

**Natural Resources Conservation Service  
Conservation Practice Standard**

**Practice Nutrient Management  
Code 590 (Acre)**

**DEFINITION**

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

**PURPOSES**

1. To budget and supply nutrients for plant production.
2. To properly utilize manure or organic by-products as a plant nutrient source.
3. To minimize agricultural non-point source pollution of surface and ground water resources.
4. 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**

**Criteria Applicable to All Purposes**

1. Plans for nutrient management are to comply with all applicable Federal, state, and local laws and regulations. All nutrient management plans concerning sludge application are to meet the minimum criteria of the standard and the rules and regulations of the Ohio Environmental Protection Agency (OEPA) and the Ohio Department of Health as appropriate.
2. Plans for nutrient management are to be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503. The content is to conform to the "Nutrient Management Plan" - Plans and Specifications - contained with this standard.
3. Persons who approve plans for Nutrient Management will be certified through Ohio NRCS; or other approved NRCS programs within Ohio.
4. Plans for nutrient management that are elements of a more comprehensive conservation plan are to recognize other requirements of the conservation plan and be compatible with its other requirements.
5. A nutrient budget for nitrogen, phosphorus, and potassium is to 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.

6. Realistic yield goals are to be established based on soil productivity information, potential yield, historical yield data, or a combination of yield data. An additional 10% can be added to the potential and/or historical yields to account for management and technology. When historical yield data is not available base realistic yield goals on local research or similar soil, cropping systems in the area. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.
7. Plans for nutrient management are to 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.
8. Erosion, runoff, and water management controls are to be installed, as needed, on fields that receive nutrients.
9. Soil Sampling and Laboratory Analysis (Testing)
  - a. Nutrient planning is to be based on current soil test results developed in accordance with The Ohio State University guidance or industry practice if recognized by The Ohio State University. Soil tests are required prior to plan development. Current soil tests are those that are no older than five (5) years or as defined in the following table. Soil tests 3 years old and less are preferred.

**Soil Testing Interval Criteria**

5 Year Maximum Interval	4 – 5 Year Maximum Interval	3 Year Interval
On land not receiving manure or organic by-products.	On land receiving manure or organic by-products that are applied every 4 <sup>th</sup> to 5 <sup>th</sup> year.	On land receiving manure or organic by-products every 3 <sup>rd</sup> year or more often.

- b. Soil samples for soil tests should generally represent 25 acres or less or one field, whichever is less. Soil sampling depth for P and K shall be 8 inches. Under no till conditions pH can be tested using the top 4 inches only.
  - c. NOTE: Soil tests taken soon after manure, bio-solid, or other organic-by-product application may produce high (inaccurate) Phosphorus results. Soil tests (other than Pre-Side Dress Nitrogen Tests – PSNT, or equivalent) should not be taken for 9 to 12 months following a manure or other organic-by-product application.
  - d. Soil samples shall be collected and prepared according to The Ohio State University guidance or standard industry practice. Soil test analyses shall be performed by laboratories that can provide the North Central Region 13 (NCR 13) method of testing. (NCR 13 specifies extraction methods appropriate for the Midwest conditions).
  - e. 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 budget, e.g. pH, electrical conductivity (EC), soil organic matter, nitrogen, phosphorus, and potassium. The minimum analysis for Ohio is to include: pH, Phosphorus, potassium, calcium, magnesium, and CEC.
10. Plant Tissue Testing. Tissue sampling and testing, where used, is to be done in accordance with The Ohio State University standards or recommendations.

11. Nutrient Application Rates, Methods of Application and Timing

- a. Soil amendments (liming materials) are to be applied, as needed, to adjust soil pH to the range needed for the planned crop(s). Timing, methods of application, and maximum rates shall be in accordance with The Ohio State University / Tri-State Fertility Recommendations. See "**Table 2 – Soil pH Recommendations for Various Crops on Various Soils**" for recommended soil pH for planned crops.
- b. To avoid excessive denitrification on POORLY DRAINED soils and minimize leaching on COARSE textures (excessively well drained) soils most of the recommended (manufactured type) nitrogen should be applied as a sidedress application for spring planted crops.
- c. The planned rates of nutrient application, as documented in the nutrient budget, are to be determined based on the following guidance:

