

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

**NUTRIENT MANAGEMENT
(Acre)**

CODE 590

DEFINITION

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

PURPOSES

It is intended that nutrient management plans developed from this standard be used to help producers improve or maintain their level of management and expertise as it relates to the application of nutrients on the lands they own and/or control.

- To budget and supply nutrients for plant production.
- To minimize the potential for environmental damage including agricultural non-point source pollution of surface and ground water resources.
- To maintain or improve the physical, chemical and biological condition of soil.
- To properly utilize all sources of organic material, including animal waste, as a plant nutrient source.
- To prevent or reduce excess nutrient concentrations in the soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. Soil amendments include composted animal waste.

CRITERIA

General Criteria Applicable to All Purposes.

Nutrient Management Plans (NMPs) shall comply with all applicable federal, state and local laws and regulations.

NMPs that address land application of animal waste shall comply with the State of Idaho Waste Management Guidelines for Confined Feeding Operations.

NMPs shall 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.

Persons who approve plans for nutrient management shall be certified through the joint Idaho State Department of Agriculture, NRCS, and University of Idaho (U of I) certification program, or other acceptable program as designated by the State Conservationist.

If nutrients are applied on an annual basis, annual soil samples shall be taken and an annual nutrient budget developed in order to develop and maintain NMPs. Refer to other sections in the standard.

A nutrient budget for nitrogen (N), phosphorus (P), and potassium (K) shall be developed that considers all potential sources of nutrients including, but not limited to, animal waste, composted animal waste, other composted by-products, and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

Nutrient Management Plans based upon application of commercial fertilizer only.

Nutrient budgets based upon applications of commercial fertilizer only shall follow the University of Idaho Fertilizer Guides, (Fertilizer Guides) or crop specific Production Guides.

Budgets will not be developed for crops that do not have Fertilizer Guides.

Nutrient Management Plans which include application of animal waste.

Nutrient budgets which include application of animal waste shall be based upon the Phosphorus Threshold (TH) as discussed in this

standard. Budgets shall be based upon:

- Tables, values and guides generated from Idaho OnePlan Nutrient Management Program or other NRCS approved programs.
- Values contained in the NRCS Agricultural Waste Management Field Handbook, Chapters 4 and 6.
- Use data from laboratory analysis of waste, when available.

Phosphorus Threshold (TH)

The P TH is used in the nutrient budgeting process when land application of animal waste is included. It is used:

- To determine the method for developing the nutrient budget, which could be crop uptake or recommended application rate cited in the Fertilizer Guides.
- To track trends in soil P concentrations over time.
- The TH is the soil test P concentration above which there is no agronomic response to additional applications of P for crops grown in Idaho or for which there is a high probability of P leaching.
- A soil test P concentration is a chemical evaluation of the capability of the soil, as represented by a soil sample, to supply adequate plant available P during the growing season for optimum growth.
- The nutrient budget is developed using Fertilizer Guide recommendations or Crop Uptake if soil test P concentrations are equal to or less than the designated threshold (TH).
- The nutrient budget is developed using Crop Uptake estimates if soil test phosphorus concentrations are greater than the designated TH.

Nutrient Management Plans

Plans shall be based upon realistic yield goals for the crops included in the crop rotation evaluated.

Plans shall specify the form (liquid, gas or solid), source (dairy, feedlot, commercial fertilizer, etc.), amount, timing, and method of application of nutrients on each field or Conservation Management Unit (CMU) to achieve realistic production goals, while minimizing N and/or P

**NRCS, IDAHO
February 2005**

movement to surface and/or ground water.

Crop rotations shall be documented in the nutrient management plan.

Irrigation Water Management (449) shall be a component of a nutrient management plan if nutrients are applied on irrigated pasture, hayland or cropland.

The Phosphorus Transport Risk Analysis Tool shall be used to determine if additional conservation practices will be required to prevent off-site movement of P. Off-site movement is defined as movement of P off the field or management unit or downward through the soil profile beyond the root zone.

Soil Sampling and Laboratory Analysis

Soil samples shall be collected and prepared such that they are representative of the entire field or portion of the field to be managed separately. (See U of I CES NO. 704, Soil Sampling).

Exception: Precision agriculture techniques where grid sampling is utilized to develop nutrient management units within a field.

