NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE GENERAL SPECIFICATION

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

GENERAL SPECIFICATIONS

Procedures, technical detail, and other information listed below provide additional guidance for carrying out selected components of the (590) Nutrient Management Practice. This material is referenced from the conservation practice standard for the named practice and supplements the requirements and considerations listed therein.

Soil Test Interpretations

Soil test recommendations are located in Oklahoma Cooperative Extension Service Publication ***PSS-2225, OSU Soil Test Interpretations (http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1490/PSS-2225web.pdf)***. The information contained in the tables shall be used in conjunction with a current soil test analysis (no older than 2 years) to prepare nutrient budgets and to develop nutrient management plans for land users.

Nutrient requirements for crops not listed within the tables should be referred to Oklahoma State University (OSU) Extension Educators or Specialists.

Oklahoma State Extension Fact Sheets are available on-line at the following web site:

http://pods.dasnr.okstate.edu/docushare/dsweb/View/Collection-12

Soil Sampling Requirements

Fields used for production of cultivated crops may be sampled any time after harvest or before planting. Non-cultivated fields should be sampled during the dormant season. Do not sample immediately after lime, fertilizer or manure applications.

Soil sampling depth will follow current Oklahoma State University recommendations contained within the Soil Sampling Fact Sheet (PSS – 2207)

A minimum of 20 core samples shall be taken randomly from the field or sample area. The core samples shall be collected and mixed thoroughly in a clean plastic container. Approximately one (1) pint of the mixed core samples will be placed in a bag and sent for testing.

The Oklahoma Cooperative Extension Service Office is available to assist with the soil testing process. Additional information concerning soil sampling can be found in the Oklahoma Cooperative Extension Service Publication ***PSS-2207, How to Get a Good Soil Sample***

http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-9166/PSS-2207web.pdf.

If a soil test laboratory other than OSU is used, the lab shall use the same phosphorus and potassium extractant (Mehlich-3) as used by the OSU lab and nutrient recommendations will be the same as those used by OSU. The soil testing laboratory shall be a member of the North

American Proficiency Testing Program - Performance Assessment Program (NAPT-PAP) or Agricultural Laboratory Proficiency Program.

Soil testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient management plan (e.g. N, P, K, micro-nutrients, salinity and pH).

Test result conversion factors:

PPM or mg/kg x 2 = lbs/ac.
Elemental P x 2.29915 = P_2O_5
Elemental K x 1.2047 = K_2O

Nutrient Application Timing, Method, and Placement

Timing, method, and placement of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, cropping system limitations, weather and climatic conditions, and field accessibility. Nutrients materials will be applied uniformly to the area.

Nutrients shall be applied anytime during active forage growth by broadcasting, injection or incorporation. For warm season plants (bermudagrass, corn, etc.), late spring application is optimal. However, for cool season plants (fescue, wheat, etc.), a split application in the early fall and early spring works best.

Nutrients will be applied in a manner that avoids nutrient loss and control and trap nutrients before they leave the field(s) by surface, leaching, or subsurface drainage (e.g. tile, karst). Inorganic and organic nutrients will not be applied to the following areas:

- To areas within 100 feet of a perennial stream, pond, well, wetland or sinkhole, unless an established buffer strip is present. The width of the buffer strip will be used as a setback distance for application purposes. The buffer strip must meet the requirements for design and maintenance established in the appropriate NRCS buffer standard and specification.
- To areas within 50 feet of an intermittent stream unless an established buffer strip is present. The width of the buffer strip will be used as a setback distance for application purposes. The buffer strip must meet the requirements for design and maintenance established in the appropriate NRCS buffer standard and specification.
- To fields with >15% slope.
- To soils less than 10 inches in depth to bedrock.

Biosolids Application

When sewage sludge is applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soils shall be monitored in accordance with the US Code, Reference 40CFR, Parts 403 and 503, and/or any applicable state and local laws or regulations. The role of monitoring the application of sewage or municipal sludge in Oklahoma is the responsibility of the Oklahoma Department of Environmental Quality (DEQ). Contact DEQ for information concerning the use of municipal sludge. Additional information pertaining to biosolids can be found in Oklahoma Cooperative Extension Service Publication ***CR-2201, Using Biosolids as a Plant Nutrient Source. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2646/CR-2201web.pdf***

Oil/Gas Well Waste Application

The Oklahoma Corporation Commission regulates land applications of waste material from oil and gas wells. Contact the Oklahoma Corporation Commission for information concerning regulations and permitting for land applications of these materials.

