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June 30, 2003

MEMORANDUM:

TO: All Technical Specialists designated by the Soil and Water Conservation Commission to Implement Animal Waste Regulation (15A NCAC 2H .0217)

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SUBJECT: SEVENTH Guidance MEMO (Revision Two)
Implementing the Environmental Management Commission's Regulations for Animal Waste Management (15ANCAC 2H .0217)

In an effort to continue to address questions from technical specialists and provide uniform interpretations to technical specialists regarding the requirements of the animal waste management rules, the 1996 session of the General Assembly formalized the creation of an interagency committee. This committee, the SB 1217 Interagency Group, is made up of two (2) representatives of each of our agencies.

Please find attached **new and revised pages** for the SEVENTH Guidance MEMO as adopted by the Group. These **numbered and dated pages must be inserted** into the SEVENTH Guidance MEMO as **Revision Two**. All other pages in the SEVENTH Guidance MEMO are unchanged and **must be retained**. If your current copy of the SEVENTH Guidance MEMO was printed double sided, there may be unmodified pages on the front or back of these new pages, **the pages not modified must still be retained in order to have the most current guidance**. The new items contained in this Revision are **new issues 1.26, 1.27, 1.28, 3.13, 3.14, and the new appendix items are the DSWC Copper and Zinc Projection Worksheet and the NCDA&CS Guidelines for Tissue Analysis**. Revisions are made to issues **1.1, 1.20, 1.23, 7.1, and the Animal Waste Application Windows attachment**.

We support the revisions to the SEVENTH Guidance document and each of our agencies will continue to work with the committee in the development of future guidance. While much of the guidance provided on the modified pages was contained in previous memos, the new guidance is noted by **bold type and underlines**.

In cases where there may be contradictions with past guidance issued by any of the respective agencies, this Guidance will take precedence.

Seventh Senate Bill (SB) 1217 Interagency Group Guidance Document June 5, 2003

In an effort to address questions from technical specialists and provide uniform interpretations to technical specialists regarding the requirements of the animal waste management rules, the 1996 session of the General Assembly created an interagency committee. The SB 1217 Interagency Group, consists of two (2) representatives from each of the following agencies: the Division of Soil and Water Conservation (DSWC); the Division of Water Quality (DWQ), the Department of Agriculture (NCDA & CS); and Cooperative Extension Service (NCCES), and the Natural Resources Conservation Service (NRCS), United States Department of Agriculture.

The foundation for this Guidance Document is the previous Guidance Documents developed by the agencies represented on SB 1217 dated June 20, 1995, May 3, 1996, August 9, 1996, January 2, 1997, May 21, 1997, August 18, 1997, the Sixth Guidance Memo, Revision One (January 8, 1998), Revision Two (August 25, 1998), Revision Three (October 29, 1998), Revision Four (April 12, 1998), Revision Five (January 12, 2000), the Seventh Guidance Memo (January 9, 2001), and Revision One (March 26, 2003). The committee adopted these documents as the foundation for this and future guidance documents. **The new guidance is noted by bold type and underlines.**

This guidance is intended to address the common issues involved in implementing the animal waste management rules and statutes. Additional guidance will be provided as necessary to continue to clarify the issues contained in this memorandum as well as new issues that may arise. The nature of the rules will require judgment on the part of technical specialists.

Guidance developed by the SB 1217 Interagency Group represent guidelines to address questions from technical specialists and provides uniform interpretations regarding requirements of animal waste management rules. However, for areas where no standards exist, DWQ acknowledges these guidelines as acceptable criteria to base a Certified Animal Waste Management Plan (CAWMP). Any requested deviations from this guidance must be considered by DWQ on a case-by-case basis to insure that the proposal provides equal or better protection. These guidelines may also be incorporated by DWQ as permit conditions for an operation's individual permit or general permit.

