensuring state or tribal water quality standards are met. Federal regulations, 40 CFR part 122.44(d) require permit limitations to control all pollutants that may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard. Water quality-based effluent limitations might be needed when there is a dry-weather discharge (e.g., from tile drain systems or*** **clean** ***water irrigation on fields where manure was previously applied) from the land application area that causes or contributes to an excursion above any state water quality standard.]***

7. **Effluent Limitations—Other Discharges.**

   [All discharges other than agricultural stormwater should be addressed under a CAFO permit. Therefore, if there are situations or conditions that result in a discharge during the term of the permit and that are not addressed under the effluent limitations above, such discharges should be addressed either here or in part IV.B of this permit (Special Conditions, Additional Special Conditions) through the application of BPJ and, to the extent necessary, the use of water quality-based effluent limitations. The language provided below includes examples. Such conditions should be developed using state-specific requirements and CAFO-specific conditions.]

   a. Process wastewater discharges from outside the production area, including: washdown of equipment that has been in contact with manure, raw materials, products or by-products that occurs outside the production area; runoff of pollutants from raw materials, products or by-products (such as manure, litter, bedding and feed) from the CAFO that have been spilled or otherwise deposited outside the production area which are discharged to waters of the United States; and **[Insert any other discharges meeting this description]** shall be identified in the NMP. The NMP shall identify measures necessary to meet applicable water quality standards. **[Specify additional requirements here or cross-reference requirements elsewhere in this permit]**

   b. Wastewater discharges that do not meet the definition of process wastewater, including: (1) discharges associated with feed, fuel, chemical, or oil spills, equipment repair, and equipment cleaning, where the equipment has not been in contact with manure, raw materials, products or by-products; (2) domestic wastewater discharges; and **[Insert any other discharges meeting this description]** shall be identified in the NMP. The NMP shall identify measures necessary to meet applicable water quality standards. **[Specify additional requirements here or cross-reference requirements elsewhere in this permit]**.

   c. Stormwater discharges that are not addressed under the effluent limitations in Section II above remain subject to applicable industrial or construction stormwater discharge requirements. ***[Permit writers might want to clarify that such stormwater excludes process wastewater, discharges that qualify as agricultural stormwater, and discharges from construction activities that disturb less than one acre. Permit writers also may want to discuss the applicability of the no exposure provisions specified in 40 CFR part 122.26(g), as well as either specify or reference the applicable stormwater requirements or reference an applicable stormwater permit.]*** **[Where appropriate, reference general permit or other applicable stormwater requirements.**

   In addition to meeting the above effluent limitations in Part II.A of this permit, the permittee must comply with the special conditions established in Part IV of this permit.

B. Other Legal Requirements

No condition of this permit shall release the permittee from any responsibility or requirements under other statutes or regulations, federal, state/Indian tribe or local.

Part III. Effluent Limitations and Standards of the Nutrient Management Plan

A. Procedural Requirements for Implementing the Terms of the Nutrient Management Plan

CAFO owners or operators seeking coverage under this general permit must submit a Nutrient Management Plan (NMP) with the NOI, as required by Part I.E.1 of this permit. The NMP shall specifically identify and describe practices that will be implemented to assure compliance with the effluent limitations and other conditions of this permit set forth in this part and Part II.A of this permit (Effluent Limitations and Standards). The NMP must be developed in accordance with the technical standards identified in Appendix B of this permit. ***[Alternatively, technical standards may be identified in this section.]***

1. **Schedule.** The completed NMP must be submitted to the permitting authority with the NOI for CAFOs seeking coverage under this permit. The CAFO shall implement its NMP upon authorization under this permit, in accordance with the terms of the NMP set forth in Part III.B of this permit.

2. **NMP Review and Terms**

    a. Upon receipt of the NMP, the permitting authority will review the NMP. The permitting authority may request additional information from the CAFO owner or operator if additional information is necessary to complete the NMP, or to clarify, modify, or supplement previously submitted material.

    b. The permitting authority will use the NMP to identify site-specific permit terms, to be incorporated into this permit. The permitting authority will identify site-specific permit terms with respect to protocols for the land application of manure, litter, and process wastewater. The permitting authority will also identify site-specific permit terms with respect to manure, litter, and process wastewater storage capacities and site-specific conservation practices on the basis of the CAFO's NMP to the extent that such terms are necessary to support the application rates expressed in the NMP. The permitting authority will also identify site-specific permit terms with respect to mortality management, clean water diversions, preventing direct contact of animals with waters of the United States, chemical handling, protocols for manure and soil testing, and record keeping as appropriate.

c. When the permitting authority determines that the NMP and NOI are complete, the permitting authority will notify the public of the permitting authority's proposal to grant coverage under the permit and make available for public review and comment the NOI submitted by the CAFO, including the CAFO's NMP, and the permitting authority will identify the terms of the NMP to be incorporated into the permit. ***[The permit should state where and how notice to the public will be provided.]***

d. The period for the public to comment and request a hearing on the proposed terms of the NMP to be incorporated into the permit shall be ***[The permitting authority can specify in the permit; cite a state regulation; or use a time period specified in 40 CFR part 124.10 (i.e., 30 days)]***.

e. The permitting authority will respond to comments received during the comment period, as provided in 40 CFR part 124.17, and, if necessary, require the CAFO owner or operator to revise the NMP to be granted permit coverage.

f. When the permitting authority authorizes the CAFO owner or operator to discharge under the general permit, the terms of the NMP shall be incorporated as terms and conditions of the permit for the CAFO. The permitting authority will notify the CAFO owner or operator that coverage has been authorized and of the applicable terms and conditions of the permit. Those site-specific permit terms will be provided to the permittee in a ***[permitting authority specify procedure/ mechanism (e.g., permit authorization notice/letter, certificate of coverage, permit modification)]***.

g. Each CAFO covered by this permit must comply with the site-specific permit terms established by the permitting authority on the basis of the CAFO's site-specific NMP.

3. NMP Content. The site-specific NMP at a minimum must include practices and procedures necessary to implement the applicable effluent limitations and standards in Part II.A of this permit. In addition, the NMP and each CAFO covered by this permit must, as applicable do the following:

a. Ensure adequate storage of manure, litter, and process wastewater, including procedures to ensure proper operation and maintenance of the storage facilities. All wastewater and manure containment structures shall at a minimum be designed, constructed, operated, and maintained in accordance with the standards of the *Natural Resources Conservation Service, Field Office Technical Guide* ***[or other standards identified by the permitting authority]***. Storage capacity must be sufficient to meet the minimum applicable state requirements, including ***[permitting authority specify or reference state storage requirements]***, and it must be sufficient to allow the CAFO to comply with the land application schedule specified in the NMP. The NMP must describe the extent that the NMP depends on off-site transport or other means of handling to ensure adequate storage capacity, if applicable.

[If the CAFO needs to maintain storage capacity that exceeds the minimum state capacity requirements to comply with the land application provisions in the NMP, the storage capacity shall become a term of this permit and site-specific terms are to be developed by the permitting authority on the basis of the submitted NMP.]

b. Ensure proper management of mortalities (i.e., dead animals) 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. Mortalities shall be handled in such a way as to prevent the discharge of pollutants to waters of the United States. Mortality handling practices shall be in accordance with all applicable state and local regulatory requirements, including **[*Insert state/local regulatory requirements as appropriate. Any such state/local requirements should be consistent with NRCS Practice Standard 316 as applicable.]***.

c. 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 Part II.A of this permit. Where clean water is not diverted, the CAFO owner or operator must document that it has been accounted for in meeting the requirement to ensure adequate storage capacity as a condition of this permit. Clean water includes, but is not limited to, rain falling on the roofs of facilities and runoff from adjacent land.

d. Prevent the direct contact of animals confined or stabled at the facility with waters of the United States.

e. 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 the management of potentially hazardous or toxic chemicals shall 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 United States. Include references to any applicable chemical handling protocols and indicate that other protocols included in the NMP will be reviewed.

f. Identify appropriate site-specific conservation practices to be implemented, including as appropriate buffers or equivalent practices, to control runoff of pollutants to waters of the United States and specifically to minimize the runoff of nitrogen and phosphorus. Each CAFO covered by this permit must implement the site-specific conservation practices determined by the permitting authority to be a term of this permit, as specified in ***[Identify mechanism (e.g., permit authorization notice/letter, certificate of coverage, permit modification) that the permitting authority will use to specify terms.]***, including residue management, conservation crop rotation, grassed waterways, strip cropping, vegetated buffers, riparian buffers, setbacks, terracing, and diversions. At a minimum, such practices must be adequate to keep erosion levels in each field at or less than the soil loss tolerance (T) value specified in the *Natural Resources Conservation Service, Field Office Technical Guide* ***[or other standards identified by the Permitting Authority]***. ***[Comment: Note that conservation practices become terms of the NMP in two ways:***

i. Conservation practices are terms based on the information, protocols, BMPs and activities deemed necessary to meet part 122.42(e)(1).

ii. Conservation practices become permit terms to the extent that they influence the risk of runoff rating and consequently the application rate. Site-specific terms are to be developed by the permitting authority based on the submitted NMP.]

g. Identify protocols for appropriate testing of manure, litter, process wastewater, and soil. Manure, wastewater and soil sampling must be conducted in accordance with the requirements of Part III.A.2.b of this permit and the following protocols: ***[Insert specific references for the protocols that are to be used]***.

h. Establish 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.

The CAFO's site-specific NMP shall document the calculation of land application rates of manure, litter, or process wastewater. The following technical standard for nutrient management established by the permitting authority shall be used for calculating these rates. ***[Insert reference to state technical standards]*** The rate calculation shall address the form, source, amount, timing, and method of application on each field to achieve realistic production goals while minimizing nitrogen and phosphorus movement to surface water. The rate calculation shall be based on the results of a field specific assessment of the potential for nitrogen and phosphorus transport from the field to surface waters using the following assessment protocol ***[Insert phosphorus risk assessment tool established by the permitting authority].***

Application rates may be expressed in NMPs consistent with one of the two approaches described in Parts III.A.3.h.i and ii of this permit. ***[The permitting authority may limit CAFOs to one approach for specifying application rates or allow both approaches.]***

Development of site-specific terms will be based on the permitting authority's review of the NMP submitted in accordance with the requirements of Part III.B of this permit. To support the development of site-specific terms the submitted NMP must include at a minimum:

- Names of fields available for land application.
- Field-specific rates of application properly developed as specified in paragraph i or ii below in the following chemical forms in this part and **[specify forms of nitrogen and phosphors to be used for expressing application rates]**.
- ***[Placeholder for EPA-or state-specified timing restrictions such as no saturated, frozen, or snow covered ground or during periods of crop dormancy].***
- The information specified in paragraph i and ii below for the selected approach.
- Any additional information necessary to assess the adequacy of the application rates included in the NMP.

i. Linear Approach. Expresses rates of application as pounds of nitrogen and phosphorus. CAFOs selecting the linear approach to address rates of application must include in the NMP submitted to the permitting authority the following information for each crop, field, and year covered by the NMP, which will be used by the permitting authority to establish site-specific permit terms:

  - The maximum application rate (pounds/acre/year of nitrogen and phosphorus) from manure, litter, and process wastewater.
  - The outcome of the field-specific assessment of the potential for nitrogen and phosphorus transport from each field. [If a state does not have an N transport risk assessment, the NMP must document any basis for assuming that nitrogen will be fully used by crops.] The CAFO must specify any conservation practices used in calculating the risk rating.
  - The crops to be planted or any other uses of a field such as pasture or fallow fields.
  - The realistic annual yield goal for each crop or use identified for each field.
  - The nitrogen and phosphorus recommendations from ***[permitting authority to specify acceptable sources]*** for each crop or use identified for each field.
  - Credits for all residual nitrogen in each field that will be plant-available.
  - Consideration of multi-year phosphorus application. For any field where nutrients are applied at a rate based on the crop phosphorus requirement, the NMP must account for single-year nutrient applications that supply more than the crop's annual phosphorus requirement.

- All other additions of plant available nitrogen and phosphorus (i.e., from sources other than manure, litter, or process wastewater or credits for residual nitrogen).
- The form and source of manure, litter, and process wastewater to be land-applied.
- The timing and method of land application. The NMP also must include storage capacities needed to ensure adequate storage that accommodates the timing indicated.
- The methodology that will be used to account for the amount of nitrogen and phosphorus in the manure, litter, and wastewater to be applied.
- Any other factors necessary to determine the maximum application rate identified in accordance with this Linear Approach.

ii. Narrative Rate Approach. Expresses a narrative rate of application that results in the amount, in tons or gallons, of manure, litter, and process wastewater to be land applied. CAFOs selecting the narrative rate approach to address rates of application must include in the NMP submitted to the permitting authority the following information for each crop, field, and year covered by the NMP, which will be used by the permitting authority to establish site-specific permit terms:

- The maximum amounts of nitrogen and phosphorus that will be derived from all sources of nutrients (pounds/acre for each crop and field).
- The outcome of the field-specific assessment of the potential for nitrogen and phosphorus transport from each field. ***[If a state does not have an N transport risk assessment, the NMP must document any basis for assuming that nitrogen will be fully used by crops.]*** The CAFO must specify any conservation practices used in calculating the risk rating.
- The crops to be planted in each field or any other uses of a field such as pasture or fallow fields, including alternative crops if applicable. Any alternative crops included in the NMP must be listed by field, in addition to the crops identified in the planned crop rotation for that field.
- The realistic annual yield goal for each crop or use identified for each field for each year, including any alternative crops identified.
- The nitrogen and phosphorus recommendations from ***[the permitting authority to specify acceptable sources]*** for each crop or use identified for each field, including any alternative crops identified.
- The methodology (including formulas, sources of data, protocols for making determination, etc.) and actual data that will be used to account for: (1) the results of soil tests required by Parts II.A.4.b and III.A.3.g of this permit, (2) credits for all nitrogen in the field that will be plant-

available, (3) the amount of nitrogen and phosphorus in the manure, litter, and process wastewater to be applied, (4) consideration of multi-year phosphorus application (for any field where nutrients are applied at a rate based on the crop phosphorus requirement, the methodology must account for single-year nutrient applications that supply more than the crop's annual phosphorus requirement), (5) all other additions of plant available nitrogen and phosphorus to the field (i.e., from sources other than manure, litter, or process wastewater or credits for residual nitrogen), (6) timing and method of land application, and (7) volatilization of nitrogen and mineralization of organic nitrogen.

- Any other factors necessary to determine the amounts of nitrogen and phosphorus to be applied in accordance with the Narrative Rate Approach.
- NMPs using the Narrative Rate Approach must also include the following projections, which will not be used by the permitting authority in establishing site-specific permit terms:
  - i. Planned crop rotations for each field for the period of permit coverage.
  - ii. Projected amount of manure, litter, or process wastewater to be applied.
  - iii. Projected credits for all nitrogen in the field that will be plant-available.
  - iv. Consideration of multi-year phosphorus application.
  - v. Accounting for other additions of plant-available nitrogen and phosphorus to the field.
  - vi. The predicted form, source, and method of application of manure, litter, and process wastewater for each crop.

4. Signature. The NMP shall be signed by the owner/operator or other signatory authority in accordance with Part VII.E of this permit (Signatory Requirements).
5. A current copy of the NMP shall be kept on site at the permitted facility in accordance with Part VII.C of this permit and provided to the permitting authority upon request.
6. Recordkeeping Requirement
   a. Large CAFOs using the linear rate approach must calculate the maximum amount of manure, litter, and process wastewater to be land applied at least once each year using the results of the most recent representative manure, litter, and process wastewater tests of nitrogen and phosphors. Such representative test must be taken within 12 months of the date of land application.

b. All CAFOs using the narrative rate approach must calculate maximum amounts of manure, litter, and process wastewater to be land applied at least once each year using the methodology specified in the NMP pursuant to Part III.A.3.h of this permit before land applying manure, litter, and process wastewater. Such calculations must rely on the following data:

   i. A field-specific determination of soil levels of nitrogen and phosphorus. For nitrogen, the determination must include a concurrent determination of nitrogen that will be plant available. For phosphorus, the determination must include the results of the most recent soil test conducted as required in Parts II.A.4.b and III.A.3.g of this permit.

   ii. The results of the most recent representative manure, litter, and process wastewater tests for nitrogen and phosphorus taken within 12 months of the date of land application, as required in Parts II.A.4.b and III.A.3.g of this permit, in order to determine the amount of nitrogen and phosphorus in the manure, litter, and process wastewater to be applied.

c. Identify and maintain all records necessary to document the development and implementation of the NMP and compliance with the permit.

7. Changes to the NMP

a. When a CAFO owner or operator covered by this permit makes changes to the CAFO's NMP previously submitted to the permitting authority, the CAFO owner or operator must provide the permitting authority with the most current version of the CAFO's NMP and identify changes from the previous version, except that annual calculations of application rates for manure, litter, and process wastewater as required in Part III.A.6.a of this permit (for the Linear Approach) and Part III.A.6.b of this permit (for the Narrative Rate Approach) are not required to be submitted to the permitting authority.

b. When changes to an NMP are submitted to the permitting authority, the permitting authority will review the revised NMP to ensure that it meets the requirements of Parts II.A and III.A.3 of this permit. If the permitting authority determines that the changes to the NMP necessitate revision to the terms of the NMP incorporated into the permit issued to the CAFO, the permitting authority must determine whether such changes are substantial. Substantial changes to the terms of an NMP incorporated as terms and conditions of a permit include the following:

   i. Addition of new land application areas not previously included in the CAFO's NMP, except if the added land application area is covered by the terms of an NMP incorporated into an existing NPDES permit and the CAFO complies with such terms when applying manure, litter, and process wastewater to the added land.

   ii. For NMPs using the Linear Approach, changes to the field-specific maximum annual rates of land application (pounds of nitrogen and phosphorus from manure, litter, and process wastewater). For NMPs using the Narrative Rate Approach, changes to the maximum amounts of nitrogen and phosphorus derived from all sources for each crop.

iii. Addition of any crop or other uses not included in the terms of the CAFO's NMP.

iv. Changes to site-specific components of the CAFO's NMP, where such changes are likely to increase the risk of nitrogen and phosphorus transport to waters of the United States.

v. If the permitting authority determines that the changes to the terms of the NMP are not substantial, the permitting authority will include the revised NMP in the permit record, revise the terms of the permit on the basis of the site-specific NMP, and notify the CAFO and the public of any changes to the terms of the permit on the basis of revisions to the NMP.

vi. If the permitting authority determines that the changes to the terms of the NMP are substantial, the permitting authority will notify the public, make the proposed changes and the information submitted by the CAFO owner or operator available for public review and comment, and respond to all significant comments received during the comment period. The permitting authority may require the CAFO to further revise the NMP, if necessary. Once the permitting authority incorporates the revised terms of the NMP into the permit, the permitting authority will notify the CAFO of the revised terms and conditions of the permit. ***[The permitting authority can specify a period for processing substantial changes and the permit should state where and how notice to the public will be provided.]***

B. Terms of The Nutrient Management Plan

Any CAFO authorized under this general permit must comply with the terms of the CAFO's site-specific NMP, as established by the permitting authority pursuant to the procedural requirements of Part III.A of this permit. The terms of the NMP for each CAFO authorized by this permit are a part of this permit and are set forth as follows:

[The permit must clearly establish that the terms of the NMP are enforceable terms and conditions of the permit. In addition, the permitting authority must identify how the terms of the NMP are documented and included or otherwise incorporated into the permit. Any permit text must be part of the text of the permit as a whole. The location of the CAFO's entire NMP must also be identified so that the public can refer to the document as a whole.]

Permit Terms and Conditions

[In this section add the site-specific components of the NMP that are necessary to meet the requirements of 40 CFR part 122.42(e)(5(i) or (ii)].

Part IV. Special Conditions

A. Facility Closure

The following conditions shall apply to the closure of lagoons and other earthen or synthetic lined basins and other manure, litter, or process wastewater storage and handling structures:

1. Closure of Lagoons and Other Surface Impoundments
   a. No lagoon or other earthen or synthetic lined basin shall be permanently abandoned.

   b. Lagoons and other earthen or synthetic lined basins shall be maintained at all times until closed in compliance with this section.

   c. All lagoons and other earthen or synthetic lined basins must be properly closed if the permittee ceases operation. In addition, any lagoon or other earthen or synthetic lined basin that is not in use for a period of 12 consecutive months must be properly closed unless the facility is financially viable, intends to resume use of the structure at a later date, and either (1) maintains the structure as though it were actively in use, to prevent compromise of structural integrity; or (2) removes manure and wastewater to a depth of one foot or less and refills the structure with clean water to preserve the integrity of the synthetic or earthen liner. In either case, the permittee shall notify the **[Permitting Authority]** of the action taken and shall conduct routine inspections, maintenance, and record keeping as though the structure were in use. Before restoration or use of the structure, the permittee shall notify the **[Permitting Authority]** and provide the opportunity for inspection.

   d. All closure of lagoons and other earthen or synthetic lined basins must be consistent with ***[insert citation to specific standards as determined to be applicable by the permitting authority]***. Consistent with that standard, the permittee shall remove all waste materials to the maximum extent practicable and dispose of them in accordance with the permittee's NMP, unless otherwise authorized by the **[Permitting Authority]**.

   e. Unless otherwise authorized by the **[Permitting Authority]**, completion of closure for lagoons and other earthen or synthetic lined basins shall occur as promptly as practicable after the permittee ceases to operate or, if the permittee has not ceased operations, 12 months from the date on which the use of the structure ceased, unless the lagoons or basins are being maintained for possible future use in accordance with the requirements above.

2. Closure Procedures for Other Manure, Litter, or Process Wastewater Storage and Handling Structure

   No other manure, litter, or process wastewater storage and handling structure shall be abandoned. Closure of all such structures shall occur as promptly as practicable after the permittee has ceased to operate, or, if the permittee has not ceased to operate, within 12 months after the date on which the use of the structure ceased. To close a manure, litter, or process wastewater storage and handling structure, the permittee shall remove all manure, litter, or process wastewater and dispose of it in accordance with the permittee's NMP, or document its transfer from the permitted facility in accordance with off-site transfer requirements specified in this permit ***[Insert Permit Cite]***, unless otherwise authorized by the **[PERMITTING AUTHORITY]**.

B. Additional Special Conditions

[This section is to be used by the permitting authority to specify any additional special conditions such as procedures for emergency discharge impact abatement, irrigation control, spill control procedures, specific measurements to be collected (i.e., rainfall), and groundwater protection requirements (e.g., monitoring, liners) that are determined necessary by the permitting authority.]

Part V. Discharge Monitoring and Notification Requirements

A. Notification of Discharges Resulting from Manure, Litter, and Process Wastewater Storage, Handling, On-site Transport and Application

If, for any reason, there is a discharge of pollutants to waters of the United States, the permittee is required to make immediate oral notification within 24 hours to the **[PERMITTING AUTHORITY (CONTACT NUMBER)]** and notify the **[PERMITTING AUTHORITY]** in writing within 5 working days of the discharge from the facility. In addition, the permittee shall keep a copy of the notification submitted to the **[PERMITTING AUTHORITY]** together with the other records required by this permit. The discharge notification shall include the following information:

1. A description of the discharge and its cause, including a description of the flow path to the receiving waterbody and an estimate of the flow and volume discharged.

2. The period of noncompliance, including exact dates and times, the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate and prevent recurrence of the discharge.

B. Monitoring Requirements for All Discharges from Retention Structures

If any overflow or other discharge of pollutants occurs from a manure and/or wastewater storage or retention structure, whether or not authorized by this permit, the **[PERMITEE]** shall take the following actions:

1. All discharges shall be sampled and analyzed. Samples must, at a minimum, be analyzed for the following parameters: total nitrogen, ammonia nitrogen phosphorus,

fecal coliform, 5-day biochemical oxygen demand (BOD5), total suspended solids, pH, and temperature. The discharge must be analyzed in accordance with approved EPA methods for water analysis listed in 40 CFR Part 136. ***[The permitting authority may specify additional parameters that are to be analyzed (e.g., metals).]***

2. Record an estimate of the volume of the release and the date and time.
3. ***[The permitting authority should insert the specific procedures that are to be followed by the permittee in collecting these samples. The permitting authority should also specify the time frame for reporting the results of the analyses.]*** The discharge must be collected in accordance with approved EPA methods for water analysis listed in 40 CFR Part 136.
4. If conditions are not safe for sampling, the permittee must provide documentation of why samples could not be collected and analyzed. For example, the permittee may be unable to collect samples during dangerous weather conditions (such as local flooding, high winds, hurricane, tornadoes, electrical storms, and such). However, once dangerous conditions have passed, the permittee shall collect a sample from the retention structure (pond or lagoon) from which the discharge occurred.

C. General Inspection, Monitoring, and Record-Keeping Requirements

The permittee shall inspect, monitor, and record the results of such inspection and monitoring in accordance with Table V–A.

Table V-A. NPDES Large CAFO Permit Record-Keeping Requirements

Parameter	Units	Frequency
Permit and Nutrient Management Plan *(Note: Required by the NPDES CAFO Regulation—applicable to all CAFOs)*		
The CAFO must maintain on-site a copy of the current NPDES permit, including **[SPECIFY MECHANISM TO IDENTIFY SITE-SPECIFIC TERMS]**.	N/A	Maintain at all times
The CAFO must maintain on-site a current, site-specific NMP that reflects existing operational characteristics. The operation must also maintain on-site all necessary records to document that the NMP is being properly implemented with respect to manure and wastewater generation, storage and handling, and land application. In addition, records must be maintained that the development and implementation of the NMP is in accordance with the minimum practices defined in 40 CFR part 122.42(e).	N/A	Maintain at all times

Table V-A. NPDES Large CAFO Permit Record-Keeping Requirements *(continued)*

Parameter	Units	Frequency
Soil and Manure/Wastewater Nutrient Analysis ***(Note: Required by the CAFO ELG—applicable to Large CAFOs)***		
Analysis of manure, litter, and process wastewater to determine nitrogen and phosphorus content.[a]	ppm Pounds/ton	At least annually after initial sampling
Analysis of soil in all fields where land application activities are conducted to determine phosphorus content.[a]	ppm	At least once every 5 years after initial sampling
Operation and Maintenance ***(Note: Required by the CAFO ELG—applicable to Large CAFOs)***		
Visual inspection of all water lines	N/A	Daily[b]
Documentation of depth of manure and process wastewater in all liquid impoundments	Feet	Weekly
Documentation of all corrective actions taken. Deficiencies not corrected within 30 days must be accompanied by an explanation of the factors preventing immediate correction.	N/A	As necessary
Operation and Maintenance ***(Note: Required by the CAFO ELG—applicable to Large CAFOs)***		
Documentation of animal mortality handling practices	N/A	As necessary
Design documentation for all manure, litter, and wastewater storage structures including the following information:		
• Volume for solids accumulation	Cubic yards/ gallons	Once in the permit
• Design treatment volume	Cubic yards/ gallons	term unless revised
• Total design storage volume[c]	Cubic yards/ gallons	
• Days of storage capacity	Days	
Documentation of all overflows from all manure and wastewater storage structures including: ***(Note: Required by the NPDES Regulation—applicable to all CAFOs)***		
• Date and time of overflow	Month/day/ year	Per event
• Estimated volume of overflow	Total gallons	Per event
• Analysis of overflow (as required by the permitting authority)	TBD	Per event

Table V-A. NPDES Large CAFO Permit Record-Keeping Requirements *(continued)*

Parameter	Units	Frequency
Land Application *(Note: Required by the CAFO ELG—applicable to Large CAFOs)*		
For each application event where manure, litter, or process wastewater is applied, documentation of the following by field:		
• Date of application	Month/day/year	Daily
• Method of application	N/A	Daily
• Weather conditions at the time of application and for 24 hours before and after application	N/A	Daily
• Total amount of nitrogen and phosphorus applied[d]	Pounds/acre	Daily
Documentation of the crop and expected yield for each field	Bushel/acre	Seasonally
Documentation of the actual crop planted and actual yield for each field	Bushel/acre	Seasonally
Documentation of test methods and sampling protocols used to sample and analyze manure, litter, and wastewater and soil.	N/A	Once in the permit term unless revised
Documentation of the basis for the application rates used for each field where manure, litter, or wastewater is applied.	N/A	Once in the permit term unless revised
Documentation showing the total nitrogen and phosphorus to be applied to each field including nutrients from the application of manure, litter, and wastewater and other sources	Pounds/acre	Once in the permit term unless revised
Documentation of manure application equipment inspection	N/A	Seasonally
Manure Transfer *(Note: Required by the NPDES CAFO Regulation—applicable to Large CAFOs)*		
For all manure transfers the CAFO must maintain the following records:		
• Date of transfer	N/A	As necessary
• Name and address of recipient	N/A	As necessary
• Approximate amount of manure, litter, or wastewater transferred	Tons/gallons	As necessary

Notes:

a. For the specific analyses to be used, see the state nutrient management technical standard.

b. Visual inspections should take place daily during the course of normal operations. The completion of such inspection should be documented in a manner appropriate to the operation. Some operations might wish to maintain a daily log. Other operations might choose to make a weekly entry, when they update other weekly records that required daily inspections have been completed.

c. Total design volume includes normal precipitation less evaporation on the surface of the structure for the storage period, normal runoff from the production area for the storage period, 25-year, 24-hour precipitation on the surface of the structure, 25-year, 24-hour runoff from the production area, and residual solids.

d. Including quantity/volume of manure, litter, or process wastewater applied and the basis for the rate of phosphorus application.

D. Additional Monitoring Requirements

[This section is to be used by the permitting authority to specify any additional monitoring and analysis that the permittee is to perform.]

1. Additional monitoring for some high risk operations: Upon notification by **[Permitting Authority]**, the permittee may be required to conduct ambient monitoring of surface or groundwater or both. For example, facilities with historical compliance problems, especially large facilities, facilities with significant environmental concerns, or facilities impacting impaired waterbodies. ***[The permitting authority should establish appropriate ambient surface and groundwater monitoring requirements in the NPDES permit.]***

2. Upon request by **[Permitting Authority]**, the permittee may be required to collect and analyze samples including but not limited to soils, surface water, groundwater, or stored waste in a manner and frequency specified by **[Permitting Authority]**.

Part VI. Annual Reporting Requirements

[This example permit includes the minimum information required by the NPDES regulations. The permitting authority can use its discretion concerning additional information required to be submitted with the annual report.]

A. The permittee must submit an annual report to the permitting authority by [Date] of each year.

B. The annual report must include the following information:
[The permitting authority can use its discretion and authority to request additional information from the permittee. The permitting authority might wish to provide an example of the specific format for the annual report. An example report is included in the NPDES CAFO Permit Writer Guidance.]

1. The number and type of animals, whether in open confinement or housed under roof.

2. Estimated amount of total manure, litter, and process wastewater generated by the CAFO in the previous 12 months (tons/gallons).

3. Estimated amount of total manure, litter, and process wastewater transferred to other person by the CAFO in the previous 12 months (tons/gallons).

4. Total number of acres for land application covered by the NMP.

5. Total number of acres under control of the CAFO that were used for land application of manure, litter, and process wastewater in the previous 12 months.

6. Summary of all manure, litter, and process wastewater discharges from the production area that have occurred in the previous 12 months, including date, time, and approximate volume.

7. A statement indicating whether the current version of the CAFO's NMP was developed or approved by a certified nutrient management planner.

8. Actual crops planted and actual yields for each field for the preceding 12 months.

9. Results of all samples of manure, litter or process wastewater for nitrogen and phosphorus content for manure, litter and process wastewater that was land applied.

10. Results of calculations conducted in accordance with Part III.A.6.a of this permit (for the Linear Approach) and Part III.A.6.b of this permit (for the Narrative Rate Approach).

11. Amount of manure, litter, and process wastewater applied to each field during the preceding 12 months.

12. For CAFOs using the Narrative Rate Approach to address rates of application:
    i. The results of any soil testing for nitrogen and phosphorus conducted during the preceding 12 months.
    ii. The data used in calculations conducted in accordance with Part III.A.3.h of this permit.
    iii. The amount of any supplemental fertilizer applied during the preceding 12 months.

Part VII. Standard Permit Conditions

A. General Conditions

1. In accordance with the provisions of 40 CFR Part 122.41 *et. seq.*, this permit incorporates by reference all conditions and requirements applicable to NPDES Permits set forth in the Clean Water Act, as amended, (the Act) and all applicable regulations.

2. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation, and reissuance; for denial of a permit renewal application; and/or for requiring a permittee to apply for and obtain an individual NPDES permit.

3. The permittee shall comply with effluent standards and prohibitions established under section 307(a) of the Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

4. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

5. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state/tribal or local laws or regulations.

6. The permittee shall furnish to the permitting authority, within a reasonable time, any information that the permitting authority might request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the permitting authority, on request, copies of records required to be kept by this permit.

7. Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of the permit, the Act, or applicable regulations, which avoids or effectively defeats the regulatory purpose of the permit may subject the permittee to criminal enforcement pursuant to 18 U.S.C. 1001.

8. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state/tribal law or regulation under authority preserved by section 510 of the Act.

9. The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Bypass
    a. *Definitions*
        i. Bypass means the intentional diversion of waste streams from any portion of a treatment facility.
        ii. Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
    b. *Bypass not exceeding limitations.* The permittee may allow any bypass to occur that does not cause effluent limitations to be exceeded but only if it also is for essential maintenance to assure efficient operation. Those bypasses are not subject to Parts VII.A.10.c. and 10.d.of this permit.
    c. *Notice*

i. *Anticipated bypass.* If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 10 days before the date of the bypass.

ii. *Unanticipated bypass.* The permittee shall submit notice of unanticipated bypass as required Part VII.D.5.of this permit (24-hour notice).

d. *Prohibitions of bypass.*

i. Bypass is prohibited, and the permitting authority may take enforcement action against a permittee for bypass, unless the following are true:

- Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage.
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. That condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance.
- The permittee submitted notices as required under Part VII.A.10.c of this permit.

ii. The permitting authority may approve an anticipated bypass, after considering its adverse effects, if the permitting authority determines that it will meet the three conditions listed above in Part VII.A.10.d.(i) of this permit.

11. Upset

a. *Definition.* Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance caused by operational error, improperly designed treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. *Effect of an upset.* An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Part VII.A.11.c. of this permit are met.

c. *Conditions necessary for a demonstration of upset.* A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence of the following:

i. An upset occurred and that the permittee can identify the cause(s) of the upset.

ii. The permitted facility was at the time being properly operated.

iii. The permittee submitted notice of the upset as required in Part VII.D.5 of this permit (24-hour notice).

iv. The permittee complied with any remedial measures required under Part VII.A.14 of this permit (duty to mitigate).

d. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

12. *Duty to reapply.* If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit.

13. *Need to halt or reduce activity not a defense.* It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

14. *Duty to mitigate.* The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit, which has a reasonable likelihood of adversely affecting human health or the environment.

15. *Inspection and entry.* The permittee shall allow the permitting authority, or an authorized representative (including an authorized contractor acting as a representative of the permitting authority), upon presentation of credentials and other documents as may be required by law, to do the following:

   a. Enter the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

   b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

   c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit.

   d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

B. Proper Operation and Maintenance

The permittee shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

C. Monitoring and Records

1. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

2. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 5 years from the date of the sample, measurement, report, or application. That period may be extended by request of the permitting authority at any time.

3. Records of monitoring information shall include the following:
   a. The date, exact place, and time of sampling or measurements.
   b. The individual(s) who performed the sampling or measurements.
   c. The date(s) analyses were performed.
   d. The individual(s) who performed the analyses.
   e. The analytical techniques or methods used.
   f. The results of such analyses.

4. The permittee shall follow the following monitoring procedures:
   a. Any required monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit or approved by the Regional Administrator.
   b. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instruments at intervals frequent enough to ensure accuracy of measurements and shall maintain appropriate records of such activities.
   c. An adequate analytical quality control program, including the analyses of sufficient standards, spikes, and duplicate samples to ensure the accuracy of all required analytical results shall be maintained by the permittee or designated commercial laboratory.

5. INSERT MONITORING REPORTS STANDARD CONDITION 40 CFR part 122.41(l)(4) HERE.

D. Reporting Requirements

1. The permittee shall give notice to the permitting authority as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when any of the following are true:
   a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR part 122.29(b).

   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. The notification applies to pollutants that are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42(a)(1).

   c. The alteration or addition results in a significant change in the permittee's manure use or disposal practices, and such alteration, addition, or change could justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an NMP.

2. The permittee shall give advance notice to the **[Permitting Authority]** of any planned physical alterations or additions or changes in activity that could result in noncompliance with requirements in this permit.

3. This permit is not transferable to any person except after notice to the **[Permitting Authority]**. The **[Permitting Authority]** may require modification or revocation and reissuance of the permit to change the name or the permittee and incorporate such other requirements as might be necessary under the Act.

4. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date.

5. The permittee shall report any noncompliance that could endanger human health or the environment. Any information must be provided orally to **[Permitting Authority Contact Information]** within 24 hours from the time that the permittee becomes aware of the circumstances. A written submission shall also be provided to **[Permitting Authority]** within 5 days of the time the permittee becomes aware of the circumstances. The report shall contain the following information:

   a. A description of the noncompliance and its cause.

   b. The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue.

   c. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

6. The following shall be included as information, which must be reported within 24 hours:

   a. Any unanticipated bypass that exceeds any effluent limitation in the permit.

   b. Any upset that exceeds any effluent limitation in the permit.

   c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the permitting authority in the permit to be reported within 24 hours.

The permitting authority may waive the written report on a case-by-case basis for reports under the above if the oral report has been received within 24 hours.

7. The permittee shall report all instances of noncompliance not reported under above and of this section, at the time monitoring reports are submitted. The reports shall contain the information listed in Part VII.D.6of this permit.

8. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the **[Permitting Authority]**, the permittee shall promptly submit such facts or information to the **[Permitting Authority]**.

E. Signatory Requirements

All applications, reports, or information submitted to the **[Permitting Authority]** shall be signed and certified consistent with 40 CFR part 122.22:

1. All notices of intent shall be signed as follows:
   a. For a corporation: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means either of the following:
      i. A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation.
      ii. The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions that govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
   b. For a partnership or sole proprietorship: By a general partner for a partnership or the proprietor, respectively.
2. All reports required by the permit and other information requested by the **[Permitting Authority]** shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if the following are true:
   a. The authorization is made in writing by a person described above.
   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of

plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or any individual or position having overall responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or an individual occupying a named position.

c. The written authorization is submitted to the **[Permitting Authority]**.

F. Certification

Any person signing a document under this section shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G. Availability of Reports

Any information submitted pursuant to this permit may be claimed as confidential by the submitter. If no claim is made at the time of submission, information may be made available to the public without further notice.

H. Penalties for Violations of Permit Conditions

1. Criminal Penalties:

   a. Negligent violations: The Act provides that any person who negligently violates section 301, 302, 306, 307, 308, 318, or 405 of the Act or any condition or limitation implementing those provisions in a permit issued under section 402 is subject to a fine of not less than $2,750 nor more than $27,500 per day of violation, or by imprisonment for not more than one year, or both.

   b. Knowing violations: The Act provides that any person who knowingly violates sections 301, 302, 306, 307, 308, 318, or 405 of the Act or any permit conditions implementing those provisions is subject to a fine of not less than $5,500 nor more than $55,000 per day of violation, or by imprisonment for not more than 3 years, or both.

   c. Knowing endangerment: The Act provides that any person who knowingly violates sections 301, 302, 303, 306, 307, 308, 318, or 405 of the Act or permit conditions implementing those provisions and who knows at that time that he or she is placing another person in imminent danger of death or serious bodily injury is subject to a fine of not more than $275,000, or by imprisonment for not more than 15 years, or both.

d. False statements: The Act provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $11,000, or by imprisonment for not more than 2 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $22,000 per day of violation, or by imprisonment of not more than 4 years, or by both. [See section 309(c)4 of the Clean Water Act.]

2. Civil penalties: The Act provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $27,500 per day for each violation. [See section 309(d).]

3. Administrative penalties: The Act provides that the Administrator may assess a Class I or Class II administrative penalty if the Administrator finds that a person has violated sections 301, 302, 306, 307, 308, 318, or 405 of the Act or a permit condition or limitation implementing these provisions, as follows [See section 309(g).]:
   a. Class I penalty: Not to exceed $11,000 per violation nor shall the maximum amount exceed $27,500.
   b. Class II penalty: Not to exceed $11,000 per day for each day during which the violation continues nor shall the maximum amount exceed $137,500.

Part VIII. Definitions

Animal feeding operation means a lot or facility (other than an aquatic animal production facility) where the following conditions are met: (i) animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and (ii) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

Application means the U.S. Environmental Protection Agency standard national forms for seeking coverage under for an NPDES permit, including any additions, revisions or modifications to the forms; or forms approved by U.S. Environmental Protection Agency for use in *approved states*, including any approved modifications or revisions [e.g. for NPDES general permits, a written NOI pursuant to 40 CFR part 122.28; for NPDES individual permits, Form 1 and 2B pursuant to 40 CFR part 122.1(d)].

Concentrated animal feeding operation (CAFO) means an AFO that is defined as a Large CAFO or Medium CAFO by 40 CFR parts 122.23 (4) and (6), or that is designated as a CAFO.

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

Grab sample means a sample that is taken from a wastestream on a one-time basis without consideration of the flow rate of the wastestream and without consideration of time.

Land application means the application of manure, litter, or process wastewater onto or incorporated into the soil.

Land application area means land under the control of a CAFO owner or operator, whether it is owned, rented, or leased, to which manure, litter, or process wastewater from the production area is or could be applied.

Large CAFO means an AFO that stables or confines as many as or more than the numbers of animals specified in any of the following categories: (i) 700 mature dairy cattle, whether milked or dry; (ii)1,000 veal calves; (iii)1,000 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs; (iv) 2,500 swine each weighing 55 pounds or more; (v)10,000 swine each weighing less than 55 pounds; (vi) 500 horses; (vii) 10,000 sheep or lambs; (viii) 55,000 turkeys; (ix) 30,000 laying hens or broilers, if the AFO uses a liquid manure handling system; (x)125,000 chickens (other than laying hens), if the AFO uses other than a liquid manure handling system; (xi) 82,000 laying hens, if the AFO uses other than a liquid manure handling system; (xii) 30,000 ducks (if the AFO uses other than a liquid manure handling system); or (xiii) 5,000 ducks (if the AFO uses a liquid manure handling system).

Liquid manure handling system means a system that collects and transports or moves waste material with the use of water, such as in washing pens and flushing confinement facilities. That includes the use of water impoundments for manure or wastewater treatment.

Manure is defined to include manure, litter, bedding, compost and raw materials or other materials commingled with manure or set aside for land application or other use.

Medium CAFO means any AFO that stables or confines as many or more than the numbers of animals specified in any of the following categories: (i) 200 to 699 mature dairy cattle, whether milked or dry cows; (ii) 300 to 999 veal calves; (iii) 300 to 999 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs; (iv) 750 to 2,499 swine each weighing 55 pounds or more; (v) 3,000 to 9,999 swine each weighing less than 55 pounds; (vi)150 to 499 horses, (vii) 3,000 to 9,999 sheep or lambs, (viii) 16,500 to 54,999 turkeys, (ix) 9,000 to 29,999 laying hens or broilers, if the AFO uses a liquid manure handling system; (x) 37,500 to 124,999 chickens (other than laying hens), if the AFO uses other than a liquid manure handling system; (xi) 25,000 to 81,999 laying hens, if the AFO uses other than a liquid manure handling system; (xii) 10,000 to 29,999 ducks (if the AFO uses other than a liquid manure handling system); or (xiii) 1,500 to 4,999 ducks (if the AFO uses a liquid manure handling system) and either one of the following conditions are met (a) pollutants are discharged into waters of the United States through a man-made ditch, flushing system, or other similar man-made device; or

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

Notice of Intent (NOI) is a form submitted by the owner/operator applying for coverage under a general permit. It requires the applicant to submit the information necessary for adequate program implementation, including, at a minimum, the legal name and address of the owner or operator, the facility name and address, type of facility or discharges, and the receiving stream(s). 40 CFR § 128.28(b)(2)(ii).

Process wastewater means water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other AFO facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process wastewater also includes any water that comes into contact with or is a constituent of raw materials, products, or by-products including manure, litter, feed, milk, eggs, or bedding.

Production area means that part of an AFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal containment area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milk rooms, milking centers, cowyards, barnyards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms and diversions that separate uncontaminated stormwater. Also included in the definition of production area is any egg washing or egg processing facility, and any area used in the storage, handling, treatment, or disposal of mortalities.

Small CAFO means an AFO that is designated as a CAFO and is not a Medium CAFO.

Setback means a specified distance from waters of the United States or potential conduits to waters of the United States where manure, litter, and process wastewater may not be land applied. Examples of conduits to surface waters include open tile line intake structures, sinkholes, and agricultural well heads.

The Act means Federal Water Pollution Control Act as amended, also known as the Clean Water Act as amended, found at 33 U.S.C. 1251 *et seq*.

Vegetated buffer means a narrow, permanent strip of dense perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the field for the purposes of slowing water runoff, enhancing water infiltration, and minimizing the risk of any potential nutrients or pollutants from leaving the field and reaching waters of the United States.

Waters of the United States means (1) all waters that are used, were used in the past, or might be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide; (2) all interstate waters, including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, and streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters: (a) that are or could be used by interstate or foreign travelers for recreational or other purposes; from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or that are or could be used for industrial purposes by industries in interstate commerce; (4) all impoundments of waters otherwise defined as waters of the United States; (5) tributaries of waters identified in (1) through (4) of this definition; (6) the territorial sea; and (7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in items (1) through (6) of this definition.

Appendix A. (Insert Form 2B/Notice of Intent or Appropriate State Form)

Appendix B. (Insert State Technical Standards for Nutrient Management)

Appendix C. Historic Properties Requirements

Appendix D. Notice of Termination

Appendix K

NRCS Conservation Practice Standards

U.S. Department of Agriculture, Natural Resources Conservation Service Conservation (USDA-NRCS) Practice Standards

This appendix describes selected conservation practice standards developed by USDA-NRCS that NPDES permit writers and inspectors might encounter in their review of CAFO nutrient management plans. USDA-NRCS maintains the most recent national version of many of the standards along with their associated job sheets and statements of work in its National Handbook of Conservation Practice Standards (available at *http://www.nrcs.usda.gov/Technical/Standards/nhcp.html*).

Each state's NRCS office adopts and may modify those practices that are applicable in that state. Some state NRCS offices also develop state-specific standards that are not found in the national handbook. NPDES permit writers and inspectors should refer to the practice standards that are applicable in their state. All state-specific conservation practice standards are available in the Electronic Field Office Technical Guide (eFOTG, available at *http://www.nrcs.usda.gov/technical/efotg/*). To find a specific standard, use the interactive maps on eFOTG to select the appropriate state and county. Then select Section IV from the menu at the left side of the screen for a list of practice standards available in that state.

Conservation Practice: Access Control (Code 472)
Application: Production Area

Barriers can be used to prevent, restrict, or control access to an area to maintain or improve the quantity and quality of natural resources or to minimize liability and human health concerns. Barriers consist of natural or artificial structures such as logs, vegetation, earth fill, boulders, fences, gates, electronic and sonic devices, and signs. In those cases where a waterbody is present in the feedlot area of the operation, the NMP should address the installation and maintenance of a fence, or similar barrier, to prevent animals from entering the water. In addition, the slope of the feedlot should be contoured to divert runoff away from the waterbody.

Conservation Practice: Access Road (Code 560)
Application: Production Area

The standard establishes a travel-way for equipment and vehicles constructed as part of a conservation plan.

The purpose of this practice is to provide a fixed route for vehicular travel for resource activities involving the management of timber, livestock, agriculture, wildlife habitat, and other conservation enterprises while protecting the soil, water, air, fish, wildlife, and other adjacent natural resources where access is needed from a private or public road or highway to a land use enterprise or conservation measure, or where travel ways are needed in a planned land use area.

Access roads range from seasonal use roads, designed for low speed and rough driving conditions, to all-weather roads heavily used by the public and designed with safety as a high priority. Some roads are constructed for a single purpose only; i.e., control of forest fires, logging and forest management activities, access to remote recreation areas, or access for maintenance of facilities.

Access roads should be located so as to minimize adverse effects on wetlands, waterbodies, wildlife habitat, and air quality. Considerations should be given to the following:

- Effects on downstream flows or aquifers that would affect other water uses or users.
- Effects on the volume and timing of downstream flow to prohibit undesirable environmental, social or economic effects.
- Short-term and construction-related effects of this practice on the quality of on-site downstream water courses.
- Overall effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff from construction activities.
- Effects on wetlands and water-related wildlife habitats that would be associated with the practice.
- Establishing vegetation on road shoulders wider than 2-4 feet.
- Limiting the number of vehicles and vehicle speed will reduce the potential for generation of particulate matter and decease safety and air quality concerns.

Conservation Practice: Agrichemical Handling Facility (Code 309)
Application: Production Area

An agrichemical handling facility has an impervious surface to provide a safe environment on farm and ranch operations for the storage, mixing, loading and cleanup of agrichemicals. The practice is also used to retain incidental spillage, retain leakage, and reduce pollution to surface water, groundwater, air, and/or soil.

The practice applies where

- The handling of agrichemicals creates significant potential for pollution of surface water, groundwater, air or soil and a facility is needed to properly manage and handle the chemical operation.
- An adequate water supply is available for filling application equipment tanks, rinsing application equipment and chemical containers as needed for the operation.
- Soils and topography are suitable for construction.

The standard does not apply to the handling or storage of fuels or to commercial or multi-landowner agrichemical handling operations.

Conservation Practice: Anaerobic Digester (Code 366)
Application: Production Area

An anaerobic digester is a component of a waste management system that provides biological treatment in the absence of oxygen. Anaerobic digesters are designed to treat manure and other by-products of animal agricultural operations for one or more of the following reasons:

- To capture biogas for energy production.
- To manage odors.
- To reduce the net effect of greenhouse gas emissions.
- To reduce pathogens.

The practice applies where

- Biogas production and capture are components of a planned animal waste and by-product(s) management system.
- Sufficient and suitable organic feedstocks are readily available.
- Existing facilities can be modified to the requirements of this standard or for new construction.
- The operator has the interest and skills to monitor and maintain processes or contracts with a consultant to provide the services.

Conservation Practice: Animal Mortality Facility (Code 316)
Application: Production Area

Animal mortality facilities treat and dispose of livestock and poultry carcasses for routine or catastrophic mortality events. Such facilities reduce effects on surface and groundwater resources, reduce odors, and decrease the spread of pathogens. The planning and design of animal mortality facilities or processes must conform to all federal, state, and local laws, rules, and regulations.

This conservation practice applies to livestock and poultry operations where animal carcass treatment or disposal is needed. This practice, however, might not be applicable to catastrophic mortality resulting from disease, unless directed by the appropriate state or federal authority (the state veterinarian or USDA APHIS).

Conservation Practice: Composting Facility (Code 317)
Application: Production Area

A composting facility is a structure or device to contain and facilitate the controlled aerobic decomposition of manure or other organic material by microorganisms into a biologically stable organic material that is suitable for use as a soil amendment.

The purpose of this practice is to reduce the pollution potential and improve the handling characteristics of organic waste solids. Composting facilities can also be used to produce a soil amendment that adds organic matter and beneficial organisms, provides slow-release plant-available nutrients, and improves soil condition.

This application applies where

- Organic waste material is generated by agricultural production or processing.
- The facility is a component of a planned waste management system.
- The facility can be constructed, operated, and maintained without polluting air or water resources.
- The compost can be applied to the land or marketed to the public.

Conservation Practice: Conservation Buffers

Contour Buffer Strips – (Code 332)
Contour Stripcropping – (Code 585)
Filter Strip – (Code 393)
Grassed Waterways – (Code 412)
Riparian Forest Buffer – (Code 391)
Stripcropping – (Code 586)
Terrace – (Code 600)
Windbreak – (Code 380)

Application: Land-Application Areas/Production Area

All the conservation practices identified in the USDA *CNMP Technical Guidance* are considered together because they all function to intercept sediment and other pollutants to prevent them from reaching surface waters. Buffers function by intercepting runoff containing nutrients, sediments and other potential pollutants; storing the runoff; and then releasing it slowly into the waterbody. Buffers also reduce and contain flooding by slowing water discharge into streams and providing an area for surplus water. Windbreaks also can be used to reduce wind erosion and the deposition of soil into surface water. Some of the conservation buffers can be applied in the land-application areas and to the production area. Those practices include filter strips, contour buffer strips, and grassed waterways. The use of such conservation practices around the production area would likely be limited to those instances where surface water is near the production area.

Contour Buffer Strips: Contour buffer strips are strips of perennial vegetation, such as grass, alternated with wider cultivated strips that are farmed on the contour. Contour buffer strips allow runoff and trap sediment. Because the grass buffer strip is established on the contour, runoff flows evenly across the entire surface of the strip, reducing sheet and rill erosion. The grass slows runoff, helping the water soak into the soil and reducing erosion. Sediment, nutrients and other pollutants are filtered from the runoff as it flows through the strip thereby improving surface water quality. Buffer strips should be at least 15 feet wide and usually make up one-fifth to one-third of the slope. The specific recommendations for establishing buffers vary from site to site. Cultivated strip widths are determined by variables such as slope, soil type, field conditions, climate, and erosion potential. Contour buffer strips are unsuitable in fields where irregular, rolling topography makes following a contour impractical.

Contour Stripcropping: In stripcropping, crops are arranged so that a strip of grass or forage is alternated with a strip of row crop (such as corn). The crops are planted across the slope of the land, as in contour buffer strips. Less than half the field should be planted in row crops. The grass or forage strips reduce erosion, slow runoff water, and trap sediment. The practice combines the benefits of contouring and crop rotation. Strip cropping is not as effective if the crop strips are too wide, especially on steep slopes. Maximum crop strip widths range from 130 feet, for 1 to 2 percent slopes down, to 50 feet for 21 to 25 percent slopes.

Grassed Waterways: Grassed waterways are natural or constructed vegetated channels designed to direct surface water, flowing at non-erosive velocities, to a stable outlet (another vegetated channel, earth ditch, or the like). Grassed waterways usually are used to control gully erosion. In concentrated flow areas, grassed waterways can act as an important component of erosion control by slowing the flow of water and filtering sediment. Other benefits of grassed waterways include the safe disposal of runoff water, improved water quality, improved wildlife habitat, reduced damage associated with sediment, and an improvement in overall landscape aesthetics. Grassed waterways are typically used to control runoff in a field. There might be circumstances, however, where they are used to control runoff from the production area of an operation. Grassed waterways are usually planted with perennial grasses, preferably native species where possible. Some common grass species used in waterways are timothy, tall fescue, and Kentucky bluegrass. Grassed waterways are generally constructed to be either trapezoid or parabolic in cross section, with the requirement that the bottom (shorter) width of trapezoidal waterways not exceed 100 feet unless multiple or divided waterways are provided to control the meandering of low flows.

Filter strips: Filter strips are areas of grass or other permanent vegetation that intercept runoff, trapping sediment and pesticides before they reach a body of water. A properly installed buffer can effectively trap 90 percent of sediment and nitrate moving from a farm field. A filter strip can be 20 to 120 feet wide and is usually planted with native grasses. Filter strips are one type of conservation buffer that is often applied to the area between the production area and an adjacent waterbody. In those areas, a filter strip is a gently sloping grass area that is planted between the livestock yard and drainage ways to streams and is managed to filter runoff from the livestock yard. Influent waste is distributed uniformly across the high end of the strip and allowed to flow through the strip. Nutrients and suspended material remaining in the runoff water are filtered through the grass, absorbed by the soil, and ultimately taken up by the plants. Filter strips should be designed and sized to match the characteristics of the livestock yard. A typical practice is to make the filter strip area about equal to the livestock yard area.

Riparian Buffers: Riparian buffers are streamside vegetation consisting of trees, shrubs, and grasses. They are used to intercept pollutants from an adjacent farm field. Riparian buffers provide many important benefits by reducing the amounts of both eroded soil sediment and nonpoint source pollutants (such as pesticides, herbicides, and surplus nutrients) that enter surface water.

Terraces: Although terraces are not true buffer strips, they are linear conservation practices that perform similar functions (e.g., water diversion, sediment trapping). They are more commonly installed as a diversion measure. A diversion is an earthen embankment, channel, or combination ridge and channel that is built across a slope to intercept and store water runoff. Pollutants in terraces can leach into groundwater. Some terraces are built level from end to end to contain water used to grow crops and recharge groundwater. Others, known as gradient terraces, are built with some slope or grade from one end to the other and can slow water runoff. Both help to reduce soil erosion. In the production area, terraces can be used as a part of an overall diversion system based on the topography of the feedlot. An earthen ridge or terrace can be constructed across the slope upgrade from a production area to prevent runoff from entering the area or to direct runoff from one area of the yard to a common collection area.

Windbreaks: The main purpose of windbreaks is to reduce wind erosion of soil from agricultural fields and to protect farmsteads from severe wind. Windbreaks redirect the wind and modify its force. They also provide habitat, food, and migration corridors for wildlife; aesthetic benefits; livestock protection; and energy conservation. (Adapted from NRCS's *National Handbook of Conservation Practices*, at *http://www.nrcs.usda.gov/technical/standards/nhcp.html*.)

Conservation Practice: Conservation Crop Rotation (Code 328)
Application: Land-Application Area

Crop rotation combined with recommended tillage practices can play an important role in reducing wind and water erosion. Solid-seed crops such as small grains provide more protection against water erosion than row crops, and permanent crops like hay or pasture provide even more protection. Managing crops to provide sufficient residue throughout the year is essential for satisfactory control of both wind and water erosion.

No-till or minimum-till farming is highly desirable as a conservation practice, but crop rotation must be used to reduce the buildup of insects, weeds and disease-causing organisms. Crop rotation also means that succeeding crops are of a genus, species, subspecies, or variety different from that of the previous crop. Examples are barley after wheat, row crops after small grains, and grain crops after legumes. The planned rotation sequence could be for a 2- or 3-year period or longer. Legumes in the rotation can be used to increase the available soil nitrogen. Symbiotic nitrogen-fixing bacteria called *Rhizobia* form nodules on the roots of leguminous plants and fix atmospheric nitrogen or convert it to organic nitrogen. The amount of nitrogen fixed varies with species, available soil nitrogen, and many other factors. Fixed nitrogen not removed from the land by harvest becomes available to succeeding crops as the legume tissues undergo microbial decomposition. A well-planned rotation can contribute to more efficient use of plant nutrients. In a 3-year corn/alfalfa rotation, for example, manure can be applied during the corn rotation, resulting in efficient use of nitrogen and often a buildup phosphorus and potassium levels. During the alfalfa phase of the rotation, when manure is not applied, the forage crop uses the soil phosphorus and potassium that were built up during the corn phase of the rotation. The combination of nutrient management and crop rotation can reduce or eliminate the need for purchased fertilizer. If conservation cropping is used in the plan, the inspector should check that the sequence and types of crops being grown are consistent with the plan. The nutrient application rates identified in the plan are based on the specific crop rotation used in the calculations. (Adapted from NRCS *National Handbook of Conservation Practices*, at *http://www.nrcs.usda.gov/technical/standards/nhcp.html*.)

Conservation Practice: Cover Crop (Code 340)
Application: Land-Application Areas

A cover crop is a close-growing crop that temporarily protects the ground from wind and water erosion during times when cropland is not adequately protected against soil erosion. Common cover crops include cereal rye, oats, clover, crown vetch, and winter wheat. Cover crops are most often recommended when low residue-producing crops such as soybeans or corn silage are grown on erodible land. Note that if the cover crop is a legume, the nutrient budget calculated in the operation's NMP should account for the addition of nitrogen provided by the crop to the soil.

Conservation Practice: Critical Area Planting (Code 342)
Application: Production Area

The USDA standard is for establishing permanent vegetation on sites that have or are expected to have high erosion rates and on sites that have physical, chemical, or biological conditions that prevent the establishment of vegetation with normal practices.

The purpose of this practice is to

- Stabilize areas with existing or expected high rates of soil erosion by water.
- Stabilize areas with existing or expected high rates of soil erosion by wind.
- Rehabilitate and revegetate degraded sites that cannot be stabilized through normal farming practices.
- Stabilize coastal areas, such as sand dunes and riparian areas.

If gullies or deep rills are present, they will be treated, if feasible, to allow equipment operation and ensure proper site and seedbed preparation. On the basis of a soil test, soil amendments will be added, as necessary, to ameliorate or eliminate physical or chemical conditions that inhibit plant establishment and growth. Required amendments should be included in the site specification with amounts, timing, and method of application. Such required amendments include

- Compost or manure to add organic matter and improve soil structure and water holding capacity.
- Agricultural limestone to increase the pH of acid soils.
- Elemental sulfur to lower the pH of calcareous soils.

