



Natural Resources Conservation Service CONSERVATION PRACTICE STANDARD NUTRIENT MANAGEMENT

Code 590

(Ac.)

I. DEFINITION

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

II. PURPOSES

To [budget](#), supply, and conserve nutrients for plant production. To minimize the risk of 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 and reactive nitrogen emissions (ammonia, inorganic oxidized forms, and organic compounds). To maintain or improve the physical, chemical, and biological condition of the soil.

III. CONDITIONS WHERE PRACTICE APPLIES

This standard applies to all [fields](#) where plant nutrient sources and soil amendments are applied during the course of a [rotation](#).

IV. CRITERIA

This section establishes requirements for planning, design parameters, acceptable management processes, and performance requirements for nutrient management plan development and implementation. Nutrient management plans shall be prepared according to all of IV. Criteria A., B., C., D., and E., as well as VI. Plans and Specifications, and VII. Operations and Maintenance.

All of the information contained in this section is required. Wisconsin Conservation Planning Technical Note WI-1 (Technical Note WI-1) is the companion document to this standard and includes criteria that are required where referenced within this section.

A. Criteria for Surface and Groundwater Resources

1. Nutrient Criteria for All Sites

- a. Develop and implement an annual field-specific nutrient application plan. Account for the source, rate, timing, form, and method of application for all [major nutrients](#) consistent with this standard and nutrient application guidelines found in University of [Wisconsin-Extension \(UWEX\) Publication \(Pub.\) A2809](#), "Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin," (UWEX Pub. A2809) unless use of one of the following options are appropriate:
 - For crops not listed in UWEX Pub. A2809, use other appropriate Land Grant University recommendations.
 - For nutrient application decisions based on plant tissue analysis, the sampling and testing of plants and the resulting nutrient recommendations shall be done in accordance with University of Wisconsin recommendations. See IV.A.1.o.
 - [Adaptive Nutrient Management](#) has validated alternative nutrient management strategies that improve nutrient use efficiency. See IV.A.1.i.

Annual plan updates shall document the crops, tillage, nutrient application rates, sources, and methods actually implemented.

- b. The plan shall be based on yield goals that are attainable under average growing conditions and established using soil productivity, local climate information, multi-year documented yields, and/or local research on yields for similar soils and crop management systems. Yield goals should not be higher than 15% above the previous 3-5 year average.
- c. The plan shall include a Winter Spreading Plan that is consistent with sections IV.A.2.d., VI. Plans and Specifications, and Technical Note WI-1 Part II, if manure and/or organic by-products are mechanically applied.
- d. The plan shall demonstrate that adequate acreage is available for all nutrients from manure and/or organic by-products applied to fields while maintaining compliance with the standard. If an adequate land base is NOT present the plan shall document the strategy to utilize the remaining projected volume of manure or other nutrient sources produced on the farm.
- e. Soils shall be tested a minimum of once every four years by a DATCP-certified laboratory for pH, phosphorus (P), potassium (K), and organic matter. A laboratory list is provided in Part VI of the Technical Note WI-1. Soil sampling shall be consistent with UWEX Pub. A2809, "Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin," or A2100, "Sampling Soils for Testing." For perennial fruit crops, use of soil test recommendations from UWEX Pub. A2809 is only required as the basis for fertilizer applications prior to establishment of new plantings. Subsequent nutrient recommendations should be based on plant tissue analysis results. See IV.A.1.o.
- f. Where practical, adjust soil pH to the specific range of the crop(s) grown to optimize nutrient utilization.
- g. Annual P and K nutrient recommendations may be combined into a single application that does not exceed the total nutrient recommendation for the rotation. Commercial P fertilizers shall not be applied to soils testing excessively high in P for the crop being grown with the exception below (IV.A.1.h).
- h. All the nitrogen (N), P, and K fertilizer shall be credited against crop needs, which are based on the crop to be grown and on soil test results. The exceptions are: 1. Up to 20 pounds per acre of P2O5 starter fertilizer may be applied to corn grown on soils testing excessively high, where no fertilizer is recommended. 2. To account for variability in N mineralization and manure application, when nutrients other than commercial fertilizers are used to meet 100% of the N requirement for corn, an additional 20 pounds per acre of commercial N may be applied as starter fertilizer.
- i. Available N from all sources shall not exceed the annual N requirement of non-legume crops consistent with UWEX Pub. A2809, or the annual N removal by a legume crop or a legume and companion crop. See Technical Note WI-1, Part III.B for additional nitrogen utilization planning guidance.

Where excessive rainfall has caused crop N deficiency, up to 46 pounds per acre of in-season supplemental N may be applied if the need for rescue N is documented using "Guidelines for Adaptive Nutrient Management", Technical Note WI-1, Appendix 3. To justify applying more than 46 pounds per acre, two different methods must be used to document the need.
- j. First and second-year legume nitrogen credits shall be applied as described in UWEX Pub. A2809 Table 9.4 through 9.6 or through soil nitrate testing as identified in Chapter 6 of UWEX Pub. A2809.
- k. Where gleaning or pasturing occurs, verify through computations that the manure nutrients deposited within a field, do not exceed the N and P limitations of this standard.
- l. Estimates of first-year available nutrient credits for manure shall be established in accordance with one of the following methods:
 - (1) Manure samples shall be collected for three or more consecutive years, as necessary, to establish a representative baseline. After which samples should be collected once every four years. If no operational changes occur, less frequent manure testing is allowable.

- Sample all manure types separately according to UWEX Pub. A3769 “Recommended Methods of Manure Analysis.”
 - Send manure samples to a laboratory participating in the Manure Analysis Proficiency (MAP) testing program where the manure analyses shall consist of total N, total P₂O₅, total K₂O, and dry matter content at a minimum and the results shall be interpreted according to Table 3 in UWEX Pub. A2809.
- (2) Use an average or “book” value of available nutrients. Follow Table 9.3 in UWEX Pub. A2809. See Part IV, Table 3 of the Technical Note WI-1.