Nitrogen, Phosphorus, and Potassium Application Rates, Methods of Application, and Timing - Planned nitrogen (N), phosphate (P<sub>2</sub>O<sub>5</sub>), and potash (K<sub>2</sub>O) application rates are to follow the recommended rates in the "Tri-State Fertility Guide" and/or the current "Ohio Agronomy Guide" as closely as possible. Excess potash is not to be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages. Adjust N rates for contributions from previous crops (legumes or forages), and soil organic matter (**Table 3**). Applications of phosphate (P<sub>2</sub>O<sub>5</sub>), and potash (K<sub>2</sub>O) via fertilizer, manure, or other organic by-products can be made for multiple years of the rotation as long as no more than 500 lbs/ac of potash (K<sub>2</sub>O) and 250 lbs/ac of (P<sub>2</sub>O<sub>5</sub>) are applied in any one year. [NOTE: In cases where liquid manure exceeds 60 lbs. P<sub>2</sub>O<sub>5</sub> per 1000 gallons or solid type manure exceeds 80 lbs. P<sub>2</sub>O<sub>5</sub> per ton P<sub>2</sub>O<sub>5</sub> rates can be increased up to a maximum of 500 lbs. P<sub>2</sub>O<sub>5</sub> /ac as long as nitrogen rates for the next crop are not exceeded nor the annual limit for K<sub>2</sub>O . See the additional criteria for P<sub>2</sub>O<sub>5</sub> applications exceeding 250 lbs/ac see "Additional Criteria for Manure and other Organic By-Products".] When manure or other organic by-products are a source of nutrients, see "Additional Criteria for Manure and other Organic By-Products" below.

- d. Timing and placement of nutrients:
  - (1) Commercial Fertilizer Phosphate (P<sub>2</sub>O<sub>5</sub>), and potash (K<sub>2</sub>O) applications can be made anytime throughout the rotation by broadcasting, injection, or incorporation per soil test results and realistic yields.
  - (2) Commercial Fertilizer Nitrogen (N) Applications.
    - (a). Perennial Forages.**  
Nitrogen - split the recommended yearly rate into 2 or 3 split applications during early spring (green up), after first cutting or grazing (late May early June), or late summer.
    - (b). Winter Small Grains.**  
Nitrogen – apply up to 20-30 lbs/ac in the Fall at planting. Add the remaining recommended amount in the early Spring (February - April).
    - (c). Spring Seeded Crops.**  
Nitrogen – See Table 1.
- e. Forms of Nitrogen, Additives, and Placement. See **Table 1** - Forms of Nitrogen and Placement.

- f. Commercial fertilizer nutrients are not to be applied to frozen, snow-covered, or saturated soil unless the soil surface has 50% residue cover or is established in a growing crop (e.g. wheat, hay, etc.). See the Waste Utilization Standard (633) for criteria to apply manure or other organic by-products during winter periods.
- g. Other Plant Nutrients - The planned rates of application of other nutrients are to be consistent with The Ohio State University guidance or industry practice if recognized by The Ohio State University.
- h. Starter Fertilizers - Starter fertilizers containing nitrogen (N), phosphate (P<sub>2</sub>O<sub>5</sub>), and potash (K<sub>2</sub>O) may be applied in accordance with The Ohio State University recommendations, or industry practice if recognized by The Ohio State University. When starter fertilizers are used, they are to be included in the nutrient budget.

