Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

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

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- 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 byproducts 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.

On agricultural land, this practice applies when nutrient management is a component of a conservation management system.

On animal feeding operations (AFOs) or concentrated animal feeding operations (CAFOs), this practice applies when nutrient management is a component of a comprehensive nutrient management plan (CNMP).

On agricultural land where manure is utilized as a source of nutrients, this practice applies where there is documentation that there is or will be an adequate land base to maintain or achieve the agronomic critical range for phosphorus, as defined below.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient budget for soil 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, commercial fertilizer, and irrigation water.

Land application of nutrients shall be done in accordance with soil test results and recommendation of a Technical Service Provider or other certified nutrient management planner based on University of Connecticut, Soil Nutrient Analysis Laboratory or equivalent soil testing laboratory.

Any nutrients transferred to others shall be documented according to the Comprehensive Nutrient Management Plan and record keeping.

Enhanced efficiency fertilizers used in Connecticut must be defined by the Association of American Plant Food Control Officials (AAPFCO), and registered for use in CT.

For nutrient risk assessment policy and procedures see Title 190, General Manual (GM), Part 402, Nutrient Management, and Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation.

To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with guidelines developed by UConn or industry practice recognized by the land-grant university.

The NRCS-approved nutrient risk assessment for nitrogen must be completed on all sites unless Connecticut NRCS, with the concurrence of the CT DEEP water quality control authorities and state Department of Public Health drinking water authorities, has determined specific conditions where nitrogen leaching is not a risk to water quality, including drinking water.

The nitrogen leaching index for specific fields and cropping operations can be found in RUSLE2 (Revised Universal Soil Loss Equation v2)

The NRCS-approved nutrient risk assessment for phosphorus must be completed when:

- phosphorus application rate exceeds UConn fertility rate guidelines for the planned crop(s), or
- the planned area is within a phosphorus impaired watershed (contributes to 303d-listed water bodies), or
- CT NRCS and the CT DEEP have not determined specific conditions where the risk of phosphorus loss is low.

If increases in soil phosphorus levels are expected, 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 AFOs, a quantification of manure produced in excess of crop nutrient requirements, and
- a long-term strategy with improvements within 5 years, and proposed implementation timeline for reducing soil P to levels that protect water quality.

A phosphorus risk assessment will not be required when CT NRCS, with concurrence of the CT DEEP water quality control authority, has determined specific conditions where the risk of phosphorus loss is low. These fields must have a documented agronomic need for phosphorus; based on soil test phosphorus (STP) and UConn nutrient recommendations.

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

Areas contained within minimum application setbacks to surface waters, dwellings, and wells (e.g., wetlands, water courses, wellheads, and concentrated flow paths such as gullies, ditches, or surface inlets

that discharge directly to a surface water) must receive nutrients consistent with setback restrictions per NRCS National Setbacks Database and local regulations. See Table 1.

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

The application rate in inches per hour (in/hr) of water containing nutrients applied through irrigation systems shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil and in no case shall application result in runoff.

Soil pH must be maintained in a range that is appropriate for the crop being grown, to ensure an adequate level for crop nutrient availability and utilization. Refer to UConn documentation for guidance.

Applications of nutrients to cultivated fields with soils in flooding frequency classes “occasional”, “frequent”, or “very frequent” shall be by injection or limited to periods within 24 hours of tillage and/or planting operations. Any non-injected manure applications shall be incorporated within 24 hours.

Flooding frequency classes are defined in Section 618.26(b) (1) of the current NRCS National Soil Survey Handbook (GM Title 430VI-NSSH, Part 618, 2010).

When annual crops are not present on cultivated land, applications shall be incorporated within 24 hours, regardless of the soil flooding frequency class.

When annual crops are present, nutrient applications shall be incorporated by cultivation or injection, if possible.

Nutrients on pastures and hayland shall be applied soon after cutting or grazing and before significant re-growth has occurred.

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

The University of Connecticut Soil Nutrient Analysis Laboratory (UConn) has developed and will maintain tools for establishing nutrient application recommendations including soil and plant tissue tests and record keeping procedures and requirements.

Nutrient planning must be based on current soil, manure, and (where used as supplemental information) tissue test results. For tissue sampling and testing, refer to UConn Stalk Nitrate Test methods or other available methods recognized by UConn.

Tissue sampling will be completed for the implementation of the CNMP.