Note: Consider analysis for ammonium-N for liquid (<4.0% dry matter) manures, which have the potential for more than 50% of the total N to be in the ammonium form.

For areas receiving manure applications in consecutive years, it is recommended that a second-year N credit be included in the nutrient management plan. Follow Chapter 9 in UWEX Pub. A2809 to determine second-year N credits.

- m. Organic by-products other than manure shall be analyzed for total N, ammonium N, total P, total K, and solids content and applied to fields in accordance with this standard and any applicable regulations including restrictions on heavy metal content, mandatory separation distances and land application rates.
 - n. Manures, organic by-products, and fertilizers shall not run off the field site during or immediately after application. If the applied material ponds, runs off, infiltrates to subsurface tiles, or flows toward wells or [direct conduits to groundwater](#), implement the following activities as appropriate:
 - (1) Stop application.
 - (2) Take corrective action to prevent off-site movement.
 - (3) Modify the application rate, method, depth of injection, and/or timing.
 - (4) Notify the Wisconsin Department of Natural Resources (WDNR) in the event that a spill or accidental release of any material or substance when required by the Agricultural Spill Law (s.289.11, Wis. Stats.) or the terms of a WPDES permit. Refer to “Agricultural Spills and How to Handle Them,” Pub-RR-687-2002, August 2002 and the Technical Note WI-1, Part V, for WDNR contact information.
 - o. Where nutrient application decisions are based on plant tissue analysis, for crops such as cranberries or established fruits, the sampling and testing of plants and the resulting nutrient recommendations shall be done in accordance with University of Wisconsin recommendations and/or other recommendations in the references section of this standard. Also see Technical Note WI-1 Appendix 2.
2. Nutrient Application Prohibitions
- a. Nutrients shall not be spread on the following:
 - (1) Surface water; [saturated soils](#); areas of active snow melt where water is flowing; [concentrated flow channels](#); or non-harvested [vegetative buffers](#), except for the establishment of perennial vegetation in the concentrated flow channels, or non-harvested vegetative buffers.
 - (2) A non-farmed wetland.
 - (3) A potable well or direct conduits to groundwater and within 50 feet of these features, unless directly deposited by gleaning or pasturing animals or applied as starter fertilizer to corn. See V.A.1.h and K.
 - (4) Within eight feet of irrigation wells, except for nutrients applied through fertigation.
 - (5) Land where vegetation is not removed mechanically or by grazing, except to provide nutrients for establishment and maintenance of a conservation practice.
 - (6) Fields exceeding [tolerable soil loss \(T\)](#). Erosion controls shall be implemented so that tolerable soil loss (T) over the crop rotation will not be exceeded on fields that receive nutrients.

- (7) Fields with [ephemeral erosion](#) in which mitigation practices in IV.C. 1.c. have not been implemented.
- b. Do not apply manure within areas delineated by the local Land Conservation Committee or in a [conservation plan](#) as [areas contributing runoff](#) to direct conduits to groundwater unless the manure is [substantially buried](#) within 24 hours of application.
- c. Application of untreated manure is prohibited; however, [treated manure](#) may be mechanically applied on the following areas:
- (1) Within 1000 feet of a public water supply designated as a [Community potable water well](#).
 - (2) Within 100 feet of a public water supply designated as a [Non-community potable water well](#).
- Note: Commercial fertilizer and manure deposited by grazing animals may be applied consistent with this standard. Based on site conditions as related to well placement, an additional setback may be needed to protect wells from contamination.
- d. All farms mechanically applying manure and/or organic by-products must have a Winter Spreading Plan that has application areas in compliance with criteria (1) - (7) below. The balance of the crop nutrient requirement may be applied in other seasons. These criteria do not apply to manure deposited through winter gleaning or pasturing of plant residue. Winter applications shall be conducted according to Section VI.B.

A Winter Spreading Plan identifies:

- Quantity of manure and/or organic by-products spread during periods of frozen or snow-covered soil, or generated in 14 days, whichever is greater;
- Capacity of storage for each manure type generated;
- Capacity for stacking manure that is $\geq 16\%$ dry matter without permanent storage. Refer to NRCS [313 Standard, Waste Storage Facility](#), to locate potential stacking sites.

In addition, when frozen or snow-covered soils prevent [effective incorporation](#) at the time of application:

- (1) Do not apply nutrients within the [Surface Water Quality Management Area \(SWQMA\)](#).
- (2) Do not exceed the P removal of the following growing season's crop when applying manure. Liquid manure and/or organic by-products applications are limited to 7,000 gallons per acre. All winter applications are not to exceed 60 pounds of P2O5 per acre.
- (3) Do not apply manure and/or organic by-products to fields where concentrated flow channels are present unless two or more of the following are implemented:
 - a. Contour buffer strips or contour strip cropping;
 - b. Leave all crop residue (this prohibits removal of silage or bedding) and no fall tillage;
 - c. Apply in intermittent strips on no more than 50% of the field;
 - d. Apply on no more than 25% of the field during each application waiting a minimum of 14 days between applications;
 - e. Reduce application rate to 3,500 gallons or 30 pounds of P2O5, whichever is less;
 - f. No application within 200 feet of all concentrated flow channels;
 - g. Fall tillage is on the contour and slopes are less than 6%.
- (4) Do not apply manure and/or organic by-products on slopes greater than 6%, unless the plan documents that no other accessible fields are available for winter spreading AND two or more of the following are implemented:
 - a. Contour buffer strips or contour strip cropping;
 - b. Leave all crop residue (this prohibits removal of silage or bedding) and no fall tillage;
 - c. Apply in intermittent strips on no more than 50% of the field;

- d. Apply on no more than 25% of the field during each application waiting a minimum of 14 days between applications; or
 - e. Reduce application rate to 3,500 gallons or 30 pounds of P₂O₅, whichever is less.
- (5) Do not apply N and P commercial fertilizer. An exception is allowed for grass pastures and on winter grains that do not fall within a prohibition area defined by IV.A.2.
 - (6) Do not surface apply liquid manure and/or organic by-products during February and March on areas depicted on the 590 spreading restriction maps as areas where DNR Well Compensation funds provided replacement water supplies for wells contaminated with livestock manure or [Silurian dolomite \(SD\) soils](#).
 - (7) Do not apply manure and/or organic by-products within 300 feet of direct conduits to groundwater.