If there is a need for any additional information or clarification, please do not hesitate to contact any of the following members of the Senate Bill 1217 Interagency Group:

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For additional information also see <http://www.soil.ncsu.edu/interagency/>

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USEFUL WEBLINKS

1. WASTE UTILIZATION PLANS

1.1 Parts of a Waste Utilization Plan (except for dry poultry litter – see 5.3)

A waste utilization plan (WUP) is one part of a total waste management plan. The WUP should be reported in a format comparable to the current NRCS format prior to certification (see Field Office Tech. Guide IV, Standard 633 - Waste Utilization). As a minimum the plan will include:

- List of all fields receiving waste by tract number, field number, and acres receiving waste. For irrigated spray fields, show wettable or effective acres as appropriate (see NCCES Publications Irrigated Acreage Determination Procedures for Wastewater Application Equipment for Stationary Sprinkler (AG-553-6) or Hard Hose Traveler (AG-553-7))
- Maps of all fields to be used for waste application
- Amount of manure produced and used annually (see NRCS Practice Standard Code 633 – Waste Application)
- Waste application method
- All crops to be grown by field
- Realistic yield expectations (RYE) for intended crops when available and/or applicable (see NRCS Practice Standard Code 590 – Nutrient Management). For current RYE tables see weblinks page <http://www.soil.ncsu.edu/nmp/ncnmwg/index.html>
- Dominant soil series for each waste application field (see county soil survey)
- N application rate by field; based on RYE, or actual yields or NCDA or CES recommendation if RYE data is not available
- N balance which equals N applied minus RYE N rate in lbs/acre (N balance must be zero or deficit)
- Waste application windows (see NRCS Practice Standard Code 590 – Nutrient Management (Criteria item # 13) and Appendix 1.1 A, 1.21A & 1.21B)
- Irrigation parameters where irrigation is used (see NRCS Practice Standard Code 633, D₁, D₂, & D₃)
- Calibration information (see NC Publication Field Calibration Procedures for Stationary AG-553-1, Traveler AG-553-2, and Center Pivots & Linear AG-553-3)
- Required specification from NRCS Waste Utilization Standard Code 633
- Emergency action plan (Appendix 1.1B)
- Odor checklist (Appendix 1.1C (dairy), 1.1D (swine), or 1.1E (poultry) depending on animal type)
- Insect checklist (Appendix 1.1F)
- Mortality checklist (Appendix 1.1G)
- Waste sampling within 60 days of land application
- Annual soil sampling: 1) lime requirement, 2) measurement of copper accumulation, 3) measurement of zinc accumulation

1.19 Soil Testing For Copper and Zinc

SB 1217 requires annual soil analysis for copper (Cu) and zinc (Zn) on fields that receive manure, and requires that alternative crop sites be used when these metal levels approach excess levels. When soil Cu or Zn levels reach values in the following table the producer shall contact a qualified specialist to discuss options for future manure applications.

Zinc and Copper Toxicity Levels in Soils

Metal	Soil Test Index	Recommended Action
Zn	300	Limit application on peanuts. Maintain soil pH \geq 6.0.
	500	Cease application on peanut land. Maintain soil pH \geq 6.0.
	2000	Caution: seek alternative site (all crops). Maintain soil pH \geq 6.0.
Cu	3000	Cease application (all crops). Maintain soil pH \geq 6.0.
	2000	Caution: seek alternative site (all crops). Maintain soil pH \geq 6.0.
	3000	Cease application (all crops). Maintain soil pH \geq 6.0.

