TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE WYOMING NATURAL RESOURCES CONSERVATION SERVICE

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To: All Offices

From: Bonda Habets
State Conservation Agronomist

Colorado Nitrogen Leaching Index Risk Assessment

(Version 2.0)

The attached Colorado Nitrogen Leaching Index (CONLI) Risk Assessment has been accepted nationally by NRCS. It has been developed in cooperation with Colorado State University Cooperative Extension to comply with the revised Natural Resources Conservation Service Nutrient Management Policy, April 1999. All NRCS employees, Technical Service Providers and other non-NRCS employees are required to follow these procedures when assisting with the implementation of Federal conservation programs for which NRCS has technical responsibility. Other Federal, State and/or local regulations take precedence over NRCS Policy when they are more restrictive.

A risk assessment of the potential for nitrogen leaching is required for ALL nutrient management plans developed for Conservation Management Units (CMUs) located in hydrologic unit areas identified or designated as having impaired water quality associated with nitrogen. A CMU is a field, or group of fields, that have the same land use, similar treatment needs and management requirements. A CMU has definite boundaries such as a fence, drainage, road, vegetation, topography or soil lines.

A nitrogen leaching risk assessment is also required to meet Resource Management System Water Quality Criteria for land application areas included in Comprehensive Nutrient Management Plans.

When risk assessments are required, Nutrient Management Plans shall include a record of the site rating for each field in the CMU and information about conservation practices and management actions that can be applied to decrease the nitrogen leaching potential. The results of such assessments and recommendations shall be discussed with the producer as a normal part of the planning process.

A Preliminary Nitrogen Leaching Index Risk Screening Tool is included with the CONLI. Use the screening tool to make an initial determination for fields that meet the nitrogen risk assessment requirement. If the preliminary screening tool indicates that a risk assessment is not required for the field, document the field specific information used to make the initial determination and include that information in the plan to meet the risk assessment requirement.

Colorado Nitrogen Leaching Index Risk Assessment

(Version 2.0)

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The Colorado Nitrogen Leaching Index is a qualitative field assessment tool developed to rank the relative potential for nitrogen leaching from agricultural fields. It can provide planners, producers and consultants a way to identify fields where the risk of nitrogen leaching may be high.

The Colorado Nitrogen Leaching Index is not designed to quantify nitrogen losses from agricultural fields. Rather, it is a planning tool for developing alternatives for the land user to minimize the potential for nitrogen leaching below the crop root zone.

A Preliminary Nitrogen Leaching Risk Screening Tool is included below to make an initial determination as to whether or not a Leaching Risk Assessment should be completed for an individual field or crop rotation.

Preliminary Nitrogen Leaching Risk Screening Tool

Will commercial nitrogen fertilizer, animal manure, effluent or other organic nutrients be applied to this field?

NO ® **A Colorado Nitrogen Leaching Index Risk Assessment is not required for this field.**

YES

Is the field irrigated, sub-irrigated, or is the average annual precipitation greater than 18 inches?

NO ® **A Colorado Nitrogen Leaching Index Risk Assessment is not required for this field.**

YES

Complete a Colorado Nitrogen Leaching Index Risk Assessment for this field.

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Procedures for Making an Assessment

The Colorado Nitrogen Leaching Index consists of four site and management Risk Factors that can affect the potential for nitrogen leaching below the crop root zone. In order to complete an assessment, the relative risk associated with each of these four factors must be rated. The rating scale ranges from Low (1), to Medium (2), to High (3), to Very High (4). Instructions for rating each Risk Factor are provided below. The rating process requires a field-specific knowledge of soil permeability, irrigation efficiency, climate, ground water surface elevation, nitrogen and manure/effluent application rates and application timing. Once the Risk Factors have been rated, add the values together and compare the sum with the Risk Interpretations to determine the relative risk for nitrogen leaching below the crop root zone. Implementation of certain Best Management Practices may also be considered to mitigate or decrease the relative risk potential.

Risk Factors

Factor 1. Soil Permeability Class

The soil properties that affect permeability are distribution of pore sizes and pore shapes. Permeability classes for specific soils can be found in the soil survey publication for your area. Contact your local Natural Resources Conservation Service Field Office for soils information. Soil permeability class must be determined first and then the associated risk can be determined from Table 1.