3. Nutrient Application Restrictions

- a. For all nutrient applications on non-frozen soil within a SWQMA use one or more of the following practices as appropriate to address water quality concerns for the site:
 - (1) Install/maintain permanent vegetative buffers (harvesting is allowed unless restricted by other laws or programs). Refer to [NRCS Field Office Technical Guide \(FOTG\)](#), Section IV, Standard 393, Filter Strip, or ATCP 48 for land located within a drainage district.
 - (2) Maintain greater than 30% crop residue or vegetative cover on the soil surface after nutrient application.
 - (3) Effective incorporation of nutrients within 72 hours of application, leaving adequate residue to meet tolerable soil loss.
 - (4) Establish a crop or [cover crop](#) prior to, at, or promptly following application.
 - (5) Apply nutrients within seven days of planting on [long term no-till](#) soil with less than 30% residue.
- b. When unincorporated liquid manure and/or organic by-products applications with ≤ 11.0% dry matter occur on non-frozen soils within a SWQMA, OR where [subsurface drainage](#) is present:
 - (1) Limit applications to 12,000 gallons per acre per application.
 - (2) No applications are allowed on saturated soils.
 - (3) No ponding is allowed at the application site.
 - (4) Visually monitor accessible tile outlets before, during, and after applications for potential discharge of manure and/or organic by-products. If a discharge is observed, implement the activities in IV.A.1.n.
 - (5) Follow VI.A.12. for subsurface drainage practices.

Sequential applications may be made to meet the desired nutrient additions consistent with this standard. Wait a minimum of 7 days between sequential applications.

B. Criteria to Minimize Entry of Nutrients to Groundwater

- 1. To minimize N leaching to groundwater on [N restricted soils](#) which include [high permeability soils \(P\)](#), or [rock soils](#) with less than 20 inches to bedrock (R), or [wet soils](#) with less than 12 inches to [apparent water table](#) (W), use the following applicable management practices and the crop N rate guideline from UWEX Pub. A2809 or rates specified below:

Note: The balance of the crop N requirements may be applied the following spring or summer. The Technical Note WI-1 provides a list of N-restricted soils which have a higher potential for N leaching to groundwater in Appendix 1 and more information on [nitrification inhibitors](#) in Part III.B.2.

- a. For commercial N fertilizer applications:
 - (1) No late summer or fall applications on areas identified as having soil depth of 5 feet or less over bedrock, P, R, W soils, areas within 1,000 feet of a Community potable water well, except where needed for establishment of fall seeded crops or blended commercial fertilizer

materials are needed to meet UWEX Pub. A2809 guidelines. For these exceptions, the N application rate shall not exceed 36 pounds N per acre and all nutrients must be credited towards the requirement of the crop.

- (2) On P, R, W, and combination soils, when commercial N is applied, follow IV.A.1(h) and (i).
- (3) On P soils, when commercial N is applied for full season crops in the spring and summer, do not exceed the UWEX Pub. A2809 crop N rate guidelines and apply one of the following management strategies:
 - A split or delayed N application to apply a majority of crop N requirement after crop establishment.
 - Use a nitrification inhibitor with ammonium forms of N.
 - Use slow and controlled release fertilizers for a majority of the crop N requirement applied near the time of planting.
- b. For late summer and fall applications of manure and/or organic by-products with > 4% dry matter:
 - (1) On W soils or combination W soils, use rates that will not smother these crops and limit N rates to those specified in UWEX Pub. A2809 or 120 pounds per acre of available N, whichever is less.
 - (2) On P and R soils:
 - a. When a crop is growing, such as perennial crops, overwintering annual crops, double crops, and cover crops, use rates that will not smother these crops and limit N rates to those specified in UWEX Pub. A2809 or 120 pounds per acre of available N, whichever is less.
 - b. For annual crops that will not be planted until the following spring or summer, delay application until soil temperatures are less than 50°F or October 1, whichever occurs first, and limit N rates to those specified in UWEX Pub. A2809 or 90 pounds per acre of available N, whichever is less.
- c. For applications of manure and/or organic by-products with ≤ 4.0% dry matter:
 - (1) On W soils or combination W soils, reduce applications to 90 pounds per acre of available N or apply no more than 120 pounds of available N per acre and use at least one of the following practices:
 - a. Use a nitrification inhibitor.
 - b. Apply on an established cover crop, or an overwintering annual crop, or a perennial crop.
 - c. Establish a cover crop within 14 days of application.
 - d. Surface apply and do not incorporate for at least 3 days.
 - e. Delay application until October 1 or soil temperatures are less than 50°F.
 - (2) On P and R soils, delay applications until soil temperatures are less than 50°F or October 1, whichever occurs first, and use a nitrification inhibitor or surface apply and do not incorporate for at least 3 days. Application rates are limited to those in section IV.B.1.b.(2).
2. Where P enrichment of groundwater is identified as a conservation planning concern, implement practices to reduce delivery of P to groundwater.

C. Additional Criteria to Minimize Entry of Nutrients to Surface Water

1. Where manure, organic by-products, or fertilizers are applied:
 - a. Avoid building soil test P values, when possible, beyond the non-responsive soil test range for the most demanding crop in the rotation. For most agronomic crops in Wisconsin, the non-responsive soil test range is 30 to 50 parts per million (ppm) Bray P-1 soil test.
 - b. Establish perennial vegetative cover in all areas of concentrated flow that result in reoccurring gullies.

