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. NOTE: State regulations take precedence over this standard.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient plan 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 (sewage sludge), effluent, organic matter, soil biological activity, all soil amendments, commercial fertilizer, and irrigation water.

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 State fertilizer control official, or similar authority, with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims.
For nutrient risk assessment policy and procedures see Title 190, General Manual (GM), Part 402, Nutrient Management, and Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation.

To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with Texas A&M AgriLife Extension Soil, Water and Forage Testing Laboratory (SWFTL) guidelines, or industry practice recognized by SWFTL. See http://soiltesting.tamu.edu/

**Conservation Management Unit (CMU) Risk Assessment.** In fields with identified or designated nutrient related water quality impairment, a CMU specific risk assessment of the potential for nutrient transport shall be completed. Use an appropriate nutrient risk assessment tool for the nutrient in question.

The NRCS-approved nutrient risk assessment for nitrogen must be completed on all CMU sites unless the State NRCS, with the concurrence of State water quality control authorities, has determined specific conditions where nitrogen is not a risk to water quality, including drinking water.

A Nitrogen Leaching Index will be completed on CMU/fields receiving manures, organic by products or soil amendments that have gravelly, sandy or loamy sand surface textures. Appropriate measures will be planned to reduce leaching potential on sites with a leaching index greater than 2.

For nitrogen risk assessment, see Agronomy Technical Note TX-11, “Nitrogen Leaching Index for Texas”, Revised December 2012, for guidance.

The NRCS-approved nutrient risk assessment for phosphorus (Agronomy Technical Note Number 15 – Phosphorus Assessment Tool) must be completed when:

- Conservation Management Units receive manures, organic by-products or soil amendments
- phosphorus application rate exceeds SWFTL fertility rate guidelines for the planned crop(s), or
- the planned area is within a phosphorus impaired watershed (contributes to 303d-listed water bodies), or
- the NRCS and State water quality control authority have not determined specific conditions where the risk of phosphorus loss is low.

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

For Phosphorus risk assessment, see Agronomy Technical Note TX-15, “Phosphorus Assessment Tool for Texas”, Revised December 2012, for guidance.

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

Areas contained within minimum application setbacks (e.g., sinkholes, wellheads, gullies, ditches, surface inlets or rapidly permeable soil areas) shall not receive direct application of nutrients.

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

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Soil pH must be maintained in a range that enhances an adequate level for crop nutrient availability and utilization. Refer to "Table 1 of Agronomy Technical Note TX-13 –Liming Information and Recommendations" for recommended pH ranges for common crops.

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

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

Current soil tests are those that do not exceed the appropriate frequency discussed in Appendix 1 or as required by state code or regulation. State regulations for application of manure take precedence over Appendix 1 guidelines. Budgeting procedures to be used during years when soil tests are not taken are also included in Appendix 1. Soil sampling depths will vary according to cropping system and previous management. Appendix 2 will be used to determine soil sampling depth. The area represented by a soil test must be that acreage recommended by SWFTL, or as determined by state regulations.

Soil test information will be no older than 90 days upon initiating new plans.

Soil and tissue samples shall be collected and prepared according to SWFTL guidance or state regulations. Soil test analyses shall be performed by laboratories that use the acceptable soil test methods as stated in Appendix 3. Additional SWFTL information can be found in the links shown in Appendix 4 or other Texas A&M AgriLife Research and Extension published material.

Where a conservation management unit (CMU) is used as the basis for a sampling unit, all acreage in the CMU must have similar soil type, cropping history, and management practice treatment.

The soil and tissue tests must include analyses pertinent to monitoring or amending the annual nutrient budget or plan, e.g., pH, electrical conductivity (EC), phosphorus, potassium, or other nutrients and test for nitrogen where applicable. The SWFTL guidelines require that soil analyses include pH, electrical conductivity, NO$_3$-N, P, K, Ca, Mg, S and Na. Other analyses, such as soil organic matter content, may be pertinent to monitoring or amending the annual nutrient budget.