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

- 1. Nutrient values of manure, organic by-products, and biosolids are to be determined prior to land application based on laboratory analysis. Initially, acceptable "book values" recognized by (1) the NRCS and/or The Ohio State University, (2) values from similar operations, or (3) historic records for the operation (if they accurately estimate the nutrient content of the material) may be used to plan the first year of manure or organic by-product nutrient application rates. Book values recognized by NRCS may be found in the Midwest Plans Services (MWPS) - 18 Section I, "Manure Characteristics date 2000 and in OSU Bulletin 604 (when republished in 2002 or 2003).
- 2. Manure and Organic By-Product Nutrient Application Rates.
  - a. For liquid wastes, the surface application rate is to be adjusted to avoid ponding or surface runoff. The total application is not to exceed the field capacity of the soil. NOTE: When liquid wastes are applied the liquid can follow soil macropores directly to the tile creating a surface water pollution hazard from direct tile discharge. When liquid wastes are applied to fields with tile, the outlets must be monitored during and after application and provisions planned to plug the tile or capture the tile flow if liquid manure reaches the tile outlets.
  - b. Acceptable phosphorus based application rates are to be determined as a function of soil fertility recommendations based on soil test values and estimated phosphorus removal in harvested plant biomass. See **Table 4** – Approximate Nutrients Removed by Crops (Lbs./Ac).
  - c. Multiple year applications of P<sub>2</sub>O<sub>5</sub> may be applied at a rate equal to the recommended P<sub>2</sub>O<sub>5</sub> application rate or estimated P<sub>2</sub>O<sub>5</sub> removal in harvested plant biomass in a single application. When such applications are made, the application rate shall:
    - (1) Not exceed the recommended nitrogen application rate for the succeeding crop, or
    - (2) Not exceed the estimated nitrogen removal in harvested plant biomass (for legumes) during the year of application when there is no recommended nitrogen application, or
    - (3) Not exceed a Phosphate (P<sub>2</sub>O<sub>5</sub>) application rate of 250 lbs/ac per year, or
    - (4) Not exceed the Potash (K<sub>2</sub>O) application rate of 500 lbs.ac per year.

- d. Applications of P<sub>2</sub>O<sub>5</sub> above 250 lbs./ac are not recommended. However, if P<sub>2</sub>O<sub>5</sub> concentrations in the liquid manure exceed 60 lbs. P<sub>2</sub>O<sub>5</sub> per 1000 gallons or 80 lbs. P<sub>2</sub>O<sub>5</sub> per ton for solid manure or other bio-solids rates higher than 250 lbs/ac may need to be applied due to limitations of the application equipment. In no case shall P<sub>2</sub>O<sub>5</sub> applications exceed 500 lbs./ac of P<sub>2</sub>O<sub>5</sub> during one year from manure or other bio-solids. **When P<sub>2</sub>O<sub>5</sub> applications exceed 250 lbs/ac the following additional criteria applies:**
- (1) P<sub>2</sub>O<sub>5</sub> applications exceeding 250 lbs./ac in any one year shall not be applied on fields with a soil test exceeding 100 ppm Bray P1 or equivalent.
  - (2) The manure or bio-solids shall be immediately injected or incorporated 3-5 inches deep.
  - (3) Not applied on either frozen or snow covered soil.
  - (4) No further P<sub>2</sub>O<sub>5</sub> applications for a minimum of 3 years on land below 40 ppm Bray P1 or equivalent and no additional P<sub>2</sub>O<sub>5</sub> for a minimum of 5 years above 40 ppm Bray P1 or equivalent.
  - (5) P<sub>2</sub>O<sub>5</sub> applications rates shall stay within the maximum application rates criteria for both nitrogen and potash.

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

- (1) Where the purpose is to minimize agricultural non-point source pollution of surface and ground water an assessment shall be completed to determine the potential for nitrogen and/or phosphorus transport from the field. The Nitrogen Leaching Index (LI), Section I Field Office Technical Guide, is to be used to assess nitrogen transport and Phosphorus Soil Test Assessment Procedure or the Phosphorus Index (PI) Risk Assessment Method, Section I Field Office Technical Guide, is to be used to assess the risk of Phosphorus movement from the field(s). NOTE: The Purdue Manure Management Planner (MMP) version 0.15 or higher will calculate the N leaching Index and the Soil Test Assessment Methods for the fields involved in the nutrient management plan. A Phosphorus Index spreadsheet is available to calculate the P Index Assessment Method
- (2) 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 (crop rotation, cover crops, residue management, timing and method of nutrient application, etc.).
- (3) The planned rates of nitrogen and phosphorus application recorded in the plan shall be determined based on the following criteria using either the Phosphorus Index Risk Assessment Method **OR** the Phosphorus Soil Test Risk Assessment Method and the Nitrogen Leaching (LI) Index:
  - a. Criteria for Nitrogen Application via Manure, Organic By-Products, and Biosolids (during Summer and Fall Periods): On fields with a "High Nitrogen Leaching Potential" (rating more than 10) and with no growing crop, manure and other organic by-products application is to be limited to 50 lbs/ac of Nitrogen (Ammonium N + 1/3 of the Organic N) calculated at the time of application prior to October 1<sup>st</sup> to limit nitrogen leaching. When a grass or legume cover crop is growing or established immediately after waste application, manure or other organic by-products can be applied prior to October 1<sup>st</sup> at the recommended Nitrogen rate for the next non-legume crop or the Nitrogen removal rate for the next legume crop.
  - b. Criteria for Nitrogen via Commercial Fertilizer Sources:
    - (1) **COARSE TEXTURED SOILS:** On fields with a "High Nitrogen Leaching Potential" apply the recommended nitrogen for spring planted crops in split applications with most applied as a sidedress application. For perennial crops apply split the recommended application between two or three periods including early spring, early summer, or late summer. For