- c. In crop fields where ephemeral erosion is an identified problem, a minimum of one of the following runoff-reducing practices shall be implemented:
 - (1) Install/maintain contours, contour strips and/or contour buffer strips. Refer to [NRCS FOTG](#), Section IV, Standard 585, Contour Farming Standard 220, Strip Cropping, and/or Standard 332, Contour Buffer Strip.
 - (2) Install/maintain filter strips (NRCS FOTG, Section IV, Standard 393, Filter Strip) along surface waters and concentrated flow channels that empty into surface waters.
 - (3) Maintain greater than 30% crop residue or vegetative cover on the soil surface after planting.
 - (4) Establish fall cover crops.
 - (5) Reduce tillage, adjust the crop rotation, or implement other practices to control ephemeral erosion.
- 2. Develop a P management strategy when manure or organic by-products are applied during the crop rotation to minimize surface water quality impacts. Use either the [Phosphorus Index \(PI\)](#) in section IV.C.2.a. or Soil Test Phosphorus Management Strategy in section IV.C.2.b. on all fields within a farm or tract and follow IV.A.1.h.
 - a. PI Strategy – The planned average PI values for up to an 8-year rotation in each field shall be 6 or lower. P applications on fields with an average PI greater than 6 may be made only if additional P is needed and according to UWEX Pub. A2809. Strategies for reducing the PI, algorithms, and software for calculating the Wisconsin PI can be found at <http://wpindex.soils.wisc.edu/>.
 - b. Soil Test Phosphorus Strategy - Management strategies based on soil test phosphorus may be used. Operations using this strategy shall have a conservation plan addressing all soil erosion that is consistent with the current crops and management or use the erosion assessment tools included with the Phosphorus Index model.

Available phosphorus applications from all sources shall be based on the following soil test P values (Bray P-1):

 - (1) Less than 50 ppm soil test P - nutrient application rates allowed up to the N needs of the following crop or the N removal for the following legume crop.
 - (2) 50-100 ppm soil test P - P application shall not exceed the total crop P removal for crops to be grown over a maximum rotation length of 8 years.
 - (3) Greater than 100 ppm soil test P - total P applications from all sources shall not exceed guidelines from UWEX Pub. A2809. If manure P applications above these guidelines are necessary due to lack of suitable application sites, P applications shall be 25% less than the cumulative annual crop removal over a maximum rotation length of 8 years.

D. Additional Criteria to Protect Air Quality by Reducing Particulates, Odors, and Reactive Nitrogen Emissions Where Air Quality is Identified in a Conservation Plan or Nutrient Management Plan as a Resource Concern

- 1. Apply one or more of the following management strategies that minimizes nutrient volatilization and particulate losses while maintaining tolerable soil erosion levels for wind and water:
 - a. Slow or controlled release fertilizers
 - b. Nitrification inhibitors
 - c. [Urease inhibitors](#)
 - d. Nutrient enhancement technologies
 - e. Immediate incorporation or injection
 - f. Stabilized nitrogen fertilizers
 - g. Residue and tillage management
 - h. No-till or strip-till
 - i. In-field and edge-of-field wind breaks

- j. NRCS Wind Erosion Prediction System (WEPS) to confirm fields meet tolerable soil loss
- k. Other technologies that minimize the impact of these emissions
- 2. 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 off-site.

E. Additional Criteria to Protect the Physical, Chemical, and Biological Condition of the Soil

- 1. Nutrients shall be applied in a manner that does not permanently degrade the soil's structure, chemical properties, or biological condition.
- 2. To the extent practical, nutrients shall not be applied when the potential for soil compaction and/or the creation of ruts is high.

V. CONSIDERATIONS

The following statements are optional management considerations and are not required practices.

- A. Seed and stabilize all concentrated flow channels. Install and maintain vegetative filter strips, riparian buffers, and other buffer areas adjacent to surface water and wetlands in conjunction with other conservation practices in order to reduce the amounts of sediment and nutrients that reach surface water and/or groundwater.
- B. Use additional management practices found in the Technical Note WI-1, Part III to improve N use efficiency. Use variable-rate nitrogen, phosphorus, and potassium application rates based on site-specific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors. Application rates must be consistent with recommendations found in UWEX Pub. A2809.
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.
- C. Apply nutrients not specifically addressed by this standard (i.e., secondary and micro nutrients) based on recommendations found in UWEX Pub. A2809.
- D. To minimize N leaching on medium and fine-textured soils, avoid fall commercial N applications for crops to be seeded the following spring. If commercial N is applied in the fall, use ammonium forms of N and delay N application until soil temperatures drop below 50°F. Use of a nitrification inhibitor with fall-applied N is recommended.
- E. For liquid and slurry manure, consider using a nitrification inhibitor to limit the potential risk for N loss.
- F. Use irrigation strategies (ex. irrigation scheduling, reduced-pressure drop nozzles for center pivots, etc.) to minimize N leaching losses, improve crop water use efficiency, and not exceed intake/infiltration capacity of the soil.
- G. Consider the use of animal feeding strategies based on published nutrition research findings (National Research Council, etc.) to reduce excess P in rations when manure applications are made to cropland.
- H. Consider delaying surface applications of nutrients if precipitation capable of producing runoff is forecast within 24 hours of the time of planned application.
- I. Consider modifying the crop rotation in order to provide crop fields for the application of manure during the summer crop growing season.
- J. On fields directly adjacent to or on fields with areas of concentrated or channelized flow that drain directly to surface waters, consider the following:
 - For operations using the soil test P strategy, avoid raising soil test P levels beyond optimum. In addition, implement conservation practices that reduce delivery of nutrients.
 - For operations using the P-Index, reduce the P-Index values by applying additional conservation practices.
- K. Where residual nitrate carryover is probable, the preplant soil nitrate test is recommended to adjust N application rates for corn.
- L. To improve N use efficiency of wheat, the preplant soil nitrate test is recommended to adjust the N

application rate.