Current soil tests are those that are no older than 3 years, but may be taken on a more frequent interval if recommended by UConn or as required by State code.

Soil samples shall be collected and prepared in a manner recognized by UConn. Refer to UConn soil sampling requirements for more information.

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 per UConn guidelines. These tests can include: pH, soil organic matter, phosphorus, potassium, or other nutrients and test for nitrogen where applicable.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing ProgramPerformance Assessment Program (NAPT-PAP) under the auspices of the Soil Science Society of America (SSSA) and NRCS, or other NRCSapproved 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, Connecticut NRCS 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 P2O5, total potassium (K) or K2O, and percent solids, or follow guidance developed by UConn 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, Connecticut, or local regulations require more frequent testing.

Samples must be collected, prepared, stored, and shipped, following land-grant university guidance or industry practice. Manure samples are to be analyzed at laboratories recognized by UConn, following their sampling and testing requirements. When developing the CNMP, use manure book values for all nutrients unless better information is available.

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

Nutrient Application Rates

Planned nutrient application rates for nitrogen, phosphorus, and potassium must not exceed guidelines developed by UConn or industry practice when recognized by the university.

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

If UConn does not provide specific guidance to meet these criteria, application rates must be based on plans that consider realistic yield goals and associated plant nutrient uptake rates.

Realistic yield goals must be established based on historical yield data, soil productivity information, climatic conditions, nutrient test results, level of management, and local research results considering comparable production conditions.

Estimates of yield response must consider factors such as soil quality, drainage, pH, etc., prior to assuming nitrogen and/or phosphorus are deficient.

For new crops or varieties, industry- demonstrated yield, and nutrient utilization information as well as book values may be used until information is available from UConn.

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.

Nutrient Application Timing and Placement

Timing and placement of all nutrients must correspond as closely as possible 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.

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

Nitrogen Application – Follow UConn recommendations or industry practice when recognized by UConn. Recommendations are based on current soil and tissue tests documented yield information, and certain management activities. Use the Presidedress Nitrogen Test (PSNT) and corn stalk nitrate test if available for the crop. If manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.

Phosphorus Application – Follow UConn recommendations based on current soil phosphorus tests. If manure or other organic by-products are a source of nutrients, see "Additional Criteria" below. Potassium Application – Follow UConn recommendations based on current soil test. Do not apply potassium in situations that may cause unacceptable nutrient imbalances in crops or forages. When forage quality is an issue associated with excess potassium application, UConn standards shall be used to set forage quality guidelines.

Other Plant Nutrients – Follow UConn recommendations based on current soil test. The recommended rates of application of other nutrients shall be consistent with UConn guidance or industry practice as recognized by UConn.

Starter Fertilizers – Starter fertilizers containing nitrogen, phosphorus and potassium may be applied in accordance with UConn recommendations or industry practice if recognized by UConn. When starter fertilizers are used, they shall be included in the nutrient accounting.

Nutrients must not be surface-applied immediately before, during, or after precipitation events likely to create surface runoff offsite. Spreading is not allowed when conditions include:

- frozen and/or snow-covered soils, and
- when the top 2 inches of soil are saturated from rainfall or snow melt.

Soil pH Amendments – Soil amendments shall be applied, as recommended, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients.

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

Planners must use the current 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). Technical criteria for risk assessments can be found in NI-190-302.

A field level evaluation of the potential for nitrogen and/or phosphorus losses will be completed for all fields.

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 to tile.

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 where applicable and available:

• 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), PreSidedress Nitrate Test (PSNT), and PrePlant Soil Nitrate Test (PPSN)

• tissue testing, chlorophyll meters, and spectral analysis technologies

• other technologies recommended by UConn that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Nutrient application shall be based upon the setbacks as described in Table 1. If incorporation occurs within 24 hours, setbacks may be reduced. Nutrients (other than manure) applied as fertilizer and other soil amendments can be applied per soil test recommendations and best management practices up to the field boundary, unless site specific setbacks are necessary.

