NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, Nitrogen emissions (ammonia, oxides of Nitrogen), 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. This standard does not apply to one-time nutrient applications to establish perennial crops.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient budget for Nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including, but not limited to, green manures, legumes, crop residues, compost, animal manure, organic by-products, biosolids, waste water, organic matter, soil biological activity, commercial fertilizer, and irrigation water.

Enhanced efficiency fertilizers used in the state must be defined by the Association of American Plant Food Control Officials (AAPFCO) and be accepted for use by the state fertilizer control official, or similar authority, with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims.

To avoid salt damage, the rate and placement of applied Nitrogen and potassium in starter fertilizer must be consistent with South Dakota State University (SDSU) guidelines or industry practice recognized by SDSU.

Soil pH must be maintained in a range that enhances an adequate level for crop nutrient availability and utilization. Refer to the SDSU EC 750, “Fertilizer Recommendations Guide” for guidance.

The SD Natural Resources Conservation Service (NRCS)-approved nutrient loss risk assessment for Nitrogen must be completed on all sites unless the South Dakota Nitrogen Loss Risk Screening Tool demonstrates that Nitrogen leaching is not a risk to water quality, including drinking water.

The SD NRCS-approved nutrient loss risk assessment for phosphorus will be completed for all fields. The assessment is contained in the current NRCS nutrient management specification.

On organic operations, the nutrient sources and management must be consistent with the USDA’s National Organic Program.

Areas contained within minimum application setbacks (e.g., sinkholes, wellheads, gullies, ditches, or surface inlets) must receive nutrients consistent with the setback restrictions.

Applications of irrigation water must minimize the risk of nutrient loss to surface and groundwater.

All chemigation, as required by SD law, must have an effective check valve interlock, low pressure drain, and vacuum relief. See SD Codified Law (SDCL) 34-2A-3, Administrative Rules of SD, Chapter 74:02:09, Chemigation, for specific requirements.

For questions concerning SD law, please contact the SD Department of Environment and Natural Resources (SD DENR), Water Rights Program, at (605) 773-3352, or the SD Department of Agriculture (SDDA) at (605) 773-4432.

Spills, leaks, discharges, or releases of manure or process wastewater from permitted operations must be reported to the SD DENR. Releases of 25 pounds of liquid or 500 pounds of dry commercial fertilizer must be reported to the SDDA.

Soil, Manure, and Tissue Sampling and Laboratory Analyses (Testing).

Nutrient planning must be based on current soil, manure, and (where used as supplemental information) tissue test results developed in accordance with SDSU guidance, or industry practice, if recognized by SDSU.

Soil samples will be taken as per SDSU recommendations found in the SDSU Soil Testing Laboratory Soil Sample Information Sheet, or SDSU-FS935, “Recommended Soil Sampling Methods for South Dakota.”

If a field or portion of a field is determined to have a HIGH risk of Nitrogen leaching through the use of the SD NRCS Nutrient Loss Risk Assessment for Nitrogen, then deep soil sampling and analysis is required. Prior to the application of Nitrogen above starter application rates, a nitrate Nitrogen test (zero-to-two-foot and two-to-four-foot sample) will be taken and analyzed. An acceptable alterative to the zero-to-four-feet sampling method would be to take a zero-to-two-foot sample prior to any Nitrogen applications above starter rates as recommended by SDSU and to again sample zero to two foot within four weeks after fall crop harvest.

Current soil tests for Nitrogen recommendations will be those no older than one year old. Soil tests for immobile nutrients are those that are no older than two years. The area represented by a soil test must be that acreage recommended by SDSU.

Where a conservation management unit (CMU) is used as the basis for a sampling unit, all acreage in the CMU must have similar soil type, cropping history, and management practice treatment.