Inorganic/Commercial Nutrient Application Rates

Application rates of inorganic/commercial sources of nutrients shall be based on recommendations that consider current soil test results, realistic yield goals and management capabilities. OSU nutrient recommendations for major crops and grasses are contained in OSU Publication PSS-2225

The following guidance shall also be used when applying inorganic/commercial sources of nutrients:

- **Nitrogen Application** - N application rates shall match the plant uptake rate for the yield goal as closely as possible. The nitrogen requirement is calculated by subtracting the soil test nitrogen value from the nitrogen required for a selected crop and yield goal**.**
- **Phosphorus (P_2O_5) Application -** P_2O_5 application rates must not exceed OSU fertilizer recommendations.
- **Potassium (K_2O) Application** - K_2O application rates shall match the required rates as closely as possible.
- **Other Plant Nutrients -** The planned rates of application for secondary and micronutrients shall be consistent with OSU guidance *(Publication PSS-2225)*.
- **Starter Fertilizers** - Starter fertilizers containing N, P, and/or K may be applied to row crops to overcome early stress of the root environment such as a cool, wet soil. Starter fertilizers are typically applied in the row with the seed or banded alongside the seed. When fertilizers containing N and K_2O dissolve in the soil they can contribute to salt concentration in the soil solution. The distance of the fertilizer from the seed is the most important factor when considering potential salt injury. A common method of starter fertilizer placement to reduce potential salt damage is 2 inches below and 2 inches to the side of the seed row. Typically, the sum of the N and K_2O is used as a guideline as to how much can be applied without causing salt injury. In general, OSU guidance recommends no more than 30 lbs. of applied N + K_2O per acre for wheat or 7 lbs/ac for corn. No more than 90 lbs. per acre of P_2O_5 will be used in a starter fertilizer. These rates will vary with crop selection and climate conditions. The OSU Cooperative Extension Service Office is available for assistance in this area. The amount of starter fertilizer applied will be included in the nutrient budget.

Total nutrient application will be considered adequate when the applied rate is no more than 10% above the recommended target rate. Lower applied rates may be justified due to environmental, crop, or management changes.

Organic Nutrient Application Rates

All manure or organic by-products shall be tested prior to land application.

Preliminary planning decisions may be based on values found in the Agricultural Waste Management Field Handbook, Chapter 4 - Agricultural Waste Characteristics. Actual application rates will be adjusted accordingly based on the current manure analysis.

Plant nutrient removal rates can be found in Table 5. Crops not listed in Table 5 may be found in the Agricultural Waste Management Field Handbook, Chapter 6 – Role of Plants in Waste Management (Table 6-6).

Do not apply manure or organic by-products in the following situations as described in the Published County Soil Survey or Section II of the NRCS Field Office Technical Guide:

- Liquid animal manure will not be land applied within 500 feet of the corner of an occupied residence not owned or operated by the feeding operation. Adjacent landowner may record a waiver to the residence distance requirements prior to application and waiver must adhere to Oklahoma Concentrated Animal Feeding Operation Act Section 20-57.
- Liquid animal manure will not be land applied within 300 feet of an existing public or private drinking water well.
- To areas within 100 feet of a perennial stream, pond, well, wetland or sinkhole, unless an established buffer strip is present. The width of the buffer strip will be used as a setback distance for application purposes. The buffer strip must meet the requirements for design and maintenance established in the appropriate NRCS buffer standard and specification.
- To areas within 50 feet of an intermittent stream unless an established buffer strip is present. The width of the buffer strip will be used as a setback distance for application purposes. The buffer strip must meet the requirements for design and maintenance established in the appropriate NRCS buffer standard and specification.
- To fields with >15% slope.
- To soils less than 10 inches in depth to bedrock.
- On soils that are frequently flooded.
- On soils that are frozen, snow covered, or water saturated (including periods of heavy rain when water ponding has occurred on the soil surface).
- On soils where the rock fragments in the surface layer are 3 to 10 inches in diameter and exceed 50% of the surface.
- On soils where the rock fragments in the soil surface layer are >10” in diameter and exceed 25% of the surface.
- On soils where the rock fragments are >10 inches in diameter which covers >3% of the soil surface and the slope is >8%. (Soil map unit name will include the description of Extremely Stoney, Extremely Bouldery, or Extremely Rubbly or Very Rubbly)
- On areas eroding at levels greater than the soil loss tolerance, “T”, from wind or water erosion or active gullies unless following a conservation plan that will reduce erosion below “T”. Use current Oklahoma NRCS soil loss prediction methods.