- M. Where cropland with less than 50' soil depth overlays Silurian Carbonate Bedrock, identify karst land features that are direct conduits to groundwater and use management practices to minimize N loss to groundwater. See Technical Note WI-1 for a list of soils and/or map.
- N. On Silurian dolomite (SD) soils in the spring, summer or fall and before crop planting or after crop harvest, implement at least one of the following if liquid manure is injected or surface applied:
 - 1. Complete pre-tillage prior to application
 - 2. Immediately incorporate manure after application
 - 3. Reduce application rate to 7,000 gallons per application; complete sequential applications to meet desired nutrient additions consistent with this standard. Wait a minimum of three days between sequential applications.
- O. When there is a high risk of transport of nutrients, the coordinated installation of conservation practices can be used to avoid, control, or trap manure or nutrients before they can leave the field by surface and subsurface drainage. The number of applications and application rates must also be considered to limit the transport of nutrients to tile.
- P. Incorporate nutrient applications in flood prone areas of a field in order to prevent nutrient losses to surface waters. Consider applying manure nutrients after seasonal flooding risk period(s) has passed.
- Q. Nutrient containers should be recycled in compliance with State and local guidelines or regulations.
- R. Avoid applying manure and other organic by-products upwind of residences.
- S. Use the Wisconsin NRCS recognized [Nitrogen Leaching Index](#) to evaluate N pathway loss via leaching, solution runoff, reactive N emissions for planning N reduction alternatives located on the Wisconsin NRCS website under Nutrient Management: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/technical/cp/> or refer to Technical Note WI-1, Part III.B.
- T. Evaluate conditions for high risk of snow melt within ten days or less before manure nutrient application.

VI. PLANS AND SPECIFICATIONS

- A. The minimum requirements for a nutrient management plan are specified in the previous sections of this standard and expanded in Part I of the Technical Note WI-1. The following items are required in a nutrient management plan:
 - 1. Field features identified on maps or aerial photos including:
 - a. Field location, soil survey map unit(s), field boundary, acres, field identification number, a North directional arrow if north is not oriented at the top of the page;
Areas prohibited from receiving nutrient applications: Surface water, established concentrated flow channels with perennial cover, non-farmed wetlands, lands where established vegetation is not removed, and fields eroding at a rate exceeding tolerable soil loss (T);
 - b. Direct conduits to groundwater, such as wells, sinkholes, swallets, fractured bedrock at the surface, mine shafts, non-metallic mines, tile inlets discharging to groundwater, quarries, or depressional groundwater recharge areas over shallow fractured bedrock, and their restrictions or prohibited areas defined in IV.A.2. and IV.A.3.;
 - c. Regulated water sources including potable water wells, Community potable water wells, and Non-community potable water wells, and their restrictions or prohibition areas;
 - d. Areas prohibited from receiving nutrient applications to frozen or snow-covered soil: Slopes > 6% ; Surface Water Quality Management Areas (SWQMA); Areas where DNR Well Compensation funds provided replacement water supplies for wells contaminated with livestock manure; Silurian Dolomite soils; Additional areas identified as contributing runoff to surface or groundwater;
 - e. N-restricted soils including areas identified as having soil depth of 5 feet or less over bedrock, P, R, W soils, and areas within 1,000 feet of a Community potable water well, and listed in Appendix 1 of Technical Note WI-1;
 - f. Areas of concentrated flow that result in reoccurring gullies;

2. Each field's tolerable and calculated soil losses;
 3. Soil test reports and results of soil, plant, manure, or organic by-product sample analysis with the initial plan and upon resampling. For subsequent updates, this information should be available upon request. Tissue test reports must be provided annually to document the need for nutrient applications based on tissue analysis results;
 4. Current and planned crops and crop yields, realistic yield goals;
 5. Recommended nutrient application rates;
 6. Documentation of actual nutrient applications including the rate, form, timing, and method. Revise the plan to reflect any changes in crops, yields, tillage, management, and soil or manure analyses;
 7. For supplemental nitrogen application, documentation of weather conditions; soil conditions; crop growth stage; and photographs, soil/tissue testing, crop canopy reflectance sensing, or nitrogen management models;
 8. Guidance for implementation and maintaining records;
 9. Soil test P-ppm, P balance calculation, or P Index level where applicable;
 10. Other management activities required by regulation, program requirements, or producer goals;
 11. A narrative to explain other implementation clarifications.
 12. The location, to the maximum extent practical, of inlets, outlets, tile lines and tile depth of subsurface drainage systems in fields where nutrients are applied. To address discharges of liquid manure and/or organic by-products from the tile lines follow IV.A.1.n. See Technical Note WI-1 Part III.D. for guidance for locating tile line/subsurface drainage, preventing discharges of liquid manure or organic by-products from tile lines and emergency response actions in Technical Note WI-1.
 13. When grouping fields for nutrient application purposes, N, P, and K application rates shall match individual field recommendations as closely as possible to make implementation feasible.
- B. The Winter Spreading Plan shall be developed according to the criteria defined in the NRCS FOTG Standard 590, Nutrient Management and be consistent with Part II of Technical Note WI-1.
- The plan shall:
1. Reflect a minimum of 14 days of manure and/or organic by-products generated by the farm or all manure and/or organic by-products anticipated to be spread during frozen or snow-covered soil, whichever is greater;
 2. Document the storage capacity for each manure type generated;
 3. Document the capacity for stacking manure that is = 16% dry matter without permanent storage. Refer to NRCS 313 Standard, Waste Storage Facility, to locate potential stacking sites;
 4. Provide Winter Manure Spreading Plan Implementation Maps (as per Part II of Technical Note WI-1) that identify areas of fields that meet the restrictions for applications on frozen or snow-covered soil;
 5. Document that fields with slopes less than 6% are not accessible for winter spreading, if winter spreading on fields with slopes greater than 6%.
 6. Identify necessary runoff mitigation practices in IV.A.2.d.(3) and (4);
- C. Persons who review or approve plans for nutrient management shall be certified through any certification program acceptable to the NRCS (NRCS General Manual, Title 180, Part 409.9, NRCS TechReg) or other appropriate agencies within the state.
- D. Industrial wastes, municipal sludge and some organic by-products are regulated by the Wisconsin Department of Natural Resources (WDNR). They must be spread in accordance with a Wisconsin Pollution Discharge Elimination System (WPDES) permit as obtained from the WDNR and also in accordance with IV.A.1.m.
- E. Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450 Part 401.03 and Title 190, Part 402, the contents of this standard, the procedures contained in the National Planning Procedures Handbook, and NRCS National Agronomy Manual, Section 503. Plans for Nutrient Management that are elements of a more comprehensive conservation plan or

