**NATURAL RESOURCES CONSERVATION SERVICE**

**CONSERVATION PRACTICE STANDARD**

# NUTRIENT MANAGEMENT

**(Ac.)**

**CODE 590**

## DEFINITION

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

## PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

## CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. This standard does not apply to one-time nutrient applications to establish perennial crops (not to exceed rotational phosphorus crop uptake.

## CRITERIA

### General Criteria Applicable to All Purposes

A Nutrient Management Plan (NMP) for nitrogen (N), phosphorus (P) and potassium (K) must be developed when nutrients are applied.

An annual nutrient budget for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including, but not limited to, green manures, legumes, crop residues, compost, animal manure, organic by-products, biosolids, waste water, organic matter, soil biological activity, commercial fertilizer, and irrigation water.

NMPs shall be developed in accordance with Idaho Natural Resources Conservation Service (NRCS) policy requirements of Title 190, General Manual (GM), Part 402, Amendment ID 9, (Idaho Nutrient Management Planning), and Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation.

Nutrients shall be applied considering the plant's growth habits, irrigation practices and other conditions so as to maximize availability to the plant and minimize the risk of runoff, leaching and volatilization losses.

Enhanced efficiency fertilizers, used in the State must be defined by the Association of American Plant Food Control Officials (AAPFCO) and be accepted for use by the Plant Industries Division, Idaho State Department of Agriculture (ISDA) fertilizer control official, or similar authority, with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims.

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

On organic operations, the nutrient sources and management must be consistent with the United State Department of Agriculture's (USDA) National Organic Program.

Sensitive areas (e.g., sinkholes, wellheads, gullies, ditches, or surface inlets) shall not receive direct application of nutrients, including

applications through irrigation systems. The need for application setbacks to protect sensitive areas will be based on a risk assessment evaluation.

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

**Soil and Tissue Sampling and Laboratory Analyses (Testing)**.

Nutrient planning must be based on current soil, manure, and (where used as supplemental information) tissue test results developed in accordance with UI guidance (Dow, 1980), or industry practice, if recognized by the UI.

Current soil tests are those that are no older than 3 years, with the exception of Nitrate-N and Ammonium-N soil tests, which require annual soil tests for development of the annual nutrient budget.

If the field has a history of recent manure application or the management has changed significantly, then the requirement is no older than nine (9) months. The area represented by a soil test must represent the specifications as outlined in the Nutrient Management

Conservation Jobsheets using the principles as outlined in the UI publication "Soil Sampling" (CES Number 704). Where a CMU is used as the basis for a fertility management, all acreage in the CMU must have similar soil type, cropping history, and management practice treatment.

Soil samples shall be collected and prepared such that they are representative of the entire CMU, field or portion of the field to be managed separately. Requirements for soil sampling shall follow the specifications outlined in the UI publication CES 704 or crop-specific soil sampling requirements outlined in the UI Fertilizer Guide (FG) Recommendations or as outlined in the adjacent states' Land Grant University (LGU) crop production guidelines if used in the absence of a UI FG.

The soil and tissue tests must include analyses pertinent to monitoring nutrient risk or amending the annual nutrient budget, e.g., pH, electrical conductivity (EC) and sodicity where salts are a concern, soil organic matter, phosphorus, potassium, or other nutrients and test for nitrogen where applicable. Follow UI FG regarding required analyses.

Laboratory analysis shall include the soil test components listed in Table 1. Soil samples will be analyzed for soil test phosphorus (STP) using the test methods specified in the applicable UI FGs or other UI production publications containing nutrient guidelines when UI guidelines are not available.