1.20 Role of Plant Tissue Analysis in Justifying Additional Waste Applications and/or Extending Application Windows

Plant tissue analysis can be used to justify additional waste applications, when crop nutrient deficiencies are suspected. When utilized correctly, tissue testing provides useful information about crop nutrient status and is an accepted tool for proper waste management. To justify additional N **and/or extend the application period**, the producer shall work with a NCDA&CS regional agronomist, **or an agronomist certified by the N.C. Agricultural Consultants Association (NCACA) or Certified Crop Advisor Program (CCA)**. Other qualified professionals may be identified later. **The agronomist** will collect a plant tissue sample for nutrient analysis **in accordance with NCDA&CS guidelines (Appendix 1.20)**, evaluate the crop maturity, and determine the N requirement relative to growth stage. Following interpretation of the plant tissue analysis, **the agronomist** can make recommendations, **in accordance with NCDA&CS guidelines (Appendix 1.20)**, for further applications of N **and/or to extend the application period**. The recommendation shall be documented **as a Conditional Amendment, signed by a designated technical specialist**, and kept on file for three years **(five years for NPDES permitted facilities) at the farm and the local SWCD office (and the DWQ regional office for NPDES permitted facilities)**.

During the annual operation review or inspection, the evaluation will establish if the grower is improperly applying high N rates early in the season to establish additional need later. Improper waste management is a violation of the CAWMP and subject to an appropriate enforcement action.

1.21 Overseeding Coastal Bermuda Harvested for Hay or Grazed

The allowable N rate for any small grain overseeded in coastal Bermuda is 50 lbs N/acre above the normal application rate for coastal Bermuda. No reduction in the 50 lbs N/acre is required if the small grain is grazed.

To prevent damage to the coastal Bermuda stand, the CAWMP shall specify that the small grain must be harvested before heading.

If other alternatives established by NCSU (Appendix 1.21A) are used, criteria given in this publication, including seeding and harvest dates, shall be strictly followed.

Until management suggestions for prairie grass (matua) overseeded in coastal Bermuda are provided by NCSU, the N rates for overseeded prairie grass must follow the N rates for overseeded small grain established in Appendix 1.21A.

1.22 Burning Baled Hay

15NCAC 2D.1903 *PERMISSIBLE OPEN BURNING WITHOUT A PERMIT*, paragraph (b)(5) allows “fires purposely set to agricultural land for disease and pest control and fires set for other agricultural or apicultural practices acceptable to the Department of Agriculture.” The practice of burning baled hay does not meet the intent or definition of this exemption since it does not control disease or destroy pests, and therefore is not permissible as an acceptable disposal method.

1.23 Use of Farm Records to Determine PAN

Where adequate records exist, farm records may be used to determine the amount of PAN produced by the facility using the procedure provided in appendix 1.23. **Modification of a waste management plan resulting in a PAN reduction would decrease required acreage for waste application. In cases where lagoon levels and/or over-application frequently occurs due to shortage of application acres (3 out of 5 years or 2 consecutive years), DWQ may require returning to the standard WUP planning process and securing the needed additional acreage.**

1.24 N Coefficients

A value for nitrogen uptake by crop has been selected for each soil type in North Carolina. This value must not be exceeded in situations where new fields are being added to existing waste utilization plans or included in new plans unless justified by a NCDA&CS Regional Agronomist (other qualified professionals may be identified later) based on plant tissue analysis. Where existing plans are being revised or amended (i.e. no new fields being added), using the assigned program value is encouraged, but not mandated.

N coefficients by crop and soil types are included in the new nutrient management software, and are available at the web address <http://www.soil.ncsu.edu/nmp/> or your local CES office.

1.25 N Management for Nonharvested Winter Annual Cover

The maximum amount of PAN which may be applied to small grain seeded as a cover crop not for harvest is 30 lbs per acre. N application to the next crop must be reduced by the amount applied to the small grain. This option must be stated in the waste utilization plan.

1.26 Sludge Removal Planning

An annual sludge evaluation is required of all NPDES permitted operations in accordance with the Division of Water Quality's general NPDES permit conditions. Sludge removal is required when the sludge accumulation reduces the lagoon's permanent treatment storage volume to less than four feet of average depth that is free of sludge at all times (see NRCS Waste Treatment Lagoon Standard Code 359).