nutrient management plan shall recognize other requirements of the plan and be compatible with the other requirements. A Comprehensive Nutrient Management Plan (CNMP) is a conservation system unique to animal feeding operations (AFO). The CNMP will be developed to address the environmental risks identified during the resource inventory of an AFO. A CNMP will require use of all the applicable criteria in this technical standard along with the additional criteria located in NRCS National Planning Procedures Handbook, Subpart B, Part 600.54.

VII. OPERATION AND MAINTENANCE

The minimum operations and maintenance requirements for a nutrient management plan are specified in this section. The following items are required:

- A. Document the actual nutrient application including the rate, form, timing, and method of the application. Revise the plan to reflect any changes in crops, tillage, management, soils, and manure tests. Producers shall have access to the current version of the nutrient management plan.
- B. Minimize operator exposure to potentially toxic gases associated with manure, organic by-products, and chemical fertilizers, particularly in enclosed areas. Wear personal protective equipment appropriate to the material being handled.
- C. Protect commercial fertilizer from the weather, and agricultural waste storage facilities from accidental leakage or spillage. See Wisconsin administrative rules and county or local ordinances concerning regulations on siting, design, operation, and maintenance of these facilities.
- D. Temporary placement or storage of manure shall be in accordance with the criteria for temporary unconfined stacks of manure contained in [NRCS FOTG](#) Standard 313, Waste Storage Facility.
- E. When cleaning equipment after nutrient application, remove and save fertilizers or wastes in an appropriate manner. If the application equipment system is flushed, use the rinse water in the following batch of nutrient mixture where possible or dispose of according to state and local regulations. Always avoid cleaning equipment near high runoff areas, ponds, lakes, streams, and other water bodies. Extreme care must be exercised to avoid contaminating potable drinking water wells.
- F. Document the methodology used to determine the nutrient application rate of equipment.
- G. Concentrated flow channels where gully erosion has/will occur shall be maintained in permanent vegetation. This does not include low velocity surface drains where channel erosion does not occur.

VIII. FEDERAL, STATE, AND LOCAL LAWS

Users of this standard are responsible for compliance with applicable federal, state, tribal, and local laws, rules, or regulations governing nutrient management systems. This standard does not contain the text of federal, state, or local laws. Implementation of this standard may not eliminate nutrient losses that could result in a violation of law.

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X. DEFINITIONS

Adaptive Nutrient Management (IV.A.1.a.) - A process that utilizes on-farm research data to refine nutrient management strategies based on site specific crop production conditions. Implementation of Adaptive Nutrient Management shall use multiple years of field data collected and evaluated utilizing methods recognized by the University of Wisconsin as outlined in Technical Note WI-1, Appendix 3 "Guidelines for Adaptive Nutrient Management".

Adequate Acreage (IV.A.1.d.) – There is enough land described in the plan to use all the manure generated by the farm annually while maintaining compliance with this standard.

Apparent Water Table (IV.B.1.) - Continuous saturated zone in the soil to a depth of at least 6 feet without an unsaturated zone below it.

Areas Contributing Runoff (IV.A.2.b.) – Areas located up gradient from an identified feature which generate surface runoff during precipitation and/or melting periods that flows toward and eventually reaches the feature. The contribution area may be identified utilizing digital elevation models, topographic maps or infield measurement and/or observation.

Budget (II) - Document present and prior year's crop, estimated nutrient removal by these crops and known nutrient credits. When nutrients are applied for future crop needs in the rotation, implement a tracking process to allow adjustment of subsequent nutrient applications so that the total amount of nutrients applied to the farm or tract complies with this standard and is documented in the plan. Required as a component for all nutrient management plans.

Community Potable Water Well (IV.A.2.c.(1)) - Found in NR 811.02 (16) means a public water system, regulated under NR 811, which has at least 15 service connections and is used by at least 25 residents for at least 6 months per year. Any water system serving 7 or more single family homes, 10 or more mobile homes, 10 or more apartment units, 10 or more duplex living units or 10 or more condominium units shall be considered a community water system unless information is provided by the owner indicating that 25 year-round residents will not be served.

Concentrated Flow Channel (IV.A.2.a.(1)) - A natural channel or constructed channel that has been shaped or graded to required dimensions and established in perennial vegetation for the stable conveyance of runoff. Refer to NRCS FOTG Standard 412, Grassed Waterway, for more information on construction. This definition may include non-vegetated channels caused by ephemeral erosion. These channels include intermittent streams, drainage ditches, and drainage ends identified on the NRCS soil survey. Concentrated flow channels are often identifiable as contiguous up-gradient deflections of contour lines on the USGS 1:24,000 scale topographic map.

Conservation Plan (IV.A.2.b.) - A plan developed and field verified by a conservation planner to document crop management and the conservation practices used to control sheet and rill erosion to tolerable levels (T) and to provide treatment of ephemeral soil erosion. A conservation plan must be signed by the land operator and approved by the county Land Conservation Committee or their representative. A conservation plan will be needed for designating winter spreading restrictions other than those specifically listed in this standard, and when implementing the soil test P management strategy where the soil erosion assessment is not calculated with the Wisconsin Phosphorus Index model. A conservation planner must develop conservation plans using the minimum criteria found in the USDA, NRCS National Planning Procedures Handbook and the Wisconsin Field Office Technical Guide and be qualified by one of the following:

1. Meeting the minimum criteria in the NRCS General Manual, Title 180, Part 409.9(c), NRCS Certified Conservation Planner Designation.
2. Meeting the NRCS TechReg Certified Conservation Planner Option 1, 2, 3.
3. For non-NRCS funded plans meet the training and performance criteria established by the county Land Conservation Committee.