**Table 1. Soil sampling depth and testing criteria for annual budget development.**

| Depth (inches) | Soil Constituent Analyzed [1] | Sample Date No Older Than: |
|---|---|---|
| **Northern Idaho** | | |
| 0 – 12 | $NO_3$-N, $NH_4$-N, S | 9 months |
| | P, K, pH, % SOM[2], | 3 years (9 months if manure was applied within 3 years) |
| 12 – 24 | $NO_3$-N | 9 months |
| **Southern Idaho** | | |
| 0 – 12 | $NO_3$-N, $NH_4$-N, S | 3 months |
| | P, K, pH, % SOM[2], % free lime, EC[3] | 3 years (9 months if manure was applied within 3 years) |
| 12 – 24 | $NO_3$-N, $NH_4$-N | 3 months |
| **Soil Quality Criteria[4]** | | |
| 0 – 12 | Soil pH<6: SMP pH[5], CEC and Base Cations[6] or Soil pH>8.5: CEC and Base Cations | 3 years |

[1] Northern Idaho, STP is determined from a standardized extraction using either Morgan (Sodium Acetate) or Bray1 (Ammonium Fluoride-Hydrochloric Acid) methods, and in Southern Idaho from a standardized extraction using the Olsen (Sodium Bicarbonate) method.
[2] SOM is soil organic matter.
[3] Electrical conductivity, salt concentration, soluble salts, etc.
[4] Soil Quality is an important component of NM. The analyzes required will be used to develop the best corrective action for this CMU.
[5] Shoemaker, McLean, and Pratt (SMP) buffer pH lime requirement determination.
[6] Cation Exchange Capacity (CEC), Basic Exchangeable Cations (Ca, Mg, K, and Na).

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the

North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) under the auspices of the Soil Science Society of America (SSSA) and NRCS, or other NRCS approved program that considers laboratory performance and proficiency to assure accuracy of soil test results.

**Surface and Groundwater Risk Assessment.**

Planners must use the current NRCS approved Nitrogen and Phosphorus Risk Assessment tools: Idaho Nutrient Transport Risk Assessment (INTRA), Idaho OnePlan Nutrient Management Planner (OnePlan NMP) and/or Idaho Commercial Fertilizer Planner (ICFNMP); and the current erosion assessment tools: Revised Universal Soil Loss Equation-2 (RUSLE-2) and/or Wind Erosion Prediction System (WEPS) to assess the risk of nutrient and soil losses from the CMU. The identified resource concerns must be addressed to meet current planning criteria. Technical criteria for risk assessments can be found in NI-190-302 and Idaho Water Quality Technical Note 6.

The initial Water Quality Risk Assessment for the CMU is developed using INTRA to document the benchmark Surface and Ground Water Quality (environmental) Risk from historic applications of nutrients and the potential for nutrient transport from the CMU into surface and/or ground waters.

Prior to application of manure or commercial fertilizer to the CMU the planner with assistance from the producer must develop the Nitrogen and/or Phosphorus risk to surface and/or groundwater using either Idaho OnePlan NMP and/or the Idaho Commercial Fertilizer Nutrient Management Planner (ICFNMP).

When there is a moderate or greater risk from the application of nutrients, a system of conservation practices (CPs), including the N and P application criteria listed in Table 2, must be used to avoid, control, or trap manure and nutrients before they can leave the field by surface or subsurface drainage (e.g., tile). The number of applications and the application rates must also be considered to limit the transport of nutrients to surface waters, ground water or conveyance systems like tile drains, surface drains and ponds.

**Table 2.**INTRA Risk Criteria for Fertilizer and Manure Applications

| INTRA Index | Fertilizer and Manure Application Rate | Additional Mitigating Practices |
|---|---|---|
| LOW | P can exceed the crop rotation's P requirement.<br><br>N rates cannot exceed the N requirement for the crop grown following application. | Restrictions limited to mitigating INTRA N leaching risk factors that score HIGH or VERY HIGH in the Ground Water Quality Risk Assessment evaluation. |
| MODERATE | P cannot exceed the rotation's crop P uptake rates.<br><br>N rates must not exceed the N requirement for the crop grown following application. | Appropriate in-field CPs to control runoff/erosion (e.g. residue and tillage mgt) OR filtering practices (buffers) are needed to prevent off-site transport.<br><br>The field must be prepared to prevent runoff from the field following application and prior to incorporation. |
| HIGH | P cannot exceed the rotation's crop P removal rates.<br><br>N rates must not exceed the N requirement for the crop grown following application. | Appropriate in-field CPs to control runoff/erosion (e.g. residue and tillage mgt) AND filtering practices (buffer) are needed to prevent off-site transport.[1]<br><br>The field must have a mitigation plan to prevent runoff from leaving the field throughout the year. |

[1] Lagoon wastewater application can be made for emergency where it has been determined by either ISDA or EPA that the lagoon is at risk and the field has been prepared as a part of the mitigation plan for a surface application of wastewater. Emergency winter application of liquid waste will not be allowed on sod or perennial crops. Rates of emergency application will be determined using a water budget process.