Considerable planning is needed for sludge removal. Periodic sludge removal does not warrant a full revision to the operation's waste utilization plan. A WUP conditional amendment, approved by a technical specialist, must be developed that outlines the sludge removal and land application procedures to be used based on waste concentrations and volumes. The amendment including calculations, waste application rates, sludge survey measurements, map and other related documents are considered part of the CAWMP; must contain the items noted in section 1.6; and should be based on the following items and/or considerations:

- **A good representative sludge analysis and liquid analysis taken prior to sludge removal are required to accurately determine the amount of plant available nitrogen (PAN), phosphorus, copper and zinc contained in the waste. Proper sludge sampling techniques are found in the CES publication #AG 604.**
- **A soil sample report for fields proposed to receive the sludge must be obtained (1) within the twenty-four months prior to sludge application and (2) following the last application of waste prior to the proposed sludge application. This report will serve as the basis for estimating persistent metal (copper and zinc) effects on soil indices.**
- **An evaluation of the lagoon is needed to determine the volume of sludge to be removed. Approved lagoon evaluation and sludge measuring techniques are those described in the CES publication #AG 604 or any other method approved by the DWQ. The method of removal will have a significant impact on the volume of liquid to be removed. For example, agitation and pumping will result in waste slurry meaning removal of sludge and liquid, versus dredging which results in sludge and partial liquid removal. The estimation of volume and methodology of sampling should appropriately reflect the physical nature (solid:liquid constitution) of material that will be applied, which may vary**

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- **greatly depending on the method of removal.**
- **It is highly recommended that sludge be applied only to fields that are not used for continual animal waste application to prevent phosphorus and persistent metal build-up that may render sites unsuitable for long-term waste application.**

If the sludge is to be applied on sprayfields already listed in the CAWMP, the operation's overall PAN balance must include the additional PAN from the sludge and still remain in a PAN deficit for the animal operation.

- It is highly recommended that potential increases in copper and zinc soil levels be estimated during plan development. The DSWC Copper and Zinc Projection Worksheet (Appendix 1.26) may be used to provide a conservative (maximum potential) estimate for increase in soil index values. [Note: The equilibrated post-application soil index may be less than the projected maximum value. Practical methodology for more precise estimation is not available.] Due to the inherent variability of waste and soil sampling, it is recommended that conservative soil target levels be set for copper (e.g. Cu-I < 700-1000) and zinc (e.g. Zn-I < 300 for land where peanuts may be grown; for other cropland Zn-I < 700-1000). See section 1.19 for maximum copper and zinc soil index limits.
- New fields receiving animal waste or sludge for the first time must meet current setbacks, buffers and other requirements as described in sections 1.8 and 8.1.
- If sludge is applied on conventionally tilled bare soil, the waste shall be incorporated into the soil within two days after application on the land. This NPDES/General Permit requirement does not apply to no-till fields, pastures or fields where crops are actively growing.
- Sludge application must be balanced with a current waste analysis on the SLUR-1 and SLUR-2 forms, or on other forms approved by DWQ.
- The permittee is responsible for documenting all sludge applications made to both the owned and leased fields listed in the CAWMP/WUP sludge amendment.
- For sludge transfers, the permittee must document the name and address of the recipient, and volume of sludge removed from the farm. The permittee must provide the third party receiver with a current sludge and liquid analyses and information for proper land application management as required by the farm's permit.
- The third party receiver is responsible for obtaining coverage under the appropriate DWQ permit, and for the documentation and proper land application of the sludge on the approved site(s).

1.27 RYE Source

The official source for RYEs information is the Interagency Nutrient Management Committee tables found at the website listed in item 1.1. Also, the NRCS Nutrient Management (590) Standard provides a method to establish RYEs using farm records.

1.28 Combination Haying and Grazing

For waste management planning, the rate of n removal for grazing is 25% less than haying. In situations where the forage is removed through both haying and grazing, the NRCS 590 Standard allows for applying the appropriated RYE application rate for each harvest method.

For example: The RYE is 6 tons and one hay cutting would harvest 1.5 tons leaving 4.5 tons for grazing.

