

**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 (ammonium 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. The nutrient budget shall use reasonable yields to set nutrient requirements

based on currently accepted University of California guidance, or industry standards when acceptable to University of California.

Realistic yield goals 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, tissue, and manure/organic by-products tests.

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

Plans for nutrient management 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.

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.

On irrigated lands, irrigation management shall be optimized based on Practice 449 "Irrigation Water Management". This applies whether or not nutrients are being applied with the irrigation water.

Nutrient loss to erosion, leaching, runoff, and subsurface drainage shall be addressed, as needed.

Soil, Manure, and Tissue Sampling and Laboratory Analyses (Testing) Nutrient planning shall be based on current soil, manure, and tissue test results developed in accordance with University of California guidance, or industry practice if recognized by

the University of California. When used to assess P and K, current soil tests are no older than three years. Soil sampling used for managing N applications shall be timely, collected very near anticipated application times and considering previous and planned irrigation events or N applications.

Soil, manure, irrigation water, and tissue samples shall be collected and prepared according to University of California guidance or standard industry practice. Soil, water, manure, and tissue test analyses shall be performed by laboratories that are accepted in one or more of the following:

- Laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program (NAPT) under the auspices of the Soil Science Society of America <http://www.naptprogram.org/about/participants/>, or
- Environmental Laboratory Accreditation Program (ELAP) <http://www.dhs.ca.gov/ps/ls/elap/default.htm>
- For manure, laboratories successfully meeting the requirements and performance standards of the Manure Proficiency (MAP) Program <http://ghex.colostate.edu/map/>

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), soil organic matter, texture, nitrogen, phosphorus and potassium.

Nutrient Application Rates. Soil amendments shall be applied as needed, to adjust soil properties, including soil pH, to adequately provide for crop nutrient availability and utilization.

Recommended nutrient application rates shall be based on current (updated, as appropriate) University of California recommendations, (and/or industry practice when recognized by the university) that consider current soil test results, tissue tests, realistic yield goals and management capabilities. If University of

California does not provide state or regional recommendations, then UC guidance from County Farm Advisors on nutrient application rates, or industry practice when consistent with local UC guidance, is acceptable. 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 - When forage quality is impaired by excess soil potassium levels, application of potassium shall be reduced or suspended until desirable levels in the soil and forage are regained.
- Other Plant Nutrients - The planned rates of application of other nutrients shall be consistent with University of California guidance or industry practice if recognized by University of California.
- Starter Fertilizers - When starter fertilizers are used, they shall be included in the overall nutrient budget, and applied in accordance with University of California recommendations, or industry practice if recognized by University of California.

Nutrient Application Timing. Timing 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., leaching index, 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) unless precision application technology indicates variable rates are appropriate. Precise placement with banding, use of drip irrigation, or other strategies to maximize root access to nutrients, is desirable.
- Nutrients shall not be applied to frozen, snow-covered or saturated soil if the potential risk for runoff exists.
- Nutrients shall be applied considering plant nutrient uptake patterns during the growing season, root growth patterns, irrigation practices, nutrient mobility, 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 leaching, runoff, or volatilization of nutrients.
- Incorporate or irrigate in any broadcast fertilizers within the shortest practicable timeframe. Apply nitrogen fertilizers as close to anticipated plant need as is possible.

Conservation Management Unit (CMU) Risk Assessment. In areas with identified or designated agricultural phosphorus related water quality impairment, a CMU specific risk assessment of the potential for phosphorus transport from the area shall be completed using the California P Index. In areas with identified or designated agricultural nitrogen related water quality impairment, a CMU specific risk assessment of the potential for nitrogen transport from the area to ground water or surface water shall be completed by evaluating the irrigation, soils, cropping, runoff management, nitrogen application strategies in use, and other factors pertinent to the site.

Note: California regulators may select an alternative method to the PI to manage P application. California NRCS is developing a tool for evaluating risk of N loss. This section will be revised in either case.

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, a risk assessment of the potential for nutrient transport from the CMU shall be completed using the California P Index to adjust the management of nutrient applications.