Table 1. Soil Permeability Class Risk

Low (1)	Medium (2)	High (3)	Very High (4)
Very Slow, Slow and Moderately Slow (<0.6 in/hr) (<4.0 μm/sec) Sandy clay loam, Clay loam, Silty clay loam, Sandy clay, Silty clay, Clay	Moderate (0.6-2.0 in/hr) (4.0-14.0 μm/sec) Very fine sandy loam, Loam, Silt loam, Silt	Moderately Rapid (2.0-6.0 in/hr) (14.0-42.0 μm/sec) Coarse sandy loam, Sandy loam, Fine sandy loam	Rapid and Very Rapid (> 6.0 in/hr) (>42.0 μm/sec) Coarse sand, Sand, Fine sand, Very fine sand, Loamy coarse sand, Loamy sand, Loamy fine sand, Loamy very fine sand

Factor 2. Irrigation Application Efficiency

Irrigation application efficiency is the ratio of the average depth of irrigation water infiltrated and stored in the crop root zone to the average depth of irrigation water applied, expressed as a percentage. Application efficiencies will vary depending upon management, system design and site conditions. If measured efficiencies are not available, select the appropriate risk category based upon a best estimate. Use the Medium (2) risk category for non-irrigated fields that receive greater than 18 inches average annual precipitation and the High (3) risk category for sub-irrigated fields.

Table 2. Irrigation Application Efficiency Risk

Low (1)	Medium (2)	High (3)	Very High (4)
High Efficiency > 85 %	Moderate Efficiency 61 - 85%	Moderate - Low Efficiency 35 – 60 %	Low Efficiency < 35 %
Drip, Micro irrigation, LEPA, Low pressure center pivots	Furrow with surge, Sprinkler, Center pivot, Side roll/hand move, Non-irrigated w/ > 18 inches average annual precipitation	Border, Furrow and Sub-irrigated	Flood

Factor 3. Nitrogen Application Rate

Agronomic rates are field-specific estimates of crop needs for the current growing season that include an accounting of all N and P available to the crop before manure and or fertilizer application. Use University of Wyoming "Guide to Fertilizer Recommendations B-1045", to calculate field specific agronomic rates.

If commercial fertilizer N will be applied to the field with or without manure, use Risk Factor Table 3a and add the available manure N applied to the fertilizer N applied. Use Risk Factor Table 3b if only manure and or effluent and no commercial N fertilizer will be applied. See Table 3c for approximate nutrient composition of selected types of manure at time of application. See Table 3d to estimate the amount of organic N available to the crop from applied manure and or effluent.

Table 3a. Nitrogen Application Rate Risk (Commercial N fertilizer with or without manure)

Low (1)	Medium (2)	High (3)	Very High (4)
Total N application below agronomic rate	Total N application rate equal to agronomic rate	Total N application 1 to 50 pounds per acre above agronomic rate	Total N application greater than 50 pounds per acre above agronomic rate

Table 3b. Manure/Effluent Application Rate Risk (No Commercial N fertilizer)

Low (1)	Medium (2)	High (3)	Very High (4)
Applied at P agronomic rate	Applied at N agronomic rate	Applied above N agronomic rate	Applied above N agronomic rate more than one consecutive year

Table 3c. Approximate Nutrient Content of Selected Types of Manure at Time of Application

Type of Manure	Moisture Content %	Total N	NH_4-N	P_2O_5	K_2O
		Pounds per Ton			
Swine	82	10	6	9	8
Beef	32	23	7	24	41
Dairy Cattle	46	13	5	16	34
Sheep	31	29	5	26	38
Chicken w/o litter	55	33	26	48	34
Turkey w/o litter	78	27	17	20	17
Horse w/o bedding	22	19	4	14	36

Source: USDA SCS Agricultural Waste Management Field Handbook (1992), modified with data collected from Colorado feeding operations when possible. Nutrient composition of manure will vary with age, breed, feed rations and manure handling practices.

Table 3d. Approximate Percentage of Organic N Mineralized from Manure Over Three Years

Manure Source		% of Organic N Available		
		1st year	2nd year	3rd year
Beef, dairy cattle	solid (without bedding)	30-40	10-15	5-10
	liquid (anaerobic)	25-35	5-10	2-7
Swine	solid	45-55	3-8	2-7
	liquid (anaerobic)	35-45	4-9	2-7
Sheep	solid	20-30	10-15	5-10
Horse	solid (with bedding)	15-25	5-10	2-7
Poultry	solid (without litter)	30-40	10-15	5-10

Source: Best Management Practices for Manure Utilization, CSU Cooperative Extension Bulletin 568A, 1999.