The calculation would be: 1.5 tons X 50 lbs N/ton + 4.5 X 50 (.75) N/ton = 244 lbs N per acres.

(2) a honey wagon/tanker is available with the capacity to empty the structure or (3) a secondary containment structure is available to store the waste. For exemption from the one-foot structural freeboard requirement, consideration must be also given to the location of the seasonal high water table, proximity of the solids trap to drainage ways, flushing volumes and frequencies, and other case-by-case circumstances which may affect the system management. Under no circumstances will a solids trap be allowed to operate with a structural freeboard equal to or less than a 25-year, 24-hour storm event. Solids traps are also required to have a minimal dike wall or comparable best management practice (BMP) in place to prevent outside surface water from entering the structure.

3.11 Trees on Embankments

Trees, shrubs, and other woody vegetation shall not be allowed to grow on the lagoon/waste storage pond embankments. All trees shall be removed in accordance with good engineering practices. Lagoon/waste storage pond areas shall be accessible, and vegetation shall be kept mowed. Removal of trees does not constitute a retrofit requiring a complete structural upgrade to current standards.

3.12 Proper Use of Lagoon (359) Standard

Current NRCS standards allow for design treatment volumes (i.e. Table 2. Livestock Anaerobic Lagoon Criteria) that are lower than in previous standards for farrow/wean, farrow/feeder, and boar/stud operations. However if this is done, the current standards for sludge storage, excess water, etc. shall also be used to properly utilize the standard. Attempting to use these new volumes on existing operations that have been designed and approved under an earlier standard in order to increase the number of animals will be considered an expansion and all current criteria for expansion shall be met.

3.13 Use of Chronic Rainfall Volume In Post '96 Designed Lagoons

Lagoons constructed to the NRCS standard revised in 1996, included an additional storage for chronic rainfall. This storage is located immediately above the temporary storage and is designed to store above average rainfall events. Use of this volume without above average rainfall would not be consistent with the operating procedures of the CAWMP.

3.14 Lagoon Level Management Option

In preparation for above average rainfall during fall and winter, and to improve crop establishment during fall droughts, some flexibility is offered in managing lagoon levels according to NRCS N.C. Bulletin 210-3-4 (When released at the NRCS web site at www.nc.nrcs.usda.gov). During the period of June 15 through October 31, the lagoon liquid level may be lowered to 8 inches below the stop pump mark. All other criteria in the CAWMP must be followed during this temporary drawdown period including adherence to application rates.

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From November 1 to June 30, standard lagoon level management is required. During this period, no pumping is allowed when the liquid level is below the stop pump mark.

7. PERMITS

7.1 Issuance of Permits to Animal Waste Management Facilities

Beginning January 1, 1997, DWQ began issuing COC under general permits and individual permits for facilities with 250 or more swine, 100 or more cattle, 75 or more horses, 1,000 or more sheep or 30,000 or more poultry with a liquid waste management system. Facilities with fewer animal numbers may continue to be deemed permitted as long as they remain in compliance. DWQ may however require any facility to apply for an individual permit based on existing or projected environmental impacts.

DWQ will notify each facility by certified mail as to the date by which they shall submit the permit application. Under SB1217 statute, a facility that fails to submit an application to DWQ by the date specified shall not operate the facility after that date. Every day of operation after that date is considered an additional violation subject to appropriate enforcement actions.

Under SB1217 statute, no person shall construct a new or expanding facility after January 1, 1997 without first receiving a permit from DWQ.

The SB1217 Interagency Group recommends contacting DWQ prior to construction of a lagoon or holding pond. For storage structure construction on an existing, expanding, or new operation, DWQ requires approval of the design before construction begins. (See Sections 2.12 and 2.13)

7.2 Truck Washes

Truck washes located at a farm may be deemed permitted or covered under the general permit process as a part of a farm if the truck transports animals from that farm and returns to that farm to be washed, or the truck brings animals to the farm and is washed at the farm.