Cover Crop (IV.A.3.a.(4)) – Grasses, legumes, forbs or other herbaceous plants established for seasonal cover and conservation purposes. Cover crops are typically terminated prior to the production of viable seed.

Crop N Deficiency (IV.A.1.i.) - The condition where plant tissue concentrations of N are low enough to limit crop growth and development. Nitrogen deficiency in corn exhibits as yellowing at the tips of the oldest leaves. As deficiency progresses yellowing moves along the midrib towards the stalk and yellowing moves from the bottom leaves towards the top. In general N deficiency produces a paler green or yellow color in the oldest leaves. For more detail see: [https://www.ipni.net/ppiweb/bcrops.nsf/\\$webindex/8A1BFC4E9E01AEB0852568F1005777BC/\\$file/97-3p08.pdf](https://www.ipni.net/ppiweb/bcrops.nsf/$webindex/8A1BFC4E9E01AEB0852568F1005777BC/$file/97-3p08.pdf). Crop N deficiency is often caused by low availability of soil inorganic N which may be a product of nitrate leaching, denitrification, or slow mineralization of N from soil organic matter, manure, crop residues.

Direct Conduits to Groundwater (IV.A.1.n.) – Wells, excluding irrigation wells; sinkholes; swallets (a sinkhole or rock hole that intercepts a stream, diverting all or a portion of it to the groundwater); fractured bedrock at the surface, mine shafts; non-metallic mines; tile inlets discharging to groundwater, quarries, or depressional groundwater recharge areas over shallow fractured bedrock. For the purpose of nutrient management planning, these features will be identified on the Nutrient Application Restriction Maps, NRCS soil survey and/or USGS 1:24,000 scale topographic map, or otherwise determined through on-site evaluation and documented in a conservation plan, nutrient management plan or other local process approved by the Land Conservation Committee.

Documented Yields (IV.A.1.b.) - Crop production yield records documented by field for at least two consecutive years that are used to determine phosphorus and potassium fertility recommendations. Yield record documentation may include measurements of harvested crop weight, volume, or the use of calibrated yield-monitors.

Double Crop (IV.B.1.a.(3)) – Two crops grown and harvested in the same harvest season. A second crop is typically planted early enough to allow for at least one month's growth.

Effective Incorporation (IV.A.2.d.) - Mixing with topsoil or residue, or subsurface placement of nutrients by such means as injector, disc, sweep, mold-board plow, chisel plow, or other tillage/infiltration methods. Nutrients will not run off the field or drain to subsurface tiles during application.

Ephemeral Erosion (IV.2.a.(7)) – Erosion which forms by the convergence of overland sheet flow and rill erosion to form shallow channels which reoccur in the same locations even after these channels are filled by tillage. The location of ephemeral erosion channels are typically determined by the macro topography of the field. Ephemeral erosion channels are characterized by a dendritic (branch shaped) pattern vs. the small parallel channel pattern formed by rill erosion (Page 10 Technical Note WI-1).

Fields (III) - A group or single nutrient management unit with the following conditions: similar soil type, similar cropping history, same place in rotation (i.e., second year corn fields, established alfalfa), similar nutrient requirements, and close proximity. Examples include: alternate strips in a contour strip system, pasture, variable rate nutrient application management units, and other management units where grouping facilitates implementation of the nutrient management plan.

Gleaning or Pasturing (IV.A.1.k.) - An area of land where animals graze or otherwise seek feed in a manner that maintains the vegetative cover over all the area and where the vegetative cover is the primary food source for the animals. Livestock shall be managed to avoid the routine concentration of animals within the same area of the field. Manure deposited near a well by grazing of livestock does not require incorporation.

Long term No-till (IV.A.3.a.(5)) – No tillage has occurred for a minimum of three consecutive previous years.

Major Nutrients (IV.A.1.a) - Nitrogen (N), phosphorus (P), and potassium (K).

Nitrification Inhibitor (IV.B.1.) - A compound that temporarily blocks the activity of nitrifying bacteria and limits the conversion of ammonium to nitrate. Use of a nitrification inhibitor with ammonium based fertilizers or manure has the potential to reduce nitrate loss via leaching or denitrification. Follow product label.

Nitrogen Leaching Index (V.S.) - A tool written in the programming language Java and developed by the USDA—Agricultural Research Service and designed for use in Wisconsin to calculate nitrogen uptake and leaching for different farming and management operations.

Non-community Potable Water Well (IV.A.2.c.(2)) – Public water system, regulated under NR 812, which serves at least 25 or more people for 6 months or more per year. Well users may be non-transient (same 25 people) or transient. Non-community potable wells include schools, restaurants, or churches.

N Restricted Soils (IV.B.1.) Are defined below and also include the area within 1000 feet draining to community potable water wells or areas identified as having soil depth of 5 feet or less over bedrock (See Technical Note WI-1).

High Permeability Soils (P) – Are equivalent to drained hydrologic group A meeting both of the following criteria:

1. Permeability = 6 inches/hour or more in all parts of the upper 20 inches and
2. Permeability = 0.6 inches/hour or more in all parts of the upper 40 inches.

Use the lowest permeability listed for each layer when evaluating a soil. For a multi-component map unit (complex), evaluate each component separately. If the high permeability components meet the criteria and cannot be separated, the entire map unit should be considered as high permeability.

