

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments

PURPOSES

- To supply nutrients for plant production
- To properly utilize manure or organic by-products as a plant nutrient source
- To minimize agricultural non-point source pollution of surface and ground water resources
- 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

Nutrient management practices shall comply with all applicable federal, state, and local laws and regulations.

Nutrient management practices shall be developed in accordance with policy requirements of the Natural Resources Conservation Service (NRCS) General Manual (GM), Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the Kansas NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook

(NPPH), and the NRCS National Agronomy Manual (NAM), Section 503.

All nutrient management plans that address land application of swine waste from operations with 1,000 or more animal units will comply with Kansas Department of Agriculture's Regulations pertaining to Kansas Statutes Annotated (K.S.A.) 65-1, 178 et. seq.

Persons who approve plans for nutrient management shall be certified in Kansas according to the state supplement to the GM, Title 190, Part 402.03(a).

Plans for nutrient management that are elements of a more comprehensive conservation plan shall recognize other requirements of the conservation plan and be compatible with its other requirements.

Nutrient source, time, and method of application shall be planned to conform to seasonal variations in plant uptake needs and soil profile properties to optimize economic return and minimize nutrient loss by leaching or surface transport.

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 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 and manure/organic by-products tests. Yield goals should be based on the past five crop years. To estimate expected crop yield, eliminate the

extreme high and extreme low yields and average the remaining three years. The expected yield may be increased by ten percent to establish crop nutrient needs. If long-term data for an individual field is not available, use yield data from similar soils or cropping and management conditions elsewhere on the farm or in the local area. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

The nutrient management practice specification shall specify the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground waters.

Field risk assessment. Plans for nutrient management will include a determination of the vulnerability of the application site to leach nitrates to an aquifer and the vulnerability for phosphorous loss to surface water. Use the following guidance to make the vulnerability determinations:

- Vulnerability for nitrate leaching to an aquifer: Use Appendix A “Soil Potential for Surface Loss and Leaching” in Section II – Soil and Site Information of the Kansas FOTG.
- Vulnerability for phosphorus loss to surface waters will be assessed through the use of Kansas Site Assessment Index – Phosphorus, Section II of the Kansas FOTG.

Erosion, run-off, and water management controls shall be installed, as needed, on fields that receive nutrients.

All nutrients shall not be surface applied without incorporation on soils that are frequently or very frequently flooded, as defined by the National Cooperative Soil Survey Handbook, Part 618.26, during the months of March through June, or other periods with a high potential to flood.

Soil sampling and laboratory analysis (testing). Nutrient planning shall be based on current soil test results developed in accordance with Kansas State University

guidance. A soil test is considered current if no older than three years.

Soil samples shall be collected and prepared according to the Kansas State University Bulletin MF-734 (revised).

Soil test analysis shall be performed according to the analytical procedures in the “Recommended Chemical Soil Test Procedures for the North Central Region” (NCR-221).

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

Annually cropped fields will have a soil test taken the first year of a new plan or rotation; thereafter, once in three years. If organic sources of fertilizers are used two or more consecutive years, annual soil testing is required.

Plant tissue testing. Tissue sampling and testing, where used, shall be done in accordance with Kansas State University standards or recommendations. Additional nutrients above the soil test recommendations may be added if interpretation of the tissue testing shows a need.

Nutrient application rates. Recommended nutrient and soil amendment application rates shall be based on Kansas State University Cooperative Extension Service Bulletins C-529 Wheat Production Handbook, C-449 Soybean Production Handbook, C-560 (Revised) Corn Production Handbook, C-687 (Revised) Grain Sorghum Production Handbook, C-683 (Revised) Alfalfa Production Handbook, MF-2384 High Plains Sunflower Production Handbook, C-729 Tall Fescue Production, and Utilization and C-402 Smooth Brome Production and Utilization (and/or industry practice when recognized by Kansas State University), plant nutrient removal rates as described in Chapter 6 of the Agriculture Waste Management Field Handbook of the NRCS National Engineering Field Manual, or from an approved equivalent research database and will be based on realistic yield

goals, associated plant nutrient uptake rates, and management strategies.