The soil and tissue tests must include analyses pertinent to monitoring or amending the annual nutrient budget, e.g., pH, electrical conductivity (EC), and sodicity where salts are a concern, soil organic matter, phosphorus, potassium, or other nutrients and test for Nitrogen where applicable. Follow SDSU guidelines regarding required analyses.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) under the auspices of the Soil Science Society of America (SSSA) and NRCS, or other NRCS-approved program that considers laboratory performance and proficiency to assure accuracy of soil test results. Alternate proficiency testing programs must have solid stakeholder (e.g., water quality control entity, NRCS state staff, growers, and others) support and be regional in scope.

Nutrient values of manure, organic by-products and biosolids must be determined prior to land application.

Manure analyses must include, at minimum, total Nitrogen (N), ammonium N, total phosphorus (P) or P_2O_5, total potassium (K) or K_2O, and percent solids, or SDSU guidance regarding required analyses.

Manure, organic by-products, and biosolids samples must be collected and analyzed at least annually, or more frequently if needed to account for operational changes (feed management, animal type, manure handling strategy, etc.,) impacting manure nutrient concentrations. If no operational changes occur, less frequent manure testing is allowable where

operations can document a stable level of nutrient concentrations for the preceding three consecutive years, unless federal, state, or local regulations require more frequent testing.

Samples must be collected, prepared, stored, and shipped, following SDSU guidance (SD-NRCS-FS-36) or industry practice.

When planning for new or modified livestock operations, acceptable "book values" recognized by the NRCS (e.g., NRCS Agricultural Waste Management Field Handbook) and SDSU, or analyses from similar operations in the geographical area, may be used if they accurately estimate nutrient output from the proposed operation.

Manure testing analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program (MTLCP) under the auspices of the Minnesota Department of Agriculture, or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results.

Nutrient Application Rates. Planned nutrient application rates for Nitrogen, phosphorus, and potassium must not exceed SDSU guidelines provided in the most current SDSU EC750 "Fertilizer Recommendations Guide" or industry practice when recognized by SDSU.

At a minimum, determination of rate must be based on crop/cropping sequence, current soil test results, SD NRCS approved nutrient risk assessments, and realistic yield goals.

Nitrogen and phosphorus application rates must be planned based on risk assessment results as determined by SD NRCS approved Nitrogen and phosphorus risk assessment tools.

For fields where phosphorus risk assessment results equate to LOW risk and it is desirable to build soil test phosphorus levels, commercial fertilizer applications may be made at a rate equal to the estimated phosphorus removal in harvested plant biomass for the crop rotation or multiple years in the crop sequence.

Where phosphorus risk assessment results equate to MODERATE risk, additional phosphorus may be applied up to the phosphorus crop requirement rate for the planned crops in the planned five year or shorter rotation, not to exceed the Nitrogen requirement for the succeeding crop.

When phosphorus risk assessment results equate to HIGH risk, additional phosphorus may be applied up to the phosphorus crop removal rate (one year), not to exceed the Nitrogen requirement for the succeeding crop. However, the following requirements must also be met:

- a soil phosphorus drawdown strategy has been implemented, and
- a site assessment for nutrients and soil loss has been conducted to determine mitigation practices that are required to protect water quality.
- any deviation from these high risk requirements must have the approval of the Chief of the NRCS.

Manure or organic by-products may be applied on legumes at rates equal to the estimated removal of Nitrogen in harvested plant biomass, not to exceed land grant university recommendations.

Manure may be applied 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 at one time. When such applications are made, the application rate must not exceed the phosphorus risk assessment criteria, must not exceed the recommended Nitrogen application rate during the year of application or harvest cycle, and no additional phosphorus may be applied in the current year and any additional years for which the single application of phosphorus is supplying nutrients.

Potassium shall not be applied in situations in which excess (greater than soil test potassium recommendation) causes unacceptable nutrient imbalances in crops or forages.

Realistic yield goals will be established from one or more of the following acceptable sources:

- average of the 3 highest multi-peril crop insurance crop yields plus 10 percent;

- proven yields on a field-by-field or farm-by-farm basis for a continuous 3-year average yield plus 10 percent;
- NRCS Crop Yield Tables (Productivity Indexes and 5 years of SD Agricultural Statistics Service crop yield Information) plus 10 percent.