fall planted crops apply up to 20-30 lbs/ac of the recommended amount in the fall and the remainder in the spring. Do not apply nitrogen in the fall for spring planted crops on high leaching potential COARSE soils.

- (2) **FINE TO MEDIUM TEXTURED SOILS:** On fields with a "High Nitrogen Leaching Potential" apply the recommended nitrogen for spring planted crops prior to planting spring crops or split applications between pre-plant and a sidedress application. For perennial crops split the recommended application between two or three periods including early spring, early summer, or late summer. For fall planted crops apply 20-30 lbs/ac of the recommended amount in the fall and the remainder in the spring. Nitrogen may be fall applied for spring planted crops following the guidance in Table 1 of this standard.

Phosphorus Assessment Methods and Management Criteria

- a. Criteria for fields with commercial Phosphorus fertilizer application only. Phosphorus is not to be applied above that amount recommended per the Tri-State Fertility Guide or other Ohio State University unless needed for specialty (e.g. vegetable crops) crops. For specialty crops, follow the appropriate industry and land grant university recommendations. Erosion rates shall be managed to less than or equal to "T" for a rotation. The plan shall include any additional management planned to minimize transport (incorporation, crop residue management, filter strips, etc.).
- b. Criteria for fields with commercial fertilizer and/or animal manure, other organic by-products, or biosolids are applied. Use either the "Phosphorus Index (PI) Risk Assessment Method", or the Phosphorus Soil Test Risk Assessment Method, Section I Field Office Technical Guide, to determine the application/management criteria for Phosphorus. The plan shall include a list of fields and their ratings and any additional management planned to minimize transport of Phosphorus (incorporation, crop residue management, filter strips, etc.). The NRCS Phosphorus Index Software Program or the Phosphorus Index Worksheets shall be used to calculate the Phosphorus Index for each field where the PI method is used. The results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

Criteria Applicable to the Phosphorus Index and Soil Test Method of Assessment Ratings and Management:

1. Nitrogen application rates from manure, other organic by-products, or biosolids shall be based on Total Ammonium Nitrogen Content plus 1/3 of the Organic Nitrogen calculated at time of application when applied during the summer, fall, or winter for spring planted crops. When applied in the spring for spring planted crops the nitrogen application rate can be adjusted to apply the recommended nitrogen within the P2O5, K2O, and other limitations.
2. Nitrogen rates are not to exceed the succeeding crop's recommended Nitrogen for non-legume crops or the Nitrogen removal in the crop's biomass for legume crops.
3. All applications are based on current soil test results (not more than 3-5 years old).
4. No manufactured P2O5 applied above 40 ppm Bray P1 or equivalent test, unless recommended by appropriate industry standards or the land grant universities for specialty crops, vegetable crops, etc.