Soil test analyses must be performed by laboratories participating in the North American Proficiency Testing Program under the auspices of the Soil Science Society of America (SSSA) and NRCS or SWFTL approved program that considers laboratory performance and proficiency to assure accuracy of soil test results.

Nutrient values of manure, organic by-products, soil amendments and biosolids (sewage sludge) must be determined prior to land application or as directed by Texas Commission on Environmental Quality (TCEQ) permit requirements.

At a minimum, manure analyses shall identify total nitrogen, phosphorus, potassium, calcium, magnesium, sodium, iron, manganese, zinc, copper, sulfur and percent moisture or percent solids, as appropriate for solids or effluent.

Salt concentration in the soil shall be monitored so that manure applications do not cause plant damage or negatively impact soil health.

Manure, organic by-products, and biosolids (sewage sludge) 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. If there is no prior sampling history, manure testing shall be developed and maintained until a consistent (maintaining a certain nutrient concentration with minimal variation) level of nutrient values is realized for that operation.

**Heavy Metal Monitoring.** When sewage sludge is applied, the accumulation of potential pollutants (including arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc) in the soil shall be monitored in accordance with the TCEQ Regulations, TAC, Title 30, Chapter 312 – Sludge Use, Disposal and Transportation and any local laws or regulations.

Samples shall be collected, prepared, stored, and shipped, following SWFTL guidance, state regulations or industry practice.

When planning for the first year of new or modified livestock operations, acceptable “book values” recognized by the NRCS (e.g., NRCS Agricultural Waste Management Field Handbook) and Texas A&M University Soil and Crop Sciences Department, 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 SWFTL recognized program that considers laboratory performance and proficiency to assure accurate manure test results. The method of manure analyses as specified by SWFTL is found in Appendix 3 under heading of “Biosolids”.

**Nutrient Application Rates.**

Planned nutrient application rates for nitrogen, phosphorus, potassium and other nutrients must not exceed SWFTL guidelines or industry practice when recognized by SWFTL.

Nitrogen and phosphorus application rates shall match the recommended rates as closely as possible. If actual application rates differ from the recommended fertilizer rates, records for the nutrient management plan shall document the reason.

When agricultural manures are land applied, application rates shall be consistent with the requirements of the NRCS conservation practice standard for Nutrient Management (590) and Appendix 5, Table 1 or Table 2.

In planning for new operations, acceptable “book values” recognized by the NRCS and/or Texas A&M University Soil and Crop Sciences Department may be used if they accurately estimate nutrient output from the proposed operation (e.g., NRCS Agricultural Waste Management Field Handbook).

Where agricultural manures are to be spread on land not owned or controlled by the producer, the 590 Organic Nutrient Management Plan, as a minimum, shall document the amount of manure transferred.

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 SWFTL 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.

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.
Yield goal may be determined by collecting the actual yield for the past six years, dropping the highest and lowest yields in this time frame, then averaging the yields of the remaining four years.

It may be difficult to locate phosphorus fertilizer formulations that do not include nitrogen. When recommended nutrient rates cannot be matched with available formulations, it may be best to meet 100% of the phosphorus recommendation and follow-up with the remaining required nitrogen.

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

For multi-year nutrient budgets, the applications of irrigation water, organic by-products, effluent, manures, soil amendments, biosolids (sewage sludge), starter fertilizers, or pop-up fertilizers must be accounted for.

Biosolids (sewage sludge) shall be applied in accordance with TCEQ Regulations, TAC, Title 30, Chapter 312 – Sludge Use, Disposal and Transportation and any local regulations regarding the use of biosolids (sewage sludge) as a nutrient source.

**Nutrient Sources.**

Nutrient sources utilized must be compatible with the application timing, tillage and planting system, soil properties, crop, crop rotation, 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 (e.g., Nitrogen Leaching Index, Phosphorus Index) results.

Pre-plant nitrogen applications must not precede the normal planting date of the target crop by more than 120 days if incorporated within 48 hours and 30 days if surface applied.