For new crops or varieties, industry-demonstrated yield and nutrient utilization information may be used until SDSU information is available.

Lower than recommended nutrient application rates are permissible if the grower's objectives are met.

Applications of biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient budget.

Nutrient Sources.

Nutrient sources utilized must be compatible with the application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Biosolids (treated sewage sludge) shall be applied in accordance with all applicable state and federal regulations listed in 40 CFR 503 which is adopted in Administrative Rules of SD, Chapter 74:52:09:01 by reference.

Nutrient Application Timing and Placement. **T**iming and placement of all nutrients must correspond as closely as practical with plant nutrient uptake (utilization by crops), and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment results.

If a field is determined highly vulnerable for nitrate leaching, commercial nitrogen will not be applied more than 45 days prior to planting, with the exception of incidental N in commercial phosphorus, manure or organic by-product applications.

All commercial phosphorus sources must be placed below the soil surface except surface application can be made on no-till crop land or on lands under perennial vegetation such as pasture or hay land.

Manure or organic by-product applications (broadcast or incorporated) shall not be made within 35 feet of a surface water or conveyance if a perennial grass filter strip is established and maintained. If an established and maintained perennial grass filter strip is not present, applications (broadcast or incorporated) shall not be made within 100 feet of a surface water or conveyance.

Nutrients must not be surface-applied if nutrient losses offsite are likely. This precludes spreading on:

- frozen soil (soil that is impenetrable to either liquid manure or commercial fertilizer applied on the ground surface due to frozen soil moisture) and/or snow-covered soils (soils covered by one-inch or more of snow, or covered by more than one-half inch of ice), and
- when the top two inches of soil are saturated (soil so wet or water-logged that farm equipment cannot travel over the area effectively) from rainfall or snow melt.

Exceptions for the above criteria can be made for surface-applied manure as follows:

Liquid manure handling systems. Liquid manure is not to be applied to saturated, snow covered or frozen soil except in emergency situations, resulting from natural disaster, extraordinary weather events, or catastrophic equipment or structural failure.

Solid manure handling systems. Solid manure is not to be applied to saturated, snow covered or frozen soils, except in the following situations:

1. When incidental amounts of manure is collected during feedlot snow removal or cleaning of feed bunks or enclosed pens to facilitate livestock feeding and handling.
2. When a natural disaster or extraordinary weather (ie. excessive precipitation) prevent manure application during planned application periods.

General requirements for manure application on saturated, snow covered or frozen soil.

a. If a permitted facility, the producer is responsible to contact SD DENR prior to applying on saturated, snow-covered, or frozen soil.
b. The producer is required to provide documentation and updates to the existing nutrient management plan with dates, location(s), and volume of any emergency liquid manure or solid manure winter applications.
c. Application rates cannot exceed recommended rates based on fall soil test results.
d. Winter applications of nutrients must be set back a minimum of 300 feet from surface waters or water conveyances and a minimum of 1,000 feet from named lakes, rivers, and perennial streams.
e. No winter nutrient applications on floodplain soils classified as frequently or occasionally flooded on National Cooperative Soil Survey.
f. Winter applications only allowed on fields with slopes less than four percent.
g. Fields with lowest predicted soil loss (water erosion) will generally have the highest priority for winter applications.
h. Manure will be uniformly spread.
i. A manure nutrient test is recommended (if not available), to determine nutrient content.

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

Planners must use the current SD NRCS approved Nitrogen, phosphorus, and soil erosion risk assessment tools to assess the risk of nutrient and soil loss. Identified resource concerns must be addressed to meet current planning criteria (quality criteria). When there is a high risk of transport of nutrients, conservation practices must be coordinated to avoid, control, or trap manure and nutrients before they can leave the field by surface or subsurface drainage (e.g., tile). The number of applications and the application rates must also be considered to limit the transport of nutrients.

Conservation practices must be implemented to control water erosion to the soil loss tolerance.

Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater. The following nutrient use efficiency strategies or technologies must be considered:

- slow and controlled release fertilizers
- nitrification and urease inhibitors
- enhanced efficiency fertilizers
- incorporation or injection
- timing and number of applications
- soil nitrate and organic N testing
- coordinate nutrient applications with optimum crop nutrient uptake
- Corn Stalk Nitrate Test (CSNT), Pre-Sidedress Nitrate Test (PSNT), and Pre-Plant Soil Nitrate Test (PPSN)
- tissue testing, chlorophyll meters, and spectral analysis technologies
- other SDSU recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Additional Criteria Applicable to Properly Utilize Manure or Organic By-Products as a Plant Nutrient Source

When manures are applied and soil salinity is a concern, salt concentrations must be monitored to prevent potential crop damage and/or reduced soil quality.

The total single application of liquid manure:

- must not exceed the soil's infiltration or water holding capacity
- be based on crop rooting depth
- must be adjusted to avoid runoff or loss to subsurface tile drains.

Crop production activities and nutrient use efficiency technologies must be coordinated to take advantage of mineralized plant-available Nitrogen to minimize the potential for Nitrogen losses due to denitrification or ammonia volatilization.

Additional Criteria to Protect Air Quality by Reducing Odors, Nitrogen Emissions and the Formation of Atmospheric Particulates

To address air quality concerns caused by odor, Nitrogen, sulfur, and/or particulate emissions the source, timing, amount, and placement of nutrients must be adjusted to minimize the negative impact of these emissions on the environment and human health. One or more of the following may be used:

- slow or controlled release fertilizers;
- nitrification inhibitors;
- urease inhibitors;
- nutrient enhancement technologies;
- incorporation;
- injection;
- stabilized Nitrogen fertilizers;
- residue and tillage management;
- no-till or strip-till;
- other technologies that minimize the impact of these emissions.

Do not apply poultry litter, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material offsite.

Additional Criteria to Improve or Maintain the Physical, Chemical, and Biological Condition of the Soil to Enhance Soil Quality for Crop Production and Environmental Protection

Time the application of nutrients to avoid periods when field activities will result in soil compaction.

In areas where salinity is a concern, select nutrient sources that minimize the buildup of soil salts.

Conservation practices must be implemented to control erosion to the soil loss tolerance.

CONSIDERATIONS

Elevated soil test phosphorus levels are detrimental to soil biota. Soil test phosphorus levels should not exceed state-approved soil test thresholds established to protect the environment.

Use no-till/strip-till in combination with cover crops to sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve infiltration, and enhance soil biological activity to improve nutrient use efficiency.

Use nutrient management strategies such as cover crops, crop rotations, and crop rotations with perennials to improve nutrient cycling and reduce energy inputs.

Use variable-rate Nitrogen application based on expected crop yields, soil variability, soil nitrate or organic N supply levels or chlorophyll concentration.

Use variable-rate Nitrogen, phosphorus, and/or potassium application rates based on site-specific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors.

Develop site-specific yield maps using a yield monitoring system. Use the data to further diagnose low- and high-yield areas, or zones, and make the necessary management changes. See Title 190, Agronomy Technical Note (TN) 190.AGR.3, Precision Nutrient Management Planning.

Use manure management conservation practices to manage manure nutrients to limit losses prior to nutrient utilization.

Apply manure at a rate that will result in an “improving” Soil Conditioning Index (SCI) without exceeding acceptable risk of Nitrogen or phosphorus loss.

Use legume crops and cover crops to provide Nitrogen through biological fixation and nutrient recycling.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standard (CPS) Feed Management (592).

Soil test information should be no older than 1 year when developing new plans.

Excessive levels of some nutrients can cause induced deficiencies of other nutrients, e.g., high soil test phosphorus levels can result in zinc deficiency in corn.

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients.

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in the NRCS' National Nutrient Policy in GM 190, Part 402, Nutrient Management.

Potassium should not be applied in situations where an excess (greater than soil test potassium recommendation) causes nutrient imbalances in crops or forages.

Workers should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling anhydrous ammonia 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.

Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips. These practices can also reduce the loss of nitrates or soluble phosphorus.

