

**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 budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

Realistic yield shall be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soil, cropping systems, and soil and manure/organic by-products tests.

For new crops or varieties, industry yield guidelines may be used until documented yield information is available.

Nutrient management plans shall specify the source, amount, timing and method of application of nutrients on each field to achieve realistic production goals, while minimizing movement of nutrients and other potential contaminants to surface and/or ground waters.

Where agricultural wastes are to be spread on land not owned or controlled by the producer, the nutrient management plan, as a minimum, shall document the amount of waste to be transferred, the nutrient analysis of the material, and who will be responsible for the use of the waste.

Areas contained within established minimum application setbacks (e.g., sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas) shall not receive direct application of nutrients. Setbacks in respect to manure are found under Additional Criteria: Applicable to manure or Organic By....

Set back for other nutrients shall be determined on a site-specific basis concerning the specific risk(s) to water quality.

Erosion, runoff, and water management controls shall be installed, according to the RMS level of treatment, on all fields. To achieve the resource management system level for erosion control and water quality as stated in the eFOTG. This includes addressing sheet and rill erosion to T.

Soil and Tissue Sampling and Laboratory Analyses (Testing). Nutrient planning shall be based on current soil and tissue (where used as a supplement) test results developed in accordance with Cornell University guidance, or industry practice if recognized by the Cornell University. Current soil tests are those that are no older than three years.

Soil and Tissue samples shall be collected and prepared according to the Cornell University guidance or standard industry practice. Soil test analyses shall be performed by Cornell University laboratories or laboratories where results can be converted to Cornell University soil test analysis equivalents.

Soil and tissue testing shall include analyses for any nutrients for which specific information is needed to develop the nutrient plan. Request analyses pertinent to monitoring or amending the annual nutrient budget, e.g. pH, electrical conductivity (EC), exchangeable acidity, soil organic matter, nitrogen, phosphorus and potassium.

Nutrient Application Rates. Soil amendments shall be applied, as needed, to adjust soil pH to an adequate level for crop nutrient availability and utilization.

Recommended nutrient application rates shall be based on Cornell University guidelines (and/or industry practice when recognized by the university) that consider current soil test results, realistic yield goals and management capabilities. If the Cornell University does not provide specific guidelines, application shall be based on realistic yield goals and associated plant nutrient uptake rates.

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance:

- Nitrogen Application - Planned nitrogen application rates shall match the recommended rates as closely as possible, except when manure or organic by-products are a source of nutrients. When manure or organic by-products are a source of nutrients, see "Additional Criteria" below.
- Phosphorus Application - Planned phosphorus application rates shall match the recommended rates as closely as possible, except when manure or organic by-products are sources of nutrients. When manure or organic by-products are a source of nutrients, see "Additional Criteria" below.
- Potassium Application - Potassium shall not be applied in situations in which excess (greater than soil test potassium recommendation) causes unacceptable nutrient imbalances in crops or forages, as determined by farm manager and animal nutritionist. When forage quality is an issue associated with excess potassium application, state standards shall be used to set forage quality guidelines.
- Other Plant Nutrients - The planned rates of application of other nutrients shall be consistent with Cornell University guidance or industry practice if recognized by the Cornell University in the state.
- Starter Fertilizers - When starter fertilizers are used, they shall be included in the overall nutrient budget, and applied in accordance with Cornell University guidelines, or industry practice if recognized by the Cornell University within the state.

Nutrient Application Timing. Timing of nutrient application (particularly nitrogen) shall correspond as closely as possible with the plant growth stage and nutrient uptake characteristics, while considering cropping system limitations, climatic conditions, risk assessment tools (e.g., NY Leaching index, NY P index) 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 not be applied to frozen, snow-covered or saturated soil if the potential risks for runoff exist.
- The Nitrogen Leaching Index and Phosphorus Index will be used to evaluate both leaching and runoff risk respectively.
- Nutrients shall be applied considering the plant growth stage, irrigation practices, and other conditions as to maximize availability to the plant and minimize the risk of runoff, leaching, and/or volatilization losses.
- Nutrient applications associated with irrigation systems shall be applied in a manner that prevents or minimizes resource impairment.

Risk Assessment. In all areas, with the potential for nutrient transport from the area the following shall be completed.

The planned rates of phosphorus application shall be consistent with the New York Phosphorus Index (PI) rating.

Use the NY Leaching Index (LI) from the Leaching Index Maps for each soil-mapping component, as described in the Soil Rating for Nitrate and Soluble Nutrients in Section I-3 of the Water Quality Workbook 1988.

A LI below 2 indicates that the potential for soluble nutrient leaching below the root zone is low. Apply nitrogen in accordance with recommendations.

A LI between 2 and 10 indicates that the potential for soluble nutrient leaching below the root zone is intermediate. Additional site evaluations are in order. Practices specified under LI's greater than 10 should be considered.

