TECHNICAL NOTES

US DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

AGRONOMY - 61 Albuquerque, NM

October 2012

Irrigated Leaching Index and Salt Management Tool For New Mexico

Background

Water quality is often a resource concern on irrigated lands in New Mexico. The **Irrigated Leaching Index and Salt Management Tool** will be used in conservation planning when irrigation is done near an impaired water body or in a known water contaminated area. Risk assessment specifically for Nitrates, (NO_3-), which are soluble salts is required when N levels in the soil are high and there is a possibility of leaching it below the root zone. In New Mexico this is most likely where manure has been applied. See Nutrient Management Policy, **Attachment A.**

Salt management is an issue on most of the irrigated lands in NM. The additional water needed to manage salt is termed the Salt Leaching Requirement. It is added to the amount of water calculated to meet the Consumptive Use (CU) requirement of a crop at a specified irrigation efficiency.

The Leaching Index

The Leaching Index **, LI,** uses the effective rainfall and the net applied irrigation compared to the Consumptive Use, (CU), required by the crop by month. Effective rainfall is the amount of rainfall each month above 0.5 inch.

(CU + Salt leaching requirement) - (Rainfall – 0.5 in) = monthly irrigation requirement

Where:

- **CU** is the consumptive use of the crop by month for the given location by month in inches, from the FOTG.
- The **salt leaching requirement** is the additional irrigation water required which maintains the salt level in the soil to a 10% yield reduction level.

Leaching Requirement for Salt Management

Most of the irrigation water in New Mexico contains salts. Use of this water adds salts to the soil. If no water leaches below the root zone salts will accumulate and will eventually reduce yields. The amount of water required to maintain root-zone soil salinity low enough to produce an acceptable yield (10% reduction) of a specific crop is called the **leaching requirement**. It depends upon the salt load of the applied water and the salt tolerance of the crop. Satisfying the leaching requirement is easier on light-textured soil and more difficult on heavy -textured soils. *The salt management equation is from Rhoades, US Salinity Lab, Riverside, CA, 1977.*

Monthly Salt Leaching Requirement

The monthly leaching requirement is determined using basic salt management equation developed by Rhoades. It maintains the soil solution at a salt level where about 10% yield reduction may occur. **Attachment B Crop Salt Tolerances** shows yield loss levels at the 10, 25, 50 and maximum percentage levels.

<u>The surface or flood irrigation equation is:</u>

(Irrigation Water EC) / (5 x Soil EC to reduce yield 10%) = % increase water needed that month.

<u>The sprinkler equation is:</u>

(Irrigation Water EC) / (2 x Maximum Crop Soil EC) = % increase water needed that month.

Note: Maximum Crop Soil EC is the upper most limit of salt that a crop can tolerate and still survive. **Attachment B** shows a range of crops and levels of salt tolerances.

- **CONSERVATION PLANNING**

Any water applied above the crop CU and the Salt Leaching requirement is considered excess leaching. The LI statement of "**Not Meeting CU**", means water requirements (CU plus the salt leaching requirement) are not met, and that crop stress may reduce yield and salt may build up.

The LI statement of "**OK**" means that the amount of water applied (inches, CU plus leaching requirement) is not exceeded by 0.75 inch in that month.

A LI statement of "**Potent. for Leach**" means that the monthly irrigation requirement is being exceeded by more than 0.75 inch. A potential for ground water pollution exists. Irrigation water management (IWM) must be applied or improved, and additional conservation practices should be considered.

A LI statement of "**Do Not Exceed TWHC**" means that an application of irrigation water was made when there is no crop planted. TWHC stands for Total Water Holding Capacity of the soil. Irrigation during this time is fine if the soil can hold the water applied. Soil water holding capacities found in the irrigation guide

The Leaching Tool is located at http://www.nm.nrcs.usda.gov/technical/tech-notes/agro.html

Leaching Tool Instructions

Nitrogen and Other Salts Leaching Index Tool for New Mexico						October 2012
Client:	Mr. Producer	**Field No:**	1	**Acres:**	10	**Date:** 9/24/12
Impaired water body or know water contaminated area:	Stream of concern near Los Lunas					
Crop Grown:	corn, silage; Los Lunas			**EC water (dS/m):**	2	**ECe Crop:** 2.5
Irrigation Type:	☑ Surface Irrigation	**Leaching Percent Increase for Surface:**	9%			
	☐ Sprinkler & Drip Irrigation	**Leaching Percent Increase for Sprinkler:**				

- Fill in the **Client information.**

- Select the **Crop Grown; Location** from the pull-down menu. This sets the consumptive use of irrigation water, CU, by month.
- Enter the **EC water (ds/m)** from an irrigation water test from an approved lab. This is not the EC value listed in the soil test, it is specifically the EC of the irrigation water.
- The **ECe Crop** auto-populates. This is the estimated soil electrical conductivity level that would cause a 10% yield reduction in the selected crop. This is important because it shows a benchmark. **Attachment B Crop Salt Tolerances** shows yield loss levels at the 10, 25, 50 and maximum percentage levels.
- Select the **Irrigation Type** by right clicking the box. **Leaching Percent Increase for SurfaceSprinkler** auto-populates.