Conservation Practice: Diversion (Code 362)
Application: Production Area

A diversion is an earthen channel with a supporting ridge constructed across a slope to collect runoff water and safely divert it to a stable outlet, thereby preventing erosion of an area below. Diversions are effective in intercepting storm runoff and directing it away from fields susceptible to erosion, preventing water from flowing over areas where high concentrations of pollutants are present (such as feedlots), and diverting runoff water away from gullies to a stable outlet. The practice can also be applied in land-application areas to reduce nutrient loss.

Diversions can be used to move surface water away from the production area to a clean-water drainage system independent of the water-handling system. Such an approach reduces the amount of water to be handled, reduces the amount of solids eroded from the lot, and maintains available common diversion practices:

- Waterways, small terraces, and roof gutters to direct water away from the production area.
- An earthen ridge or diversion terrace constructed across the slope to prevent runoff from entering the production area.
- A catch basin with a pipe outlet installed above the production area if a diversion terrace is not practical.

All roofs that would contribute to runoff from the production area should have gutters, downspouts, and outlets that discharge water away from the confinement area. The design of the diversion should be based on a 25 year, 24-hour storm.

Conservation Practice: Fence (Code 382)
Application: Production Area/Land-Application Area

An area of land can be enclosed or divided with a suitable permanent structure that acts as a barrier to livestock.

Conservation Practice: Field Border (Code 386)
Application: Land-Application Areas

The USDA standard defines a field border as a strip of permanent vegetation established at the edge or around the perimeter of a field.

The practice can be applied to accomplish one or more of the following:

- Reduce erosion from wind and water.
- Protect soil and water quality.
- Manage pest populations.
- Provide wildlife food and cover.
- Increase carbon storage.
- Improve air quality.

The practice is applied around the perimeter of fields. Its use can support or connect other buffer practices within and between fields. The practice can also apply to recreation land or other land uses where agronomic crops including where forages are grown.

Conservation Practice: Heavy-Use Area Protection (Code 561)
Application: Production Area

The USDA standard establishes the stabilization of areas frequently and intensively used by people, animals, or vehicles by any combination of establishing vegetative cover, surfacing with suitable materials, or installing needed structures.

The purpose of the practice is to provide a stable, non-eroding surface for areas frequently used by animals, people or vehicles. It also helps to protect and improve water quality.

The treated area can include all areas where livestock congregate and cause surface stability problems. That includes feeding areas, portable hay rings, watering facilities, feeding troughs, mineral boxes, and other facilities where livestock concentrations cause resource concerns.

To reduce the negative water quality impact of heavy-use areas, consider locating them as far as possible from waterbodies or water courses. In some cases, it could require relocating the heavily used area rather than armoring an area that is already in use.

Conservation Practice: Irrigation Water Management (Code 449)
Application: Land-Application Area

Irrigation water management is controlling the rate, amount, and timing of irrigation water in a planned and prudent manner. The purpose of the practice is to manage soil moisture for crop production and erosion control, minimize leaching of soluble plant nutrients, and protect groundwater and surface water quality. Without proper management, fields are often irrigated too often and at excessive rates. If irrigation water is over-applied, the excess water can cause soil erosion and leaching of nutrients and pesticides. Over-application also wastes water, energy, and money. The volume of water applied and the frequency of applications should determined by crop needs and soil conditions. Soil moisture should be monitored to predict when irrigation is needed. When crops are irrigated, the volume applied should not exceed the available water-holding capacity of the soil in the root zone or the moisture control zone. In addition, the infiltration rate of the soil should not be exceeded. This practice should be applied in conjunction with other erosion and sediment control practices. (Adapted from NRCS's *National Handbook of Conservation Practices*, at *http://www.nrcs.usda.gov/technical/standards/nhcp.html*.)

Conservation Practice: Livestock Shade Structure (Code 717)
Application: Pasture

This standard is available in some states but is not included in the *National Handbook of Conservation Practices*. The standard describes a livestock shade structure as a portable, metal frame structure with a mesh fabric roof that is to provide shade for livestock. The practice can be applied as part of a resource management system to protect livestock from excessive heat and also to protect surface waters from pollution by excluding livestock from existing shade on streambanks. The standard includes considerations for the design, placement, construction, operation, and maintenance of livestock shade structures.

Conservation Practice: Nutrient Management (Code 590)
Application: Land Application

The USDA *CNMP Technical Guidance* uses NRCS Conservation Practice Standard 590, Nutrient Management, to guide the proper land application of nutrients. The standard states that nutrient application rates are to be established considering current soil tests, realistic yield goals and management capabilities. In cases where manure is the source of applied nutrients, the rate also shall be based on an analysis of the nutrient value of the manure, NRCS book values, or historical documented records.

Conservation Practice: Residue Management (Code 344)
No-Till and Strip Till (Code 329A)
Mulch Till (Code 345)
Ridge Till (Code 346)
Application: Land Application

These cropping practices retain crop residues on or near the surface of a field. As a group these practices are often referred to as conservation tillage. Conservation tillage is any tillage system that leaves at least 30 percent of the field surface covered with crop residue after cropping is completed, and it involves reduced or minimum tillage. The residue can reduce soil detachment by absorbing the impact of falling raindrops. The remaining residue might form small dams that can retard runoff and create puddles of water that absorb raindrop energy, thus reducing soil erosion. Such practices require use of some specialized equipment.

No-till/strip till: In these systems, the soil is left undisturbed from harvest to planting except for strips up to one-third of the row width. (The strips could involve only residue disturbance or could include soil disturbance.) Planting or drilling is accomplished using disc openers, coulter(s), row cleaners, in-row chisels, or rototillers. Weeds are controlled primarily with crop protection products; cultivation can be used for emergency weed control. Other common terms used to describe no-till, include row-till, and slot-till.

Ridge-till: Ridge-till is a system in which seeds are planted into a seedbed prepared by scraping off the top of the ridge. The scraped-off ridge usually provides an excellent environment for planting. Ridges are formed during cultivation of the previous year's crop. Ridge-till operations consist of planting in the spring and at least one cultivation to recreate the ridges for the next year. Rows remain in the same place each year and any crop residue on the ridges at planting is pushed between the rows.

Mulch-till: This system uses full-width tillage involving one or more tillage strips, which disturbs the entire soil surface and is done before or during planting. Tillage tools such as chisels, field cultivators, discs, sweeps, or blades are used. Weeds are controlled with crop protection products or cultivation or both.

Conversation Practice: Roof Runoff Management (Code 558)
Application Area: Production Area

This USDA Conservation Practice Standard is not identified in the *CNMP Technical Guidance*; however, it can be used to address roof runoff entering the production area.

This USDA standard establishes the plans and specifications for designing, constructing, and operating roof runoff management facilities. Such facilities include erosion-resistant channels or subsurface drains with rock-filled trenches along building foundations below eaves, roof gutters, downspouts, and appurtenances.

The purpose of this practice is to prevent roof runoff water from flowing across concentrated waste areas, barnyards, roads and alleys; reduce pollution and erosion; improve water quality; prevent flooding; improve drainage; and protect the environment.

Conversation Practice: Roofs and Covers (Code 367)
Application Area: Production Area

The practice standard addresses a rigid, semi-rigid, or flexible manufactured membrane, composite material, or roof structure placed over a waste management facility to provide a roof or cover for

- Improving water quality.
- Diverting clean water from animal management areas (i.e., barnyard, feedlot or exercise area) or waste storage facilities.
- Capturing biogas for energy production.
- Reducing net effect of greenhouse gas emissions.
- Improving air quality and reducing odor.

The practice criteria address the structure's service life, materials, loads, design, access, repair, and safety. Operation and maintenance requirements are included.

Conservation Practice: Sediment Basin (Code 350)
Application: Production Area/Land-Application Area

The USDA standard defines this practice as a basin constructed with an engineering outlet, formed by an embankment or excavation or a combination of the two.

The purpose of the practice is to capture and detain sediment laden runoff, or other debris, for a sufficient length of time to allow it to settle out in the basin.

This practice applies to urban land, construction sites, agricultural land, and other disturbed lands where

- Physical conditions or land ownership precludes treatment of a sediment source by installing erosion-control measures.
- A sediment basin offers the most practical solution.
- Failure of the basin will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads, or in the use of public utilities.
- The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway.
- The effective height of the dam is 35 feet or less. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam.
- The Hazard Class of the dam is low.

Conservation Practice: Solid/Liquid Waste Separation Facility (Code 632)
Application: Production Area

A solid/liquid waste separation facility is a filtration or screening device, settling tank, settling basin, or settling channel used to separate a portion of solids from a liquid waste stream.

The practice is used to partition solids, liquids and their associated nutrients as part of a conservation management system to improve or protect air and water quality and animal health, or to meet other management objectives.

This practice applies where solid/liquid separation will

- Remove solids from the liquid waste stream as a primary treatment process and allow further treatment processes to be applied such as composting and anaerobic digestion.
- Allow partly digested feed to be separated from the liquid waste stream so that it can be used as a feed supplement or for bedding.
- Reduce problems associated with solids accumulation in liquid storage facilities.

- Reduce solids in stored liquids so liquids can be recycled for other uses (i.e. flush water).
- Reduce solids in stored liquids to better facilitate land application of liquids using irrigation techniques.
- Assist with partitioning nutrients in the waste stream to improve nutrient management.

Conservation Practice: Structure for Water Control (Code 587)
Application: Production Area

The USDA standard establishes a structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water.

The practice can be applied as a management component of a water management system to control the stage, discharge, distribution, delivery, or direction of water flow.

The practice applies wherever a permanent structure is needed as an integral part of a water-control system to serve one or more of the following functions:

- Convey water from one elevation to a lower elevation within, to, or from a water conveyance system such as a ditch, channel, canal, or pipeline designed to operate under open channel conditions. Typical structures are drops, chutes, turnouts, surface water inlets, head gates, pump boxes, and stilling basins.
- Control the elevation of water in drainage or irrigation ditches. Typical structures are checks, flashboard risers, and check dams.
- Control the division or measurement of irrigation water. Typical structures are division boxes and water measurement devices.
- Keep trash, debris or weed seeds from entering pipelines. A typical structure is a debris screen.
- Control the direction of channel flow resulting from tides and high water or back-flow from flooding. Typical structures are tide and water management gates.
- Control the water table level, remove surface or subsurface water from adjoining land, flood land for frost protection, or manage water levels for wildlife or recreation. Typical structures are water level control structures, flashboard risers, pipe drop inlets, and box inlets.
- Convey water over, under, or along a ditch, canal, road, railroad, or other barriers. Typical structures are bridges, culverts, flumes, invented siphons, and long span pipes.
- Modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures are chutes, cold water release structures, and flashboard risers.
- Provide silt management in ditches or canals. A typical structure is a sluice.

- Supplement a resource management system on land where organic waste or commercial fertilizer is applied.
- Create, restore, or enhance wetland hydrology.

Conservation Practice: Waste Storage Facility (Code 313)
Application: Production Area/Land-Application Area

The USDA standard defines this practice as a waste storage impoundment made by constructing an embankment or excavating a pit or dugout, or by fabricating a structure. The purpose of the standard is to temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.

Conditions where this practice applies include

- Where the storage facility is a component of a planned agricultural waste management system.
- Where temporary storage is needed for organic wastes generated by agricultural production or processing.
- Where the storage facility can be constructed, operated, and maintained without polluting air or water resources.
- Where site conditions are suitable for constructing the facility.
- Facilities using embankments with an effective height of 35 feet or less where damage resulting from failure would be limited to damage of farm buildings, agricultural land, or township and county roads.
- Where fabricating structures including tanks, stacking facilities, and pond appurtenances.

Conservation Practice: Waste Treatment Lagoon (Code 359)
Application: Production Area

A waste treatment lagoon is an impoundment made by constructing an embankment or excavating a pit or dugout.

The purpose of the practice is to biologically treat waste, such as manure and wastewater, and thereby reduce pollution potential by serving as a treatment component of a waste management system.

Lagoons should be outside floodplains to minimize the potential for stream contamination and should have as little drainage area as possible.

The practice can be applied under the following conditions:

- The lagoon is a component of a planned agricultural waste management system.

- Treatment is needed for organic wastes generated by agricultural production or processing.
- On any site where the lagoon can be constructed, operated, and maintained without polluting air or water resources.
- At lagoons using embankments with an effective height of 35 feet or less, where damage resulting from failure would be limited to damage of farm buildings, agricultural land, or township and country roads.

Conservation Practice: Waste Utilization (Code 633)
Application: Land-Application Areas

This practice applies where agricultural wastes that include animal manure and wastewater from livestock and poultry operations are generated or used. The standard recommends sampling and analysis requirements for the manure and wastewater as well as record-keeping requirements. In addition to general criteria, the standard includes specific criteria to protect water quality.

All agricultural waste shall be utilized in a manner that minimizes the opportunity for contaminating surface and groundwater supplies. Agricultural waste shall not be applied on soils that are frequently flooded, as defined by the National Cooperative Soil Survey, during the period when flooding is expected. When liquid wastes are applied, the application rate must not exceed the infiltration rate of the soil, and the amount of waste applied must not exceed the moisture-holding capacity of the soil profile at the time of application.

The standard also includes criteria to reduce atmospheric losses and the reduction of odors from spreading operations. (Adapted from NRCS's *National Handbook of Conservation Practices*, at *http://www.nrcs.usda.gov/technical/standards/nhcp.html*.)

Conservation Practice: Water and Sediment Control Basin (Code 638)
Application: Production Area/Land-Application Area

The USDA standard defines the practice as an earth embankment or a combination ridge and channel constructed across the slope of minor watercourses to form a sediment trap and water detention basin with a stable outlet.

The practice can be applied as part of a resource management system for one or more of the following purposes:

- To reduce watercourse and gully erosion.
- To trap sediment.
- To reduce and manage onsite and downstream runoff.

This practice applies to sites where

- The topography is generally irregular.

- Watercourse or gully erosion is a problem.
- Sheet and rill erosion is controlled by other conservation practices.
- Runoff and sediment damages land and works of improvements.
- Adequate outlets can be provided.

Do not use this standard in place of terraces. When the ridge or channel extends beyond the detention basin or level embankment, use Conservation Practice Standard (600), Terrace or (362) Diversion, where appropriate.

Appendix L

Nutrient Management Planning Software

Software Programs

This appendix describes the types of software available to develop nutrient management plans (NMPs) and which programs are used in specific states. Permit writers should be familiar with the program(s) commonly used in their state to ensure they are familiar with the format and content of NMPs they will be reviewing. Table L-1 below describes which software is being used in each state, and Table L-2 provides a brief description of each software program along with contacts and websites to refer to for more information. EPA has supported the development of Manure Management Planner (MMP), and this appendix briefly outlines how MMP works and who can and should use it.

Table L-1. Specific software programs available in each state

State	NMP software available	Description number in Table 2
Alabama	Manure Management Planner (MMP)	4
Alaska		
Arizona		
Arkansas	MMP	4
California	California Central Valley NMP	1
	MMP	4
Colorado	MMP	4
Connecticut		
Delaware	NuMan MD Pro 3.0	10
	MMP	4
Florida	MMP	4
Georgia	MMP	4
Hawaii		
Idaho	Idaho OnePlan	3
Illinois	MMP	4
Indiana	MMP	4
Iowa	MMP	4
Kansas	Nutrient Utilization Plan Worksheet	13
	MMP	4
Kentucky	MMP	4

Table L-1. Specific software programs available in each state *(continued)*

State	NMP software available	Description number in Table 2
Louisiana		
Maine		
Maryland	NuMan MD Pro 3.0	10
	NuMan Reporter 2.0	12
	MMP	4
Massachusetts	MMP	4
Michigan	MMP	4
Minnesota	MPCA MMP	5
	NMP for Minnesota	11
	MMP	4
Mississippi	MMP	5
Missouri	MMP	5
Montana	MMP	5
Nebraska	MMP	5
Nevada		
New Hampshire		
New Jersey	MMP	5
New Mexico	NMSU Soil Test Interpretation Report Software	7
	NMSU Dairy Annual Nutrient Manager Software	6
	MMP	4
New York	Cropware	2
North Carolina	North Carolina Nutrient Management Software	8
North Dakota	MMP	4
Ohio	Crop Nutrient Management Software	14
	MMP	4
Oklahoma	MMP	4

Table L-1. Specific software programs available in each state *(continued)*

State	NMP software available	Description number in Table 2
Oregon	Oregon OnePlan	15
	MMP	4
Pennsylvania	Penn State NMP Spreadsheet	16
	MMP	4
Puerto Rico		
Rhode Island	MMP	4
South Carolina		
South Dakota	NRCS Tool in South Dakota	9
	MMP	4
Tennessee	MMP	4
Texas	Texas Waste Utilization and Nutrient Management Plan Worksheet	18
Utah	Utah's Manure Actual Nutrient Content spreadsheet	19
	MMP	4
Vermont	MMP	4
Virgin Islands		
Virginia	NuMan Reporter 2.0	12
Washington	MMP	4
West Virginia	NuMan Reporter 2.0	12
Wisconsin	SNAP Plus	17
	MMP	4
Wyoming		

Table L-2. Description of software programs

Number	Software	Description	For more information
1	California Central Valley Dairy Waste and Nutrient Management Software	Designed for existing milk cow dairies as mandated by the Waste Discharge Requirements General Order No. R5-2007-0035. The software is applicable to owners and operators of existing milk cow diaries that were operating as of October 17, 2005, filed a complete Report of Waste Discharge in response to the 2005 Report of Waste Discharge Request Letter, and have not expanded since October 17, 2005. The software was developed with a grant from the California State Water Resources Control Board and was designed to minimize leaching of nutrients and salts to groundwater and transport of those constituents to surface water.	See the California EPA website. Adobe PDF Reader software is needed. *http://www.waterboards.ca.gov/centralvalley/water_issues/dairies/complying_with_general_order/software/index.shtml*
2	Cropware	Supported by the NYS NRCS, the NYS Department of Agriculture and Markets, and the NYS Department of Environmental Conservation. It is a key component of Comprehensive NMPs (CNMPs) as it can develop plans in accordance with the NRCS Nutrient Management Standard (Standard 590). For effective nutrient management planning, Cropware integrates Cornell crop nutrient guidelines for a full range of agronomic and vegetable crops, nutrient credits from various sources including manure, soil, sod, and fertilizer, and environmental risk indices, including the New York State Phosphorus Runoff Index and the Nitrate Leaching Index.	Cropware Version 2.0.34 operates on Microsoft Windows operating systems and is available to any New York user at no charge. For a Cropware training session, questions about the software, or to order a Cropware CD, contact Patty Ristow at *plr27@cornell.edu* *http://nmsp.cals.cornell.edu/software/cropware.html*
3	Idaho OnePlan	Combines government regulations and current best management practices (BMPs) for agriculture into a single plan. This software is designed to include nutrient, pest and waste management, water quality and wetlands, air quality, financial assistance, endangered species, and petroleum storage tanks. The OnePlan software questionnaire along with data access to aerial photos, soil data, hydrology maps, roads, and GIS maps is used to generate a report and plan of action with effective area-specific BMPs.	Information on how to become certified to use the Nutrient Management Planner is at *http://oneplan.org/NMPlan.asp* For information regarding NMP software training, contact Hillary Simpson, State Nutrient Management Coordinator at the Idaho State Department of Agriculture at (208) 736-3049 or *hsimpson@agri.idaho.gov*

Table L-2. Description of software programs *(continued)*

Number	Software	Description	For more information
3	Idaho OnePlan *(continued)*	The Idaho OnePlan Nutrient Management Planner is the only officially recognized planning tool for creating certified NMPs in Idaho. The software and training to become Certified Nutrient Management Planners in Idaho is offered by the state and the USDA.	
4	Manure Management Planner (MMP)	See the description below.	*http://www.agry.purdue.edu/mmp/* For agronomic questions, contact Brad Joern at (765) 494-9767 or *bjoern@purdue.edu* For software questions, contact Phil Hess at (765) 494-8050 or *pjhess@purdue.edu*
5	MPCA Manure Management Planner	Developed by the Minnesota Pollution Control Agency (MPCA), the MMP is a spreadsheet that is designed to meet Minnesota 7020 feedlot rule requirements. This MMP is required for operations with 100 or more animal units (AU) after October 23, 2000, or when manure from a feedlot capable of holding 300 or more AU is applied by someone other than a certified animal waste technician. Because records of actual manure application practices are required at all facilities with 100 or more AU, this program also has a record-keeping tab.	*www.pca.state.mn.us/hot/feedlot-management.html* George Schwint, MPCA Feedlot Engineer, at (303) 214-3793 or *George.schwint@pca.state.mn.us*
6	NMSU Dairy Annual Nutrient Manager Software	Developed by New Mexico State University and USDA, it balances nutrients according to user-defined crops planted, soil analyses, effluent irrigated, dry manure applied, and chemical fertilizers used.	*http://aces.nmsu.edu/ces/dairy/tools.html* Victor E. Cabrera, Extension Dairy Specialist, at (505) 985-2292 x107 or at *vcabrera@nmsu.edu*
7	NMSU Soil Test Interpretation Report Software	Microsoft Excel spreadsheet developed by New Mexico State University and NRCS to recommend nutrient application for crop production. This software is a requirement for both organic manure applications and inorganic fertilizer applications to apply the 590 Nutrient Management practice. This software requires soil values including salinity, pH, phosphorous, and potassium obtained from proper soil testing.	*http://www.nm.nrcs.usda.gov/technical/water/nmafo.html*

Table L-2. Description of software programs *(continued)*

Number	Software	Description	For more information
8	North Carolina Nutrient Management Software	The North Carolina Nutrient Management Software is useful in writing commercial fertilizer and animal waste plans. It produces NMPs in the required format to meet state requirements for Waste Management Plans for animal operations.	Can be downloaded at *http://www.soil.ncsu.edu/programs/nmp/ncnmwg/nmp/software.htm* Vernon Cox at (919) 715-6109
9	NRCS Tool in South Dakota	South Dakota uses the NRCS Tool for developing an initial NMP, the NRCS Tool for annual NMP using the phosphorus assessment tool, and the DENR Tool for calculating manure application rates.	*http://denr.sd.gov/des/sw/ManureNutrientManagementTools.aspx* Kent Woodmansey at (605) 773-3351
10	Nutrient Management for Maryland Version 3.0 (NuMan Pro 3.0)	NuMan Pro 3.0 is the most advanced Windows software available to complete Maryland NMPs. It is derived from the NuMan Reporter 2.0.	*http://www.anmp.umd.edu/Software/index.cfm* Direct questions to *http://www.anmp.umd.edu/About_NM/Staff.cfm*
11	Nutrient Management Planner for Minnesota	Nutrient Management Planner Version 3.0 was developed by the University of Minnesota Extension Service and the USDA-NRCS. This planning aid will produce an MMP to meet MPCA requirements for most feedlots and NRCS requirements. It is designed to assist producers and agronomists plan and keep records of field-specific fertilizer and manure applications. Specifically, it can develop annual field-specific NMPs for crop and livestock farms, create long-range strategic NMPs including CNMPs, and provide crop recommendations. The crop recommendations are consistent with the USDA-NRCS-Minnesota 590 Standard for nutrient management and are based on published information from the University of Minnesota Extension Service.	Requires Microsoft Access 2003 or Access 2007 and can be ordered from the University of Minnesota Extension at *http://shop.extension.umn.edu* Ann Lewandowski at UM Water Resources Center at *alewand@umn.edu* or (612) 624-6765.
12	Nutrient Management Reporter Version 2.0 (NuMan Reporter 2.0)	NuMan Reporter 2.0 is a software program designed to help prepare the Maryland Department of Agriculture's Annual Implementation Report (AIR). The AIR describes the nutrient management activities that have been applied over the past year. NuMan Reporter 2.0 is not required to complete this report but facilitates the	*http://www.anmp.umd.edu/Software/numanreporter_features.cfm* Contact the Agricultural Nutrient Management Program at (301) 405-1318.

Table L-2. Description of software programs *(continued)*

Number	Software	Description	For more information
12	Nutrient Management Reporter Version 2.0 (NuMan Reporter 2.0) *(continued)*	reporting process. NuMan Reporter 2.0 can also be used to generate other NMPs. This program is designed to summarize the number of acres, total amount of nutrients recommended as fertilizer, and the total amounts of organic material recommended on a crop code basis.	
13	Nutrient Utilization Plan Worksheet	Form with spreadsheets specific to swine and non-swine facilities to calculate elements required for the NMP.	*http://www.kdheks.gov/feedlots/*
14	Ohio Crop Nutrient Management Software	The Crop Nutrient Management software is a tool to help Ohio farmers develop a manure NMP. After soil and manure testing is performed to analyze nutrient availability, the software is used to determine the appropriate nutrient application for each field. The final development of a manure NMP can be done with the assistance of the local Soil and Water Conservation District and the soil conservationist. The software was developed by the Ohio State University Extension and is available at Ohio county Extension offices for a nominal charge.	*http://ohioline.osu.edu/agf-fact/0207.html* For assistance, contact an Ohio county Extension agent or Soil and Water Conservation District technician
15	Oregon OnePlan	The Oregon OnePlan is nutrient management software developed jointly by the Idaho Department of Agriculture, the NRCS, EPA, USDA Agricultural Research Service, University of Idaho College of Agriculture and Marshall and Associates. The software is a modification of Idaho's OnePlan for use in Oregon. It is designed for developing CNMPs and for preparing Field Annual Nutrient Budgets.	At the time of publication, an active link to Oregon OnePlan was not available. Jennifer Zwicke, NRCS Oregon Environmental Engineer at (503) 414-3231 or *Jennifer.Zwicke@or.usda.gov*
16	Penn State Nutrient Management Plan Spreadsheet	The Penn State Nutrient Management Plan Spreadsheet is a tool designed to produce the necessary components of an NMP as required by Pennsylvania's Nutrient Management Act (Act 38, 2005) Program.	*http://panutrientmgmt.cas.psu.edu/main_planning_tools.htm* Jennifer Weld, Project Associate at Penn State University, at (570) 366-1558 or *jlm23@psu.edu*

Table L-2. Description of software programs *(continued)*

Number	Software	Description	For more information
17	SNAP-Plus Nutrient Management Software	SNAP-Plus is a Microsoft Windows-based program designed for preparing NMPs in accordance with Wisconsin's Nutrient Management Standard Code 590. It is a simple software program consisting of several models including nutrient management (SNAP), conservation assessment (RUSLE2), and the Wisconsin Phosphorus Index (PI) that is designed to make multiyear nutrient and conservation planning easier.	*http://www.snapplus.net/* Sue Porter at (608) 224-4605 or *Sue.Porter@wisconsin.gov*
18	Texas Waste Utilization and Nutrient Management Plan Worksheet	The Texas Waste Utilization and Nutrient Management Plan Worksheet develops a plan that will meet the USDA-NRCS Nutrient Management (590) Standard and Waste Utilization (633) Standard for all types of livestock. The worksheet incorporates the animal waste spreadsheet for liquids, solids, biosolids, as well as both poultry-producer and non-producer spreadsheets. It also contains the Phosphorus Index spreadsheet used in Texas.	*http://nmp.tamu.edu/*
19	Utah's Manure Actual Nutrient Content spreadsheet	No information found	

Manure Management Planner (MMP)

The U.S. Environmental Protection Agency (EPA), in coordination with the U.S. Department of Agriculture (USDA), has worked on developing a planning tool that would generate a single document that meets the objectives of both agencies. The one document would include the required elements of an NMP and the elements of a voluntary comprehensive nutrient management plan (CNMP) developed in accordance with USDA technical guidance. A CNMP is a plan much like the NMP required by EPA's CAFO regulations. There are some minor differences between the scope of the two documents, such as a CNMP option to include feed management plans (which are not required for the NMP) and an NMP requirement to address chemical disposal (which is not part of a CNMP). However, the EPA and USDA agree that there is no reason why one document could not suffice for both the CNMP and NMP by accommodating both agencies' requirements. To that end, EPA and USDA have partnered to develop MMP, software that integrates both sets of planning requirements. Even though both agencies promote the use of a single tool, it remains the CAFO operator's responsibility to provide that information to the director to meet the requirements of the CAFO rule, because USDA does not make facility-specific information available to other agencies or the public. EPA encourages the use of MMP to facilitate the development and review of NMPs under the NPDES permit program.

The MMP software, developed under a grant from EPA and USDA to Purdue University, is a computer program that provides permitting authorities and producers with a mix of programs, not available elsewhere, to assist in CNMP and NMP development. The objective of the effort was to accelerate the CNMP and NMP development process by integrating other software used to calculate manure application rates. Among those tools are the revised universal soil loss equation (RUSLE2), the Phosphorus Index (PI), and other state-specific risk assessment tools used in CNMP and NMP development. MMP incorporates field-specific data tables that allow the producer to list the type of crops planned, crop rotation by planting season, nutrients available for each crop on the basis of previous manure applications and the rate of application per crop. MMP helps the user allocate manure (where, when, and how much) on a monthly basis for the length of the plan (1–10 years). That allocation process helps determine if the operation has sufficient crop acreage, seasonal land availability, manure storage capacity, and application equipment to manage the manure produced in an environmentally responsible manner. MMP is also useful for identifying changes that may be needed for a non-sustainable operation to become sustainable and determine what changes might be needed to keep an operation sustainable if the operation expands. MMP's data tables provide permitting authorities with specific information that can be extracted as terms of the NMP to be inserted into a permit.

Version 0.3.0.1 (October 11, 2010) of MMP supports 34 states (Alabama, Arkansas, California, Colorado, Delaware, Florida, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Massachusetts, Maryland, Michigan, Minnesota, Missouri, Mississippi, Montana, North Dakota, Nebraska, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Washington, and Wisconsin) and generates fertilizer recommendations based on each state's extension guidelines. The MMP software is available without charge. It is strictly a voluntary tool. There might be some situations at a livestock operation, such as varying terrains and unusual cropping sequences, that MMP cannot accommodate; thus the program might not be a good fit for all operators. Permitting authorities and producers can still choose to use established state NMP software to develop and implement their NMP. More information on MMP is at the Purdue University Web site, *http://www.agry.purdue.edu/mmp/*.

Appendix M

Nutrient Management Recordkeeping Calendar Template

This calendar is adapted from the University of Nebraska Extension publication, Nutrient Management Recordkeeping Calendar: July 2011–December 2012.

EPA thanks Nebraska Extension, Leslie Johnson, and Purdue University for permission to adapt the calendar for use in the Permit Writers' Manual.

Nutrient Management

Recordkeeping Calendar

July 2011-December 2012

Records for
Concentrated Animal Feeding Operations

NPDES Permit Info: ____________________

General Directions

- Record the initials of the person performing each inspection.
- Record any maintenance and/or repairs.
- Correct all deficiencies as soon as possible and maintain records documenting any actions taken to correct deficiencies.** Document factors that prevented immediate correction of deficiencies if such deficiencies are not corrected within 30 days.
- Keep records of mortality management practices.**
- Maintain records documenting the current design of any manure or litter storage structures, including the volume for solids accumulation, design treatment volume, total design storage volume[1], and the approximate number of days of storage capacity.**

Per Event

- Record the method used for land application for manure, litter, or process wastewater and the date of application.*
- Before use, inspect any equipment used for land application of manure and/or wastewater.**
- Maintain records of the date, time, and estimated volume of any overflow.**

Daily Inspections and Records

- Inspect all water lines (both drinking and cooling) in the CAFO production area.**
- Weather Information - Record any measurable rainfall that occurs at the facility (at a minimum of 24 hours prior to and following land application.)**

[1]Total design storage volume includes normal precipitation less evaporation on the surface of the structure for the storage period, normal runoff from the production area for the storage period, 25-yr, 24-hr precipitation on the surface of the structure, 25-yr, 24-hr runoff from the production area, and residual solids.

Weekly Inspections and Records

- Inspect all storm water and runoff diversion devices used to channel contaminated storm water to storage structures.**
- Inspect all manure, litter, and process wastewater impoundments.**
- Record the liquid depth of the manure storage structure as indicated on the depth marker.**

Yearly Inspections and Records

- Complete and submit an annual report for the previous year.*
- Keep all records, including records, such as this calendar, identified to document implementation and management of the NMP minimum elements, on site for a minimum of 5 years.*

Yearly Sample Collection and Analysis for Land Application

- Collect manure and/or wastewater samples at least once per year and analyze for total nitrogen and phosphorus, at a minimum.**
- Collect soil samples once every five years and analyze for phosphorus. **

Requirements applicable to all CAFOs are marked with an asterisk (*). Requirements applicable only to Large Dairy Cow, Cattle, Swine, Poultry, and Veal Calf CAFOs are indicated with an double asterisk (**). All CAFOs are encouraged to keep the records identified here. Permittees are only responsible for maintaining records identified in their NPDES permit.

Note: Additional information and space for records is provided at the end of each year.

Disclaimer

The information in this calendar should assist producers to meet legal requirements and protect environmentally sensitive areas around their operations. The use of this calendar and accompanying information is intended to serve as a guide and does not guarantee compliance with the NPDES regulations.

3

Manure / Wastewater Applied

Field ID & Location ___________ Acres Applied _________ Date ________
Manure Source __________ Application Method ____________________
Application Rate __________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields_______________
Estimated N Removed_____________ Estimated P Removed___________
Areas of setback or other conservation practices_____________________

Field ID & Location ___________ Acres Applied _________ Date ________
Manure Source __________ Application Method ____________________
Application Rate __________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields_______________
Estimated N Removed_____________ Estimated P Removed___________
Areas of setback or other conservation practices_____________________

Field ID & Location ___________ Acres Applied _________ Date ________
Manure Source __________ Application Method ____________________
Application Rate __________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields_______________
Estimated N Removed_____________ Estimated P Removed___________
Areas of setback or other conservation practices_____________________

Field ID & Location ___________ Acres Applied _________ Date ________
Manure Source __________ Application Method ____________________
Application Rate __________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields_______________
Estimated N Removed_____________ Estimated P Removed___________
Areas of setback or other conservation practices_____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight _________________ Date ___________
Recipient Name and Address ____________________________

☐ Nutrient analysis provided

Manure volume/weight _________________ Date ___________
Recipient Name and Address ____________________________

☐ Nutrient analysis provided

Manure volume/weight _________________ Date ___________
Recipient Name and Address ____________________________

☐ Nutrient analysis provided

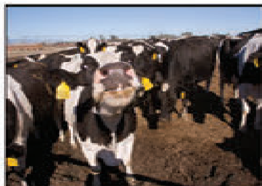
Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date ______
Notes_______________________________________

July 2011

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
					1 Rainfall______ Water Lines Inspection______	2 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
3 Rainfall______ Water Lines Inspection______	4 Rainfall______ Water Lines Inspection______	5 Rainfall______ Water Lines Inspection______	6 Rainfall______ Water Lines Inspection______	7 Rainfall______ Water Lines Inspection______	8 Rainfall______ Water Lines Inspection______	9 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
10 Rainfall______ Water Lines Inspection______	11 Rainfall______ Water Lines Inspection______	12 Rainfall______ Water Lines Inspection______	13 Rainfall______ Water Lines Inspection______	14 Rainfall______ Water Lines Inspection______	15 Rainfall______ Water Lines Inspection______	16 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
17 Rainfall______ Water Lines Inspection______	18 Rainfall______ Water Lines Inspection______	19 Rainfall______ Water Lines Inspection______	20 Rainfall______ Water Lines Inspection______	21 Rainfall______ Water Lines Inspection______	22 Rainfall______ Water Lines Inspection______	23 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
24 Rainfall______ Water Lines Inspection______	25 Rainfall______ Water Lines Inspection______	26 Rainfall______ Water Lines Inspection______	27 Rainfall______ Water Lines Inspection______	28 Rainfall______ Water Lines Inspection______	29 Rainfall______ Water Lines Inspection______	30 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
31 Rainfall______ Water Lines Inspection______	**In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.**						•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______

5

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Notes: ____

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date ______
Notes______________________________________

August 2011

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
	1 Rainfall________ Water Lines Inspection________	2 Rainfall________ Water Lines Inspection________	3 Rainfall________ Water Lines Inspection________	4 Rainfall________ Water Lines Inspection________	5 Rainfall________ Water Lines Inspection________	6 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)_______ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________________
7 Rainfall________ Water Lines Inspection________	8 Rainfall________ Water Lines Inspection________	9 Rainfall________ Water Lines Inspection________	10 Rainfall________ Water Lines Inspection________	11 Rainfall________ Water Lines Inspection________	12 Rainfall________ Water Lines Inspection________	13 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)_______ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________________
14 Rainfall________ Water Lines Inspection________	15 Rainfall________ Water Lines Inspection________	16 Rainfall________ Water Lines Inspection________	17 Rainfall________ Water Lines Inspection________	18 Rainfall________ Water Lines Inspection________	19 Rainfall________ Water Lines Inspection________	20 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)_______ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________________
21 Rainfall________ Water Lines Inspection________	22 Rainfall________ Water Lines Inspection________	23 Rainfall________ Water Lines Inspection________	24 Rainfall________ Water Lines Inspection________	25 Rainfall________ Water Lines Inspection________	26 Rainfall________ Water Lines Inspection________	27 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)_______ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________________
28 Rainfall________ Water Lines Inspection________	29 Rainfall________ Water Lines Inspection________	30 Rainfall________ Water Lines Inspection________	31 Rainfall________ Water Lines Inspection________	**In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.**			•Lagoon Depth Marker (ft)_______ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________________

7

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices________________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight __________________ Date ____________
Recipient Name and Address _______________________________

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address _______________________________

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address _______________________________

☐ Nutrient analysis provided

Notes: ____

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date ______
Notes________________________________

September 2011

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.				1 Rainfall________ Water Lines Inspection________	2 Rainfall________ Water Lines Inspection________	3 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)________ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________
4 Rainfall________ Water Lines Inspection________	5 Rainfall________ Water Lines Inspection________	6 Rainfall________ Water Lines Inspection________	7 Rainfall________ Water Lines Inspection________	8 Rainfall________ Water Lines Inspection________	9 Rainfall________ Water Lines Inspection________	10 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)________ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________
11 Rainfall________ Water Lines Inspection________	12 Rainfall________ Water Lines Inspection________	13 Rainfall________ Water Lines Inspection________	14 Rainfall________ Water Lines Inspection________	15 Rainfall________ Water Lines Inspection________	16 Rainfall________ Water Lines Inspection________	17 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)________ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________
18 Rainfall________ Water Lines Inspection________	19 Rainfall________ Water Lines Inspection________	20 Rainfall________ Water Lines Inspection________	21 Rainfall________ Water Lines Inspection________	22 Rainfall________ Water Lines Inspection________	23 Rainfall________ Water Lines Inspection________	24 Rainfall________ Water Lines Inspection________	•Lagoon Depth Marker (ft)________ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________
25 Rainfall________ Water Lines Inspection________	26 Rainfall________ Water Lines Inspection________	27 Rainfall________ Water Lines Inspection________	28 Rainfall________ Water Lines Inspection________	29 Rainfall________ Water Lines Inspection________	30 Rainfall________ Water Lines Inspection________		•Lagoon Depth Marker (ft)________ Date________ •Manure Storage & Equipment Inspection________ Notes________ Date________ •Water & Runoff Diversion or Containment Devices____ Notes________ Date________ •Maintenance or Repairs________ Date________ Notes________

9

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)______________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_______________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)______________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_______________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)______________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_______________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)______________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_______________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date ___________
Recipient Name and Address ____________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date ___________
Recipient Name and Address ____________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date ___________
Recipient Name and Address ____________________________

☐ Nutrient analysis provided

Notes: ____

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date _____
Notes________________

October 2011

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.						1 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
2 Rainfall___ Water Lines Inspection___	3 Rainfall___ Water Lines Inspection___	4 Rainfall___ Water Lines Inspection___	5 Rainfall___ Water Lines Inspection___	6 Rainfall___ Water Lines Inspection___	7 Rainfall___ Water Lines Inspection___	8 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
9 Rainfall___ Water Lines Inspection___	10 Rainfall___ Water Lines Inspection___	11 Rainfall___ Water Lines Inspection___	12 Rainfall___ Water Lines Inspection___	13 Rainfall___ Water Lines Inspection___	14 Rainfall___ Water Lines Inspection___	15 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
16 Rainfall___ Water Lines Inspection___	17 Rainfall___ Water Lines Inspection___	18 Rainfall___ Water Lines Inspection___	19 Rainfall___ Water Lines Inspection___	20 Rainfall___ Water Lines Inspection___	21 Rainfall___ Water Lines Inspection___	22 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
23 Rainfall___ Water Lines Inspection___	24 Rainfall___ Water Lines Inspection___	25 Rainfall___ Water Lines Inspection___	26 Rainfall___ Water Lines Inspection___	27 Rainfall___ Water Lines Inspection___	28 Rainfall___ Water Lines Inspection___	29 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
30 Rainfall___ Water Lines Inspection___	31 Rainfall___ Water Lines Inspection___						•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___

11

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Notes: ____

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date _____
Notes________________________________

November 2011

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
		1 Rainfall___ Water Lines Inspection___	2 Rainfall___ Water Lines Inspection___	3 Rainfall___ Water Lines Inspection___	4 Rainfall___ Water Lines Inspection___	5 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
6 Rainfall___ Water Lines Inspection___	7 Rainfall___ Water Lines Inspection___	8 Rainfall___ Water Lines Inspection___	9 Rainfall___ Water Lines Inspection___	10 Rainfall___ Water Lines Inspection___	11 Rainfall___ Water Lines Inspection___	12 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
13 Rainfall___ Water Lines Inspection___	14 Rainfall___ Water Lines Inspection___	15 Rainfall___ Water Lines Inspection___	16 Rainfall___ Water Lines Inspection___	17 Rainfall___ Water Lines Inspection___	18 Rainfall___ Water Lines Inspection___	19 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
20 Rainfall___ Water Lines Inspection___	21 Rainfall___ Water Lines Inspection___	22 Rainfall___ Water Lines Inspection___	23 Rainfall___ Water Lines Inspection___	24 Rainfall___ Water Lines Inspection___	25 Rainfall___ Water Lines Inspection___	26 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
27 Rainfall___ Water Lines Inspection___	28 Rainfall___ Water Lines Inspection___	29 Rainfall___ Water Lines Inspection___	30 Rainfall___ Water Lines Inspection___	**In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.**			•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___

13

Manure / Wastewater Applied

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ______ Date ______
Recipient Name and Address ______

☐ Nutrient analysis provided

Manure volume/weight ______ Date ______
Recipient Name and Address ______

☐ Nutrient analysis provided

Manure volume/weight ______ Date ______
Recipient Name and Address ______

☐ Nutrient analysis provided

Notes: ______

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

December 2011

Monthly Inspections
Mortality Management System ________ Date ______
Notes ______

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
				1 Rainfall___ Water Lines Inspection___	2 Rainfall___ Water Lines Inspection___	3 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
4 Rainfall___ Water Lines Inspection___	5 Rainfall___ Water Lines Inspection___	6 Rainfall___ Water Lines Inspection___	7 Rainfall___ Water Lines Inspection___	8 Rainfall___ Water Lines Inspection___	9 Rainfall___ Water Lines Inspection___	10 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
11 Rainfall___ Water Lines Inspection___	12 Rainfall___ Water Lines Inspection___	13 Rainfall___ Water Lines Inspection___	14 Rainfall___ Water Lines Inspection___	15 Rainfall___ Water Lines Inspection___	16 Rainfall___ Water Lines Inspection___	17 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
18 Rainfall___ Water Lines Inspection___	19 Rainfall___ Water Lines Inspection___	20 Rainfall___ Water Lines Inspection___	21 Rainfall___ Water Lines Inspection___	22 Rainfall___ Water Lines Inspection___	23 Rainfall___ Water Lines Inspection___	24 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___
25 Rainfall___ Water Lines Inspection___	26 Rainfall___ Water Lines Inspection___	27 Rainfall___ Water Lines Inspection___	28 Rainfall___ Water Lines Inspection___	29 Rainfall___ Water Lines Inspection___	30 Rainfall___ Water Lines Inspection___	31 Rainfall___ Water Lines Inspection___	•Lagoon Depth Marker (ft)___ Date___ •Manure Storage & Equipment Inspection___ Notes___ Date___ •Water & Runoff Diversion or Containment Devices___ Notes___ Date___ •Maintenance or Repairs___ Date___ Notes___

15

2011 Yearly Records and Reporting Requirements

Manure must be analyzed a minimum of once annually for nitrogen and phosphorus content, and soil analyzed a minimum of once every five years for phosphorus content. Use sampling results in determining application rates for manure, litter, and other process wastewater.

Annual Report

Date report submitted __________

NOTE: The annual report must include for the previous 12 month period: the number and type of animals, whether in open confinement or house under roof; estimated amount of total manure litter, and process wastewater generated; estimated amount of total manure, litter and process wastewater transferred; total acres for land application; summary of all discharges; a statement indicating whether a certified planner was used for the current NMP; in addition to the information used to develop the NMP.

NMP

Date of NMP______________

Location of NMP_____________

NOTE: Annual recalculation of the amount of manure, litter, and process wastewater allowed to be applied must rely on the results of the most recent representative manure, litter, and process wastewater tests taken within 12 months of the date of land application.

Soil Sampling

Field ID and Location	Sample Depth	Date of Collection	Field ID and Location	Sample Depth	Date of Collection

Manure/Wastewater Sampling

Sampling Location	Sample Depth	Date of Collection

Accidental Spill or Unauthorized Discharge

Date and time of spill or discharge __________

Length of time of spill or discharge __________

Location and source of spill ________________

Date and time of oral notification to permitting authority (must be 24 hours from the time the permittee is aware of the circumstances)________________

Estimated discharge volume ______________

Date of sample collection (must be analyzed by a laboratory) ________________

Description of the cause of the discharge

____

Precipitation amount (if cause of the discharge) ____________ Date ____________

Accidental Spill or Unauthorized Discharge

Date and time of spill or discharge __________

Length of time of spill or discharge __________

Location and source of spill ________________

Date and time of oral notification to permitting authority (must be 24 hours from the time the permittee is aware of the circumstances)________________

Estimated discharge volume ______________

Date of sample collection (must be analyzed by a laboratory) ________________

Description of the cause of the discharge

____

Precipitation amount (if cause of the discharge) ____________ Date ____________

Accidental Spill or Unauthorized Discharge

Date and time of spill or discharge __________

Length of time of spill or discharge __________

Location and source of spill ________________

Date and time of oral notification to permitting authority (must be 24 hours from the time the permittee is aware of the circumstances)________________

Estimated discharge volume ______________

Date of sample collection (must be analyzed by a laboratory) ________________

Description of the cause of the discharge

____

Precipitation amount (if cause of the discharge) ____________ Date ____________

Corrective Action Explanation

Record any actions taken to correct deficiencies________________

If applicable, explain any factors preventing immediate correction________________

Corrective Action Explanation

Record any actions taken to correct deficiencies________________

If applicable, explain any factors preventing immediate correction ________________

Corrective Action Explanation

Record any actions taken to correct deficiencies________________

If applicable, explain any factors preventing immediate correction________________

17

Additional Recording Page for Field Specific Land Application of Manure, Litter, or Process Wastewater

Manure / Wastewater Applied:

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Manure / Wastewater Applied:

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices_________________________

Additional Notes

2011-2012

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P _______
Crop(s)__________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

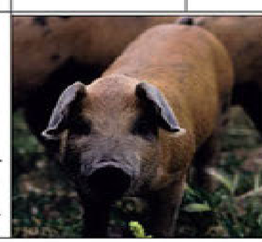
☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

January 2012

Sun	Mon	Tue	Wed	Thu	Fri	Sat	
							Monthly Inspections Mortality Management System ________ Date _____ Notes_______________
							Weekly Inspections
1 Rainfall_____ Water Lines Inspec-tion_____	*2* Rainfall_____ Water Lines Inspec-tion_____	*3* Rainfall_____ Water Lines Inspec-tion_____	*4* Rainfall_____ Water Lines Inspec-tion_____	*5* Rain-fall_____ Water Lines Inspec-	*6* Rainfall_____ Water Lines Inspec-tion_____	*7* Rainfall_____ Water Lines Inspec-tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
8 Rainfall_____ Water Lines Inspec-tion_____	*9* Rainfall_____ Water Lines Inspec-tion_____	*10* Rainfall_____ Water Lines Inspec-tion_____	*11* Rainfall_____ Water Lines Inspec-tion_____	*12* Rain-fall_____ Water Lines Inspec-	*13* Rainfall_____ Water Lines Inspec-tion_____	*14* Rainfall_____ Water Lines Inspec-tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
15 Rainfall_____ Water Lines Inspec-tion_____	*16* Rainfall_____ Water Lines Inspec-tion_____	*17* Rainfall_____ Water Lines Inspec-tion_____	*18* Rainfall_____ Water Lines Inspec-tion_____	*19* Rain-fall_____ Water Lines Inspec-	*20* Rainfall_____ Water Lines Inspec-tion_____	*21* Rainfall_____ Water Lines Inspec-tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
22 Rainfall_____ Water Lines Inspec-tion_____	*23* Rainfall_____ Water Lines Inspec-tion_____	*24* Rainfall_____ Water Lines Inspec-tion_____	*25* Rainfall_____ Water Lines Inspec-tion_____	*26* Rain-fall_____ Water Lines Inspec-	*27* Rainfall_____ Water Lines Inspec-tion_____	*28* Rainfall_____ Water Lines Inspec-tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
29 Rainfall_____ Water Lines Inspec-tion_____	*30* Rainfall_____ Water Lines Inspec-tion_____	*31* Rainfall_____ Water Lines Inspec-tion_____					•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____

21

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices______________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices______________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices______________________

Field ID & Location ____________ Acres Applied _________ Date ________
Manure Source ___________ Application Method ______________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)_________________________ Expected Yields_________________
Estimated N Removed______________ Estimated P Removed_____________
Areas of setback or other conservation practices______________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Notes: ____

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date ______
Notes ______________________________

February 2012

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
			1 Rainfall____ Water Lines Inspection____	2 Rainfall____ Water Lines Inspection____	3 Rainfall____ Water Lines Inspection____	4 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
5 Rainfall____ Water Lines Inspection____	6 Rainfall____ Water Lines Inspection____	7 Rainfall____ Water Lines Inspection____	8 Rainfall____ Water Lines Inspection____	9 Rainfall____ Water Lines Inspection____	10 Rainfall____ Water Lines Inspection____	11 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
12 Rainfall____ Water Lines Inspection____	13 Rainfall____ Water Lines Inspection____	14 Rainfall____ Water Lines Inspection____	15 Rainfall____ Water Lines Inspection____	16 Rainfall____ Water Lines Inspection____	17 Rainfall____ Water Lines Inspection____	18 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
19 Rainfall____ Water Lines Inspection____	20 Rainfall____ Water Lines Inspection____	21 Rainfall____ Water Lines Inspection____	22 Rainfall____ Water Lines Inspection____	23 Rainfall____ Water Lines Inspection____	24 Rainfall____ Water Lines Inspection____	25 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
26 Rainfall____ Water Lines Inspection____	27 Rainfall____ Water Lines Inspection____	28 Rainfall____ Water Lines Inspection____	29 Rainfall____ Water Lines Inspection____				•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____

23

Manure / Wastewater Applied

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________ Date ________
Recipient Name and Address ________
____

☐ Nutrient analysis provided

Manure volume/weight ________ Date ________
Recipient Name and Address ________
____

☐ Nutrient analysis provided

Manure volume/weight ________ Date ________
Recipient Name and Address ________
____

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

March 2012

Monthly Inspections
Mortality Management System ________ Date _____
Notes________________________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.				*1* Rainfall________ Water Lines Inspec- tion________	*2* Rainfall________ Water Lines Inspec- tion________	*3* Rainfall________ Water Lines Inspec- tion________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes_________________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes_________________ Date__________ •Maintenance or Repairs________ Date__________ Notes_____________________________
4 Rainfall________ Water Lines Inspec- tion________	*5* Rainfall________ Water Lines Inspec- tion________	*6* Rainfall________ Water Lines Inspec- tion________	*7* Rainfall________ Water Lines Inspec- tion________	*8* Rainfall________ Water Lines Inspection ________	*9* Rainfall________ Water Lines Inspec- tion________	*10* Rainfall________ Water Lines Inspec- tion________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes_________________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes_________________ Date__________ •Maintenance or Repairs________ Date__________ Notes_____________________________
11 Rainfall________ Water Lines Inspec- tion________	*12* Rainfall________ Water Lines Inspec- tion________	*13* Rainfall________ Water Lines Inspec- tion________	*14* Rainfall________ Water Lines Inspec- tion________	*15* Rainfall________ Water Lines Inspection ________	*16* Rainfall________ Water Lines Inspec- tion________	*17* Rainfall________ Water Lines Inspec- tion________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes_________________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes_________________ Date__________ •Maintenance or Repairs________ Date__________ Notes_____________________________
18 Rainfall________ Water Lines Inspec- tion________	*19* Rainfall________ Water Lines Inspec- tion________	*20* Rainfall________ Water Lines Inspec- tion________	*21* Rainfall________ Water Lines Inspec- tion________	*22* Rainfall________ Water Lines Inspec- tion________	*23* Rainfall________ Water Lines Inspec- tion________	*24* Rainfall________ Water Lines Inspec- tion________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes_________________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes_________________ Date__________ •Maintenance or Repairs________ Date__________ Notes_____________________________
25 Rainfall________ Water Lines Inspec- tion________	*26* Rainfall________ Water Lines Inspec- tion________	*27* Rainfall________ Water Lines Inspec- tion________	*28* Rainfall________ Water Lines Inspec- tion________	*29* Rainfall________ Water Lines Inspec- tion________	*30* Rainfall________ Water Lines Inspec- tion________	*31* Rainfall________ Water Lines Inspec- tion________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes_________________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes_________________ Date__________ •Maintenance or Repairs________ Date__________ Notes_____________________________

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields______________
Estimated N Removed_____________ Estimated P Removed____________
Areas of setback or other conservation practices_________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields______________
Estimated N Removed_____________ Estimated P Removed____________
Areas of setback or other conservation practices_________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields______________
Estimated N Removed_____________ Estimated P Removed____________
Areas of setback or other conservation practices_________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ___________ Application Method ________________
Application Rate ___________ Total Applied N________ Applied P _______
Crop(s)________________________ Expected Yields______________
Estimated N Removed_____________ Estimated P Removed____________
Areas of setback or other conservation practices_________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)
(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date ____________
Recipient Name and Address ________________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date ____________
Recipient Name and Address ________________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date ____________
Recipient Name and Address ________________________________

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

April 2012

Monthly Inspections
Mortality Management System ________ Date ______
Notes______________________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
1 Rainfall______ Water Lines Inspec- tion______	2 Rainfall______ Water Lines Inspec- tion______	3 Rainfall______ Water Lines Inspec- tion______	4 Rainfall______ Water Lines Inspec- tion______	5 Rainfall______ Water Lines Inspec- tion______	6 Rainfall______ Water Lines Inspec- tion______	7 Rainfall______ Water Lines Inspec- tion______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
8 Rainfall______ Water Lines Inspec- tion______	9 Rainfall______ Water Lines Inspec- tion______	10 Rainfall______ Water Lines Inspec- tion______	11 Rainfall______ Water Lines Inspec- tion______	12 Rainfall______ Water Lines Inspec- tion______	13 Rainfall______ Water Lines Inspec- tion______	14 Rainfall______ Water Lines Inspec- tion______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
15 Rainfall______ Water Lines Inspec- tion______	16 Rainfall______ Water Lines Inspec- tion______	17 Rainfall______ Water Lines Inspec- tion______	18 Rainfall______ Water Lines Inspec- tion______	19 Rainfall______ Water Lines Inspec- tion______	20 Rainfall______ Water Lines Inspec- tion______	21 Rainfall______ Water Lines Inspec- tion______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
22 Rainfall______ Water Lines Inspec- tion______	23 Rainfall______ Water Lines Inspec- tion______	24 Rainfall______ Water Lines Inspec- tion______	25 Rainfall______ Water Lines Inspec- tion______	26 Rainfall______ Water Lines Inspec- tion______	27 Rainfall______ Water Lines Inspec- tion______	28 Rainfall______ Water Lines Inspec- tion______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
29 Rainfall______ Water Lines Inspec- tion______	30 Rainfall______ Water Lines Inspec- tion______						•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______

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Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields____________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields____________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields____________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields____________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Notes: ______________________________

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

May 2012

Monthly Inspections
Mortality Management System ________ Date ______
Notes____________________________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
		1 Rainfall_________ Water Lines Inspec-tion____________	2 Rainfall_________ Water Lines Inspec-tion____________	3 Rainfall_________ Water Lines Inspec-tion____________	4 Rainfall_________ Water Lines Inspec-tion____________	5 Rainfall_________ Water Lines Inspec-tion____________	•Lagoon Depth Marker (ft)_______ Date___________ •Manure Storage & Equipment Inspection___________ Notes__________________ Date___________ •Water & Runoff Diversion or Containment Devices_____ Notes__________________ Date___________ •Maintenance or Repairs________ Date___________ Notes______________________________
6 Rainfall_________ Water Lines Inspec-tion____________	7 Rainfall_________ Water Lines Inspec-tion____________	8 Rainfall_________ Water Lines Inspec-tion____________	9 Rainfall_________ Water Lines Inspec-tion____________	10 Rainfall_________ Water Lines Inspec-tion____________	11 Rainfall_________ Water Lines Inspec-tion____________	12 Rainfall_________ Water Lines Inspec-tion____________	•Lagoon Depth Marker (ft)_______ Date___________ •Manure Storage & Equipment Inspection___________ Notes__________________ Date___________ •Water & Runoff Diversion or Containment Devices_____ Notes__________________ Date___________ •Maintenance or Repairs________ Date___________ Notes______________________________
13 Rainfall_________ Water Lines Inspec-tion____________	14 Rainfall_________ Water Lines Inspec-tion____________	15 Rainfall_________ Water Lines Inspec-tion____________	16 Rainfall_________ Water Lines Inspec-tion____________	17 Rainfall_________ Water Lines Inspec-tion____________	18 Rainfall_________ Water Lines Inspec-tion____________	19 Rainfall_________ Water Lines Inspec-tion____________	•Lagoon Depth Marker (ft)_______ Date___________ •Manure Storage & Equipment Inspection___________ Notes__________________ Date___________ •Water & Runoff Diversion or Containment Devices_____ Notes__________________ Date___________ •Maintenance or Repairs________ Date___________ Notes______________________________
20 Rainfall_________ Water Lines Inspec-tion____________	21 Rainfall_________ Water Lines Inspec-tion____________	22 Rainfall_________ Water Lines Inspec-tion____________	23 Rainfall_________ Water Lines Inspec-tion____________	24 Rainfall_________ Water Lines Inspec-tion____________	25 Rainfall_________ Water Lines Inspec-tion____________	26 Rainfall_________ Water Lines Inspec-tion____________	•Lagoon Depth Marker (ft)_______ Date___________ •Manure Storage & Equipment Inspection___________ Notes__________________ Date___________ •Water & Runoff Diversion or Containment Devices_____ Notes__________________ Date___________ •Maintenance or Repairs________ Date___________ Notes______________________________
27 Rainfall_________ Water Lines Inspec-tion____________	28 Rainfall_________ Water Lines Inspec-tion____________	29 Rainfall_________ Water Lines Inspec-tion____________	30 Rainfall_________ Water Lines Inspec-tion____________	31 Rainfall_________ Water Lines Inspec-tion____________			•Lagoon Depth Marker (ft)_______ Date___________ •Manure Storage & Equipment Inspection___________ Notes__________________ Date___________ •Water & Runoff Diversion or Containment Devices_____ Notes__________________ Date___________ •Maintenance or Repairs________ Date___________ Notes______________________________

29

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight ________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight ________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