Soil sample analysis will be performed by a laboratory that is successfully meeting the requirements and performance standards of the North American Proficiency Testing – Performance Assessment Program (NAPT-PAP).

Laboratory analysis shall include components shown below and in Table 1.

- South Idaho Fertilizer Guides, (Irrigated Cropland): First foot sample shall include NO₃-N, NH₄-N, P, K, % soil organic matter, pH, and % free lime. The producer or their representative may want the analysis to include additional elements. The analysis for the second foot shall include NO₃-N and NH₄-N.
- Northern Idaho Fertilizer Guides (generally Non-Irrigated Cropland): First foot sample shall include NO₃-N, NH₄-N, P, K, % soil organic matter and pH. The producer or their representative may want the analysis to include additional elements. The analysis for the second foot shall include NO₃-N.

Soil samples will be analyzed for P using the test methods utilized in the development of the Fertilizer Guides. For example, the Northern Idaho Fertilizer Guide for Winter Wheat uses the Bray-1 or Morgan (sodium acetate) tests on soils with a pH less than 6.2 or the Olsen (sodium bicarbonate) test for soils with pH greater than 6.2. However, the Southern Idaho Fertilizer Guides for Winter Wheat utilizes only the Olsen test.

Soil Sampling - Development of the Initial Nutrient Management Plan

Soil samples are taken annually on each field for which a nutrient budget is developed, or as prescribed by specific Fertilizer Guides.

For soil sample and starter fertilizer applications:

- Soil samples are not required when a starter application of less than or equal to 20 pounds N and/or 20 pounds P₂O₅ are applied. Soil samples will be required if additional nutrients are applied.
- The North Idaho Winter Wheat Fertilizer Guide includes an alternative P application scenario which accounts for additional P applications when the following crop is peas or lentils. If this alternative is used, then the starter application discussed above is not allowed.

A composite soil sample may be taken which represents several fields under the following conditions. Fields being grouped into one Conservation Management Unit (CMU) must:

- Have the same predominate soil type.
- Be in the same crop rotation.
- Have the same previous crop.
- Have the same current crop.
- The composite soil sample must be representative of all fields in the CMU.

Soil sampling taken for the purpose of developing the annual nutrient budget must be taken no earlier than 3 months prior to applying the bulk of the fertilizer for the designated crop(s).

Soil tests can be taken at any time of the year to determine the concentration of P for comparison to the TH.

Depth of soil samples. Soil samples taken for

purposes of developing the nutrient budget shall be taken as described in Table 1 or the appropriate Fertilizer Guide.

Depth ¹	Nutrient Analyzed
<u>Northern Idaho</u> 0 - 12 inches ¹	NO ₃ -N, NH ₄ -N, P, & K, % soil organic matter, pH
12 - 24 inches	NO ₃ -N ²
<u>Southern Idaho</u> 0-12 inches ¹	NO ₃ -N, NH ₄ -N, P, & K, % soil organic matter, pH, % free lime
12 - 24 inches	NO ₃ -N, NH ₄ -N

¹ Follow specific fertilizer guide requirements for depth of soil samples. Some guides do not require soil samples to be taken at both the 1st and 2nd foot depths.

² Northern Idaho: Testing for NH₄-N in the second foot is recommended in the UI Fertilizer guides but not required.

Accounting for nitrogen in the root zone. North Idaho Fertilizer Guides recommends sampling to the 3rd and/or 4th foot for some crops. If the laboratory analysis provides this data, account for it in the nutrient budget.

Soil samples taken for comparison to the P threshold will be taken at the depth shown in Table 2, dependent upon the on-site surface or ground water resource concern.

- Surface water concerns exist when surface runoff leaves field(s) from precipitation, rain on snow or frozen ground, or irrigation.
- Ground water concerns exist when surface water (from any source) does not leave the field. A high water table, fractured bedrock, poor irrigation water management, cobbles, gravel or coarse-textured soils can contribute to downward movement of water and nutrients.

Primary Resource Concern	P Threshold Soil Sample Depth
Surface Water	0" – 12"
Ground Water	18" – 24"

When considering soil P threshold levels, a surface water resource concern has priority over a groundwater concern. When neither resource

concern is present, the nutrient management plan is developed based on the TH for the ground water concern in order to prevent concentrations of nutrients above the agronomic requirement of the crop, and to maintain soil quality and long-term sustainability of the cropland resource.