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

**Nutrient Application using the 4-Rs**.

Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater.

The following nutrient management strategies or technologies must be considered when selecting which practice to apply;

- slow and controlled release fertilizers,
- nitrification and urease inhibitors,
- enhanced efficiency fertilizers,
- incorporation or injection,
- timing and number of applications,
- soil nitrate and organic N testing,
- coordinate nutrient applications with optimum crop nutrient uptake,
- Corn Stalk Nitrate Test (CSNT),
- Pre-Sidedress Nitrate Test (PSNT),
- Pre-Plant Soil Nitrate Test (PPSN),
- tissue testing, chlorophyll meters, and spectral analysis technologies,
- other UI recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

**Nutrient Application Rates**.

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

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

If the UI or an adjacent State's LGU does not provide specific guidance that meets these criteria, application rates must be based on plans that consider realistic yield goals and associated plant nutrient uptake rates.

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

For new crops or varieties, industry-demonstrated yield, and nutrient utilization information may be used until land-grant university information is available.

Lower-than-recommended nutrient application rates are permissible if the grower's objectives are met.

Applications of biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient budget. To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with UI guidelines, or industry practice recognized by the UI.

**Nutrient Sources**.

Nutrient sources utilized must be compatible with the application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

**Nutrient Application Timing and Placement**.

Timing and placement of all nutrients must correspond as closely as practical with plant nutrient uptake (utilization by crops), and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment results.

**Nutrient Incorporation.**

Nutrient Incorporation is often the best method of reducing or mitigating the application of surface applied nutrients. Incorporation of phosphorus into the seed bed is an effective way of increasing the availability of P to the crop. This practice also reduces the P from direct contact with surface runoff.

Proper nutrient application in combination with other mitigating practices will help reduce potential of transport to gullies, ditches, surface inlets, sinkhole areas, fractured bedrock or wellhead areas. There should be 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. Recommended mitigating practices include:

- Split fall/spring applications utilizing soil temperatures (<50 $^{o}$ F), nitrification inhibitors, or time release fertilizers, or split spring applications of N to provide nutrients at the times of maximum crop uptake;
- Band P near the seed row;
- Incorporate broadcasted 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 crop usage.

**Protecting 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 sub-basins with impacted surface water (as identified in Idaho Department of Environmental Quality's "Integrated Report").

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 UI Fertilizer Guides when addressing movement of N in the soil profile.

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

Persons who approve plans for nutrient management involving the application of animal waste (manure) shall be certified through the joint certification program of the ISDA, NRCS, UI and Idaho Operations Environmental Protection Agency (EPA), or other acceptable program as designated by the State Conservationist.

For purposes of this standard, animal waste containing less than 10% solids will be classified as a liquid.

**Manure Sampling and Laboratory Analyses (Testing).**

Nutrient values of manure, organic by-products and biosolids must be determined prior to land application.

Manure analyses must include, at minimum, total nitrogen (N), ammonium N, total phosphorus (P) or $P_2O_5$, total potassium (K) or $K_2O$, and percent solids, or follow UI guidance regarding required analyses.

Manure, organic by-products, and biosolids samples must be collected and analyzed at least annually, or more frequently if needed to account for operational changes (feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. If no operational changes occur, less frequent manure testing is allowable where operations can document a stable level of nutrient concentrations for the preceding three consecutive years, unless federal, State, or local regulations require more frequent testing.

Samples must be collected, prepared, stored, and shipped, following UI (CIS 1139) guidance or industry practice.

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

Manure testing analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program (MTLCP) under the auspices of the Minnesota Department of Agriculture, or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results.

**Application of Manure and Organic By-Products**.

Manure nitrogen and phosphorus application rates must be planned based on INTRA risk assessment results utilizing the strategies and mitigating conservation practices listed in Tables 2 and 3.