June 2012

Monthly Inspections
Mortality Management System ________ Date _____
Notes________________________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
					1 Rainfall_______ Water Lines Inspection_______	2 Rainfall_______ Water Lines Inspection_______	•Lagoon Depth Marker (ft)_______ Date_______ •Manure Storage & Equipment Inspection_______ Notes_______ Date_______ •Water & Runoff Diversion or Containment Devices_______ Notes_______ Date_______ •Maintenance or Repairs_______ Date_______ Notes_______
3 Rainfall_______ Water Lines Inspection_______	4 Rainfall_______ Water Lines Inspection_______	5 Rainfall_______ Water Lines Inspection_______	6 Rainfall_______ Water Lines Inspection_______	7 Rainfall_______ Water Lines Inspection_______	8 Rainfall_______ Water Lines Inspection_______	9 Rainfall_______ Water Lines Inspection_______	•Lagoon Depth Marker (ft)_______ Date_______ •Manure Storage & Equipment Inspection_______ Notes_______ Date_______ •Water & Runoff Diversion or Containment Devices_______ Notes_______ Date_______ •Maintenance or Repairs_______ Date_______ Notes_______
10 Rainfall_______ Water Lines Inspection_______	11 Rainfall_______ Water Lines Inspection_______	12 Rainfall_______ Water Lines Inspection_______	13 Rainfall_______ Water Lines Inspection_______	14 Rainfall_______ Water Lines Inspection_______	15 Rainfall_______ Water Lines Inspection_______	16 Rainfall_______ Water Lines Inspection_______	•Lagoon Depth Marker (ft)_______ Date_______ •Manure Storage & Equipment Inspection_______ Notes_______ Date_______ •Water & Runoff Diversion or Containment Devices_______ Notes_______ Date_______ •Maintenance or Repairs_______ Date_______ Notes_______
17 Rainfall_______ Water Lines Inspection_______	18 Rainfall_______ Water Lines Inspection_______	19 Rainfall_______ Water Lines Inspection_______	20 Rainfall_______ Water Lines Inspection_______	21 Rainfall_______ Water Lines Inspection_______	22 Rainfall_______ Water Lines Inspection_______	23 Rainfall_______ Water Lines Inspection_______	•Lagoon Depth Marker (ft)_______ Date_______ •Manure Storage & Equipment Inspection_______ Notes_______ Date_______ •Water & Runoff Diversion or Containment Devices_______ Notes_______ Date_______ •Maintenance or Repairs_______ Date_______ Notes_______
24 Rainfall_______ Water Lines Inspection_______	25 Rainfall_______ Water Lines Inspection_______	26 Rainfall_______ Water Lines Inspection_______	27 Rainfall_______ Water Lines Inspection_______	28 Rainfall_______ Water Lines Inspection_______	29 Rainfall_______ Water Lines Inspection_______	30 Rainfall_______ Water Lines Inspection_______	•Lagoon Depth Marker (ft)_______ Date_______ •Manure Storage & Equipment Inspection_______ Notes_______ Date_______ •Water & Runoff Diversion or Containment Devices_______ Notes_______ Date_______ •Maintenance or Repairs_______ Date_______ Notes_______

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Fields and setbacks

(List all fields used for land application and identify setbacks if applicable)

Field ID and Location	Areas of setback

Soil Sampling

Field ID and Location	Sample Depth	Date of Collection	Field ID and Location	Sample Depth	Date of Collection

Risk Assessment Results

Date Completed	Field ID and Location	Risk Rating	Management

Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices________________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Notes: ______________________________

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

July 2012

Monthly Inspections
Mortality Management System ________ Date _____
Notes ____

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
1 Rainfall____ Water Lines Inspection____	2 Rainfall____ Water Lines Inspection____	3 Rainfall____ Water Lines Inspection____	4 Rainfall____ Water Lines Inspection____	5 Rainfall____ Water Lines Inspection____	6 Rainfall____ Water Lines Inspection____	7 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
8 Rainfall____ Water Lines Inspection____	9 Rainfall____ Water Lines Inspection____	10 Rainfall____ Water Lines Inspection____	11 Rainfall____ Water Lines Inspection____	12 Rainfall____ Water Lines Inspection____	13 Rainfall____ Water Lines Inspection____	14 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
15 Rainfall____ Water Lines Inspection____	16 Rainfall____ Water Lines Inspection____	17 Rainfall____ Water Lines Inspection____	18 Rainfall____ Water Lines Inspection____	19 Rainfall____ Water Lines Inspection____	20 Rainfall____ Water Lines Inspection____	21 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
22 Rainfall____ Water Lines Inspection____	23 Rainfall____ Water Lines Inspection____	24 Rainfall____ Water Lines Inspection____	25 Rainfall____ Water Lines Inspection____	26 Rainfall____ Water Lines Inspection____	27 Rainfall____ Water Lines Inspection____	28 Rainfall____ Water Lines Inspection____	•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____
29 Rainfall____ Water Lines Inspection____	30 Rainfall____ Water Lines Inspection____	31 Rainfall____ Water Lines Inspection____		**In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.**			•Lagoon Depth Marker (ft)____ Date____ •Manure Storage & Equipment Inspection____ Notes____ Date____ •Water & Runoff Diversion or Containment Devices____ Notes____ Date____ •Maintenance or Repairs____ Date____ Notes____

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Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)__________________________ Expected Yields____________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices__________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)__________________________ Expected Yields____________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices__________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)__________________________ Expected Yields____________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices__________________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)__________________________ Expected Yields____________________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices__________________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Manure volume/weight __________________ Date ____________
Recipient Name and Address ______________________________
____

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

August 2012

Monthly Inspections
Mortality Management System ________ Date ______
Notes________________________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
			1 Rainfall__________ Water Lines Inspec-tion__________	2 Rainfall__________ Water Lines Inspec-tion__________	3 Rainfall__________ Water Lines Inspec-tion__________	4 Rainfall__________ Water Lines Inspec-tion__________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes__________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes__________ Date__________ •Maintenance or Repairs________ Date__________ Notes______________________
5 Rainfall__________ Water Lines Inspec-tion__________	6 Rainfall__________ Water Lines Inspec-tion__________	7 Rainfall__________ Water Lines Inspec-tion__________	8 Rainfall__________ Water Lines Inspec-tion__________	9 Rainfall__________ Water Lines Inspec-tion__________	10 Rainfall__________ Water Lines Inspec-tion	11 Rainfall__________ Water Lines Inspec-tion__________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes__________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes__________ Date__________ •Maintenance or Repairs________ Date__________ Notes______________________
12 Rainfall__________ Water Lines Inspec-tion__________	13 Rainfall__________ Water Lines Inspec-tion__________	14 Rainfall__________ Water Lines Inspec-tion__________	15 Rainfall__________ Water Lines Inspec-tion__________	16 Rainfall__________ Water Lines Inspec-tion__________	17 Rainfall__________ Water Lines Inspec-tion__________	18 Rainfall__________ Water Lines Inspec-tion__________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes__________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes__________ Date__________ •Maintenance or Repairs________ Date__________ Notes______________________
19 Rainfall__________ Water Lines Inspec-tion__________	20 Rainfall__________ Water Lines Inspec-tion__________	21 Rainfall__________ Water Lines Inspec-tion__________	22 Rainfall__________ Water Lines Inspec-tion__________	23 Rainfall__________ Water Lines Inspec-tion__________	24 Rainfall__________ Water Lines Inspec-tion__________	25 Rainfall__________ Water Lines Inspec-tion__________	•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes__________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes__________ Date__________ •Maintenance or Repairs________ Date__________ Notes______________________
26 Rainfall__________ Water Lines Inspec-tion__________	27 Rainfall__________ Water Lines Inspec-tion__________	28 Rainfall__________ Water Lines Inspec-tion__________	29 Rainfall__________ Water Lines Inspec-tion__________	30 Rainfall__________ Water Lines Inspec-tion__________	31 Rainfall__________ Water Lines Inspec-tion__________		•Lagoon Depth Marker (ft)_______ Date__________ •Manure Storage & Equipment Inspection__________ Notes__________ Date__________ •Water & Runoff Diversion or Containment Devices____ Notes__________ Date__________ •Maintenance or Repairs________ Date__________ Notes______________________

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Manure / Wastewater Applied

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Field ID & Location ________ Acres Applied ________ Date ________
Manure Source ________ Application Method ________
Application Rate ________ Total Applied N________ Applied P ________
Crop(s)________ Expected Yields________
Estimated N Removed________ Estimated P Removed________
Areas of setback or other conservation practices________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________ Date ________
Recipient Name and Address ________

☐ Nutrient analysis provided

Manure volume/weight ________ Date ________
Recipient Name and Address ________

☐ Nutrient analysis provided

Manure volume/weight ________ Date ________
Recipient Name and Address ________

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

September 2012

Monthly Inspections
Mortality Management System ________ Date _____
Notes____________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.						1 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
2 Rainfall______ Water Lines Inspection______	3 Rainfall______ Water Lines Inspection______	4 Rainfall______ Water Lines Inspection______	5 Rainfall______ Water Lines Inspection______	6 Rainfall______ Water Lines Inspection______	7 Rainfall______ Water Lines Inspection______	8 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
9 Rainfall______ Water Lines Inspection______	10 Rainfall______ Water Lines Inspection______	11 Rainfall______ Water Lines Inspection______	12 Rainfall______ Water Lines Inspection______	13 Rainfall______ Water Lines Inspection______	14 Rainfall______ Water Lines Inspection______	15 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
16 Rainfall______ Water Lines Inspection______	17 Rainfall______ Water Lines Inspection______	18 Rainfall______ Water Lines Inspection______	19 Rainfall______ Water Lines Inspection______	20 Rainfall______ Water Lines Inspection______	21 Rainfall______ Water Lines Inspection______	22 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
23 Rainfall______ Water Lines Inspection______	24 Rainfall______ Water Lines Inspection______	25 Rainfall______ Water Lines Inspection______	26 Rainfall______ Water Lines Inspection______	27 Rainfall______ Water Lines Inspection______	28 Rainfall______ Water Lines Inspection______	29 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
30 Rainfall______ Water Lines Inspection______							

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Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ________________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date __________
Recipient Name and Address ________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ________________________

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

October 2012

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Monthly Inspections Mortality Management System ______ Date ______ Notes______
							Weekly Inspections
	1 Rainfall______ Water Lines Inspection______	2 Rainfall______ Water Lines Inspection______	3 Rainfall______ Water Lines Inspection______	4 Rainfall______ Water Lines Inspection______	5 Rainfall______ Water Lines Inspection______	6 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
7 Rainfall______ Water Lines Inspection______	8 Rainfall______ Water Lines Inspection______	9 Rainfall______ Water Lines Inspection______	10 Rainfall______ Water Lines Inspection______	11 Rainfall______ Water Lines Inspection______	12 Rainfall______ Water Lines Inspection______	13 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
14 Rainfall______ Water Lines Inspection______	15 Rainfall______ Water Lines Inspection______	16 Rainfall______ Water Lines Inspection______	17 Rainfall______ Water Lines Inspection______	18 Rainfall______ Water Lines Inspection______	19 Rainfall______ Water Lines Inspection______	20 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
21 Rainfall______ Water Lines Inspection______	22 Rainfall______ Water Lines Inspection______	23 Rainfall______ Water Lines Inspection______	24 Rainfall______ Water Lines Inspection______	25 Rainfall______ Water Lines Inspection______	26 Rainfall______ Water Lines Inspection______	27 Rainfall______ Water Lines Inspection______	•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______
28 Rainfall______ Water Lines Inspection______	29 Rainfall______ Water Lines Inspection______	30 Rainfall______ Water Lines Inspection______	31 Rainfall______ Water Lines Inspection______				•Lagoon Depth Marker (ft)______ Date______ •Manure Storage & Equipment Inspection______ Notes______ Date______ •Water & Runoff Diversion or Containment Devices______ Notes______ Date______ •Maintenance or Repairs______ Date______ Notes______

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Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices______________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices______________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices______________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ______________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)________________________ Expected Yields______________
Estimated N Removed______________ Estimated P Removed____________
Areas of setback or other conservation practices______________________

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ______________________________

☐ Nutrient analysis provided

Notes: ______________________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Fields and setbacks
(List all fields used for land application and identify setbacks if applicable)

Field ID and Location	Areas of setback

Soil Sampling

Field ID and Location	Sample Depth	Date of Collection	Field ID and Location	Sample Depth	Date of Collection

Risk Assessment Results

Date Completed	Field ID and Location	Risk Rating	Management

Manure / Wastewater Applied

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Field ID & Location ______ Acres Applied ______ Date ______
Manure Source ______ Application Method ______
Application Rate ______ Total Applied N______ Applied P ______
Crop(s)______ Expected Yields______
Estimated N Removed______ Estimated P Removed______
Areas of setback or other conservation practices______

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ______ Date ______
Recipient Name and Address ______

☐ Nutrient analysis provided

Manure volume/weight ______ Date ______
Recipient Name and Address ______

☐ Nutrient analysis provided

Manure volume/weight ______ Date ______
Recipient Name and Address ______

☐ Nutrient analysis provided

Notes: ______

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

Monthly Inspections
Mortality Management System ________ Date _____
Notes ______________________________

November 2012

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
				1 Rainfall_____ Water Lines Inspection_____	2 Rainfall_____ Water Lines Inspection_____	3 Rainfall_____ Water Lines Inspection_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
4 Rainfall_____ Water Lines Inspection_____	5 Rainfall_____ Water Lines Inspection_____	6 Rainfall_____ Water Lines Inspection_____	7 Rainfall_____ Water Lines Inspection-	8 Rainfall_____ Water Lines Inspection_____	9 Rainfall_____ Water Lines Inspection_____	10 Rainfall_____ Water Lines Inspection_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
11 Rainfall_____ Water Lines Inspection_____	12 Rainfall_____ Water Lines Inspection_____	13 Rainfall_____ Water Lines Inspection_____	14 Rainfall_____ Water Lines Inspection-	15 Rainfall_____ Water Lines Inspection_____	16 Rainfall_____ Water Lines Inspection_____	17 Rainfall_____ Water Lines Inspection_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
18 Rainfall_____ Water Lines Inspection_____	19 Rainfall_____ Water Lines Inspection_____	20 Rainfall_____ Water Lines Inspection_____	21 Rainfall_____ Water Lines Inspection-	22 Rainfall_____ Water Lines Inspection_____	23 Rainfall_____ Water Lines Inspection_____	24 Rainfall_____ Water Lines Inspection_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
25 Rainfall_____ Water Lines Inspection_____	26 Rainfall_____ Water Lines Inspection_____	27 Rainfall_____ Water Lines Inspection_____	28 Rainfall_____ Water Lines Inspection-	29 Rainfall_____ Water Lines Inspection_____	30 Rainfall_____ Water Lines Inspection_____		•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____

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Manure / Wastewater Applied

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields____________
Estimated N Removed____________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields____________
Estimated N Removed____________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields____________
Estimated N Removed____________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Field ID & Location ____________ Acres Applied __________ Date ________
Manure Source ____________ Application Method ____________
Application Rate ____________ Total Applied N________ Applied P ________
Crop(s)____________________ Expected Yields____________
Estimated N Removed____________ Estimated P Removed____________
Areas of setback or other conservation practices____________________

Manure Spreader Calibration

Date	Equipment Type	Manure Source	Calibration Method	Calculated Amount of Manure Applied/Acre

Manure Sold or Given Away (Large CAFOs)

(Check the box provided if an nutrient analysis was provided to the recipient.)

Manure volume/weight ________________ Date __________
Recipient Name and Address ____________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ____________________

☐ Nutrient analysis provided

Manure volume/weight ________________ Date __________
Recipient Name and Address ____________________

☐ Nutrient analysis provided

Notes:

Manure Application Equipment Maintenance

Date	Equipment	Maintenance Done

December 2012

Monthly Inspections
Mortality Management System ________ Date _____
Notes________________________________

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Weekly Inspections
In case of a spill or an authorized discharge, take measures to contain the spill and contact your permitting authority within 24 hours. You may record spill information at the end of this calendar. Written reports of a spill must be completed within 5 days.						*1* Rainfall_____ Water Lines Inspec- tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
2 Rainfall_____ Water Lines Inspec- tion_____	*3* Rainfall_____ Water Lines Inspec- tion_____	*4* Rainfall_____ Water Lines Inspec- tion_____	*5* Rainfall_____ Water Lines Inspec- tion_____	*6* Rainfall_____ Water Lines Inspec- tion_____	*7* Rainfall_____ Water Lines Inspec- tion_____	*8* Rainfall_____ Water Lines Inspec- tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
9 Rainfall_____ Water Lines Inspec- tion_____	*10* Rainfall_____ Water Lines Inspec- tion_____	*11* Rainfall_____ Water Lines Inspec- tion_____	*12* Rainfall_____ Water Lines Inspec- tion_____	*13* Rainfall_____ Water Lines Inspec- tion_____	*14* Rainfall_____ Water Lines Inspec- tion_____	*15* Rainfall_____ Water Lines Inspec- tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
16 Rainfall_____ Water Lines Inspec- tion_____	*17* Rainfall_____ Water Lines Inspec- tion_____	*18* Rainfall_____ Water Lines Inspec- tion_____	*19* Rainfall_____ Water Lines Inspec- tion_____	*20* Rainfall_____ Water Lines Inspec- tion_____	*21* Rainfall_____ Water Lines Inspec- tion_____	*22* Rainfall_____ Water Lines Inspec- tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
23 Rainfall_____ Water Lines Inspec- tion_____	*24* Rainfall_____ Water Lines Inspec- tion_____	*25* Rainfall_____ Water Lines Inspec- tion_____	*26* Rainfall_____ Water Lines Inspec- tion_____	*27* Rainfall_____ Water Lines Inspec- tion_____	*28* Rainfall_____ Water Lines Inspec- tion_____	*29* Rainfall_____ Water Lines Inspec- tion_____	•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____
30 Rainfall_____ Water Lines Inspec- tion_____	*31* Rainfall_____ Water Lines Inspec- tion_____						•Lagoon Depth Marker (ft)_____ Date_____ •Manure Storage & Equipment Inspection_____ Notes_____ Date_____ •Water & Runoff Diversion or Containment Devices_____ Notes_____ Date_____ •Maintenance or Repairs_____ Date_____ Notes_____

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2012 Yearly Records and Reporting Requirements

Manure must be analyzed a minimum of once annually for nitrogen and phosphorus content, and soil analyzed a minimum of once every five years for phosphorus content. Use sampling results in determining application rates for manure, litter, and other process wastewater.

Soil Sampling

Field ID and Location	Sample Depth	Date of Collection	Field ID and Location	Sample Depth	Date of Collection

Annual Report

Date report submitted ___________

NOTE: The annual report must include for the previous 12 month period: the number and type of animals, whether in open confinement or house under roof; estimated amount of total manure litter, and process wastewater generated; estimated amount of total manure, litter and process wastewater transferred; total acres for land application; summary of all discharges; a statement indicating whether a certified planner was used for the current NMP; in addition to the information used to develop the NMP.

NMP

Date of NMP_______________

Location of NMP_____________

NOTE: Annual recalculation of the amount of manure, litter, and process wastewater allowed to be applied must rely on the results of the most recent representative manure, litter, and process wastewater tests taken within 12 months of the date of land application.

Manure/Wastewater Sampling

Sampling Location	Sample Depth	Date of Collection

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Accidental Spill or Unauthorized Discharge

Date and time of spill or discharge _________

Length of time of spill or discharge _________

Location and source of spill _______________

____

Date and time of oral notification to permitting authority (must be 24 hours from the time the permittee is aware of the circumstances)______________________________

Estimated discharge volume ______________

Date of sample collection (must be analyzed by a laboratory) ________________________

Description of the cause of the discharge

____

____

____

Precipitation amount (if cause of the discharge) ________________ Date ________________

Accidental Spill or Unauthorized Discharge

Date and time of spill or discharge _________

Length of time of spill or discharge _________

Location and source of spill _______________

____

Date and time of oral notification to permitting authority (must be 24 hours from the time the permittee is aware of the circumstances)______________________________

Estimated discharge volume ______________

Date of sample collection (must be analyzed by a laboratory) ________________________

Description of the cause of the discharge

____

____

____

Precipitation amount (if cause of the discharge) ________________ Date ________________

Accidental Spill or Unauthorized Discharge

Date and time of spill or discharge _________

Length of time of spill or discharge _________

Location and source of spill _______________

____

Date and time of oral notification to permitting authority (must be 24 hours from the time the permittee is aware of the circumstances)______________________________

Estimated discharge volume ______________

Date of sample collection (must be analyzed by a laboratory) ________________________

Description of the cause of the discharge

____

____

____

Precipitation amount (if cause of the discharge) ________________ Date ________________

Corrective Action Explanation

Record any actions taken to correct deficiencies_______________________________

____

If applicable, explain any factors preventing immediate correction________________________

____

____

Corrective Action Explanation

Record any actions taken to correct deficiencies_______________________________

____

If applicable, explain any factors preventing immediate correction ________________________

____

____

Corrective Action Explanation

Record any actions taken to correct deficiencies_______________________________

____

If applicable, explain any factors preventing immediate correction________________________

____

____

17

Additional Notes

2011-2012

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Appendix N

References for NPDES Permit Writers

EPA Programs and Information

NPDES Permit Program Basics
This website provides basic permitting tools and information.

http://cfpub.epa.gov/npdes/home.cfm?program_id=45

NPDES Permit Writers' Manual
U.S. EPA NPDES Permit Writers Manual
EPA 833-B-96-003, December 1, 1996.

To download individual chapters or the entire document, go to EPA's NPDES Permit Writers' Manual page at

http://cfpub.epa.gov/npdes/writermanual.cfm?program_id=45

CAFO Final Rule Web Page
This website provides access to the text of the rule and preamble, outreach brochures, supporting documents, and guidance documents.

http://www.epa.gov/npdes/caforule

Enforcement & Compliance History Online (ECHO)
EPA website for online inspection, violation, and enforcement facility data on CAFOs from PCS or ICIS.

http://www.epa-echo.gov/echo/compliance_report_water.html

TMDL Program
EPA Office of Wetlands, Oceans and Watersheds. TMDL Program

http://www.epa.gov/OWOW/tmdl/index.html

Clean Water Act Section 319 Nonpoint Source Management Program
EPA Office of Wetlands, Oceans and Watersheds, Clean Water Act Section 319

http://www.epa.gov/owow/nps/cwact.html

Source Water Protection Programs
EPA Office of Groundwater and Drinking Water, Source Water Protection

http://www.epa.gov/safewater/protect.html

Development Document for the Final Revisions to the National Pollutant Discharge Elimination System (NPDES) Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations
EPA-821-R-03-001

Chapter 4 of this document contains an overview of the livestock industry and profiles of specific animal sectors that EPA compiled for the 2003 CAFO rule revisions.

http://www.epa.gov/npdes/pubs/cafo_dev_doc_p1.pdf

National Management Measures to Control Nonpoint Source Pollution from Agriculture
EPA 841-B-03-004, 2003

Includes information on selecting and implementing BMPs to control the contribution of pollutants to surface water.

http://www.epa.gov/owow/nps/agmm/index.html

Risk Assessment Evaluation for Concentrated Animal Feeding Operations
EPA/600/R-04/042, May 2004

This document discusses risk factors associated with CAFOs, including nutrients and pathogens.

http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=901V0100.txt

Routine Biosecurity Procedures for EPA Personnel Visiting Farms, Ranches, Slaughterhouses and Other Facilities with Livestock and Poultry
December 10, 2001

http://www.epa.gov/oecaerth/resources/policies/monitoring/inspection/biosecuritymemo.pdf

National Agriculture Compliance Assistance Center (Ag Center)
http://www.epa.gov/agriculture/agctr.html

Non-Water Quality Impact Estimates for Animal Feeding Operations
Eastern Research Group for USEPA, December 2002

Sections 304(b) and 306 of the CWA require that EPA consider non-water quality environmental impacts of ELGs. This document provides an analysis of non-water quality impacts of the CAFO ELGs, particularly air emissions and energy impacts.

http://www.epa.gov/npdes/pubs/cafo_nonwaterquality.pdf

Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs
National Academy of Sciences, February 2003

This document presents the findings of the ad hoc committee tasked by USEPA and USDA to evaluate estimates of air emissions from animal feeding operations, identify research needs, and recommend modeling methods.

http://www.epa.gov/ttn/chief/ap42/ch09/related/nrcanimalfeed_dec2002.pdf

USDA Programs and Information

2008 Farm Bill
USDA's online gateway to information about the 2008 Farm Bill.

http://www.ers.usda.gov/FarmBill/2008/

USDA Natural Resources Conservation Service (NRCS)
http://www.nrcs.usda.gov

USDA NRCS Animal Feeding Operations (AFO) and Confined Animal Feeding Operations (CAFO)
CNMP information

http://www.nrcs.usda.gov/technical/afo/

USDA NRCS Conservation Programs
http://www.nrcs.usda.gov/wps/portal/nrcs/main/?ss=16&navtype=BROWSEBYSUBJECT&cid=null&navid=100120000000000&pnavid=100000000000000&position=BROWSEBYSUBJECT&ttype=main&pname=Financial Assistance | NRCS

Environmental Quality Incentives Program
http://www.nrcs.usda.gov/programs/eqip/

Agricultural Management Assistance Program
http://www.nrcs.usda.gov/wps/portal/nrcs/main/?ss=16&navid=100120240000000&pnavid=100120000000000&position=SUBNAVIGATION&ttype=main&navtype=SUBNAVIGATION&pname=Agricultural Management Assistance

Wildlife Habitat Incentives Program
http://www.nrcs.usda.gov/wps/portal/nrcs/main/?ss=16&navid=100120340000000&pnavid=100120000000000&position=SUBNAVIGATION&ttype=main&navtype=SUBNAVIGATION&pname=Wildlife Habitat Incentives Program

USDA NRCS Animal Feeding Operations (AFO) and Confined Animal Feeding Operations (CAFO)
CNMP information

http://www.nrcs.usda.gov/technical/afo/

USDA NRCS CNMP Technical Guidance
USDA's General Manual, Title 190 – Part 405 Comprehensive Nutrient Management Plan Technical Criteria

http://directives.sc.egov.usda.gov/26583.wba

USDA NRCS Nutrient Management Technical Practice Standard 590
USDA NRCS Nutrient Management Technical Resources, Conservation Practice Standard, Code 590.

ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/590.pdf

USDA NRCS Nutrient Management Technical Resources
This website provides computer-based tools to facilitate the development and implementation of NMPs.

http://www.nrcs.usda.gov/technical/nutrient.html

NRCS National Engineering Handbook Part 651
Agricultural Waste Management Field Handbook

http://www.wsi.nrcs.usda.gov/products/w2q/awm/handbk.html

USDA Agricultural Research Service
http://www.ars.usda.gov

USDA NIFA, formerly Cooperative State Research, Education, and Extension Service
http://www.csrees.usda.gov/

USDA NIFA Cooperative Extension System Offices
The Cooperative Extension System is a nationwide non-credit educational network.

http://nifa.usda.gov/Extension/index.html

USDA Farm Service Agency
http://fsa.usda.gov/

USDA Farm Service Agency, Conservation Reserve Program
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp

USDA Farm Service Agency, Conservation Reserve Enhancement Program
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep

USDA National Nutrient Management Policy
USDA's General Manual, Title 190 – Part 402 Nutrient Management

http://www.nrcs.usda.gov/technical/ecs/nutrient/gm-190.html

USDA Technical Service Providers (TSP) Registry
http://techreg.usda.gov/

State NRCS Field Office Technical Guidance
Click on the map to find available technical guidance for states and counties.

http://www.nrcs.usda.gov/technical/efotg/

Associations and Trade Groups

American Egg Board
http://aeb.org/

American Society of Agronomy (ASA)
http://www.agronomy.org/

Association of State and Interstate Water Pollution Control Agencies (ASIWPCA)
http://www.asiwpca.org/

Certified Crop Advisors (CCA)
https://www.agronomy.org/certifications

Certified Professional Agronomists (CPAg)
https://www.agronomy.org/certifications

Certified Professional Crop Scientists (CPCSc)
https://www.agronomy.org/certifications

Certified Professional Soil Scientists (CPSSc)
https://www.agronomy.org/certifications

ISO 14001
This website provides information on ISO 14001 and other standards from the International Standards Organization.

http://www.iso.org/iso/home.htm

National Alliance of Independent Crop Consultants (NAICC)
http://www.naicc.org/

National Association of Conservation Districts (NACD)
http://www.nacdnet.org

National Association of State Departments of Agriculture (NASDA)
http://www.nasda.org

National Cattleman's Beef Association (NCBA)
http://www.beef.org

National Milk Producers Federation (NMPF)
http://www.nmpf.org

National Pork Producers Council (NPPC)
http://www.nppc.org

National Turkey Federation (NTF)
http://www.turkeyfed.org

United States Poultry and Egg Association
http://www.poultryegg.org

Other References

Land Grant Universities
This National Institute of Food and Agriculture (NIFA) website provides directory of land-grant universities. To see a list of land-grant university websites, click a state.

http://www.csrees.usda.gov/qlinks/partners/state_partners.html

2010 Manure Analysis Proficiency Laboratories
http://www2.mda.state.mn.us/webapp/lis/manurelabs.jsp

The North American Proficiency Testing (NAPT) Program
http://www.naptprogram.org/

USDA and EPA Livestock and Poultry Environmental Stewardship Curriculum
This resource also includes the Livestock and Poultry Environmental Stewardship Program—Lesson 51- Mortality Management
(http://www.extension.org/mediawiki/files/a/a8/LES_51.pdf)

http://www.lpes.org/

USDA Agricultural Research Service and Washington State University
Soil Plant Air Water (SPAW) Hydrology Model

http://hydrolab.arsusda.gov/SPAW/Index.htm

Appendix O

Sample Site-Specific NPDES General Permit

SAMPLE
NPDES GENERAL PERMIT
FOR
CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFOs)

[US ENVIRONMENTAL PROTECTION AGENCY]

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

[The intent of this sample NPDES General Permit for CAFOs is to recommend specific permit requirements that are consistent with the NPDES CAFO regulations, CAFO ELG, the NPDES CAFO Permit Writers' Guidance including the sample Nutrient Management Plan and Technical Standard. U.S. Environmental Protection Agency encourages permitting authorities to use the recommendations of the guidance manual and this example permit as appropriate. Minimum NPDES permitting requirements for CAFOs are defined at 40 CFR Parts 122, 123, and 412 and all other applicable CWA regulations.]

In compliance with provisions of the Clean Water Act, 33 United States Code (U.S.C.) 1251 *et seq.* (the Act), owners and operators of concentrated animal feeding operations (CAFOs) in [State], except those CAFOs excluded from coverage in Part I of this permit, are authorized to discharge and must operate their facility in accordance with effluent limitations, monitoring requirements, and other provisions set forth herein.

A copy of this permit must be kept by the permittee at the site of the permitted activity.

This permit will become effective July 1, 2009.

This permit and the authorization to discharge under the NPDES permit shall expire at midnight June 30, 2014

Signed this **[DAY]** of **[MONTH]** and **[YEAR]**

[PERMITTING AUTHORITY—OFFICIAL]

Contents

Part I. Permit Area and Coverage

A. Permit Area

This permit offers statewide NPDES permit coverage for discharges from operations defined as concentrated animal feeding operations (CAFOs) in [State X].

B. Permit Coverage

This permit covers any operation that meets the following criteria:

1. Is located in the permit area as defined by Part I.A. of this permit,
2. That meets the definition of a CAFO at 40 CFR part 122.23(b)(4) *large concentrated animal feeding operation* (see Part VIII, Definitions, *large CAFO* of this permit).
3. Discharges pollutants to waters of the United States. Once an operation is defined as a CAFO, the NPDES requirements for CAFOs apply with respect to all animals in confinement at the operation and all manure, litter and process wastewater generated by those animals or the production of those animals, regardless of the type of animal.
4. Is eligible for permit coverage as defined in Part I.C of this permit.
5. Is authorized for permit coverage by the permitting authority as specified in Part I.F of this permit.

C. Eligibility for Coverage

Unless excluded from coverage in accordance with Paragraph D or F below, owners/operators of existing, currently operating animal feeding operations that are defined as CAFOs or designated as CAFOs by the Permitting Authority (See Part VIII Definitions, *CAFOs* of this permit) and that are subject to 40 CFR part 412, subpart C (Dairy Cows and Cattle Other than Veal Calves) are eligible for coverage under this permit. Eligible CAFOs may apply for authorization under the terms and conditions of this permit, by submitting a Notice of Intent (NOI) to be covered by this permit (see Appendix A of this permit).

CAFO owners/operators may also seek to be excluded from coverage under this permit by (1) submitting to the permitting authority a Notice of Termination form (see Appendix D of this permit) or (2) by applying for an individual NPDES Permit in accordance with Part I.F of this permit.

D. Limitations on Coverage

The following CAFOs are not eligible for coverage under this NPDES general permit and must apply for an individual permit:

1. CAFOs that have been notified by the permitting authority to apply for an individual NPDES permit in accordance with Part I.F (below) of this permit.

2. CAFOs that have been notified by the permitting authority that they are ineligible for coverage because of a past history of non-compliance.

3. Horse, Sheep, Duck, Veal, Poultry or Swine CAFOs.

4. Discharges that will adversely affect any species that are federally-listed as endangered or threatened ("listed") under the Endangered Species Act (ESA) and will result in the adverse modification or destruction of habitat that is federally-designated as "critical habitat" under the ESA. CAFOs seeking coverage under this general permit must follow the conditions outlined in Part IV.B.5 of this permit.

5. CAFOs that do not meet the National Historic Preservation Act eligibility provisions contained in Appendix C of this permit.

6. New dischargers to water quality impaired water (CWA, 303d list) unless the operator performs one of the following:
   a. Prevents any discharge that contains pollutant(s) for which the waterbody is impaired, and includes documentation of procedures taken to prevent such discharge in the NMP.
   b. Documents that the pollutant(s) for which the waterbody is impaired is not present at the facility, and retains documentation of this finding with the NMP.
   c. In advance of submitting the NOI, provides to the permitting authority data to support a showing that the discharge is not expected to cause or contribute to an exceedance of a water quality standard, and retains such data onsite with the NMP. To do this, the operator must provide data and other technical information to the permitting authority sufficient to demonstrate one of the following:
      i. For discharges to waters without an U.S. Environmental Protection Agency approved or established TMDL, that the discharge of the pollutant for which the water is impaired will meet in-stream water quality criteria at the point of discharge to the waterbody.
      ii. For discharges to waters with an U.S. Environmental Protection Agency approved or established TMDL, that there are sufficient remaining wasteload allocations in an U.S. Environmental Protection Agency approved or established TMDL to allow the facility's discharge and that existing dischargers to the waterbody are subject to compliance schedules designed to bring the waterbody into attainment with water quality standards.

   Operators are eligible under this section if they receive an affirmative determination from the permitting authority that the discharge will not contribute to the existing impairment, in which case the operator must maintain such determination onsite with the NMP.

7. CAFOs with discharges subject to New Source Performance Standards (NSPS) at 40 CFR part 412.

E. Application for Coverage

1. Owners/operators of CAFOs seeking to be covered by this permit must:
   a. For facilities covered by and/or expired permit that wish to have continuous permit coverage, submit an NOI to the permitting authority by [DATE].

   b. Submit a Nutrient Management Plan (NMP) with the NOI that meets the requirements of 40 CFR parts 122 and 412, where applicable.

   c. CAFO owners/operators may submit an NOI after the applicable date in Part I.E.1.a. of this permit. Regardless of when the NOI is submitted, the CAFO's authorization under this permit is only for discharges that occur after permit coverage is granted. The permitting authority reserves the right to take appropriate enforcement actions for any unpermitted discharges.

   d. If a CAFO has submitted an application for coverage under an individual permit prior to issuance of the general permit and is seeking to be covered by this general permit, the CAFO must submit an NOI for coverage.

2. Contents of the NOI: The NOI submitted for coverage under this permit must include the following information:
   a. Name of the owner or operator.

   b. Facility location and mailing addresses.

   c. Latitude and longitude of the production area (entrance to production area).

   d. Topographic map of the geographic area in which the CAFO is located showing the specific locations of the production area, land application area, and the name and location of the nearest surface waters.

   e. A diagram of the production area.

   f. Number and type of animals, whether in open confinement or housed under roof (beef cattle, broilers, layers, swine weighing 55 pounds or more, swine weighing less than 55 pounds, mature dairy cows, dairy heifers, veal calves, sheep and lambs, horses, ducks, turkeys, other).

   g. Type of containment and storage (anaerobic lagoon, roofed storage shed, storage ponds, under floor pits, aboveground storage tanks, belowground storage tanks, concrete pad, impervious soil pad, other) and total capacity for manure, litter, and process wastewater storage (tons/gallons).

   h. Total number of acres under control of the applicant available for land application of manure, litter, or process wastewater.

   i. Estimated amounts of manure, litter, and process wastewater generated per year (tons/gallons).

j. Estimated amounts of manure, litter and process wastewater transferred to other persons per year (tons/gallons).

k. An NMP that meets the requirements of the provisions of 40 CFR part 122.42(e) (including, for all CAFOs subject to 40 CFR part 412, subpart C or subpart D, the requirements of 40 CFR part 412.4(c), as applicable) and Part III of this permit.

3. Signature Requirements: The NOI must be signed by the owner/operator or other authorized person in accordance with Part VII.E of this permit.

4. Where to Submit: Signed copies of the NOI or individual permit application must be sent to: [PERMITTING AUTHORITY MAILING ADDRESS]

5. Upon receipt, the permitting authority will review the NOI and NMP to ensure that the NOI and NMP are complete. The permitting authority may request additional information from the CAFO owner or operator if additional information is necessary to complete the NOI and NMP or to clarify, modify, or supplement previously submitted material. If the permitting authority makes a preliminary determination that the NOI is complete, the NOI, NMP and draft terms for the NMP to be incorporated into the permit will be made available for a thirty (30) day public review and comment period. The process for submitting public comments and requests of hearing will follow the procedures applicable to draft permits as specified by 40 CFR parts 124.11 through 124.13. The permitting authority will respond to comments received during the comment period as specified in 40 CFR part 124.17 and, if necessary, require the CAFO owner or operator to revise the NMP in order to granted permit coverage. If determined appropriate by the permitting authority, CAFOs will be granted coverage under this general permit upon written notification by the permitting authority. The permitting authority will identify the terms of the NMP to be incorporated into the permit in the written notification.

F. Requiring an Individual Permit

1. The permitting authority may at any time require any facility authorized by this permit to apply for, and obtain, an individual NPDES permit. The permitting authority will notify the operator, in writing, that an application for an individual permit is required and will set a time for submission of the application. Coverage of the facility under this general NPDES permit is automatically terminated when (1) the operator fails to submit the required individual NPDES permit application within the defined time frame; or (2) the individual NPDES permit is issued by the permitting authority.

2. Any owner/operator covered under this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner/operator shall submit an application for an individual permit (Form 1 and Form 2B) with the reasons supporting the application to the permitting authority. If a final, individual NPDES permit is issued to an owner/operator otherwise subject to this general permit,

the applicability of this NPDES CAFO general permit to the facility is automatically terminated on the effective date of the individual NPDES permit. Otherwise, the applicability of this general permit to the facility remains in full force and effect (for example, if an individual NPDES permit is denied to an owner/operator otherwise subject to this general permit).

G. Permit Expiration

This permit will expire 5 years from the effective date. The permittee must reapply for permit coverage 180 days before the expiration of this permit unless the permit has been terminated consistent with § 122.64(b) or the CAFO will not discharge upon expiration of the permit. If this permit is not reissued or replaced before the expiration date, it will be administratively continued in accordance with the Administrative Procedures Act and remain in force and effect. Any permittee who is granted permit coverage before the expiration date will automatically remain covered by the continued permit until the earlier of any of the following:

1. Reissuance or replacement of this permit, at which time the permittee must comply with the NOI conditions of the new permit to maintain authorization to discharge.
2. Issuance of an individual permit for the permittee's discharges.
3. A formal decision by the permitting authority not to reissue this general permit, at which time the permittee must seek coverage under an individual permit.
4. The permitting authority grants the permittee's request for termination of permit coverage.

H. Change in Ownership

If a change in the ownership of a facility whose discharge is authorized under this permit occurs, coverage under the permit will automatically transfer if (1) the current permittee notifies the permitting authority at least 30 days prior to the proposed transfer date; (2) the notice includes a written agreement between the existing and new permittees containing a specific transfer date for permit responsibility, coverage, and liability; and (3) the permitting authority does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If the new CAFO owner or operator modifies any part of the NMP, the NMP shall be submitted to the permitting authority in accordance with Part III.A. of this permit and 40 CFR part 122.42(e)(6).

I. Termination of Permit Coverage

1. Coverage under this permit may be terminated in accordance with 40 CFR part 122.64 and if EPA determines in writing that one of the following three conditions are met:
   a. The facility has ceased all operations and all wastewater or manure storage structures have been properly closed in accordance with Natural Resource

Conservation Service (NRCS) Conservation Practice Standard No. 360, Closure of Waste Impoundments, as contained in the *Natural Resources Conservation Service Field Office Technical Guide* and all other remaining stockpiles of manure, litter, or process wastewater not contained in a wastewater or manure storage structure are properly disposed.

b. The facility is no longer a CAFO that discharges manure, litter, or process wastewater to waters of the United States.

c. In accordance with 40 CFR part 122.64, the entire discharge is permanently terminated by elimination of the flow or by connection to a publicly owned treatment works (POTW).

Part II. Effluent Limitations and Standards and Other Legal Requirements

A. Effluent Limitations and Standards

The following effluent limitations apply to facilities covered under this permit:

1. **Technology-based Effluent Limitations and Standards—Production Area**
   The CAFO must implement the terms of an NMP, as specified below and in Part III.B of this permit.

   a. There may be no discharge of manure, litter, or process wastewater pollutants into waters of the United States from the production area except as provided below:

   Whenever precipitation causes an overflow of manure, litter, or process wastewater, pollutants in the overflow may be discharged into waters of the United States provided:

   i. The production area is properly designed, constructed, operated and maintained to contain all manure, litter, process wastewater and the runoff and direct precipitation from the 25-year, 24-hour storm event for the location of the CAFO.

   ii. The design storage volume is adequate to contain all manure, litter, and process wastewater accumulated during the storage period including, at a minimum, the following:

   - The volume of manure, litter, process wastewater, and other wastes accumulated during the storage period.
   - Normal precipitation less evaporation during the storage period.
   - Normal runoff during the storage period.
   - The direct precipitation from the 25-year, 24-hour storm.
   - The runoff from the 25-year, 24-hour storm event from the production area.

- Residual solids after liquid has been removed.
- Necessary freeboard to maintain structural integrity.
- A minimum treatment volume, in the case of treatment lagoon.

b. Installation of a depth marker in all open surface liquid impoundments. The depth marker must clearly indicate the minimum capacity necessary to contain the runoff and direct precipitation of the 25-year, 24-hour rainfall event. The marker shall be visible from the top of the levee.

c. Weekly visual inspections of all stormwater diversion devices, runoff diversion structures, and devices channeling contaminated stormwater to the wastewater and manure storage and containment structures are conducted.

d. Weekly inspections of the manure, litter, and process wastewater impoundments noting the level as indicated by the depth marker installed in accordance with Part II.A.1.b of this permit are conducted.

e. Daily visual inspections of all water lines, including drinking water and cooling water lines are conducted.

f. Any deficiencies that are identified in daily and weekly inspections are corrected in a timely manner.

g. Dead animals are properly disposed of within three (3) days unless otherwise provided for by the permitting authority. Mortalities must not be disposed of in any liquid manure or process wastewater system that is not specifically designed to treat animal mortalities. Animals shall be disposed of in a manner to prevent contamination of waters of the United States or creation of a public health hazard.

h. Complete, on-site records documenting implementation of all required additional measures for a period of 5 years, including the records specified for Operation and Maintenance in Part V.C, Table V-A of this permit are maintained.

i. The production area must be operated in accordance with the additional measures and records specific in Part II.A.2 of this permit.

2. Additional Measures—Applicable to the Production Area

In addition to meeting the requirements in Part III.B below, the permittee must implement the following additional measures:

a. Ensure adequate storage of manure, litter, and process wastewater, including procedures to ensure proper operation and maintenance of the storage facilities.

b. Mortality handling practices shall be in accordance with all applicable state and local regulatory requirements. Any such state/local requirements should be consistent with NRCS Practice Standard 316 as applicable.

c. Ensure that clean water is diverted, as appropriate, from the production area in accordance with Part III.A.3.c of this permit.

d. Prevent direct contact of confined animals with waters of the United States.

e. Ensure that chemicals and other contaminants handled on-site are not disposed of in any manure, litter, process wastewater, or storm water storage or treatment system unless specifically designed to treat such chemicals and other contaminants.

f. Identify specific records that will be maintained to document the implementation and management of Part II.A.2. a through e of this permit.

g. In cases where CAFO-generated manure, litter, or process wastewater is sold or given away the permittee must comply with the following conditions:

  i. Maintain records showing the date and amount of manure, litter, and/or process wastewater that leaves the permitted operation.

  ii. Record the name and address of the recipient.

  iii. Provide the recipient(s) with representative information on the nutrient content of the manure, litter, and/or process wastewater.

  iv. The records must be retained on-site, for a period of 5 years, and be submitted to the permitting authority on request.

3. Water Quality-based Effluent Limitations and Standards—Production Area
The permitting authority has established the following permit conditions to protect water quality standards.

a. Discharges to Water Quality Impaired Waters

  i. If the CAFO discharges to an impaired water with an EPA approved or established TMDL, EPA will inform the facility if any additional limits or controls are necessary for the discharge to be consistent with the assumptions of any available wasteload allocation in the TMDL, or if coverage under an individual permit is necessary in accordance with Part I.F of this permit. Any additional limits or controls shall be included in the NMP.

  ii. If the CAFO discharges to an impaired water without an EPA approved or established TMDL, EPA will inform the facility if any additional limits or controls are necessary to meet water quality standards, or if coverage under an individual permit is necessary in accordance with Part I.F of this permit. Any additional limits or controls shall be included in the NMP.

  iii. If a CAFO's authorization for coverage under this permit relied on Part I.D.6 of this permit for a new discharge to an impaired water, the facility must implement and maintain any control measures or conditions on its site that enabled the CAFO to become eligible under Part I.D.6 of this permit, and shall include these control measures or conditions in its NMP.

  iv. If at any time the facility becomes aware, or EPA determines, that a discharge to an impaired water has occurred and the requirements of Part II.A.3.a.i-iii of this permit have not been addressed, the facility must take corrective action to fulfill the requirements of Part II.A.3.a.i-iii of this permit. Any changes to the NMP required to fulfill the requirements of Part II.A.3.a.i-iii of this permit shall be done in accordance with Part III.A.7 of this permit.

b. Tier 2 Antidegradation Requirements for New or Increased Dischargers

   i. If the CAFO discharges directly to waters designated by a State or Tribe as Tier 2 or Tier 2.5 for antidegradation purposes under 40 CFR part 131.12(a) (see list of Tier 2 and 2.5 waters on EPA's website at *http://www.U.S. Environmental Protection Agency.gov/npdes/stormwater/msgp*), the permitting authority may notify the facility that additional analyses, control measures, or other permit conditions are necessary to comply with the applicable antidegradation requirements, or notify you that an individual permit application is necessary in accordance with Part I.F of this permit. Any such additional requirements shall be included in the NMP.

4. Technology-based Effluent Limitations and Standards—Land Application Areas under the Control of the CAFO Owner/Operator

Permittees that apply manure, litter, or process wastewater to land under the permitted CAFO's ownership or operational control must implement the terms of an NMP, as specified below and in Part III.B of this permit. The NMP must be developed in accordance with the requirements of this section and Part III.A of this permit.

a. Determination of application rates. Application rates for manure, litter, or process wastewater must minimize phosphorus and nitrogen transport from the field to surface waters in compliance with the technical standards for nutrient management established by the permitting authority, as follows:

   i. Application rates must be determined in accordance with the result of the Iowa Phosphorus Index as specified in IAC Chapter 567—65.17(17).

   ii. Realistic yield goals must be established in accordance with the procedures in IAC Chapter 567—65.17(6).

   iii. The crop nutrient recommendations provided in Appendix A5, "Crop Nitrogen Usage Rate Factors for Various Crops," and Appendix A6, "Nutrient Removal for Iowa Crops," of Iowa DNR's Manure Management Plan Form or Iowa State University Extension publication PM-1688, "General Guide to Crop Nutrient and Limestone Recommendations in Iowa," must be used.

   iv. Nitrogen credits for prior legume crops must be determined in accordance with values specified in footnote t of Iowa DNR's Manure Management Plan form.

   v. Nitrogen mineralization rates must be consistent with the ranges identified in Iowa State University Extension publication PMR 1003, "Using Manure Nutrients for Crop Production."

vi. Nitrogen loss factors must be consistent with those provided in Appendix A7, "Nitrogen Application Losses," of Iowa DNR's Manure Management Plan Form.

vii. Timing and method of manure, litter, and process wastewater application must be addressed in accordance with the criteria and considerations in Iowa NRCS Conservation Practice Standard Code 590 (Nutrient Management).

viii. For fields where P-based management is required, in accordance with the outcome of the Iowa Phosphorus Index, multi-year phosphorus application is permitted on fields that do not have a high potential for phosphorus runoff to surface water. Such applications must be in accordance with the procedures and limitations specified in footnote bb of Iowa DNR's Manure Management Plan Form.

b. Manure and soil sampling. Manure must be analyzed at least once annually for nitrogen and phosphorus content in accordance with the manure testing requirements of Iowa NRCS Conservation Practice Standard Code 590 (Nutrient Management). Manure samples must be analyzed by a laboratory listed with the Manure Testing Laboratory Certification Program (MTLCP). Soil must be analyzed at least once every 4 years in accordance with soil testing requirements established in IAC Chapter 567—65.17(16). The results of the analyses must be used in determining application rates for manure, litter, and process wastewater.

c. Inspection of land application equipment for leaks. Equipment used for land application of manure, litter, or process wastewater must be inspected periodically for leaks.

d. Land application setback requirements. Manure, litter, or process wastewater must not be applied closer than 100 feet to any downgradient water of the United States, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to waters of the United States. The permittee may elect to use a 35-foot vegetated buffer where applications of manure, litter, or process wastewater are prohibited as an alternative to the 100-foot setback to meet the requirement. As a compliance alternative, the permittee may demonstrate that a set-back or buffer is not necessary because implementation of alternative conservation practices or field-specific conditions will provide pollutant reductions equivalent or better than the reductions that would be achieved by the 100-foot setback.

e. Record Keeping requirements. Complete, on-site records including the site-specific NMP must be maintained to document implementation of all required land application practices. Such documentation must include the records specified for Soil and Manure/Wastewater Nutrient Analyses and Land Application in Part V.C, Table V-A of this permit.

5. **Additional Measures—Applicable to the Land Application under the Control of the CAFO Owner/Operator**

   a. Additional BMPs to control discharges from land application areas.

      i. Areas shall be identified that, due to topography, activities or other factors, have a high potential for significant soil erosion. Where these areas have the potential to contribute pollutants to waters of the United States, measures used to limit erosion and pollutant runoff shall be identified.

      ii. Irrigation systems shall be managed so as to minimize (a) ponding or puddling of wastewater on land application fields, (b) contamination of ground and surface water and (c) the occurrence of nuisance conditions, such as odors and flies.

   b. Prohibitions

      i. There shall be no discharge of manure, litter, or process wastewater to waters of the United States from a CAFO as a result of the application of manure, litter or process wastewater to land areas under the control of the CAFO, except where it is an agricultural stormwater discharge. Where manure, litter, or process wastewater has been applied in accordance with the terms of the NMP as set forth in Part II.A. and III.B of this permit, a precipitation related discharge of manure, litter, or process wastewater from land areas under the control of the CAFO is considered to be an agricultural stormwater discharge.

      ii. Nutrients and organic nutrient sources shall not be surface applied to frozen, snow covered ground, or saturated soil if a potential risk for runoff exists. A potential risk for runoff exists on slopes greater than 5% unless erosion is controlled to soil loss tolerance levels ("T") or less. Manure may be surface applied to frozen, snow covered or saturated ground if a potential risk for runoff exists only under one of the following conditions with the permission of the permitting authority:

         - Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure.
         - On an emergency basis.

6. **Water Quality-based Effluent Limitations and Standards–Applicable to the Land Application under the Control of the CAFO Owner/Operator**
   There shall be no unauthorized dry weather discharges from land application sites.

7. **Effluent Limitations–Other Discharges**

   a. Process wastewater discharges from outside the production area, including washdown of equipment that has been in contact with manure, raw materials, products or byproducts that occurs outside of the production area and runoff of pollutants from raw materials, products or byproducts (such as manure, feathers, litter, bedding and feed) from the CAFO that have been spilled or otherwise deposited outside the production area and which are discharged to waters of the United States, shall be identified in the NMP. The NMP shall identify measures necessary to meet applicable water quality standards.

b. Discharges that do not meet the definition of process wastewater, including: (1) discharges associated with feed, fuel, chemical, or oil spills, equipment repair, and equipment cleaning, where the equipment has not been in contact with manure, raw materials, products or byproducts; and (2) domestic wastewater discharges to waters of the United States shall be identified in the NMP. The NMP shall identify measures necessary to meet applicable water quality standards.

c. Storm water discharges that are not addressed under the effluent limitations in Part II.A.1-6 of this permit, remain subject to applicable industrial or construction storm water discharge requirements.

In addition to meeting the above effluent limitations in Part II.A of this permit, the permittee must comply with the special conditions established in Part IV of this permit.

B. Other Legal Requirements

No condition of this permit shall release the permittee from any responsibility or requirements under other statutes or regulations, federal, state/Indian tribe or local.

Part III. Effluent Limitations and Standards of the Nutrient Management Plan

A. Procedural Requirements for Implementing the Terms of the Nutrient Management Plan

CAFO owners or operators seeking coverage under this general permit must submit a Nutrient Management Plan (NMP) with the NOI, as required by Part I.E.1. of this permit. The NMP shall specifically identify and describe practices that will be implemented to assure compliance with the effluent limitations and other conditions of this permit set forth in this part and Part II.A of this permit (Effluent Limitations and Standards). The NMP must be developed in accordance with the technical standards for nutrient management identified in Appendix B of this permit.

1. **Schedule.** The completed NMP must be submitted to the permitting authority with the NOI for CAFOs seeking coverage under this permit. The CAFO shall implement its NMP upon authorization under this permit, in accordance with the terms of the NMP set forth in Part III.B of this permit.

2. **NMP Review and Terms.**

    a. Upon receipt of the NMP, the permitting authority will review the NMP. The permitting authority may request additional information from the CAFO owner or operator if additional information is necessary to complete the NMP, or to clarify, modify, or supplement previously submitted material, the Director may request such information from the CAFO owner or operator.

b. The permitting authority will use the NMP to identify site-specific permit terms to be incorporated into this permit. The permitting authority will identify site-specific permit terms with respect to protocols for the land application of manure, litter, and process wastewater. The permitting authority will also identify site-specific permit terms with respect to manure, litter, and process wastewater storage capacities and site-specific conservation practices on the basis of the CAFO's NMP to the extent that such terms are necessary to support the application rates expressed in the NMP. The permitting authority will also identify site-specific permit terms with respect to mortality management, clean water diversions, preventing direct contact of animals with waters of the United States, chemical handling, protocols for manure and soil testing, and record keeping as appropriate.

c. When the permitting authority determines that the NMP and notice of intent are complete, the permitting authority will make available to the public the NOI submitted by the CAFO, including the CAFO's NMP, and the terms of the NMP to be incorporated into the permit, as determined by the permitting authority. The permitting authority will notice the proposal to grant coverage under the permit and the availability of the aforementioned documentation for public review and comment. The notice will also provide the opportunity for a public hearing on the NOI and draft NMP in accordance with 40 CFR parts 124.11 and 12.

d. The period for the public to comment and request a hearing on the proposed terms of the NMP to be incorporated into the permit shall be thirty (30) days.

e. The permitting authority will respond to comments received during the comment period, as provided in 40 CFR part 124.17, and, if necessary, require the CAFO owner or operator to revise the NMP to be granted permit coverage.

f. When the permitting authority authorizes the CAFO owner or operator to discharge under the general permit, the terms of the NMP shall be incorporated as terms and conditions of the permit for the CAFO. The permitting authority will notify the CAFO owner or operator that coverage has been authorized and of the applicable terms and conditions of the permit. Those site-specific permit terms will be provided to the permittee in a written permit authorization notice which will be included as Part III.B of this permit.

g. Each CAFO covered by this permit must comply with the site-specific permit terms established by the permitting authority on the basis of the CAFO's site-specific NMP.

3. **NMP Content.** The site-specific NMP at a minimum must include practices and procedures necessary to implement the applicable effluent limitations and standards

in Part II.A of this permit. In addition, the NMP and each CAFO covered by this permit must, as applicable, do the following:

a. Ensure adequate storage of manure, litter, and process wastewater, including procedures to ensure proper operation and maintenance of the storage facilities. All wastewater and manure containment structures shall at a minimum be designed, constructed, operated, and maintained in accordance with the standards of the Natural Resources Conservation Service, Field Office Technical Guide. Storage capacity must be sufficient to meet the minimum requirements of Part II.A.1 of this permit and also must be sufficient to allow the CAFO to comply with the land application schedule specified in the NMP. To the extent that the NMP depends on off-site transport or other means of handling to ensure adequate storage capacity this must be described in the NMP.

   If the CAFO needs to maintain storage capacity that exceeds the minimum capacity requirements of Part II.A.1 of this permit to comply with the land application provisions of the NMP, the storage capacity shall become a term of this permit and the permitting authority will develop site-specific terms based on the submitted NMP.

b. Ensure proper management of mortalities (i.e., dead animals) to ensure that they are not disposed of in a liquid manure, storm water, or process wastewater storage or treatment system that is not specifically designed to treat animal mortalities. Mortalities shall be handled in such a way as to prevent the discharge of pollutants to waters of the United States.

c. 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 Part II.A of this permit. Where clean water is not diverted, the CAFO owner or operator must document that it has been accounted for in meeting the requirement to ensure adequate storage capacity as a condition of this permit. Clean water includes, but is not limited to, rain falling on the roofs of facilities and runoff from adjacent land.

d. Prevent the direct contact of animals confined or stabled at the facility with waters of the United States.

e. 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 the management of potentially hazardous or toxic chemicals shall 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 United States. Include references to any applicable chemical handling protocols and indicate that other protocols included in the NMP will be reviewed.

f. Identify appropriate site-specific conservation practices to be implemented, including as appropriate buffers or equivalent practices, to control runoff of pollutants to waters of the United States and specifically, to minimize the runoff of nitrogen and phosphorus. Each CAFO covered by this permit must implement the site-specific conservation practices determined by the permitting authority to be a term of this permit, as specified in the CAFO's permit authorization notice. Those practices may include residue management, conservation crop rotation, grassed waterways, strip cropping, vegetated buffers, riparian buffers, setbacks, terracing, and diversions.

g. Identify protocols for appropriate testing of manure, litter, process wastewater, and soil. Manure, wastewater and soil sampling must be conducted in accordance with the requirements of Part II.A.4.b. of this permit and the following protocols:

   i. Manure, litter, and process wastewater must be sampled annually in accordance with protocols established in Iowa NRCS Conservation Practice Standard Code 590 (Nutrient Management) and Iowa State University Extension publication 1558, "How to Sample Manure for Nutrient Analysis."

   ii. Manure, litter, and process wastewater must be analyzed, at a minimum, for constituents identified in Iowa NRCS Conservation Practice Standard Code 590 (Nutrient Management) (total nitrogen, phosphorus, and potassium, and percent moisture and/or percent solids) by a laboratory listed with the Manure Testing Laboratory Certification Program (MTLCP).

   iii. Soil must be sampled and analyzed at least once every four years in accordance with protocols established in IAC Chapter 567—65.17(16).

h. Establish 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.

   The CAFO's site-specific NMP shall document the calculation of land application rates of manure, litter, or process wastewater. The technical standards identified in Appendix B of this permit shall be used for calculating these rates. The rate calculation shall address the form, source, amount, timing, and method of application on each field to achieve realistic production goals while minimizing nitrogen and phosphorus movement to surface water. The rate calculation shall be based on the results of a field specific assessment of the potential for nitrogen and phosphorus transport from the field to surface waters using the Iowa Phosphorus Index, as specified in IAC Chapter 567—65.17(17).

   Development of site-specific terms will be based on the permitting authority's review of the NMP submitted in accordance with the requirements of Parts I.E and III.A of this permit. To support the development of site-specific terms the submitted NMP must include at a minimum:

   - Names of fields available for land application.

- Field-specific rates of application properly developed as specified below, under Narrative Rate Approach, in the following chemical forms in this part and [nitrogen and phosphorus].
- The information specified for the narrative rate approach in the paragraph below.
- Any additional information necessary to assess the adequacy of the application rates included in the NMP.