- On soils that are occasionally flooded. However, manure may be applied between June 20 and September 20 on soils classified as occasionally flooded. Manure may also be applied to soils classified as occasionally flooded between February 1 and April 20 if the area is established to cool season grasses 4 inches in height at the time of application. In no case will manure be applied when the soil is water saturated or when ponding has occurred on the soil surface after periods of heavy rain.

Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, cropping system limitations, weather and climatic conditions, and field accessibility. Nutrients materials will be applied uniformly to the area.

Nutrients shall be applied to perennial plants (Bermuda, fescue) anytime during active forage growth or annual crops (corn, wheat, sorghum) up to 30 days prior to planting by broadcasting, injection or incorporation. For warm season plants (bermudagrass, corn, etc.), late spring application is optimal. However, for cool season plants (fescue, wheat, etc.), a split application in the early fall and early spring works best.

The application rate for waste water effluent applied with irrigation shall not exceed field capacity for the soil, create runoff and shall minimize ponding. Refer to Agronomy Technical Note OK-18 Determining Infiltration Rates when Irrigating with Liquid Animal Waste.

The following shall also be used when applying manure or organic by-products:

- **Nitrogen Application –** The amount of N applied from manure will not exceed the annual crop requirement for N. In some situations, additional N from inorganic/commercial sources may be required to supplement the organic sources. Manure may be applied to a legume crop at a rate equal to the estimated N removal in the harvested plant biomass.
- **Phosphorus Application –** The maximum planned rates of organic P application shall be determined using the Oklahoma Phosphorus Assessment Worksheet and not exceed Nitrogen needs of the crop.

Field Scale Sensor Based Technologies

This nutrient management technique involves the utilization of N-Rich (Nitrogen) Strips in conjunction with a GreenSeeker™ hand held sensor and the Sensor Based Nitrogen Rate Calculator to make top-dress nitrogen rate recommendations to an entire field. This technology is adapted to winter wheat, canola, cotton, corn, and grain sorghum.

An N-Rich Strip is an area within the field that has received enough nitrogen fertilizer so that nitrogen will not be deficient during the growing season within that area or strip. The N-Rich strip should receive 40-60 lbs of nitrogen above preplant application. If pre-plant nitrogen is applied to the rest of the field, nitrogen application should be no more than 50% of the total nitrogen needed for the yield goal. The application of the N-Rich Strip should take place at the time of pre-plant fertilizer application, planting, or soon thereafter. For winter wheat, the placement of the strips can be delayed for up to one month after sowing.

The N-rich strip will then be used in conjunction with the GreenSeeker™ hand held sensor to determine mid-season N rates. By knowing the yield potential of the reference strip and the yield potential of the rest of the field, the N rate can then be calculated by using the “Sensor-Based Nitrogen Rate Calculator” *(**http://www.soiltesting.okstate.edu/SBNRC/SBNRC.php**)*.

Refer to Oklahoma State University, Department of Plant and Soil Sciences, Nitrogen Use Efficiency webpage *(**http://nue.okstate.edu/**)* and the Oklahoma Cooperative Extension Service Current Report "Reference Strip Series: Applying your Nitrogen-Rich and Ramp Calibration Strips" (***http://npk.okstate.edu/referencestrips/Documents/CR-2255web.pdf***) for additional information and guidance.

The N-Rich Strip will be managed with basic 590 requirements for management of P, K, and pH, which includes soil testing and nutrient budgeting.

Precision Application (Variable Rate)

The basic principles of soil sampling still apply to precision sampling. An adequate number of samples should be collected to accurately characterize the field or management unit. Samples should be collected to the proper depth for non-mobile and mobile nutrients and field conditions. When the sampling technique only measures one nutrient (e.g. GreenSeeker), the other nutrients will be managed to meet basic 590 requirements.