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

1. Nutrients are to be applied in such a manner to minimize salt damage to existing or planned crops.
2. Nutrients are not to be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

**CONSIDERATIONS**

1. Consider draw-down strategies when nutrients are at excessive soil test levels. Draw-down strategies may include stopping the application of the nutrient(s) at the excessive level, changing the rotation to crops using more of the excessive nutrient(s), and removal of crop biomass (e.g. straw or hay).
2. Consider additional practices such as Conservation Cover (327), Grassed Waterway (412), Contour Buffer Strips (332), Filter Strips (393), Riparian Forest Buffer (391A), Conservation Crop Rotation (328), Cover and Green Manure (340), and Residue Management (329A, 329B, or 329C, and 344) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and to protect or improve water quality. This is very critical for soils with soil test "P" levels above 50 ppm.
3. Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:
  - a. Split applications of nitrogen to provide nutrients at the times of maximum crop utilization.
  - b. Greater nitrogen efficiency for crop production and reduced leaching potential can be obtained by applying the recommended nitrogen rate prior to planting spring seeded crops on FINE & MEDIUM textured soils with moderate to good drainage.
  - c. Maintain high potassium soil test levels (200 ppm) to improve nitrogen efficiency for crop production.
  - d. Avoiding winter nutrient application for spring seeded crops.
  - e. Band applications of phosphorus near the seed row.
  - f. Inject or incorporate nutrients with good erosion control practices to reduce surface runoff of nutrients, especially Phosphorus.
  - g. Applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques.
  - h. Immediate incorporation of land applied manure, biosolids, or organic by-products.
  - i. Delaying field application of animal manure, biosolids, or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.
4. Consider additional application setback distances from neighbors, environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.
5. Consider the potential problems from odors associated with the land application of animal manure or other organic by-products especially when applied near or upwind of residences.
6. Consider nitrogen volatilization losses associated with the land application of animal manure. Volatilization losses can become significant, if manure or other organic by-products are not immediately incorporated into the soil after application.
7. Consider the potential to affect National Register listed or eligible cultural resources.
8. Consider using soil test information no older than one year when developing new plans, particularly if animal manure is to be a nutrient source.
9. On land where manure or other organic by-products are applied, consider soil testing the year prior to the planned application.

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10. Consider all sources and forms of plant nutrients (soil, legumes, manure, other organic by-products, crop residues, and commercial fertilizers) that are available for plant growth and production when developing a nutrient management budget.
11. Nitrogen and Phosphorus are critical nutrients in planning for water quality. Timing, placement, method of application, rate of application, and form of fertilizer applied are important considerations for managing these nutrients to reduce pollution of surface and ground water.
12. Proper pH is critical for the availability of both soil and applied nutrients.
13. Good soil condition (tilth and structure) should be maintained for efficient uptake of nutrients by plants. Avoid field operations that may result in soil compaction and use rotations with high residue producing crops.
14. Use cover crops (wheat, rye, ryegrass) to take up some of the residual nitrates in the soil during late fall and early spring. It is critical to establish cover crops in the early fall to achieve the desired results. Cereal Rye is among the best to recover residual soil nitrates.
15. Consider using nitrification inhibitors for early spring N applications especially on poorly and somewhat poorly drained soils.
16. Keep good field records of soil test results, yields achieved, and nutrients applied (time, form, rate, and method of application).
17. Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.
18. 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.)
19. 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.
20. Consider the alternate methods to better utilize the nutrients from manure by transporting to fields or farms needing additional nutrients or brokering the manure to others in need of the nutrients from the manure.

## PLANS AND SPECIFICATIONS

1. 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. See references at the end of this standard for software to assist in planning and documenting specifications.
2. The following minimum components shall be included in the "Nutrient Management Plans".
  - a. Aerial photograph or map and a soil map of the site (can be the conservation plan map).
  - b. Nitrogen and Phosphorus Transport Assessments
  - c. Current and/or planned plant production sequence or crop rotation.
  - d. Results of soil, plant, water, manure or organic by-product sample analyses.
  - e. Realistic yield goals for the crops in the rotation.
  - f. Quantification of all nutrient sources.
  - g. Recommended nutrient rates, timing, form, and method of application and incorporation.
  - h. Location of designated sensitive areas or resources and the associated, nutrient management restriction.
  - i. Guidance for implementation, operation, maintenance, and record keeping.
  - j. Complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

### **Additional components for a "Nutrient Management Plan" involving livestock and/or manure, sludge, or other bio-solids applied to the land:**