	Jan (in/mo)	Feb (in/mo)	Mar (in/mo)	Apr (in/mo)	May (in/mo)	Jun (in/mo)	Jul (in/mo)	Aug (in/mo)	Sep (in/mo)	Oct (in/mo)	Nov (in/mo)	Dec (in/mo)
CU by Month[1] (in):	0.0	0.0	0.0	0.3	2.8	5.9	8.5	7.4	1.9	0.0	0.0	0.0
Salt Leaching Requirement[2] (in):	0.0	0.0	0.0	0.0	0.26	0.5	0.8	0.7	0.2	0.0	0.0	0.0
Net Irrigation Requirement (in):	0.0	0.0	0.0	0.3	3.1	6.5	9.3	8.0	2.1	0.0	0.0	0.0
Actual or Estimated Net Application (in):				3	6	9.5	9.4	4.5	3	3	3	
Net Irrigation-Net Application (in):	**0.0**	**0.0**	**0.0**	**2.7**	**2.9**	**3.0**	**0.1**	**(3.5)**	**0.9**	**3.0**	**3.0**	**0.0**
Leaching Index[3]:	**OK**	**OK**	**OK**	**Potent. for Leach**	**Potent. for Leach**	**Potent. for Leach**	**OK**	**Not Meeting CU**	**Potent. for Leach**	**Do Not Exceed TWHC**	**Do Not Exceed TWHC**	**OK**
	Total Annual Crop Need (inches/year) =			**29.2**								

- Enter the **Actual or Estimated Net Application (in)** for each month the irrigation water is applied. These numbers are gathered when the client is interviewed and the field is inventoried. See 449 Irrigation Water Management http://www.nm.nrcs.usda.gov/technical/fotg/section-4/std-specs.html

Attachment A

Title 190, General Manual (GM), Part 402 http://directives.sc.egov.usda.gov/Default.aspx

E. Nitrogen and Phosphorus risk assessments must be required in accordance with National Instruction, Title 190, Part 302, Nutrient Management Policy Implementation, and CPS Code 590, Nutrient Management.
(1) When such risk assessments are made, nutrient management plans will include:
(i) A record of the site risk assessment rating for each field, and
(ii) Information about conservation practices and management actions that are planned to minimize the offsite movement of nutrients.
(2) The results of the nitrogen and phosphorus risk assessment(s) and recommendations must be discussed with the producer as a normal part of the planning process.
(3) When NRCS and State water quality control officials, based on previous risk assessments from locations with similar site and transport factors, have determined that additional site-specific assessment(s) of risk are not required (nitrogen and phosphorus), sufficient documentation establishing why the site was excluded must be provided.

NI 190 Part 302 - Nutrient Management Policy Implementation
302.2 Technical Criteria for Risk Assessments Used in Nutrient Planning
http://directives.sc.egov.usda.gov/Default.aspx

B. Nitrogen Risk Assessment Criteria.
Leaching Index.—The current NRCS-approved tool to assess the nitrogen leaching potential is the Leaching Index (LI). If States have not already developed tables for the use of the LI, the Revised Universal Soil Loss Equation (RUSLE) 2 calculates LI values for the selected soil and climate. Interpretations of the LI values can be found in the chapter, "Water Percolation: An Indicator of Nitrogen-Leaching Potential." (Williams, J.R., and D.E. Kissell, 1991. Water Percolation: An Indicator of Nitrogen-Leaching Potential. In Follett, Keeney and Cruse (eds). Managing Nitrogen for Groundwater Quality and Farm Profitability. SSSA, Madison, WI, pp 80-81.)

(i) At the State and county levels, NRCS must run sufficient field scenarios to establish geographic regions and map units within the State where nitrogen (N) leaching is not a potential risk to water quality. With the concurrence of the State water quality control authorities, no nitrogen leaching assessment is required in these scenarios.
(ii) When N leaching is a resource concern, planners must use the NRCS-approved nutrient risk assessment for N on all sites.

Attachment B

Section 2 of 22 (2b – Crop Salt Tolerances)