Application rates should be expressed in NMPs consistent with the narrative rate approach described below:

Narrative Rate Approach. Expresses a narrative rate of application that results in the amount, in tons or gallons, of manure, litter, and process wastewater to be land applied. The narrative rate approach must include in the NMP submitted to the permitting authority the following information for each crop and field covered by the NMP, which will be used by the permitting authority to establish site-specific permit terms:

- The maximum amounts of nitrogen and phosphorus that will be derived from all sources of nutrients (pounds/acre for each crop and field).
- The outcome of the field-specific assessment of the potential for nitrogen and phosphorus transport from each field. The potential for nitrogen and phosphorus transport shall be determined using the Iowa Phosphorus Index as specified in IAC Chapter 567—65.17(17). The CAFO must specify any conservation practices used in calculating the risk rating.
- The crops to be planted in each field or any other uses of a field such as pasture or fallow fields, including alternative crops if applicable. Any alternative crops included in the NMP must be listed by field, in addition to the crops identified in the planned crop rotation for that field.
- The realistic annual yield goal for each crop or use identified for each field for each year, including any alternative crops identified.
- The nitrogen and phosphorus recommendations from Appendix A5, "Crop Nitrogen Usage Rate Factors for Various Crops," and Appendix A6, "Nutrient Removal for Iowa Crops," to Iowa DNR's Manure Management Plan Form for each crop or use identified for each field, including any alternative crops identified.
- The methodology (including formulas, sources of data, protocols for making determination, etc.) and actual data that will be used to account for: (1) the results of soil tests required by Parts II.A.4.b and III.A.3.g of this permit, (2) credits for all nitrogen in the field that will be plant-available, (3) the amount of nitrogen and phosphorus in the manure, litter, and process wastewater

to be applied, (4) consideration of multi-year phosphorus application (for any field where nutrients are applied at a rate based on the crop phosphorus requirement, the methodology must account for single-year nutrient applications that supply more than the crop's annual phosphorus requirement), (5) other additions of plant available nitrogen and phosphorus to the field (i.e., from sources other than manure, litter, or process wastewater or credits for residual nitrogen), (6) timing and method of land application, and (7) volatilization of nitrogen and mineralization of organic nitrogen.

- Any other factors necessary to determine the amounts of nitrogen and phosphorus to be applied in accordance with the Narrative Rate Approach

The NMPs must also include the following projections, which will not be used by the permitting authority in establishing site-specific permit terms:

- Planned crop rotations for each field for the period of permit coverage.
- Projected amount of manure, litter, or process wastewater to be applied.
- Projected credits for all nitrogen in the field that will be plant-available.
- Consideration of multi-year phosphorus application.
- Accounting for other additions of plant-available nitrogen and phosphorus to the field.
- The predicted form, source, and method of application of manure, litter, and process wastewater for each crop.

4. **Signature.** The NMP shall be signed by the owner/operator or other signatory authority in accordance with Part VII.E of this permit (Signatory Requirements).

5. **A current copy of the NMP** shall be kept on site at the permitted facility in accordance with Part VIII.C of this permit and provided to the permitting authority upon request.

6. **Recordkeeping Requirement.**

   a. All CAFOs using the narrative rate approach must calculate maximum amounts of manure, litter, and process wastewater to be land applied at least once each year using the methodology specified in the NMP pursuant to Part III.A.3.h of this permit before land applying manure, litter, and process wastewater. Such calculations must rely on the following data:

      i. A field-specific determination of soil levels of nitrogen and phosphorus. For nitrogen, the determination must include a concurrent determination of nitrogen that will be plant available. For phosphorus, the determination must include the results of the most recent soil test conducted as required in Parts II.A.4.b and III.A.3.g of this permit,

ii. The results of the most recent representative manure, litter, and process wastewater tests for nitrogen and phosphorus taken within 12 months of the date of land application, as required in Parts II.A.4.b and III.A.3.g of this permit, in order to determine the amount of nitrogen and phosphorus in the manure, litter, and process wastewater to be applied.

b. Identify and maintain all records necessary to document the development and implementation of the NMP and compliance with the permit.

7. Changes to the NMP

a. When a CAFO owner or operator covered by this permit makes changes to the CAFO's NMP previously submitted to the permitting authority, the CAFO owner or operator must provide the permitting authority with the most current version of the CAFO's NMP and identify changes from the previous version, except that annual calculations of application rates for manure, litter, and process wastewater as required in Part III.A.6.a of this permit are not required to be submitted to the permitting authority.

b. When changes to an NMP are submitted to the permitting authority, the permitting authority will review the revised NMP to ensure that it meets the requirements of Parts II.A and III.A.3. If the permitting authority determines that the changes to the NMP necessitate revision to the terms of the NMP incorporated into the permit issued to the CAFO, the permitting authority must determine whether such changes are substantial. Substantial changes to the terms of an NMP incorporated as terms and conditions of a permit include, but are not limited to the following:

i. Addition of new land application areas not previously included in the CAFO's NMP, except if the added land application area is covered by the terms of an NMP incorporated into an existing NPDES permit and the CAFO complies with such terms when applying manure, litter, and process wastewater to the added land.

ii. For NMPs using the Narrative Rate Approach, changes to the maximum amounts of nitrogen and phosphorus derived from all sources for each crop.

iii. Addition of any crop or other uses not included in the terms of the CAFO's NMP.

iv. Changes to site-specific components of the CAFO's NMP, where such changes are likely to increase the risk of nitrogen and phosphorus transport to waters of the United States.

c. If the permitting authority determines that the changes to the terms of the NMP are not substantial, the permitting authority will include the revised NMP in the permit record, revise the terms of the permit on the basis of the site-specific NMP, and notify the CAFO and the public of any changes to the terms of the permit on the basis of revisions to the NMP.

d. If the permitting authority determines that the changes to the terms of the NMP are substantial, the permitting authority will notify the public, make the proposed changes and the information submitted by the CAFO owner or operator available for public review and comment, and respond to all significant comments received during the comment period. The public notice will be provided using the guidelines described in Part III.A.2.c of this permit. The permitting authority may require the permittee to further revise the NMP, if necessary. Once the permitting authority incorporates the revised terms of the NMP into the permit, the permitting authority will notify the permittee of the revised terms and conditions of the permit.

B. Site-Specific Terms of the Nutrient Management Plan

This permit specifically authorizes **DEF Feedlot** to discharge as of **September 1, 2009** when the facility is operating in compliance with the terms and conditions of this permit. The site-specific terms of the NMP set forth in this section are applicable to **DEF Feedlot**:

1. The permittee must ensure adequate storage of manure, litter, and process wastewater, including procedures to ensure proper operation and maintenance of the storage facilities by complying with section 2.3 of the nutrient management plan.

2. The permittee must ensure proper management of mortalities by following NRCS IA Standard 316, Animal Mortality Facility, October 2007 for proper management of dead animals. Dead animals will be disposed of utilizing Valley Rendering Services. When rendering services are used, dead animals will be picked up within 24 hours. Dead animals will be stored in a separate bermed area adjacent to the production area to control runoff. Adequate space must be available in the bermed area to hold normal animal mortality at the feedlot operation. Process wastewater that runs off this area must be collected and transported to the waste storage ponds. There are no additional operation and maintenance activities required with plan to be used to address normal animal mortality at the operation. Under no circumstances, will the manure treatment systems be used to manage any mortality.

3. The permittee must ensure that clean water is diverted, as described in section 2.2 of the nutrient management plan.

4. The permittee must ensure that chemicals and other contaminants handled on-site as described in section 3.4 of the nutrient management plan.

5. The permittee must implement the following conservation practices:

6. The permittee will maintain the specific records required by section 7 of the NMP.

7. The permittee will implement the following protocols to land apply manure, litter or process wastewater to ensure appropriate agricultural utilization of the nutrients in the manure, litter or process wastewater:

The methodology is expressed within Manure Management Planner (MMP) version 0.29. The permitting authority has determined that the methodology used by MMP encompasses all the factors of the methodology and the plan was developed in accordance with the State's technical standard. Additional site specific permit terms for expressing protocols for land application under the narrative rate approach include:

Field	Area	Conservation Practice	NRCS Iowa Conservation Practice Reference
Bob's Farm North – 8N	56.4 Acres	50' Stream Vegetated Buffer	Riparian Forest Buffer (Ac.) (391) (August 2007)
		Contour Farming	Contour Farming (Ac.) (330) (May 2005)
		Residue Management	Residue Management, Seasonal (Ac.) (344) (March 2007)
Bob's Farm South – 8S	79.6 Acres	50' Stream Vegetated Buffer	Riparian Forest Buffer (Ac.) (391) (August 2007)
		Contour Farming	Contour Farming (Ac.) (330) (May 2005)
		Residue Management	Residue Management, Seasonal (Ac.) (344) (March 2007)

Fields available for land application					Outcome of the assessment of the potential for nutrient transport							Alternative Crops			
Field	Subfield	Crop Year	Total Acres	Timing limitations for land application	P Loss risk	Manure Application Rate	Planned crops or other use	Realistic Annual Yield Goal	Total N and P recommend-ations for each crop on each field	Max lbs N/acre derived from all sources	Max lbs P_2O_5/acre derived from all sources	Crops	Yield Goal	N Rec (lbs/acre)	P Rec (lbs/acre)
Bob's Farm South	8S	2010	79.6	Field slope 7%. Manure may only be surface applied to this field when the ground is frozen, snow covered or saturated if one of the following conditions exists: 1. Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure 2. On an emergency basis	Medium	Manure shall not be applied in excess of two times the crop phosphorus removed with crop harvest over the period of the crop rotation	Soy-bean	61 bu/acre	Soybean Recommend-ations: 232 lbs N /acre 49 lbs P_20_5 /acre Corn Recommend-ations: 210 lbs N /acre 73 lbs P_20_5 /acre	Soybeans = 0 lbs Corn = 210 lbs	Soybeans = 0 lbs Corn = 190 lbs	Wheat	78 bu/acre	88	41
		2011					Corn	195 bu/acre				Corn	41 ton/acre	205	51
		2012					Soy-bean	61 bu/acre							
		2013					Corn	195 bu/acre							
		2014					Soy-bean	61 bu/acre							

Part IV. Special Conditions

A. Facility Closure

The following conditions shall apply to the closure of lagoons and other earthen or synthetic lined basins and other manure, litter, or process wastewater storage and handling structures:

1. Closure of Lagoons and Other Surface Impoundments
    a. No lagoon or other earthen or synthetic lined basin shall be permanently abandoned.

    b. Lagoons and other earthen or synthetic lined basins shall be maintained at all times until closed in compliance with this section.

    c. All lagoons and other earthen or synthetic lined basins must be properly closed if the permittee ceases operation. In addition, any lagoon or other earthen or synthetic lined basin that is not in use for a period of 12 consecutive months must be properly closed unless the facility is financially viable, intends to resume use of the structure at a later date, and either (1) maintains the structure as though it were actively in use, to prevent compromise of structural integrity; or (2) removes manure and wastewater to a depth of one foot or less and refills the structure with clean water to preserve the integrity of the synthetic or earthen liner. In either case, the permittee shall notify the permitting authority within thirty (30) days of basin closure detailing the actions taken, and shall conduct routine inspections, maintenance, and record keeping as though the structure were in use. Prior to restoration of use of the structure, the permittee shall notify the permitting authority in writing and provide the opportunity for inspection.

    d. All closure of lagoons and other earthen or synthetic lined basins must be consistent with NRCS Conservation Practice Standard Code 360 (Closure of Waste Impoundments). Consistent with this standard the permittee shall remove all waste materials to the maximum extent practicable and dispose of them in accordance with the permittee's nutrient management plan, unless otherwise authorized by the permitting authority.

    e. Unless otherwise authorized by the permitting authority completion of closure for lagoons and other earthen or synthetic lined basins shall occur as promptly as practicable after the permittee ceases to operate or, if the permittee has not ceased operations, 12 months from the date on which the use of the structure ceased, unless the lagoons or basins are being maintained for possible future use in accordance with the requirements above.

2. Closure Procedures for Other Manure, Litter, or Process Wastewater Storage and Handling Structure

    No other manure, litter, or process wastewater storage and handling structure shall be abandoned. Closure of all such structures shall occur as promptly as practicable after the permittee has ceased to operate, or, if the permittee has not ceased to operate, within 12 months after the date on which the use of the structure ceased. To close a manure, litter, or process wastewater storage and handling structure, the permittee shall remove all manure, litter, or process wastewater and dispose of it in accordance with the permittee's NMP, or document its transfer from the permitted facility in accordance with Manure Transfer requirements specified in Table V-A in Part V.C of this permit unless otherwise authorized by the permitting authority.

B. Additional Special Conditions

1. Liner Requirement: The permittee shall document that no direct hydrologic connection exists between the contained wastewater and surface waters of the United States. Where the permittee cannot document that no direct hydrologic connection through ground water exists, the ponds, lagoons and basins of the containment facilities must have a liner which will prevent the potential contamination of surface waters.
   a. Documentation of no direct hydrologic connection. The permittee can document lack of hydrologic connection by either: (1) documenting that there will be no significant leakage from the retention structure; or (2) documenting that any leakage from the retention structure would not migrate to surface waters. For documentation of no significant leakage, in-situ materials must, at a minimum, meet the minimum criteria for hydraulic conductivity and thickness described in Part IV.B.1.b of this permit. Documentation that leakage will not migrate to a surface water must include maps showing ground water flow paths, or that the leakage enters a confined environment. This documentation must be certified in writing by a NRCS engineer or a Professional Engineer and must include information on the hydraulic conductivity and thickness of the natural materials underlying and forming the walls of the containment structure up to the wetted perimeter.
   b. Liner Construction. Liners constructed and maintained in accordance with NRCS design specifications shall be considered to prevent hydrologic connection which could result in the contamination of surface waters. Where no site-specific assessment has been done by a NRCS engineer or Professional Engineer, the liner shall be constructed to have hydraulic conductivities no greater than 1x10 (-7) cm/sec, with a thickness of 1.5 feet or greater or its equivalency in other materials.
   c. Liner Maintenance. The permittee must maintain the liner to inhibit infiltration of wastewaters. Liners shall be protected from animals by fences or other protective devices. No tree shall be allowed to grow such that the root zone would intrude or compromise the structure of the liner. Any mechanical or structural damage to the liner must be evaluated by a NRCS Engineer or Professional Engineer within thirty (30) days of the damage. Documentation of liner maintenance shall be kept with the Nutrient Management Plan (NMP). The permittee shall have a NRCS Engineer

or Professional Engineer review the documentation and do a site evaluation a minimum of once every five (5) years. If notified by the permitting authority that a direct hydrological connection to waters of the United States exists for the contamination of surface waters or drinking water, the permittee shall install a leak detection system or monitoring wells, or take other appropriate measures in accordance with that notice. Documentation of compliance with the notification must be kept with the NMP, as well as all sampling data. Data from the monitoring wells must be kept on site for three (3) years with the NMP. The first year's sampling shall be considered the baseline data and must be retained on site for the life of the facility.

2. Retention Structure Dewatering. A schedule must be developed for liquid waste removal from the retention structure(s). A date log indicating weekly inspection of wastewater level in the retention facility, including specific measurement of wastewater level must be kept. Retention facilities shall be equipped with either irrigation or evaporation or liquid removal systems capable of dewatering the retention facilities. Operators using pits, ponds, or lagoons for storage and treatment of storm water, manure and process generated wastewater, including flush water waste handling systems, shall maintain sufficient available storage capacity to contain the runoff and the direct precipitation from a 25-year, 24-hour rainfall event. The operator shall restore the storage capacity as soon as possible after any rainfall event or accumulation of wastes reduces such storage capacity, weather permitting.

3. Spills. Appropriate measures necessary to prevent spills and to cleanup spills of any toxic and other pollutants shall be taken. Handling procedures and storage for these materials must be specified in the NMP. Procedures for cleaning up spills shall be identified, and the necessary equipment to implement clean up shall be made available to facility personnel. All spills and clean-up activities must be documented. Documentation of spills and clean-up must be kept with the NMP.

4. Solids, sludges, manure or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner to prevent pollutants from being discharged to waters of the United States.

5. Manure, litter, and process wastewater handling, treatment, and management shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or contribute to the taking of endangered or threatened species of plant, fish or wildlife. The operator shall notify State and Federal wildlife agencies, the permitting authority, and the U.S. Environmental Protection Agency within 48 hours if any dead or injured threatened or endangered species or protected migratory birds are observed in or on receiving waters following a discharge or on the facility's land application areas at any time.

6. Manure, litter, and process wastewater handling, treatment, and management shall not create an environmental or public health hazard; shall not result in the contamination of drinking water; shall conform to State guidelines and/or regulations for the protection of surface water quality.

7. Employee Training. Employees responsible for permit compliance must be regularly trained or informed of any information pertinent to the proper operation and maintenance of the facility and waste disposal. Training shall include topics such as land application of wastes, proper operation and maintenance of the facility, good housekeeping and material management practices, necessary record-keeping requirements, and spill response and clean up. The permittee is responsible for determining the appropriate training frequency for different levels of personnel and the NMP shall identify periodic dates for such training.

Part V. Discharge Monitoring and Notification Requirements

A. Notification of Discharges Resulting from Manure, Litter, and Process Wastewater Storage, Handling, On-site Transport and Application

If, for any reason, there is a discharge of pollutants to waters of the United States, the permittee is required to make immediate oral notification within 24 hours to the permitting authority. The permittee is also required to notify the permitting authority in writing at the address in Part I.E.4 of this permit within 5 working days of the discharge from the facility. In addition, the permittee shall keep a copy of the notification submitted to the permitting authority together with the other records required by this permit. The discharge notification shall include the following information:

1. A description of the discharge and its cause, including a description of the flow path to the receiving waterbody and an estimate of the flow and volume discharged.
2. The period of noncompliance, including exact dates and times, the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate and prevent recurrence of the discharge.

B. Monitoring Requirements for All Discharges from Retention Structures

If any overflow or other discharge of pollutants occurs from a manure and/or wastewater storage or retention structure, whether or not authorized by this permit, the permittee shall take following actions:

1. All discharges shall be sampled and analyzed. Samples must, at a minimum, be analyzed for the following parameters: total nitrogen, ammonia nitrogen phosphorus, fecal coliform, 5-day biochemical oxygen demand (BOD5), total suspended solids, pH, and temperature. The discharge must be analyzed in accordance with approved U.S. Environmental Protection Agency methods for water analysis listed in 40 CFR part 136.

2. Record an estimate of the volume of the release and the date and time.

3. Samples shall consist of grab samples collected from the over-flow or discharges from the retention structure. A minimum of one sample shall be collected from the initial discharge (within 30 minutes). The sample shall be collected and analyzed in accordance with U.S. the U.S. Environmental Protection Agency approved methods for water analysis listed in 40 CFR part 136. Samples collected shall be representative of the monitored discharge. The discharge must be collected in accordance with approved U.S. Environmental Protection Agency methods for water analysis listed in 40 CFR part 136.

4. If conditions are not safe for sampling, the permittee must provide documentation of why samples could not be collected and analyzed. For example, the permittee may be unable to collect samples during dangerous weather conditions (such as local flooding, high winds, hurricane, tornadoes, electrical storms, and such). However, once dangerous conditions have passed, the permittee shall collect a sample from the retention structure (pond or lagoon) from which the discharge occurred.

C. General Inspection, Monitoring, and Record-Keeping Requirements

The permittee shall inspect, monitor, and record the results of such inspection and monitoring in accordance with Table V–A.

Table V-A. NPDES Large CAFO Permit Record-keeping Requirements

Parameter	Units	Frequency
Permit and Nutrient Management Plan ***(Note: Required by the NPDES CAFO Regulation—applicable to all CAFOs)***		
The CAFO must maintain on-site a copy of the current NPDES permit, including the permit authorization notice. **[SPECIFY MECHANISM TO IDENTIFY SITE-SPECIFIC TERMS]**	N/A	Maintain at all times
Permit and Nutrient Management Plan ***(Note: Required by the NPDES CAFO Regulation—applicable to all CAFOs)***		
The CAFO must maintain on-site a current-site specific NMP that reflects existing operational characteristics. The operation must also maintain on-site all necessary records to document that the NMP is being properly implemented with respect to manure and wastewater generation, storage and handling, and land application. In addition, records must be maintained that the development and implementation of the NMP is in accordance with the minimum practices defined in 40 CFR part 122.42(e).	N/A	Maintain at all times

Table V-A. NPDES Large CAFO Permit Record-keeping Requirements *(continued)*

Parameter	Units	Frequency
Soil and Manure/Wastewater Nutrient Analysis ***(Note: Required by the CAFO ELG—applicable to Large CAFOs)***		
Analysis of manure, litter, and process wastewater to determine nitrogen and phosphorus content.[a]	ppm Pounds/ton	At least annually after initial sampling
Analysis of soil in all fields where land application activities are conducted to determine phosphorus content.[a]	ppm	At least once every 5 years after initial sampling
Operation and Maintenance ***(Note: Required by the CAFO ELG—applicable to Large CAFOs)***		
Visual inspection of all water lines	N/A	Daily[b]
Documentation of depth of manure and process wastewater in all liquid impoundments	Feet	Weekly
Documentation of all corrective actions taken. Deficiencies not corrected within 30 days must be accompanied by an explanation of the factors preventing immediate correction.	N/A	As necessary
Documentation of animal mortality handling practices	N/A	As necessary
Design documentation for all manure, litter, and wastewater storage structures including the following information:		
• Volume for solids accumulation • Design treatment volume • Total design storage volume[c] • Days of storage capacity	Cubic yards/gallons Cubic yards/gallons Cubic yards/gallons Days	Once in the permit term unless revised
Documentation of all overflows from all manure and wastewater storage structures including: ***(Note: Required by the NPDES Regulation—applicable to all CAFOs)***		
• Date and time of overflow	Month/day/year	Per event
• Estimated volume of overflow	Total gallons	Per event
• Analysis of overflow (as required by the Permitting Authority)	TBD	Per event
Land Application ***(Note: Required by the CAFO ELG—applicable to Large CAFOs)***		
For each application event where manure, litter, or process wastewater is applied, documentation of the following by field:		
• Date of application	Month/day/year	Daily
• Method of application	N/A	Daily
• Weather conditions at the time of application and for 24 hours prior to and following application	N/A	Daily
• Total amount of nitrogen and phosphorus applied[d]	Pounds/acre	Daily

Table V-A. NPDES Large CAFO Permit Record-keeping Requirements *(continued)*

Parameter	Units	Frequency
Documentation of the crop and expected yield for each field	Bushel/acre	Seasonally
Documentation of the actual crop planted and actual yield for each field	Bushel/acre	Seasonally
Documentation of test methods and sampling protocols used to sample and analyze manure, litter, and wastewater and soil.	N/A	Once in the permit term unless revised
Documentation of the basis for the application rates used for each field where manure, litter, or wastewater is applied.	N/A	Once in the permit term unless revised
Documentation showing the total nitrogen and phosphorus to be applied to each field including nutrients from the application of manure, litter, and wastewater and other sources	Pounds/acre	Once in the permit term unless revised
Documentation of manure application equipment inspection	N/A	Seasonally
Manure Transfer ***(Note: Required by the NPDES CAFO Regulation—applicable to Large CAFOs)***		
For all manure transfers the CAFO must maintain the following records:		
• Date of transfer	N/A	As necessary
• Name and address of recipient	N/A	As necessary
• Approximate amount of manure, litter, or wastewater transferred	Tons/gallons	As necessary

Notes:

a. For the specific analyses to be used, see the state nutrient management technical standard.

b. Visual inspections should take place daily during the course of normal operations. The completion of such inspection should be documented in a manner appropriate to the operation. Some operations might wish to maintain a daily log. Other operations might choose to make a weekly entry, when they update other weekly records that required daily inspections have been completed.

c. Total design volume includes normal precipitation less evaporation on the surface of the structure for the storage period, normal runoff from the production area for the storage period, 25-year, 24-hour precipitation on the surface of the structure, 25-year, 24-hour runoff from the production area, and residual solids.

d. Including quantity/volume of manure, litter, or process wastewater applied and the basis for the rate of phosphorus application.

Part VI. Annual Reporting Requirements

A. The permittee must submit an annual report to the permitting authority by the 31st of July of each year.

B. The annual report must include the following information:

1. The number and type of animals, whether in open confinement or housed under roof.
2. Estimated amount of total manure, litter, and process wastewater generated by the CAFO in the previous 12 months (tons/gallons).
3. Estimated amount of total manure, litter, and process wastewater transferred to other person by the CAFO in the previous 12 months (tons/gallons).
4. Total number of acres for land application covered by the NMP.
5. Total number of acres under control of the CAFO that were used for land application of manure, litter, and process wastewater in the previous 12 months.
6. Summary of all manure, litter, and process wastewater discharges from the production area that have occurred in the previous 12 months, including date, time, and approximate volume.
7. A statement indicating whether the current version of the CAFO's NMP was developed or approved by a certified nutrient management planner.
8. Actual crops planted and actual yields for each field for the preceding 12 months.
9. Results of all samples of manure, litter or process wastewater for nitrogen and phosphorus content for manure, litter and process wastewater that was land applied.
10. Results of calculations conducted in accordance with Part III.A.6.a of this permit.
11. Amount of manure, litter, and process wastewater applied to each field during the preceding 12 months.
12. For rates of application:
    - i. The results of any soil testing for nitrogen and phosphorus conducted during the preceding 12 months.
    - ii. The data used in calculations conducted in accordance with Part III.A.3.h of tis permit.
    - iii. The amount of any supplemental fertilizer applied during the preceding 12 months.

Part VII. Standard Permit Conditions

A. General Conditions

1. In accordance with the provisions of 40 CFR part 122.41 *et. seq.*, this permit incorporates by reference all conditions and requirements applicable to NPDES Permits set forth in the Clean Water Act, as amended, (the Act) and all applicable regulations.

2. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation, and reissuance; for denial of a permit renewal application; and/or for requiring a permittee to apply for and obtain an individual NPDES permit.

3. The permittee shall comply with effluent standards and prohibitions established under section 307(a) of the Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

4. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

5. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state/tribal or local laws or regulations.

6. The permittee shall furnish to the permitting authority, within a reasonable time, any information that the Director might request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the permitting authority, on request, copies of records required to be kept by this permit.

7. Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of the permit, the Act, or applicable regulations, which avoids or effectively defeats the regulatory purpose of the permit may subject the permittee to criminal enforcement pursuant to 18 U.S.C. 1001.

8. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established

pursuant to any applicable state/tribal law or regulation under authority preserved by section 510 of the Act.

9. The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Bypass
    a. *Definitions*
        i. Bypass means the intentional diversion of waste streams from any portion of a treatment facility.
        ii. Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
    b. *Bypass not exceeding limitations.* The permittee may allow any bypass to occur that does not cause effluent limitations to be exceeded but only if it also is for essential maintenance to assure efficient operation. Those bypasses are not subject to Parts VII.A.10.c. and 10.d. of this permit.
    c. *Notice*
        i. *Anticipated bypass.* If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 10 days before the date of the bypass.
        ii. *Unanticipated bypass.* The permittee shall submit notice of unanticipated bypass as required in Part VII.D.5. of this permit (24-hour notice).
    d. *Prohibitions of bypass.*
        i. Bypass is prohibited, and the permitting authority may take enforcement action against a permittee for bypass, unless the following are true:
            - Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage.
            - There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. That condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance.

- The permittee submitted notices as required under Part VII.A.10.c. of this permit.

ii. The permitting authority may approve an anticipated bypass, after considering its adverse effects, if the permitting authority determines that it will meet the three conditions listed above in Part VII.A.10.d.(i) of this permit.

11. Upset

a. *Definition. Upset* means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance caused by operational error, improperly designed treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. *Effect of an upset.* An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Part VII.A.11.c. of this permit are met.

c. *Conditions necessary for a demonstration of upset.* A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence of the following:

i. An upset occurred and that the permittee can identify the cause(s) of the upset.

ii. The permitted facility was at the time being properly operated.

iii. The permittee submitted notice of the upset as required in Part VII.D.5 of this permit (24-hour notice).

iv. The permittee complied with any remedial measures required under Part VII.A.14 of this permit (duty to mitigate).

d. *Burden of proof.* In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

12. *Duty to reapply.* If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit.

13. *Need to halt or reduce activity not a defense.* It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

14. *Duty to mitigate.* The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit, which has a reasonable likelihood of adversely affecting human health or the environment.

15. *Inspection and entry.* The permittee shall allow the permitting authority, or an authorized representative (including an authorized contractor acting as a representative of the permitting authority), upon presentation of credentials and other documents as may be required by law, to do the following:
    a. Enter the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit
    b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit
    c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit
    d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

B. Proper Operation and Maintenance

The permittee shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

C. Monitoring and Records

1. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.
2. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 5 years from the date of the sample, measurement, report, or application. That period may be extended by request of the permitting authority at any time.
3. Records of monitoring information shall include the following:
    a. The date, exact place, and time of sampling or measurements.
    b. The individual(s) who performed the sampling or measurements.
    c. The date(s) analyses were performed.
    d. The individual(s) who performed the analyses.

e. The analytical techniques or methods used.

f. The results of such analyses.

4. The permittee shall follow the following monitoring procedures:

   a. Any required monitoring must be conducted according to test procedures approved under 40 CFR part 136, unless other test procedures have been specified in this permit or approved by the permitting authority.

   b. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instruments at intervals frequent enough to ensure accuracy of measurements and shall maintain appropriate records of such activities.

   c. An adequate analytical quality control program, including the analyses of sufficient standards, spikes, and duplicate samples to ensure the accuracy of all required analytical results shall be maintained by the permittee or designated commercial laboratory.

5. Monitoring reports. Monitoring results shall be reported at the intervals specified elsewhere in this permit.

   a. Monitoring results must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the permitting authority for reporting results of monitoring of sludge use or disposal practices.

   b. If the permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR part 136 or, in the case of sludge use or disposal, approved under 40 CFR part 136 unless otherwise specified in 40 CFR part 503, or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the permitting authority.

   c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the permitting authority in the permit.

D. Reporting Requirements

1. The permittee shall give notice to the permitting authority as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when any of the following are true:

   a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR part 122.29(b).

   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. The notification applies to pollutants that are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR part 122.42(a)(1).

c. The alteration or addition results in a significant change in the permittee's manure use or disposal practices, and such alteration, addition, or change could justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an NMP.

2. The permittee shall give advance notice to the permitting authority of any planned physical alterations or additions or changes in activity that could result in noncompliance with requirements in this permit.

3. This permit is not transferable to any person except after notice to permitting authority. The permitting authority may require modification or revocation and reissuance of the permit to change the name or the permittee and incorporate such other requirements as might be necessary under the Act.

4. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date.

5. The permittee shall report any noncompliance that could endanger human health or the environment. Any information must be provided orally to the permitting authority within 24 hours from the time that the permittee becomes aware of the circumstances. A written submission shall also be provided to the permitting authority within 5 days of the time the permittee becomes aware of the circumstances. The report shall contain the following information:

   a. A description of the noncompliance and its cause

   b. The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue

   c. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance

6. The following shall be included as information, which must be reported within 24 hours:

   a. Any unanticipated bypass that exceeds any effluent limitation in the permit

   b. Any upset that exceeds any effluent limitation in the permit

   c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the permitting authority in the permit to be reported within 24 hours

   The permitting authority may waive the written report on a case-by-case basis for reports under the above if the oral report has been received within 24 hours.

7. The permittee shall report all instances of noncompliance not reported under above and of this section, at the time monitoring reports are submitted. The reports shall contain the information listed in Part VII.D.6 of this permit.

8. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the permitting authority, the permittee shall promptly submit such facts or information to the permitting authority.

E. Signatory requirements

All applications, reports, or information submitted to the permitting authority shall be signed and certified consistent with 40 CFR part 122.22:

1. All notices of intent shall be signed as follows:
   a. For a corporation: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means either of the following:
      i. A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation.
      ii. The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions that govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
      iii. For a partnership or sole proprietorship: By a general partner for a partnership or the proprietor, respectively.
2. All reports required by the permit and other information requested by the U.S. Environmental Protection Agency shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if the following are true:
   a. The authorization is made in writing by a person described above.
   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or any individual or position having overall responsibility for environmental matters for the company. A duly authorized

representative may thus be either a named individual or an individual occupying a named position.

c. The written authorization is submitted to the U.S. Environmental Protection Agency.

F. Availability of Reports

Any information submitted pursuant to this permit may be claimed as confidential by the submitter. If no claim is made at the time of submission, information may be made available to the public without further notice.

G. Penalties for Violations of Permit Conditions

1. Criminal Penalties:
   a. Negligent violations: The Act provides that any person who negligently violates section 301, 302, 306, 307, 308, 318, or 405 of the Act or any condition or limitation implementing those provisions in a permit issued under section 402 is subject to a fine of not less than $2,750 nor more than $27,500 per day of violation, or by imprisonment for not more than one year, or both.
   b. Knowing violations: The Act provides that any person who knowingly violates sections 301, 302, 306, 307, 308, 318, or 405 of the Act or any permit conditions implementing those provisions is subject to a fine of not less than $5,500 nor more than $55,000 per day of violation, or by imprisonment for not more than 3 years, or both.
   c. Knowing endangerment: The Act provides that any person who knowingly violates sections 301, 302, 303, 306, 307, 308, 318, or 405 of the Act or permit conditions implementing those provisions and who knows at that time that he or she is placing another person in imminent danger of death or serious bodily injury is subject to a fine of not more than $275,000, or by imprisonment for not more than 15 years, or both.
   d. False statements: The Act provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $11,000, or by imprisonment for not more than 2 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $22,000 per day of violation, or by imprisonment of not more than 4 years, or by both. [See section 309(c)4 of the Clean Water Act.]

2. Civil penalties: The Act provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $27,500 per day for each violation. [See section 309(d).]

3. Administrative penalties: The Act provides that the Administrator may assess a Class I or Class II administrative penalty if the Administrator finds that a person has violated sections 301, 302, 306, 307, 308, 318, or 405 of the Act or a permit condition or limitation implementing these provisions, as follows [See section 309(g).]:

   a. Class I penalty: Not to exceed $11,000 per violation nor shall the maximum amount exceed $27,500.

   b. Class II penalty: Not to exceed $11,000 per day for each day during which the violation continues nor shall the maximum amount exceed $137,500.

Part VIII. Definitions

Animal feeding operation means a lot or facility (other than an aquatic animal production facility) where the following conditions are met: (i) animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and (ii) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

Application means the EPA standard national forms for seeking coverage under for an NPDES permit, including any additions, revisions or modifications to the forms; or forms approved by EPA for use in *approved states,* including any approved modifications or revisions [e.g. for NPDES general permits, a written NOI pursuant to 40 CFR part 122.28; for NPDES individual permits, Form 1 and 2B pursuant to 40 CFR part 122.1(d)].

Concentrated animal feeding operation (CAFO) means an AFO that is defined as a Large CAFO or Medium CAFO by 40 CFR parts 122.23 (4) and (6), or that is designated as a CAFO.

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

Grab sample means a sample that is taken from a wastestream on a one-time basis without consideration of the flow rate of the wastestream and without consideration of time.

Land application means the application of manure, litter, or process wastewater onto or incorporated into the soil.

Land application area means land under the control of a CAFO owner or operator, whether it is owned, rented, or leased, to which manure, litter, or process wastewater from the production area is or could be applied.

Large CAFO means an AFO that stables or confines as many as or more than the numbers of animals specified in any of the following categories: (i) 700 mature dairy cattle, whether milked or dry; (ii)1,000 veal calves; (iii)1,000 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs; (iv) 2,500 swine each weighing 55 pounds or more; (v)10,000 swine each weighing less than 55 pounds; (vi) 500 horses; (vii) 10,000 sheep or lambs; (viii) 55,000 turkeys; (ix) 30,000 laying hens or broilers, if the AFO uses a liquid manure handling system; (x)125,000 chickens (other than laying hens), if the AFO uses other than a liquid manure handling system; (xi) 82,000 laying hens, if the AFO uses other than a liquid manure handling system; (xii) 30,000 ducks (if the AFO uses other than a liquid manure handling system); or (xiii) 5,000 ducks (if the AFO uses a liquid manure handling system).

Liquid manure handling system means a system that collects and transports or moves waste material with the use of water, such as in washing pens and flushing confinement facilities. That includes the use of water impoundments for manure or wastewater treatment.

Manure is defined to include manure, litter, bedding, compost and raw materials or other materials commingled with manure or set aside for land application or other use.

Medium CAFO means any AFO that stables or confines as many or more than the numbers of animals specified in any of the following categories: (i) 200 to 699 mature dairy cattle, whether milked or dry cows; (ii) 300 to 999 veal calves; (iii) 300 to 999 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs; (iv) 750 to 2,499 swine each weighing 55 pounds or more; (v) 3,000 to 9,999 swine each weighing less than 55 pounds; (vi) 150 to 499 horses, (vii) 3,000 to 9,999 sheep or lambs, (viii) 16,500 to 54,999 turkeys, (ix) 9,000 to 29,999 laying hens or broilers, if the AFO uses a liquid manure handling system; (x) 37,500 to 124,999 chickens (other than laying hens), if the AFO uses other than a liquid manure handling system; (xi) 25,000 to 81,999 laying hens, if the AFO uses other than a liquid manure handling system; (xii) 10,000 to 29,999 ducks (if the AFO uses other than a liquid manure handling system); or (xiii) 1,500 to 4,999 ducks (if the AFO uses a liquid manure handling system) *and* either one of the following conditions are met (a) pollutants are discharged into waters of the United States through a man-made ditch, flushing system, or other similar man-made device; or (b) pollutants are discharged directly into waters of the United States that originate outside and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.

Notice of Intent (NOI) is a form submitted by the owner/operator applying for coverage under a general permit. It requires the applicant to submit the information necessary for adequate program implementation, including, at a minimum, the legal name and address of the owner or operator, the facility name and address, type of facility or discharges, and the receiving stream(s). 40 CFR § 128.28(b)(2)(ii)

Process wastewater means water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other AFO facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process wastewater also includes any water that comes into contact with or is a constituent of raw materials, products, or by-products including manure, litter, feed, milk, eggs, or bedding.

Production area means that part of an AFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal containment area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milk rooms, milking centers, cowyards, barnyards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms and diversions that separate uncontaminated stormwater. Also included in the definition of production area is any egg washing or egg processing facility, and any area used in the storage, handling, treatment, or disposal of mortalities.

Small CAFO means an AFO that is designated as a CAFO and is not a Medium CAFO.

Setback means a specified distance from waters of the United States or potential conduits to waters of the United States where manure, litter, and process wastewater may not be land applied. Examples of conduits to surface waters include open tile line intake structures, sinkholes, and agricultural well heads.

The Act means Federal Water Pollution Control Act as amended, also known as the Clean Water Act as amended, found at 33 U.S.C. 1251 *et seq*.

Vegetated buffer means a narrow, permanent strip of dense perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the field for the purposes of slowing water runoff, enhancing water infiltration, and minimizing the risk of any potential nutrients or pollutants from leaving the field and reaching waters of the United States.

Waters of the United States means (1) all waters that are used, were used in the past, or might be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide; (2) all interstate waters, including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, and streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters: (a) that are or could be used by interstate or foreign travelers for recreational or other purposes; from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or that are or could be used for industrial purposes by industries in interstate commerce; (4) all impoundments of waters otherwise defined as waters of the United States; (5) tributaries of waters identified in (1) through (4) of this definition; (6) the territorial sea; and (7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in items (1) through (6) of this definition.

Appendix A.

(Insert Form 2B/Notice of Intent or Appropriate State Form)

Appendix B.

Sample Technical Standard for Nutrient Management

While this sample technical standard is adapted from Iowa state publications, it does not constitute Iowa's technical standard for nutrient management. This documentation has not been identified by the Iowa State Director as required by 40 C.F.R. 123.36 nor has EPA reviewed these documents for consistency with the requirements of 40 C.F.R. 412.4(c)(2). EPA is circulating this technical standard to demonstrate how the terms of the nutrient management plan depend on technical information that would be found in a technical standard. Some of the original documents have been modified to better illustrate the relationship between techincal standards and terms. Circulation of the sample technical standards herein does not constitute an endorsement of this technical documentation as an adequate technical standard for Iowa. This sample is intended for educational purposes only and does not create or remove any legal rights or requirements upon any member of the public, States or any other Federal agency.

Introduction and Instructions for the

Manure Management Plan Form

Iowa law requires certain confinement feeding operations to develop and obtain Department of Natural Resources (DNR) approval of a manure management plan (MMP), to apply manure in accordance with the plan, to submit annual updates of the manure management plan, to pay an annual compliance fee and to provide copies of the manure management plan to the counties where the operation is located and where manure is applied. Manure management plans submitted to the DNR must use the attached forms. Submit one copy of the MMP to the DNR, two if you are applying for a construction permit. Additionally, submit one copy to the county where the facility is located, one to each county where manure will be applied, and keep a copy within 30 miles of the operation. It is recommended that one copy be kept for your manure applicator.

These forms are not intended for use if manure is being sold. Plans involving the sale of manure should be developed in accordance with the requirements of DNR rules 567 Iowa Administrative Code 65.17(2). These rules are found in Appendix A.9 of these forms. Forms can be found on the DNR website at http://www.state.ia.us/epd/wastewtr/feedlot/manure.htm.

Who Needs to Submit a Plan and Annual Updates?

- Owners of confinement animal feeding operations constructed or expanded after May 31, 1985 (unless the operation is a small animal feeding operation [1]);
- If you are constructing a manure storage structure or a confinement building – you must submit an original manure management plan (unless the operation is a small animal feeding operation [1]);
- Owners of out-of-state confinement operations that apply manure in Iowa (unless the operation is a small animal feeding operation [1]).

Instructions for Use of These Forms

- Make additional copies of pages 2 and 3 as needed.
- A copy of the manure management plan and attachments listed on the following page must be provided to the county where the facility is located and each county where manure is applied. Submit a signed copy of the **Verification of County Receipt for MMP** to the DNR for each county involved. Use the form for non-permitted sites Verification of County Receipt (Form 542-8046) Verification of County Receipt (Form 542-8046) **OR** if a construction permit is required, use the Construction Application Package and use fee forms for construction permit sites (Form 542-1428).
- In addition to the required forms, information indicated on the following page must be submitted to DNR and maintained as part of the current manure management plan.

1. **Small animal feeding operation:** an animal feeding operation which has an animal unit capacity of 500 au or less.

SECTION A:

Attachments to be submitted to the county and maintained with the current MMP within thirty miles of the site (in addition to required forms): *These items are not required to be submitted to DNR.*

- A plat map which shows the location of the confinement feeding operation and of all fields being used for manure application;
- Aerial photos (available from the county Farm Services Agency office) or similar photos of all fields being used for manure application. For each field, mark the field boundaries, areas not available or unsuitable for manure application, and areas where specific restrictions on manure application apply;
- Information documenting the optimum yields calculated for the manure application fields (if required – see footnote "h");
- Operations using irrigation to apply manure must provide information indicating how they will comply with applicable restrictions and requirements, and any additional methods or practices that will be used to reduce potential odors.

SECTION B:

Attachments to be submitted to DNR (in addition to required forms):

With Annual Updates

- The **Annual Compliance Fee form** – Annual Compliance Fee (Form 542-8064) rev. 3/06 and a check for the amount due ($0.15 per animal unit);
- MMP Short Form 2 (Form 542-8162)

With an Original MMP (new construction or expansion) and with an Original P Index-Based MMP

- A plat map which shows the location of the confinement operation.
- Written manure application agreements for all fields identified in the plan that are not owned or rented for crop production purposes by the owner of the confinement feeding operation;
- Manure sampling results, if sample results were used to determine the manure's nutrient content for this plan;
- When the P index is required, the MMP must include the NRCS P index "detailed report" from the Iowa P index calculator (available at http://www.ia.nrcs.usda.gov/) with a P index for each field and a document (e.g. RUSLE2 profile erosion calculation record) indicating the inputs and results of RUSLE2 for each field in the plan. The "detailed report" should be submitted with this form once every 4 years as the update.
- **For permitted sites only:** The aerial photos of the manure application fields must be submitted for permitted sites.
- The Filing Fee form [for facilities filing an MMP **for construction, expansion or modification or** filing an **original (first-time)** MMP] and a check for the $250 filing fee and the indemnity fee if required: *(No indemnity fee applies if the operation was constructed or expanded prior to May 31, 1995 and no construction permit was required.)*
  - For **non-permitted sites**: Indemnity fee and MMP filing fee and form (Form 542-4021) rev 3/06.
  - For **permitted sites** - please follow instructions in the Construction Permit Application form (Form 542-4021) rev. 6/03).
  - Verification form of county receipt for non-permitted sites, OR if applying for a construction permit, follow the instructions on the application (Form 542-4021).

- DNR may request submittal of the attachments listed in Section A that are maintained with the current MMP.

Plan Updates & Recordkeeping

Prior to making changes in an operation's manure management practices, the operation must update the plan to show the proposed changes. Updates that occur after the submittal of the plan should be maintained on site and indicated with the next annual update to DNR and the counties.
Records of manure application must be maintained within thirty miles of the confinement site, and must be available for DNR inspection. For a list of record keeping requirements, see 65.17(13) of appendix A9. Records must be maintained for five years after the year of manure application or for the length of the crop rotation, whichever is greater.

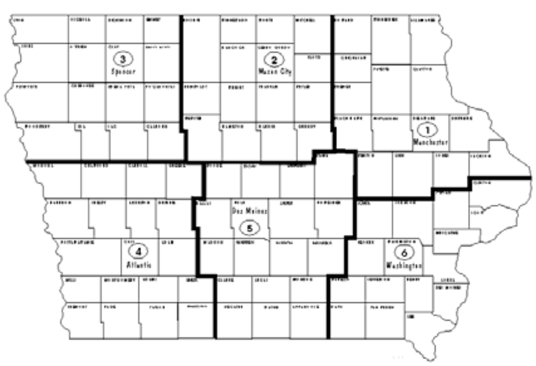
Assistance

Assistance in developing a manure management plan may be available from a number of sources, including private consultants, Iowa State University Extension, and USDA's Natural Resources Conservation Service. Some of these sources will prepare a complete plan for an operation, while others will only provide general assistance. Contact your county extension or NRCS office to determine the assistance they will provide, as well as to obtain a list of consultants who will prepare plans. If you have specific questions about the Manure Management Plan forms, contact your regional DNR field office. See attached map for contact information and to determine the appropriate office.

Mail Plan and Attachments

Please mail the plan, attachments and annual updates to the appropriate Iowa Department of Natural Resources field office (See map below). If submitting a construction permit application, follow instructions on the application form (Form 542-1428). Questions on permits? Please call 515-281-8941.

IOWA DEPARTMENT OF NATURAL RESOURCES
Environmental Services Division Field Office Locations

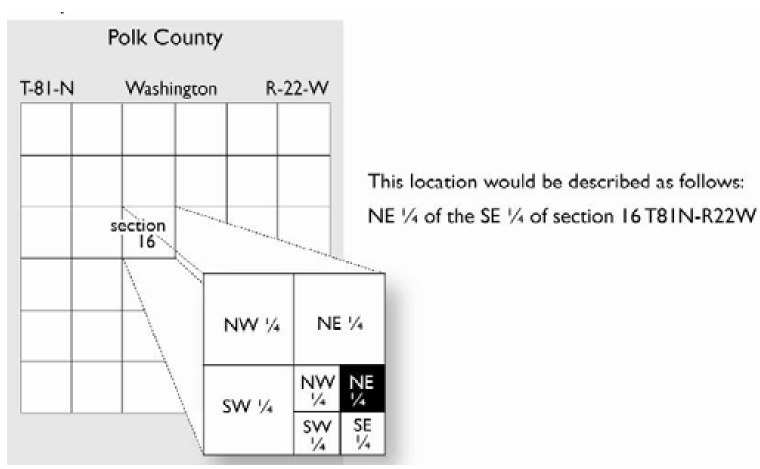


DNR Environmental Services Division

Field Office #1 909 West Main, Ste 4 Manchester, IA 52057 563-927-2640	**Field Office #2** 2300 15th St SW Mason City, IA 50401 641-424-4073
Field Office #3 1900 N. Grand Ave. Spencer, IA 51301 712-262-4177	**Field Office #4** 1401 Sunnyside Lane Atlantic, IA 50022 712-243-1934
Field Office #5 401 SW 7th, Ste I Des Moines, IA 50309 515-725-0268	**Field Office #6** 1023 W. Madison Washington, IA 52353 319-653-2135

Example of Legal Description for Facility

Please refer to the example on the right when describing the location of your operation on Page 1. This property is located in Washington Township, Polk County.



Manure Management Plan Form

Animal Feeding Operation Information

Instructions: Complete this form for your animal feeding operation. Footnotes are provided on page 4.

The information within this form, and the attachments, describes my animal feeding operation, my manure storage and handling system, and my planned manure management system. I (we) will manage the manure, and the nutrients it contains, as described within this manure management plan (MMP) and any revisions of the plan, individual field information, and field summary sheet, and in accordance with current rules and regulations. Deviations permitted by Iowa law will be documented and maintained in my records.

Signed: ______________________________ **Date:** __________
(Signature) (Print name)

- -

Name of operation: ______________________________ **Facility ID No.** __ __ __ __ __

Location of the operation*: ______________________________
(911 Address)

____
(Town) (State) (Zip Code)

_____ ¼ of the _____ ¼ of Sec _____ T_____ R_____ ______________ ______________
(¼ ¼) (¼) (Section) (Tier & Range) (Township Name) (County)

Owner and Contacts of the animal feeding operation:

Owner ______________________________ Phone ______________

Address ______________________________

Email address (optional) ______________________________ Cell phone (optional) ______________

Contact person (if different than owner) ______________________________ Phone ______________

Address ______________________________

Email address (optional) ______________________________ Cell phone (optional) ______________

Contract Company (if applicable) ______________________________ Phone ______________

Address ______________________________

This manure management plan is for: (check one)

___ existing operation, not expanding ___ existing operation, expanding ___ existing operation, new owner ___ new operation

Construction and Expansion Dates: ______________ date of initial construction

______________ ______________ ______________ and date(s) of all expansion(s)

Table 1. Information about livestock production and manure management system

1	2	3	4	5	6	7	8
Animal Type/ Production phase [a]	Max. Number of Animals Confined (head)	Manure Storage Structure [b]	N [c] lb/1000 gal or lb/ton	P_2O_5 [c] lb/1000 gal or lb/ton	gal/space/day or ton/space/year [d]	Days/yr Facility Occupied	Annual Manure Produced [e] (gal or tons)
						Total Gallons	
						Total Tons	

Estimate of Annual Animal Production [f]**:** __________ animals/year

Source of Nutrient Content Data (columns 4, 5): standard tables, analysis of manure samples, other: ______________

____

* An example of a legal description is available on page 3 of the Introduction and Instructions.

Manure Management Plan Form

Determining Maximum Allowable Manure Application Rates

Instructions: Complete a worksheet for each unique combination of the following factors (crop rotation, optimum crop yield, manure nutrient concentration, remaining crop N need, method of application) that occurs at this operation. Footnotes are given on pages 4, 5 and 6.

Management Identification (Mgt ID)[g]: ______________________

(identify this application scenario by letter)

Method used to determine optimum yield [h]: ______________________ **Timing of Application:** ______________

Method of Application [i]: ______________________________________ **Application Loss Factor [i]:** __________

If spray irrigation is used, identify method [j]: ____

Table 2. Manure Nutrient Concentration

Manure Nutrient Content (lbs/1000gal or lbs/ton)					
Manure Storage Structure(s) [k]					
Total N		**P_2O_5**			
% TN available 1st year[l]		**% 2nd year**		**% 3rd year**	
Available N 1st year[m]		**2nd year [n]**		**3rd year [o]**	

Table 3. Crop Usage Rates [p]

(lbs/bu or lbs/ton)	**N**	**P_2O_5**
Corn		0.375
Soybean	3.8	0.8
Alfalfa	50	12.5

* Use blank space above to add crop not listed.

Table 4. Calculations for rate based on nitrogen (always required).

1	**Applying Manure For** (crop to be grown)[q]					
2	**Optimum Crop Yield [h]**	bu or ton/acre				
3	**P_2O_5 removed with crop by harvest [r]**	lb/acre				
4	**Crop N utilization [s]**	lb/acre				
5a	**Legume N credit [t]**	lb/acre				
5b	**Commercial N planned [u]**	lb/acre				
5c	**Manure N carryover credit [v]**	lb/acre				
6	**Remaining crop N need [w]**	lb/acre				
7	**Manure rate to supply remaining N [x]**	gal/acre or ton/acre				
8	**P_2O_5 applied with N-based rate [y]**	lb/acre				

Table 5. Calculations for rate based on phosphorus (fill out only if P-based rates are planned)

9	**Commercial P_2O_5 planned [z]**	lb/acre				
10	**Manure rate to supply P removal [aa]**	gal/acre or ton/acre				
11	**Manure rate for P based plan [bb]**	gal/acre or ton/acre				
12	**Manure N applied with P-based plan [cc]**	lb/acre				

Table 6. Application rates that will be carried over to page 3.

13	**Planned Manure Application Rate [dd]**	gal/acre or ton/acre				

Manure Management Plan Form

Year by Year Manure Management Plan Summary

Page 3

Instructions: Complete this form for each of the next four growing seasons, to demonstrate sufficient land base to apply manure over multiple crop years. If this page is identical for multiple years (e.g. every other year), submit only once for the identical years, and indicate which years the form represents. Footnotes are given on page 6.

Crop Year(s): ________________________

1	2	3	4	5	6	7	8	9	10	11
								Planned Application		Correct Soils Test for P[ll] (Yes or No)
Field Designation[ee]	Field Location ___ ¼ of the ___1/4 Sec ___ T____ R____ Township Name ____________ County Name ___________	Mgt ID[ff]	Planned Crop	Acres receiving manure[gg]	Own, rent, or agreement (include length of agreement)[hh]	P Index Value[ii]	HEL (Y/N)[jj]	gal or tons/acre	gal or ton/field[k]	

Total acres available for manure application ______

Total gallons that could be applied ______

Total tons that could be applied ______

Manure Management Plan Footnotes

[a] Complete Appendix B1 Worksheet if a manure storage structure receives manure from several animal production phases and the manure and nitrogen production values given in Appendices A1 and A2 do not adequately represent the operation (such as with a farrow-to-finish swine operation where half the pigs produced are sold as feeders and the remainder held for finishing).

[b] For example, indoor or outdoor formed storage, earthen basin, or anaerobic lagoon; to simplify calculations similar manure storage structures that contain manure with essentially the same nutrient concentrations may be grouped together (for example, the manure storage structures for a 3-building finishing unit with below-building pits could be identified as "3 below-building finishing pits").

[c] From standard tables (Appendix A4), your own samples, or other sources – identify source in space provided below Table 1 on page 1. If your own samples are used, DNR requires submittal of laboratory reports supporting manure concentrations. If your own samples are used, the results may need to be converted from parts per million (ppm) to pounds/1000 gallons. The formula for making this conversion is: N or P_2O_5 concentration (lb/1000 gal) = N or P_2O_5 concentration in parts per million (ppm) X 0.00834. For solid manure the conversion is: N or P_2O_5 concentration (lb/ton) = N or P_2O_5 concentration in parts per million (ppm) X 0.002. If measured volume or weight of manure is used in the plan, actual N and P_2O_5 concentrations must also be used.

[d] From Appendix A1; adjust values if operation has data justifying use of different volumes or weights (e.g., operation uses large volume of clean up water, and thus its manure production volume per animal space is higher than that given in table). If actual volumes or weights are used, DNR may require submittal of supporting data. If actual manure N and P_2O_5 concentrations are used in the plan, measured volume or weight must also be used.

[e] Annual manure produced (**liquid** manure) = maximum number of animals confined (column 2) multiplied by (x) gal/space/day (column 6) x days/ year building occupied (column 7). Annual manure produced (**solid** manure) = maximum number of animals confined (column 2) x tons/space/year (column 6).

[f] Estimated Annual Animal Production = Maximum number of animals confined (column 2 of Table 1) x production cycles per year. If operation has no production cycles (e.g. sows) state only total maximum number confined.

[g] Use the management ID to identify each unique combination of the following factors (crop rotation, optimum crop yields, manure nutrient concentration, remaining crop N need, method of application) that occur. The idea behind the management ID is to group fields with identical management on the same page 2, to avoid the redundancy of doing the exact same calculations for multiple fields.
For example, if 8 fields in the plan are in a corn/bean rotation with yields of 160 and 50 bu/acre and all will receive injected manure with the same nutrient concentration and availability, then page two would only need to be filled out once for the 8 fields and the management ID (e.g. "A") would represent all 8 fields. The same management ID could be used to describe these fields even if they were in different phases of the crop rotation (i.e. some are in corn and some in beans each year).

[h] Yields can be used from any of the following:

- USDA Iowa ag statistics county yield averages
- Multi-peril insurance proven yields
- USDA Farm Service Agency proven yields
- Individual farm proven yields
- Soil survey interpretation records

Documentation of the information used to determine optimum yields must kept with the plan (DNR may require submittal of yield documentation). Documentation may include copies of historical farm yield records, soil survey maps and average yields for the soils found, FSA yield data, etc... If Iowa Ag Statistics county average yields, Appendix A8, are used, documentation is not required to determine optimum yields for corn and soybean crops. The optimum yield for each crop may be set equal to either the average of the last 5-year county yields plus 10 percent or the average of the highest 4 out of the last 5-year county average. If crops other than corn or soybeans are grown, Iowa Ag Statistics yield data for those crops will need to be obtained and optimum yield levels calculated (both the yield data and the calculations should be kept with the plan). If proven yield methods are used to determine optimum yields, the Appendix B2 Worksheet should be used to calculate the optimum yields.

[i] Use list of application methods and application loss factors provided in Appendix A7. If methods other than those listed in Appendix A7 are used, identify the methods and the nitrogen loss factors for those methods.

[j] Use of spray irrigation for manure application: Iowa law includes a number of requirements and restrictions on applying manure through spray irrigation. If spray irrigation is being used, the plan should identify the actions the operation will take to ensure compliance with these requirements and restrictions. In addition, the plan should identify any additional methods or practices the operation will use to reduce potential odor, if any additional methods will be used.

[k] From Table 1 column 3.

[l] Recent research by Iowa State University indicates 100 percent of the nitrogen contained in liquid manure from confinement swine operations is available for plant use in the first year after application. Prior research indicates this may not be the case for liquid manure from other animal species or for solid (dry) manure from confinement operations. A manure management plan may be developed based on the assumption that less than 100 percent of the nitrogen remaining in the manure after deducting application losses will be available for plant use in the first crop year after manure application. However, for planning purposes all nitrogen not considered available in the first crop year must be accounted for in subsequent crop years, and must be considered in determining allowable nitrogen applications (from all sources) during those years. Suggested availability values are: liquid swine manure – 100% in 1st crop year; other liquid manure – 75%, 15%, and 10% in 1st, 2nd, & 3rd crop years respectively; solid manure – 60-75% in 1st crop year, remainder split between 2nd and 3rd years.

[m] 1st year available N = Total N x Application loss factor x Percentage of TN available in the first year (e.g. for 95% N available in first year multiply by 0.95), Appendix B3 can be used to make the calculation.

[n] 2nd year available N = Total N x Application loss factor x Percentage of TN available in the second year. Appendix B3 can be used to make the calculation.

[o] 3rd year available N = Total N x Application loss factor x Percentage of TN available in the third year. Appendix B3 can be used to make the calculation.

[p] Appendices A5 and A6 list crop nitrogen and phosphorus requirements for various crops. These values, or crop use requirements from other credible sources, may be used to determine the crop nitrogen needs and phosphorus removal rates for the crops included in the crop schedule for the fields. For non-legume crops such as corn or grasses, the crop N need value represents the amount of nitrogen required to produce the optimum yield for that crop, and is determined by multiplying the crop nitrogen requirement (in lb/bu or lb/ton of yield) times the optimum crop yield. For legume crops such as soybeans or alfalfa, the crop utilization value represents the amount of nitrogen these legumes will utilize from the soil in producing the optimum crop yield, provided nitrogen is available at these levels in the soil. Again, this amount is determined by multiplying the crop utilization rate (in lb/bu or lb/ton of yield) times the optimum crop yield.

[q] As a minimum, Table 4 should indicate the full crop rotation for the management ID (i.e. , for a corn, corn, soybean rotation, Table 4 should cover a minimum of three crop years).

[r] P_2O_5 removed with crop by harvest = P_2O_5 crop usage rate (Table 3) x Optimum crop yield (row 2)

[s] Crop N utilization = N crop usage rate (Table 3) x Optimum crop yield (row 2)

[t] Credit for nitrogen carryover from prior year legume crops should be determined as follows:

- last year's soybean crop: 1 lb nitrogen per bushel of yield, maximum of 50 lb nitrogen per acre credit
- legume forage crop:
  - ◊ last year's crop with 50 to 100% alfalfa or other legume in stand: 100 to 140 lb nitrogen per acre
  - ◊ last year's crop with 20 to 50% alfalfa or other legume in legume/grass mixture: 50 to 80 lb nitrogen per acre
  - ◊ two years ago crop with 50 to 100% alfalfa or other legume in stand: 30 lb nitrogen per acre
- last year's legume green manure crop: 100 lb nitrogen per acre

[u] Amount of N applied with commercial fertilizer (e.g. starter, with herbicide carrier, etc...).