***Sensor Based*:**
Utilizing optical sensors mounted on fertilizer applicators or variable rate Nitrogen top-dressing. Aerial imagery can also be used to create application maps prior to nitrogen fertilization. Proper sensor technologies require the use of N-Rich strips. Application of N-rich strip should follow the methods described in the *Field Scale Sensor Based Technologies* section.

Variable rate systems incorporate biomass sensors mounted on the fertilizer applicator, sprayer or spreader. The sensors collect canopy reflectance measurement and according to predetermined algorithms, changes nitrogen rate as the applicator moves through a field. The result is infinite application zones for nitrogen based on real time canopy measurements.

***Zone Management*:**

Utilize information to determine a minimum of 3 nutrient management zones within a field to collect soil samples or determine yield goals. Data / information may consist of but is not limited to: soil type, soil texture, depth to limiting layer, soil electrical conductivity (EC), landscape position, and yield monitor data. Zones delineate areas of a field with similar characteristics. Composite soil samples are collected from each zone. Fertilizer rates will be based upon OSU, Department of Plant and Soil Sciences recommendations as described in the *Nutrient Application Rates* section. Sampling and testing standards should be followed as described in *Soil Sampling Requirements* section.

***Grid Sampling*:**

Use of grid soil sampling, at a resolution of 0.5 – 6 acre grids, to determine needs of essential plant nutrients or lime.

A field is laid out into quadrants of equal size and proportion. Quadrant (grid) size may range from 0.5 to 6.5 acres is size depending upon field, environment, and crop potential. Composite soil samples are collected from each quadrant. Each nutrient, measured through soil testing, spatial distribution is independently analyzed. Distribution maps and recommendation maps are then developed for each nutrient. Fertilizer rates should be based upon Oklahoma State University, Department of Plant and Soil Sciences recommendations as described in the *Nutrient Application Rates* section. Sampling and testing standards should be followed as described in *Soil Sampling Requirements* Section.

Due to the expense of grid sampling, grid sampling results for phosphorus can be used for up to 3 years. Since nitrogen is a mobile nutrient, yield monitor data or field sensor data will be used to correlate nitrogen needs with the grid maps.

Field Risk Assessment

The NRCS-approved nutrient risk assessment for nitrogen shall be completed, as listed below, on all sites when the application of inorganic or organic amendments is planned.

When applications of manure or other organic by-product amendments are planned, a field specific NRCS approved nutrient risk assessment of the potential for phosphorus transport from the site shall be completed, as listed below.

Nitrogen

Nitrogen is most often associated with the impairment of the quality of groundwater. Nitrogen leaching out of the root zone may enter and contaminate the ground water drinking supply.

To supply the needed plant nutrients to achieve realistic yield goals and minimize the transport of nitrogen to the ground water, a nutrient risk assessment procedure for nitrogen has been developed. This risk assessment procedure was developed to assist with the identification of fields or areas of a field that have varying risks of nitrogen transport and to assist with the development of land treatment and management alternatives to minimize nitrogen transport.

A nutrient risk assessment for nitrogen shall be completed by determining the Leaching Index (LI) from the Revised Universal Soil Loss Equation (RUSLE2) or Nitrogen Leaching Index Worksheet referenced in Oklahoma Agronomy Technical Note 20 and determining the Vulnerability Class from the Nutrient Vulnerable Groundwater Map of Oklahoma (**Exhibit 1**).

The minimum number of mitigating activities shall be applied according to **Table 1**:

Table 1 Nitrogen Risk Assessment Rating

Leaching Index (LI)	Groundwater Vulnerability Rating	Mitigating Activities	RATING
0 - 5	Very Low/Low	None (0)	LOW
	Moderate	None (0)	
	High	One (1) activity	
	Very High	One (1) activity	
5 - 10	Very Low/Low	None (0)	MODERATE
	Moderate	One (1) activity	
	High	Two (2) activities	
	Very High	Two (2) activities	
10+	Very Low/Low	One (1) activity	HIGH
	Moderate	Two (2) activities	
	High	Three (3) activities	
	Very High	Four (4) activities	

Mitigating Activities:

- Delay nitrogen application until plants are actively growing (4" minimum height).
- Apply split applications of 50% of the total nitrogen needs.
- Seasonal nitrogen requirements for actively growing plants shall be split to provide no more than 40 lbs of actual nitrogen every 4-6 weeks. Warm season plants – apply ≤40 lbs/acre Nitrogen during early spring (green up), after first cutting or grazing (late May - early June), or late summer. Cool season plants - apply ≤40 lbs/ac in the fall at planting. Add the remaining recommended amount in the early spring (Feb-March).
- Nitrogen will not be applied during expected heavy rainfall months (April, May, and June) on warm season plants.
- Lower realistic yield expectation by 25%.
- Use enhanced efficiency fertilizer products (sulfur coated urea products, polymer coated fertilizers, uncoated slow release fertilizers).
- Utilize nitrogen rich strip and GreenSeeker sensors to make mid-season nitrogen applications.
- Use precision agricultural technologies to precisely apply variable rates of nitrogen fertilizer.
- Utilize annual soil testing.
- Banding nitrogen applications.
- Use legume crops and cover crops to provide nitrogen through biological fixation and nutrient recycling.

Mitigation Products such as Enhanced Efficiency Fertilizer Products

Enhanced Efficiency Fertilizer products are formulations or coatings to fertilizer which alter reactions to reduce nutrient losses. There are many different formulations and mechanisms for reducing losses. Most products target nitrogen losses (**Table 2**) however some target phosphorus.

Nitrification inhibitors are substances which are added to fertilizers for the purpose of inhibiting conversion of ammonium-N to nitrate-N. These inhibitors can reduce N loss from leaching and denitrification but are only effective on fertilizers that either contain or are converted to ammonium, including anhydrous ammonia, urea, ammonium nitrate and ammonium sulfate.

Urease inhibitors are substances that inhibit conversion of urea to ammonia and carbon dioxide, reducing ammonia volatilization losses. Urease inhibitors can be effective for up to ten to fourteen days which can allow more time for rain to incorporate the N fertilizer.

Controlled release fertilizers reduce nutrient losses and increase nutrient availability by either slowing release or altering reactions that lead to losses. These products are commonly applied fertilizers such as urea which has been coated with sulfur or a polymer. The coating delays the availability of the nutrient for plant uptake after application and controls nutrient release over time.

Table 2 Nitrogen Mitigating Products

Type of Product	Active Ingredient	Examples of Product Names*
Nitrification Inhibitors	2-Chloro-6 trichloromethyl pyridine (Nitrapyrin)	N-Serve, Instinct
	Terrazole	
	Dicyandiamide	Super U, Guardian
	Dicyandiamide + 2-chloro-6 trichloromethyl pyridine	
Urease Inhibitors	N-butyl-thiophosphoric triamide (NBPT)	Agrotain
Controlled Release Fertilizers		
Sulfur Coated Urea Products		SCU, Poly S
Polymer-coated Fertilizer		ESN, Multicoate, Osmocote, Polyon, Duration, Nutricote, Tricote, Poly S
Uncoated Slow Release Fertilizers	Isobutylidene diurea (IBDU)	Par Ex, IB Nitrogen
	Methylene urea (MU)	CoRon Nitamin,
	Urea formaldehyde (UF)	Nitroform
	Triazone	N-Sure

*Example product names are not inclusive of all products or promoting products. Use chemical name to determine if the product contains the active ingredients listed.

Phosphorus

Phosphorus is most often associated with the impairment of the quality of surface water. Phosphorus leachate or runoff entering the surface water may contribute to excessive algae growth which may cause low oxygen levels in surface water. This in turn may impair aquatic life and adversely affect the taste of water.

To minimize the transport of phosphorus to surface water, a nutrient risk assessment procedure for phosphorus has been developed. This risk assessment procedure was developed to assist with the identification of fields or areas of a field that have varying risks of phosphorus transport and to assist with the development of land treatment and management alternatives to minimize phosphorus transport.

A nutrient risk assessment for phosphorus will be completed when:

- Manure or organic by-products amendments are applied.

This assessment shall be prepared using the Oklahoma Phosphorus Assessment Worksheet **(Exhibit 2 and Table 3)**.