Nutrients must not be surface-applied if nutrient losses offsite are likely. This precludes spreading on:

- frozen and/or snow-covered soils, and
- when the top 6 inches of soil are saturated from rainfall or snow melt.

Exceptions for the above criteria can be made for surface-applied manure when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. The adequate treatment level and specified conditions for winter applications of manure must be defined by NRCS in concurrence with the water quality control authority in the State. At a minimum, the following site and management factors must be considered:

- slope,
- organic residue and living covers,
- amount and form of nutrients to be applied, and
- adequate setback distances to protect local water quality.
Priority areas for land application of agricultural nutrients (organic and inorganic) should be on gentle slopes located as far as possible from waterways. When manures or effluent are applied on more sloping land or land adjacent to waterways that drains directly into the waterway, other conservation practices should be installed to reduce the potential for offsite transport of effluent or manures.

Effluent or manures will not be applied to slopes steeper than 8% with a runoff curve >80 or steeper than 16% slope with a runoff curve 70 or greater, unless applied as a component of an erosion control plan, i.e., Critical Area Planting (342), reclamation work, etc.

It is preferable to apply manures on pastures and hayland at spring greenup or soon after cutting or grazing before regrowth has occurred.

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

Planners must use the current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the risk of nutrient and soil loss. Identified resource concerns must be addressed to meet current planning criteria (quality criteria). Technical criteria for risk assessments can be found in NI-190-302.

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. When there is a high risk of transport of nutrients, conservation practices must be coordinated to avoid, control, or trap manure and nutrients before they can leave the field by surface or subsurface drainage (e.g., tile). The number of applications and the application rates must also be considered to limit the transport of nutrients to tile. All agricultural nutrients (organic and inorganic) shall be utilized in a manner that minimizes the opportunity for contamination of surface and ground water supplies.

The required minimum distance (setback) will be maintained from private or public drinking water supply wells. A minimum application distance for water wells used exclusively for agricultural irrigation will be planned and implemented. An exception to the full well setback zone for a private drinking water well or a water well used exclusively for agricultural irrigation may be established by a licensed Texas professional engineer or licensed Texas professional geoscientist to document that additional wellhead protective measures will be or have been implemented that will prevent pollutants from entering the well and contaminating groundwater. Additional protective measures may include a sanitary seal, annular seal, a steel sleeve, or surface slab. Refer to Texas Commission on Environmental Quality, Chapter 321 – Control of Certain Activities by Rule.

When using an irrigation system for fertigation, the system shall be equipped with properly designed operating valves and components to prevent backflows into ground and surface water.

Agricultural effluent and manures shall not be land applied on soils that are frequently flooded or ponded, as defined by the National Cooperative Soil Survey, during the period when flooding is expected.

When effluents are applied, the application rate shall not exceed the infiltration rate of the soil, and the amount shall not exceed the moisture holding capacity of the upper 24 inches of the soil profile at the time of application. Effluent application shall not result in direct runoff of effluent from edge of the field during the time of application. As guidance, refer to NRCS publication "Determining Effluent Application Rates" (December 2012) and NRCS Program Aid 1619 – “Estimate Soil Moisture by Feel and Appearance”.

Effluents or manures shall not be applied to frozen, snow-covered or saturated soil if the potential risk for runoff exists. The basis for the decision to apply effluent or manures under these conditions shall be documented in the 590 Organic Nutrient Management Plan.
Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater. The following nutrient use efficiency strategies or technologies must be considered:

- soil test and tissue test
- incorporation or injection
- timing and number of applications
- soil nitrate N testing prior to planting
- coordinate nutrient applications with optimum crop nutrient uptake
- SWFTL and Texas A&M AgriLife Research and Extension recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

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

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

The total single application of liquid manure:

- must not exceed the soil’s infiltration or water holding capacity to 24 inches
- 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.

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

Application of all organic soil amendments will not exceed the values listed in **APPENDIX 5, Table 1** or **Table 2**.