- a. Planned rates, timing, form, and method of application for manure, organic by-products, or biosolids.
  - b. If applicable, specify the number of animal units, types of animals, and how the manure will be stored and managed.
  - c. If applicable, specify the feed diet that is planned if it is designed to reduce the nutrient content of the manure and list those types of feed or amendments that will be used.
  - d. If applicable, list any management and runoff control measures that affect manure storage and management.
  - e. Specify the number of acres needed to utilize the manure and/or waste at a Phosphorus removal rate.
3. If increases in soil phosphorus levels are expected, plans shall document:
    - a. The soil phosphorus levels at which it may be desirable to convert to phosphorus based implementation.
    - b. The relationship between soil phosphorus levels and potential for phosphorus transport from the field.
    - c. The potential for soil phosphorus drawdown from the production and harvesting of crops.
  4. When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements, or producer goals.
  5. In addition to the requirements described above, plans for nutrient management shall also include:
    - (a) A 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.
    - (b) A discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.
    - (c) 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.

**OPERATION AND MAINTENANCE**

1. The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:
  - a. 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.
  - b. Protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
  - c. Calibration of application equipment to ensure uniform distribution of material at planned rates.
  - d. 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.
  - e. Maintaining records to document plan implementation. As applicable, records include:
    - (1) The last 3 soil test results and recommendations for nutrient application for each field.
    - (2) Quantities, analyses and sources of nutrients applied.
    - (3) Dates and methods 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.
    - (6) Dates of review and person performing the review, and recommendations that resulted from the review.
2. Records should be maintained for five years or for a period longer than five years if required by other federal, state, or local ordinances, or program or contract requirements.
3. 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.
4. 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 runoff and leaching.
5. The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

**TABLES**

- Table 1. Forms of Nitrogen, Placement, and Timing of Application (Other than Starter).  
Table 2. Soil pH Recommendations for Various Crops on Various Soils.  
Table 3. Nitrogen Credits from Soil Organic Matter and Previous Crops  
Table 4. Approximate Nutrients Removed by Crops

## **PLANS**

See the 590 Practice Documentation sheet at the end of this standard that lists the minimum documentation needed for a nutrient management plan. The Purdue MMP software with its CNMP Document Maker Tool will generate a nutrient management plan with all the required components. The Missouri Spatial Nutrient Planner (SNMP) is useful to produce a map of the planned fields. Both software programs can be downloaded from [www.agry.purdue.edu/mmp](http://www.agry.purdue.edu/mmp).

### **References:**

1. USDA-NRCS NATIONAL NUTRIENT MANAGEMENT STANDARD 590, APRIL 1999
2. (OHIO, MICHIGAN, INDIANA) TRI-STATE FERTILITY GUIDE, EXTENSION BULLETIN E-2567, JULY 1995
3. WATERBORNE PATHOGENS IN AGRICULTURAL WATERSHEDS, USDA-NRCS WATERSHED INSTITUTE, JUNE 2000
4. DISPELLING COMMON MYTHS ABOUT PHOSPHORUS IN AGRICULTURE AND THE ENVIRONMENT, TECHNICAL PAPER, USDA-NRCS WATERSHED INSTITUTE
5. AGRICULTURE PHOSPHORUS AND EUTROPHICATION, USDA-ARS-149, JULY 1999
6. NRCS - AGRICULTURAL WASTE MANAGEMENT FIELD HANDBOOK
7. THE OHIO LIVESTOCK WASTE MANAGEMENT GUIDE (OSU BULLETIN 604 – 1992)
8. MIDWEST PLANS SERVICE (MWPS) - 18
9. SECTION I, 2000 "MANURE CHARACTERISTICS"
10. OHIO DEPARTMENT OF AGRICULTURE LIVESTOCK ENVIRONMENTAL PERMITTING PROGRAM