**Nitrogen-based manure applications** are allowed on CMUs receiving manure, where the INTRA phosphorus risk assessment results equate to **LOW** risk, where nitrogen-based applications are made the application:

1) Can apply additional phosphorus and potassium at rates greater than crop requirement;
2) Cannot exceed the UI nitrogen recommendation for the succeeding crop (current year crop);

3) The application of manure shall match plant uptake characteristics as closely as possible, taking into consideration the timing and availability of nutrient following application(s) in order to minimize leaching and atmospheric losses;
4) Any leaching factors in the nitrogen risk assessment scoring higher than LOW must be mitigated with conservation practices to reduce the potential leaching of nitrogen in the current crop grown.

**Phosphorus-based manure applications** are allowed on CMUs with restrictions based on the INTRA Surface Water Quality Risk Assessment and STP Idaho Threshold Criteria (Table 3). Where phosphorus-based applications are made the application rate shall:

1) Not exceed the recommended nitrogen UI application rate for the current crop during the year of application; and
2) Not be made on sites considered vulnerable to offsite phosphorus transport unless appropriate conservation practices, best management practices or management activities are used to reduce the vulnerability.

When manures are applied, and soil salinity is a concern, salt concentrations must be monitored to prevent potential crop damage and/or reduced soil quality.

The total single application of liquid manure;

- must not exceed the soil's infiltration or water holding capacity,
- be based on crop rooting depth,
- must be adjusted to avoid runoff or loss to subsurface tile drains.

Crop production activities and nutrient use efficiency technologies must be coordinated to take advantage of mineralized plant-available nitrogen to minimize the potential for nitrogen losses due to denitrification or ammonia volatilization.

For fields receiving manure, where **INTRA** phosphorus risk assessment results equate to **MODERATE** risk, additional phosphorus may be applied at a phosphorus crop uptake rate for the planned crops in the rotation.

When **INTRA** phosphorus risk assessment results equate to **HIGH** risk, additional phosphorus may be applied at phosphorus crop removal rates if the following requirements are met;

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

Any deviation from these high risk requirements must have the approval of the Chief of the NRCS.

**Table 3. Phosphorus Thresholds for Phosphorus Applications based on Primary Resource Concern and STP**

| **Idaho Soil Test Phosphorus Thresholds** | | | | |
|---|---|---|---|---|
| **Primary Resource Concern [1]** | **IDPTH Soil Sample Depth** | **STP (ppm)** | | |
| | | **Olsen ($NaHCO_3$)** | **Bray-1 ($NH_4F$-HCl)** | **Morgan (NaAcO)** |
| | | **Agronomic Threshold** | | |
| Surface Water | 0" – 12" | 40 | 70 | 7 |
| | | **Drawdown Threshold[2]** | | |
| Surface Water | 0" – 12" | 80 | 140 | 14.0 |
| | | **"Zero Out" Threshold[3]** | | |
| Surface Water | 0" – 12" | 160 | 280 | 28 |

[1] If 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 necessary.
[2] If the STP factor in the INTRA Surface Water risk is HIGH producer is required to develop a drawdown strategy which includes a 50% reduction in the proposed P application. A site assessment for nutrients and soil loss must be conducted to determine if mitigation practices are required to protect water quality.
[3] The STP factor in the INTRA Surface Water risk is VERY HIGH and has reached a point above where the risk of P loss from a field is too great to warrant the application of P in any form.

Manure or organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass, not to exceed UI recommendations.

Manure may be applied at a rate equal to the recommended phosphorus application, or estimated phosphorus removal in harvested plant biomass for the first crop of the rotation, or multiple years in the crop sequence at one time. When such applications are made, the application rate must not exceed the acceptable phosphorus risk assessment criteria, must not exceed the recommended nitrogen application rate during the year of application or harvest cycle, and no additional phosphorus must be applied in the current year and any additional years for which the single application of phosphorus is supplying nutrients.

Manure must not be surface-applied if nutrient losses offsite are likely. This prevents spreading on;

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

Exceptions for the above criteria is made for the emergency application of lagoon slurry/wastewater where is has been determined by either ISDA or EPA that the lagoon is at risk and the risk from field application is less than the risk associated from a direct discharge from the lagoon. The field has to be prepared to prevent a direct discharge from the field and specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients.