Crop (name)	Yield loss 0%		Yield loss 10%		Yield loss 25%		Yield loss 50%		Maximum
	ECe[1]	ECw[2]	ECe[1]	ECw[2]	ECe[1]	ECw[2]	ECe[1]	ECw[2]	ECe[3]
Alfalfa	2.0	1.3	3.4	2.2	5.4	3.6	8.8	5.9	15.5
Almond	1.5	1.0	2.0	1.4	2.8	1.9	4.1	2.7	7.0
Apple	1.7	1.0	2.3	1.6	3.3	2.2	4.8	3.2	8.0
Apricot	1.6	1.1	2.0	1.3	2.6	1.8	3.7	2.5	6.0
Barley	8.0	5.3	10.0	6.7	13.0	8.7	18.0	12.0	28.0
Beans	1.0	0.7	1.5	1.0	2.3	1.5	3.6	2.4	6.5
Beets	4.0	2.7	5.1	3.4	6.8	4.5	9.6	6.4	15.0
Bermuda Grass	6.9	4.6	8.5	5.7	10.8	7.2	14.7	9.8	22.5
Blackberry	1.5	1.0	2.0	1.3	2.6	1.8	3.8	2.5	6.0
Boysenberry	1.5	1.0	2.0	1.3	2.6	1.8	3.8	2.5	6.0
Broccoli	2.8	1.9	3.9	2.6	5.5	3.7	8.2	5.5	13.5
Cabbage	1.8	1.2	2.8	1.9	4.4	2.9	7.0	4.6	12.0
Cantaloupe	2.2	1.5	3.6	2.4	5.7	3.8	9.1	6.1	16.0
Carrot	1.0	0.7	1.7	1.1	2.8	1.9	4.6	3.1	8.0
Clover	1.5	1,0	2.3	1.6	3.6	2.4	5.7	3.8	10.0
Corn, Grain & Silage	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10.0
Corn Silage	1.8	1.2	3.2	2.1	5.2	3.5	8.6	5.7	15.5
Corn, Sweet	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10.0
Cotton	7.7	5.1	9.6	6.4	13.0	8.4	17.0	12.0	27.0
Cucumber	2.5	1.7	3.3	2.2	4.4	2.9	6.3	4.2	10.0
Fescue, Tall	3.9	2.6	5.8	3.9	8.6	5.7	13.3	8.9	23.0
Grape	1.5	1.0	2.5	1.7	4.1	2.7	6.7	4.5	12.0
Lettuce	1.3	0.9	2.1	1.4	3.2	2.1	5.2	3.4	9.0
Love Grass	2.0	1.3	3.2	2.1	5.0	3.3	8.0	5.3	14.0
Meadow Foxtail	1.5	1.0	2.5	1.7	4.1	2.7	6.7	4.6	12.0
Onion	1.2	0.8	1.8	1.2	2.8	1.8	4.3	2.9	7.5
Orchard Grass	1.5	1.0	3.1	2.1	5.5	3.7	9.6	6.4	17.5
Peach	1.7	1.0	2.2	1.4	2.9	1.9	4.1	2.7	6.5
Pear	1.7	1.0	2.3	1.6	3.3	2.2	4.8	3.2	8.0
Pecan[4]	1.9	1.3**	2.4*	1.6**	3.2*	2.4**	4.6	3.0**	8.0*
Pepper	1.5	1.0	2.2	1.5	3.3	2.2	5.1	3.4	8.5
Potato, Irish	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10.0
Potato, Sweet	1.5	1.0	2.4	1.6	3.8	2.5	6.0	4.0	10.5
Radish	1.2	0.8	2.0	1.3	3.1	2.1	5.0	3.4	9.0
Raspberry	1.0	0.7	1.4	1.0	2.1	1.4	3.2	2.1	5.5
Ryegrass, Perennial	5.6	3.7	6.9	4.6	8.9	5.9	12.2	8.1	19.0
Safflower	5.3	3.5	6.2	4.1	7.6	5.0	9.9	6.6	14.5
Soybean	5.0	3.3	5.5	3.7	6.2	4.2	7.5	5.0	10.0
Spinach	2.0	1.3	3.3	2.2	5.3	3.5	8.6	5.7	15.0
Strawberry	1.0	0.7	1.3	0.9	1.8	1.2	2.5	1.7	4.0
Sudan Grass	2.8	1.9	5.1	3.4	8.6	5.7	14.4	9.6	26.0
Sugar Beet	7.0	4.7	8.7	5.8	11.0	7.5	15.0	10.0	24.0
Tomato	2.5	1.7	3.5	2.3	5.0	3.4	7.6	5.0	12.5
Trefoil, Big	2.3	1.5	2.8	1.9	3.6	2.4	4.9	3.3	7.5
Trefoil, Birdsfoot	5.0	3.3	6.0	4.0	7.5	5.0	10.0	6.7	15.0
Vetch	3.0	2.0	3.9	2.6	5.3	3.5	7.6	5.0	12.0
Wheat	6.0	4.0	7.4	4.9	9.5	6.4	13.0	8.7	20.0
Wheatgrass, Crested	3.5	2.3	6.0	4.0	9.8	6.5	16.0	11.0	28.5
Wheatgrass, Fairway	7.5	5.0	9.0	6.0	11.0	7.4	15.0	9.8	22.0
Wheatgrass, Tall	7.5	5.0	9.9	6.6	13.3	9.0	19.4	13.0	31.5
Wild Rye, beardless	2.7	1.8	4.4	2.9	6.9	4.6	11.0	7.4	19.5

[1] ECe is the electrical conductivity of saturated soil extract, reported in millimhos per centimeter at 25°C.

[2] ECw is the electrical conductivity of the irrigation water, reported in millimhos per centimeter at 25°C.

[3] Maximum ECe is the conductivity of saturated soil extract, reported in millimhos per centimeter at 25°C, at which the plant dies. [4] Complete data is not currently available for pecans. The * is an interpolation between the 0% and 50% range. The ** for ECw is calculated as ECe x 0.67, which is a general rule of thumb for these ratios under average conditions. RDFischer 2/09