To meet local nutrient requirements as identified in the fertilizer guide, the 0" – 12" soil sample can be used to determine other diagnostic needs.

Fields that are part of a non-irrigated cropland rotation that includes summer fallow do not have to be soil sampled the year the field(s) are in summer fallow.

Non-inversion cropping systems (i.e., no till or direct seeding systems) or areas where resource problems dictate closer management may require soil samples in zones less than 0" - 12".

In situations where specialty crops are raised or environmental considerations have been identified (high water tables, leaching vulnerability, tile drains, fractured bedrock, deep or shallow soils), sampling greater than or less than the prescribed depths may be appropriate. The NRCS soil survey data is sufficient to make this determination unless site-specific conditions vary substantially from the survey. The production system and environmental considerations will determine soil-sampling depth. Soil samples will represent the field or CMU being planned.

Phosphorus TH concentrations by resource concern are listed in Table 3. Use the primary resource concern identified and site characteristics to determine the TH of the site.

Table 3			
Primary Resource Concern	<u>P Threshold Concentration</u>		
	Olsen	Bray-1	Morgan
Surface Water	40 ppm	60 ppm	6 ppm
Ground Water			
< 5 feet	20 ppm	25 ppm	2.5 ppm
> 5 feet	30 ppm	45 ppm	4.5 ppm

The Olsen test can be used on land units with pH values above and below 6.2; however, when pH is > 6.2 use the Olsen evaluation. Use Bray-1

or Morgan when soil pH is < 6.2.

Fields that are part of a long term sod, pasture, or alfalfa crops in rotation, may not require annual soil samples if nutrients are not applied on a regular basis. Soil samples are to be taken when nutrients will be applied as part of an on-going management program.

Soil sampling – Maintenance of the Nutrient Management Plan

For purposes of maintaining a developed NMP, soil samples and nutrient budgets will use as previously described.

For purposes of tracking P trends, soil samples will be taken and analyzed as described in Tables 2 and 3.

Soil samples for tracking changes in soil test P will be taken at the end of the crop rotation period where waste application was made.

Plant Tissue Testing

Tissue sampling and testing is recommended during the growing season to monitor crop nutrient concentrations.

Tissue sampling shall be done in accordance with University of Idaho guidelines or the guidelines of the laboratory performing the tissue analysis.

Nutrient Application Rates – Developing the Nutrient Budget

Reference "Nutrient Application Timing" for additional criteria concerning timing of applications which include N.

N application rates will be determined for each crop in the rotation.

P application rates will be determined for a single crop or for the crop rotation. Table 4 outlines the P application rates based on soil sample P concentrations as compared to the site TH for P applications that include land application of animal waste.

Table 4	
Soil Test P	P Application Rate
Surface Water < TH (ppm)	Fertilizer Guide P rate, or Crop P uptake.
> TH (ppm) ¹	Crop P uptake If land application of animal waste is included, the N applied as animal waste can not exceed the N requirement of the crop.
Ground Water < TH (ppm)	Fertilizer Guide P rate, or Crop uptake.
> TH (ppm) ¹	Fertilizer guide P rate, or Crop P uptake not to exceed the N requirement of the crop. If land application of animal waste is included, the N applied as animal waste can not exceed the N requirement of the crop.

¹ **Note: When soil test P concentrations are above the TH, the planner, in cooperation with the producer, will design a nutrient management plan that will reduce soil test P concentrations below the TH and minimize potential off-site transport. This may require adjustments in crop rotation, irrigation method and scheduling, form, timing or placement of P applied, and changes in P application rates less than crop P uptake.**

K applications shall not cause unacceptable nutrient imbalance in crops and forage quality or cause K shortages to limit crop growth and sustainability.

Nutrient applications are recommended when plant tissue tests indicate a need for nutrient application to correct or prevent a deficiency.

Calibrate waste and fertilizer application equipment to ensure recommended rates are applied.

Nutrient Application Timing

Application of solid wastes. Solid waste shall be

incorporated unless applications are made on frozen ground, perennial crops or cropland under no-till; in those cases, emergency tillage (i.e., chiseling and disking cross slope), construction of berms or other containment practices will be applied to prevent surface runoff.