### **NUTRIENT MANAGEMENT SOFTWARE:**

1. Purdue Manure Management Planner (MMP) software version 0.15 or later  
[WWW.AGRY.PURDUE.EDU.MMP](http://WWW.AGRY.PURDUE.EDU.MMP)
2. Missouri Spatial Nutrient Management Planner (SNMP) software [WWW.AGRY.PURDUE.EDU/MMP](http://WWW.AGRY.PURDUE.EDU/MMP)
3. Ohio P index May 2002.xls Spreadsheet (or later) [WWW.OH.NRCS.USDA.GOV](http://WWW.OH.NRCS.USDA.GOV)
4. Ohio Farm Nutrient Balance May 2002.xls Spreadsheet (or later) [WWW.OH.NRCS.USDA.GOV](http://WWW.OH.NRCS.USDA.GOV)

**Table 1. Forms of Nitrogen, Placement, and Timing of Application (Other than Starter).**

Nitrogen Form	Applied in Fall Soil <50° F	Applied in Spring Soil <50° F	Applied Spring Soil >50° F	Early Summer Sidedress or Split
Urea – Broadcast		X <sub>3)</sub>		
Urea – Incorporate <sub>2)</sub>	X <sub>1)</sub>	X <sub>4)</sub>	X <sub>4)</sub>	X <sub>5)</sub>
Urea with Urease (Inhibitor)			X <sub>4)</sub>	X
UAN – Broadcast		X <sub>3)</sub>		
UAN – Incorporate		X <sub>4)</sub>	X <sub>4)</sub>	X <sub>5)</sub>
Ammonium Based	X <sub>1)</sub>	X <sub>3) 4)</sub>	X <sub>4)</sub>	X <sub>5)</sub>
NH <sub>3</sub> Inject Only	X <sub>1)</sub>	X	X	X <sub>5)</sub>
NH <sub>3</sub> Inject Only with Inhibitor	X <sub>1) 7)</sub>	X <sub>4)</sub>	X <sub>6)</sub>	

Footnotes:

1. Only recommended on well drained silt loam and loam soils with low to medium leaching potential.
2. Incorporation includes the use of standard primary and secondary tillage tools, knife, and injectors.
3. Preferred timing for wheat production.
4. Preferred timing for corn production on FINE OR MEDIUM textured soils that are tile drained to minimize nitrate leaching losses in tile flow.
5. Recommended for untilled poorly and somewhat poorly drained MEDIUM and FINE soils; and for COARSE TEXTURE soils.
6. On poorly and somewhat poorly drained soils.
7. Option for Fall application for spring planted crops on soils with a high leaching potential (due to being tile drained).

**Table 2 - Soil pH Recommendations for Various Crops on Various Soils<sub>1</sub>**

Crop	Mineral Soil Subsoil pH > 6	Mineral Soil Subsoil pH < 6	Organic Soils
Alfalfa	6.5	6.8	5.3
Other Forage Legumes	6.0	6.8 <sub>2)</sub>	5.3
Corn	6.0	6.5	5.3
Soybeans	6.0	6.5	5.3
Small Grains	6.0	6.5	5.3
Other Crops	6.0	6.5	5.3

- Footnotes:
1. Source - Tri-State Fertilizer Recommendations Extension Bulletin E-2567, July 1995.
  2. Birdsfoot Trefoil should be limed to pH 6.0

**Table 3. Nitrogen Credits from Soil Organic Matter and Previous Crops**

Source	Nitrogen Credit (lbs/ac)
From Soil Organic Matter	
0-8% O.M. Mineral Soils	0
> 20% Organic Soils	40-80
<b>From Previous Crops:</b>	
Corn & Most Crops	0
Soybeans prior to corn only	30
Grass Sod & Pastures	40
Established Forages Legumes <sup>1)</sup> 40 + 20 X (plants/sq. ft.) [Max 140 lbs/ac]	40-140 <sup>3)</sup>
Annual Legumes <sup>2)</sup>	40 <sup>3)</sup>

Footnotes:

1. Established more than one year.
2. N credit is variable. When a heavy growth follows small grain harvest the N credit can be considerably higher.
3. Actual N availability will depend on how the forage is managed. If the forage is incorporated (even shallow) the N availability is generally (weather dependent) much higher. If forage residue is left on top (No till) breakdown of the organic N and movement into the soil is very moisture dependent. A dry year will capture less of the potential nitrogen.