[v] Manure N carryover credit represents the amount of nitrogen available for crop use due to manure applications made in prior crop years. The carryover N credit is determined by:

1. multiplying the amount of manure (in 1000 gal/acre or ton/acre) applied to the field in the previous crop by the 2nd Year Available N concentration for the applicable manure storage source and method of application;
2. multiplying the amount of manure (in 1000 gal/acre or ton/acre) applied to the field two crop years ago by the 3rd Year Available N concentration for the applicable manure storage source and method of application; adding the resulting N carryover credit values together.

[w] Remaining crop N need = Crop N utilization (row 4) minus (–) Legume N credit (row 5a) – Commercial N planned (row 5b) – Manure N carryover credit (row 5c)

[x] Manure rate to supply remaining N = Remaining crop N need (row 6) divided by (/) 1st year available N (Table 2) (x 1000 for liquid manure)

[y] P_2O_5 applied with N-based rate = Manure rate to supply remaining N need (row 7) x P_2O_5 concentration (Table 2) (Divide by 1000 for liquid manure)

[z] Amount of P_2O_5 applied with commercial fertilizers.

[aa] Manure rate to supply P removal = (P_2O_5 removed with crop by harvest (row 3) – Commercial P_2O_5 planned (row 9))/ Manure P_2O_5 content (Table 2) (x 1000 for liquid manure).

[bb] Manure rates for a P based plan can apply up to the amount of P_2O_5 removed with harvest by the next 4 anticipated crops in a single application if the application rate doesn't exceed the N-based rate (row 7) and no additional P is applied for the period covered by the application. For example, in a corn/soybean rotation if the "manure rate to supply P removal" (row 10) was 2,000 gal/acre for the corn crop and 1,500 for the bean crop, then 3,500 gal/acre could be applied in a single application if the nitrogen rate was not exceeded. Phosphorus in addition to crop removal may be applied if soil tests are very low or low in phosphorus and additional phosphorus is recommended by Pm-1688 "General Guide to Crop Nutrient and Limestone Recommendations in Iowa."

[cc] Manure N applied with P-based plan = Manure rate for P based plan (row 11) x 1st year available N (Table 2) (divided by 1000 for liquid manure)

[dd] Manure application rate that is planned. Use these values for page 3 of the form.

[ee] Field designation may be by Farm Services Agency (FSA) field number, landowner's name, or other suitable designation. A plat map showing the animal feeding operation and all application fields should be kept in the plan. In addition, aerial photos (e.g. FSA section photos) of the fields receiving manure should be in the plan with the boundaries of the individual application fields marked. Also marked on aerial photos should be areas of the fields that are unavailable or unsuitable for manure application, and areas where specific restrictions on manure application apply. DNR may require submittal of plat maps and aerial photos. Areas with specific restrictions on manure application include:

- within 200 feet of a designated area: A designated area means a known sinkhole, or a cistern, abandoned well, unplugged agricultural drainage well, agricultural drainage well surface tile inlet, drinking water well, lake, or a farm pond or a privately owned lake as defined in Iowa Code Section 462A.2. A designated area does not include a terrace tile inlet or surface tile inlet other than an agricultural drainage well surface tile inlet. Iowa law requires manure from an animal feeding operation be injected or incorporated within the same day of application if applied within 200 feet of a designated area. However, this restriction does not apply if a 50-foot buffer of permanent vegetation surrounds the designated area and no manure is applied within the 50-foot buffer.
- within 750 feet of neighboring residence, church, school, business, or public use area: Iowa law requires liquid manure from a confinement feeding operation be injected or incorporated within 24 hours of application if applied within 750 feet of a neighboring residence not owned by the owner of the confinement feeding operation, a church, school, business, or public use area. However, this restriction does not apply if a written waiver is obtained from the owner of the property benefiting by this distance requirement.
- areas where liquid manure is applied through spray irrigation systems: see footnote *"t"* for page 2.

[ff] Identify how the field will be managed using management IDs from page 2.

[gg] The number of acres of the field that will receive manure. Acres not available for manure application include areas where topography, soils, or other factors make manure application impossible; areas where manure will not be applied; areas where application is prohibited under a manure disposal agreement; and areas where Iowa law or DNR rules prohibit manure application. It may also include areas where Iowa law or DNR rules restrict manure application to methods different than those being used by the operation.

[hh] A copy of all written manure application agreements for all fields identified in the plan that are not owned or rented for crop production purposes by the owner of the animal feeding operation must be kept with the plan (agreements must be signed by the landowner). DNR requires submittal of manure application agreements. If manure is applied based on an agreement, also indicate in column 6 the length of the agreement (e.g. annual, 3-yr, 10-yr).

[ii] The MMP must be based on the P index in accordance with DNR rules as indicated in the table below. If the P index is required, submit a NRCS P index detailed report containing a P index for each field in the MMP. Additionally, when the P index is required, the manure management plan must include a document (e.g. NRCS RUSLE2 profile erosion calculation record) indicating the inputs and results of RUSLE2 for each field in the plan (These documents must be submitted to the DNR).

Implementation Date for P-index Based Plans	
Original MMP Submitted	**P-index Based MMP Update Due**
Prior to April 1, 2002	First update after August 25, 2008
Between April 1, 2002 and October 24, 2004	First update after August 25, 2006
On and after October 25, 2004	Upon submittal

[jj] Identify if the field receiving manure is classified as Highly Erodible Land (HEL). Conservation plans are not required in the MMP for HEL if the plan is using the P Index.

[kk] gallons or tons / field = Acres receiving manure (column 5) x gallons or tons/acre (column 9)

[ll] Check "yes" if soil sampling meets minimum requirements. Refer to Rule 65.17(16) in the Iowa Administrative Code for minimum soil sampling requirements. This rule can be found in Appendix A of the MMP. If correct sampling was not used, fields must be resampled within one year.

Appendix A to the

Manure Management Plan Form

Contents

Appendix A

Appendix A1: Manure Production Per Space of Capacity [1]

		Daily		Yearly
Swine	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Nursery, 25 lb.	1 head	0.2 gal	0.7 gal	0.34 tons
Grow-finish, 150 lb.				
Formed storage*				
Dry feed	1 head	1.2 gal		2.05 tons
Wet/dry feed	1 head	0.9 gal		2.05 tons
Earthen storage**	1 head	1.2 gal		2.05 tons
Lagoon***	1 head		4.1 gal	2.05 tons
Gestation, 400 lb.	1 head	3.0 gal	3.7 gal	2.77 tons
Sow & Litter, 450 lb.	1 crate	3.5 gal	7.5 gal	6.16 tons
Farrow-nursery	Per sow in breeding herd	2.2 gal	5.4 gal	6.09 tons
Farrow-finish	Per sow in breeding herd	9.4 gal	30 gal	12.25 tons

Dairy, Confined	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Cows, 1200 & up lb.	1 head	18.0 gal	40.1 gal	14 tons
Heifers, 900 lb.	1 head	8.8 gal	29.9 gal	6.5 tons
Calves, 500 lb.	1 head	4.9 gal	16.5 gal	1.5 tons
Veal calves, 250 lb.	1 head	2.5 gal	8.2 gal	1.1 tons
Dairy herd	Per productive cow in herd	18.5 gal	59.8 gal	20 tons

Beef, Confined	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Mature cows, 1000 lb.	1 head	7.2 gal	15.7 gal	12.23 tons
Finishing, 900 lb.	1 head	6.5 gal	13.1 gal	11.00 tons
Feeder calves, 500 lb.	1 head	3.6 gal	7.3 gal	6.11 tons

Poultry	Space	Dry Manure
Layer, cages	1000 head	10.5 tons
Broiler, litter	1000 head	9.00 tons
Turkeys, litter	1000 head	35.00 tons

* Formed manure storage structure
** Earthen manure storage basin
*** Anaerobic lagoon

1 This table is from Table 5 of Chapter 567-65, Rules for Animal Feeding Operations.

Appendix A2: Annual Pounds of Nitrogen Per Space of Capacity [2]

Swine	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Nursery, 25 lb.	1 head	2	1	5
Grow-finish, 150 lb.				
Formed storage*				
Dry feeders	1 head	21		29
Wet/dry feeders	1 head	19		29
Earthen storage**	1 head	14		29
Lagoon***	1 head		6	29
Gestation, 400 lb.	1 head	27	5	39
Sow & Litter, 450 lb.	1 crate	32	11	86
Farrow-nursery	Per sow in breeding herd	22	8	85
Farrow-finish	Per sow in breeding herd	150	44	172

Dairy, Confined	Space	Liquid, Pit* or Basin**	Liquid Lagoon***	Solid Manure
Cows, 1200 & up lb.	1 head	164	59	140
Heifers, 900 lb.	1 head	81	44	65
Calves, 500 lb.	1 head	45	24	15
Veal calves, 250 lb.	1 head	22	12	10
Dairy herd	Per productive cow in herd	169	87	180

Beef, Confined	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid, Manure
Mature cows, 1000 lb.	1 head	105	23	147
Finishing, 900 lb.	1 head	95	19	132
Feeder calves, 500 lb.	1 head	53	11	73

Poultry	Space	Dry Manure
Layer, cages	1000 head	367
Broiler, litter	1000 head	585
Turkeys, litter	1000 head	1400

* Formed manure storage structure
** Earthen manure storage basin
*** Anaerobic lagoon

2 This table is from Table 3 of Chapter 567-65, Rules for Animal Feeding Operations. Source: PM 1811, Managing Manure Nutrients for Crop Production

Appendix A3: Annual Pounds of Phosphorus (as P_2O_5) per Space of Capacity[3]

Swine	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Nursery, 25 lb.	1 head	1	0.7	3
Grow-finish, 150 lb.				
Formed storage*				
Dry feeders	1 head	15		18
Wet/dry feeders	1 head	13		18
Earthen storage**	1 head	10		18
Lagoon***	1 head		5	18
Gestation, 400 lb.	1 head	27	4	25
Sow & Litter, 450 lb.	1 crate	26	8	55
Farrow-nursery	Per sow in breeding herd	18	6	55
Farrow-finish	Per sow in breeding herd	109	33	110

Dairy, Confined	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Cows, 1200 & up lb	1 head	78	44	42
Heifers, 900 lb.	1 head	38	33	20
Calves, 500 lb.	1 head	22	18	5
Veal calves, 250 lb.	1 head	10	9	3
Dairy herd-per productive cow in herd		80	66	80

Beef, Confined	Space	Liquid, Pit* or Basin**	Liquid, Lagoon***	Solid Manure
Mature cows, 1000 lb.	1 head	66	17	73
Finishing, 900 lb.	1 head	59	14	66
Feeder calves, 500 lb.	1 head	33	8	37

Poultry	Space	Dry Manure
Layer, cages	1000 head	840
Broiler, litter	1000 head	585
Turkeys, litter	1000 head	1400

* Formed manure storage structure
** Earthen manure storage basin
*** Anaerobic lagoon

3. Source: Pm-1811 Managing Manure Nutrients for Crop Production

Appendix A4: Nutrients in Animal Manure

(modified from Table 2 of ISU Extension Pm-1811)

Liquid, Pit — lbs./1,000 gallon

Management System	N	P_2O_5	K_2O
Swine			
Nursery, 25 lbs.	35	20	20
Grow-finish, 150 lbs (wet/dry)	58	40	45
Grow-finish, 150 lbs. (dry feed)	50	42	30
Grow-finish, 150 lbs. (earthen)	32	22	20
Gestation, 400 lbs.	25	25	25
Sow and litter [1], 450 lbs.	25	20	15
Farrow-nursery [2]	27	23	22
Farrow-finish[3]	44	32	24
Dairy—confined			
Cows, 1,200 lbs. or more	25	12	11
Heifers, 900 lbs.	25	12	11
Calves, 500 lbs.	25	12	11
Veal calves, 250 lbs.	25	12	11
Dairy herd[4]	25	12	11
Beef—confined			
Mature cows, 1,000 lbs.	40	25	35
Finishing, 900 lbs.	40	25	35
Feeder calves, 500 lbs.	40	25	35

Lagoon [5]

Management System	N	P_2O_5	K_2O
(all animals)	4	3	4

Solid Manure (Bedded) — lbs./ton

Management System	N	P_2O_5	K_2O
Swine—confined			
Nursery, 25 lbs.	14	9	11
Grow-finish, 150 lbs.	14	9	11
Gestation, 400 lbs	14	9	11
Sow and litter, 450 lbs.	14	9	11
Farrow-nursery	14	9	11
Farrow-finish	14	9	11
Dairy—confined			
Cows, 1,200 lbs. or more	12	6	12
Heifers, 900 lbs.	12	6	12
Calves, 500 lbs.	12	6	12
Veal calves, 250 lbs.	12	6	12
Dairy herd	12	6	12
Beef—confined			
Mature cows, 1,000 lbs.	12	6	12
Finishing, 900 lbs.	12	6	12
Feeder calves, 500 lbs.	12	6	12
Poultry			
Layer, caged, 4 lbs. [6]	35	80	50
Broiler, litter, 2 lbs.	65	65	45
Turkeys, litter, 10 lbs.	40	40	25

Open Lot Runoff

Management System	N	P_2O_5	K_2O
Earthen lots (liquids)			
Beef, 400 sq. ft./hd.	3	1	6
Dairy, 1,000 sq. ft./hd.	3	1	6
Swine, 50 sq. ft./hd.	3	1	6
Concrete lots (liquids)			
Beef, 400 sq. ft./hd.	6	2	7
Dairy, 1,000 sq. ft./hd.	6	2	7
Swine, 50 sq. ft./hd.	15	5	10
Open lot (solids, scraped)			
Beef, 400 sq. ft./hd.	22	16	14
Dairy, 1,000 sq. ft./hd.	11	6	11
Swine, 50 sq. ft./hd.	15	14	9

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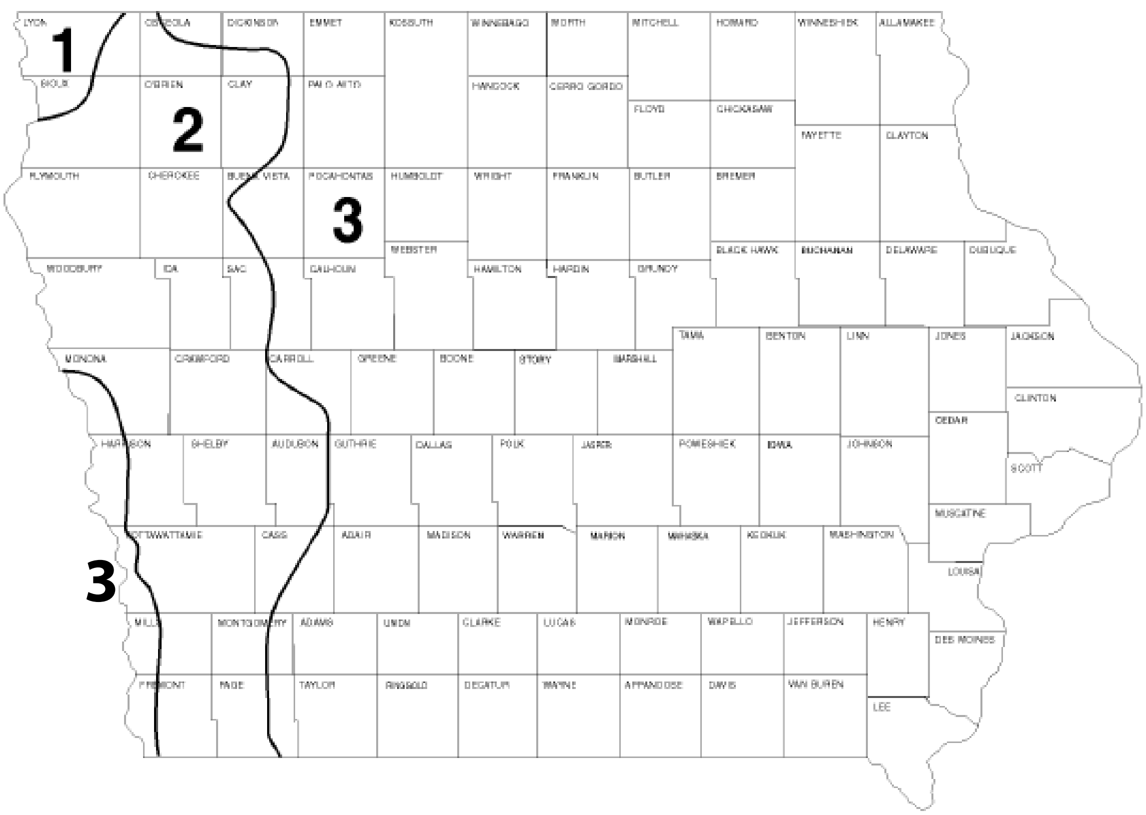
1 Sow and litter figures are per farrowing crate.
2 Farrow-nursery figures are per sow in the breeding herd and include one farrowing sow, five gestation sows, and nine nursery pig spaces.
3 Farrow-finish figures are per sow in the breeding herd and include one farrowing sow, five gestation sows, nine nursery pigs, and 36 finishing pig spaces.
4 Per productive cow in the herd; includes lactating cow, 330 days; dry cow, 35 days; heifer, 222 days; and calf, 165 days.
5 Weights assumed: beef, 1,000 pounds; dairy, 1,200 pounds; swine, 150 pounds.
6 Wet basis at 41 percent moisture.

Appendix A5: Crop Nitrogen Usage Rate Factors for Various Crops [3]

Corn	Zone 1	0.9 lbs/bu	Orchardgrass	38.0 lbs/ton
	Zone 2	1.1 lbs/bu	Tall fescue	38.0 lbs/ton
	Zone 3	1.2 lbs/bu	Switchgrass	21.0 lbs/ton
Corn silage		7.5 lbs/ton	Vetch	56.0 lbs/ton
Soybean		3.8 lbs/bu	Red clover	43.0 lbs/ton
Oats		0.75 lbs/bu	Perennial ryegrass	24.0 lbs/ton
Alfalfa		50.0 lbs/ton	Timothy	25.0 lbs/ton
Wheat		1.3 lbs/bu	Wheat straw	13.0 lbs/ton
Smooth bromegrass		40.0 lbs/ton	Oat straw	12.0 lbs/ton
Sorghum-sudan			40.0 lbs/ton	

The following map outlines the three zones for the corn nitrogen usage rates indicated in the Table 4. Zone 1 corresponds to the Moody soil association. Zone 2 corresponds to the Marshall, Monona-Ida-Hamburg, and Galva-Primghar-Sac soil associations. Zone 3 corresponds to the remaining soil associations.



3 Appendix A5 and the accompanying map are from Table 4 in Appendix B of Chapter 567-65.

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Appendix A6: Nutrient Removal for Iowa Crops[4]

		Pounds/Unit		
Crop	Units		P_2O_5	K_2O
Corn	bu.	-	0.375	0.3
Corn Silage	ton (65% H_2O)	-	3.5	8.0
Corn Silage	bu. grain equivalent	-	0.55	1.25
Soybean	bu.	3.8	0.8	1.5
Alfalfa	ton	50	12.5	40
Oat and Straw	bu.	0.75	0.4	1.0
Wheat	bu.	1.3	0.6	0.3
Smooth bromegrass	ton	40	9	47
Orchardgrass	ton	38	14	68
Tall fescue	ton	38	12	66
Switchgrass	ton	21	12	66
Sorghum-sudan	ton	40	12	38
Vetch	ton	56	12	47
Red clover	ton	43	12	35
Perennial ryegrass	ton	24	12	34
Timothy	ton	25	9	32
Wheat straw	ton	13	4	25
Oat straw	ton	12	5	33

Appendix A7: Nitrogen Application Losses

Application Method	Application Loss Factor [5]
Knifed in or soil injection of liquid manure	0.98
Surface apply liquid or solid (dry) manure with incorporation within 24 hours	0.95
Surface apply liquid or solid (dry) manure with incorporation after 24 hours	0.80
Surface apply liquid manure with no incorporation	0.75
Surface apply solid (dry) manure with no incorporation	0.70
Irrigate liquid manure with no incorporation	0.60

4. Appendix A6 is from PM 1688: General Guide for Crop Nutrient Recommendations in Iowa
5. Percent of applied nitrogen remaining after deducting application losses

Appendix A8: Iowa Ag Statistics
County Corn and Soybean Yield Averages, 2004 - 2008

	Corn			Soybeans		
County	5-yr. avg. yield (bu./a)	5-yr. ave. yield + 10% (bu./a)	Avg. yield of 4 highest (bu./a)	5-yr. avg. yield (bu./a)	5-yr. ave. yield + 10% (bu./a)	Avg. yield of 4 highest (bu./a)
Adair	167.1	183.9	169.2	50.0	55.0	51.2
Adams	156.2	171.9	159.0	47.2	51.9	49.4
Allamakee	168.8	185.7	170.2	47.6	52.4	49.2
Appanoose	149.9	164.9	157.9	43.0	47.3	46.1
Audubon	173.5	190.8	176.7	52.1	57.3	52.8
Benton	174.5	191.9	175.6	52.3	57.5	52.8
Black Hawk	177.2	194.9	180.3	52.1	57.4	52.8
Boone	181.1	199.2	184.9	51.2	56.3	53.1
Bremer	180.6	198.7	185.5	51.8	57.0	53.7
Buchanan	172.7	189.9	175.1	49.6	54.6	50.7
Buena Vista	172.6	189.9	180.0	50.3	55.3	50.9
Butler	180.3	198.3	181.6	51.0	56.1	52.0
Calhoun	178.1	195.9	181.2	49.6	54.6	50.5
Carroll	176.3	193.9	179.7	50.6	55.6	51.0
Cass	172.6	189.8	176.3	50.6	55.6	51.9
Cedar	175.8	193.4	183.7	49.8	54.8	50.3
Cerro Gordo	172.1	189.3	173.6	48.2	53.0	49.2
Cherokee	175.9	193.5	183.8	55.1	60.6	55.4
Chickasaw	172.9	190.2	176.4	49.4	54.3	50.6
Clarke	142.1	156.4	150.4	41.5	45.6	45.3
Clay	172.9	190.2	176.3	48.9	53.8	49.3
Clayton	175.0	192.5	176.0	52.7	58.0	53.6
Clinton	165.5	182.0	177.7	48.5	53.3	50.0
Crawford	170.0	187.0	177.8	51.6	56.8	52.3
Dallas	174.8	192.3	177.5	52.2	57.4	53.6
Davis	151.2	166.4	160.3	44.5	48.9	46.6
Decatur	152.9	168.2	163.1	45.4	49.9	49.0
Delaware	174.6	192.1	178.5	52.1	57.3	53.6
Des Moines	177.6	195.4	183.4	50.6	55.7	51.6
Dickinson	170.4	187.4	173.3	47.2	52.0	48.2
Dubuque	177.7	195.5	182.7	52.7	58.0	54.9
Emmet	174.8	192.3	177.1	48.2	53.0	49.2
Fayette	173.7	191.1	175.5	50.8	55.9	52.4

updated 3/2009

Appendix A8: Iowa Ag Statistics
County Corn and Soybean Yield Averages, 2004 - 2008

	Corn			Soybeans		
Counties	5-yr. avg. yield (bu./a)	5-yr. ave. yield + 10% (bu./a)	Avg. yield of 4 highest (bu./a)	5-yr. avg. yield (bu./a)	5-yr. ave. yield + 10% (bu./a)	Avg. yield of 4 highest (bu./a)
Floyd	173.5	190.9	175.7	49.0	53.9	50.2
Franklin	179.4	197.3	182.5	49.3	54.3	50.6
Fremont	158.7	174.6	161.9	48.0	52.8	49.8
Greene	176.3	193.9	180.6	49.9	54.9	50.9
Grundy	182.9	201.1	184.6	56.0	61.6	56.8
Guthrie	164.6	181.1	166.1	47.7	52.5	48.8
Hamilton	178.5	196.4	183.9	49.7	54.6	50.5
Hancock	176.9	194.5	178.3	50.0	55.0	51.6
Hardin	180.5	198.5	185.9	52.8	58.0	54.0
Harrison	162.4	178.7	167.5	44.4	48.8	45.6
Henry	172.5	189.8	177.4	50.7	55.7	51.5
Howard	168.7	185.6	170.7	47.1	51.8	48.8
Humboldt	181.8	200.0	184.3	50.5	55.6	51.3
Ida	170.6	187.6	181.9	49.8	54.7	50.6
Iowa	172.4	189.7	178.7	50.9	56.0	52.0
Jackson	159.7	175.7	168.6	49.2	54.1	50.0
Jasper	183.9	202.3	186.4	54.9	60.4	55.5
Jefferson	162.9	179.1	167.7	48.1	53.0	49.8
Johnson	162.7	179.0	169.4	47.7	52.4	48.2
Jones	168.1	184.9	173.0	49.9	54.9	50.9
Keokuk	164.7	181.2	172.2	49.3	54.3	50.2
Kossuth	178.5	196.4	180.4	50.2	55.2	52.0
Lee	160.8	176.9	168.7	47.2	51.9	48.5
Linn	169.9	186.8	174.3	48.8	53.7	49.4
Louisa	166.9	183.6	175.3	47.4	52.2	47.9
Lucas	140.7	154.7	147.3	42.1	46.3	45.6
Lyon	177.7	195.5	181.3	53.2	58.5	54.0
Madison	163.3	179.6	165.4	48.9	53.8	50.8
Mahaska	175.0	192.5	178.7	52.2	57.5	53.6
Marion	159.1	175.0	163.1	49.0	53.9	50.1
Marshall	185.4	204.0	186.8	55.7	61.3	57.0
Mills	162.3	178.5	166.0	48.5	53.4	50.4
Mitchell	176.1	193.7	177.5	49.6	54.5	51.0

Appendix A8: Iowa Ag Statistics
County Corn and Soybean Yield Averages, 2004 - 2008

	Corn			Soybeans		
Counties	5-yr. avg. yield (bu./a)	5-yr. ave. yield + 10% (bu./a)	Avg. yield of 4 highest (bu./a)	5-yr. avg. yield (bu./a)	5-yr. ave. yield + 10% (bu./a)	Avg. yield of 4 highest (bu./a)
Monona	151.3	166.4	161.8	44.8	49.3	45.4
Monroe	152.0	167.2	156.0	43.9	48.3	46.7
Montgomery	162.1	178.3	166.3	48.0	52.8	50.6
Muscatine	165.7	182.2	173.3	48.0	52.8	49.1
O Brien	179.2	197.1	182.5	54.2	59.6	55.6
Osceola	177.0	194.7	179.9	51.2	56.4	52.2
Page	153.9	169.3	159.2	47.6	52.3	50.2
Palo Alto	175.8	193.4	179.1	49.2	54.2	50.5
Plymouth	167.3	184.0	174.8	50.1	55.1	50.4
Pocahontas	178.1	195.9	181.0	49.8	54.8	50.8
Polk	172.4	189.6	177.0	49.4	54.3	50.8
Pottawattamie	174.6	192.0	177.6	50.5	55.5	52.9
Poweshiek	179.5	197.5	181.9	53.8	59.2	55.2
Ringgold	140.9	155.0	147.4	42.9	47.2	47.2
Sac	172.4	189.6	182.0	50.9	56.0	51.9
Scott	175.5	193.1	182.2	52.2	57.4	52.6
Shelby	175.5	193.0	177.5	51.3	56.4	52.1
Sioux	177.5	195.3	182.7	55.2	60.7	55.6
Story	180.1	198.1	185.1	52.0	57.2	53.5
Tama	178.9	196.8	180.4	53.9	59.3	55.1
Taylor	145.9	160.5	148.7	44.6	49.0	47.3
Union	154.7	170.1	156.3	47.0	51.7	49.4
Van Buren	153.8	169.2	161.3	46.5	51.1	48.0
Wapello	157.9	173.7	163.3	47.5	52.3	48.9
Warren	156.4	172.0	161.8	49.7	54.7	51.9
Washington	174.7	192.1	180.1	50.5	55.6	50.9
Wayne	142.4	156.6	152.3	44.6	49.0	48.2
Webster	181.1	199.2	184.6	49.3	54.2	49.9
Winnebago	181.1	199.2	182.9	49.9	54.9	51.9
Winneshiek	174.6	192.1	175.8	48.7	53.6	50.1
Woodbury	161.3	177.4	169.2	45.9	50.5	46.4
Worth	175.3	192.8	176.6	47.8	52.6	49.6
Wright	179.5	197.4	183.4	50.0	55.0	51.0

Appendix A9: Chapter 567-- 65. 16 and 567-- 65.17 Rules for Animal Feeding Operations

Please note: Manure management plans that include the phosphorus index will be phased in between the fall of 2004 and 2008, depending upon the date that the original MMP was submitted to the DNR. See 65.17(1)"d" below for the phase in schedule.

Disclaimer: Producers should consult Chapter 65 of the Iowa Administrative Code for more information and the actual wording of rules governing animal feeding operations. Consult Chapter 459 of the Iowa Code for actual wording of the laws governing animal feeding operations in Iowa.

567—65.16(455B) Manure management plan requirements.

65.16(1) In accordance with Iowa Code section 455B.203 as amended by 2002 Iowa Acts, chapter 1137, section 38, the following persons are required to submit manure management plans to the department, including an original manure management plan and an updated manure management plan, as required by this rule:
a. An applicant for a construction permit for a confinement feeding operation. However, a manure management plan shall not be required of an applicant for an egg washwater storage structure.
b. The owner of a confinement feeding operation, other than a small animal feeding operation, if one of the following applies:
(1) The confinement feeding operation was constructed or expanded after May 31, 1985, regardless of whether the confinement feeding operation structure was required to have a construction permit.
(2) The owner constructs a manure storage structure, regardless of whether the person is required to be issued a permit for the construction pursuant to Iowa Code section 455B.200A as amended by 2002 Iowa Acts, chapter 1137, sections 28 and 29, or whether the person has submitted a prior manure management plan.
c. A person who applies manure in Iowa that was produced in a confinement feeding operation, other than a small operation, located outside of Iowa.
d. A research college is exempt from this subrule and the manure management plan requirements of rule 65.17(459) for research activities and experiments performed under the authority of the research college and related to animal feeding operations.

65.16(2) Effective February 13, 2002, an owner of a proposed confinement feeding operation who is required to file a manure management plan pursuant to paragraph 65.16(1)*"b"* shall submit the confinement feeding operation's manure management plan to the department at least 30 days before the construction of an animal feeding operation structure begins, as that term is defined in subrules 65.8(1) and 65.8(2). After the manure management plan has been received by the department, the department will date-stamp the plan as received and provide written confirmation of receipt to the owner. In addition to the content requirements specified in rule 65.17(459), the owner shall include:
a. Documentation that the board of supervisors or auditor of the county where the confinement feeding operation is proposed to be located received a copy of the plan.
b. Information (e.g., maps, drawings, aerial photos) that clearly shows the intended location of the animal feeding operation structures and locations and animal weight capacities of any other confinement feeding operations within a distance of 2,500 feet in which the owner has an ownership interest or which the owner manages.

65.16(3) Scope of manure management plan; updated plans; annual compliance fee.
a. Each confinement feeding operation required to submit a manure management plan shall be covered by a separate manure management plan.

b. The owner of a confinement feeding operation who is required to submit a manure management plan under this rule shall submit an updated manure management plan on an annual basis to the department. The updated plan must reflect all amendments made during the period of time since the previous manure management plan submission. The owner of the animal feeding operation shall also submit the updated manure management plan on an annual basis to the board of supervisors of each county where the confinement feeding operation is located and to the board of supervisors of each county where manure from the confinement feeding operation is land-applied. If the owner of the animal feeding operation has not previously submitted a manure management plan to the board of supervisors of each county where the confinement feeding operation is located and each county where manure is land-applied, the owner must submit a complete manure management plan to each required county. The county auditor or other county official or employee designated by the county board of supervisors may accept the updated plan on behalf of the board. The updated plan shall include documentation that the county board of supervisors or other designated county official or employee received the manure management plan update. The department will stagger the dates by which the updated manure management plans are due and will notify each confinement feeding operation owner of the date on which the updated manure management plan is due. To satisfy the requirements of an updated manure management plan, an owner of a confinement feeding operation must submit one of the following:
(1) A complete manure management plan;
(2) A department-approved document stating that the manure management plan submitted in the prior year has not changed; or
(3) A department-approved document listing all the changes made since the previous manure management plan was submitted and approved.
c. An annual compliance fee of $0.15 per animal unit at the animal feeding operation shall accompany an annual manure management plan update submitted to the department for approval. The annual compliance fee is based on the animal unit capacity of the confinement feeding operation stated in the updated annual manure management plan submission. If the person submitting the manure management plan is a contract producer, as provided in Iowa Code chapter 202, the active contractor shall pay the annual compliance fee.

65.16(4) The department shall review and approve or disapprove all complete manure management plans within 60 days of the date they are received.

65.16(5) Manure shall not be removed from a manure storage structure, which is part of a confinement feeding operation required to submit a manure management plan, until the department has approved the plan. As an exception to this requirement, until July 1, 2002, the owner of a confinement feeding operation may remove and apply manure from a manure storage structure in accordance with a manure management plan submitted to the department prior to September 18, 2001, but which has not been approved within the required 60-day period. Manure shall be applied in compliance with rule 65.2(455B).

\65.16(6) All persons required to submit a manure management plan to the department shall also pay to the department an indemnity fee as required in Iowa Code section 455J.3 except those operations constructed prior to May 31, 1995, which were not required to obtain a construction permit.

65.16(7) Any person submitting an original manure management plan must also pay to the department a manure management plan filing fee of $250. This fee shall be included with each original manure management plan being submitted. If the confinement feeding operation is required to obtain a construction permit and to submit an original manure management plan as part of the construction permit requirements, the applicant must pay the manure management plan filing fee together with the construction permit application fee, which total $500.

567—65.17(459) Manure management plan content requirements. All manure management plans are to be submitted on forms or electronically as prescribed by the department. The plans shall include all of the information specified in Iowa Code section 459.312 and as described below.

65.17(1) *General.*
a. A confinement feeding operation that is required to submit a manure management plan to the department shall not apply manure in excess of the nitrogen use levels necessary to obtain optimum crop yields. When a phosphorus index is required in a manure management plan as provided in 65.17(1)*"d,"* a confinement feeding operation shall not apply manure in excess of the rates determined in conjunction with the phosphorus index. Information to complete the required calculations may be obtained from the tables in this chapter, actual testing samples or from other credible sources including, but not limited to, Iowa State University, the United States Department of Agriculture (USDA), a licensed professional engineer, or an individual certified as a crop consultant under the American Registry of Certified Professionals in Agronomy, Crops, and Soils (ARCPACS) program, the Certified Crop Advisors (CCA) program, or the Registry of Environmental and Agricultural Professionals (REAP) program.
b. Manure management plans shall comply with the minimum manure control requirements of 65.2(455B) and the requirements for land application of manure in 65.3(455B).
c. Manure management plans shall include all of the following:
(1) The name of the owner and the name of the confinement feeding operation, including mailing address and telephone number.
(2) The name of the contact person for the confinement feeding operation, including mailing address and telephone number.
(3) The location of the confinement feeding operation identified by county, township, section, 1/4 section and, if available, the 911 address.
(4) The animal unit capacity of the confinement feeding operation and, if applicable, the animal weight capacity.
d. A person who submits a manure management plan shall include a phosphorus index as part of the manure management plan as follows:
(1) A person who submitted an original manure management plan prior to April 1, 2002, shall submit a phosphorus index with the first manure management plan update on and after August 25, 2008.
(2) A person who submitted an original manure management plan on or after April 1, 2002, but prior to October 25, 2004, shall submit a phosphorus index with the first manure management plan update on and after August 25, 2006.
(3) A person who submits an original manure management plan on and after October 25, 2004, shall include the phosphorus index as part of the original manure management plan and manure management plan updates.

65.17(2) *Manure management plans for sales of manure.* Selling manure means the transfer of ownership of the manure for monetary or other valuable consideration. Selling manure does not include a transaction where the consideration is the value of the manure, or where an easement, lease or other agreement granting the right to use the land only for manure application is executed.
a. Confinement feeding operations that will sell dry manure as a commercial fertilizer or soil conditioner regulated by the Iowa department of agriculture and land stewardship (IDALS) under Iowa Code chapter 200 or 200A shall submit a copy of their site-specific IDALS license or documentation that manure will be sold pursuant to Iowa Code chapter 200 or 200A, along with the departmentapproved manure management plan form for sales of dry manure. Operations completely covered by this paragraph are not required to meet other manure management plan requirements in this rule.
b. A confinement feeding operation not fully covered by paragraph *"a"* above and that has an established practice of selling manure, or a confinement feeding operation that contains an animal species for which el-ling manure is a common practice, shall submit a manure management plan that includes the following:
(1) Until a phosphorus index is required as part of the manure management plan, an estimate of the number of acres required for manure application shall be calculated by dividing the total nitrogen available to be applied from the confinement feeding operation by the crop usage rate. Crop usage rate may be estimated by using a corn crop usage rate factor and an estimate of the optimum crop yield for the property in the vicinity of the confinement feeding operation.
(2) When a phosphorus index is required as part of the manure management plan, an estimate of the number of acres required for manure application shall be calculated by one of the following methods:

1. Dividing the total phosphorus (as P2O5) available to be applied from the confinement feeding operation by the corn crop removal of phosphorus. The corn crop removal of phosphorus may be estimated by using the phosphorus removal rate in Table 4a at the end of this chapter and an estimate of the optimum crop yieldfor the property in the vicinity of the operation.
2. Totaling the quantity of manure that can be applied to each available field based on application rates determined in conjunction with the phosphorus index in accordance with 65.17(17), and ensuring that the total quantity that can be applied is equal to or exceeds the manure annually generated at the operation.
(3) The total nitrogen available to be applied from the confinement feeding operation.
(4) The total phosphorus (as P2O5) available to be applied from the confinement feeding operation if the phosphorus index is required in accordance with 65.17(1)*"d."*
(5) An estimate of the annual animal production and manure volume or weight produced.
(6) A manure sales form, if manure will be sold, shall include the following information:
1. A place for the name and address of the buyer of the manure.
2. A place for the quantity of manure purchased.
3. The planned crop schedule and optimum crop yields.
4. A place for the manure application methods and the timing of manure application.
5. A place for the location of the field including the number of acres where the manure will be applied.
6. A place for the manure application rate.
7. When a phosphorus index is required as part of a manure management plan in accordance with 65.17(1)*"d,"* a place for a phosphorus index of each field receiving manure, as defined in 65.17(17)*"a,"* including the factors used in the calculation. A copy of the NRCS phosphorus index detailed report shall satisfy the requirement to include the factors used in the calculation.
(7) Statements of intent if the manure will be sold. The number of acres indicated in the statements of intent shall be sufficient according to the manure management plan to apply the manure from the confinement feeding operation. The permit holder for an existing confinement feeding operation with a construction permit may submit past records of manure sales instead of statements of intent. The statements of intent shall include the following information:
1. The name and address of the person signing the statement.
2. A statement indicating the intent of the person to purchase the confinement feeding operation's manure.
3. The location of the farm where the manure can be applied including the total number of acres available for manure application.
4. The signature of the person who may purchase the confinement feeding operation's manure.
(8) The owner shall maintain in the owner's records a current manure management plan and copies of all of the manure sales forms; the sales forms must be completed and signed by each buyer of the manure and the applicant, and the copies must be maintained in the owner's records for three years after each sale. Effective August 25, 2006, the owner shall maintain in the owner's records copies of all of the manure sales forms for five years after each sale. An owner of a confinement feeding operation shall not be required to maintain current statements of intent as part of the manure management plan.

65.17(3) *Manure management plan for nonsales of manure.* Confinement feeding operations that will not sell all of their manure shall submit the following for that portion of the manure which will not be sold:
a. Calculations to determine the land area required for manure application.
b. The total nitrogen available to be applied from the confinement feeding operation.
c. The planned crop schedule and optimum crop yields.
d. Manure application methods and timing of the application.
e. The location of manure application.
f. An estimate of the annual animal production and manure volume or weight produced.
g. Methods, structures or practices that will be used to reduce soil loss and prevent surface water pollution.
h. Methods or practices that will be utilized to reduce odor if spray irrigation equipment is used to apply manure.
i. When a phosphorus index is required as part of the manure management plan in accordance with 65.17(1)*"d,"* the following are required:

for Farm Service Agency programs.
2. Proven yields for multiperil crop insurance. Yields established for the purpose of purchasing multiperil crop insurance shall be used as proven yield data.
3. Proven yields from other methods. The plan shall use the proven yield data and indicate the method used in determining the proven yield.
b. Crop schedule. Crop schedules shall include the name and total acres of the planned crop on a field-by-field or farm-by-farm basis where manure application will be made. A map may be used to indicate crop schedules by field or farm. The planned crop schedule shall name the crop(s) planned to be grown for the length of the crop rotation beginning with the crop planned or actually grown during the year this plan is submitted or the first year manure will be applied. The confinement feeding operation owner shall not be penalized for exceeding the nitrogen or phosphorus application rate for an unplanned crop, if crop schedules are altered because of weather, farm program changes, market factor changes, or other unforeseeable circumstances.

65.17(7) *Manure application methods and timing.*
a. The manure management plan shall identify the methods that will be used to land-apply the confinement feeding operation's manure. Methods to land-apply the manure may include, but are not limited to, surface-apply dry with no incorporation, surface-apply liquids with no incorporation, surface-apply liquid or dry with incorporation within 24 hours, surface-apply liquid or dry with incorporation after 24 hours, knifed in or soil injection of liquids, or irrigated liquids with no incorporation.
b. The manure management plan shall identify the approximate time of year that land application of manure is planned. The time of year may be identified by season or month.

65.17(8) *Location of manure application.*
a. The manure management plan shall identify each farm where the manure will be applied, the number of acres that will be available for the application of manure from the confinement feeding operation, and the basis under which the land is available.
b. A copy of each written agreement executed with the owner of the land where manure will be applied shall be maintained with the current manure management plan. The written agreement shall indicate the acres on which manure from the confinement feeding operation may be applied and the length of the agreement. A written agreement is not required if the land is owned or rented for crop production by the owner of the confinement feeding operation.
c. If a present location becomes unavailable for manure application, additional land for manure application shall be identified in the current manure management plan prior to the next manure application period.

65.17(9) *Estimate of annual animal production and manure volume or weight produced.* Volumes or weights of manure produced shall be estimated based on the numbers of animals, species, and type of manure storage used. The plan shall list the annually expected number of production animals by species. The volume of manure may be estimated based on the values in Table 5 at the end of this chapter and submitted as a part of the plan. If the plan does not use the table to determine the manure volume, other credible sources for standard table values or the actual manure volume from the confinement feeding operation may be used.

65.17(10) *Methods to reduce soil loss and potential surface water pollution.* The manure management plan shall include an identification of the methods, structures or practices that will be used to prevent or diminish soil loss and potential surface water pollution during the application of manure. Until a phosphorus index is required in accordance with 65.17(1)*"d,"* the current manure management plan shall maintain a summary or copy of the conservation plan for the cropland where manure from the animal feeding operation will be applied if the manure will be applied on highly erodible cropland. The conservation plan shall be the conservation plan approved by the local soil and water conservation district or its equivalent. The summary of the conservation plan shall identify the methods, structures or practices that are contained in the conservation plan. When a phosphorus index is required in accordance with 65.17(1)*"d,"* the manure management plan shall indicate for each field in the plan the crop rotation, tillage practices and supporting practices used to calculate sheet and rill erosion for the phosphorus index. A copy of the NRCS RUSLE2 profile erosion calculation record shall satisfy the requirement to indicate the crop rotation, tillage practices and supporting practices to calculate sheet and rill erosion. The plan shall also identify the highly erodible cropland where manure will be applied. The manure management plan may include additional information such as whether the manure will be injected or incorporated or the type of manure storage structure.

65.17(11) *Spray irrigation.* Requirements contained in subrules 65.3(2) and 65.3(3) regarding the use of spray irrigation equipment to apply manure shall be followed. A plan which has identified spray irrigation equipment as the method of manure application shall identify any additional methods or practices to reduce potential odor, if any other methods or practices will be utilized.

65.17(12) *Current manure management plan.* The owner of a confinement feeding operation who is required to submit a manure management plan shall maintain a current manure management plan at the site of the confinement feeding operation or at a residence or office of the owner or operator of the operation within 30 miles of the site. The plan shall include completed manure sales forms for a confinement feeding operation from which manure is sold. If manure management practices change, a person required to submit a manure management plan shall make appropriate changes consistent with this rule. If values other than the standard table values are used for manure management plan calculations, the source of the values used shall be identified.

65.17(13) *Record keeping.* Records shall be maintained by the owner of a confinement feeding operation who is required to submit a manure management plan. This recorded information shall be maintained for three years following the year of application or for the length of the crop rotation, whichever is greater. Effective August 25, 2006, records shall be maintained for five years following the year of application or for the length of the crop rotation, whichever is greater. Records shall be maintained at the site of the confinement feeding operation or at a residence or office of the owner or operator of the facility within 30 miles of the site. Records to demonstrate compliance with the manure management plan shall include the following:
a. Factors used to calculate the manure application rate:
(1) Optimum yield for the planned crop.
(2) Types of nitrogen credits and amounts.
(3) Remaining crop nitrogen needed.
(4) Nitrogen content and first-year nitrogen availability of the manure.
(5) Phosphorus content of the manure if required in accordance with 65.17(3)*"i."* If an actual sample is used, documentation shall be provided.
b. If phosphorus-based application rates are used, the following shall be included:
(1) Crop rotation.
(2) Phosphorus removed by crop harvest of that crop rotation.
c. Maximum allowable manure application rate.
d. Actual manure application information:
(1) Methods of application when manure from the confinement feeding operation was applied.
(2) Date(s) when the manure from the confinement feeding operation was applied.
(3) Location of the field where the manure from the confinement feeding operation was applied, including the number of acres.
(4) The manure application rate.
e. Effective August 25, 2005, date(s) and application rate(s) of commercial nitrogen and phosphorus on fields that received manure. However, if the date and application rate information is for fields which are not owned for crop production or which are not rented or leased for crop production by the person required to keep records pursuant to this subrule, an enforcement action for noncompliance with a manure management plan or the requirements of this subrule shall not be pursued against the person required to keep records pursuant to this subrule or against any other person who relied on the date and application rate in records required to be kept pursuant to this subrule, unless that person knew or should have known that nitrogen or phosphorus would be applied in excess of maximum levels set forth in paragraph 65.17(1)*"a."* If manure is applied to fields not owned, rented or leased for crop production by the person required to keep records pursuant to this subrule, that person shall obtain from the person who owns, rents or leases those fields a statement specifying the planned commercial nitrogen and phosphorus fertilizer rates to be applied to each field receiving the manure.

f. When a phosphorus index is required in accordance with 65.17(1)*"d,"* a copy of the current soil test lab results for each field in the manure management plan.
g. For sales of manure under 65.17(2)*"b,"* record-keeping requirements of 65.17(2)*"b"*(8) shall be followed.

65.17(14) *Record inspection.* The department may inspect a confinement feeding operation at any time during normal working hours and may inspect the manure management plan and any records required to be maintained. As required in Iowa Code section 459.312(12), Iowa Code chapter 22 shall not apply to the records which shall be kept confidential by the department and its agents and employees. The contents of the records are not subject to disclosure except as follows:
a. Upon waiver by the owner of the confinement feeding operation.
b. In an action or administrative proceeding commenced under this chapter. Any hearing related to the action or proceeding shall be closed.
c. When required by subpoena or court order.

65.17(15) *Enforcement action.* An owner required to provide the department a manure management plan pursuant to this rule who fails to provide the department a plan or who is found in violation of the terms and conditions of the plan shall not be subject to an enforcement action other than assessment of a civil penalty pursuant to Iowa Code section 455B.191.

65.17(16) *Soil sampling requirements for fields where the phosphorus index must be used.* Soil samples shall be obtained from each field in the manure management plan at least once every four years. Each soil sample shall be analyzed for phosphorus and pH. The soil sampling protocol shall meet all of the following requirements:
a. Acceptable soil sampling strategies include, but are not limited to, grid sampling, management zone sampling, and soil type sampling. Procedural details can be taken from Iowa State University extension publication PM 287, "Take a Good Soil Sample to Help Make Good Decisions," NCR-13 Report 348, "Soil Sampling for Variable-Rate Fertilizer and Lime Application," or other credible soil sampling publications.
b. Each soil sample must be a composite of at least ten soil cores from the sampling area, with each core containing soil from the top six inches of the soil profile.
c. Each soil sample shall represent no more than ten acres. For fields less than or equal to 15 acres, only one soil sample is necessary.
d. Soil analysis must be performed by a lab enrolled in the IDALS soil testing certification program.
e. The soil phosphorus test method must be an appropriate method for use with the phosphorus index. If soil pH is greater than or equal to 7.4, soil phosphorus data from the Bray-1 extraction method is not acceptable for use with the phosphorus index.

65.17(17) *Use of the phosphorus index.* Manure application rates shall be determined in conjunction with the use of the Iowa Phosphorus Index as specified by the USDA Natural Resources Conservation Service (NRCS) Iowa Technical Note No. 25.
a. The phosphorus index shall be used on each individual field in the manure management plan. The fields must be contiguous and shall not be divided by a public thoroughfare or a water source as each is defined in this chapter. Factors to be considered when a field is defined may include, but are not limited to, cropping system, erosion rate, soil phosphorus concentration, nutrient application history, and the presence of site-specific soil conservation practices.
b. When sheet and rill erosion is calculated for the phosphorus index, the soil type used for the calculation shall be the most erosive soil map unit that is at least 10 percent of the total field area.
c. The average (arithmetic mean) soil phosphorus concentration of a field shall be used in the phosphorus index.
d. Soil phosphorus concentration data is considered valid for use in the phosphorus index if the data is four years old or less and meets the requirements of 65.17(16).
e. For an original manure management plan, previous soil sampling data that does not meet the requirements of 65.17(16) may be used in the phosphorus index if the data is four years old or less. In the case of fields for

which soil sampling data is used that does not meet the requirements of 65.17(16), the fields must be soil-sampled according to the requirements of 65.17(16) no more than one year after the manure management plan is approved.
f. The following are the manure application rate requirements for fields that are assigned the phosphorus index site vulnerability ratings below as determined by the NRCS Iowa Technical Note No. 25 to the NRCS 590 standard rounded to the nearest one-hundredth:
(1) Very Low (0-1).
1. Manure shall not be applied in excess of a nitrogen-based rate in accordance with 65.17(18).
2. If, pursuant to 65.17(19), manure is applied at phosphorus-based rates within soil sampling periods on fields in the Very Low risk category, each soil sample may represent up to 20 acres for the next required soil sampling.
(2) Low (>1-2).
1. Manure shall not be applied in excess of a nitrogen-based rate in accordance with 65.17(18).
2. If, pursuant to 65.17(19), manure is applied at phosphorus-based rates within soil sampling periods on fields in the Low risk category, each soil sample may represent up to 20 acres for the next required soil sampling.
(3) Medium (>2-5).
1. Manure may be applied at a nitrogen-based rate in accordance with 65.17(18) if current or planned soil conservation and phosphorus management practices predict the rating of the field to be not greater than 5 for the next determination of the phosphorus index as required by 65.17(17)*"h"*(3).
2. Manure shall not be applied in excess of two times the phosphorus removed with crop harvest over the period of the crop rotation.
3. If, pursuant to 65.17(19), manure is applied at phosphorus-based rates within soil sampling periods on fields in the Medium risk category, each soil sample may represent up to 20 acres for the next required soil sampling.
(4) High (>5-15). Manure shall not be applied on a field with a rating greater than 5 and less than or equal to 15 until practices are adopted which reduce the phosphorus index to at least the Medium risk category. However, prior to December 31, 2008, fields with a phosphorus index greater than 5 and less than or equal to 10 may receive manure at a phosphorus-based rate in accordance with 65.17(19) if practices will be adopted to reduce the phosphorus index to the Medium risk category.
(5) Very High (>15). Manure shall not be applied on a field with a rating greater than 15.
g. Additional commercial fertilizer may be applied as follows on fields receiving manure:
(1) Phosphorus fertilizer may be applied in addition to phosphorus provided by the manure up to amounts recommended by soil tests and Iowa State University extension publication PM 1688, "General Guide for Crop Nutrient Recommendations in Iowa."
(2) Nitrogen fertilizer may be applied in addition to nitrogen provided by the manure to meet the remaining nitrogen need of the crop as calculated in the current manure management plan. Additional nitrogen fertilizer may be applied up to the amounts indicated by soil test nitrogen results or crop nitrogen test results as necessary to obtain the optimum crop yield.
h. Updating the phosphorus index.
(1) When any inputs to the phosphorus index change, an operation shall recalculate the phosphorus index and adjust the application rates if necessary.
(2) If additional land becomes available for manure application, the phosphorus index shall be calculated to determine the manure application rate before manure is applied.
(3) An operation must submit a complete manure management plan using a new phosphorus index for each field in the manure management plan a minimum of once every four years.

65.17(18) *Requirements for application of a nitrogen-based manure rate to a field.*
a. Nitrogen-based application rates shall be based on the total nitrogen content of the manure unless the calculations are submitted to show that nitrogen crop usage rates based on plant-available nitrogen have not been exceeded for the crop schedule submitted.
b. The correction factor for nitrogen losses shall be determined for the method of application by the following

or from other credible sources for nitrogen volatilization correction factors.
Knifed in or soil injection of liquids 0.98
Surface-apply liquid or dry with incorporation within 24 hours 0.95
Surface-apply liquid or dry with incorporation after 24 hours 0.80
Surface-apply liquids with no incorporation 0.75
Surface-apply dry with no incorporation 0.70
Irrigated liquids with no incorporation 0.60
c. Nitrogen-based application rates shall be based on the optimum crop yields as determined in 65.17(6) and crop nitrogen usage rate factor values in Table 4 at the end of this chapter or other credible sources.
d. A nitrogen-based manure rate shall account for legume production in the year prior to growing corn or other grass crops and shall account for any planned commercial fertilizer application.

65.17(19) *Requirements for application of a phosphorus-based manure rate to a field.*
a. Phosphorus removal by harvest for each crop in the crop schedule shall be determined using the optimum crop yield as determined in 65.17(6) and phosphorus removal rates of the harvested crop from Table 4a at the end of this chapter or other credible sources. Phosphorus crop removal shall be determined by multiplying optimum crop yield by the phosphorus removal rate of the harvested crop.
b. Phosphorus removal by the crop schedule shall be determined by summing the phosphorus crop removal values determined in 65.17(19)*"a"* for each crop in the crop schedule.
c. The phosphorus applied over the duration of the crop schedule shall be less than or equal to the phosphorus removed with harvest during that crop schedule as calculated in 65.17(19)*"b"* unless additional phosphorus is recommended by soil tests and Iowa State University extension publication PM 1688, "General Guide for Crop Nutrient Recommendations in Iowa."
d. Additional requirements for phosphorus-based rates.
(1) No single manure application shall exceed the nitrogen-based rate of the planned crop receiving the particular manure application.
(2) No single manure application shall exceed the rate that applies to the expected amount of phosphorus removed with harvest by the next four anticipated crops in the crop schedule.
e. If the actual crop schedule differs from the planned crop schedule, then any surplus or deficit of phosphorus shall be accounted for in the subsequent manure application.
f. Phosphorus in manure should be considered 100 percent available unless soil phosphorus concentrations are below optimum levels for crop production. If soil phosphorus concentrations are below optimum levels for crop production phosphorus availability, values suggested in Iowa State University extension publication PM 1811, "Managing Manure Nutrients for Crop Production" or other credible sources shall be used.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount, source, placement, form and timing of the application of plant nutrients and soil amendments.

PURPOSE

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To protect air quality by reducing nitrogen emissions (ammonia and NO_x compounds) and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient management plan for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to:

- legume credits,
- animal manure and organic by-products,
- waste water,
- commercial fertilizer,
- crop rotation,
- soil nutrient availability,
- and irrigation water.

Land receiving nutrients shall be evaluated for environmentally sensitive areas such as, but not limited to:

- perennial water bodies,
- areas of concentrated flow,
- surface inlets,
- Karst topography,
- wellhead protection areas,
- flood plain,
- coarse textured soils.

Soil and Tissue Sampling and Laboratory Analyses (Testing)

At a minimum, obtain soil test analyses for phosphorus, potassium, and pH. All soil samples shall be collect ed according to Iowa State University (ISU) for sampling methods based on soil maps, management zones, or grid sampling. See ISU PM 287 "Take a Good Sample to Help Make Good Decisions." The minimum frequency for soil testing shall be once during a four-year period for continuous row crop or once during the cycle of other crop rotations that consists of close grown crops such as grasses and legumes. The sampling frequency can be less frequent for organic matter, however no greater than every 12 years.

Use of the Late Spring Nitrate Test and Fall Corn Stalk Test is encouraged in determining rates of nitrogen and/or evaluating the nitrogen management program. See ISU publications PM-1714 "Nitrogen Fertilizer

Recommendations for Corn in Iowa" and PM 1584 "Corn Stalk Test to Determine Nitrogen".

All soil tests shall be analyzed by a soil test lab that is certified according to Iowa Department of Agriculture and Land Stewardship (IDALS) soil test lab certification standards. See ISU-Extension publication, PM-1310 (rev) "Interpretation of Soil Test Results. and PM-1688 "A General Guide for Crop Nutrient and Limestone Recommendations in Iowa."

Nutrient Application Rates

Nutrient application includes form, source, amount, timing and method of application on each field. Plant nutrients may be applied as broadcast, starter, surface band other than starter, or injected band applications. Nutrients shall be applied to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground waters.

All commercial nutrient applications shall be based on ISU recommendations for the soil type and crop to be grown. Use the most recent publications. See ISU-Extension Publications PM1714 "Nitrogen Fertilizer Recommendations for Corn in Iowa", PM-1688 "General Guide for Crop Nutrient Recommendations in Iowa", and PM 869 "Fertilizing Pasture". Unless specific nutrient content for animal manure has been obtained through sample analysis, the nutrient value of animal manures will be estimated using the Agricultural Waste Management Field Handbook (AWMFH), Chapter 4.

All nutrient applications shall be based on realistic yield potential for the field. Guidance for estimating realistic yield potentials is outlined in ISU-Extension Publication PM-1268 (rev) "Establishing Realistic Yields." Realistic yield potentials can be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soils, cropping systems, and soil and manure/organic by-products tests. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Phosphorus and Potassium.

All nutrient values for phosphorus and potassium should be expressed in pounds of P_2O_5 and K_2O.

Phosphorus and potassium application for crop and forage production (including non-crop areas) shall be based on soil test results. Phosphorus and potassium additions shall not exceed crop removal rates when soil test levels are optimum or above unless specified under "Additional Criteria Applicable to Manure and Organic By-Products or Biosolids Applied as a Plant Nutrient Source".

Commercial Nitrogen:

The amount of nitrate-nitrogen that moves below the crop root zone is directly related to nitrogen application rate. Therefore, over-application in an attempt to produce unrealistic yields or offset anticipated losses shall be avoided.

No fall application of commercial nitrogen shall be made with the following exceptions:

- Anhydrous ammonia if: (1) mid-day soil temperatures, at 4"soil depth, is not greater than 50 ^{o}F and trending lower; (2) soil moisture conditions are conducive to proper application and sealing and (3) soil texture conditions favor the retention of applied nitrogen.
- Application of nitrogen associated with products that contain phosphorus and/or potassium.
- Nitrogen associated with the production of winter grains.

For more information consult Iowa State University website on nitrogen management. http://extension.agron.iastate.edu/soilfertility/nutrienttopics/nutrienttopics.html

Where the Late Spring Nitrate Test is not applicable, use the general recommendations for nitrogen found in Iowa State Publications ISU PM-1714 "Nitrogen Fertilizer Recommendations for Corn in Iowa", ISU PM-869 "Fertilizing Pasture", ISU PM-1584 "Cornstalk Testing to Evaluate Nitrogen Management".

All nutrient additions shall be adjusted for contributions from legumes, manure or other organic nutrient sources.

Legume contributions are shown in ISU Publication PM-1714 "Nitrogen Fertilizer Recommendations for Corn in Iowa".

Soil pH shall be maintained at levels shown in ISU Publication PM-1688 "General Guide for Crop Nutrient Recommendations in Iowa". All recommendations are based on Effective Calcium Carbonate Equivalents (ECCE).

For soil tests requiring less than 2000 pounds per acre ECCE, the lime requirement may be waived.

Application equipment for fertilizers and manure shall be calibrated at least annually to determine actual applied rates. After calibration, adjustments can be made in the application process to meet the planned or intended rates.