The animal waste management system shall be designed to adequately handle the volume of the waste from the truck wash and no chemical is added to the truck wash water that would interfere with the treatment system.

Truck washes serving more than one farm are commercial operations and not animal raising operations. Therefore they shall apply for and receive an individual permit before they can legally operate.

7.3 Public Livestock Markets

As per NCGS 143-215.10A, public livestock markets are not considered animal operations and cannot be permitted or covered by a general permit. Therefore any size of treatment system serving a public livestock market shall be covered by an individual permit before it can legally operate.

APPENDICES

- 1.1 A WASTE APPLICATION WINDOWS FOR COMMON CROPS WHICH RECEIVE ANIMAL WASTE, REVISED 6/5/03.
- 1.1 B EMERGENCY ACTION PLAN, 12/18/96
- 1.1 C DAIRY FARM WASTE MANAGEMENT ODOR CONTROL CHECKLIST, 11/11/96
- 1.1 D SWINE FARM WASTE MANAGEMENT ODOR CONTROL CHECKLIST, 11/11/96
- 1.1 E POULTRY LAYER FARM WASTE MANAGEMENT ODOR CONTROL CHECKLIST, 11/11/96
- 1.1 F INSECT CONTROL CHECKLIST FOR ANIMAL OPERATIONS, 11/11/96
- 1.1 G MORTALITY MANAGEMENT METHODS, 12/18/96
- 1.20 GUIDELINES FOR PLANT TISSUE ANALYSIS TO JUSTIFY ADDITIONAL WASTE APPLICATIONS AND/OR EXTENDING APPLICATION WINDOWS, 6/19/03
- 1.21 A CROP MANAGEMENT PRACTICES FOR SELECT FORAGES USED IN WASTE MANAGEMENT, DR. JIM GREEN, 6/29/98
- 1.23 USE OF ON-FARM RECORDS FOR MODIFYING A CERTIFIED ANIMAL WASTE MANAGEMENT PLAN AG-439-42, 9/2000
- 1.26 DSWC COPPER AND ZINC PROJECTION WORKSHEET – EXAMPLE, 6/5/03
- 2.2 A NOTIFICATION OF CHANGE OF OWNERSHIP FORM, 7/15/00
- 2.2 B REQUEST FOR REMOVAL, 7/00
- 2.2 C REQUEST FOR REACTIVATION, 7/00
- 2.4 COMPONENTS OF AN ANIMAL WASTE MANAGEMENT PLAN, 12/6/96
- 2.5 A ANIMAL WASTE MANAGEMENT CERTIFICATION FORM, 12/5/00
- 2.5 B TECHNICAL SPECIALIST FOR ANIMAL WASTE MANAGEMENT CERTIFICATION, 11/18/98
- 3.1 ANIMAL WASTE STORAGE POND AND LAGOON CLOSURE FORM, 7/12/00
- 5.1 A GENERAL GUIDELINES FOR DAIRIES, 8/9/96
- 5.1 B GENERAL GUIDELINES FOR UNPAVED BEEF FEEDLOTS, 7/23/97
- 5.2 GENERAL GUIDELINES FOR SWINE ON DRY LOTS, 7/23/97
- 5.3 POULTRY DRY LITTER MANAGEMENT PLAN, 3/11/97
- 6.1 WETTABLE ACRE DETERMINATION CERTIFICATION, 7/99

- 6.5 ANIMAL WASTEWATER LAND APPLICATION SYSTEM PLANS DESIGN CHECKLIST, 7/23/97**
- 8.1 ANIMAL WASTE LAND APPLICATION SETBACKS, 2/5/99**
- 8.3 WASTE MANAGEMENT FACILITY SITE EVALUATION (NC-CPA-17), 11/00**
- 11.1A OPERATOR IN CHARGE FORM**
- 11.1B CLASSIFICATION OF ANIMAL WASTE MANAGEMENT SYSTEMS, 7/21/98**

Animal Waste Application Windows¹
For Common Crops Which Receive Animal Waste

These application windows include 30 days prior to planting and greenup of Bermuda grass.
 End 30 days before harvest.