**Table 4. Approximate Nutrients Removed by Crops (Lbs/Acre) <sup>3</sup>**

Crop	Unit	Nitrogen	P2O5	K2O
Alfalfa <sup>1)</sup>	Ton	56	13	50
Grasses (Cool Season)	Ton	40	13	50
Corn (Grain)	Bushel	0.9	0.37	0.27
Corn (Stover)	Bushel	0.67	0.19	1.06
Corn Silage <sup>2)</sup>	Ton	9.0	3.1	9.0
Oats (Grain)	Bushel	0.65	0.25	0.20
Oats (Straw)	Bushel	0.35	0.15	1.0
Sorghum (Grain)	CWT	1.38	0.40	0.40
Sorghum (Stover)	CWT	1.05	0.66	3.03
Soybeans <sup>1)</sup>	Bushel	3.8	0.8	1.4
Sugarbeets (roots)	Ton	4.0	2.0	10.0
Tobacco (leaf)	CWT	3.5	0.83	6.16
Tobacco (Stem and Suckers)	CWT	2.75	0.75	3.25
Wheat (Grain)	Bushel	1.27	0.64	0.40
Wheat (Straw)	Bushel	0.40	0.07	0.66

Footnotes:

1. Inoculated legumes fix nitrogen from the air.
2. 6 bushels of grain = 1 ton of silage
3. Source. Ohio Agronomy Guide and National Plant Food Institute and others.

<b>Practice Documentation For:</b> <i>Nutrient Management - 590</i>
<b>The following documentation must be in the case folder or engineering subfolder.</b>
<b>Practice Planning</b>
<ol style="list-style-type: none"> <li>1. Is the practice part of a conservation plan?</li> <li>2. Have the purpose(s) for the practice been identified?</li> <li>3. Is the location of the practice identified on a map or plan drawing?</li> </ol>
<b>Practice Design</b>
<p>Have the following design criteria been addressed?</p> <ol style="list-style-type: none"> <li>1. Aerial photograph or map and a soil map of the site.</li> <li>2. Current and/or planned plant production sequence or crop rotation.</li> <li>3. Results of soil, plant, water, manure or organic by-product sample analyses.</li> <li>4. Realistic yield goals for the crops in the rotation.</li> <li>5. Quantification of all nutrient sources.</li> <li>6. N &amp; P Risk assessments as appropriate.</li> <li>7. Recommended nutrient rates, timing, form, and method of application and incorporation.</li> <li>8. Location of designated sensitive areas or resources and the associated, nutrient management restriction.</li> <li>9. Guidance for implementation, operation, maintenance, recordkeeping.</li> <li>10. Complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.</li> <li>11. Planned fields and acres.</li> </ol>
<b>Practice Installation / Application</b>
<p>Does the practice meet the minimum criteria for the planned purpose(s)?</p> <p>Have the following criteria been documented in the assistance notes or practice jobsheet?</p> <ol style="list-style-type: none"> <li>1. Statement of the rates, methods, and timing of nutrient applications based on the review of nutrient application records.</li> <li>2. Currency of soil tests and crop records.</li> <li>3. Acres applied to standard.</li> </ol>
<b>Practice Deficiencies</b>
<p>If applicable, have the practice deficiencies been communicated with the decisionmaker?</p>
<b>Practice Maintenance</b>
<p>Have the following maintenance actions been communicated to the decisionmaker?</p> <ol style="list-style-type: none"> <li>1. 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.</li> <li>2. Protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.</li> <li>3. Calibration of application equipment to ensure uniform distribution of material at planned rates.</li> <li>4. 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.</li> <li>5. Maintaining records to document plan implementation. As applicable, records include:</li> <li>6. Soil test results and recommendations for nutrient application.</li> <li>7. Quantities, analyses and sources of nutrients applied.</li> <li>8. Dates and method of nutrient applications.</li> <li>9. Crops planted, planting and harvest dates, yields, and crop residues removed.</li> <li>10. Results of water, plant, and organic by-product analyses.</li> <li>11. Dates of review and person performing the review, and recommendations that resulted from the review.</li> </ol>
<b>Other Comments:</b>