Application rates under **APPENDIX 5, Table 1** are based on crop requirement rates. A Nutrient Management Plan (NMP) is required where Soil Test P Level is less than 200 ppm statewide or less than 350 ppm in arid areas with distance to a named stream greater than one mile.

Application rates under **APPENDIX 5, Table 2** are based on crop removal rates. A Nutrient Utilization Plan (NUP) is required where Soil Test P Level is equal to or greater than 200 ppm in non-arid areas, or equal to or greater than 350 ppm in arid areas with distance to a named stream greater than one mile, or equal to or greater than 200 ppm in arid areas with distance to a named stream less than one mile.
When phosphorus risk assessment results equate to HIGH or VERY HIGH risk and the soil test phosphorus level is greater than the critical phosphorus level for a given phosphorus index rating, additional phosphorus may be applied according to APPENDIX 5, Table 1 or Table 2 if the following requirements are met:

- a soil phosphorus drawdown strategy has been implemented, and
- a site assessment for nutrients and soil loss has been conducted to determine if mitigation practices are required to protect water quality.
- any deviation from these high risk requirements must have the approval of the Chief of the NRCS.

There is a point above which the risk of phosphorus loss from a field is too great to warrant additional application of phosphorus for plant production. When soil test phosphorus levels are greater than or equal to 500 ppm, with a P-Index rating of “HIGH” or “VERY HIGH”, there will be no additional application of phosphorus to a CMU or field.

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 SWFTL recommendations.

Manure may be applied at a rate equal to the recommended phosphorus application, or estimated phosphorus removal in harvested plant biomass for the crop 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.

Additional practices to enhance the producer’s ability to manage manure effectively include modification of the animal’s diet to reduce the manure nutrient content, or utilizing manure amendments that stabilize or tie-up nutrients.

**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 shall be used:

- incorporation
- injection
- 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 from the application area.

**Additional Criteria to Improve or Maintain the Physical, Chemical, and Biological Condition of the Soil to Enhance Soil Health 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.

**CONSIDERATIONS**

The use of management activities and technologies listed in this section may improve both the production and environmental performance of nutrient management systems.

For sites in which there are special environmental concerns, other sampling techniques, efficiency strategies or technologies may be considered:

- slow and controlled release fertilizers
- nitrification inhibitors and urease inhibitors
- enhanced efficiency fertilizers
- Corn Stalk Nitrate Test (CSNT), Pre-sidedress Nitrate Test (PSNT), and Pre-Plant Soil Nitrate Test (PPSN).
- soil surface sampling for phosphorus accumulation or pH changes

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.

When tillage is a planned activity for the field, surface applications of manure and fertilizer nitrogen formulations that are subject to volatilization on the soil surface (e.g. urea) should be incorporated into the soil within 24 hours after application to minimize odor.

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

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.

If land application of composted or treated animal mortality residues is planned, a description of planned routine and catastrophic mortality management activities will be included in the 590 Organic Nutrient Management Plan.
Apply manure at a rate that will result in an “improving” Soil Conditioning Index (SCI) without exceeding acceptable risk of nitrogen or phosphorus loss.

Use legume crops and cover crops to provide nitrogen through biological fixation and nutrient recycling.

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

Excessive levels of some nutrients can cause induced deficiencies of other nutrients, e.g., high soil test phosphorus levels can result in micronutrient deficiencies in crops.

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients.

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

Potassium should not be applied in situations where an excess (greater than soil test potassium recommendation) causes nutrient imbalances in crops or forages. When forage quality is an issue associated with excess potassium application, soil test magnesium levels should be maintained at high levels. Potassium to magnesium ratio should be less than 5 to 1, and the calcium to magnesium ratio should not exceed 15 to 1.

Forage testing or livestock supplementation may reduce the potential problems of grass tetany and milk fever which can occur due to manure application, in which potassium is often over applied. Grass tetany should not be a problem if magnesium concentrations in forage are 0.2% or more.