Table 1. CT Setbacks by Feature Type

Application Criteria	Setback (feet)
Surface Waters - including Public Water Supply Watersheds or Concentrated Flow Paths to surface waters	
Applied up-gradient, permanent vegetated buffer ≥ 35 feet	35
Applied up-gradient, no permanent vegetated buffer ≥ 35 feet	100
Applied down-gradient	35
Dwellings (producer does not own	
Manure injection or incorporation the same day	75
Manure applications surface applied (no incorporation)	100
Wells: Public/Private/Agricultural	
< 10 gpm output: Applied up gradient, permanently vegetated buffer ≥ 35 feet	35
< 10 gpm output: Applied up gradient and no permanently vegetated buffer ≥ 35 feet	100
≥ 10 gpm and < 50 gpm output: All applications	100

≥ 50 gpm output or stratified drift: All applications	200

Source: National Setbacks Database and Regulations of CT State Agencies, Section 1913-B51d.

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

The total single application of liquid manure:

- must not exceed the soil's infiltration or water holding capacity
- must 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. Crop removal rates shall be based on the current UConn agronomic requirements for N, P and K.

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

For fields receiving manure, where phosphorus risk assessment results equate to:

LOW risk, additional phosphorus and potassium can be applied at rates greater than crop requirement not to exceed the nitrogen requirement for the succeeding crop.

MODERATE risk, additional phosphorus and potassium may be applied at a phosphorus crop requirement rate for the planned crops in the rotation.

HIGH risk, additional phosphorus and potassium may be applied at phosphorus crop removal rates if the following requirements are met:

- a soil phosphorus drawdown strategy has been implemented, and
- a site assessment for nutrients and soil loss has been conducted to determine if mitigation practices are required to protect water quality.

VERY HIGH risk, there are three options:

- No Phosphorus Application to the field, or
- Implement a soil phosphorus drawdown strategy for the field, with mitigating practices to protect water quality, or
- any deviation from these high risk requirements must have the approval of the Chief of the NRCS.

Soil phosphorus drawdown strategies may include manure consumer markets, regional composting, off-farm manure sales or export, introduced technologies for nutrient management, application of manure at rates that reduce soil test phosphorus values, or other management strategies to reduce soil P index values.

Current soil test results and recommendations should be followed for all nutrient applications. Manure or organic by-products may be applied at rates equal to the estimated removal of nitrogen in harvested plant biomass, not to exceed UConn recommendations, if the P risk assessment result is LOW or MODERATE risk.

A single year phosphorus recommendation or a multiple year phosphorus recommendation (not to exceed two year P application) may be applied in one application. When such applications are made:

- the application rate must not exceed the acceptable phosphorus risk assessment criteria
- must not exceed the recommended nitrogen application rate during the year of application or harvest cycle
- no additional phosphorus is applied during the multiple years for which the single, multiple year application was made.

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 or rutting.

CONSIDERATIONS

General Consideration

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 potassium application rates based on sitespecific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors.

Use Precision Agriculture Technologies where available to 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) Code 592, Feed Management.

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. Follow soil test recommendations to avoid nutrient imbalances.

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, especially where liquid manure is used.

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 nutrients 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.

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

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, grassed waterway, conservation cover, cover crop, riparian forest buffer, residue management or contour buffer strips). These practices can also reduce the loss of nitrates or soluble phosphorus.

Use Conservation Practice Standard Code 309 - Agrichemical Handling Facility to protect air, soil, and water quality.

Use bioreactors and multistage drainage strategies when recommended by UConn.

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.

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

Consider timing applications to minimize potential problems with odors associated with the land application of animal manures.

Use high-efficiency irrigation technologies (e.g., micro-irrigation, sprinkler systems) 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, consider the potential for transport of odors,
- results of approved risk assessment tools for nitrogen, phosphorus, and erosion losses as determined by approved tools for nutrient loss such as the P-Loss Index,
- 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 draw-down 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 nutrient chemical composition (i.e. NH3, P2O5),
- 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. Ensure all components are in accordance with the CNMP.

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 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 5 years.

If increases in soil phosphorus levels are expected (i.e., when N-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 AFOs, a quantification of manure produced in excess of crop nutrient requirements, and
- a long-term strategy with improvements within 5 years, and proposed implementation timeline for reducing soil P 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 phosphorus in accordance with guidance from UConn and State law.

Significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

At a minimum, the CNMP should be reviewed annually to semi-annually.

Any manure transferred to others shall be documented according to the Comprehensive Nutrient Management Plan and record keeping, taking the name, quantity, and date of manure transfer, and providing them a copy of the fertilizer equivalent (N-P-K) manure test results from within the last 12 months.

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 5 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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