Table 3 Nutrient Risk Assessment for Phosphorus – Organic Source Application Rates

Soil Test P Index	0 – 8% Slope	8 - 15% Slope	0 - 15% Slope
	Soil > 20" Deep	Soil > 20" Deep	Soil 10" to 20" Deep
0 – 120	Low Risk	Low Risk (1)	Low Risk (2)
121-300	Low Risk (3)	Low Risk (2&3)	Moderate Risk
>300	Moderate Risk	High Risk	High Risk

Manure or Organic by-products Amendment Application Rates

The following rates are maximum P_2O_5 rates and are not to exceed the Nitrogen requirement of the crop:

Low risk Sites

Maximum Rate per application allowed: 200 lbs P_2O_5 per acre or 300 lbs P_2O_5 per acre when applied by sprinkler irrigation and managed to prevent runoff from the field.

(1) Split Application Only: Application will be no more than ½ the maximum allowed P_2O_5 rate per application at least 30 days apart and total application will not exceed Nitrogen requirement of the crop
(2) Reduced rate Only: 100 lbs P_2O_5 per acre or 150 lbs P_2O_5 per acre when applied by sprinkler irrigation and managed to prevent runoff from the field.
(3) Split Application of Maximum Rate if the following conditions are met:
    - Crop field contains a grass buffer or filter strip with a minimum width of 30 feet, between the crop and transition to a water body (perennial stream, intermittent stream, pond, well, or wetland)
    - Hay field is not grazed, hay is transported off site, and is not fed in the same field. When grazed and hayed, the field must meet pasture conditions below.
    - Pasture has the following conditions:
        i. Perennial vegetation covers >80% with less than 5% bare ground.
        ii. Pasture is grazed evenly throughout with minimal overgrazing.
        iii. Livestock concentration areas are more than 100 feet to perennial or intermittent stream, pond, or wetland and cover less than 0.1 acre.
        iv. Compaction is minor
        v. Evidence of erosion from sheet and rill and wind is minimal, gullies are stable with vegetative cover.

When the above conditions are not met, then a "Moderate Rating" applies. Ratings may be reevaluated following management improvements to meet the above conditions.

Moderate Risk

Application will be no more than the expected P_2O_5 crop removal rate based on Table 5 and a realistic yield goal. It may not be feasible or practical to apply nutrients at P_2O_5 removal rate.

High Risk

No manure application

TABLE 4 NITROGEN CREDITS

Average Nitrogen Remaining After Legume Crop

Legume	*Nitrogen remaining for next crop (Legume hayed or harvested) Lbs of N/Ac	**Green manure crop nitrogen remaining (Legume unharvested) Lbs of N/Ac
Alfalfa	80	200
Ladino Clover	60	180
Sweet Clover	60	120
Red Clover	40	115
White Clover	20	100
Soybeans	20	60
Cowpeas	30	90
Vetch	40	80
Lespedeza (annual)	20	85
Peas	40	70
Peanuts	20	40
Beans	20	40

* These numbers are derived from crops that are harvested and have the remaining crop residues returned to the soil by tillage. (Reference - Oklahoma Soil Fertility Handbook, Sixth Edition (2006), pg. 18)

** A green manure crop is not harvested or grazed and is returned to the soil just prior to maturity. These numbers reflect the amount of nitrogen available for the next crop when the legume is used as a green manure crop. The numbers are adjusted to account for 30% nitrogen loss due to volatilization, leaching, and microbial action. (Reference – Soil Fertility and Fertilizers, Tidsdale and Nelson, pg. 128 and 566)