Agricultural manures can contain pathogens and nutrients that can potentially be carried into surface water by rainfall runoff. Manures should be utilized in a manner that maximizes food safety. Refer to the following:

- Texas AgriLife Extension publication on Land Application of Organic Fertilizers or Amendments
- USDA NRCS Technical Note No. 7, “Reducing Risk of E. Coli 0157:H7 Contamination” and Nutrient Management Technical Note No.9, “Introduction to Waterborne Pathogens in Agricultural Watersheds”.
- On organic operations, management must be consistent with the USDA’s National Organic Program Rules, refer to Part 205.203 Soil fertility and crop nutrient management practice standard.

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.

Cover crops can effectively utilize and/or recycle residual nitrogen.

Use application methods, sampling and timing strategies that reduce the risk of nutrient transport to 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,
• tile drainage water management to reduce nutrient discharge through drainage systems,
• 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.
• delay field application of animal manures or organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.
• limit effluent application to the volume of liquid that can be stored in the root zone or top 24 inches.

Use the Agrichemical Handling Facility (309) conservation practice standard to protect air, soil, and water quality when handling agrichemicals.

**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. Odors associated with the land application of manures and organic by-products can be offensive to the occupants of nearby homes. Avoid applying these materials upwind of occupied structures when residents are likely to be home (evenings, weekends and holidays).

On tilled cropland, incorporate surface applications of solid forms of manure or other organic by-products into the soil within 24 hours of application to minimize emissions and to reduce odors. On grazing land or forest land where incorporation is not an option, timing and placement of manures will be managed to reduce the impact of odor on adjacent land owners.

When manure is being injected into the subsurface, it shall be applied at a depth and rate that minimize leaks onto the soil surface and disturbances to the soil surface and plant community.

All materials shall be handled in a manner to minimize the generation of particulate matter, odors and greenhouse gases.

Operators will handle and apply poultry litter or other dry types of animal manures when the potential for wind-driven loss is low and there is less potential for transport of particulates into the atmosphere.

Solid manure should be handled and applied when there is less potential for blowing and emission of particulates in the atmosphere. The basis for applying manure under these conditions should be documented in the 590 Organic Nutrient Management Plan.

Liquid forms of manure should be applied when there is high humidity, little or no wind, a rainfall event predicted in the near future and/or other conditions that will minimize volatilization losses into the atmosphere. The basis for applying manure under these conditions should be documented in the 590 Organic Nutrient Management Plan.

Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses. Modifying the equipment can reduce the potential for volatilization of nitrogen from the time the manure leaves the application equipment until it reaches the surface of the soil (e.g., reduced pressure, drop down tubes for center pivots). Nitrogen volatilization from manure in a surface irrigation system will be reduced when applied under a crop canopy.
Nutrient applications associated with irrigation systems should be applied in accordance with the requirements of Irrigation Water Management (Code 449).

**PLANS AND SPECIFICATIONS**

Plans and specifications for nutrient management 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 resource impairment.

In planning for new operations, acceptable “book values” recognized by the NRCS and/or Texas A&M University Soil and Crop Sciences Department may be used if they accurately estimate nutrient output from the proposed operation (e.g., NRCS Agricultural Waste Management Field Handbook).

Nutrient management plans shall include a statement that the plan was developed based on requirements of the current standard and any applicable Federal, State or local regulations, policies, or programs, which may include the implementation of other practices and/or management activities. Changes in any of these requirements may necessitate a revision of the plan.

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 series, surface texture, pH, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and/or ponding frequency,
- location of designated sensitive areas and the associated nutrient application restrictions and setbacks,
- for manure applications, 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,
- results of approved risk assessment tools for nitrogen, phosphorus, and erosion losses,
- historic, current and planned plant production sequence or crop rotation,
- documentation indicating the approximate locations and acreage represented by the composite soil samples, soil sampling depths, and other procedures including the time of year sampling will be conducted and the soil testing frequency.
- soil, water, compost, manure, organic by-product, and plant tissue sample analyses applicable to the plan,
- soil test for phosphorus must be Mehlich III by (ICP) inductively coupled plasma
- nutrient recommendations will be based on applicable analyses and SWFTL guidance
- when soil phosphorus levels are > 200 ppm in non-arid areas or >350 ppm in arid areas (See Phosphorus Assessment Tool For Texas, Agronomy Technical Note Number 15), include a discussion of the risk associated with phosphorus accumulation and proposed options for a phosphorus draw-down strategy,
- realistic yield goals for the crops,
• complete nutrient budget for nitrogen, phosphorus, and potassium for the plant production sequence or crop rotation,