Winter application of solids on 0 – 2% slope fields can be considered if it is determined there is no potential for runoff.

Fall and winter application of solid wastes on shallow and/or sandy soils should be made when soil temperatures are <50 ° F to minimize nitrification.

Application of liquid wastes. Application of liquid waste shall not be made outside the active crop growing period, unless a site specific water budget shows that deep percolation of wastewater or runoff will not occur prior to the next crop-growing season. For purposes of this standard, animal waste in the slurry form will be managed as a liquid. Liquid waste shall be applied to crops at amounts not exceeding soil water holding capacity in the crop-rooting zone.

Application of liquid wastes through surface or sprinkler irrigation systems will be timed to prevent deep percolation or runoff. The number of applications will be based on the volume of waste to be disposed of as well as related concerns with surface runoff and deep percolation.

Application of commercial fertilizer. Commercial fertilizer applications shall be timed to provide for residue decomposition and crop production needs while avoiding surface runoff and leaching.

Reference “Nutrient Application Timing” for additional criteria concerning timing of applications which include N.

Criteria Applicable to Utilizing Organic Waste Resources as a Plant Nutrient Source.

Organic biosolids, (i.e., waste from food processing facilities), shall be applied as prescribed by federal, state, or local regulations.

Criteria for Maintenance or Improvement of Physical, Chemical or Biological Condition of Soil.

Biosolids, other than animal waste, and sewage

sludge shall be applied as prescribed by federal, state, or local regulations (40 CFR parts 403 and 503).

Records of application and chemical composition of biosolids must be maintained as required by the state.

Additional Criteria to Protect Water Quality on Vulnerable Sites.

Vulnerable sites are:

- Areas of average annual precipitation greater than 24 inches.
- Coarse textured soils and/or areas with high water tables (perched water less than 24 inches) with average annual precipitation greater than 21 inches or under irrigation.
- Idaho Nitrate Priority Areas and the 303d list which identifies nutrient impaired stream segments.

Reference UI Fertilizer Guides section "Water Quality Considerations" or sections which address N movement in soils. Specific guidance is provided in the Fertilizer Guides for application of N in high precipitation areas, or on irrigated crops. Follow the Fertilizer guides when addressing movement of N in the soil profile.

All fields or CMUs included in the NMP will be evaluated using the Phosphorus Transport Risk Analysis Tool. Resource and or environmental concerns identified by the analysis will be addressed with inclusion of needed conservation practices to address the concern.

Utilize nutrient timing, source and placement to reduce N and P pollution of ground and surface waters. Special consideration will be given to application and placement of nutrients on sensitive areas (i.e., Highly Erodible Lands (HEL), within flood plains, near sensitive water bodies, in areas of ground water contamination within sole source aquifers, wellhead protection areas, or within other areas of water quality concern).

In areas of special consideration, methods will include:

- Application of nutrients to crop fields to avoid or reduce potential of transport to gullies, ditches, surface inlets, sinkhole areas, or wellhead areas.
- No application of animal waste on sites

where runoff is delivered directly to a conveyance channel or receiving water body unless runoff is treated with a conservation buffer or other mitigating practice prior to delivery.

In areas of special consideration, recommended methods may include:

- Split fall/spring applications utilizing soil temperatures (<50 ° F), nitrification inhibitors, or time release fertilizers, or split spring applications of N to provide nutrients at the times of maximum crop uptake.
- Band or place applications of P near the seed row.
- Incorporate broadcast nutrients.
- Farm on the contour or cross slope on all non-irrigated fields adjacent to wetlands if nutrient runoff appears to pose a more significant hazard than leaching.
- Utilize fall cover crops whenever possible to immobilize excess residual N and retain for spring crops.
- Use Cover (327), Residue Management (329A, B or C), Conservation Crop Rotation (328), Grassed Waterway (412), Irrigation Water Management (449), Riparian Forest Buffers (391), Filter Strips (393), Fencing (382), Watering Facility (614), etc., as needed to protect or improve water quality.

CONSIDERATIONS

Individual conservation practices should be planned as part of a comprehensive conservation plan, which addresses all resource concerns on the unit and reaches a Resource Management System level of treatment.

Rotations included in a nutrient management plan should meet the criteria of the Conservation Practice Standard Conservation Crop Rotation 328.