Use application methods and timing strategies that reduce the risk of nutrient transport by ground and surface waters, such as:

- split applications of Nitrogen to deliver nutrients during periods of maximum crop utilization,
- banded applications of Nitrogen and/or phosphorus to improve nutrient availability,
- drainage water management to reduce nutrient discharge through drainage systems, and
- incorporation of surface-applied manures or organic by-products if precipitation capable of producing runoff or erosion is forecast within the time of planned application.

Use the agricultural chemical storage facility conservation practice to protect air, soil, and water quality.

Use bioreactors and multistage drainage strategies when approved by the land-grant university.

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

Avoid applying manure and other by-products upwind of inhabited areas.

Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses.

PLANS AND SPECIFICATIONS

The following components must be included in the nutrient management plan:

- aerial site photograph(s)/imagery or site map(s) and a soil survey map of the site;
- soil information including: soil type surface texture, pH, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and/or ponding frequency;
- location of designated sensitive areas and the associated nutrient application restrictions and setbacks;
- for manure applications, location of nearby residences, or other locations where humans may be present on a regular basis, and any identified meteorological (e.g., prevailing winds at different times of the year), or topographical influences that may affect the transport of odors to those location;
- results of approved risk assessment tools for Nitrogen, phosphorus, and erosion losses;
- documentation establishing that the application site presents low risk for phosphorus transport to local water when

phosphorus is applied in excess of crop requirement;

- current and/or planned plant production sequence or crop rotation;
- soil, water, compost, manure, organic by-product, and plant tissue sample analyses applicable to the plan;
- when soil phosphorus levels are increasing, include a discussion of the risk associated with phosphorus accumulation and a proposed phosphorus drawdown strategy;
- realistic yield goals for the crops;
- complete nutrient budget for Nitrogen, phosphorus, and potassium for the plant production sequence or crop rotation;
- listing and quantification of all nutrient sources and form;
- all enhanced efficiency fertilizer products that are planned for use;
- in accordance with the Nitrogen and phosphorus risk assessment tool(s), specify the recommended nutrient application source, timing, amount (except for precision/variable rate applications specify method used to determine rate), and placement of plant nutrients for each field or management unit; and
- guidance for implementation, operation, and maintenance, and recordkeeping.

In addition, the following components must be included in a precision/variable rate nutrient management plan:

- Document the geo-referenced field boundary and data collected that was processed and analyzed as a Geographic Information Systems (GIS) layer or layers to generate nutrient or soil amendment recommendations.
- Document the nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.
- Document if a variable rate nutrient or soil amendment application was made.
- Provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all applications that resulted from use of the precision agriculture process for nutrient or soil amendment applications.
- Maintain the electronic records of the GIS data layers and nutrient applications for at least five years.

If increases in soil phosphorus levels are expected (i.e., when Nitrogen-based rates are used), the nutrient management plan must document:

- the soil phosphorus levels at which it is desirable to convert to phosphorus based planning;
- the potential plan for soil test phosphorus drawdown from the production and harvesting of crops; and
- management activities or techniques used to reduce the potential for phosphorus transport and loss;
- for Animal Feeding Operations (AFO), a quantification of manure produced in excess of crop nutrient requirements; and
- a long-term strategy and proposed implementation timeline for reducing soil Phosphorous to levels that protect water quality.

OPERATION AND MAINTENANCE

Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised, as needed with each soil test cycle, changes in manure volume or analysis, crops, or crop management.

Fields receiving animal manures and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with land grant university guidance and state law.

Significant changes in animal numbers, management, and feed management will

necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

Records must be maintained for at least five years to document plan implementation and maintenance. 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, source of nutrients, and rates of application;
- 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, nutrient analyses of harvested biomass, and crop residues removed;
- dates of plan review, name of reviewer, and recommended changes resulting from the review; and
- all enhanced efficiency fertilizer products used.

Additional records for precision/variable rate sites must include:

- maps identifying the variable application source, timing, amount, and placement of all plant nutrients applied; and
- GPS-based yield maps for crops where yields can be digitally collected.

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