All specifications will be consistent with federal, state, and local regulations.

Nutrient Application Timing

Timing and method of nutrient application (particularly nitrogen) shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions, risk assessment tools, (e.g., P-index) manure storage capacity and field accessibility.

Nutrient Application Methods

Application methods to reduce the risk of nutrient transport to surface and ground water, or into the atmosphere shall be employed.

To minimize nutrient losses:

- Apply nutrient materials uniformly to application area(s).
- Nutrients shall be applied considering the plant growth habits, irrigation practices, and other conditions so as to maximize availability to the plant and minimize the risk of runoff, leaching, and volatilization losses.
- Nutrient applications associated with irrigation systems shall be applied in a manner that prevents or minimizes resource impairment.

Nutrients and organic nutrient sources shall not be surface applied to frozen, snow covered ground, or saturated soil if a potential risk for runoff exists. A potentia l risk for runoff exis ts on slopes greater than 5% unless erosion is controlled to soil loss tolerance levels ("T") or less. Manure may be surface applied to frozen, snow covered or saturated ground if a potential risk for runoff exists only under one of the following conditions.

- o Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure.
- o On an emergency basis.

Manure surface applied to frozen, snow covered, or saturated ground shall be based on a manure disposal plan. That plan shall include:

- Under what circumstances the manure may be applied to frozen, snow covered, or saturated ground. (Ex: storage capacity exceeded).
- Rates of application.
- Area of application.
- Other requirements such as runoff control as indicated through the use of the Iowa Phosphorus Index assessment tool

Conservation Management Unit (CMU) Risk Assessment

In areas with identified or designated nutrient related water quality impairment, a CMU (which is defined as a portion of a field, field, group of fields, or other land units of the same land use and having similar treatment needs and management plans) shall be assessed for the potential phosphorus transport risk from the area. See Agronomy Technical Note 25,

Iowa Phosphorus Index.
Any one of the following threshold factors will trigger CMU risk assessment:

- The CMU is located in a watershed directly draining into waters identified in the Iowa Department of Natural Resources (DNR) Iowa Integrated Report as impacted by phosphorus. http://wqm.igsb.uiowa.edu/wqa/303d.html
- Manure or organic by-products are applied
- Soil loss exceeds the tolerable level
- The average soil test phosphorus level in the very high range as shown in ISU Publication PM-1688 "General Guide for Crop Nutrient Recommendation in Iowa".

Additional Criteria Applicable to Manure and Organic By-Products or Biosolids Applied as a Plant Nutrient Source

When animal manures or organic by-products are applied, the Iowa Phosphorus Index will be used as the risk assessm ent tool to evaluate the potential for phosphorus transport from the CMU and to adjust the amount, placement, form and timing of application of phosphorus sources.

Manure shall be analyzed for nutrient content of total nitrogen, phosphorus and potassium, percent moisture, and or percent solids. This analysis shall be done at least annually for each different source of manure being generated at the animal feeding operation. Methods for sampling manure are discussed in ISU Publication PM-1558 "How to Sample Manure for Nutrient Analysis".

In planning for new animal feeding operations, acceptable "book values" for the nutrient content and volume of manure that are recognized by the NRCS may be used for the proposed animal feeding operation (NRCS Agricultural Waste Management Field Handbook, Chapter 4). In the alternative, nutrient content and volumes for proposed animal feeding operations may be based on historic nutrient content and volumes from existing animal feeding operations utilizing similar design and management as the proposed animal feeding operation.

For additional information on manure and other organic nutrient management refer to Standard and Specificati on Waste Utilization (633) and the Agricultural Waste Management Field Handbook.

Biosolids (sewage sludge) shall be applied in accordance with USEPA regulations. (40 CFR Parts 403 (Pretreatment) and 503 (Biosolids) and other state and/or local regulations regarding the use of biosolids as a nutrient source.

Manure and Organic By-Product Nutrient Application Rates

Planned application rates of nitrogen and phosphorus shall be determined based on the following guidance:

A. Nitrogen Application.

When determining allowable nutrient application rates from manure or other organic sources, nitrogen may be applied based on crop nitrogen needs for that crop year. This may allow application of more phosphorus and potassium than required by the crop. This practice may continue as long as the risk of phosphorus moving to surface waters based on the Iowa Phosphorus Index is very low, low or medium.

When the plan is being implemented on a phosphorus standard, manure or other organic by-products shall be applied at rates consistent with the phosphorus standard. In such situations, an additional nitrogen application from nonorganic sources may be required to supply the recommended amounts of nitrogen.

Manure or other organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in the harvested portion of the crop that is removed from the field in that growing season.

B. Phosphorus Application.

When manure or other organic by-products are used, the planned rates of phosphorus application shall be determined with reference to the Iowa Phosphorus Index (Agronomy Technical Notice 25). The Iowa Phosphorus Index (Iowa PI) assesses the potential for phosphorus movement from a field to surface water, and designates fields as very low risk, low risk, medium risk, high risk, and very high risk. Conservation practices and/or phosphorus management practices can be adopted that reduce the risk of phosphorus movement and may reduce the risk rating on the field. See Agronomy Technical Notice 25, Iowa Phosphorus Index.

- If a field is rated very low risk, low risk, or medium risk by the Iowa PI, the application of manure or organic by-products may be made based on the nitrogen needs of the crop as set forth in subpart A above.

- If a field is rated in the medium risk category, planned conservation and phosphorus management practices should not increase the rating of the field above the medium risk category.

- If a field is rated high risk or very high risk by the Iowa PI; Manure or organic by-products may be applied to meet the needs of the planned crop rotation for phosphorus removal **if conservation practices and/or phosphorus management practices are adopted to reduce the risk of phosphorus movement.**

Nitrogen application limits of Subpart A above should not be exceeded.

C. Sensitive Areas.

Manure and other organic nutrient sources shall not be applied to the following areas unless injected or incorporated within 24 hours:

- Within 200 feet of sinkholes, drainage wells, or other direct conduits to the groundwater.

- Within 200 feet of lakes, ponds, or other perennial water bodies.

- During the peak flood periods (April, May, June, July) on land that floods more than once every 10 years.

Heavy Metal Monitoring

When sewage sludge or biosolids are applied, the application of potential heavy metal pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be in accordance with the Iowa Administrative Code (IAC) IA567—67 and IAC567--121.

Additional Criteria to Improve the Physical, Chemical and Biological Condition of the Soil

Nutrients shall be applied and managed in a manner that maintains or improves the physical, chemical and biological condition of the soil.

To the extent practicable nutrients shall not be applied when the potential for soil compaction and rutting is high.

CONSIDERATIONS

Considerations are items to be considered during the planning process, however, are not a required component of the nutrient management plan.

The use of management activities and technologies listed in this section may improve both the production and environmental performance of nutrient management systems.

The addition of these management activities, when applicable, increases the management intensity of the system and is recommended in a nutrient management system.

Action should be taken to protect National Register listed and other eligible cultural resources.

Animal feeding operations requiring removal of manure more frequently than annually should consider taking samples more frequently (i.e. seasonally or after material changes to feed rations or other operational aspects of the animal feeding operation that may impact the nutrient content of the manure) .

The nutrient budget should be reviewed annually to determine if any changes are needed for the next planned crop.

For sites on which there are special environmental concerns, other sampling techniques may be appropriate. These include soil profile sampling for nitrogen, Pre-Sidedress Nitrogen Test (PSNT).

Additional practices to enhance the producer's ability to manage manure effectively include modification of the animal's diet to reduce the manure nutrient content, or utilizing manure amendments that stabilize or tie-up nutrients.

Soil test information should be no older than one year when developing new plans, particularly if animal manures are to be used as a nutrient source.

Excessive levels of some nutrients can cause induced deficiencies of other nutrients.

If increases in soil phosphorus levels are expected, consider a more frequent (annual) soil testing interval.

To manage the conversion of nitrogen in manure or fertilizer, use products or materials (e.g. nitrification inhibitors, urease inhibitors and slow or controlled release fertilizers) that more closely match nutrient release and availability for plant uptake. These materials may improve the nitrogen use efficiency (NUE) of the nutrient management system by reducing losses of nitrogen into water and/or air.

Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Ground Water

Erosion control and runoff reduction practices can improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and protect or improve water and air quality (Consider installation of one or more NRCS FOTG, Section IV – Conservation Practice Standards).

Cover crops can effectively utilize and/or recycle residual nitrogen.

Apply nutrient materials uniformly to the application area. Application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere include:

- Split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- Use stalk-test to minimize risk of over applying nitrogen in excess of crop needs.
- Avoid winter nutrient application for spring seeded crops,
- Band applications of phosphorus near the seed row,
- Incorporate surface applied manures or organic by-products as soon as possible after application to minimize nutrient losses,
- Delay field application of animal manures or organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.
- On soils with high permeability (greater than 2 inches per hour through the 5 foot profile), apply nitrogen using split spring preplant/sidedress, at planting/sidedress or sidedress applications to provide distribution of nutrients at a time when plants will utilize the nutrients.
- Limit the application rate of liquid materials applied to not exceed the soil infiltration rate, to minimize ponding, to avoid runoff, and to minimize loss to subsurface tile drains.
- When applying manure to legume crops, limit the crop available nitrogen application to 125 pounds of nitrogen per acre.

Considerations to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere

In areas with an identified or designated nutrient management related air quality concern, any component(s) of nutrient management (i.e., amount, source, placement, form, timing of application) identified by risk assessment tools as a potential source of atmospheric pollutants should be adjusted, as necessary, to minimize the loss(es).

When tillage can be performed, surface applications of manure and fertilizer nitrogen formulations that are subject to volatilization on the soil surface (e.g., urea) should be incorporated into the soil within 24 hours after application.

When manure or organic by-products are applied to grassland, hayland, pasture or minimum-till areas the rate, form and timing of application(s) should be managed to minimize volatilization losses.

When liquid forms of manure are applied with irrigation equipment, operators should select weather conditions during application that will minimize volatilization losses.

Operators should handle and apply poultry litter or other dry types of animal manures when the potential for wind-driven loss is low and there is less potential for transport of particulates into the atmosphere.

Weather and climatic conditions during manure or organic by-product application(s) should be recorded and maintained in accordance with the operation and maintenance section of this standard.

Odors associated with the land application of manures and organic by-products can be offensive to the occupants of nearby homes. When possible, application of these materials upwind of occupied structures when residents are likely to be home (evenings, weekends and holidays) should be avoided.

When applying manure with irrigation equipment, modifying the equipment can reduce the potential for volatilization of nitrogen from the time the manure leaves the application equipment until it reaches the surface of the soil (e.g., reduced pressure, drop down tubes for center pivots). Nitrogen volatilization from manure in a surface irrigation system should be reduced when applied under a crop canopy.

When planning nutrient applications and tillage operations, encourage soil carbon buildup while discouraging greenhouse gas emissions (e.g., nitrous oxide N_2O, carbon dioxide CO_2).

Nutrient applications associated with irrigation systems should be applied in accordance with the requirements of Irrigation Water Management (Code 449).

CAFO operations seeking permits under USEPA regulations (40 CFR Parts 122 and 412) should consult with their respective state permitting authority for additional criteria.

PLANS AND SPECIFICATIONS

Plans and specifications for nutrient management shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize resource impairment.

Nutrient management plans shall include a statement that the plan was developed based on requirements of the current standard and any applicable Federal, state, or local regulations, policies, or programs, which may include the implementation of other practices and/or management activities. Changes in any of these requirements may necessitate a revision of the plan.

The following components shall be included in the nutrient management plan:

- aerial site photograph(s) or site map(s), and a soil survey map of the site,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- current and/or planned plant production sequence or crop rotation,
- results of soil, water, manure and/or organic by-product sample analyses,
- results of plant tissue analyses, when used for nutrient management,
- realistic yield goals for the crops,
- complete nutrient budget for nitrogen, phosphorus, and potassium for the crop rotation or sequence,
- listing and quantification of all nutrient sources,
- CMU specific recommended nutrient

application rates, timing, form, and method of application and incorporation, and

- guidance for implementation, operation, maintenance, and recordkeeping.

If increases in soil phosphorus levels are expected, the nutrient management plan shall document:

- the soil phosphorus levels at which it may be desirable to convert to phosphorus based planning,
- results of appropriate risk assessment tools to document the relationship between soil phosphorus levels and potential for phosphorus transport from the field,
- the potential for soil phosphorus drawdown from the production and harvesting of crops, and
- management activities or techniques used to reduce the potential for phosphorus loss.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised with each soil test cycle.
- significant changes in animal numbers and/or feed management will necessitate additional manure sampling and analyses to establish a revised average nutrient content.
- protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
- calibration of application equipment to ensure uniform distribution of material at planned rates.
- documentation of the actual rate at which nutrients were applied. When the actual rates used differ from the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:
  - Soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application,
  - quantities, analyses and sources of nutrients applied,
  - dates and method(s) of nutrient applications,
  - weather conditions and general soil moisture (e.g. wet, damp, dry) at the time of application; lapsed time to manure incorporation, rainfall or irrigation event.
  - crops planted, planting and harvest dates, yields, and crop residues removed,
  - dates of plan review, name of reviewer, and recommended changes resulting from the review.

Records should be maintained for five years; or for a period longer than five years if required by other Federal, state or local ordinances, or program or contract requirements.

Workers should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling ammoniacal nutrient sources, or when dealing with organic wastes stored in unventilated enclosures.

Material generated from cleaning nutrient application equipment should be utilized in an environmentally safe manner. Excess material should be collected and stored or field applied in an appropriate manner.

Nutrient containers should be recycled in compliance with state and local guidelines or regulations.

REFERENCES

These publications are available at County Extension Offices; Ex tension Distribution Center, Printing Building, Iowa State University, Ames, IA 50011; and several are available on the ISU Publications Home page at http://www.extension.iastate.edu/Pages/pubs/.

- ISU PM-1310 "Interpretation of Soil Test Results"
- ISU PM-287 "Take a Good Sample to Help Make Good Decisions"
- ISU PM-1714 "Nitrogen Fertilizer Recommendations for Corn in Iowa"
- ISU PM-2015 "Concepts and Rationale for Regional Nitrogen Rate Guidelines for Corn"
- ISU PM-1688 "General Guide for Crop Nutrient Recommendations in Iowa"
- ISU PM-869 "Fertilizing Pasture"
- ISUPM-1268(rev) "Establishing Realistic Yields"
- ISU PM-1584 "Cornstalk Testing to Evaluate Nitrogen Management"
- ISU PM-1436 "Nitrogen Fertilizer Management for Northeast Iowa"
- ISU PM-569 "Warm-Season Grasses for hay and Pasture"
  ISU PM-1558 "How to Sample Manure for Nutrient Analysis"
- ISU PM-1941 "Calibration and Uniformity of Solid Manure Spreaders"
- ISU PM-1948 "Calibrating Liquid Tank Manure Applicators"

The following publication is available on the NRCS web site at http://policy.nrcs.usda.gov/viewerFS.aspx?hid=21430

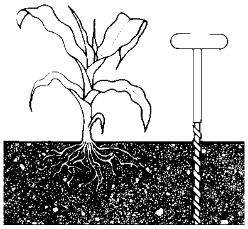
- Agricultural Waste Management Field Handbook

The following Standard on Manure Production and Characteristics is available from the American Society of Agricultural and Biological Engineers. http://asae.frymulti.com/standards.asp

- ASABE D384.2 MAR2005

The following publications are available at the Iowa Conservation Partners Home page at: http://www.ia.nrcs.usda.gov.

- Iowa Technical Note 25, Iowa Phosphorus Index
- Background and Basic Concepts of the Phosphorus Index
- Phosphorus Index Calculator (Excel Spreadsheet)
- Waste Utilization Standard (633)



Nitrogen Fertilizer Recommendations for Corn in Iowa

This pamphlet replaces all earlier guidelines for using the late-spring test for soil nitrate and all previous nitrogen fertilizer recommendations based on corn yield goals and credits for N supplied by legumes and animal manures. Recommendations concerning applications of animal manures are provided in Pm-1596a, *Managing manure nutrients for crop production*.

Nitrogen fertilization is essential for profitable corn production. It also is a major cost of production and can contribute to degradation of the environment. The economic and environmental costs of N fertilization are more important than in the past, and they are likely to become even more important in the future. These costs provide compelling reasons for intensifying efforts to improve N management practices.

The late-spring test for soil nitrate is a new technology that enables site-specific assessments of plant-available N just before the crop begins rapid uptake of N. Use of this test should help corn producers manage N to increase their profits while reducing environmental degradation. All producers are encouraged to use this test, but the way the test is used depends on whether or not the producer exercises the option for in-season fertilization (i.e., N applications after corn plants are 6 inches tall).

Producers who apply all their N before emergence of the crop (i.e., before planting, at planting, soon after planting) should apply N at rates indicated in Table 1 and use the late-spring test to evaluate their N management. Select rates within the ranges given by considering price for fertilizer, expected price for grain, supply of subsoil moisture, and feedback given by the end-of-season cornstalk test in previous years. If price and yield outlook are favorable, select the upper part of the range; if unfavorable, select the lower part of the range.

Table 1. Rates of N usually needed if all N is applied preplant or before crop emergence (option for in-season application of N not exercised).

Crop category	N rate (lb. N/acre)
Corn on recently manured soils	0-90
Corn after established alfalfa	0-30
2nd-year corn after alfalfa	0-60
Other corn after corn	150-200
Corn after soybean (no manure)	100-150

Additional information is provided on page 4.

Producers who use the option for in-season fertilization (i.e., split applications or all applied after corn plants are 6 inches tall) should apply N at rates indicated in Table 2 and then use the late-spring test to estimate additional amounts of N needed. Rates within the range given should be selected based on the extent to which the producer wants to rely on in-season fertilization, amounts of rainfall during the previous six months, and feedback given by the end-of-season cornstalk test in previous years.

Application of some N before crop emergence is desirable to avoid the possibility of early-season deficiencies and to reduce risks associated with weather conditions that prevent in-season fertilization. Application of all N before planting, however, reduces the ability to adjust N rates for the effects of spring weather on amounts of N supplied by the soil or the amounts lost during spring rainfall. Use of the late-spring test over a period of years provides information that can be used to optimize pre-emergence applications of N.

Table 2. Rates of N to apply before crop emergence if the option for in-season fertilization is exercised.

Category	N rate (lb. N/acre)
Corn on recently manured soils	0-30
Corn after established alfalfa	0-30
2nd-year corn after alfalfa	0-30
Other corn after corn	50-125
Corn after soybean (no manure)	0-75

The 30-lb. rates could be applied as a starter.

IOWA STATE UNIVERSITY
University Extension
Ames, Iowa

LEOPOLD CENTER

Pm-1714 | May 1997

Soil Sampling and Testing

Time of Soil Sampling

Soil samples should be collected when corn plants are 6 to 12 inches tall (measured from the ground surface to the center of the whorl).

Selecting Test Areas

Soil samples should be collected within several test areas that are 1 to 10 acres and seemingly uniform with respect to soil characteristics and management histories. Care should be taken to avoid unusual spots (e.g., sites of old barnyards, feedlots, or manure piles, field edges or ends where fertilizer applicators may have made skips or double applications, abnormal patches of growing weeds or plant residues, or small areas where corn plants suggest differences in N availability).

The optimal number of test areas per farm should be expected to vary with many factors. First-year users of the test should consider testing about five areas for the first 100 acres and two more areas for each additional 100 acres. Information gathered in the first year can be used to help select future sampling strategies that are appropriate for a particular farm.

Depth of Soil Sampling

Samples collected for the late-spring soil test must be representative of the surface foot of soil.

Number of Cores per Sample

Soil samples analyzed for this test should be derived from at least 16 to 24 cores. Care should be taken to ensure that the soil samples are collected in a manner that is not biased by the presence of corn rows or bands of fertilizer. At least 24 cores should be collected if anhydrous ammonia was applied for the present crop.

Sampling bias can be minimized by collecting soil samples in “sets of eight” cores that have various assigned positions relative to corn rows. By this method, the person doing the sampling moves in a random pattern within the test area to select approximate positions for collecting cores. Each time a core is collected, however, its exact position is selected relative to the two nearest corn rows. The first core is collected in a row. The second is collected one-eighth of the distance between any two rows after moving to another part of the test area. The third is collected one-quarter of the distance between any two corn rows after moving to another part of the test area. The process is continued until the eighth core is collected seven-eighths of the distance between any two corn rows.

The soil from all cores should be crushed and thoroughly mixed before a subsample is removed for analysis.

Handling and Shipping Soil Samples

Moist soil samples should be protected from temperatures above 75°F and should be refrigerated if they cannot be analyzed within two days. Mailing usually poses no problem if the samples are without refrigeration for no more than two days. Assume that soil testing laboratories will protect the samples as soon as they are received.

Soil samples expected to be without refrigeration for more than two days should be dried as soon as possible. Samples can be air-dried by spreading in a thin layer on paper — a fan will accelerate drying. Samples can be dried in an oven provided the temperature does not exceed 250° F.

Soils that are extremely wet or muddy should not be sampled. Incorrect results will be obtained if water “drips” from the samples.

Soil Analysis

The late-spring test is based on concentrations of nitrate-nitrogen (NO_3^--N) in the soil sample. Most soil testing laboratories can perform this analysis. Nitrate concentrations also can be measured on the farm by using commercially available kits.

This pamphlet expresses nitrate concentrations in terms of ppm nitrate-N (parts of N per million parts of dry soil), which is the same as ppm N as nitrate. Concentrations expressed as ppm nitrate must be multiplied by 0.23 to be converted to ppm nitrate-N.

Users of the soil test should be alert to the possibility of incorrect results on individual samples. Errors can occur during collection, handling, and analysis of samples. The impact of such errors can be substantially reduced by observing trends in soil test results and using caution when making recommendations on results that deviate from these trends.

Soil Test-based N Recommendations

Manured Soils, First-year Corn After Alfalfa, and Second-year Corn After Alfalfa

Soils that have received recent applications of animal manures or have decaying sods with alfalfa roots seem to mineralize more plant-available N after the time of soil sampling than do other soils. These soils, therefore, are treated as a separate category when making N fertilizer recommendations. These recommendations are given in Table 3.

The first step for making recommendations from Table 3 is to decide whether the top half of the table or the lower half of the table best describes the current prices for grain and fertilizer.

Table 3. Nitrogen fertilizer recommendations for manured soils[a] and corn after alfalfa.

Grain and fertilizer prices	Soil test nitrate	Recommended N rate	
		Excess[b] Rainfall	Normal Rainfall
	ppm N	——— lb. N/acre———	
Unfavorable	0-10	90	90
(1 bu buys	11-15	0	60
7 lb. of N)	16-20	0	0[c]
	> 20	0	0
Favorable	0-10	90	90
(1 bu buys	11-15	60	60
15 lb. of N)	16-25	0	30
	> 25	0	0

[a] A field should be considered manured if animal manures were applied with a reasonable degree of uniformity since harvest of the previous crop or in 2 of the past 4 years.
[b] Rainfall should be considered excess if rainfall in May exceeded 5 inches.
[c] Addition of 30 lb. N/acre may have no detectable effects on profits, but producers could reasonably elect to apply this rate.

The second step is to decide whether the "excess rainfall" column or the "normal rainfall" column of the table best describes weather conditions before the soils were sampled.

The third step is to use the results of the soil test to select the appropriate N rate specified. Interpolation between specified N rates is appropriate when site conditions fall between those given.

Corn After Soybean and Corn After Corn

The first step in making a fertilizer recommendation for this crop category is to select a critical concentration for nitrate (i.e., the concentration that distinguishes between adequate and inadequate supplies of available N). A critical concentration of 25 ppm-N is appropriate in absence of additional information.

The second step is to adjust the critical concentration if excess rainfall occurred at the site shortly before the soils were sampled. Reducing the critical concentration by 3 to 5 ppm is advised if rainfall is more than 20 percent above normal amounts between April 1 and time of soil sampling.

The third step is to estimate fertilizer needs by subtracting the concentration of soil-test nitrate (ppm-N) from the chosen critical concentration (ppm-N). This value is then multiplied by 8. A factor of 8 is used because studies have shown that it usually takes about 8 lb. of N/acre before planting to increase soil-test nitrate-N by 1 ppm.

Examples: A soil test of 15 ppm and a critical concentration of 25 ppm results in a recommendation of 80 lb. of N per acre to be applied.

(25 ppm - 15 ppm) x 8 = 80 lb. N/acre needed

A soil test of 35 ppm and a critical concentration of 25 ppm indicates that the soil already has approximately 80 lb. of N more than needed.

(25 ppm - 35 ppm) x 8 = -80 lb. N/acre needed.

Additional Information

Yield Goals and Nitrogen Credits

Yield goals (or potentials) are no longer used when making N fertilizer recommendations because research has shown no relationship between optimal rates of N fertilization and yields at these optimal rates.

The use of legume and(or) manure credits has been eliminated. The effects of those sources of N are addressed by giving recommendations for separate categories.

Addressing Variability

The best rate of N fertilization for corn varies greatly with year and location. This variability is caused by complex interactions of soil factors, management practices, and weather. Time and method of N application are important because they influence amounts of N lost before it can be used by the corn.

Great variability in optimal rates of N fertilization is a problem because the best rates across a wide range of conditions usually are not best for most individual sites in a given year. This problem was unavoidable in the past, but advances in technology offer new opportunities for site-specific management of N.

Users of the soil test should expect much greater variability in amounts of N supplied by animal manures and legumes than would be expected from commonly used methods to calculate N credits. Research has shown that this variability should be considered a reason for using the soil test rather than evidence that the test is not reliable.

Reliability of the Soil Test

The soil test should be considered only a tool for estimating availability of N in soils. Like any tool, the usefulness of this test varies with the skill of the user. First-time users are encouraged to experiment with the test in small areas before using it to guide fertilization on all their fields.

Recommendations for using the soil test are intended to maximize profits for the producer when used across many sites and years. Because many factors that influence fertilizer needs at a specific site and year happen after the soils are tested, the soil test should not be expected to be a perfect predictor of fertilizer needs. Use of the soil test is recommended because it is more reliable than other methods of estimating N fertilizer needs. Moreover, it is likely that the reliability of the soil test can be improved as new knowledge is acquired.

Where Caution is Required

The soil test may underestimate amounts of plant-available N when (1) nitrification inhibitors or urease inhibitors are applied with fertilizers, (2) more than 150 lb. N/acre are applied as anhydrous ammonia, and (3) more than 150 lb. N/acre are applied as injected manure.

Use of the soil test on sandy soils may require deeper sampling if fertilizers are applied before crop emergence and unusually large amounts of rainfall occur between fertilization and sampling. There are relatively few sandy soils in Iowa.

End-of-season Cornstalk Testing

Users of the late-spring test are encouraged to use the end-of-season cornstalk test, which is described in ISU Extension factsheet, *Cornstalk Testing to Evaluate Nitrogen Management,* Pm-1584. The end-of-season test essentially asks if the corn crop had too little, too much, or optimal amounts of N. The resulting information can be used to evaluate the reliability of the soil test or any other system of making N recommendations. When used over a period of several years, information provided by the cornstalk test can be used to help select rates of N application that are most appropriate for the soil factors and management practices that make sites differ in N fertilizer requirements.

Prepared by A.M. Blackmer and R.D. Voss, professors; and A. P. Mallarino, assistant professor, ISU Department of Agronomy.

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A General Guide for Crop Nutrient and Limestone Recommendations in Iowa

Iowa State University
University Extension

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Contents

General Guide for Crop Nutrient and Limestone Recommendations in Iowa

Introduction

Phosphorus (P), potassium (K), zinc (Zn), and lime recommendations based on soil testing are provided in this publication for the major agronomic crops grown in Iowa. Interpretation of soil test values and nutrient recommendations are based on soil samples taken to a 6- to 7-inch depth. Research results from long-term and short-term field experiments have been used to determine the interpretation of soil test values and the nutrient recommendations.

Nutrients applied to meet the recommended amounts may be from inorganic sources, from manure, or both. Nutrient contents of manures are most accurately determined by laboratory analyses.

Soil Test Procedures

The soil tests for which interpretations are given in this publication are the Bray P_1, Mehlich-3, and the Olsen tests for P, the ammonium acetate and Mehlich-3 tests for K, the DTPA test for Zn, a water-soil slurry for soil pH, and the SMP buffer method for lime requirement. The Bray P_1 test is not recommended for soils with soil pH 7.4 or higher (calcareous) because it often underestimates plant-available P in those soils and can return false low values. Soil test P interpretations in this publication apply when a colorimetric method is used to measure the P extracted by the Bray P_1, Mehlich-3, and Olsen P tests. These tests, and those for soil pH and buffer pH, are among the tests recommended for the North Central Region by the NCR-13 Regional Committee on Soil Testing and Plant Analysis. These and other tests are described in the North Central Regional Publication 221 (Revised 1998), *Recommended Chemical Soil Test Procedures for the North Central Region*. In addition, soil test P interpretations are provided when an ICP (inductively coupled plasma) analytical method is used to measure the P extracted by the Mehlich-3 P test (Mehlich-3 ICP). All laboratory procedures have some inherent variability and thus soil test results should be viewed as a potential range in values. The ranges in variation for routine soil test results produced within a laboratory are expected to be on the order of ±10% for soil test P and K, and ±0.1 pH unit.

Soil Test Categories

Soil test numerical values are reported as parts per million (ppm). Soil test values for P and K have been classified into interpretive categories designated very low (VL), low (L), optimum (Opt), high (H), and very high (VH). These categories represent a decreasing probability of an economic yield response to applied nutrients. The percentage of P and K applications expected on average to produce a yield response within each soil test category is 80% for very low, 65% for low, 25% for optimum, 5% for high, and <1% for very high. Based on input costs and expected yield increases, the optimum category is the most profitable category to maintain over time. The very high category indicates that the nutrient concentration exceeds crop needs, and further additions of that nutrient very seldom produce a profitable yield response. Recommended applications are structured so that over time soil tests will move to the optimum category.

Soil test categories for the numerical soil test values of P and K are given in Table 1. The interpretation of P and K soil test values into categories depends on the nutrient demand of the crop to be grown, the subsoil concentrations of P and K, and the soil test value. The interpretation of P soil test values for wheat and alfalfa is different than for the other agronomic crops indicating that these two crops require a higher soil P level in the surface soil for profitable production. The interpretation of P soil test values for all crops other than wheat and alfalfa, and K soil test values for all agronomic crops, differs according to subsoil P and K levels of the soil series.

Subsoil P and K levels are determined at the depth that provides the greatest range of soil test values for each nutrient. Subsoil P is determined by the Bray P_1 soil test for samples taken from the 30- to 42-inch depth. Subsoil K is determined by the ammonium acetate soil test for samples taken from the 12- to 24-inch depth. Subsoil P is designated low for subsoil test values of 8 ppm or less and high for values of 9 ppm or more. Subsoil K is designated low for subsoil test values of 50 ppm or less and high for values of 51 ppm or more. The effect of a high subsoil level of P or K is to require a lower concentration of that nutrient in the surface soil for optimum crop production.

Subsoil P and K levels for soil series with more than 5,000 acres and a corn suitability rating (CSR) greater than 30 are given in Table 15 for each of the major soil areas in Iowa that contain the principal soil associations shown in Figure 1. Subsoil levels do vary by soil series but not by soil mapping units within a soil series.

Table 1. Interpretation of soil test values for phosphorus (P) determined by Bray P_1, Mehlich-3, or Olsen extractants and potassium (K) determined by ammonium acetate or Mehlich-3 extractants for surface soil samples (6- to 7-inch deep cores).

Relative level	Wheat, alfalfa	All crops except wheat, alfalfa: Subsoil P Low	All crops except wheat, alfalfa: Subsoil P High	All crops: Subsoil K Low	All crops: Subsoil K High
	ppm				
	Bray P_1 or Mehlich-3 P			Ammonium Acetate or Mehlich-3 K	
Very low (VL)	0–15	0–8	0–5	0–90	0–70
Low (L)	16–20	9–15	6–10	91–130	71–110
Optimum (Opt)	21–25	16–20	11–15	131–170	111–150
High (H)	26–30	21–30	16–20	171–200	151–180
Very high (VH)	31+	31+	21+	201+	181+
	Olsen P				
Very low (VL)	0–10	0–5	0–3		
Low (L)	11–14	6–10	4–7		
Optimum (Opt)	15–17	11–14	8–11		
High (H)	18–20	15–20	12–15		
Very high (VH)	21+	21+	16+		
	Mehlich-3 ICP				
Very low (VL)	0–20	0–15	0–10		
Low (L)	21–30	16–25	11–20		
Optimum (Opt)	31–40	26–35	21–30		
High (H)	41–50	36–45	31–40		
Very high (VH)	51+	46+	41+		

Phosphorus and Potassium Recommendations

The recommended amounts of P_2O_5 and K_2O are based on research conducted in Iowa during many years. Applying the recommended rates for the very low and low soil test categories will result in profitable crop responses in that year and at the same time increase soil test values after crop harvest because of significant residual effects from the applied P and K.

The recommended P and K rates for the optimum soil test category are based on average nutrient removal in harvested crop parts (grain, silage, straw, and hay). The fertilization amounts shown in the tables for the optimum soil test category use default yield levels. These can be adjusted to a field-specific yield. The nutrient content per unit of yield for Iowa agronomic crops is given in Table 2.

Table 2. The nutrient content of harvested crops used to calculate nutrient removal and recommended amounts of P_2O_5 and K_2O for optimum soil test category.

Crop	Unit of Yield	Pounds per unit of yield: P_2O_5	Pounds per unit of yield: K_2O
Corn	bu	0.375	0.30
Corn silage	bu grain equivalent	0.55	1.25
Corn silage	ton, 65% H_2O	3.50	8.0
Corn stover*	ton	5.9	25.0
Soybean	bu	0.80	1.5
Soybean stover*	ton	2.8	9.9
Oat and straw	bu	0.40	1.0
Oat straw	ton	5.0	33.0
Wheat	bu	0.60	0.30
Wheat straw	ton	4.0	25.0
Sunflower	100 lb	0.80	0.70
Alfalfa	ton	12.50	40.0
Red clover	ton	12.0	35.0
Trefoil	ton	12.0	35.0
Vetch	ton	12.0	47.0
Smooth bromegrass	ton	9.0	47.0
Orchardgrass	ton	14.0	68.0
Tall fescue	ton	12.0	66.0
Timothy	ton	9.0	32.0
Perennial ryegrass	ton	12.0	34.0
Sorghum-sudan	ton	12.0	38.0
Switchgrass	ton	12.0	66.0
Reed canarygrass	ton	9.0	47.0

*Nutrients in corn and soybean stover reflect content at plant maturity (dry matter based), and will therefore be more representative of stover harvested immediately after grain harvest. Corn stover is an average content of all aboveground plant components except grain. Soybean stover is nutrient content only of stems.

The recommendation tables provide suggested P and K applications intended for a single crop grown after soil sampling. Economic considerations suggest that a new soil test should be planned every two to four years for most crops. For P and K applications after the initial crop year and between soil testing years, and for multi-year applications planned for consecutive grain crops (for example, multi-year application for corn-soybean and corn-corn rotations), adjustment should be made to the recommended annual amounts. Available research data suggest that when recommended P and K amounts are applied to soils that test in the very low category, recommended amounts for the low category can be applied to subsequent crops until the next planned soil testing, but not for more than three years. When the recommended P and K amounts are applied to soils that test in the low category, recommended amounts for the optimum category can be applied to subsequent crops until the next planned soil testing, but not for more than three years. When soil tests are in the optimum category, the crop removal amount can be applied each year. For grain crops, an amount equivalent to the sum over two crop years can be applied in one application. Annual P and K applications are recommended for silage or forage crops to minimize excessive nutrient removal when large nutrient rates are applied at one time.

The optimum soil test category is the most profitable to maintain. Phosphorus and K application in the high category seldom produces a profitable yield increase, and no recommendation is made for annual (one crop-year) application. However, if the soil test is in the lower part of the high range, a multi-year application is planned for grain crops (for example, consecutive corn and soybean crops), and it will be two to four years until the next soil sampling, consider applying a partial crop removal rate during that period to ensure adequate nutrients for subsequent crops and to moderate soil test decline. The very high soil test category indicates that the nutrient concentration exceeds crop needs, and further additions of that nutrient very seldom produce a yield response. Therefore, no application is recommended for the very high category.

Method of Application

The recommended amounts for P and K are based on yield responses to applications in many tillage systems—from conventional-tillage to reduced-tillage and no-tillage systems. Research has shown that in most reduced-tillage systems equivalent crop responses are expected for broadcast, 2×2 band, and deep band P and K applications. The exceptions are for K in ridge-tillage corn and soybean where bands placed into the ridge provide higher yields than broadcast, and K in no-tillage corn where deep banding can produce greater yield response than broadcast or 2×2 band placement. However, on average the no-tillage corn yield increase from deep K banding is not large and may often not pay for the increased application costs.

Application of banded NP or NPK starter fertilizer for corn in the high soil test category may be advantageous under conditions of limited soil drainage, cool soil, crop residues on the soil surface, or late planting dates with full-season hybrids. Placement of starter fertilizer with corn seed should be limited to 10 pounds or less of N + K_2O per acre to reduce the risk of decreased plant stand. If soils are sandy or dry, reduce the amount of N + K_2O by one-half. It is recommended that no fertilizer be placed in contact with soybean seed.

Table 3. Phosphorus and potassium recommendations for corn grain production.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
			P_2O_5 to apply (lb/acre)		
	100	75	55	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
			K_2O to apply (lb/acre)		
Fine Textured	130	90	45	0	0
Sandy Textured	110	70	45	0	0

*The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on approximate nutrient removal for the harvested yield. The amounts shown in the table for the optimum soil test category are based on 150 bu corn grain per acre. Nutrient removal amounts can be adjusted higher or lower for other yield levels. At the high soil test category, banded NP or NPK starter fertilizer may be advantageous under conditions of limited soil drainage, cool soil, crop residues on the soil surface, or late planting dates with full-season hybrids. None is recommended for the very high soil test category. Recommendations for soils with a corn suitability rating (CSR) of 30 or less should be based on expected crop yield and nutrient removal for soil test categories of optimum or lower.

Table 4. Phosphorus and potassium recommendations for soybean production.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
			P_2O_5 to apply (lb/acre)		
	80	60	40	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
			K_2O to apply (lb/acre)		
Fine Textured	120	90	75	0	0
Sandy Textured	100	85	75	0	0

*The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on approximate nutrient removal for the harvested yield. The amounts shown in the table for the optimum soil test category are based on 50 bu soybean grain per acre. Nutrient removal amounts can be adjusted higher or lower for other yield levels. Recommendations for soils with a corn suitability rating (CSR) of 30 or less should be based on expected crop yield and nutrient removal for soil test categories of optimum or lower.

Table 5. Phosphorus and potassium recommendations for oat grain and straw production.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
			P_2O_5 to apply (lb/acre)		
	50	40	30	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
			K_2O to apply (lb/acre)		
All Soil Textures	100	90	80	0	0

*The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on approximate nutrient removal for the harvested yield. The amounts shown in the table for the optimum soil test category are based on 80 bu oat grain per acre and straw. Nutrient removal amounts can be adjusted higher or lower for other yield levels.

Table 6. Phosphorus and potassium recommendations for wheat production.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
All Subsoil P Levels	0–15	16–20	21–25	26–30	31+
Olsen P:					
All Subsoil P Levels	0–10	11–14	15–17	18–20	21+
Mehlich-3 ICP:					
All Subsoil P Levels	0–20	21–30	31–40	41–50	51+
			P_2O_5 to apply (lb/acre)		
	60	50	30	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
			K_2O to apply (lb/acre)		
All Soil Textures	70	40	15	0	0

*The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on approximate nutrient removal for the harvested yield. The amounts shown in the table for the optimum soil test category are based on 50 bu wheat grain per acre. Nutrient removal amounts can be adjusted higher or lower for other yield levels.

Table 7. Phosphorus and potassium recommendations for sunflower production.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
			P_2O_5 to apply (lb/acre)		
	70	50	15	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
			K_2O to apply (lb/acre)		
All Soil Textures	90	50	15	0	0

*The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on approximate nutrient removal for the harvested yield. The amounts shown in the table for the optimum soil test category are based on 2,000 lb sunflower seed per acre. Nutrient removal amounts can be adjusted higher or lower for other yield levels.

Table 8. Phosphorus and potassium recommendations for corn silage or sorghum silage production.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
			P_2O_5 to apply (lb/acre)		
	105	90	75	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
			K_2O to apply (lb/acre)		
Fine Textured	240	210	175	0	0
Sandy Textured	220	200	175	0	0

*The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on approximate nutrient removal for the harvested yield. The amounts shown in the table for the optimum soil test category are based on approximately 22 tons corn silage per acre. Nutrient removal amounts can be adjusted higher or lower for other yield levels. At the high soil test category, banded NP or NPK starter fertilizer may be advantageous under conditions of limited soil drainage, cool soil, crop residues on the soil surface, or late planting dates with full-season hybrids. None is recommended for the very high soil test category. Recommendations for soils with a corn suitability rating (CSR) of 30 or less should be based on expected crop yield and nutrient removal for soil test categories of optimum or lower.

Table 9. Phosphorus and potassium recommendations for alfalfa and alfalfa-grass hay and pastures.

	Phosphorus Soil Test (ppm)				
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
All Subsoil P Levels	0–15	16–20	21–25	26–30	31+
Olsen P:					
All Subsoil P Levels	0–10	11–14	15–17	18–20	21+
Mehlich-3 ICP:					
All Subsoil P Levels	0–20	21–30	31–40	41–50	51+
	P_2O_5 to apply (lb/acre)				
	110	80	60	0	0

	Potassium Soil Test (ppm)				
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
	K_2O to apply (lb/acre)				
All Soil Textures	280	240	200	0	0

*For soils that test in the high soil test P category, 30 lb P_2O_5 per acre is recommended at seeding time. The recommended amounts of P_2O_5 and K_2O for the optimum soil test category are based on 5 ton per acre of harvested hay. Nutrient removal amounts can be adjusted higher or lower for other yield levels. For pastures, reduce the amount in all soil test categories for phosphorus to two-thirds and for potassium to one-half of the amount indicated for hay because more nutrients are returned to the soil when grazing.

Table 10. Phosphorus and potassium recommendations for clover- and trefoil-grass hay and pastures.

	Phosphorus Soil Test (ppm)				
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
	P_2O_5 to apply (lb/acre)				
	80	60	40	0	0

	Potassium Soil Test (ppm)				
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
	K_2O to apply (lb/acre)				
All Soil Textures	180	140	100	0	0

*The recommended amounts of P_2O_5 and K_2O in the optimum test category are based on 3 ton per acre of harvested hay. Nutrient removal amounts can be adjusted higher or lower for other yield levels. For pastures, reduce the amount in all soil test categories for phosphorus to two-thirds and for potassium to one-half of the amount indicated for hay because more nutrients are returned to the soil when grazing.

Table 11. Phosphorus and potassium recommendations for tall cool-season grasses, warm-season perennial grasses, and sorghum-sudan hay and pastures.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
Low Subsoil P	0–8	9–15	16–20	21–30	31+
High Subsoil P	0–5	6–10	11–15	16–20	21+
Olsen P:					
Low Subsoil P	0–5	6–10	11–14	15–20	21+
High Subsoil P	0–3	4–7	8–11	12–15	16+
Mehlich-3 ICP:					
Low Subsoil P	0–15	16–25	26–35	36–45	46+
High Subsoil P	0–10	11–20	21–30	31–40	41+
	P_2O_5 to apply (lb/acre)				
	90	60	30	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum***	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
Low Subsoil K	0–90	91–130	131–170	171–200	201+
High Subsoil K	0–70	71–110	111–150	151–180	181+
	K_2O to apply (lb/acre)				
All Soil Textures	160	120	80	0	0

*The amounts of P_2O_5 and K_2O for the optimum category can be adjusted for approximate nutrient removal for the harvested yield. For pastures, reduce the amount in all soil test categories for phosphorus to two-thirds and for potassium to one-half of the amount indicated for hay because more nutrients are returned to the soil when grazing.

Table 12. Phosphorus and potassium recommendations for bluegrass dominant pasture.

Phosphorus Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum**	**High**	**Very High**
Bray P_1 and Mehlich-3 P:					
All Subsoil P Levels	0–8	9–15	16–20	21–30	31+
Olsen P:					
All Subsoil P Levels	0–5	6–10	11–14	15–20	21+
Mehlich-3 ICP:					
All Subsoil P Levels	0–15	16–25	26–35	36–45	46+
	P_2O_5 to apply (lb/acre)				
	40	30	0	0	0

Potassium Soil Test (ppm)					
Soil Test Category:	**Very Low**	**Low**	**Optimum**	**High**	**Very High**
Ammonium Acetate and Mehlich-3 Extractable K:					
All Subsoil K	0–90	91–130	131–170	171–200	201+
	K_2O to apply (lb/acre)				
All Soil Textures	40	30	0	0	0

Micronutrients Recommendations

Iowa State University recommends only zinc (Zn) for corn and sorghum based on soil testing. The Zn soil test has been calibrated on Iowa soils. Zinc recommendations for corn and sorghum are given in Table 13.

Soil test procedures for the other micronutrients have not been calibrated because of either lack of or inconsistency of occurrence of deficiencies with the exception of iron deficiency on soybean. Iron deficiency on soybean occurs on high pH (calcareous) soils in central and north central Iowa and can be predicted by soil occurrence as shown in soil survey reports. Development of soybean varieties tolerant to low iron availability in calcareous soils has been an acceptable solution to the problem.

Table 13. Zinc recommendations for corn and sorghum production.

	Zinc Soil Test (ppm)		
Soil Test Category:	**Low**	**Marginal**	**Adequate**
DTPA Extractable Zn:	0–0.4	0.5–0.8	0.9+
		Zn to apply broadcast (lb/acre)	
	10	5	0
		Zn to apply in band (lb/acre)*	
	2	1	0

*Recommendation for amount to apply in band is based on other states' information.

Limestone Recommendations

Limestone recommendations (Table 14) are given in pounds of pure fine calcium carbonate ($CaCO_3$). The recommended amounts listed in Table 14 are for different soil Buffer pH, intended soil pH, and depth of soil to be neutralized. Actual rates of limestone to apply are calculated from the recommended $CaCO_3$ rate (Table 14) and the effective calcium carbonate equivalent (ECCE) of the limestone product to be applied (ECCE is determined for all agricultural limestone sources in Iowa). Soil pH is used to determine whether or not to lime the soil. The SMP Buffer (also termed the Ohio Buffer) solution has been calibrated to determine the amount of lime required to increase soil pH to a specific pH.

Recommendations are given to increase soil pH to 6.5 or to 6.9. Soil pH 6.0 is considered to be sufficient for grass pastures and grass haylands. Soil pH 6.9 is recommended for alfalfa. Soil pH 6.5 is considered to be sufficient for corn and soybean. Because of high pH (pH > 7.4) in the subsoil of the Clarion-Nicollet-Webster, Galva-Primghar-Sac, Moody, Ida-Monona, Marshall, and Luton-Onawa-Salix soil associations, soil pH 6.0 is considered sufficient for corn and soybean grown in these soil associations, but when liming is required, lime is recommended to raise soil pH to 6.5.

The amount of limestone recommended is adjusted for the incorporation depth from tillage, which determines the volume of soil to be neutralized. The equivalent depth for no-till is considered to be 2 to 3 inches.

Table 14. Lime recommendations, based on SMP Buffer Test, are given in pounds of pure fine calcium carbonate ($CaCO_3$) to increase soil pH from its present level to pH 6.5 or 6.9 for the depth of soil to be neutralized.

	Depth of soil to be neutralized*							
Buffer	**2 inch**		**3 inch**		**6 inch**		**8 inch**	
pH	**pH 6.5**	**pH 6.9**	**pH 6.5**	**pH 6.9**	**pH 6.5**	**pH 6.9**	**pH 6.5**	**pH 6.9**
	- - - - - - - - - - $CaCO_3$ to apply (lb/acre) - - - - - - - - - -							
7.0	0	400	0	600	0	1,100	0	1,500
6.9	0	600	0	1,000	0	1,900	0	2,500
6.8	200	900	300	1,400	600	2,700	800	3,600
6.7	400	1,200	700	1,800	1,300	3,500	1,700	4,700
6.6	700	1,500	1,100	2,200	2,100	4,400	2,800	5,900
6.5	900	1,700	1,400	2,600	2,800	5,200	3,700	6,900
6.4	1,200	2,000	1,800	3,000	3,500	6,000	4,700	8,000
6.3	1,400	2,300	2,100	3,400	4,200	6,800	5,600	9,100
6.2	1,700	2,600	2,500	3,900	5,000	7,700	6,700	10,300
6.1	1,900	2,800	2,900	4,300	5,700	8,500	7,600	11,400
6.0	2,200	3,100	3,200	4,700	6,400	9,300	8,600	12,400
5.9	2,400	3,400	3,600	5,100	7,100	10,100	9,500	13,500
5.8	2,600	3,700	4,000	5,500	7,900	11,000	10,600	14,700
5.7	2,900	3,900	4,300	5,900	8,600	11,800	11,500	15,900

*Soil pH 6.9 is recommended for alfalfa. Soil pH 6.5 is considered to be sufficient for corn and soybean. Because of high pH subsoils in the Clarion-Nicollet-Webster, Galva-Primghar-Sac, Moody, Ida-Monona, Marshall, and Luton-Onawa-Salix soil associations, soil pH 6.0 is considered sufficient for corn and soybean grown in these soil associations, but when liming is required, lime to soil pH 6.5. Soil pH 6.0 is sufficient for grass pastures and grass hayland.

Soils

Table 15. Subsoil phosphorus and potassium levels that are to be used to determine phosphorus and potassium nutrient recommendations for the major soil series in each of the 12 major soil areas in Iowa. Soil series of more than 5,000 acres and with a corn suitability rating of 30 or greater are listed. (Source: Iowa Soil Properties and Interpretations Database [ISPAID] 7.0, revised November 2002**)**

Abbreviations used in the subsections of this table are as indicated:
Str Sub: stratified subsoil
R: rock
S&G: sand and gravel

A. Major soil area 1 that includes the Downs, Fayette, and Fayette-Dubuque-Stonyland soil associations.

1. Loess-derived soils

Soil Name	Acres in Series	Sub P	Sub K
Arenzville	19,679	H	L
Arenzville-Chaseburg Complex	54,144	H	L
Bertrand	7,871	H	L
Caneek	9,223	H	L
Chaseburg	47,346	H	L
Chelsea-Lamont-Fayette	6,090	L	L
Colo-Ely Complex	10,234	H	L
Dinsdale	24,260	L	L
Dockery	5,430	H	L
Dorchester	22,927	H	L
Downs	545,763	H	L
Downs Benches	6,276	H	L
Downs-Tama Complex	40,208	H	H
Eitzen	9,480	L	L
Exette	27,685	H	L
Fayette	1,174,150	H	L
Fayette Benches	5,967	H	L
Huntsville	6,140	H	L
Ion	6,560	L	L
Newvienna	19,125	H	L
Orion	14,940	H	L

—continued

A. Major soil area 1 that includes the Downs, Fayette, and Fayette-Dubuque-Stonyland soil associations, continued.

1. Loess-derived soils

Soil Name	Acres in Series	Sub P	Sub K
Orwood	27,947	H	L
Ossian	6,250	H	L
Otter Overwash	6,180	H	H
Otter-Worthen Complex	24,968	H	L
Rozetta	14,800	H	L
Rozetta-Eleroy Complex	23,880	H	L
Sawmill	15,710	H	L
Tama	19,150	H	L
Worthen	11,167	H	L

2. Till-derived soils

Soil Name	Acres in Series	Sub P	Sub K
Jacwin	5,878	L	L
Lamont	14,374	H	L

B. Major soil area 2 that includes the Dinsdale-Tama and Tama-Muscatine soil associations.

Soil Name	Acres in Series	Sub P	Sub K
Ackmore	35,020	H	L
Ackmore-Colo Complex	48,635	H	L
Amana-Lawson-Perks	7,238	L	L
Ambraw	11,540	H	L
Atterberry	51,420	H	L
Atterberry Benches	9,754	H	L
Atterberry Sandy Subsoil	12,735	H	L
Bassett	7,722	H	L
Bolan	6,405	L	L
Bremer	30,630	H	H
Calco	7,094	H	L
Chelsea-Lamont-Fayette	15,046	L	L
Colo	207,339	H	L
Colo-Ely Complex	250,218	H	L

—continued

B. Major soil area 2 that includes the Dinsdale-Tama and Tama-Muscatine soil associations, continued.

Soil Name	Acres in Series	Sub P	Sub K
Dickinson	13,545	L	L
Dinsdale	358,010	H	L
Downs	70,560	H	L
Downs Sandy Subsoil	16,560	H	L
Ely	20,551	L	L
Fayette	34,295	H	L
Fayette Sandy Subsoil	5,000	H	L
Franklin	20,145	H	L
Fruitfield	7,760	L	L
Garwin	77,013	L	L
Garwin Sandy Subsoil	5,450	L	L
Judson	26,501	H	H
Kennebec	10,597	H	H
Kenyon	9,274	L	L
Killduff	110,635	H	L
Klinger	6,940	L	H
Klinger-Maxfield Complex	8,040	L	L
Koszta	8,056	H	L
Lawler 32–40″ To S&G	8,362	L	L
Lawson	14,426	H	L
Liscomb	10,375	L	L
Maxfield	35,141	L	L
Mt. Carroll	5,610	H	L
Muscatine	225,802	H	L
Muscatine Benches	7,856	H	L
Nevin	38,641	H	H
Nodaway	55,726	H	L
Nodaway-Arenzville Complex	13,160	H	L
Port Byron	9,335	H	L
Raddle	5,445	H	L
Radford	5,690	H	L
Richwood	7,272	H	L
Rowley	10,555	H	L
Saude	5,425	L	L
Sawmill	34,745	H	L
Sawmill-Garwin Complex	35,937	L	L

—continued

B. Major soil area 2 that includes the Dinsdale-Tama and Tama-Muscatine soil associations, continued.

Soil Name	Acres in Series	Sub P	Sub K
Shaffton	14,510	H	L
Shelby	11,590	H	L
Sparta	16,005	L	L
Tama	841,398	H	L
Tama Benches	18,759	H	L
Tama Sandy Subsoil	23,777	H	L
Tama-Dickinson Complex	8,895	L	L
Walford	24,465	H	L
Walford Benches	5,122	H	L
Waubeek	26,515	H	L
Waukee	5,225	H	L
Waukegan	22,137	H	L
Whittier	8,535	H	L
Wiota	24,783	H	H
Zook	16,691	H	L

C. Major soil area 3 that includes the Otley-Mahaska-Taintor and Clinton-Keswick-Lindley soil associations.

Soil Name	Acres in Series	Sub P	Sub K
Amana	16,568	H	L
Ambraw	8,405	H	L
Bremer	5,205	H	H
Clinton	377,687	H	L
Clinton Benches	24,697	H	L
Coland	5,095	H	L
Colo	38,379	H	L
Colo-Ely Complex	52,688	H	L
Colo-Zook Complex	8,070	H	L
Coppock	8,984	H	L
Ely	16,760	H	H
Fayette	7,790	H	L
Gara	51,687	H	L
Givin	43,369	H	L
Hedrick	47,455	H	L

—continued

C. Major soil area 3 that includes the Otley-Mahaska-Taintor and Clinton-Keswick-Lindley soil associations, continued.

Soil Name	Acres in Series	Sub P	Sub K
Inton	11,675	H	H
Kalona	23,015	L	L
Keomah	16,095	H	L
Klum	5,588	L	L
Ladoga	281,324	H	L
Ladoga Benches	14,194	H	L
Lawson	6,175	H	L
Lindley	44,305	H	L
Mahaska	212,911	H	H
Nevin	5,200	H	H
Nira	75,880	H	L
Nodaway	39,128	H	L
Nodaway-Cantril Complex	15,373	L	L
Nodaway-Martinsburg Complex	13,318	H	L
Nodaway-Vesser Complex	9,725	H	L
Nodaway-Vesser-Ackmore	7,210	L	L
Olmitz	6,124	L	H
Otley	295,300	H	L
Otley Benches	5,568	H	L
Otley-Nira Complex	5,670	H	L
Radford	5,504	H	L
Shelby	20,229	L	L
Sparta	11,476	L	L
Sperry	11,162	H	H
Taintor	161,872	L	L
Titus	5,340	H	L
Tuskeego	8,858	H	L
Vesser	7,911	H	L
Zook	24,622	H	L

D. Major soil area 4 that includes the Adair-Seymour, Grundy-Haig, Adair-Grundy-Haig, and Lindley-Keswick-Weller soil associations.

Soil Name	Acres in Series	Sub P	Sub K
Ackmore	5,015	H	L
Adair	47,502	L	L
Amana	6,125	H	L
Appanoose	8,353	H	L
Arispe	135,013	L	L
Armstrong	6,735	L	L
Beckwith	7,321	H	L
Belinda	31,906	H	L
Caleb	14,047	L	L
Cantril	8,156	L	L
Cantril-Coppock-Nodaway	58,539	L	L
Chequest	16,665	H	L
Clarinda	29,645	L	L
Clearfield	6,535	H	L
Clearfield-Arispe Complex	9,252	L	L
Colo	24,877	H	L
Colo-Ely Complex	13,800	H	L
Coppock	16,582	H	L
Downs	6,951	H	L
Edina	108,035	L	L
Fayette	5,362	H	L
Gara	226,070	H	L
Gara-Armstrong Complex	7,650	L	L
Grundy	160,303	H	L
Haig	121,765	H	L
Humeston	24,668	H	L
Kennebec	6,170	H	H
Kennebec-Amana Complex	11,905	H	L
Kniffin	66,856	H	L
Ladoga	6,225	H	L
Ladoga Benches	5,210	H	L
Lamoni	31,091	L	L
Landes	6,439	L	L
Lawson	13,393	H	L
Lindley	26,328	H	L
Lineville	17,597	L	L

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D. Major soil area 4 that includes the Adair-Seymour, Grundy-Haig, Adair-Grundy-Haig, and Lindley-Keswick-Weller soil associations, continued.

Soil Name	Acres in Series	Sub P	Sub K
Macksburg	8,385	H	H
Nira	19,600	H	L
Nodaway	36,717	H	L
Nodaway-Lawson-Ackmore	14,038	H	L
Nodaway-Lawson-Klum	12,710	L	L
Olmitz	20,020	L	H
Olmitz-Vesser-Colo	203,026	L	L
Pershing	218,817	H	L
Pershing Benches	29,905	H	L
Rathbun	8,328	H	L
Seymour	124,134	H	L
Sharpsburg	9,860	H	H
Shelby	116,359	L	L
Tuskeego	7,618	H	L
Vesser	35,935	H	L
Wabash	7,403	H	H
Weller	169,524	H	L
Zook	29,433	H	L
Zook-Ely Complex	11,475	H	L

E. Major soil area 5 that includes the Shelby-Sharpsburg-Macksburg soil association.

Soil Name	Acres in Series	Sub P	Sub K
Ackmore	9,380	H	L
Adair Thin Solum	30,255	L	L
Adair-Shelby Complex	10,931	L	L
Bremer	6,206	H	H
Clarinda	7,505	L	L
Clearfield	42,780	H	L
Clinton	26,697	H	L
Colo	67,442	H	L
Colo Overwash	9,364	H	L
Colo-Ackmore Complex	9,340	H	L
Colo-Ely Complex	146,672	H	L
Colo-Judson-Nodaway	36,528	H	L

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E. Major soil area 5 that includes the Shelby-Sharpsburg-Macksburg soil association, continued.