Nutrient values of manure and organic by-products shall be determined prior to land application. Samples will be taken and analyzed for nutrient concentration, moisture content, and Ec, as appropriate, with each hauling/emptying cycle for a storage/treatment facility. Manure sampling frequency may vary based on the operation's manure handling strategy and spreading schedule. Dilute manure storage ponds shall be tested at least seasonally when drawdown occurs, with testing at each application recommended. If "stable" (maintaining a certain nutrient concentration with minimal variation) levels are found after three years or more of sampling average values from all sampling may be used for planning manure applications unless continued testing is desirable for other purposes or required by law. When changes occur in manure collection, treatment, storage, herd size, or any other factor capable of significantly altering manure nutrient characteristics renew sampling to establish new characteristics. Samples shall be collected and prepared according to University of California guidance or industry practice. Manure exported from any facility shall be tested and measured as required by law.

In planning for new operations, acceptable "book values" recognized by the NRCS and/or University of California may be used (e.g., NRCS Agricultural Waste Management Field Handbook, UCCE publications, regulatory guidelines, ASABE standards, or unpublished data when appropriate).

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. Manure and organic by-product nutrient application rates shall be based on nutrient analyses procedures recommended by state regulation, or University of California. As indicated above, "book values" may be used in planning for new operations. At a minimum, manure analyses shall include appropriate nutrient and specific ion concentrations. Solid manure test results will include percent moisture. Salt concentration (Ec) shall be monitored so that manure applications do not cause plant damage or negatively impact soil or water quality.

When applying manure with sprinkler irrigation, the application rate (in/hr) of liquid materials applied shall not exceed the soil intake/infiltration rate. All applications with irrigation water shall be managed to minimize ponding, minimize leaching below the root zone, and avoid runoff. Applications with irrigation water shall conform to the principles found in NRCS Practice 449, Irrigation Water Management.

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 atmospheric losses.
- Management activities and technologies shall be used that effectively utilize mineralized nitrogen and that minimize nitrogen losses through denitrification, leaching, and ammonia volatilization.

- Manure or organic by-products may be applied on legumes at rates equal to the estimated removal 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

- When manure or organic by-products are used, the planned rates of phosphorus application shall be consistent with state regulation or the Phosphorus Index (PI) Rating. **

** Acceptable phosphorus-based manure application rates shall be determined as a function of soil test recommendation or estimated phosphorus removal in harvested plant biomass.

- 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, or
 - ◇ 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.

Heavy Metal Monitoring. When sewage sludge (biosolids) 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.

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 available risk assessment tools as a potential source of atmospheric pollutants shall be adjusted, as necessary, to minimize the loss(es).

Comply with any Federal, State, or Local air quality regulations governing the use of fertilizers or the application of manure or biosolids to land.

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.

CAFO operations seeking permits under CARB or USEPA regulations (40 CFR Parts 122 and 412) should consult with their respective state or local permitting authority for additional criteria.

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 and water quality impacts to receiving waters are considered.

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.

Action should be taken to protect National Register listed and other eligible cultural resources.

The nutrient budget should be reviewed annually to determine if any changes are needed for the next planned crop.

For some sites specific soil sampling techniques may be appropriate to better manage nitrogen. These include post-harvest deep 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 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.

Sample the liquid manure/irrigation water mixture during each application to cropland.

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.

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 corn stalk-test or other tissue tests to minimize risk of applying nitrogen in excess of crop needs.
- Where only summer crops are grown, 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.

Apply calcium or acidic soil amendments, as appropriate, to soils with infiltration rates reduced by low salt content in irrigation water or excessive sodium in the soil or irrigation water. This will improve crop health and help control runoff.

Use risk assessment tools for planning, such as the California P Index, where there is significant risk to water quality from nutrients even in areas without identified or designated nutrient related water quality impairment.

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 the occupants of nearby homes. 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 while discouraging greenhouse gas emissions (e.g., nitrous oxide N₂O, carbon dioxide CO₂).

Storage and application of ammonia based materials will be done considering methods that limit volatilization.

Endangered Species Considerations

If during the Environmental Assessment, NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

<http://www.nrcs.usda.gov/technical/cultural.html> is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

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 potential for soil phosphorus drawdown from the production and harvesting of crops when phosphorus inputs are reduced, 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 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

- Follett, R.F. 2001. Nitrogen Transformation and Transport Processes. pp. 17-44, In R.F. Follett and J. Hatfield. (eds.). 2001. Nitrogen in the Environment; Sources, Problems, and Solutions. Elsevier Science Publishers. The Netherlands. 520 pp.
- 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.

Western Fertilizer Handbook, 8th Edition or later, Western Plant Health Association

University of California publications such as crop production manuals, crop specific IPM manuals, and crop or research group websites