At a minimum, the following site and management factors must be considered;

- slope,
- soil surface condition (cross slope rough tillage),
- organic residue and living covers,
- amount and form of manure to be applied,
- adequate setback distances to protect local water quality,
- liquid waste will not be allowed on sod or perennial crops, and
- rates of application will be determined using a water budget process.

**Additional Criteria to Protect Air Quality by Reducing Odors, Nitrogen Emissions and the Formation of Atmospheric Particulates**

To address air quality concerns caused by odor, nitrogen, sulfur, and/or particulate emissions, the source, timing, amount, and placement of nutrients must be adjusted to minimize the negative impact of these emissions on the environment and human health. One or more of the following will be used;

- slow or controlled release fertilizers,
- nitrification inhibitors,
- urease inhibitors,
- nutrient enhancement technologies,
- incorporation,
- injection,
- stabilized nitrogen fertilizers,
- residue and tillage management,
- no-till or strip-till,
- other technologies that minimize the impact of these emissions.

Do not apply poultry litter, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material offsite.

**Additional Criteria to Improve or Maintain the Physical, Chemical, and Biological Condition of the Soil to Enhance Soil Quality for Crop Production and Environmental Protection**

Time the application of nutrients to avoid periods when field activities will result in soil compaction.

In areas where salinity is a concern, select nutrient sources that minimize the buildup of soil salts.

Soil pH must be maintained in a range that enhances an adequate level for crop nutrient availability and utilization (TN AGRONOMY NO. 21). Reference University of Idaho (UI) specific Fertilizer Guides and Mahler, 2002 for guidance.

Idaho soils having a pH < 6.0 should be analyzed for Shoemaker, McLean, and Pratt (SMP) buffer pH lime requirement determination (TN NM No. 8); Cation Exchange Capacity (CEC), Basic Exchangeable Cations (Ca, Mg, K, and Na). Buffered (SMP) pH. When the SMP pH test shows a requirement for lime then the SMP pH shall be used to make a lime recommendation to adjust the soil pH to an acceptable soil pH).

If the soil's electrical conductivity (EC) test also referenced as salt concentration, soluble salts, etc. shows that the crops to be grown are potentially affected by salts in the soil, then the Irrigation Management Plan (IWM) shall reflect a strategy to reduce the salt in the root zone. The IWM plan should include an analysis of the

irrigation water to determine its Sodium Adsorption Ratio (SAR) (Ag HB 60).

Idaho soils with a pH > 8.5 should be analyzed for Basic Exchangeable Cations or Saturated Paste Soluble Cations (Ca, Mg, K, and Na), and the Exchangeable Sodium Percentage (ESP) calculated. When the ESP exceeds 15% then the Conservation Plan must reflect a strategy to reduce the Sodium in the rooting zone. This is accomplished by applying gypsum (Calcium sulfate) in the absence of free calcium carbonate in the rooting zone or elemental sulfur if free lime is present in the rooting zone (Ag HB 60).

**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 (RMS) level of treatment.

Elevated P levels in surface water are detrimental to its beneficial use. Runoff waters when exposed to high levels of STP have the potential of extracting elevated of P. The STP should not exceed the "Zero-Out" threshold established to protect the environment.

Use no-till/strip-till in combination with cover crops to sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve infiltration, and enhance soil biological activity to improve nutrient use efficiency.

Use nutrient management strategies such as cover crops, crop rotations, and crop rotations with perennials to improve nutrient cycling and reduce energy inputs.

Use variable-rate nitrogen, phosphorus, and/or potassium application rates based on site-specific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors or evaluations.

Develop site-specific yield maps using a yield monitoring system. Use the data to further diagnose low- and high- yield areas, or zones, and make the necessary management changes. See Title 190, Agronomy Technical Note (TN) 190.AGR.3, Precision Nutrient Management Planning.

Use manure management conservation practices to manage manure nutrients to limit losses prior to nutrient utilization.

Apply manure at a rate that will result in an "improving" Soil Conditioning Index (SCI) without exceeding acceptable risk of nitrogen or phosphorus loss.

Use legume crops and cover crops in lieu of commercial fertilizers to provide nitrogen through biological fixation and nutrient recycling.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standard (CPS) Code 592, Feed Management.