When soil test P concentrations approach 75% of the TH, consider developing the nutrient management plan using application rates at crop P uptake or less. At 75% of TH, concentrations of P are approaching the TH and management changes should be implemented.

Vary the amount of fertilizer in different parts of the field to account for differing yield potential, fertilizer needs and the potential for leaching and runoff.

Consider applying liquid wastes mixed with irrigation water during the last 1/4 to 1/3 of the irrigation set to minimize deep percolation and runoff.

Consider split applications to provide N at the time of maximum crop utilization, especially on fall-seeded crops.

Consider routine mineral and nitrate N status testing of forages produced from land with long term and/or heavy waste application rates. Excessive soil K can lead to high K levels in forages, especially legumes like alfalfa, produced for livestock. Excess K intake by cattle is associated with decreased magnesium absorption, decreased feed intake and milk production, increased intake of water, and increased urine output. High dietary levels of K are a major concern in dairy herds. Plants with high levels of K and low levels of magnesium can cause grass tetany, a non-infectious metabolic disease in cattle.

Consider limited application of organic materials with high heavy metal concentrations.

Consider analyzing products from industrial processing used as fertilizer or soil amendments for heavy metals or other contaminants to prevent their buildup in the soil.

Consider cover crops whenever possible to utilize and recycle excessive residual N.

Band applications of P near the seed row.

Applying nutrient materials uniformly or as prescribed by precision agricultural techniques.

Delaying field application of animal wastes 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.

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

Consider N volatilization losses associated with the land application of animal wastes. Volatilization losses can become significant if wastes are not immediately incorporated into the soil after application.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to

achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

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

- Aerial site photograph or map and a soil map.
- Current and/or planned plant production sequence or crop rotation.
- Results of soil, plant, water and organic sample analyses.
- Realistic yield goals for the crops in the rotation.
- Quantification of all nutrient sources.
- Recommended nutrient rates, timing, and method of application and incorporation.
- Location of designated sensitive areas or resources and the associated practices or methods planned to protect the area.
- Guidance for implementation, operation and maintenance of the nutrient management component of the conservation plan.
- Complete nutrient budget for N, P, and K for the rotation or crop sequence.

When nutrient management plans are expected to increase soil P concentrations, such that concentrations approach the TH, plans shall include:

- A caution that P accumulation in the soil can occur and that the potential for such accumulation can contribute to water quality impairment, animal health or crop production problems.
- A discussion of the time interval after which it may be necessary to convert to P based waste or nutrient application rates for plan implementation.
- The potential for soil phosphorous drawdown from the production and harvesting of crops.

OPERATION AND MAINTENANCE

Nutrient Management Plan Review and Revision

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

Nutrient management plans shall be reviewed annually by the nutrient management planner to determine if adjustments or modifications are needed. Annual reviewers, including the producer, need not be certified.

The nutrient management planner shall revise the plan, as needed, to reflect significant changes in the operation that affect the overall nutrient management plan or upon change in landowner or tenant. Significant changes may include:

- increase in livestock by 10%;
- major changes to waste handling and storage system;
- increase or decrease in application area by 10%;
- change in crop or crop rotation;
- change in irrigation system;
- new designation as a sensitive area.

Safety

Protect fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage. Storage of manure, fertilizers and cleaning of application equipment should be done away from a wellhead.

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

Backflow protection devices shall be installed according to Idaho chemigation requirements when using irrigation systems for application or distribution of liquid waste or commercial fertilizer.

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

The disposal of material generated from cleaning nutrient application equipment should

be stored and disposed of 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.

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

Field Records

The producer will maintain field level records for a minimum of five years. As applicable, records include:

- Soil, plant tissue, organic, and water test results as collected and recommendations for nutrient application.
- Quantities, analyses and sources of nutrients applied.
- Approximate dates and methods nutrients were applied.
- Crops planted, planting and harvest dates, yields, and crop residues removed.
- Dates of annual review and person performing the review and recommendations that resulted from the review.
- Any additional information as required by this standard, (i.e., Site Vulnerability, Site Risk Assessment, Biosolids application records, and other appropriate cautions and discussions).
- Suggested Additional Records as applicable:
 - Irrigation Water Management evaluations.
 - Recommended conservation practices and management actions that can reduce the potential for nutrient movement.