The planned rates of nutrient application shall be based on the following guidance:

- **Nitrogen application**—Planned nitrogen application rates shall match the recommended rates for each crop in the rotation as closely as possible, except when manure or other organic by-products are a source of nutrients. When manure or other organic by-products are a source of nutrients, see “Additional Criteria” below.
- **Phosphorus application**—Planned phosphate (P_2O_5) application rates shall match the recommended rates as closely as possible, except when manure or other organic by-products are a source of nutrients. When manure or other organic by-products are a source of nutrients, see “Additional Criteria” below.
- **Potassium application**—Excess potassium shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages fed to livestock.
- **Other plant nutrients**—The planned rates of application of other nutrients shall be consistent with Kansas State University guidance or industry practice if recognized by Kansas State University.
- **Starter fertilizers**—Starter fertilizers containing nitrogen, phosphorus and potassium, and/or micro-nutrients may be applied in accordance with Kansas State University recommendations or industry practice if recognized by Kansas State University. When starter fertilizers are used, they shall be included in the nutrient budget.
- **Soil amendments** shall be applied as needed to adjust soil pH to the specific range of crops in the crop rotation for the optimum availability and utilization of nutrients.

Nutrient application timing. Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, while considering

cropping system limitations, weather and climatic conditions, and field accessibility.

Nutrients shall not be applied to frozen, snow-covered, or saturated soil if the potential risk of runoff exists.

Nutrient Application Methods. Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Conservation Practice Standard 449, Irrigation Water Management, and the “Kansas Chemigation Safety Law.”

Additional Criteria Applicable to Manure or Organic By-Products Applied As a Plant Nutrient Source

Nutrient values of manure and organic by-products (excluding sewage sludge) shall be determined prior to land application based on laboratory analysis, acceptable “book values” recognized by the NRCS, and Kansas State University or historic records for the operation, if they accurately estimate the nutrient content of the material. Book values recognized by NRCS may be found in the Agricultural Waste Management Field Handbook (AWMFH), Chapter 4, Agricultural Waste Characteristics.

Manure analysis for land application will provide at least:

- Dry matter (DM) or moisture content
- Ammonium nitrogen (NH_4-N)
- Organic nitrogen
- Total nitrogen
- Phosphorus (P_2O_5)
- Potassium (K_2O)

When determining nutrient values based on laboratory analysis, tests shall be performed before each land application event, or on a yearly basis until a historical record can be produced. If annual manure analyses do not vary significantly in five years, samples may be taken every three years. During non-test years, use average test results to determine land application rates.

Manure samples will be obtained and handled according to Midwest Plan Service publication MWPS-18, Manure Management Systems Series, Section 1 “Manure Characteristics” or similar approved procedure and analyzed by

Kansas State University or laboratories accepted through the North American Proficiency Testing Program (Soil Science Society of America).

Livestock manure and other organic by-products should be tested within 60 days prior to land application.

Field Risk Assessment. When animal manure or other organic by-products are applied, a field-specific assessment of the potential for phosphorus transport from the field should be completed. This assessment may be done using the Kansas Site Assessment Index – Phosphorus. In such cases, plans shall include:

- A record of the assessment rating for each field or sub-field.
- Information about conservation practices and management activities that can reduce the potential for phosphorus movement from the site.

When such assessments are done, the results of the assessment and recommendations should be used to determine the basis of the nutrient application. Use of organic by-products and animal manure will consider soil test phosphorus and run-off vulnerability categories established in “Kansas Department of Agriculture Nutrient Utilization Plan Form,” Table 1 and Table 3. Refer to Table 1 of this practice standard to determine the recommended basis of nutrient application rates corresponding to Kansas Site Assessment Index – Phosphorus.

Nutrient application rates. The planned rates of nitrogen and phosphorus application shall be determined based on the following guidance:

Nitrogen application—When the practice is being implemented on a nitrogen basis, manure or other organic by-products shall be applied at rates consistent with the agronomic nitrogen requirements for the crop immediately following the application.

Manure or other organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass.

Phosphorus application—When manure or other organic by-products are used, the

planned rates of phosphorus applied shall be consistent with Table 1 of this standard. An additional nitrogen application, from non-organic sources, may be required to supply the recommended amounts of nitrogen.

A single 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.
- Exceed the estimated nitrogen removal in harvested plant biomass during the year of application when there is no recommended nitrogen application.
- 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. Leaching and run-off practices must be included in the resource management plan.

The application rate (in/hr) for wastewater applied through sprinkler irrigation shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil.