Soil Name	Acres in Series	Sub P	Sub K
Downs	14,100	H	L
Fayette	11,697	H	L
Gara	59,582	H	L
Humeston	5,400	H	L
Judson	14,752	H	H
Kennebec	8,808	H	H
Ladoga	160,886	H	L
Lamoni	30,780	L	L
Macksburg	87,651	H	H
Nevin	16,527	H	H
Nira	84,629	H	L
Nira-Sharpsburg Complex	25,248	H	L
Nodaway	55,004	H	L
Olmitz	12,275	L	H
Sharpsburg	639,674	H	H
Sharpsburg Benches	17,294	H	H
Shelby	234,586	L	L
Tama	19,626	H	L
Vesser	8,431	H	L
Wabash	38,287	H	H
Winterset	22,844	H	H
Zook	76,217	H	L
Zook-Colo-Ely	11,165	H	L

F. Major soil area 6 that includes the Marshall soil association.

Soil Name	Acres in Series	Sub P	Sub K
Ackmore	31,048	H	L
Burchard	6,030	H	H
Calco	6,994	H	L
Colo	69,125	H	L
Colo-Judson Complex	473,474	H	L
Ely	7,226	H	H
Exira	234,720	L	H
Judson	118,471	H	H
Kennebec	62,245	H	H
Kennebec-Ackmore Complex	6,420	H	L
Marshall	926,427	H	H
Marshall Benches	44,816	H	H
Minden	6,673	H	H
Monona	50,630	L	L
Napier-Kennebec-Nodaway	53,090	L	L
Nevin	5,515	H	H
Nodaway	98,318	H	L
Shelby	34,400	L	L
Zook	55,426	H	L

G. Major soil area 7 that includes the Monona-Ida-Hamburg soil association.

Soil Name	Acres in Series	Sub P	Sub K
Calco	5,230	H	L
Castana	16,086	L	L
Ida	402,531	L	L
Kennebec	72,505	H	H
Kennebec-McPaul Complex	8,015	H	H
McPaul	9,490	H	H
McPaul-Kennebec Complex	16,000	H	H
Monona	688,686	H	H
Monona Benches	15,393	H	L
Napier	270,672	L	H
Nodaway	8,940	H	H
Rawles	8,470	H	H

H. Major soil area 8 that includes the Luton-Onawa-Salix soil association.

Soil Name	Acres in Series	Sub P	Sub K
Albaton	54,983	L	H
Blake	20,158	L	H
Blencoe	16,117	L	H
Blend	7,267	L	H
Carr	5,920	L	H
Cooper	9,748	L	H
Forney	13,916	L	H
Grable	9,845	L	H
Haynie	39,041	L	H
Keg	20,553	L	H
Lakeport	14,131	L	H
Lossing	5,767	L	H
Luton	114,634	L	H
Luton Thin Surface	17,575	L	H
McPaul	66,426	H	H
McPaul-Kennebec Complex	13,410	H	H
Modale	10,424	L	H
Moville	8,085	L	H
Napier-Castana Complex	8,900	L	L
Napier-Nodaway-Colo	5,177	L	L
Onawa	31,497	L	H
Owego	6,207	L	H
Percival	8,195	L	H
Salix	26,372	L	H
Tieville	5,858	L	H
Woodbury	16,169	L	H

I. Major soil area 9 that includes the Galva-Primghar-Sac soil association.

Soil Name	Acres in Series	Sub P	Sub K
Ackmore	11,305	H	L
Afton	45,552	L	L
Allendorf	5,520	L	L
Bolan	6,302	L	L
Calco	28,242	H	L
Colo	97,943	H	L
Colo-Judson Complex	28,610	H	L
Davis	5,970	H	L
Ely	7,235	H	H
Everly	59,439	L	L
Galva	1,068,182	L	L
Galva Benches	67,332	L	L
Galva Str Sub	15,715	L	L
Ida	9,005	L	L
Judson	7,255	H	H
Kennebec	26,265	H	H
Letri Calcareous	5,445	L	L
Marcus	159,279	L	L
Nicollet	24,494	L	L
Ocheyedan	13,358	L	H
Primghar	366,779	L	L
Radford	59,045	H	L
Ransom	12,555	L	L
Sac	169,598	L	L
Spicer	7,195	L	L
Spillco	11,195	H	L
Spillville	7,960	L	L
Steinauer	5,561	L	L
Terril	9,280	L	L
Tripoli	17,241	L	L
Wadena 24–32″ To S&G	5,910	L	L
Wilmonton	23,815	L	L

J. Major soil area 10 that includes the Moody soil association.

Soil Name	Acres in Series	Sub P	Sub K
Crofton	5,700	L	L
Egan	17,620	L	L
Moody	153,555	L	L
Moody Loamy Subsoil	5,015	L	L
Trent	13,100	L	L

K. Major soil area 11 that includes the Clarion-Nicollet-Webster soil association.

Soil Name	Acres in Series	Sub P	Sub K
Biscay Deep	43,703	L	L
Blue Earth	16,208	L	L
Bode	56,321	L	L
Brownton	57,027	L	L
Calco	10,371	H	L
Canisteo	1,297,749	L	L
Clarion	1,629,066	L	L
Clarion Long Slopes	26,815	L	L
Clarion-Storden Complex	83,342	L	L
Coland	134,671	H	L
Coland-Spillville Complex	63,328	L	L
Collinwood	19,024	L	L
Colo	18,452	H	L
Crippin	40,208	L	L
Cylinder Deep	34,026	L	L
Cylinder Moderately Deep	14,270	L	L
Dickinson	8,072	L	L
Dickman	12,231	L	L
Estherville	9,746	L	L
Fieldon	11,369	L	L
Fostoria	8,731	L	L
Guckeen	11,452	L	L
Hanlon	8,280	L	L
Hanska	5,325	L	L
Harcot	20,750	L	L
Harps	255,122	L	L

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K. Major soil area 11 that includes the Clarion-Nicollet-Webster soil association, continued.

Soil Name	Acres in Series	Sub P	Sub K
Havelock	13,735	L	L
Hayden	37,778	H	L
Kilkenny	13,704	H	L
Knoke	24,276	L	L
Kossuth	76,968	L	L
Le Sueur	14,598	H	L
Lester	104,111	H	L
Lester Long Slopes	5,050	H	L
Linder	8,683	L	L
Luther	8,684	H	L
Marna	23,015	L	L
Mayer 24–32″ To S&G	6,662	L	L
Mayer 32–40″ To S&G	5,620	L	L
Nicollet	1,067,487	L	L
Okoboji	318,210	L	L
Okoboji-Harps Complex	40,776	L	L
Ottosen	72,172	L	L
Palms	35,517	H	L
Ridgeport	16,714	H	H
Rolfe	5,355	L	H
Spicer	5,882	L	L
Spillville	66,514	H	L
Storden	109,067	L	L
Talcot 32–40″ To S&G	45,340	L	L
Terril	29,781	L	L
Truman Str Sub	7,020	H	L
Vinje	6,836	L	L
Wacousta	20,232	L	L
Wadena 24–32″ To S&G	77,175	L	L
Wadena 32–40″ To S&G	31,082	L	L
Waldorf	24,575	L	L
Webster	918,520	L	L
Webster-Nicollet Complex	77,907	L	L
Zenor	15,938	H	L

L. Major soil area 12 that includes the Kenyon-Floyd-Clyde and Cresco-Lourdes-Clyde soil associations.

Soil Name	Acres in Series	Sub P	Sub K
Ansgar	9,495	H	L
Aredale	37,724	L	L
Ashdale	6,255	H	L
Atkinson	6,978	L	L
Bassett	140,498	H	L
Bolan	26,491	L	L
Burkhardt-Saude Complex	6,857	L	L
Chelsea	12,351	L	L
Clyde	381,543	L	L
Clyde-Floyd Complex	318,086	L	L
Coggon	7,078	H	L
Coland	25,785	H	L
Cresco	47,728	L	L
Dickinson	84,505	L	L
Dickinson Loamy Subsoil	15,850	L	L
Dickinson-Ostrander Complex	5,039	L	L
Dinsdale	44,033	H	L
Donnan	24,633	L	L
Downs	9,558	H	L
Finchford	10,170	H	L
Flagler	42,799	L	L
Floyd	256,708	L	L
Franklin	23,132	H	L
Hayfield 24–32″ To S&G	23,484	H	L
Hayfield 24–40″ To S&G	9,739	H	L
Hoopeston	7,317	L	L
Jameston	6,484	L	L
Kenyon	591,170	L	L
Klinger	139,349	L	H
Lamont	7,542	H	L
Lawler 24–32″ To S&G	37,772	L	L
Lawler 32–40″ To S&G	50,196	L	L
Lourdes	19,330	L	L

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L. Major soil area 12 that includes the Kenyon-Floyd-Clyde and Cresco-Lourdes-Clyde soil associations, continued.

Soil Name	Acres in Series	Sub P	Sub K
Marshan 24–32″ To S&G	27,264	L	L
Marshan 32–40″ To S&G	88,781	L	L
Maxfield	63,479	L	L
Olin	63,200	L	L
Oran	83,395	L	L
Ostrander	94,518	L	L
Palms	10,864	L	L
Protivin	34,767	L	L
Racine	43,776	L	L
Readlyn	200,316	L	L
Riceville	13,283	L	L
Rockton 20–30″ To R	38,953	L	L
Rockton 30–40″ To R	22,146	L	L
Rossfield	8,075	H	L
Sattre	6,566	H	L
Saude	133,715	L	L
Schley	61,513	L	L
Seaton	6,008	H	L
Sparta	70,253	L	L
Spillville	34,753	L	L
Spillville-Coland Complex	29,291	L	L
Tama	5,850	H	L
Terril	22,225	L	L
Tripoli	102,559	L	L
Turlin	5,218	L	L
Udolpho	5,105	H	L
Wapsie	52,150	H	L
Waubeek	9,387	H	L
Waukee	61,392	H	L
Winneshiek	25,549	H	L

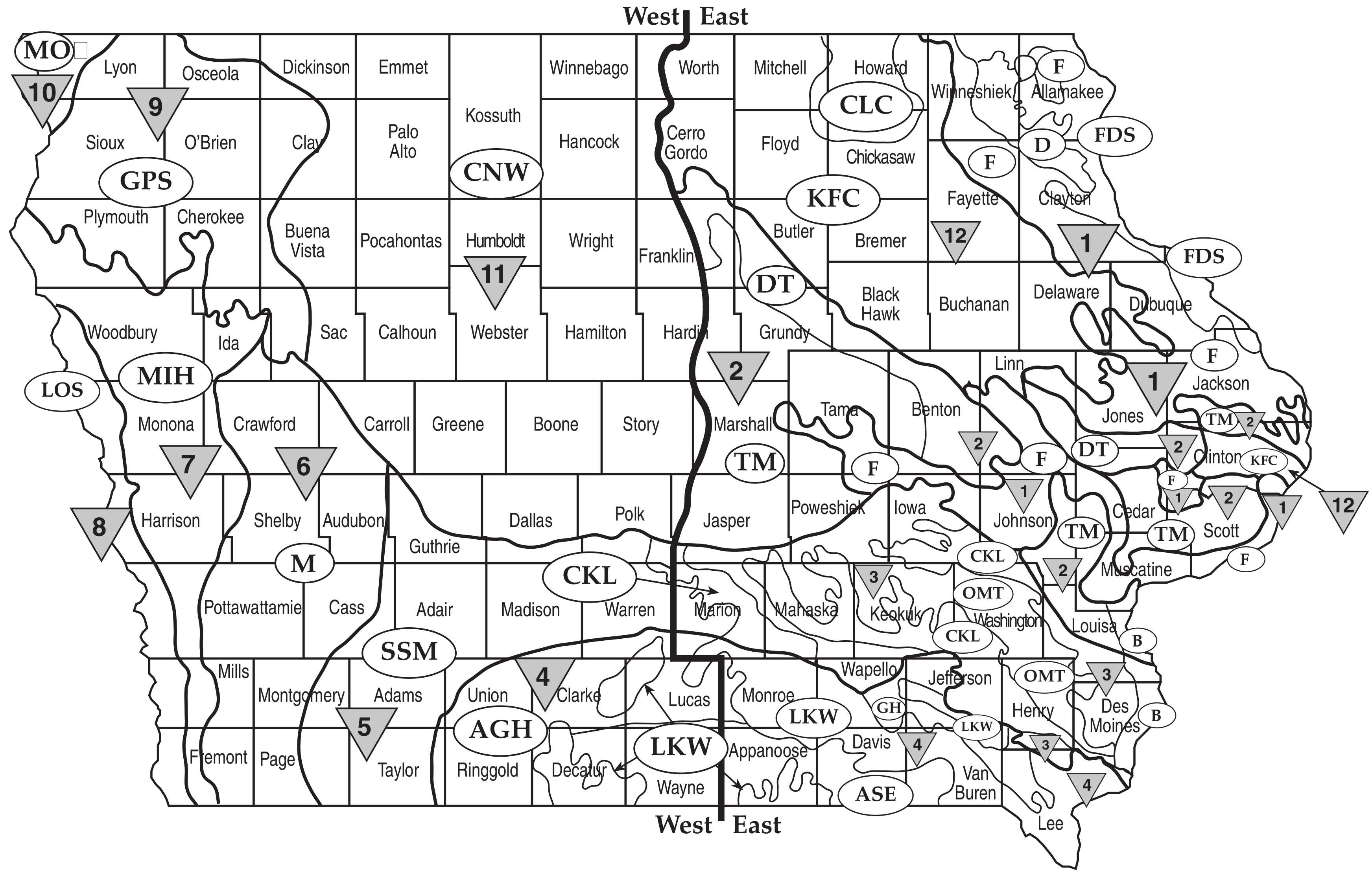

Figure 1. Map of Iowa delineating the 21 principal soil association areas (letters) and the 12 major soil areas (numbers). B designates the Mississippi bottomland.

AGH: Adair-Grundy-Haig
ASE: Adair-Seymour-Edina
CKL: Clinton-Keswick-Lindley
CLC: Cresco-Lourdes-Clyde
CNW: Clarion-Nicollet-Webster
D: Downs
DT: Dinsdale-Tama
F: Fayette
FDS: Fayette-Dubuque-Stonyland
GPS: Galva-Primghar-Sac
GH: Grundy-Haig
KFC: Kenyon-Floyd-Clyde
LKW: Lindley-Keswick-Weller
LOS: Luton-Onawa-Salix
M: Marshall
MIH: Monona-Ida-Hamburg
Mo: Moody
OMT: Otley-Mahaska-Taintor
SSM: Shelby-Sharpsburg-Macksburg
TM: Tama-Muscatine

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File: Agronomy 8-2

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Using Manure Nutrients for Crop Production

Nutrients in Animal Manure

Manure can supply nutrients required by crops and replenish nutrients removed from soil by crop harvest. Since manure contains multiple nutrients, applications should consider not only what is needed for the crop to be grown but also how the ratio of nutrients in manure could affect soil test levels. This ensures adequate nutrient supply and reduces potential for over- or under-application and subsequent buildup or depletion in the soil. Good manure nutrient management should consider short-term and long-term impacts on crop nutrient supply and soil resources.

Manure has characteristics that make nutrient management different and sometimes more complicated than fertilizer. These include a mix of organic and inorganic nutrient forms; variation in nutrient concentration and forms; variation in dry matter and resultant handling as a liquid or solid; and relatively low nutrient concentration requiring large application volumes. Since manure nutrient composition can vary significantly, sampling and laboratory analysis are always needed, while with fertilizer nutrient concentrations are provided at a guaranteed analysis.

The manure nutrient concentration varies considerably between animal species; dietary options; animal genetics; animal performance; production management and facility type; and collection, bedding, storage, handling, and agitation for land application. Use of average or "book" nutrient values can be helpful for designing a new facility and creating manure management plans but is not very helpful in determining specific manure nutrient supply or application rates due to wide variation in nutrient concentrations between production facilities. For example, a recent sampling across swine finishing facilities found a range in total N from 32 to 79 lb N/1,000 gal, P from 17 to 54 lb P_2O_5/1,000 gal, and K from 23 to 48 lb K_2O/1,000 gal. A similar or larger range can be found with other manure types. Nutrient analyses often vary greatly as storage facilities are emptied or manure is stockpiled, and also among multiple samples collected from loads during land application. Therefore, collecting multiple manure samples and maintaining a history of analysis results will improve use of manure nutrients.

For determining manure application rates and equating to crop fertilization requirements, it is most helpful if manure analyses give N, P_2O_5, and K_2O based on an as-received or wet basis in lb per ton or lb per 1,000 gal units. It is beyond the scope of this publication to give detailed manure sampling and laboratory analysis

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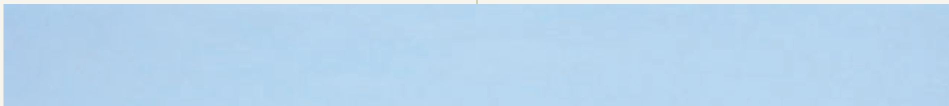
recommendations. Those can be found in the extension materials listed on page 7. If manure analyses are provided from the laboratory in other units, they must be converted to these units. See the ISU Extension manure sampling publication for appropriate conversion factors. If manure average nutrient values or methods to estimate manure nutrient concentrations based on excretion are of interest or needed for planning purposes, those can be found in the Midwest Plan Service bulletins listed on page 7.

Manure Nutrient Availability for Crops

Nutrient management guidelines use the words "manure nutrient availability" when suggesting manure applications to supply nutrients needed by crops. However, the meaning of "availability" for manure nutrients often is not clear or its use not consistent. Available is defined as present or ready for immediate use, or present in such chemical or physical form as to be usable (as by a plant). The main reasoning for using the term "available" in describing manure nutrients is that some portions are in forms that cannot be used by plants immediately upon application to soil and have to be converted to a form that plants can take up. The term "available" is not typically applied to fertilizers because most include chemical forms that plants can take up or are quickly converted upon application to soil. According to this definition, most inorganic fertilizers contain basically 100 percent crop-available nutrients. For example, anhydrous ammonia dissolves in water and rapidly changes to ammonium, urea hydrolyzes to ammonium within a few days, and ammonium is further transformed to nitrate by soil microorganisms. Monoammonium phosphate (MAP) and diammonium phosphate (DAP) are highly soluble in water and dissolve to ammonium and orthophosphate. Potassium chloride (KCl, potash), dissolves in water to potassium (K^+) and chloride (Cl^-) ions. Both orthophosphate and K ions are taken up by plants. Because all K contained in manure is in the K^+ ionic form, manure K is readily crop available in all manure sources.

For manure N and P, there is usually a mix of organic and inorganic materials that varies among manure sources, production systems, bedding, storage, and handling. This variety in forms of N and P in manure contributes to greater uncertainty in manure nutrient management compared with fertilizers. The ratio of inorganic (mainly ammonium) and organic N varies considerably with the manure source. This was shown, for example, by on-farm research that included manure sampling and analysis from swine and poultry operations. The fraction of total N as ammonium N was almost 100 percent for swine manure from the liquid portion of anaerobic lagoons, 65 to 100 percent (average 84 percent) for liquid swine manure from under-building pits or storage tanks, and 10 to 40 percent (average 20 percent) for solid poultry manure. The large ammonium-N concentration and organic-N fraction that is easily mineralized after applica-



tion to soil explain why N in liquid swine manure is considered "highly" crop available and almost comparable to fertilizer N. Other manures have lower ammonium-N concentrations and greater (and tougher to degrade) organic materials due to bedding and feed materials. Considerable P in swine manure is orthophosphate and calcium phosphate compounds (derived both from feed and mineral supplements added to rations) that are soluble or dissolve quickly once applied to soil. The rest is organic P, which varies greatly in complexity and reaction in soil. Testing manure for ammonium-N or water-soluble N can be a way of estimating immediately available N. Unfortunately, a similarly useful test does not exist for P. Therefore, the availability estimate for manure N and P can be, and often is, less than 100 percent of total N and P.

Manure Nutrient Supply

There is a clear difference between crop availability of nutrients in fertilizer or manure and season-long supply of nutrients. Significant amounts of plant usable forms of nutrients in both fertilizer and manure might be lost and became unavailable to crops after application. For example, N can be lost through processes such as leaching, volatilization, or denitrification while P can be lost through erosion and surface runoff. Also, these nutrients can be converted for short or long periods of time into forms not usable by plants through processes such as immobilization to organic materials for N and retention by soil mineral constituents for P. Nutrient loss issues are not as pertinent for P and K as for N in Iowa soils as long as there is little soil erosion and surface runoff.

The immediate or long-term fate of plant usable nutrients in soil can be similar for manure and fertilizer. However, variation in manure nutrient concentration, application rate, and application distribution affect nutrient supply and contribute to increased uncertainty with manure management. Application rate and distribution uncertainties affect all applied nutrient sources but are more difficult to manage with manure than with fertilizer. With careful manure sampling, pre-application nutrient analysis, study of nutrient analysis history, and calibration of application equipment, reasonable manure nutrient application rates can be achieved. Due to material characteristics, and sampling and analysis variability, field distribution and application rate variability often is greater for dry manure sources.

These supply issues can be important for N, P, and K, although typically are of greater concern with N. There are several reasons, including manure usually is applied for corn production where N supply is critical, many Iowa soils have optimum or higher P and K test levels where need for and response to P and K is much less than with N, and crop deficiency symptoms and yield loss resulting from nutrient supply problems are more obvious for N.

Manure nutrient loss, application rate, and distribution uncertainties usually are not included in crop nutrient availability estimates. Instead, they are handled by suggested management practices. Not all published guidelines are consistent in this regard and, therefore, suggested crop nutrient availabilities do vary between states and regions. In this publication, use of "availability" refers to manure nutrients potentially available for plant uptake (with no losses) by the first crop after application or beyond, and percent nutrient availability values provided correlate to those for commonly used fertilizers. The guidelines in this publication assume supply issues are handled in the best way possible as is done with fertilizers. It is important to understand that for successful manure nutrient management, in many instances supply issues are as, or more, critical than estimates of nutrient availability.

Improving crop nutrient supply with manure can be achieved by understanding the issues related to manure nutrient analysis, application rate, application distribution, and the benefits and risks related to management practices such as application timing and placement that influence potential losses. Additionally, use of available tools to determine initial soil nutrient levels and adjust application rates can help provide for adequate season-long nutrient supply when either manure or fertilizer is used. These tools include commonly used pre-plant soil testing for P and K, estimates of N application rate need based on response trial data (such as the *Corn Nitrogen Rate Calculator*), and tools to help determine need for additional N after planting corn such as the late-spring soil nitrate test and in-season crop sensing for N stress.

Manure Nutrient Application Recommendations

To determine manure application rates, the following information is required: needed crop nutrient fertilization rate for N, P, K, or other deficient nutrients; manure type; nutrient analysis; nutrient crop availability; and method of application. Nutrient recommendations for crops are provided in other Iowa State University Extension publications and are not repeated here (see list on page 7).

Once the needed nutrient application rate is determined, the manure rate to supply crop available nutrients is calculated based on the specific manure source being used.

An additional consideration is what portion of the needed fertilization will be supplied from manure—to meet the full crop nutrient requirement, or a partial requirement from manure and the remaining from fertilizer. This is an important consideration because manure contains multiple nutrients and a manure rate to supply the most deficient nutrient can over-supply other nutrients. Also, manure application to meet the least deficient or most environmentally restrictive nutrient application can result in under-supply of other nutrients.

In these cases, use of fertilizers in addition to manure application is necessary to appropriately meet all nutrient application requirements.

Manure Nutrient Availability Values

Many of the manure N, P, and K crop availability estimates listed in Table 1 are derived from research trials conducted in Iowa. However, when local research is lacking, applicable information was taken from research conducted in other states. For manure sources not listed in the table, values based on manure with similar characteristics can provide a reasonable estimate.

First-Year Availability Estimates

Table 1. First-year nutrient availability for different animal manure sources.

Manure Source	Nitrogen[1]	Phosphorus[2]	Potassium[2]
	- - - - - - - - - - - - - -	Percent of Total Nutrient Applied	- - - - - - - - - - - - - -
Beef cattle (solid or liquid)	30–40	60–100	90–100
Dairy (solid or liquid)	30–40	60–100	90–100
Liquid swine (anaerobic pit)	90–100	90–100	90–100
Liquid swine (anaerobic lagoon)	90–100[3]	90–100[3]	90–100
Poultry (all species)	50–60	90–100	90–100

[1]The estimates for N availability do not account for potential volatile N losses during and after land application. Correction factors for volatile loss are given in Table 2. The ranges are provided to account for variation in the proportion of ammonium N (and for poultry manure also uric acid), bedding type and amount, and both sampling and analysis.

[2]The ranges in P and K availability are provided to account for variation in sampling and analysis, and for needed P and K supply with different soil test levels. A small portion of manure P may not be available immediately after application, but all P is potentially available over time. Use lower P and K availability values for soils testing in the Very Low and Low soil test interpretation categories, where large yield loss could occur if insufficient P or K is applied and a reasonable buildup is desirable. Use 100% when manure is applied to maintain soil-test P and K in the Optimum soil test category, when the probability of a yield response is small.

[3]Values apply for the liquid portion of swine manure in lagoons; the N and P availability will be less and difficult to estimate with settled solids.

Second- and Third-Year Availability Estimates

While manure N may become crop available over multiple years for some sources, there should not be an expectation that all of the manure N will eventually become crop available. This happens because some of the N is in difficult to degrade organic forms (recalcitrant) and will become part of the soil organic matter. For some manure sources, such as with bedded systems, not all of the manure N should be accounted for in manure plans over multiple years and the first-, second-, or third-year availability may not add up to 100 percent.

Animal manure that has considerable organic material can have some residual-N availability in the second or third year after application. The second-year N availability estimate for beef cattle and dairy manure is 10 percent, and 5 percent for the third year. Other manures that have similar organic N and bedding could have similar second- and third-year N availability. Manure sources that have low organic N will not have second-year crop available N. These include liquid systems like swine manure stored in under-building pits and above-ground tanks, and anaerobic lagoons. Poultry manure, since it has considerable organic material, has some but low second-year (0–10 percent) availability and no third-year N availability.

The P and K contained in animal manure are estimated at 100 percent crop available over a long term. Residual effects of P and K not used in the year of application will be reflected in soil tests and crop use, just like fertilizer P and K applied for one year or for multiple years.

Adjusting for Manure Nitrogen Volatilization

The estimates for manure N availability in Table 1 do not consider potential volatile N losses during or after application. Losses are from various volatile N compounds in manure, such as ammonia, and ammonia that is produced when urea, uric acid, or other compounds convert to ammonium. These are similar losses that can occur from some N fertilizers such as anhydrous ammonia, urea, and urea-ammonium nitrate (UAN) solutions. If manure is left on the soil surface, losses may occur until N is moved into the soil with rainfall or incorporated with tillage. Many factors affect the rate and amount of volatile loss, such as temperature, humidity, rainfall, soil moisture, soil pH, surface residue cover, and days to incorporation. Volatile losses at or after application often are difficult to predict accurately. However, losses can be significant, and, therefore, it is important to make an adjustment for volatile N losses from applied manure and for manure management planning purposes. Values given in Table 2 provide guidance on potential volatile losses. The correction factors in Table 2 do not account for N losses during storage and handling (time from excretion to sampling for analysis) and assume a reasonable time period from sampling to land application so that the manure analysis represents the manure being applied. To estimate manure N remaining in soil after application, multiply the applied manure N rate by the appropriate correction factor.

Table 2. Correction factors to account for N volatilization losses during and after land application of animal manure.[1]

Application Method	Incorporation	Volatilization Correction Factor[2]
Direct injection	—	0.98–1.00
Broadcast (liquid/solid)	Immediate incorporation	0.95–0.99
Broadcast (liquid)	No incorporation	0.75–0.90
Broadcast (solid)	No incorporation	0.70–0.85
Irrigation	No incorporation	0.60–0.75

[1]Adapted from Midwest Plan Service MWPS-18, Third Edition. Nitrogen losses during and within four days of application.

[2]Multiply the manure total N rate applied times the volatilization correction factor to determine the portion of total manure N remaining.

Considerations for Time of Application

The time of application influences nutrient availability and potential manure and nutrient loss from soil. Fall applications allow more time for organic N and P portions of manure to mineralize so they are available for plant uptake the next crop season. This is more important for N in manures with high organic matter content, such as bedded systems. Iowa research has shown that fall versus springtime P and K application usually is not an agronomic issue for fertilizers or manure. The increased time for organic N mineralization with fall application also allows for nitrification of ammonium and therefore more potential nitrate loss through leaching or denitrification with excessively wet spring conditions. This is a more important issue for manure with large ammonium-N concentration, such as liquid swine manure. Coarse-textured soils, with high permeability, are the most likely to have leaching losses. Fine- and moderately fine-textured soils, prone to excess wetness, are most likely to have denitrification losses. Manure applied in the spring has less time for organic N and P mineralization before crop uptake. Delayed mineralization can be an important issue for manure with high organic matter content, especially in cold springs. With manure that contains a large portion of N as ammonium, spring application allows for better timing of nitrification to nitrate and subsequent crop use, and less chance of N loss.

As a general rule, do not apply manure in the fall unless the soil temperature is 50° F and cooling at the four-inch soil depth. This will slow the mineralization and nitrification processes and is an especially important consideration for manure containing a large portion of N as ammonium.

Broadcasting manure onto frozen, snow-covered, water-saturated soils increases the potential for nutrient losses with rainfall or snowmelt runoff to surface water systems. If manure must be applied in these conditions, it should be applied on relatively flat land, slopes less than 5 percent, and well away from streams and waterways (see Iowa Department of Natural Resources rules on setback distances).

Example Calculation of Manure Application Rates

Note: *The N, P, and K fertilization requirements in these examples are determined from appropriate extension publications and Web-based tools listed at the right.*

Example 1

- Manure source: liquid swine manure, finishing under-building pit.
- Manure analysis: 40 lb N/1,000 gal, 25 lb P_2O_5/1,000 gal, 35 lb K_2O/1,000 gal.
- Intended crop: corn in a corn-soybean rotation.
- Soil tests: 19 ppm Bray P-1 (Optimum), 165 ppm Ammonium Acetate K (Optimum).
- Crop yield and P and K removal for determining nutrient rates needed to maintain the Optimum soil test category: 200 bu/acre corn yield; 75 lb P_2O_5/acre and 60 lb K_2O removal.
- Manure rate: based on corn N fertilization requirement at 125 lb N/acre.
- Manure application: injected late fall.
- Manure nutrient availability: 100 percent for N, P, and K.
- Manure N volatilization correction factor: 0.98.
- Manure rate: 125 lb N/acre ÷ (40 lb N/ 1,000 gal × 0.98) = 3,200 gal/acre.
- Manure available P and K nutrients applied: 3,200 gal/acre × (25 lb P_2O_5/ 1,000 gal × 1.00) = 80 lb P_2O_5/acre; and 3,200 gal/acre × (35 lb K_2O/1,000 gal × 1.00) = 112 lb K_2O/acre.
- Phosphorus and K applied with the manure are adequate for P (slightly more than expected corn removal) and will supply more than needed K. The extra P and K can be used by the next crop and should be accounted for. However, additional P and K will need to be applied for the following soybean crop.

Example 2

- Manure source: solid layer manure.
- Manure analysis: 72 lb N/ton, 69 lb P_2O_5/ton, 54 lb K_2O/ton.
- Intended crop: corn-soybean rotation.
- Soil tests: 18 ppm Bray P-1 (Optimum), 120 ppm Ammonium Acetate K (Low).
- Manure rate: based on P requirement for the crop rotation at 120 lb P_2O_5/acre.
- Manure application: late fall, incorporated after four days.
- Manure nutrient availability: 55 percent for N, 100 percent for P and K.
- Manure N volatilization correction factor: 0.80.
- Manure rate: 120 lb P_2O_5/acre ÷ (69 lb P_2O_5/ton × 1.00) = 1.7 ton/acre.
- Manure available N and K nutrients applied: 1.7 ton/acre × (72 lb N/ton × 0.60 × 0.80) = 60 lb N/acre; and 1.7 ton/acre × (54 lb K_2O/ton × 1.00) = 92 lb K_2O/acre.
- Corn N fertilization need and K needed for the corn and soybean crops with a Low soil test category: 130 lb N/acre and 172 lb K_2O/acre.
- Crop available N and K applied with manure is not adequate for N, need additional 70 lb fertilizer N/acre (130 lb N/acre – 60 lb N/acre); and applied K is not adequate for the corn and soybean crops, need additional 80 lb K_2O/acre (172 – 92 lb K_2O/acre) from fertilizer.

Additional Resources

PM 1688 *A General Guide for Crop Nutrient and Limestone Recommendations in Iowa*

PM 287 *Take a Good Sample to Help Make Good Decisions*

PM 2015 *Concepts and Rationale for Regional Nitrogen Rate Guidelines for Corn*

PM 1714 *Nitrogen Fertilizer Recommendations for Corn in Iowa*

PM 2026 *Sensing Nitrogen Stress in Corn*

PM 1584 *Cornstalk Testing to Evaluate Nitrogen Management*

PM 1588 *How to Sample Manure for Nutrient Analysis*

A3769 *Recommended Methods of Manure Analysis* (University of Wisconsin)

MWPS-18-S1 *Manure Characteristics: Section 1* (Midwest Plan Service)

MWPS-18 *Livestock Waste Facilities Handbook, Third Edition* (Midwest Plan Service)

Corn Nitrogen Rate Calculator, **http://extension.agron.iastate.edu/soilfertility/nrate.aspx**

Using Manure Nutrients for Crop Production

Summary

- Carefully manage the nutrients in animal manure as you would manage fertilizer.
- Have representative manure samples analyzed to determine nutrient concentration. At a minimum, samples should be analyzed for moisture (dry matter) and total N, P, and K. For additional information on N composition, samples can be analyzed for ammonium. Maintain a manure analysis history for production facilities.
- Set the manure application rate according to crop fertilization requirements and for the crop availability of manure N, P, and K.
- Adjust manure rates for estimated N volatilization.
- For manure application rates, consider the crop N, P, and K fertilization requirements and field P-Index ratings, but do not exceed the crop N fertilization need.
- Consider the nutrient needs of crop rotations rather than just individual crops, which is especially important for P and K management.
- Allocate manure to fields based on soil tests and crops to be grown.
- Fall applications of manure should not be made until the soil temperature is 50° F and cooling, especially for manure sources that have a large portion of N as ammonium.
- Do not apply manure to snow-covered, frozen, or water-saturated sloping ground to reduce risk of nutrient loss and water quality impairment.

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Expert Reviewed This publication was peer-reviewed by three independent reviewers using a double-blind process.

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How to Sample Manure for Nutrient Analysis

A field-by-field nutrient management program requires multiple components to maintain adequate fertility for crop growth and development. A well-designed soil sampling plan, including proper soil test interpretations along with manure sampling, manure nutrient analysis, equipment calibration, appropriate application rates and application methods are all necessary components of a nutrient management plan. Implementing these components allows manure to be recognized and used as a credible nutrient resource, potentially reducing input costs and the potential of environmental impacts.

Animal manure has long been used as a source of nutrients for crop growth. Standard nutrient values are guides to determine the amount of nutrients that animal manure will supply as a fertilizer source. Iowa State University Extension publication, *Managing Manure Nutrients for Crop Production* (PM 1811), recommends manure nutrient content and credits by type of animal, handling system and application methods.

While “book values” like those in PM-1811 are reasonable average values, an individual farm’s manure analyses can vary from those averages by 50 percent or more. Species, age of animal, feed rations, water use, bedding type, management, and other factors make every farm’s manure different. Two key factors affecting the nutrient content of manure are manure handling and type of storage structures used. Each handling system results in different types of nutrient losses—some unavoidable and others that can be controlled to a certain degree. Because every livestock production and manure management system is unique, the best way to assess manure nutrients is by sampling and analyzing the manure at a laboratory.

This publication describes how to sample solid, semi-solid, and liquid manure. Manure with greater than 20 percent solids (by weight) is classified as dry manure and is handled as a solid, usually with box-type spreaders. Manure with 10 to 20 percent solids is classified as semi-solid manure and can usually be handled as a liquid. Semi-solid manure usually requires the use of chopper pumps to provide thorough agitation before pumping. Manure with less than 10 percent solids is classified as liquid manure and is handled with pumps, pipes, tank wagons, and irrigation equipment.

A representative manure sample is needed to provide an accurate reflection of the nutrient content. Unfortunately, manure nutrient content is not uniform within storage structures, so obtaining a representative sample can be challenging. Mixing and sampling strategies should therefore insure that samples simulate as closely as possible the type of manure that will be applied.

When to Sample Manure

Sampling manure prior to application will ensure that you receive the analysis in time to adjust nutrient application rates based on the nutrient concentration of the manure. However, sampling manure prior to application may not completely reflect the nutrient concentration of the manure due to storage and handling losses if long periods of time pass before application begins or when liquid storage facilities are not adequately agitated while sampling. “Pre-sampling” such as dipping samples off the top of storage structure for nitrogen (N) and potassium (K) concentrations, can be done to estimate application rates. (See page 3 for more on pre-sampling). Producers must remember to go back and determine the actual nutrient rates applied by using manure samples collected during application and calculating volumes.

For best results, manure should be sampled at the time of application or as close as possible to application. Sampling during application will help to ensure that samples are well-mixed and representative of the manure being applied. Because manure nutrient analysis typically takes several days at a lab, sampling at the time of application will not provide immediate manure nutrient recommendations. The results can, however, be used for subsequent manure applications and to adjust commercial fertilizer application. This is why it is important to develop a manure sampling history and use those analyses in a nutrient management plan. A manure sampling history will also help you recognize if unplanned changes have occurred to your system if management and other factors have remained constant. A manure sampling history will give you confidence in using manure, and show you how consistent nutrient concentration is from year to year.

Take manure samples annually for three years for new facilities, followed with samples every three to five years, unless animal management practices, feed rations, or manure handling and storage methods change drastically from present methods. If you apply manure several times a

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year, take samples when you plan to apply the bulk of manure. For example, it may be appropriate to sample in the spring when manure that has accumulated all winter will be applied. If storages are emptied twice a year, it may be necessary to sample in both spring and fall since the different storage temperatures in summer versus winter will affect manure nutrient levels. *NOTE: Implementation of future federal regulations may require concentrated animal feeding operations (> 1,000 animal units) to sample annually. Please check state and federal requirements to determine sampling frequency.*

How to Sample Semi-Solid or Liquid Manure

In liquid and semi-solid systems, settled solids can contain over 90 percent of the phosphorus (P), so complete agitation is needed to accurately sample the entire storage if all the manure in the storage structure is going to be applied. If, however, solids will purposely be left on the bottom of the storage structure when the manure is pumped out, as is sometimes the case with lagoons, then complete agitation during sampling may generate artificially high nutrient values. In this case agitation of the solids or sludge on the bottom of a lagoon is not needed for nutrient analysis.

Liquid manure is best sampled during land application, for it is potentially more difficult and dangerous to sample from liquid storage facilities than dry manure systems. When sampling manure during application is not possible, or pre-application analysis is desired for determining rates, refer to the section on sampling from a storage facility. If sampling from a liquid storage facility, use caution to prevent accidents, such as falling into the manure storage facility or being overcome with hazardous gases produced by manure. Have two people present at all times. Never enter confined manure storage spaces without appropriate safety gear such as a self-contained breathing apparatus.

Ideally, liquid manure should be agitated so a representative sample can be obtained for laboratory analysis. When agitating a storage pit below a building, be sure to provide adequate ventilation for both animals and humans. When agitating outdoor unformed pits, monitor activities closely to prevent erosion of berms or destruction of pit liners.

Liquid Manure Sample Preparation

All liquid samples should be handled as follows:

- Prior to sampling label a plastic bottle with your name, date and sample identification number using a waterproof pen.
- If the sample cannot be mailed or transported to a laboratory within a few hours, it should be frozen. Place the container in a tightly sealed plastic bag and keep it cold or frozen until it arrives at the laboratory.
- Most manure analysis laboratories do have plastic bottles available for sample collection. Do not use glass containers, as expansion of the gases in the sample can cause the container to break.

Liquid Manure Sampling During Land Application

Liquid Manure Applied with Tank Wagons

- Since settling begins as soon as agitation stops, samples should be collected as soon as possible after the manure tank wagon is filled unless the tanker has an agitator.
- Immediately after filling the tank wagon, use a clean plastic pail to collect manure from the loading or unloading port or the opening near the bottom of the tank. Be sure the port or opening does not have a solids accumulation from prior loads.
- Use a ladle to stir the sample in the bucket to get the solids spinning in suspension. While the liquid is spinning remove a ladle full and carefully pour in the sample bottle. See Figure 1.
- Repeat this procedure and take another sample until the sample bottle is three-quarters full (Make sure the manure solids have not settled to the bottom of the bucket as each ladle is extracted; it is important to include the solids in the sample). Screw the lid on tightly.

Figure 1. Collecting a liquid manure sample.

Liquid Manure Applied by Irrigation Systems

- Place catch pans or buckets randomly in the field to collect liquid manure that is applied by an irrigation system. Inexpensive aluminum roasting pans or plastic buckets can be used as catch pans. Use several pans at different distances from the sprinkler head.
- Immediately after the manure has been applied, collect manure from catch pans or buckets and combine the manure in one bucket to make one composite sample.
- Use a ladle to stir the sample in the bucket. While the liquid is spinning remove a ladle full and carefully pour into a sample bottle. See Figure 1.
- Repeat this procedure and take another sample until the sample bottle is three-quarters full. Screw the lid on tightly.

Liquid Manure Sampling from Storage Facilities

For best sampling results, samples should be taken with a sampling probe or tube (see Figure 2). Probes can be constructed out of 1.5-inch diameter PVC pipe. Cut the PVC pipe a foot longer than the depth of the pit. Run a 1/4 -inch rod or string through the length of the pipe and attach a plug such as a rubber stopper or rubber ball (see Figure 3). The rod or the string must be longer than the pipe. If using a rod, bend the top over to prevent it from falling out of the pipe.

- Insert the pipe slowly into the pit or lagoon, with the stopper open, to the full depth of the pit.
- Pull the string or rod to close the bottom of the pipe and extract the vertical profile sample inside the pipe (be careful not to tip the pipe and dump the sample).
- Release the sample carefully into a bucket.
- Repeat the process at least three times around the pit or lagoon creating a composite sample in the bucket.
- Use a ladle to stir the sample in the bucket to get the solids spinning in suspension. While the liquid is spinning,

Figure 2. Sampling earthen basin with sampling probe.

take a ladle full and carefully pour into a sample bottle.
- Repeat again and take another sample until sample bottle is three-quarters full. Make sure the manure solids have not settled to the bottom of the bucket as each dipper is extracted; it is important to include the solids in the sample. Screw the lid on tightly.

Figure 3. Rubber stopper attached to a metal rod to serve as a stopper for PVC manure sampling tube.

Pre-Sampling Nitrogen and Potassium from Liquid Manure

If the procedures described above for sampling liquid manure are impractical due to lack of sampling equipment, or the inability to agitate the manure, manure samples can be dipped off the top of stored liquid manure to analyze for N and K concentrations. Research has shown that top-dipped liquid samples represent approximately 90 percent of the N concentration measured in mixed, field-collected samples. Multiply the results of the N concentration from top-dipped samples by 1.1 for a better estimate of the N concentration of the liquid storage facility. Dipping a sample from the surface of a liquid storage pit does NOT provide a good estimate of P concentration in the pit and is not recommended.

How to Sample Dry or Solid Manure

In solid manure handling systems, many of which include bedding, the proportions of fecal matter, urine, and bedding will vary from one location to another within sites, and often from season to season as well. It is necessary to take samples from various places in the manure pile, stack, or litter to obtain a representative sample for analysis. It may even be beneficial to sample several times per year based on the bedding content.

Manure sampling is best done in the field as manure is applied. This ensures that losses that occur during handling, storage, and application are taken into account and that manure is better mixed, reducing stratification found during sampling storage facilities. As with field sampling of liquid manure, results will not be available in time to adjust current application rates. However, sampling during application will still allow producers to adjust any planned future commercial fertilizer rates and manure application in subsequent years. The following method describes a procedure for collecting dry or solid manure samples from the field.

Dry Manure Sampling During Land Application

Collect manure samples according to the following field sampling procedure.
- Spread a sheet of plastic or tarp on the field. A 10-feet-by-10-feet sheet works well for sampling manure.
- Fill the spreader with a load of manure.
- Drive the tractor and manure spreader over the top of the plastic to spread manure over the sheet.
- Collect subsamples as described below (Steps 1-3, Composite Sample Collection).
- Samples should be collected to represent the first, middle and last part of the storage facility or loads applied and should be correlated as to which loads are applied on certain fields to track changes in nutrient concentrations throughout the storage facility.

Sampling from Dry or Solid Storage Facilities and Open Lots

Manure should be sampled at the time of application, but if time and management practices prevent this, manure samples can be collected from the storage facility. Sampling from storages is not generally recommended due to difficulty in collecting a representative sample. Although solid manure storages are generally not fully enclosed and gases are somewhat diluted, always exercise caution when sampling from storage facilities. If you have to enter a confined storage facility, follow the safety recommendations described previously in the section on sampling liquid manure storages.

Open Paved Lots

Manure that accumulates on paved feedlots and is scraped and hauled to the field is classified as scrape-and-haul feedlot manure. Manure is usually removed from the feedlot daily or several times a week.
- Collect manure by scraping a shovel across approximately 25 feet of the paved feedlot. This process should be repeated ten or more times, taking care to sample in a direction that slices through the large-scale variations of moisture, bedding, depth, age, etc. (See Figure 4). Avoid manure that is excessively wet (near waterers) or contains unusual amounts of feed and hay.
- Use the shovel to thoroughly mix manure by continuously scooping the outside of the pile to the center of the pile.
- Collect subsamples from this pile using the hand-in-bag method that is described below (Steps 1-3 Composite Sample Collection).
- This may need to be done several times to collect several composite samples for analysis.

Figure 4. Sampling a feed-lot for manure sample.

Barn Gutter

Manure that accumulates in a barn or housing facility, is temporarily stored in a gutter, and then removed by a barn cleaner is classified as barn gutter manure. Manure is usually removed from the barn once or twice daily.
- Shovel a vertical "slice" of manure from the gutter, making sure the shovel reaches to the bottom of the gutter.
- Remove manure from the gutter and pile it on the barn floor. Mix the manure with a shovel or pitchfork to ensure that bedding is mixed thoroughly with manure. When collecting samples from a gutter, be sure to include the liquid that accumulates in the gutter's bottom. Discard foreign material and also take care not to add large amounts of barn lime.
- Repeat steps one and two from various locations along the gutter.
- Mix each pile thoroughly and collect subsamples from each pile using the hand-and-bag method that is described below (Steps 1-3, Composite Sample Collection).

Dry Stack and Manure with Litter

Manure that is stored outside in a solid waste storage facility, such as a stacking shed or horizontal concrete silo located above ground, is classified as a dry stack. These facilities are usually covered to prevent the addition of extra water. Dry manure with litter should also be sampled in the following manner.

- Remove manure from 10 to 20 locations throughout the dry stack and place it in a pile using a pitchfork or shovel. Manure should be collected from the center of the stack as well as from near the outside walls, to get samples that represent all ages and moisture levels of manure in the stack. A bucket loader can cut a path into the center of the pile to provide access for sampling. Subsamples should be collected to the depth the litter will be removed for application.
- Thoroughly mix manure with the shovel by continuously scooping the outside of the pile to the center of the pile.
- Collect a composite manure sample as described below (Steps 1-3, Composite Sample Collection).

Composite Sample Collection for Dry or Solid Samples

1. Whether collecting from a plastic tarp in the field, a feedlot, a storage facility, or a barn, sample in a grid pattern so that all areas are represented. Combine 10 to 20 subsamples in a bucket or pile and mix thoroughly. More subsamples will produce more accurate results and are often required to produce a composite that best represents nutrient levels.
2. The final composite sample that will be submitted for nutrient analysis should be collected using the hand-in-bag method. To collect a composite sample from the mixed subsamples, place a one-gallon resealable freezer bag turned inside out over one hand. With the covered hand, grab a representative handful of manure and turn the freezer bag right side out over the sample with the free hand. Be careful not to get manure in the sealable tracks.
3. Squeeze excess air out of the bag, seal, and place it in another plastic bag to prevent leaks. Label the bag with your name, date, and sample identification number with a waterproof pen and freeze it immediately to prevent nutrient losses and minimize odors. For manure with a high degree of variability, multiple samples may need to be analyzed. Manure samples should be mailed or delivered to the laboratory as soon as possible after sampling.

Manure samples should be sent to a lab for chemical analysis as quickly as possible to avoid nutrient losses. For a list of commercial laboratories, please call your ISU Extension office or visit the Web at: http://extension.agron.iastate.edu/immag/sp.html.

Table 1. Conversion Factors

To switch from	Multiply by	To get
mg/l	1.0	ppm
ppm	0.0001	percent
ppm	0.00834	lb/1,000 gal
ppm	0.002	lb/ton
ppm	0.2265	lb/acre-inch
lb/1,000 gal	0.012	percent
lb/ton	0.05	percent
percent	83.4	lb/1,000 gal
percent	20.0	lb/ton
percent	2265	lb/acre-inch
P (elemental)	2.29	P_2O_5
K (elemental)	1.2	K_2O

Additional Information and Resources

Basic manure analyses determined by laboratories include total nitrogen, total phosphorus, and total potassium. Results from commercial laboratories are presented either as a percent of the sample weight, as pounds per ton, as pounds per 1,000 gallons of manure, or in parts per million (ppm). Table 1 shows factors used to convert between measurements. Usually, nutrients are expressed as N, P_2O_5, or K_2O on a wet or "as received" basis, but some labs may instead report data on an elemental (P instead of P_2O_5, K instead of K_2O) or dry (without water) basis; so, be sure to confirm the units. In any case, manure values from commercial laboratories express nutrients as the total amount of nutrient in the manure sample. Some primary nutrients, such as N and P, may not be completely available for plant growth the first year manure is applied. A portion of some nutrients present in manure are in an organic form and unavailable for immediate plant uptake. Organic forms require transformation to an inorganic form to be available for plant uptake. This transformation is dependent on temperature, moisture, chemical environment, and time. Availability of nutrients can be limited by field losses, which are affected by the type of manure and by manure application methods. These losses are not accounted for in laboratory results. Refer to the ISU Extension publication *Managing Manure Nutrients for Crop Production* (PM 1811) for nutrient availability estimates and losses due to types of manure application methods.

PM 1518k *Manure Storage Poses Invisible Risks*
PM 1941 *Calibration and Uniformity of Solid Manure Spreaders* (12/03)
PM 1948 *Calibrating Liquid Manure Applicators* (02/04)
PM 1811 *Managing Manure Nutrients for Crop Production*

Additional resources may be found on the Iowa Manure Management Action Group (IMMAG) Web page at: http://extension.agron.iastate.edu/immag/default.htm

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Appendix C. Historic Properties Requirements

Coverage under this permit is available only if your CAFO discharges and discharge- related activities meet one of the eligibility criteria below:

> Criterion A. Your CAFO discharges do not have the potential to have an effect on historic properties and you are not constructing or installing new control measures on your site that cause subsurface disturbance.
>
> Criterion B. Your discharge-related activities (i.e., construction and/or installation of control measures that involve subsurface disturbance) will not affect historic properties.
>
> Criterion C. Your CAFO discharges and discharge-related activities have the potential to have an effect on historic properties; you have consulted with the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO), or other tribal representative regarding measures to mitigate or prevent any adverse effects on historic properties; and, you have either (1) obtained and are in compliance with a written agreement that outlines all such measures, or (2) been unable to reach agreement on such measures.
>
> Criterion D. You have contacted the SHPO, THPO, or other tribal representative and EPA in writing informing them that you have the potential to have an effect on historic properties and you did not receive a response from the SHPO, THPO, or tribal representative within 30 days of receiving your letter.

If you have been unable to reach agreement with a SHPO, THPO, or other tribal representative regarding appropriate measures to mitigate or prevent adverse effects, the permitting authority may notify you of additional measures you must implement to be eligible for coverage under this permit.

CAFO operators must determine whether their permit-related activities have potential to affect a property that is either listed or eligible for listing on the National Register of Historic Places. CAFO operators must contact the SHPO, THPO, and/or any Indian tribe that attaches religious and cultural significance to historic properties that may be affected. In instances where a Tribe does not have a THPO, CAFO operators should contact the appropriate Tribal government office.

Appendix D. Notice of Termination

(Insert Notice of Termination (NOT) Form or Appropriate State Form)

Appendix P

Sample Nutrient Management Plan

This sample Nutrient Management Plan (NMP) is based on a hypothetical facility. The accompanying photograph does not portray a facility on which this sample NMP is based. Nor do the technical standards used to develop this sample NMP constitute a technical standard that the U.S. Environmental Protection Agency (EPA) has reviewed for consistency with the requirements of Title 40 of the *Code of Federal Regulations* (CFR) part 412.4(c)(2). EPA is using this sample NMP for the purpose of demonstrating how to identify terms of the NMP as required for a confined animal feeding operation (CAFO) permit pursuant to 40 CFR part 122.42(e)(5). Circulation of this sample NMP and the technical standards therein does not constitute an endorsement of the technical standards or the NMP's approach toward managing nutrients. This sample NMP is intended for educational purposes only and does not create or remove any legal rights or requirements on any member of the public, states, or any other federal agency.

The following output was generated by using the Manure Management Planner, which is at

http://www.agry.purdue.edu/mmp/

Nutrient Management Plan

Farm contact information: DEF Feedlot
c/o John Doe
xxx Ave.
Anytownin, IA 55555
515.555.5555

Latitude/Longitude:

Plan Period: Oct 2009 - Sep 2014

Conservation Planner

As a Conservation Planner, I certify that I have reviewed both the *Comprehensive Nutrient Management Plan* and *Producer Nutrient Management Activities* documents for technical adequacy and that the elements of the documents are technically compatible, reasonable and can be implemented.

Signature: ___________*SAMPLE* __________________ Date: _______*N/A* ______
Name:
Title: Certification Credentials:

Conservation District

The Conservation District has reviewed the CNMP documents and concurs that the plan meets the District's goals.

Signature: ___________*SAMPLE*__________________ Date: _______*N/A* ______
Name:
Title:

Owner/Operator

As the owner/operator of this CNMP, I, as the decision maker, have been involved in the planning process and agree that the items/practices listed in each element of the CNMP are needed. I understand that I am responsible for keeping all the necessary records associated with the implementation of this CNMP. It is my intention to implement/accomplish this CNMP in a timely manner as described in the plan.

Signature: ___________*SAMPLE*__________________ Date: ________*N/A* _____
Name:

Contents

Section 1. Background and Site Information

1.1. General Description of Operation

Management

DEF Feedlots have been farming and operating this facility since 1978. The operation employs a number of personnel on a full-time and seasonal basis driven by need. The cattle and crop operations are handled as integrated systems. The crop operation complements the feedlot's feed and bedding requirements, and the manure generated by the feedlots provide nutrients for the crops. At the time this plan was prepared, there are no plans for expansion during the period covered by the plan.

This NMP has been prepared and is being implemented in compliance with state permit: [Identified in Appendix O of this Manual]. This five-year plan will be updated as necessary and revised and resubmitted when the permit is renewed in 2015.

Manure is handled in both solid and liquid (irrigated) forms and is distributed to crop production areas. Manure generated by the feedlots in excess of crop production needs and land availability during the growing season will be stockpiled within the footprint of the production area in a manner that is compliant with all permit requirements. Collected and stored runoff from the feedlots is planned to be used to irrigate crops to address peak water needs.

Animals

The feedlot permit is for 5,000 head of beef cattle on an 80.9-acre open feedlot. This plan covers feeder cattle of all weights and sexes arriving to be fed to heavier weights (harvest).

Facilities

Open feedlot penning is employed in this feedlot, with baled cornstalk and soybean residue added as bedding during inclement weather. Fence line feeding systems are filled with daily formulated rations from a mixer/scale delivery vehicle. Stationary fountains provide fresh drinking water. A visual inspection of all water lines is conducted daily.

All solids settling basins have been designed by a licensed engineer and approved by IDNR. Design documentation is kept on file at the operation. Weekly operation and maintenance assessments and required repairs will be conducted on all pens, settling basins, and associated equipment. Weekly inspections are conducted and documented for all manure and process wastewater holding areas to monitor available capacity.

Crop Fields

All land areas in this plan is either owned or rented and under the control of DEF Feedlots. There are 1,237 tillable acres with planned continuous corn and corn/soybean rotations. Yield goals are developed in accordance with Appendix A9: Chapter 567-- 65.17(6) Rules for Animal Feeding Operations. In accordance with the technical standard, optimum crop yield determinations allow for a crop yield increase of 10 percent. For the location of DEF Feedlots the average plus a 10% yield for corn is 195 bushels/acre and for soybeans is 61 bushels/acre. The plan includes a cropping plan for each field along with soil test results. *(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)*

Land Application of Nutrients

The cropping pattern is a continuous corn and corn/soybean rotation. That allows for any residual nitrogen from the soybean crop to be accounted for in the corn year. Manure is planned to be applied at a rate that supplies two or four years of phosphorus depending on the outcome of the required field-specific Phosphorus Index Risk Assessment. It is planned to apply the manure on a priority basis to fields that have been harvested as corn, corn silage, baled residue or soybean stubble. Actual manure distribution will take into account soil test, crop yields and uptake, ambient weather conditions; manure stockpiled, soil moisture conditions, manure analyses and growing crop production. Management strategies that will continue to evolve over the planning period will include crop rotation, feed management, tillage practices, conservation practice and treatments, seed varieties, pest management, and water conservation. All management adjustments will comply with permit requirements and any applicable state and federal regulations.

1.2. Sampling and Equipment Calibration

Manure sampling and testing frequency

Manure is analyzed annually for nutrient content of total nitrogen, phosphorus, potassium, and percent moisture. An analysis is taken for each different source of manure being generated. Manure samples are collected according to ISU Publication PM-1558 *How to Sample Manure for Nutrient Analysis*. Samples are analyzed by AGSource Cooperative Services DBA AGSource Belmond Labs.

Soil sampling and testing frequency

The minimum frequency for soil testing will be once during a four-year period. All soil samples will be collected according to Iowa State University (ISU) for sampling methods based on soil maps, management zones, or grid sampling. See ISU PM 287 *Take a Good Sample to Help Make Good Decisions*. All soil tests will be analyzed by a soil test lab that is certified according to Iowa Department of Agriculture and Land Stewardship (IDALS) soil test lab certification standards. Before sampling, each field was broken into uniform sampling areas, as is determined by the types of soils present, past management and productivity, and goals desired for field management practices. In accordance with ISU PM 287, each of these sampling areas was 10 acres or less. A total of 10–12 cores or borings per sampling area were taken and combined to form a composite sample for each field.

Equipment calibration method and frequency

Equipment will be calibrated annually and records are maintained at the operation. For record keeping requirements necessary for application equipment, see section 7.

1.3. Identified Resource Concerns

Where surface water or other sensitive areas are present in a field, setbacks are maintained during manure and commercial nutrient distribution in accordance with permit requirements. The primary resource concern to be managed under this plan is surface water runoff. Depending on the specific needs of each field to address that concern, the plan identifies the specific practices to be employed to control surface water runoff. Those practices include terraces, grassed waterways, contour farming, and residue management. Employee training is conducted regularly addressing manure storage, manure handling, and distribution. Documentation of all training activities is maintained at the operation. *(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)*

Section 2. Manure and Wastewater Handling and Storage

2.1. Map(s) of Production Area

To simplify publication of this sample plan, the production area map is not included. A production area map should be included with all NMPs developed and implemented as a condition of a National Pollutant Discharge Elimination System CAFO permit.

2.2. Production Area Conservation Practices

Clean water diversion

All clean rainwater is diverted away from the feedlot using grass covered swales and berms. Vegetation will remain established in the grassed swale and grass swales will be mowed as needed to ensure proper function. No clean water is collected. The production area will be checked weekly to insure that clean rainwater continues to flow away from the feedlot. See section 7 for record keeping requirements necessary for weekly inspections.

Measures to prevent direct contact of animals with water

Confined animals have no access to waters of the state in the production area.

2.3 Manure Storage

Storage ID	Type of Storage	Pumpable or Spreadable Capacity	Annual Manure Collected
E Lots Stack #1	Dry stack	2,199 Tons	4,375 Tons
E SetldSolidBasin #3	Dry stack	756 Tons	757 Tons
E Storage Pond #1	Earthen storage	16,502,043 Gal	10,575,180 Gal
W Lots Stack #2	Dry stack	879 Tons	1,750 Tons
W SetdSolidBasin#4	Dry stack	247 Tons	247 Tons
W Storage Pond #2	Earthen storage	3,112,645 Gal	5,876,413 Gal

Dry stacks are contained in the open feedlots. They are not covered and, therefore, are open to direct precipitation. The wastewater runoff that is generated from the feedlots is collected. Solids are settled in W SetdSolid Basin #4. The liquid is then diverted to W Storage Pond #2. W Storage Pond #2 is connected to E Storage Pond #1. Land application of liquid manure is applied directly from E Storage Pond #1.[1]

[1]For simplicity only Field 8 is illustrated in this plan. Field 8S does not receive manure application from E Storage Pond #1.

The pumpable capacity represents the total design volume as calculated in the engineering and design construction plans. Engineering design and construction plans for both types of storage structures are not included as part of this NMP but are to be kept on-site. They include calculations for

- The volume of manure, process wastewater, and other wastes accumulated during the critical storage period.
- The volume of normal precipitation minus evaporation on the storage structure surface.
- The volume of runoff from the facility's drainage area from normal rainfall events, which includes runoff from mortality area described in section 2.5.
- 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.
- The volume of solids remaining in a storage structure after liquids are removed.