TABLE 5 CROP NUTRIENT REMOVAL *

% of Dry Material Harvested					
Crop	Unit	Weight/Unit	% N	% P	% K
Barley	grain	48 lbs/bu	1.82	0.34	0.43
	straw	72 lbs/bu	0.75	0.11	1.25
Corn	grain	56 lbs/bu	1.61	0.28	0.40
	stover	56 lbs/bu	1.11	0.20	1.34
Oats	grain	32 lbs/bu	1.95	0.34	0.49
	straw	64 lbs/bu	0.63	0.16	1.66
Rye	grain	56 lbs/bu	2.08	0.26	0.49
	straw	84 lbs/bu	0.50	0.12	0.69
Sorghum	grain	56 lbs/bu	1.67	0.36	0.42
	stover	56 lbs/bu	1.08	0.15	1.31
Soybeans	beans	60 lbs/bu	6.25	0.64	1.90
	stover	75 lbs/bu	2.25	0.22	1.04
Wheat	grain	60 lbs/bu	2.08	0.62	0.52
	straw	102 lbs/bu	0.67	0.07	0.97
Cotton	lint & seed	500 lbs/bale	2.67	0.58	0.83
	burs & stalks	3 lbs/lb of lint	1.75	0.22	0.83
% of Dry Material Harvested					
Forage Crop			% N	% P	% K
Alfalfa			2.25	0.22	1.87
Bermuda			1.88	0.19	1.40
Tall Fescue			1.97	0.20	2.00
Ryegrass			1.67	0.27	1.42
Wheatgrass			1.42	0.27	2.68
Dallisgrass			1.92	0.20	1.72
Native Hay			1.06	0.40	1.58
Clovers			2.00	0.22	1.66
Lespedeza			2.33	0.21	1.06

* These crop nutrient removal figures come from the NRCS Agricultural Waste Management Field Handbook, Chapter 6, Role of Plants in Waste Management (Table 6-6). The handbook lists additional crops not listed above. These numbers represent average figures taken from multiple sources and are nutrients removed in the harvested portion of the crop. These figures can be used as guidance for waste management planning purposes. Actual waste application will be based on soil test.

Example calculation to estimate nutrients removed:

Wheat: Yield 40 bu/ac = 60 lbs/bu x 40 bu = 2400 lbs of grain

40 bu/ac x 102 lbs/bu straw = 4080 lbs/ac straw produced

1 ton/ac straw baled and removed from field = 1 ton/ac x 2000 lbs = 2000 lbs of straw/ac

Grain: 2400 lbs/ac x 0.0208 (%N/lb) = 49.92 lbs/ac Nitrogen in grain

2400 lbs/ac x 0.0062 (%P/lb) = 14.88 lbs/ac Phosphorus in grain

2400 lbs/ac x 0.0052 (%K/lb) = 12.48 lbs/ac Potassium in grain

Straw: 2000 lbs/ac x 0.0067 (%N lb) = 13.40 lbs/ac Nitrogen in straw

2000 lbs/ac x 0.0007 (%P lb) = 1.40 lbs/ac Phosphorus in straw

2000 lbs/ac x 0.0097 (%K/lb) = 19.40 lbs/ac Potassium in straw

Total Nutrient Removed = 63.32 lbs/ac N removed, 16.28 lbs/ac P removed, 31.88 lbs/ac K removed.