Run-off of wastewater applied by surface irrigation shall be contained and reused on the field or adjacent fields. The total application shall not exceed the field capacity of the soil.

Heavy metals monitoring. When biosolids are 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 U.S. Code, Reference 40 Code of Federal Regulations (CFR), Parts 403 and 503, and/or any applicable state and local laws or regulations.

Where municipal wastewater and solids (biosolids) are applied to agricultural lands as a nutrient source, the single application (annual limit) or lifetime limits of heavy metals

shall not be exceeded. The concentration of salts shall not exceed the level that will impair seed germination or plant growth.

Maximum Annual and Lifetime Heavy Metal Additions to the Soil¹		
Metal (name/symbol)	Annual Limit (lbs/ac/yr)	Lifetime Limit (lbs/ac)
Arsenic (As)	2.2	46.0
Cadmium (Cd)	2.3	33.0
Copper (Cu)	84.0	1500.0
Lead (Pb)	17.0	336.0
Mercury (Hg)	1.0	19.0
Nickel (Ni)	24.0	19.0
Selenium (Se)	5.6	112.0
Zinc (Zn)	157.0	3136.0

¹From the Code of Federal Regulations, Title 40, Vol 3, Part 503, Sec. 13, July 1, 1999

Biosolids shall not be applied to land that is closer than 100 feet to any watercourse, flooded, frozen, or snow covered.

Animals shall not be allowed to graze on the land for 30 days after the application of biosolids.

Food crops with harvested parts that touch applied biosolids and are totally above the soil surface shall not be harvested for 14 months after the application. Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of biosolids, when the application remains on the land surface for four months or longer prior to incorporation into the soil. Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of biosolids, when the application remains on the land surface for less than four months.

Additional Criteria to Minimize Agricultural Non-point Source Pollution of Surface and Ground Water Resources

In areas with an identified or designated nutrient-related water quality impairment, an assessment shall be completed of the potential for nitrogen and/or phosphorus transport from the field. The Leaching Index (LI) and/or

Kansas Site Assessment Index – Phosphorus (PI), will be used to determine the vulnerability of site for nutrient losses.

Plans developed to minimize agricultural non-point source pollution of surface or ground water resources shall include practices and/or management activities that can reduce the risk of nitrogen or phosphorus movement from the field.

All nutrient applications will be in accordance with Table 1 of this practice standard.

Nutrient values of manure and organic by-products (excluding sewage sludge) shall be determined prior to land application based on laboratory analysis.

Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties, or biological condition. Use of nutrient sources with high salt content relative to the nutrient value will be minimized to prevent damage to plants. Salt levels will be monitored by soils testing to see that they do not exceed the EC rate for the crop to be grown. See Table 13 – 3 in Chapter 13 of the National Engineering Handbook, Part 652, Irrigation Guide.

Nutrients shall not be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

CONSIDERATIONS

During the planning process, consider the relationship between nitrogen and phosphorus transport and water quality impairment.

Consider the potential for nitrogen leaching into shallow ground water and potential health impacts.

Consider the potential for phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.

When applicable, plans shall include other practices or management activities as

determined by specific regulation, program requirements, or client goals.

Consider induced deficiencies of nutrients due to excessive levels of other nutrients. Soil pH should be maintained in the optimum range for each crop to improve availability of soil nutrients, applied nutrients, and to minimize the release of potentially toxic elements.

Consider additional practices such as Conservation Practice Standards: 412, Grassed Waterway; 332, Contour Buffer Strips; 393, Filter Strips; 449, Irrigation Water Management; 391A, Riparian Forest Buffer; 328, Conservation Crop Rotation; 340, Cover and Green Manure; and 329A, 329B, or 329C, and 344, Residue Management to improve soil nutrient and water storage, infiltration, aeration, tillage, and diversity of soil organisms and to protect or improve water quality.

Consider cover crops whenever possible to utilize and recycle residual nitrogen.

Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:

- Split applications of nitrogen to provide nutrients at the times of maximum crop utilization.
- Avoiding winter nutrient application for spring seeded crops.
- Band applications of nutrients near the seed row.
- Applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques, and/or immediate incorporation of land applied manure or organic by-products.
- Delaying field application of animal manure or other organic by-products if precipitation capable of producing run-off and erosion is forecast within 24 hours of the time of the planned application.