Wet Soils (W) - Have an Apparent Water Table within 12 inches of the surface at any time of the year. The apparent water table is a continuous saturated zone in the soil to a depth of at least 6 feet without an unsaturated zone below it. A W soil is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. These soils can be non-hydric, saturated, or soggy for short periods in the spring after periods of rain or flooding and usually occur in low areas of the landscape.

Rock Soils (R) - Have less than or equal to 20 inches to bedrock. Bedrock is a general term for the solid rock (lithic) or unconsolidated material (paralithic) that underlies the soil or is exposed at the surface. If R soils are field verified and the depth is more than 20 inches to bedrock, then the soil is not considered restricted for bedrock.

Note (IV.A.1.I.) - Any section labeled as a 'note' is to be considered a recommendation rather than a requirement. The note is included in the criteria section to ensure subject continuity.

Organic By-Products (II.) – Organic materials that are produced as a byproduct of an industrial or agricultural process which can be land applied as a source of nutrients. Examples include paunch, manure solids, food production wastes, process wastewater, and waste water treatment plant bio-solids and waste water if land applied. This definition does not include hazardous and/or inorganic industrial waste or manufactured nutrient sources. Use of the term “organic” refers to carbon-based materials and is not intended as a reference to the certification criteria of the USDA National Organic Program.

Phosphorus Index (PI) (IV.C.2.) - The Wisconsin Phosphorus Index (PI) is an assessment of the potential for a given field to deliver P to surface water. The PI assessment takes into account factors that contribute to P losses in runoff from a field and subsequent transport to a water body, including:

- Soil erosion as calculated using the current approved NRCS soil erosion prediction technology located in Section I of the NRCS FOTG.
- Estimated annual field rainfall and snowmelt runoff volume.
- Soil P concentrations as measured by routine soil test P (Bray P-1).
- Rate and management of P applications in the form of fertilizer, manure, or other organic material.
- Characteristics of the runoff flow pathway from the field to surface water.
- The algorithms and software for calculating the Wisconsin PI can be found at <http://wpindex.soils.wisc.edu/>.

Rotation (III) - The sequence of crops to be grown for up to an 8-year period as specified by the conservation plan or as part of the soil erosion assessment calculated with the Wisconsin Phosphorus Index model.

Saturated Soils (IV.A.2.a.(1)) - Soils where all pore spaces are occupied by water and where any additional inputs of water or liquid wastes cannot infiltrate into the soil.

Silurian Dolomite (SD) Soils (IV.A.2.d.(6)) - Areas where Silurian dolomite bedrock is present within 60 inches of the surface. The location of Silurian dolomite limestone is determined by maps created by the Wisconsin Geologic and Natural History Survey. Depth to bedrock assessment is based on the most current Natural Resources Conservation Service soil survey map unit interpretations.

Slow and Controlled Release Fertilizer (IV.B.1.b.(2)) – Fertilizer materials that have been coated with a material (eg. polymers, sulfur) that prevents the nutrients from being immediately available. Instead the nutrients become slowly available over time.

Soil Temperature (IV.B.1.a.(3)) – The soil temperature can be documented with soil temperature at at least 4” depth, or by a 5-day average maximum daily air temperature =55°F, or 5-day average minimum daily air temperature =40°F.

Starter Fertilizer (IV.A.1.h.) – Fertilizer applied at the time of planting and placed with or in a band in close proximity to the seed.

Substantially Buried (IV.A.2.b.) – Mixing the manure or process wastewater with surface soil so that at least 80% of applied manure or process wastewater is covered with soil and the application rate is controlled to ensure that applied material stays in place and does not run off. Incorporation includes standard agricultural practices such as tillage or other practices that are the equivalent to providing 80% soil coverage.

Subsurface Drainage (IV.A.3.b.) – A conduit installed beneath the soil surface to collect and/or convey excess water. Tile drainage is an example of subsurface drainage. For the purposes of this standard, subsurface drainage does not include structures that divert surface water from ponding or running off a field.

Surface Water Quality Management Areas (SWQMA) (IV.A.2.d.(1)) - For the purposes of nutrient management planning, Surface Water Quality Management Areas are defined as follows:

1. The area within 1,000 feet from the ordinary high-water mark of navigable waters that consist of a lake, pond or flowage, except that, for a navigable water that is a glacial pothole lake, “surface water quality management area” means the area within 1,000 feet from the high-water mark of the lake.

2. The area within 300 feet from the ordinary high-water mark of navigable waters that consists of a river or stream that is defined as:
 - Perennial streams (continuous flow) identified on the NRCS soil survey and/or USGS 1:24,000 scale topographic map as solid lines,
 - Otherwise determined through an on-site evaluation and documented in an approved conservation plan or nutrient management plan. Areas within the SWQMA that do not drain to the water body are excluded from this definition.

Areas within the SWQMA that do not drain to the water body are excluded from this definition.

Tolerable Soil Loss (T) (IV.A.2.a.(6)) - For sheet and rill erosion. T-value means the maximum rate of soil erosion established for each soil type that will permit crop productivity to be sustained economically and indefinitely. Erosion calculations shall be based on current approved erosion prediction technology found in NRCS FOTG Section I or the soil loss assessment calculated using the Phosphorous Index Model. Tolerable soil erosion rates shall be determined using the RUSLE2 Related Attributes Report located in Section 2, FOTG, Soil Report.

Treated Manure (IV.A.2.c.) – Manure and/or manure constituents that HAVE been subjected to treatment or processing that has the documented effect of substantially eliminating pathogens. Treatment or processing examples include thermophilic anaerobic digestion, high temperature composting of manure solids or manipulation of pH.

Urease Inhibitor (IV.D.1.) - A compound that prevents the hydrolysis of urea by blocking the urease enzyme. Use of a urease inhibitor will reduce ammonia volatilization losses from surface applied urea.

Vegetative Buffer (IV.A.2.a.(1)) - A strip or area of perennial herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forest land) and environmentally sensitive areas (as defined in NRCS Technical Standard 393, Filter Strip).