EXHIBIT 1

NUTRIENT-VULNERABLE GROUNDWATER

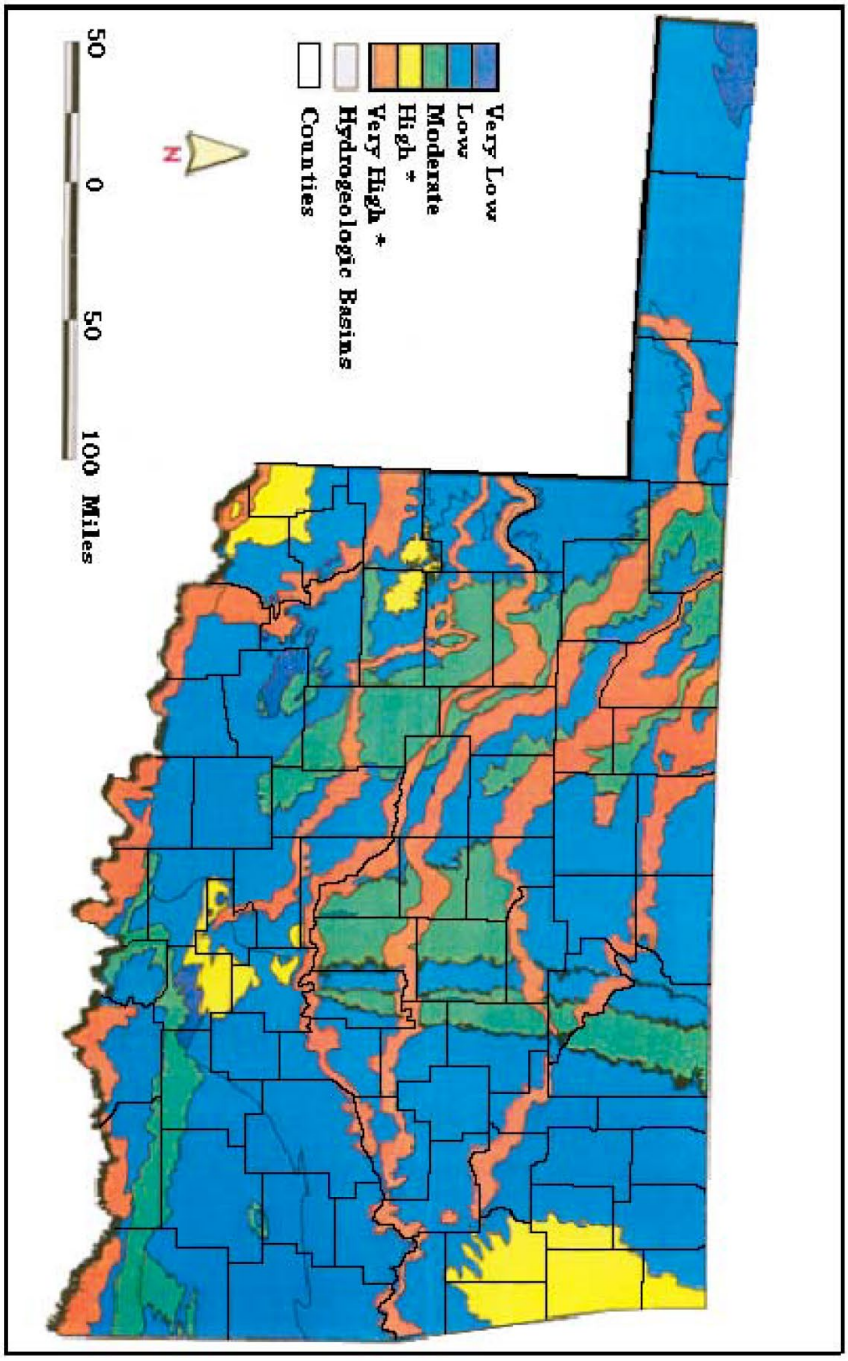

Figure 13. Groundwater vulnerability map of Oklahoma showing Vulnerability classifications by hydrogeologic basin.

* **Only these 2 classes are considered nutrient-vulnerable groundwater.**

NRCS, OK
April 2021

EXHIBIT 2

OKLAHOMA PHOSPHORUS ASSESSMENT WORKSHEET

Client Name:		Field(s):		Date:	
Planner:		Location:		Crop:	
Land Use:			Ctrl + Shift + C clears worksheet		

Site Characteristics

Soil Test P Index Mehlich III (lbs./ac)				Missing data
Application Method	Surface applied during the growing season		Surface applied on frozen, snow covered, or water saturated ground	
				Missing data
Land Slope %	0 - 8 %	8.1 - 15 %	> 15.1 %	
				Missing data

Transport Characteristics

Erosion Rate Greater Than "T"	No	Yes		
				Missing data
Flooding Frequency	None	Occasionally	Frequently	
				Missing data
Landuse Management				Missing Data
				Missing data
Distance of Manure Application to Perennial Stream, Pond, Well, Sinkhole, or Residence	> 100 ft. to perennial stream, pond, well, sinkhole or a buffer strip is established. Liquid Manure Applications > 300 ft. to Drinking Water Well and > 500 ft. to an Occupied Residence		< 100 ft. to perennial stream, pond, well, or sinkhole Liquid Manure Applications < 300 ft. to Drinking Water Well or < 500 ft. to an Occupied Residence	
				Missing data
Distance of Manure Application to Intermittent	> 50 ft. or a Buffer Strip is Established		< 50 ft.	
				Missing data
Depth of Soil	> 20.1 in.	10.1 - 20 in.	0 - 10 in.	
				Missing data
Rocks 3" - 10" in diameter and exceed 50% of the soil surface	No		Yes	
				Missing data
Rocks > 10" in diameter and exceed 25% of the soil surface	No		Yes	
				Missing data
Rocks > 10" in diameter which cover > 3% of the soil surface	No		Yes	
				Missing data

Manure Application Rates

	Incomplete data or invalid data has been entered	

NRCS, OK

April 2021