A LI greater than 10 indicates that the potential for soluble nutrient leaching below the root zone is large. The following practices shall be implemented as applicable to reduce the potential for nitrate leaching to groundwater:

- Strict timing of nitrogen application in accordance with recommendations of Cornell Cooperative Extension.
- Use of management practices such as cover crops to take up excess nutrients and reduce their movement out of the root zone.

Additional Criteria Applicable to Manure and Organic By-Products or Biosolids Applied as a Plant Nutrient Source

Nutrient values of manure and organic by-products (excluding sewage sludge or biosolids) shall be determined prior to land application. Manure sampling frequency may vary based on the operation's manure handling strategy and spreading schedule. If there is no prior sampling history, the manure shall be analyzed at least annually for a minimum of three consecutive years. Samples will be taken and analyzed with each hauling/emptying cycle for a storage/treatment facility, or no less than once per year.

A cumulative record shall be developed and maintained until consistent (maintaining a certain nutrient concentration with minimal variation) level of nutrient values is realized. Appropriate results contained in the operation's cumulative manure analyses history shall be used as a basis for nutrient allocation to fields. Samples shall be collected and prepared according to Cornell University guidance or industry practice.

In planning for new operations, manure analysis from similar operations will be used. As a last resort acceptable "book values" recognized by the NRCS and/or the Cornell University may be used if they accurately estimate nutrient output from the proposed operation (e.g., NRCS 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. Nutrient values of biosolids (sewage sludge) and related products shall be determined prior to land application based on laboratory analysis.

Manure and Organic By-Product Nutrient Application Rates. Manure and organic by-product nutrient application rates shall be based on nutrient interpretation procedures recommended by the respective state or Cornell University. At a minimum, manure analyses shall identify ammonia, organic N, P, K and percent solids.

The application rate (in/hr) of liquid materials applied shall not exceed the soil intake/infiltration rate and shall be adjusted to minimize ponding and to avoid runoff. The total application shall not exceed the field capacity of the soil and shall be adjusted, as needed, to minimize loss to subsurface tile drains.

The planned rates of nitrogen and phosphorus application recorded in the plan shall be determined based on the following guidance:

Nitrogen Application Rates

- When manure or organic by-products are used, the nitrogen availability of the planned application rates shall match plant uptake characteristics as closely as possible, taking into consideration the timing of nutrient application(s) in order to minimize leaching and/or atmospheric losses.
- Management activities and technologies shall be used that effectively utilize mineralized nitrogen. Where feasible minimize nitrogen losses through de-nitrification and ammonia volatilization.
- Manure or organic by-products may be applied on established legumes at rates not to exceed 150lb/ac of nitrogen in harvested plant biomass.
- When the nutrient management plan component is being implemented on a phosphorus basis, manure or organic by-products shall be applied at rates consistent with a phosphorus limited application rate. In such situations, an additional nitrogen application, from non-organic sources, may be required to supply, but not exceed, the recommended amounts of nitrogen in any given year.

Phosphorus Application Rates

- Phosphorus Application - The planned rates of phosphorus application shall be consistent with the New York Phosphorus Index (PI) rating. Manure applied shall be based on nitrogen rates on low or medium risk sites. Manure applied shall be based on estimated phosphorus removal rates on high risk sites. No manure shall be applied on very high risk sites as identified in the PI. The PI does not apply to abuse areas that are converted to pasture and managed according to conservation practice standard Prescribed Grazing (528)
- Acceptable phosphorus based manure application rates shall be determined as a function of soil test recommendations or estimated phosphorus removal in harvested plant biomass. Guidance for developing these acceptable rates is found in the NRCS General Manual, Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy), and the National Agronomy Manual, Section 503.

- The application of phosphorus applied as manure may be made at a rate equal to the recommended phosphorus application or estimated phosphorus removal in harvested plant biomass for the crop rotation or multiple years in the crop sequence. When such applications are made, the application rate shall:
 - ◇ Not exceed the recommended nitrogen application rate during the year of application,

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 Not exceed the estimated nitrogen removal in harvested plant biomass during the year of application when there is no recommended nitrogen application.
 - ◇ Not be made on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices, best management practices, or management activities are used to reduce the vulnerability according to the New York Phosphorus Index.

Manure Storage. When the risk assessment tools of the nutrient management plan shows that there is insufficient land at specific times, storage will be provided for this period (and any extra period that is needed for farm management purposes) according to Waste Storage Facility standard (313). When no storage is required by the NMP (and no Waste Storage Facility exists on the farm) then areas for temporary manure piles will be identified. It is appropriate **only** for manure that is of a moisture content that allows it to be stacked. A Manure Pile Area shall be located:

- With at least a 300 feet flow path to the nearest downslope watercourse,
- The flow path will be managed to provide diffuse overland flow,
- Where clean water runoff will be excluded from the Manure Pile Area,
- Where there is no groundwater spring, seep or subsurface drainage in the area.
- Where access is practicable during poor weather conditions such as excessive ice, snow or muddy ground,
- Where flooding will not occur during a 25 year 24-hour storm,
- Outside of an aquifer, recharge area.