• listing and quantification of all nutrient sources and form,

• all enhanced efficiency fertilizer products that are planned for use,

• in accordance with the nitrogen and phosphorus risk assessment tool(s), specify the recommended nutrient application source, timing, amount (except for precision/variable rate applications specify method used to determine rate), and placement of plant nutrients for each field or conservation 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.

• 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.

• Prescriptions for variable rates should be made by a Registered Professional Agronomist, Certified Crop Adviser or Nutrient Management Specialist in accordance with SWFTL guidelines.

• Maintain the electronic records of the GIS data layers and nutrient applications for at least 5 years.

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

• the soil phosphorus levels at which it is desirable to convert to phosphorus based planning,

• the potential plan for soil test phosphorus drawdown from the production and harvesting of crops,

• 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 phosphorus to levels that protect water quality (See Phosphorus Assessment Tool For Texas, Agronomy Technical Note number - 15 for soil test phosphorus levels).

OPERATION AND MAINTENANCE

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

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

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

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

Records must be maintained for at least 5 years or longer if required by other Federal, State or local ordinances, programs or contract requirements, in order to document plan implementation and maintenance. As applicable, records include:

- soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application,
- quantities, analyses and sources of nutrients applied,
- dates and method(s) of nutrient applications, source of nutrients, and rates of application,
- weather conditions and soil moisture at the time of application; lapsed time to manure incorporation; rainfall or irrigation event,
- crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and crop residues removed,
- dates of plan review, name of reviewer, and recommended changes resulting from the review.
- 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.

Workers should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling ammoniacal nutrient sources, or when dealing with organic wastes stored in unventilated enclosures.

Material generated from cleaning nutrient application equipment should be utilized in an environmentally safe manner. Excess material should be collected and stored or field applied in an appropriate manner.
Nutrient containers should be recycled in compliance with state and local guidelines or regulations.

REFERENCES


USDA NRCS Nutrient Management Technical Note No. 7, “Reducing Risk of E.coli 0157:H7 Contamination”.

USDA NRCS Nutrient Management Technical Note No.9, “Introduction to Waterborne Pathogens in Agricultural Watersheds”.
APPENDIX 1

SOIL TEST FREQUENCIES (in years) $^{1,2,3}$

<table>
<thead>
<tr>
<th></th>
<th>Rainfall &lt; 25”</th>
<th>Irrigation + Rainfall &gt; 25”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure or Organic By-Products</td>
<td>Annually</td>
<td>Annually</td>
</tr>
<tr>
<td>Vegetative Establishment $^4$</td>
<td>Prior to Planting</td>
<td>Prior to Planting</td>
</tr>
<tr>
<td>All Other Inorganic Fertilizer Applications</td>
<td>1 of 5</td>
<td>1 of 3</td>
</tr>
</tbody>
</table>

$^1$ Note: State regulations for application of animal wastes take precedence over these guidelines. Possible differences include nutrient extraction methods, soil sampling depths and frequency, and recommended nutrient application rates and volumes specified in this standard.

$^2$ For nutrient budgets between soil tests, use the following guidance:

- Nitrogen – up to the crop requirement
- Phosphorus and Potassium – up to the crop requirement unless the soil test level in year one is very high (VH). For Very High or Higher P or K levels, additional nutrients are not recommended in the second or third year unless banded in small amounts or used as pop-up fertility. Amounts up to the crop requirement may be used in the fourth and fifth year after the baseline soil test, if applicable. Recommended application rates will be comparable to SWFTL recommendations for the planned yield goal.