Soil test information should be no older than one year when developing new plans.

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients. Excessive levels of some nutrients can cause induced deficiencies of other nutrients, e.g., high soil test phosphorus levels can result in zinc deficiency in corn.

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in the NRCS National Nutrient Policy in GM 190, Part 402, Nutrient Management.

Potassium should not be applied in situations where an excess (greater than soil test potassium recommendation) causes nutrient imbalances in crops or forages.

**Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater**.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips. These practices can also reduce the loss of nitrates or soluble phosphorus.

Use application methods and timing strategies that reduce the risk of nutrient transport by ground and surface waters, such as:

- Split applications of nitrogen to deliver nutrients during periods of maximum crop utilization.
- Banded applications of nitrogen and/or phosphorus to improve nutrient availability.
- Drainage water management to reduce nutrient discharge through drainage systems, and incorporation of surface-applied manures or organic by-products if

precipitation capable of producing runoff or erosion is forecast within the time of planned application.

- Use plant tissue testing during the growing season to monitor crop nutrient concentrations. Tissue sampling shall be done in accordance with UI guidelines.
- Use the agricultural chemical storage facility conservation practice to protect air, soil, and water quality.
- Use bioreactors and multistage drainage strategies when approved by the land-grant university.
- When soil test P concentration approaches 75% of the Drawdown P Threshold, consider developing the nutrient management plan using application rates at crop P uptake or less, or consider growing crops that have a greater potential to remove P from the system.
- When soil test P concentrations are above the Drawdown P Threshold, P application rates less than crop P uptake should be utilized to reduce the soil phosphorus level.
- When monitoring indicates STP concentrations are increasing over time, consider reviewing the nutrient management plan and implementation for appropriate changes to reduce the P applied, especially when soil test P is near or above the Drawdown P Threshold.

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

- Avoid applying manure and other by-products upwind of inhabited areas.
- Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses.
- Solid manure waste applications used as part of a management system on croplands that have soils erodible by wind and low potential for runoff should utilize delayed incorporation.
- Utilize manure injection technologies.
- For manure applications, location of nearby residences, or other locations where humans may be present on a regular basis, and any identified meteorological (e.g., prevailing winds at different times of the year), or topographical influences that may affect the transport of odors to those locations;

**PLANS AND SPECIFICATIONS**

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

- Aerial site photograph(s)/imagery or site map(s), and a soil survey map of the site;
- Soil information including: soil type surface texture, pH, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and/or ponding frequency;
- Location of designated sensitive areas and the associated nutrient application restrictions and setbacks;
- Results of approved risk assessment tools (INTRA,RUSLE-2 and/or WEPS) risk assessment for nitrogen, phosphorus, and erosion losses;
- Documentation establishing that the application site presents low risk for phosphorus transport to local water when phosphorus is applied in excess of crop requirement;
- Current and/or planned plant production sequence (crop rotation);
- Soil, water, compost, manure, organic by-product, and plant tissue sample analyses applicable to the NMP plan;
- When soil phosphorus levels reach the STP Drawdown Threshold, include a discussion of the risk associated with phosphorus accumulation and a proposed phosphorus draw-down strategy;
- Realistic yield goals for the crops;
- Complete nutrient requirements for nitrogen, phosphorus, and potassium for the crop rotation;
- Amounts and types of all nutrient sources used in the NMP Plan;
- All enhanced efficiency fertilizer products that are planned for use;
- In accordance with the nitrogen and phosphorus (INTRA) risk assessment tool(s), specify the recommended nutrient application source, timing, amount (except for precision/variable rate applications specify method used to determine rate), and

placement of plant nutrients for each field or management unit; and

- Guidance for implementation, operation and maintenance, and recordkeeping.

In addition, the following components must be included in a precision/variable rate nutrient management plan:

- Document the geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations.
- Document the nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.

If increases in soil phosphorus levels are expected (i.e., when N-based manure application rates are used), the nutrient management plan must document:

- the soil phosphorus levels at which it is desirable to convert to phosphorus based planning;
- the potential plan for soil test phosphorus drawdown from the production and harvesting of crops, and management activities or techniques used to reduce the potential for phosphorus transport and loss;
- for AFOs, a quantification of manure produced in excess of crop nutrient requirements, and a long-term strategy and proposed implementation timeline for reducing soil P to levels that protect water quality,

**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.

Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised, as needed with each soil test cycle, changes in manure volume or analysis, crops, or crop management.