Soils will be evaluated for their potential to leach contaminants into ground water. Soils must be stable enough to support the unloading equipment. Grading of the area will be provided only where the ground surface slope prevents proper equipment operation and efficiency. All side slopes for any excavation and earth fill shall not be steeper than three (3) horizontal to one (1) vertical.

The Manure Pile Area shall be at one or more locations and shall have sufficient area to store accumulated manure. Unless there is evidence on the farm that the manure is more stackable, assume that the manure will not stack higher than 4 feet with a 4:1 angle of repose. Manure consistency and moisture characteristics need to be considered when locating and sizing the Manure Pile Area.

Heavy Metal Monitoring. When biosolids (sewage sludge) is applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, and/or any applicable state and local laws or regulations.

Field Risk Assessment

When animal manure or other organic by-products are applied, a field-specific assessment of the potential for phosphorus transport and nitrogen leaching from the field shall be completed annually where appropriate. This assessment will be done using the Phosphorus and Leaching Indices, and by identifying hydrologically sensitive areas. The assessment shall include:

- ◆ a record of the assessment rating for each field or sub-field, and

- ◆ information about conservation practices and management activities that can reduce the potential for phosphorus movement and nitrogen leaching from the site.

When such assessments are done, the results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

Manure shall not be spread within 100 feet, along surface flow path, to any down gradient surface waters. Surface water includes; open tile line intakes, structures or other water flow channels. However, manure can be applied closer than 100 feet of down gradient surface waters if application is in conjunction with field specific alternative conservation practices that, when installed, achieve RMS level for water quality as stated in section 3 of the eFOTG under resource quality criteria for RMS. Installed practices shall include whole field erosion control measures that satisfy RUSLE 2, and other practices such as: natural buffer areas, appropriate timing, rate of application, or incorporation and other practices as needed.

Manure will not be spread within 100 feet of a wellhead, spring or sinkhole unless specific evidence shows that it can be done without contamination.

Additional Criteria 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 shall 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) shall 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) shall be managed to minimize volatilization losses.

When liquid forms of manure are applied with irrigation equipment, operators will select weather conditions during application that will minimize volatilization losses.

Operators will 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) shall be recorded and maintained in accordance with the operation and maintenance section of this standard.

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.

Minimize the use of nutrient sources with high salt content unless provisions are made to leach salts below the crop root zone.

To the extent practicable nutrients shall not be applied when the potential for soil compaction and rutting is high.

CONSIDERATIONS

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.

The potential to affect National Register listed or eligible cultural resources.

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), Pre-Plant Soil Nitrate Test (PPSN) or soil surface sampling for phosphorus accumulation or pH changes.

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 reduce nitrogen losses from manure or fertilizer, use products or materials (e.g. nitrification inhibitors, urease inhibitors and slow or controlled release fertilizers) that more closely match soil nutrient availability and plant uptake. These materials may improve the nitrogen use efficiency (NUE) of the nutrient management system by reducing nitrogen losses into water and/or air.

When planning a temporary manure pile area consider:

- Total volume of manure, pollution potential and number of areas should be taken into consideration when evaluating the appropriateness of this practice
- Locate each Manure Pile Area so that it complements the waste utilization plan.
- Locate each Manure Pile Area away from residences and viewsheds.
- Rotate sites yearly to decrease potential of buildup of nutrients in pile areas.
- For liquid manure systems, consider the identification of fields that could safely receive over agronomic rates of manure as part of an emergency spill response plan.

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, tillage, 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.

Considerations to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere.

Odors associated with the land application of manures and organic by-products can be offensive to near-by residents. Avoid applying these materials upwind of occupied structures when residents are likely to be home (evenings, weekends and holidays).

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). N volatilization from manure in a surface irrigation system will be reduced when applied under a crop canopy.

When planning nutrient applications and tillage operations encourage soil carbon buildup by using no-till or mulch-till and cover crops where applicable, to reduce greenhouse gas emissions (e.g., nitrous oxide N₂O, carbon dioxide CO₂).

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 application restrictions,
- location of Manure Pile Areas and access routes to them,
- 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
- Waste shall be removed, at least, yearly from the manure pile area in accordance with nutrient management plan. The pile area(s) will be regraded after unloading, if needed to prevent ponding in the pile area.
- 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 guidelines for nutrient application,
 - quantities, analyses and sources of nutrients applied,
 - dates and method(s) of nutrient applications,
 - weather conditions and soil moisture 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

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Sims, J.T. (ed.) 2005. Phosphorus: Agriculture and the Environment. Agron. Monogr. 46. ASA, CSSA, and SSSA, Madison, WI.

Stevenson, F.J. (ed.) 1982. Nitrogen in Agricultural Soils. Agron. Series 22. ASA, CSSA, and SSSA, Madison, WI.

NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503.