$^3$ Annual soil testing is strongly encouraged especially in situations with high yield potential.

$^4$ After establishment year, hay and pastures will follow the appropriate purpose regarding frequency.

$^5$ Resampling and revision of nutrient management plans is recommended when production is less than 75% of planned yield goal.
### APPENDIX 2

#### SOIL SAMPLING DEPTHS $^{1,2}$

<table>
<thead>
<tr>
<th>Cropping System</th>
<th>Tillage System</th>
<th>Fertilizer Application Method</th>
<th>Recommended Sampling Depth (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row crops where stratification issues are anticipated $^3$</td>
<td>All</td>
<td>Injection ($&gt;6$ inches)</td>
<td>$0 - 3$ $^4$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$3 - 6$ $^4$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$0 - 6$</td>
</tr>
<tr>
<td>No-till systems where stratification issues are anticipated $^3$</td>
<td>Continuous No-Till</td>
<td>All</td>
<td>$0 - 6$</td>
</tr>
<tr>
<td>All other systems including pastures, range, and trees</td>
<td>All</td>
<td>All</td>
<td>$0 - 6$</td>
</tr>
</tbody>
</table>

$^1$ **NOTE:** State regulations for applications of animal wastes take precedence over these guidelines. Possible differences include nutrient methods, soil sampling depths and frequency, and recommended nutrient application rates and volumes specified in this standard.

$^2$ Sampling at additional depths may be needed if stratification or deep accumulation of nutrients are anticipated.

$^3$ Use these recommendations when the $0 - 6$ inch sample is $>200$ ppm.

$^4$ If $0 - 3$ inch soil test is $>200$ ppm and $3 - 6$ inch soil test phosphorus is less than $50\%$ of $0 - 3$ inch sample, inversion tillage is recommended.
SOIL SAMPLING PROTOCOLS

Texas A&M AgriLife Extension. Soil Sample Information Form, D-494, S12. p.2


APPENDIX 3

ACCEPTABLE SOIL AND ORGANIC TEST METHODS AND REFERENCES

REPORTED ON DRY WEIGHT BASIS ONLY

For all testing methods and method references go to Texas A&M AgriLife Extension Service Soil, Water and Forage Testing Laboratory.

APPENDIX 4

TAMU NUTRIENT MANAGEMENT WEB SITES

Soil Testing: Texas A&M AgriLife Extension
Soil, Water and Forage Testing Laboratory

Related Publications: Publications for Texas A&M Agrilife Extension
Soil, Water and Forage Testing Laboratory

Nutrient Management¹:
The Texas Nutrient Management Website

Fertilizer Calculators: Soil, Water and Forage Testing Laboratory
Fertilizer Calculators

¹ Note: Check The Texas Nutrient Management Website frequently for updates on Nutrient Management which include TAMU Crop Recommendations, Planning Tools, Certification Courses and Continuing Education Units, Links, and other reference materials.
APPENDIX 5

Commercial fertilizers will be applied in accordance with SWFTL recommendations. Application of all organic soil amendments will not exceed the values in Table 1 or 2.

**TABLE 1.** A Nutrient Management Plan (NMP) \(^1\) is required where any organic soil amendments are applied where Soil Test P Level is less than 200 ppm statewide or, less than 350 ppm in arid areas\(^2\) with distance to a named stream greater than one mile.