The 25-year, 24-hour storm for the location of the operation is 4.9 inches. The volume in E Storage Pond #1 attributed for this size storm is 2,405,282 gallons. The critical storage volume is 14,096,761 gallons. A depth marker will be placed in E Storage Pond #1 identifying 14,096,761 gallons as the upper pump down level. In addition, the storage pond contains an additional 2 feet of free board.

Operation and Maintenance

Manure will be land applied in accordance with this NMP, and solids will be removed at a frequency necessary to maintain the storage capacity as described above.

All visual inspections will be conducted as outlined in section 7.3 of this NMP. Fencing will be maintained around the perimeter of the ponds to prevent animal access.

2.4 Animal Inventory

Animal Group	Type or Production Phase	Number of Animals(1)	Average Weight (Lbs)	Confinement Period	Manure Collected (%)(2)	Storage Where Manure Will Be Stored
Cattle #1 basin	Finishing steer (beef)	2,500	850	Jan Early–Dec Late	30	E. Lots Stack #1
Cattle #1 dry stack	Finishing steer (beef)	2,500	850	Jan Early–Dec Late	60	W. SetldSolid Basin #4
Cattle #1 pond	Finishing steer (beef)	2,500	850	Jan Early–Dec Late	10	E. Storage Pond #1
Cattle #2 basin	Finishing steer (beef)	2,500	850	Jan Early–Dec Late	30	E .SetldSolid Basin #3
Cattle #2 dry stack	Finishing steer (beef)	2,500	850	Jan Early–Dec Late	60	W. Storage Pond #2
Cattle #2 pond	Finishing steer (beef)	2,500	850	Jan Early–Dec Late	10	W. Lots Stack #2

(1) Number of Animals is the average number of animals that are present in the production facility at any one time.

(2) If Manure Collected is less than 100%, this indicates that the animals spend a portion of the day outside of the production facility or that the production facility is unoccupied one or more times during the confinement period.

2.5. Normal Mortality Management

To protect surface and groundwater resources, reduce the impact of odors that result from improperly handled animal mortality, and decrease the likelihood of the spread of disease or other pathogens, approved handling and utilization methods shall be implemented in the handling of normal mortality losses.

Plan for Proper Management of Dead Animals

NRCS IA Standard 316, Animal Mortality Facility, October 2007 will be followed for proper management of dead animals. Dead animals will be disposed of utilizing Valley Rendering Services. When rendering services are used, dead animals should be picked up within 24 hours. Dead animals will be stored in a separate bermed area adjacent to the production area to control runoff. Adequate space is available in the bermed area to hold normal animal mortality at the feedlot operation. Process wastewater that runs off that area is collected and transported to the waste storage ponds. The liquid storage calculations account for this additional volume of liquid. There are no additional operation and maintenance activities required with plan to be used to address normal animal mortality at the operation. Under no circumstances will the manure treatment systems be used to manage any mortality. Contact information for Valley Rendering is (555)-555-5555.

2.6. Planned Manure Exports off the Farm

Month-Year	Manure Source	Amount	Receiving Operation	Location

During the period covered by the plan no manure is to be exported from the DEF Feedlots operation.

2.7. Planned Manure Imports onto the Farm

Month-Year	Manure's Animal Type	Amount	Originating Operation	Location

During the period covered by the plan, no manure is to be imported into the DEF Feedlots operation.

Section 3. Farmstead Safety and Security

3.1. Emergency Response Plan

In Case of an Emergency Storage Facility Spill, Leak or Failure

Implement the following first containment steps:

- **a.** Stop all other activities to address the spill.
- **b.** Stop the flow. For example, use skid loader or tractor with blade to contain or divert spill or leak.
- **c.** Call for help and excavator if needed.
- **d.** Complete the clean-up and repair the necessary components.
- **e.** Assess the extent of the emergency and request additional help if needed.

In Case of an Emergency Spill, Leak or Failure during Transport or Land Application

Implement the following first containment steps:

- **a.** Stop all other activities to address the spill and stop the flow.
- **b.** Call for help if needed.
- **c.** If the spill posed a hazard to local traffic, call for local traffic control assistance and clear the road and roadside of spilled material.
- **d.** Contain the spill or runoff from entering surface waters using straw bales, saw dust, soil or other appropriate materials.
- **e.** If flow is coming from a tile, plug the tile with a tile plug immediately.
- **f.** Assess the extent of the emergency and request additional help if needed.

Emergency Contacts

Department / Agency	Phone Number
Fire	xxx-xxx-xxxx
Rescue services	xxx-xxx-xxxx
State veterinarian	xxx-xxx-xxxx
Sheriff or local police	xxx-xxx-xxxx

Nearest available excavation equipment/supplies for responding to emergency

Equipment Type	Contact Person	Phone Number
xxxxx	John Doe	xxx-xxx-xxxx

Contacts to be made by the owner or operator within 24 hours

Organization	Phone Number
EPA Emergency Spill Hotline	xxx-xxx-xxxx
County Health Department	xxx-xxx-xxxx
Other State Emergency Agency	xxx-xxx-xxxx

Be prepared to provide the following information:

- **a.** Your name and contact information.
- **b.** Farm location (driving directions) and other pertinent information.
- **c.** Description of emergency.
- **d.** Estimate of the amounts, area covered, and distance traveled.
- **e.** Whether manure has reached surface waters or major field drains.
- **f.** Whether there is any obvious damage: employee injury, fish kill, or property damage.
- **g.** Current status of containment efforts.

3.2. Biosecurity Measures

Biosecurity is critical to protecting livestock and poultry operations. Standard operating procedures at DEF Feedlots require all visitors to check in with the facility manager before entering the operation or any production or storage facility. This procedure is included in the content of the training program given to all employees.

3.3. Catastrophic Mortality Management

In the case of catastrophic mortality on-farm disposal will be conducted if site conditions permit. On-farm methods typically include burial, composting, and incineration. The extent of mortality and specific state requirements will dictate the practice to be used. Catastrophic mortality will be addressed in a manner that is protective of surface and groundwater quality and human health. Activities will be conducted in accordance with all applicable state and local laws, regulations, and guidelines. Under no circumstances will the manure treatment systems be used to manage any mortalities.

Important! In the event of catastrophic animal mortality, contact the permitting authority before beginning carcass disposal.

3.4. Chemical Handling

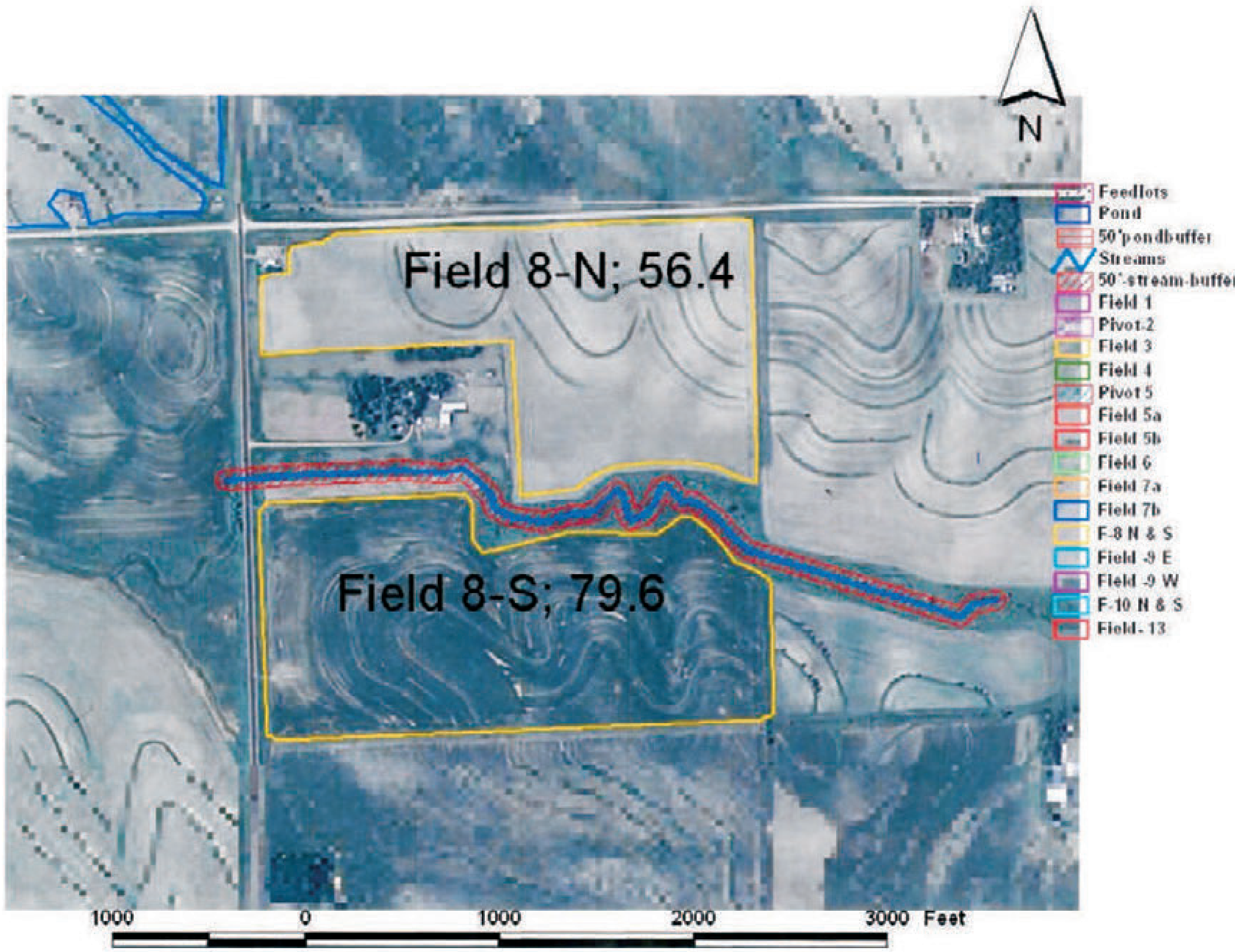
If checked, the indicated measures will be taken to prevent chemicals and other contaminants from contaminating process waste water or storm water storage and treatment systems.

	Measure
	This is not a regulatory-agency permitted facility. This section does not apply.
x	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 FIFRA label.
x	Chemical storage areas are self-contained with no drains or other pathways that will allow spilled chemicals to exit the storage area.
x	Chemical storage areas are covered to prevent chemical contact with rain or snow.
x	Emergency procedures and equipment are in place to contain and clean up chemical spills.
x	Chemical handling and equipment wash areas are designed and constructed to prevent contamination of surface waters and waste water and storm water 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 and waste water and storm water storage and treatment systems.

Section 4. Land Treatment

4.1. Map(s) of Fields and Conservation Practices

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)



4.2. Conservation Practices

The following conservation practices have been integrated with crop production practices at the DEF feedlots to control runoff and protect water quality. The specific practices being utilized in each field incorporated into this plan are specified in the table below. The table includes the NRCS conservation practice standard that dictates the implementation and management protocols that are to be employed during the planning period. *(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)*

Field	Area	Conservation Practice	NRCS Iowa Conservation Practice Reference
Bob's Farm North – 8N	56.4 Acres	50' Stream Vegetated Buffer	Riparian Forest Buffer (Ac.) (391) (August 2007)
		Contour Farming	Contour Farming (Ac.) (330) (May 2005)
		Residue Management	Residue Management, Seasonal (Ac.) (344) (March 2007)
Bob's Farm South – 8S	79.6 Acres	50' Stream Vegetated Buffer	Riparian Forest Buffer (Ac.) (391) (August 2007)
		Contour Farming	Contour Farming (Ac.) (330) (May 2005)
		Residue Management	Residue Management, Seasonal (Ac.) (344) (March 2007)

Section 5. Soil and Risk Assessment Analysis

5.1. Soil Information

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Soil Survey	Map Unit	Soil Component Name	Surface Texture	Slope Range (%)	Drainage	Hydro-logic Group	Perm. Code	Subsoil P	Subsoil K	Texture	CSR
Bob's Farm North – 8N	167	1C3	Ida	SIL	5-9%	Well	B	50	Low	Low	Fine	44
Bob's Farm South – 8S	167	1C3	Ida	SIL	5-9%	Well	B	50	Low	Low	Fine	44

5.2. Predicted Soil Erosion

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Predominant Soil Type	Slope (%)	Wind (Ton/Ac/Yr)	Irrigation (Ton/Ac/Yr)	Gully (Ton/Ac/Yr)	Ephemeral (Ton/Ac/Yr)	Plan Avg. Soil Loss (Ton/Ac/Yr)
Bob's Farm North – 8N	1C3 (Ida SIL)	7.0					3.1
Bob's Farm South – 8S	1C3 (Ida SIL)	7.0					3.9

Field	Crop Year	Starting Date (mm/dd/yyyy)	Ending Date (mm/dd/yyyy)	Soil Loss (Ton/Ac)	Primary Crop
Bob's Farm North – 8N	2010	10/23/2009	10/10/2010	2.0	Soybean
	2011	10/11/2010	10/22/2011	4.2	Corn
	2012	10/23/2011	10/10/2012	3.6	Soybean
	2013	10/11/2012	10/20/2013	2.9	Corn
	2014	10/21/2013	10/10/2014	2.6	Soybean
Bob's Farm South – 8S	2010	10/23/2009	10/10/2010	2.0	Soybean
	2011	10/11/2010	10/22/2011	3.7	Corn
	2012	10/23/2011	10/10/2012	3.6	Soybean
	2013	10/11/2012	10/20/2013	5.7	Corn
	2014	10/21/2013	10/10/2014	4.4	Soybean

5.3. Nitrogen and Phosphorus Risk Analysis – Iowa Phosphorus Index

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Crop Year	Erosion Component	Runoff Component	Drainage Component	P Index w/o P Apps	P Index w/ P Apps	P Loss Risk
Bob's Farm North – 8N	2010	1.05	0.21	0.00	1.26	1.26	Low
Bob's Farm North – 8N	2011	2.21	0.21	0.00	2.42	2.42	Medium
Bob's Farm North – 8N	2012	1.90	0.22	0.00	2.10	2.11	Medium
Bob's Farm North – 8N	2013	1.53	0.22	0.00	1.73	1.74	Low
Bob's Farm North – 8N	2014	1.37	0.24	0.00	1.58	1.61	Low
Bob's Farm South – 8S	2010	1.07	0.23	0.00	1.29	1.29	Low
Bob's Farm South – 8S	2011	1.97	0.23	0.00	2.20	2.20	Medium
Bob's Farm South – 8S	2012	1.92	0.34	0.00	2.15	2.26	Medium
Bob's Farm South – 8S	2013	3.04	0.34	0.00	3.27	3.37	Medium
Bob's Farm South – 8S	2014	2.35	0.34	0.00	2.57	2.68	Medium

5.4. Additional Field Data Required by Risk Assessment Procedure

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Distance to Water (Feet)	Buffer Width (Feet)	Type of Artificial Drainage	Sediment Trap Conservation Practice	Landform Region	Residue Management	Land Use
Bob's Farm North – 8N	500	None	None	None	Northwest Iowa Plains	Tillage Used	Row crops - SR + CR, good
Bob's Farm South – 8S	500	None	None	None	Northwest Iowa Plains	Tillage Used	Row crops - SR + CR, good

Section 6. Nutrient Management

6.1. Field Information

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field ID	Sub-field ID	Total Acres	Spreadable Acres	FSA Farm	FSA Tract	FSA Field	County	Predominant Soil Type	Slope (%)
Bob's Farm North – 8N	8 N	56.4						1C3 (Ida SIL)	7.0
Bob's Farm South – 8S	8 S	79.6						1C3 (Ida SIL)	7.0

6.2. Manure Application Setback Distances

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Setback Distance
Bob's Farm North – 8N	There are no surface waters or other sensitive features present in this field that require manure application setback. A stream is present in the land area between field 8N and 8S, and a 50-foot vegetated buffer is maintained where there is no manure application
Bob's Farm South – 8S	There are no surface waters or other sensitive features present in this field that require manure application setback. A stream is present in the land area between field 8N and 8S, and a 50-foot vegetated buffer is maintained where there is no manure application

6.3. Soil Test Data

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Test Year	OM (%)	P Test Used	P	K	Mg	Ca	Units	Soil pH	Buffer pH	CEC (meq/100g)
Bob's Farm North – 8N	2009	3.1	Bray P1	28	221	390	2,208	ppm	7.0	7.0	14.9
Bob's Farm South – 8S	2009	3.0	Bray P1	32	196	418	1,941	ppm	6.8	7.0	13.7

6.4. Manure Nutrient Analysis(1)

Manure Source	Dry Matter (%)	Total N	NH_4-N	Total P_2O_5	Total K_2O	Avail. P_2O_5(2)	Avail. K_2O(2)	Units	Analysis Source and Date
E Lots Stack #1		7.0	2.6	10.0	14.0	10.0	14.0	Lb/Ton	Mid West Labs
E SetldSolidBasin #3		7.9	2.9	2.9	8.8	2.9	8.8	Lb/Ton	Mid West Labs
E Storage Pond #1		1.7	1.0	0.5	3.0	0.5	3.0	Lb/1000Gal	Mid West Labs
W Lots Stack #2		7.0	2.6	10.0	14.0	10.0	14.0	Lb/Ton	Mid West Labs
W SetdSolidBasin#4		7.9	2.9	2.9	8.8	2.9	8.8	Lb/Ton	Mid West Labs
W Storage Pond #2		1.7	1.0	0.5	3.0	0.5	3.0	Lb/1000Gal	Mid West Labs

(1) Entered analysis may be the average of several individual analyses.

(2) Iowa assumes that 100% of manure phosphorus and 100% of manure potassium is crop available. First-year per-acre nitrogen availability for individual manure applications is given in the Planned Nutrient Applications table. For more information about nitrogen availability in Iowa, see "Managing Manure Nutrients for Crop Production," Iowa State Extension, PM 1811, Nov. 2003.

6.5. Planned Crops and Fertilizer Recommendations

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	Crop Year	Planned Crop	Yield Goal (per Acre)	N Rec (Lbs/A)	P_2O_5 Rec (Lbs/A)	K_2O Rec (Lbs/A)	N Removed (Lbs/A)	P_2O_5 Removed (Lbs/A)	K_2O Removed (Lbs/A)
Bob's Farm North – 8N	2010	Soybean	61.0 Bu	0	0	0	232	49	92
Bob's Farm North – 8N	2011	Corn	195.0 Bu	160	0	0		73	59
Bob's Farm North – 8N	2012	Soybean	61.0 Bu	0	0	0	232	49	92
Bob's Farm North – 8N	2013	Corn	195.0 Bu	160	0	0		73	59
Bob's Farm North – 8N	2014	Soybean	61.0 Bu	0	0	0	232	49	92
Bob's Farm South – 8S	2010	Soybean	61.0 Bu	0	0	0	232	49	92
Bob's Farm South – 8S	2011	Corn	195.0 Bu	160	0	0		73	59
Bob's Farm South – 8S	2012	Soybean	61.0 Bu	0	0	0	232	49	92
Bob's Farm South – 8S	2013	Corn	195.0 Bu	160	0	0		73	59
Bob's Farm South – 8S	2014	Soybean	61.0 Bu	0	0	0	232	49	92

* Unharvested cover crop or first crop in double-crop system.

[a] Custom fertilizer recommendation.

6.6. Manure Application Planning Calendar

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

October 2009 through September 2010

Field	Total Acres	Spread. Acres	Pre-dominant Soil Type	Primary 2010 Crop (Prev. Primary Crop)	Oct '09	Nov '09	Dec '09	Jan '10	Feb '10	Mar '10	Apr '10	May '10	Jun '10	Jul '10	Aug '10	Sep '10
Bob's Farm North – 8N	56.4	56.4	Ida SIL (1C3 5-9%)	Soybean (Corn)												
Bob's Farm South – 8S	79.6	79.6	Ida SIL (1C3 5-9%)	Soybean (Corn)												

October 2010 through September 2011

Field	Total Acres	Spread. Acres	Pre-dominant Soil Type	Primary 2011 Crop (Prev. Primary Crop)	Oct '10	Nov '10	Dec '10	Jan '11	Feb '11	Mar '11	Apr '11	May '11	Jun '11	Jul '11	Aug '11	Sep '11
Bob's Farm North – 8N	56.4	56.4	Ida SIL (1C3 5-9%)	Corn (Soybean)		39.5										
Bob's Farm South – 8S	79.6	79.6	Ida SIL (1C3 5-9%)	Corn (Soybean)		100.9										

October 2011 through September 2012

Field	Total Acres	Spread. Acres	Pre-dominant Soil Type	Primary 2012 Crop (Prev. Primary Crop)	Oct '11	Nov '11	Dec '11	Jan '12	Feb '12	Mar '12	Apr '12	May '12	Jun '12	Jul '12	Aug '12	Sep '12
Bob's Farm North – 8N	56.4	56.4	Ida SIL (1C3 5-9%)	Soybean (Corn)												
Bob's Farm South – 8S	79.6	79.6	Ida SIL (1C3 5-9%)	Soybean (Corn)												

October 2012 through September 2013

Field	Total Acres	Spread. Acres	Pre-dominant Soil Type	Primary 2013 Crop (Prev. Primary Crop)	Oct '12	Nov '12	Dec '12	Jan '13	Feb '13	Mar '13	Apr '13	May '13	Jun '13	Jul '13	Aug '13	Sep '13
Bob's Farm North – 8N	56.4	56.4	Ida SIL (1C3 5-9%)	Corn (Soybean)								60.2				
Bob's Farm South – 8S	79.6	79.6	Ida SIL (1C3 5-9%)	Corn (Soybean)												

October 2013 through September 2014

Field	Total Acres	Spread. Acres	Pre-dominant Soil Type	Primary 2014 Crop (Prev. Primary Crop)	Oct '13	Nov '13	Dec '13	Jan '14	Feb '14	Mar '14	Apr '14	May '14	Jun '14	Jul '14	Aug '14	Sep '14
Bob's Farm North – 8N	56.4	56.4	Ida SIL (1C3 5-9%)	Soybean (Corn)							50.4	3.2				
Bob's Farm South – 8S	79.6	79.6	Ida SIL (1C3 5-9%)	Soybean (Corn)												

Slope > 10%	Slope > 5% (Winter only)[1]	Crop in field	No. indicates total loads "X" indicates other manure apps

1) Nutrients and organic nutrient sources shall not be surface applied to frozen, snow-covered ground, or saturated soil if a potential risk for runoff exists. A potential risk for runoff exists on slopes greater than 5% unless erosion is controlled to soil loss tolerance levels ("T") or less. Manure may be surface applied to frozen, snow-covered or saturated ground if a potential risk for runoff exists only under one of the following conditions.

- Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure.
- On an emergency basis.

Manure surface applied to frozen, snow covered, or saturated ground shall be based on a manure disposal plan. That plan shall include:

- Under what circumstances the manure may be applied to frozen, snow covered, or saturated ground. (Ex: storage capacity exceeded).
- Rates of application.
- Area of application.
- Other requirements such as runoff control as indicated through the use of the Iowa Phosphorus Index assessment tool.

6.7. Planned Nutrient Applications (Manure-spreadable Area)

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Field	App. Month	Target Crop	Nutrient Source	Application Method	Rate Basis	Rate/ Acre	Loads, Speed or Time	Total Amount Applied	Acres Cov.	Avail N (Lbs/A)	Avail P_2O_5 (Lbs/A)	Avail K_2O (Lbs/A)
Bob's Farm North – 8N	Nov 2010	Corn	E SetldSolidBasin #3	Dry Box Spreader, Not incorporated	2-yr P	10.5 Ton	28.4 Lds	426 Ton	40.6	20	30	92
Bob's Farm North – 8N	Nov 2010	Corn	W SetdSolidBasin #4	Dry Box Spreader, Not incorporated	2-yr P	10.5 Ton	11.1 Lds	166.5 Ton	15.9	20	30	92
Bob's Farm North – 8N	Apr 2011	Corn	28-0-0	Shallow subsurface band (<4")	Supp. N	47 Gal		2,651 Gal	56.4	140	0	0
Bob's Farm North – 8N	Apr 2013	Corn	28-0-0	Shallow subsurface band (<4")	1-yr N	41 Gal		2,312 Gal	56.4	122	0	0
Bob's Farm North – 8N	May 2013	Corn	E SetldSolidBasin #3	Dry Box Spreader, incorp. w/in 7 day(s)	1-yr P	16 Ton	60.2 Lds	903 Ton	56.4	35	46	141
Bob's Farm North – 8N	Apr 2014	Soy-bean	E SetldSolidBasin #3	Dry Box Spreader, incorp. w/in 7 day(s)	1-yr P	17 Ton	50.4 Lds	756 Ton	44.5	37	49	150
Bob's Farm North – 8N	May 2014	Soy-bean	W SetdSolidBasin #4	Dry Box Spreader, incorp. w/in 7 day(s)	1-yr P	17 Ton	3.2 Lds	48 Ton	2.8	37	49	150
Bob's Farm South – 8S	Nov 2010	Corn	E Lots Stack #1	Dry Box Spreader, Not incorporated	3-yr P	19 Ton	100.9 Lds	1,514 Ton	79.7	32	190	266
Bob's Farm South – 8S	Apr 2011	Corn	28-0-0	Shallow subsurface band (<4")	Supp. N	43 Gal		3,423 Gal	79.6	128	0	0
Bob's Farm South – 8S	Apr 2013	Corn	28-0-0	Shallow subsurface band (<4")	1-yr N	53 Gal		4,219 Gal	79.6	158	0	0
Bob's Farm South – 8S	Sep 2014	Corn	W Lots Stack #2	Dry Box Spreader, Not incorporated	Custom	20 Ton	100 Lds	1,500 Ton	75.0	34	200	280

6.8. Field Nutrient Balance (Manure-spreadable Area)

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Year	Field	Size Acres	Crop	Yield Goal/ Acre	Fertilizer Recs[1]			Nutrients Applied[2]			Balance After Recs[3]			Balance After Removal[4]	
					N Lb/A	P_2O_5 Lb/A	K_2O Lb/A	N Lb/A	P_2O5 Lb/A	K_2O Lb/A	N Lb/A	P_2O_5 Lb/A	K_2O Lb/A	P_2O_5 Lb/A	K_2O Lb/A
2010	Bob's Farm North – 8N	56.4	Soybean	61	0	0	0	0	0	0	0	0	0	-49	-92
2011	Bob's Farm North – 8N	56.4	Corn	195	160	0	0	160	30	92	0	30	92	-43	33
2012	Bob's Farm North – 8N	56.4	Soybean	61	0	0	0	0	0	0	0	30	92	-49	-59
2013	Bob's Farm North – 8N	56.4	Corn	195	160	0	0	157	46	141	0†	76	233	-27	82
2014	Bob's Farm North – 8N	56.4	Soybean	61	0	0	0	31	41	126	0[a]	117	359	-8	116
Total	**Bob's Farm North – 8N**				**320**	**0**	**0**	**348**	**117**	**359**					
2010	Bob's Farm South – 8S	79.6	Soybean	61	0	0	0	0	0	0	0	0	0	-49	-92
2011	Bob's Farm South – 8S	79.6	Corn	195	160	0	0	160	190	266	0	190	266	117	207
2012	Bob's Farm South – 8S	79.6	Soybean	61	0	0	0	0	0	0	0	190	266	68	115
2013	Bob's Farm South – 8S	79.6	Corn	195	160	0	0	158	0	0	2†	190	266	-5	56
2014	Bob's Farm South – 8S	79.6	Soybean	61	0	0	0	0	0	0	0	190	266	-49	-36
Total	**Bob's Farm South – 8S**				**320**	**0**	**0**	**318**	**190**	**266**					

1 Fertilizer Recs are the crop fertilizer recommendations. The N rec accounts for any N credit from previous legume crop.

2 Nutrients Applied are the nutrients expected to be available to the crop from that year's manure applications plus nutrients from that year's commercial fertilizer applications and nitrates from irrigation water. With a double-crop year, the total nutrients applied for both crops and the year's balances are listed on the second crop's line.

3 For N, Nutrients Applied minus Fertilizer Recs for indicated crop year. Also includes amount of residual N expected to become available that year from prior years' manure applicaitions. For P_2O_5 and K_2O, Nutrients Applied minus Fertilizer Recs *through* the indicated crop year, with positive balances carried forward to subsequent years. Negative values indicate a potential need to apply additional nutrients.

4 Nutrients Applied minus amount removed by harvested portion of crop through the indicated year. Positive balances are carried forward to subsequent years.

¤ Indicates a custom fertilizer recommendation in the Fertilizer Recs column.

[a] Indicates in the Balance After Recs N column that the legume crop is assumed to utilize some or all of the supplied N.

† Indicates in the Balance After Recs N column that the value includes residual N expected to become available that year from prior years' manure applications.

6.9. Field Nutrient Status

Field Nutrient Status Details

(Please note that for ease of publication, the sample plan provides this information for Field 8 only.)

Plan File: Sample ***Last Saved:*** 7/8/2010
Operation: DEF Feedlot ***State:*** Iowa ***Init. File Rev:*** 8/13/2009

Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2010	Bob's Farm North	8 N	Crop Fertilizer Recs	Soybean		61 Bu	56.4	0	0	0
2010	Bob's Farm North	8 N	Crop Nutrient Removal	Soybean		61 Bu	56.4	232	49	92
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2010	Bob's Farm North	8 N	Total Nutrients Applied	Spreadable Area			56.4	0	0	0
2010	Bob's Farm North	8 N	Balance After Recs	Spreadable Area			56.4	0	0	0
2010	Bob's Farm North	8 N	Balance After Removal	Spreadable Area			56.4	-232	-49	-92
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2011	Bob's Farm North	8 N	Crop Fertilizer Recs	Corn		195 Bu	56.4	160	0	0
2011	Bob's Farm North	8 N	Crop Nutrient Removal	Corn		195 Bu	56.4		73	59
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
Nov 10	Bob's Farm North	8 N	Manure App (2-yr P)	W SetdSolidBasin#4	Dry Box Spreader	10.5 Ton	15.9	20	30	92
Nov 10	Bob's Farm North	8 N	Manure App (2-yr P)	E SetldSolidBasin #3	Dry Box Spreader	10.5 Ton	40.6	20	30	92
Apr 11	Bob's Farm North	8 N	Fertilizer App (1-yr N)	28-0-0	Shallow subsurface band(<4")	47 Gal	56.4	140	0	0
2011	Bob's Farm North	8 N	Total Nutrients Applied	Spreadable Area			56.4	160	30	92
2011	Bob's Farm North	8 N	Balance After Recs	Spreadable Area			56.4	0	30	92
2011	Bob's Farm North	8 N	Balance After Removal	Spreadable Area			56.4		-43	33
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2012	Bob's Farm North	8 N	Crop Fertilizer Recs	Soybean		61 Bu	56.4	0	0	0
2012	Bob's Farm North	8 N	Crop Nutrient Removal	Soybean		61 Bu	56.4	232	49	92
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2012	Bob's Farm North	8 N	Residual Manure N				56.4	6		
2012	Bob's Farm North	8 N	Total Nutrients Applied	Spreadable Area			56.4	6	0	0
2012	Bob's Farm North	8 N	Balance After Recs	Spreadable Area			56.4	0	30	92
2012	Bob's Farm North	8 N	Balance After Removal	Spreadable Area			56.4	-226	-49	-59
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2013	Bob's Farm North	8 N	Crop Fertilizer Recs	Corn		195 Bu	56.4	160	0	0
2013	Bob's Farm North	8 N	Crop Nutrient Removal	Corn		195 Bu	56.4		73	59
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2013	Bob's Farm North	8 N	Residual Manure N				56.4	3		
May 13	Bob's Farm North	8 N	Manure App (1-yr P)	E SetldSolidBasin #3	Dry Box Spreader	16 Ton	56.4	35	46	141
Apr 13	Bob's Farm North	8 N	Fertilizer App (1-yr N)	28-0-0	Shallow subsurface band(<4")	41 Gal	56.4	122	0	0
2013	Bob's Farm North	8 N	Total Nutrients Applied	Spreadable Area			56.4	160	46	141
2013	Bob's Farm North	8 N	Balance After Recs	Spreadable Area			56.4	0	76	233
2013	Bob's Farm North	8 N	Balance After Removal	Spreadable Area			56.4		-27	82
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2014	Bob's Farm North	8 N	Crop Fertilizer Recs	Soybean		61 Bu	56.4	0	0	0
2014	Bob's Farm North	8 N	Crop Nutrient Removal	Soybean		61 Bu	56.4	232	49	92
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2014	Bob's Farm North	8 N	Residual Manure N				56.4	10		
Apr 14	Bob's Farm North	8 N	Manure App (1-yr P)	E SetldSolidBasin #3	Dry Box Spreader	17 Ton	44.5	37	49	150
May 14	Bob's Farm North	8 N	Manure App (1-yr P)	W SetdSolidBasin#4	Dry Box Spreader	17 Ton	2.8	37	49	150
2014	Bob's Farm North	8 N	Total Nutrients Applied	Spreadable Area			56.4	41	41	126
2014	Bob's Farm North	8 N	Balance After Recs	Spreadable Area			56.4	0[a]	117	359
2014	Bob's Farm North	8 N	Balance After Removal	Spreadable Area			56.4	-191	-8	116

Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2010	Bob's Farm South	8 S	Crop Fertilizer Recs	Soybean		61 Bu	79.6	0	0	0
2010	Bob's Farm South	8 S	Crop Nutrient Removal	Soybean		61 Bu	79.6	232	49	92
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2010	Bob's Farm South	8 S	Total Nutrients Applied	Spreadable Area			79.6	0	0	0
2010	Bob's Farm South	8 S	Balance After Recs	Spreadable Area			79.6	0	0	0
2010	Bob's Farm South	8 S	Balance After Removal	Spreadable Area			79.6	-232	-49	-92
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2011	Bob's Farm South	8 S	Crop Fertilizer Recs	Corn		195 Bu	79.6	160	0	0
2011	Bob's Farm South	8 S	Crop Nutrient Removal	Corn		195 Bu	79.6		73	59
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
Nov 10	Bob's Farm South	8 S	Manure App (3-yr P)	E Lots Stack #1	Dry Box Spreader	19 Ton	79.7	32	190	266
Apr 11	Bob's Farm South	8 S	Fertilizer App (1-yr N)	28-0-0	Shallow subsurface band(<4")	43 Gal	79.6	128	0	0
2011	Bob's Farm South	8 S	Total Nutrients Applied	Spreadable Area			79.6	160	190	266
2011	Bob's Farm South	8 S	Balance After Recs	Spreadable Area			79.6	0	190	266
2011	Bob's Farm South	8 S	Balance After Removal	Spreadable Area			79.6		117	207
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2012	Bob's Farm South	8 S	Crop Fertilizer Recs	Soybean		61 Bu	79.6	0	0	0
2012	Bob's Farm South	8 S	Crop Nutrient Removal	Soybean		61 Bu	79.6	232	49	92
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2012	Bob's Farm South	8 S	Residual Manure N				79.6	10		
2012	Bob's Farm South	8 S	Total Nutrients Applied	Spreadable Area			79.6	10	0	0
2012	Bob's Farm South	8 S	Balance After Recs	Spreadable Area			79.6	0	190	266
2012	Bob's Farm South	8 S	Balance After Removal	Spreadable Area			79.6	-222	68	115
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2013	Bob's Farm South	8 S	Crop Fertilizer Recs	Corn		195 Bu	79.6	160	0	0
2013	Bob's Farm South	8 S	Crop Nutrient Removal	Corn		195 Bu	79.6		73	59
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2013	Bob's Farm South	8 S	Residual Manure N				79.6	4		
Apr 13	Bob's Farm South	8 S	Fertilizer App (1-yr N)	28-0-0	Shallow subsurface band(<4")	53 Gal	79.6	158	0	0
2013	Bob's Farm South	8 S	Total Nutrients Applied	Spreadable Area			79.6	162	0	0
2013	Bob's Farm South	8 S	Balance After Recs	Spreadable Area			79.6	2	190	266
2013	Bob's Farm South	8 S	Balance After Removal	Spreadable Area			79.6		-5	56
Year	*Field ID*	*Sub ID*	*Nutrient Needs*	*Crop*		*Yield Goal*	*Acres*	*N*	*P_2O_5*	*K_2O*
2014	Bob's Farm South	8 S	Crop Fertilizer Recs	Soybean		61 Bu	79.6	0	0	0
2014	Bob's Farm South	8 S	Crop Nutrient Removal	Soybean		61 Bu	79.6	232	49	92
Date	*Field ID*	*Sub ID*	*Nutrient Activity*	*Source*	*Equipment/Method*	*Rate*	*Acres*	*N*	*P_2O_5*	*K_2O*
2014	Bob's Farm South	8 S	Total Nutrients Applied	Spreadable Area			79.6	0	0	0
2014	Bob's Farm South	8 S	Balance After Recs	Spreadable Area			79.6	0	190	266
2014	Bob's Farm South	8 S	Balance After Removal	Spreadable Area			79.6	-232	-49	-36

Notes

(1) If a field has a non-spreadable area, it is listed in a separate section following the field's spreadable area.
(2) Yield Goal, Rate, N, P2O5 and K2O values are all per acre.
(3) The crop's N fertilizer rec accounts for any N credit from a previous legume crop.
(4) If a field has more than one manure application in the same crop year, or if the total area covered that year is less than or greater than the field's area, a field average isused in calculating balances. This field average is the sum of each manure application's area times its per-acre amount of nutrient applied, divided by the field's area.
(5) Any positive P2O5 or K2O balance is carried over to the next year. Available N not utilized in the current crop year is assumed lost.
¤ Indicates a custom fertilizer recommendation in the Crop Fertilizer Recs columns.
[a] Indicates in the Balance After Recs N column that the legume crop is assumed to utilize some or all of the supplied

6.10. Manure Inventory Annual Summary

Manure Source	Plan Period	On Hand at Start of Period	Total Generated	Total Im-ported	Total Trans-ferred In	Total Applied	Total Ex-ported	Total Trans-ferred Out	On Hand at End of Period	Units
E Lots Stack #1	Oct '09–Sep '10	200	4,375	0	0	2,385	0	0	2,190	Ton
E SetldSolidBasin #3	Oct '09–Sep '10	100	757	0	0	477	0	0	380	Ton
E Storage Pond #1	Oct '09–Sep '10	750,000	10,575,180	0	0	11,182,050	0	0	143,130	Gal
W Lots Stack #2	Oct '09–Sep '10	100	1,750	0	0	975	0	0	875	Ton
W SetdSolidBasin#4	Oct '09–Sep '10	75	247	0	0	195	0	0	127	Ton
W Storage Pond #2	Oct '09–Sep '10	400,000	5,876,413	0	0	5,182,199	0	0	1,094,214	Gal
All Sources (liquid)	**Oct '09–Sep '10**	**1,150,000**	**16,451,593**	**0**	**0**	**16,364,249**	**0**	**0**	**1,237,344**	**Gal**
All Sources (solid)	**Oct '09–Sep '10**	**475**	**7,129**	**0**	**0**	**4,032**	**0**	**0**	**3,572**	**Ton**
E Lots Stack #1	Oct '10–Sep '11	2,190	4,375	0	0	3,888	0	0	2,677	Ton
E SetldSolidBasin #3	Oct '10–Sep '11	380	757	0	0	678	0	0	459	Ton
E Storage Pond #1	Oct '10–Sep '11	143,130	10,575,180	0	0	10,165,500	0	0	552,810	Gal
W Lots Stack #2	Oct '10–Sep '11	875	1,750	0	0	1,752	0	0	873	Ton
W SetdSolidBasin#4	Oct '10–Sep '11	127	247	0	0	249	0	0	125	Ton
W Storage Pond #2	Oct '10–Sep '11	1,094,214	5,876,413	0	0	5,842,899	0	0	1,127,728	Gal
All Sources (liquid)	**Oct '10–Sep '11**	**1,237,344**	**16,451,593**	**0**	**0**	**16,008,399**	**0**	**0**	**1,680,538**	**Gal**
All Sources (solid)	**Oct '10–Sep '11**	**3,572**	**7,129**	**0**	**0**	**6,567**	**0**	**0**	**4,134**	**Ton**
E Lots Stack #1	Oct '11–Sep '12	2,677	4,375	0	0	4,157	0	0	2,896	Ton
E SetldSolidBasin #3	Oct '11–Sep '12	459	757	0	0	716	0	0	501	Ton
E Storage Pond #1	Oct '11–Sep '12	552,810	10,575,180	0	0	9,148,950	0	0	1,979,040	Gal
W Lots Stack #2	Oct '11–Sep '12	873	1,750	0	0	1,833	0	0	790	Ton
W SetdSolidBasin#4	Oct '11–Sep '12	125	247	0	0	144	0	0	228	Ton
W Storage Pond #2	Oct '11–Sep '12	1,127,728	5,876,413	0	0	5,842,899	0	0	1,161,242	Gal
All Sources (liquid)	**Oct '11–Sep '12**	**1,680,538**	**16,451,593**	**0**	**0**	**14,991,849**	**0**	**0**	**3,140,282**	**Gal**
All Sources (solid)	**Oct '11–Sep '12**	**4,134**	**7,129**	**0**	**0**	**6,849**	**0**	**0**	**4,414**	**Ton**
E Lots Stack #1	Oct '12–Sep '13	2,896	4,375	0	0	4,622	0	0	2,649	Ton
E SetldSolidBasin #3	Oct '12–Sep '13	501	757	0	0	903	0	0	355	Ton
E Storage Pond #1	Oct '12–Sep '13	1,979,040	10,575,180	0	0	10,165,500	0	0	2,388,720	Gal
W Lots Stack #2	Oct '12–Sep '13	790	1,750	0	0	1,332	0	0	1,208	Ton
W SetdSolidBasin#4	Oct '12–Sep '13	228	247	0	0	240	0	0	235	Ton
W Storage Pond #2	Oct '12–Sep '13	1,161,242	5,876,413	0	0	6,032,982	0	0	1,004,673	Gal
All Sources (liquid)	**Oct '12–Sep '13**	**3,140,282**	**16,451,593**	**0**	**0**	**16,198,482**	**0**	**0**	**3,393,393**	**Gal**
All Sources (solid)	**Oct '12–Sep '13**	**4,414**	**7,129**	**0**	**0**	**7,097**	**0**	**0**	**4,447**	**Ton**
E Lots Stack #1	Oct '13–Sep '14	2,649	4,375	0	0	2,714	0	0	4,311	Ton
E SetldSolidBasin #3	Oct '13–Sep '14	355	757	0	0	756	0	0	356	Ton
E Storage Pond #1	Oct '13–Sep '14	2,388,720	10,575,180	0	0	8,132,400	0	0	4,831,500	Gal
W Lots Stack #2	Oct '13–Sep '14	1,208	1,750	0	0	2,699	0	0	260	Ton
W SetdSolidBasin#4	Oct '13–Sep '14	235	247	0	0	273	0	0	209	Ton
W Storage Pond #2	Oct '13– Sep '14	1,004,673	5,876,413	0	0	6,881,019	0	0	67	Gal
All Sources (liquid)	**Oct '13–Sep '14**	**3,393,393**	**16,451,593**	**0**	**0**	**15,013,419**	**0**	**0**	**4,831,567**	**Gal**
All Sources (solid)	**Oct '13–Sep '14**	**4,447**	**7,129**	**0**	**0**	**6,441**	**0**	**0**	**5,135**	**Ton**

6.11. Fertilizer Material Annual Summary

Product Analysis	Plan Period	Product Needed Oct–Dec	Product Needed Jan–Sep	Total Product Needed	Units
28-0-0	Oct '09–Sep '10	0	54,461	54,461	Gal
28-0-0	Oct '10–Sep '11	0	46,909	46,909	Gal
28-0-0	Oct '11–Sep '12	0	51,098	51,098	Gal
28-0-0	Oct '12–Sep '13	0	43,833	43,833	Gal
28-0-0	Oct '13–Sep '14	0	59,803	59,803	Gal

6.12. Whole-farm Nutrient Balance (Manure-spreadable Area)

	N (Lbs)	P_2O_5 (Lbs)	K_2O (Lbs)
Total Manure Nutrients on Hand at Start of Plan[1]	5,438	4,082	9,190
Total Manure Nutrients Collected[2]	393,872	361,937	719,700
Total Manure Nutrients Imported[3]	0	0	0
Total Manure Nutrients Exported[4]	0	0	0
Total Manure Nutrients on Hand at End of Plan[5]	44,663	49,753	83,442
Total Manure Nutrients Applied[6]	354,897	317,506	646,223
Available Manure Nutrients Applied[7]	118,283	317,506	646,223
Commercial Fertilizer Nutrients Applied[8]	763,771	0	0
Available Nutrients Applied[9]	882,054	317,506	646,223
Nutrient Utilization Potential[10]	1,243,599	409,494	422,760
Nutrient Balance of Spreadable Acres[11*]	-361,545	-91,988	223,463
Average Nutrient Balance per Spreadable Acre per Year[12*]	-58	-15	36

1. Values indicate total manure nutrients present in storage(s) at the beginning of the plan.
2. Values indicate total manure nutrients collected on the farm.
3. Values indicate total manure nutrients imported onto the farm.
4. Values indicate total manure nutrients exported from the farm to an external operation.
5. Values indicate total manure nutrients present in storage(s) at the end of plan.
6. Values indicate total nutrients present in land-applied manure. Losses due to rate, timing and method of application are not included in these values.
7. Values indicate available manure nutrients applied on the farm based on rate, time and method of application. These values are based on the total manure nutrients applied (row 6) after accounting for state-specific nutrient losses due to rate, time and method of application.
8. Values indicate nutrients applied as commercial fertilizers and nitrates contained in irrigation water.
9. Values are the sum of available manure nutrients applied (row 7) and commercial fertilizer nutrients applied (row 8).
10. Values indicate nutrient utilization potential of crops grown. For N the value generally is based on crop N recommendation for non-legume crops and crop N uptake or other state-imposed limit for N application rates for legumes. P_2O_5 and K_2O values generally are based on fertilizer recommendations or crop removal (whichever is greatest).
11. Values indicate available nutrients applied (row 9) minus crop nutrient utilization potential (row 10). Negative values indicate additional nutrient utilization potential and positive values indicate over-application.
12. Values indicate average per acre nutrient balance. Values are calculated by dividing nutrient balance of spreadable acres (row 11) by the number of spreadable acres in plan and by the length of the plan in years. Negative values indicate additional average per acre nutrient utilization potential and positive values indicate average per acre over-application.

* Non-trivial, positive values for N indicate that the plan was not properly developed. Negative values for N indicate additional nutrient utilization potential which may or may not be intentional. For example, plans that include legume crops often will not utilize the full N utilization potential for legume crops if manure can be applied to non-legume crops that require N for optimum yield. Positive values for P_2O_5 and/or K_2O do not necessarily indicate that the plan was not developed properly. For example, producers may be allowed to apply N-based application rates of manure to fields with low soil test P values or fields with a low potential P-loss risk based on the risk assessment tool used by the state. Negative values for P_2O_5 and K_2O indicate that planned applications to some fields are less than crop removal rates.

Section 7. Record Keeping

7.1. Land Application Equipment Inspections

The equipment identified in the table below is used to apply manure, litter, and process wastewater. This equipment will be inspected at least once annually, within one month before use. Inspection dates will be recorded in the table below.

Equipment	Inspection Date				
	2010	2011	2012	2013	2014
Dry Box Spreader					
Injector					

7.2. Record Keeping Forms

The records identified below will be maintained at the indicated frequencies using the forms identified. [Note: the referenced forms are included in Appendix D.]

Record	Frequency	Form
Visual inspections of structures used to store, contain, or treat manure, litter, and process wastewater, including wastewater levels as indicated on depth markers and actions taken to correct deficiencies	Weekly	AFO Weekly Storage, Containment, and Treatment Structure Inspections Log Sheet (a separate form will be completed for each structure)
Visual inspections of storm water diversion structures and channels including actions taken to correct deficiencies	Weekly	CAFO Weekly Storm Water Diversion and Channel Inspections Log Sheet
Land application records, including • Date of application • Source of manure, litter, or process wastewater applied • Method of application • Weather conditions during and for 24 hours before and after application • Amount of manure, litter, or process wastewater applied • Total N and P applied, including calculations	Per application event	CAFO Nutrient Land Application Log Sheet (a separate form will be completed for each field)
Water line inspections, including drinking and cooling water lines	Daily	Daily Water Line Inspection Log Sheet
Off-site transfers of manure, litter, and process wastewater, including recipient name and address, date of transfer, and amount transferred	Per transfer event (if any)	Manure, Litter, and Process Wastewater Transfer Record Form

7.3. Records Maintained in NMP

In addition, the following records will be maintained as indicated below.

Record	Frequency	Documentation Method/Location
Expected crop yield	Once per permit/ NMP cycle unless NMP revised	NMP Section 6.5
Test methods used to sample and analyze manure, litter, soil, and process wastewater	Per sampling event	Methods identified on laboratory reports
Results from manure, litter, process wastewater, and soil sampling	Per sampling event	Laboratory reports of analytical results maintained with NMP
Basis for determining manure application rates in accordance with the technical standards for nutrient management identified in the permit	Once per permit/ NMP cycle unless NMP revised	NMP outlines basis for rate determination
Calculations showing the total amount of N and P to be applied to each field	Once per permit/ NMP cycle unless NMP revised	Calculations are performed within MMP software; data inputs and results are included in NMP

Section 8. Publications and References

8.1. Publications

Crop Fertilizer Recommendations

"Crop Nutrient Recommendations," PM 1688, Sept 2008
http://www.extension.iastate.edu/Publications/PM1688.pdf

Manure Nutrient Availability

"Managing Manure Nutrients for Crop Production," Iowa State Extension, PM 1811, Nov. 2003
This document no longer exists on Iowa State Extension's web site. Similar technical information can be found in "Using Manure Nutrients for Crop Production," Iowa State Extension, PMR 1003, September 2008.
http://www.extension.iastate.edu/Publications/PMR1003.pdf

Phosphorus Assessment

"Technical Note No. 25, Iowa Phosphorus Index," Iowa NRCS, August 2004
ftp://ftp-fc.sc.egov.usda.gov/IA/technical/Technot25Aug04.pdf

Practice Standards

Iowa NRCS Nutrient Management Standard (590), December 2008
http://efotg.sc.egov.usda.gov//references/public/IA/IA590Dec08.pdf

8.2. Software and Data Sources

MMP Version	MMP 0.2.9.0
MMP Plan File	Sample
MMP Initialization File for Iowa	8/13/2009
MMP Soils File for Iowa	11/17/2009
Phosphorus Assessment Tool	2007.06.29
NRCS Conservation Plan(s)	n/a
RUSLE2 Library	Version: 1.32.3.0 Build: Dec 17 2007 Science: 20061020
RUSLE2 Database	moses1.gdb

8.3. Initialization Files

Initialization File Summary

Init. File: ia.mmi ***State:*** Iowa ***Revision:*** 8/13/2009

Crops

Name	Yield Units	N Removed (Lb/YldUnit)	P_2O_5 Removed (Lb/YldUnit)	K_2O Removed (Lb/YldUnit)	Source of Fertilizer Recommendations
Alfalfa hay	Ton	50	12.5	40.0	*"Crop Nutrient Recommendations," PM 1688, Sept 2008*
Alfalfa seeding	Ton	50	12.5	40.0	*"Crop Nutrient Recommendations," PM 1688, Sept 2008*
Alfalfa-grass hay	Ton	50	12.5	40.0	*"Crop Nutrient Recommendations," PM 1688, Sept 2008*
Alfalfa-grass pasture	Ton	50	8.3	20.0	*"Crop Nutrient Recommendations," PM 1688, Sept 2008*
Bluegrass pasture	Ton		9	30	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Bromegrass hay	Ton	40	9	47	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Bromegrass pasture	Ton	40	6	23.5	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Clover/trefoil-grass hay	Ton	43	12	35	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Clover/trefoil-grass past	Ton	43	8	17.5	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Corn	Bu		0.375	0.30	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Managing Manure Nutrients," PM 1811, Nov 03*
Corn silage	Ton		3.5	8	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Managing Manure Nutrients," PM 1811, Nov 03*
CRP					
Fallow					
Legume cover					
Oat	Bu	0.75	0.4	1.0	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Managing Manure Nutrients," PM 1811, Nov 03*
Oat + forage seeding	Bu	0.75	0.4	1.0	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Managing Manure Nutrients," PM 1811, Nov 03*
Orchardgrass hay	Ton	38	14	68	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Orchardgrass pasture	Ton	38	9.3	34	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Other					
Perennial ryegrass hay	Ton	24	12	34	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Perennial ryegrass past	Ton	24	8	17	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Reed canarygrass hay	Ton		9	47	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Reed canarygrass pasture	Ton		6	23.5	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*

Initialization File Summary

Init. File: ia.mmi ***State:*** Iowa ***Revision:*** 8/13/2009

Name	Yield Units	N Removed (Lb/YldUnit)	P_2O_5 Removed (Lb/YldUnit)	K_2O Removed (Lb/YldUnit)	Source of Fertilizer Recommendations
Small grain cover					
Sorg-sudan hay	Ton	40	12	38	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Sorg-sudan pasture	Ton	40	8	19	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Soybean	Bu	3.8	0.8	1.5	*"Crop Nutrient Recommendations," PM 1688, Sept 2008*
Sunflower	CWT	3.5	0.8	0.7	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Managing Manure Nutrients," PM 1811, Nov 03*
Switchgrass hay	Ton	21	12	66	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Switchgrass pasture	Ton	21	8	33	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Tall fescue hay	Ton	38	12	66	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Tall fescue pasture	Ton	38	8	33	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Timothy hay	Ton	25	9	32	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Timothy pasture	Ton	25	6	16	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Fertilizing Pasture," PM 869, June 1997*
Wheat	Bu	1.3	0.6	0.3	*"Crop Nutrient Recommendations," PM 1688, Sept 2008 and "Managing Manure Nutrients," PM 1811, Nov 03*

Initialization File Summary

Init. File: ia.mmi ***State:*** Iowa ***Revision:*** 8/13/2009

Storage Types

Name	% N Lost in Handling & Storage	% Org. N Mineralized First Year	Water Dilution Factor	Source of Storage N Data
Manure pack	30	25	1	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Open lot	50	35	1	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Dry stack	25	45	1	Adapted from "Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Underfloor dry storage	35	60	1	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Litter	35	60	1	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Daily scrape & haul (liquid)	25	25	1	Adapted from "Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Underfloor liquid storage	20	35	1	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993

Initialization File Summary

Init. File: ia.mmi **State:** Iowa **Revision:** 8/13/2009

Name	% N Lost in Handling & Storage	% Org. N Mineralized First Year	Water Dilution Factor	Source of Storage N Data
Outside prefab liquid storage	20	30	1.2	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Earthen storage	30	30	1.4	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Lagoon, 1 stage	75	30	2.5	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Lagoon, 2 stage	80	30	2.5	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Lagoon, 3 stage	80	30	2.5	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993
Washwater	75	30	6	"Livestock Waste Facilities Handbook," MWPS-18, Third Edition, 1993

Initialization File Summary

Init. File: ia.mmi **State:** Iowa **Revision:** 8/13/2009

Animal Types

Name	Daily Manure (Lb/AU)	Daily Manure (Gal/AU)	Daily Total N (Lb/AU)	Daily P_2O_5 (Lb/AU)	Daily K_2O (Lb/AU)	Water Dilution Factor	Source of Daily Excretion Data
Sow & litter	59	7.3	0.45	0.30	0.34	1.4	AWMFH Chapter 4, Table 4-10(c), March 2008
Nursery pig	88	10.5	0.92	0.34	0.42	1.5	AWMFH Chapter 4, Table 4-10(d), March 2008
Grow-finish pig	65	8.2	0.54	0.21	0.29	1.25	AWMFH Chapter 4, Table 4-10(d), March 2008
Wean-to-finish pig	71	8.8	0.64	0.23	0.32	1.3	AWMFH Chapter 4, Table 4-10(d), March 2008
Gestating sow	25	3.1	0.16	0.11	0.13	1.3	AWMFH Chapter 4, Table 4-10(c), March 2008
Boar	19	2.2	0.14	0.11	0.11	1.2	AWMFH Chapter 4, Table 4-10(c), March 2008
Calf (dairy)	83	9.7	0.42	0.11	0.13	1.05	AWMFH Chapter 4, Table 4-5(b), March 2008
Weaned heifer/steer (dairy)	56	6.7	0.27	0.11	0.14	1.05	AWMFH Chapter 4, Table 4-5(b), March 2008
Growing heifer/steer (dairy)	56	6.7	0.27	0.11	0.14	1.05	AWMFH Chapter 4, Table 4-5(b), March 2008
Breeding heifer (dairy)	56	6.7	0.27	0.11	0.14	1.05	AWMFH Chapter 4, Table 4-5(b), March 2008
Milk cow (dairy)	108	12.7	0.71	0.27	0.40	1.05	AWMFH Chapter 4, Table 4-5(b), March 2008
Dry cow (dairy)	51	6.3	0.30	0.10	0.12	1.05	AWMFH Chapter 4, Table 4-5(b), March 2008

Initialization File Summary

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Name	Daily Manure (Lb/AU)	Daily Manure (Gal/AU)	Daily Total N (Lb/AU)	Daily P_2O_5 (Lb/AU)	Daily K_2O (Lb/AU)	Water Dilution Factor	SSource of Daily Excretion Data
Veal calf	60	7.2	0.20	0.07	0.30	1.05	AWMFH Chapter 4, Table 4-12, March 2008
Suckling calf (beef)	77	9.0	0.45	0.18	0.35	1.05	AWMFH Chapter 4, Table 4-8(b), March 2008
Weaned calf (beef)	77	9.0	0.45	0.18	0.35	1.05	AWMFH Chapter 4, Table 4-8(b), March 2008
Growing steer (beef)	77	9.0	0.45	0.18	0.35	1.05	AWMFH Chapter 4, Table 4-8(b), March 2008
Finishing steer (beef)	65	8.2	0.36	0.10	0.30	1.05	AWMFH Chapter 4, Table 4-8(d), March 2008
Brood cow/heifer (beef)	104	12.7	0.35	0.18	0.30	1.05	AWMFH Chapter 4, Table 4-8(b), March 2008
Sheep	40	4.7	0.45	0.16	0.36	1.0	AWMFH Chapter 4, Table 4-13, March 2008
Horse	51	6.1	0.18	0.06	0.06	1.0	AWMFH Chapter 4, Table 4-14(b), March 2008
Broiler	88	10.5	0.96	0.64	0.65	1.0	AWMFH Chapter 4, Table 4-11(d), March 2008
Layer	57	7.0	1.10	0.76	0.47	1.0	AWMFH Chapter 4, Table 4-11(b), March 2008
Turkey tom	34	4.3	0.53	0.37	0.30	1.0	AWMFH Chapter 4, Table 4-11(d), March 2008
Turkey hen	48	5.8	0.72	0.46	0.37	1.0	AWMFH Chapter 4, Table 4-11(d), March 2008
Duck	102	12.7	1.00	0.80	0.60	1.0	AWMFH Chapter 4, Table 4-11(d), March 2008

Initialization File Summary

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Ration Amendments

Name	Water Dilution % Reduced	Total N Production % Reduced	P_2O_5 Production % Reduced	K_2O Production % Reduced	Storage N Loss % Reduced
Wet/Dry Feeding	50				
Phased Feeding		10	10	10	
Phytase			20		
Alum					25
HAP Corn			20		
HAP Soybean			20		

Initialization File Summary

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Equipment Types

Name	Is Liquid	Is Injected	Is Irrigated	Has Aerial N Loss	Capacity Units	Application Units
Solid spreader	☐				Ton	Feet
Liquid spreader, injected	☒	☒			Gal	Feet
Liquid spreader, surface spray	☒			☒	Gal	Feet
Liquid spreader, knives up	☒				Gal	Feet
Hose pull, injected	☒	☒			Gal/Min	Feet
Hose pull, knives up	☒				Gal/Min	Feet
Traveling gun	☒		☒	☒	Gal/Min	Feet
Standing pipe	☒		☒	☒	Gal/Min	Acres
Center pivot	☒		☒	☒	Gal/Min	Acres

Initialization File Summary

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Misc.

% Total P Manure Available	100
% Total K Manure Available	100
CEC Estimation	K/390 + Ca/200 + Mg/120 + 12*(7 - Min(BufferpH, 7))
Soil Test P Change	Round(NetP2O5/20)
Soil Test K Change	Round((NetK2O - NumYears*20) / (4 + 0.2*CEC))
Source of Manure N Availability Data	"Managing Manure Nutrients for Crop Production," Iowa State Extension, PM 1811, Nov. 2003