Fields receiving animal manures and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with land- grant university guidance and State law.

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

- increase or decrease 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,
- changes in livestock type,
- changes in feed rations.

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

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

**Field Records**. Records must be maintained for at least 5 years to document plan implementation and maintenance. As applicable, records include:

- Soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application;
- Document if a variable rate nutrient or soil amendment application was made.
- Provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all applications that resulted from use of the precision agriculture process for nutrient or soil amendment applications.
- Maintain the electronic records of the GIS data layers and nutrient applications for at least 5 years. Quantities, analyses and sources of nutrients applied;
- Dates, and method(s) of nutrient applications, source of nutrients, and rates of application;

- Weather conditions and soil moisture at the time of application; lapsed time to manure incorporation; rainfall or irrigation event;
- Crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and crop residues removed;
- Dates of plan review, name of reviewer, and recommended changes resulting from the review; and
- All enhanced efficiency fertilizer products used.

Additional records for precision/variable rate sites must include:

- Maps identifying the variable application source, timing, amount, and placement of all plant nutrients applied; and
- GPS-based yield maps for crops where yields can be digitally collected.
- Document if a variable rate nutrient or soil amendment application was made.
- Provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all applications that resulted from use of the precision agriculture process for nutrient or soil amendment applications.
- Maintain the electronic records of the GIS data layers and nutrient applications for at least 5 years.

**Annual Nutrient Budget.** Soils samples used to develop the annual nutrient budget shall meet the criteria in Table 1. The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance:

Nitrogen (N), Phosphorus (P) and Potassium (K) application rates shall match the UI FG recommended rates as closely as possible or within reasonable limits, except when manure or organic by-products are a source of nutrients.

Reasonable limits are defined as 40 lb-N, 20 lb-$P_2O_5$ and 40 lb-$K_2O$ per acre.

When the applied fertilizer rate exceeds the reasonable limits defined above, the application must be justified by either a pre-application soil test, or an approved tissue test or feed analysis. Mitigating Conservation Practices (MCPs) are required

MCPs are required for over-application of N without justification, a post-harvest rooting depth soil test (Soil Nitrate-N, % moisture and Soil Texture) at foot increments will be required to determine if the soil solution throughout and at the bottom of the rooting depth exceed the National drinking water standard of 10 ppm Nitrate-N.

Potassium shall not be applied in situations in which excess $K_2O$ causes unacceptable nutrient imbalances in crops or forages.

The planned rates of application of other plant nutrients shall be consistent with the UI Nutrient Recommendations,

A starter band of up to 30 lb of $P_2O_5$ per acre is allowed on fields with a STP less than the Agronomic Threshold under special localized conditions (wet-cold or high P fixing soils). When starter fertilizers are used, they shall be applied in accordance with the UI recommendations.

**Safety.** 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. If the history of composting is not complete, then take extra caution in handling these materials since they could be a source of E-coli and intrinsic viruses and other disease vectors.

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.

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.

Safety must be a primary consideration in managing animal waste. It must be considered during planning, siting, and designing of agricultural waste management system (AWMS) components, as well as during the actual operation of handling wastes. The operator must be made aware of safety aspects of any waste management system and the AWMS components under consideration. The potential for an accident with waste management components is always present.

Odors and nuisance flies can be a problem with storage and management of animal wastes. The operator must be made aware that enlarging the surface area of the waste management system also increases the potential for generation of greater risk to odors and nuisance flies.

A variety of gases can be generated in the operation of an AWMS that can cause asphyxiation, poisoning, and explosions. Manure gases can accumulate when manure is stored in environments that do not have adequate ventilation, such as underground covered waste storage tanks. Waste storage facilities and lagoons placed in open environments also store and release gases, especially during agitation. These gases can reach toxic concentrations and displace oxygen. The four main gases are ammonia ($NH_3$), carbon dioxide ($CO_2$), hydrogen sulfide ($H_2S$), and methane ($CH_4$).

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