<table>
<thead>
<tr>
<th>P – Index Rating</th>
<th>Maximum TMDL Annual P Application Rate (^3)</th>
<th>Maximum Annual P Application Rate</th>
<th>Maximum Biennial Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low, Low</td>
<td>Annual Crop Nitrogen (N) Requirement</td>
<td>1.0 Times Annual Crop N Requirement</td>
<td>2.0 Times Annual Crop N Requirement</td>
</tr>
<tr>
<td>Medium</td>
<td>2.0 Times Annual Crop P Requirement (^3)</td>
<td>2.0 Times Annual Crop P Requirement (^3)</td>
<td>2.0 Times Annual Crop N Requirement</td>
</tr>
<tr>
<td>High (^5)</td>
<td>1.5 Times Annual Crop P Requirement (^3)</td>
<td>1.5 Times Annual Crop P Requirement (^3)</td>
<td>Double the Maximum Annual P Application Not to Exceed 2 times the Annual Crop N Requirement</td>
</tr>
<tr>
<td>Very High (^5)</td>
<td>1.0 Times Annual Crop P Requirement (^3)</td>
<td>1.0 Times Annual Crop P Requirement (^3)</td>
<td>Double the Maximum Annual P Application Not to Exceed 2 times the Annual Crop N Requirement</td>
</tr>
</tbody>
</table>

**TABLE 2.** A Nutrient Utilization Plan (NUP) \(^1\) is required where Soil Test P Level is: equal to or greater than 200 ppm in non-arid areas\(^2\), or equal to or greater than 350 ppm in arid areas\(^2\) with distance to a named stream greater than one mile, or equal to or greater than 200 ppm in arid areas \(^2\) with distance to a named stream less than one mile.

<table>
<thead>
<tr>
<th>P – Index Rating</th>
<th>Maximum TMDL Annual P Application Rate (^3)</th>
<th>Maximum Annual P Application Rate</th>
<th>Maximum Biennial Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low, Low</td>
<td>1.0 Times Annual Crop P Removal (^3)</td>
<td>Annual Crop N Removal</td>
<td>2.0 Times Crop N Removal</td>
</tr>
<tr>
<td>Medium</td>
<td>1.0 Times Annual Crop P Removal (^2)</td>
<td>1.5 Times Annual Crop P Removal (^1)</td>
<td>Double the Maximum Annual P Application Not to Exceed 2 Times the Annual Crop N Removal</td>
</tr>
<tr>
<td>High (^5)</td>
<td>1.0 Times Annual Crop P Removal (^2)</td>
<td>1.0 Times Annual Crop P Removal (^4)</td>
<td>Double the Maximum Annual P Application Not to Exceed 2 Times the Annual Crop N Removal</td>
</tr>
<tr>
<td>Very High (^5)</td>
<td>0.5 Times Annual Crop P Removal (^2)</td>
<td>0.5 Times Annual Crop P Removal (^4)</td>
<td>Double the Maximum Annual P Application Not to Exceed 2 Times the Annual Crop N Removal</td>
</tr>
</tbody>
</table>

Footnotes applicable to both Tables:

1. NMP and NUP designations are consistent with TCEQ Regulations, TAC, Title 30, §321.40.
2. All counties will use the 200 ppm P level limit to determine if Table 1 or Table 2 is to be used, however, in counties receiving less than 25 inches of annual rainfall the 350 ppm P level limit will apply if the field application area is greater than 1 mile from a named stream or lake. See map in current Texas Agronomy Technical Note 15, Phosphorus Assessment Tool for Texas for county rainfall designations.
3. Not to exceed the annual nitrogen requirement rate.
4. Not to exceed the annual nitrogen removal rate.
5. When soil test phosphorus levels are ≥ 500 ppm, with a P-Index rating of “High” or “Very High”, there will be no additional application of phosphorus to a CMU or field.

NRCS, TEXAS
December 2012
APPROVAL AND CERTIFICATION

Nutrient Management

(Ac.)

CODE 590

PRACTICE SPECIFICATIONS APPROVED:

/s/ William H. Durham  December 12, 2012
State Conservation Agronomist  Date

/s/ Susan C. Baggett  December 12, 2012
State Resource Conservationist  Date

CERTIFICATION:

Reviewed and determined adequate without need of revision.

________________________  ______________________
Zone Agronomist  Date

________________________  ______________________
Zone Agronomist  Date

________________________  ______________________
Zone Agronomist  Date

________________________  ______________________
Zone Agronomist  Date

________________________  ______________________
Zone Agronomist  Date

NRCS, TEXAS
December 2012