Consider minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets, or rapidly permeable soil areas.

Consider the potential problems from odors associated with the land application of animal manure, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manure. Volatilization losses can become significant, if manure is not immediately incorporated into the soil after application.

Consider the potential to affect National Register listed or eligible cultural resources.

Consider using soil test information no older than one year when developing new plans, particularly if animal manure is to be a nutrient source.

Consider annual reviews to determine if changes in the nutrient rates are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques. (For example: 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.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content, to enhance the producer's ability to manage manure effectively.

PLANS AND SPECIFICATIONS

Plans and specifications 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 water quality impairment.

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

- Aerial photograph or map and a soil map of the site.
- Current and/or planned plant production sequence or crop rotation.
- Results of soil, plant, water, manure, or organic by-product sample analyses.
- Realistic yield goals for the crops in the rotation.

- Quantification of all nutrient sources.
- Recommended nutrient rates, timing, form, and method of application and incorporation.
- Location of designated sensitive areas or resources and the associated nutrient management restriction.
- Guidance for implementation, operation, maintenance, record keeping.
- A complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence will be used to evaluate potential credits and debits of plant nutrients within the proposed annual management cycles.
- A statement that the plan was developed based on the requirements of the current standard and any applicable federal, state, or local regulations or policies; and changes in any of these requirements may necessitate a revision of the plan.

If increases in soil phosphorus levels are expected, plans shall document:

- The soil phosphorus levels at which it may be desirable to convert to phosphorus-based implementation.
- The relationship between soil phosphorus levels and potential for phosphorus transport from the field.
- The potential for soil phosphorus draw down from the production and harvesting of crops.

When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements, or producer goals.

In addition to the requirements described above, plans for nutrient management may also include:

- Discussion about the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow ground water and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased

potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.

- Discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.

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.
- 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 or exceed the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:
 1. Soil test results and recommendations for nutrient application
 2. Quantities, analyses, and sources of nutrients applied
 3. Dates and method of nutrient applications
 4. Crops planted, planting and harvest dates, yields, and crop residues removed
 5. Results of water, plant, and organic by-product analyses,

dates of review and person performing the review, and recommendations resulting from the review

Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning nutrient application equipment should

be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for run-off and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

Table 1: Basis for Nutrient Application Rates for Livestock Manure and In Areas of Impaired Water Quality by Nutrients			
Soil Test Phosphorus Level (ppm P)		P Index Rating	
Bray-1 or Mehlic-3	Olsen		
			For legumes: (alfalfa, soybeans, clover, etc.)
0-50	0-19		Use 1.0 x agronomic N requirement: Annual legumes or prior to establishment of perennial legumes Use 1.5 x P ₂ O ₅ removal rate: Perennial legume crops
			For All Other Crops
0-50	0-31	Very Low, Low	Use 1.0 x agronomic N requirement
		Medium	Use 1.0 x agronomic N requirement
		High, Very High	Use 1.5 x P ₂ O ₅ removal
51-75	32-47	Very Low, Low	Use 1.0 x agronomic N requirement
		Medium	Use 1.5 x P ₂ O ₅ removal
		High, Very High	Use 1.5 x P ₂ O ₅ removal
76-100	48-62	Very Low, Low	Use 1.5 x P ₂ O ₅ removal
		Medium	Use 1.5 x P ₂ O ₅ removal
		High, Very High	Use 1.0 x P ₂ O ₅ removal
101-150	63-93	Very Low, Low	Use 1.5 x P ₂ O ₅ removal
		Medium	Use 1.5 x P ₂ O ₅ removal
		High, Very High	Use 1.0 x P ₂ O ₅ removal
151-200**	94-124	Very Low, Low	Use 1.5 x P ₂ O ₅ removal
		Medium	Use 1.0 x P ₂ O ₅ removal
		High, Very High	Use no livestock waste or P ₂ O ₅
Over 200	125-	Very Low, Low	Use 1.0 x P ₂ O ₅ removal
		Medium	Use no livestock waste or P ₂ O ₅
		High, Very High	Use no livestock waste or P ₂ O ₅

Notice: When applying nutrients based on P₂O₅ removal, do not exceed the recommended N application for the crop. **When applying swine waste, do not exceed recommendations established by the Kansas Department of Agriculture's Regulations pertaining to K.S.A. 65-1, 178 et. seq.