Factor 4. Nitrogen Application Timing
Nitrogen applications split throughout the growing season have a lower potential for leaching below the crop root zone than applications made before crop planting.

Table 4. Nitrogen Application Timing Risk

Low (1)	Medium (2)	High (3)	Very High (4)
In season split applications, (2 or more splits)	Any nitrogen application 0 to 3 months before crop planting	Any nitrogen application 3 to 5 months before crop planting	Any nitrogen application more than 5 months before crop planting

Factor 5. Best Management Practice (BMP) Implementation Credits
Specific BMPs may be applied to decrease the relative potential for nitrogen leaching. To take a BMP credit, subtract one point from the gross score for each of the following BMPs implemented on-site.

- Use of slow release commercial N fertilizers such as sulfur coated urea or urea formaldehyde;
- Use of cover crops planted after harvest or crop failure to utilize excess nutrients;
- Use of nitrification inhibitors to delay the conversion of NH_4 to NO_3 (BMP credit not applicable for fall applications on soils with rapid or very rapid permeabilities);
- Use of deep rooted crops, such as alfalfa, in the rotation;
- Use of deep (4-5 ft) soil sampling to determine sub-soil nitrogen credit; or,
- Implementation of an Irrigation Water Management Plan that meets NRCS (Code 449) criteria.

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Colorado Nitrogen Leaching Index Risk Assessment (Version 2.0)					
Factor	**Low (1)**	**Medium (2)**	**High (3)**	**Very High (4)**	**Score**
1. Permeability Class (See Table 1)	Very Slow, Slow and Moderately Slow	Moderate	Moderately Rapid	Rapid and Very Rapid	
2. Irrigation Application Efficiency (See Table 2)	High > 85 %	Moderate 60 – 85 %	Moderately Low 35 – 60 %	Low < 35 %	
3a. Nitrogen Application Rate (commercial N fertilizer with or without manure)	Total N application below agronomic rate	Total N application rate equal to agronomic rate	Total N application rate 1 to 50 pounds per acre above agronomic rate	Total N application rate greater than 50 pounds per acre above agronomic rate	
3b. Manure - Effluent Application Rate, (No commercial N fertilizer)	Applied at P agronomic rate	Applied at N agronomic rate	Applied above N agronomic rate	Applied above N agronomic rate more than one consecutive year	
4. Nitrogen Application Timing	In season split application (2 or more splits)	Any nitrogen application 0 to 3 months before crop planting	Any nitrogen application 3 to 5 months before crop planting	Any nitrogen application more than 5 months before crop planting	
Gross Score (Sum of Factors 1 through 4)					
5. Best Management Practice (BMP) Implementation Credits	Subtract one point for each of the following BMPs implemented on this field: Slow release N fertilizer; Cover crops; Nitrification inhibitors*****; Deep rooted crops in rotation; Deep (4-5 ft) soil sampling to determine sub-soil N credit; Irrigation Water Management Plan.				
Net Score (Sum of Factors 1 through 4 less Factor 5, BMP Implementation Credits)					

***** BMP credit not applicable for fall applications on soils with rapid or very rapid permeabilities

Net Score	Risk Interpretations
< 8	This field has a **LOW** risk for nitrogen leaching if management is maintained at the current level. If there is an underlying aquifer that is shallow (< 20 ft) or used locally as a public drinking water source, increase the risk to **MEDIUM**.
8 to 11	This field has a **MEDIUM** risk for nitrogen leaching and some management changes may be needed to decrease risk. Apply nitrogen at agronomic rates or lower using spring or split in-season applications. If there is an underlying aquifer that is shallow (< 20 ft) or used locally as a public drinking water source, increase the risk to **HIGH.**
12 to 15	This field has a **HIGH** risk for nitrogen leaching and management changes should be implemented to decrease risk. Manure should be applied at P agronomic rates. Apply nitrogen using split in-season applications at or below the agronomic rate. Changes in irrigation management and/or method may also be necessary. If there is an underlying aquifer that is shallow (< 20 ft) or used locally as a public drinking water source, increase the risk to **VERY HIGH**.
16	This field has a **VERY HIGH** risk for nitrogen leaching and management changes are needed to decrease risk. **Manure applications are NOT recommended**. Apply nitrogen using split in-season applications at or below the agronomic rate. Changes in irrigation management and/or method are necessary to protect ground water. Implement all appropriate BMPs.