Bermuda grass	Begin March 1 st	End September 30 th
Small Grain Overseeded in Bermuda grass	Begin October 1 st	End March 31 st
Corn	Begin February 15 th	End June 30 th
Cotton	Begin March 15 th	End August 1 st
Cucumbers – Direct consumption	Begin March 1 st (100 % at planting)	
– For Processing (2 seasons)	Begin April 1 st Begin July 1 st	End May 31 st End August 31 st
Rye	Begin September 1 st	End March 31 st
<u>Barley</u> , Oats, Triticale	Begin September 1 st	End April 15 th
Wheat	Begin September 1 st	End April 30 th
Peanuts	Begin April 1 st	End September 30 th
Sorghum/ Sudan Grass Hay	Begin March 15 th	End August 31 st
Soybeans	Begin April 1 st	End September 15 th
Tobacco – Flue Cured	Begin March 15 th	End June 30 th
– Burley	Begin May 15 th	End August 15 th
Fescue ²	Begin August 1 st	End July 31 st

¹ Dates shown represent statewide limits. Planting and harvesting dates vary across the state and from year to year. Actual values shall reflect site specific conditions and in no case allow application more than either 30 days prior to planting/breaking dormancy or less than 30 days before harvest. See General Permit for food crops

² Mountains – limit N application during June and July / no nitrogen in December and January
 Piedmont & Coastal Plain – limit N application during June and July / no nitrogen in Dec and Jan during severe winters.

Guidelines for Using Plant Tissue Analysis to Justify Additional Waste Applications and/or Extending Application Windows

These suggestions for supplemental applications of RYE-based, plant-available nitrogen (PAN) rates (over and above certified animal waste management plan limits) are based on practical experience with diagnostic field interpretations of NCDA&CS plant tissue analysis index values.

- **How to collect the proper tissue sample**
[see also www.ncagr.com/agronomi/pictorial.htm]

Crop & Stage of Growth*	What to Sample (plant size)	Size of Sample
coastal bermuda (vegetative stage)	upper portion of plant	10–15 handfuls
corn, grain (seedlings < 12 in tall)	entire above-ground plant	20–30 stalks
corn, grain (plants > 12 in tall)	1st fully developed leaf below whorl	10–15 leaves
soybean (seedlings)	entire above-ground plant	20–30 plants
soybean (prior to bloom)	1st fully developed trifoliolate below tip	20 leaves

* Plant tissue nutrient concentrations change with the growth stage of the crop. This requires that specific plant tissue samples be collected at the specific stages of growth for which sufficiency ranges have been developed.

If initial samples indicate that nitrogen is low and additional nutrients are applied, collect new tissue samples to determine when plant nutrient content reaches the sufficient level. At that point, stop applications if the recommended level of PAN has been reached.

- **How to adjust waste application based on tissue sample results**

Plant Tissue Interpretation Index	% RYE-based PAN to Supplement
> 50 (sufficient)	none
45–50 (marginally low)	5–10%
35–44 (moderately low)	10–20%
25–34 (low)	20–30%
< 25 (deficient)	30–35%

Consider the following factors when making supplemental applications.

- 1) Waterlogged soils may limit root development.
- 2) More poorly drained soils that are saturated for prolonged periods may lose nitrogen due to denitrification.
- 3) If other nutritional factors are involved, such as low soil pH, magnesium deficiency, low sulfur, and/or low potassium, then apply corrective fertilizer as soon as possible and limit PAN applications as shown above.

Compiled by NCDA&CS Agronomic Division, June 19, 2003

DSWC Copper and Zinc Projection Worksheet

Example

III. VOLUME TO BE REMOVED¹: Date Measured: 7/18/01

Lagoon dimensions: Top – 480 X 86 ; Bottom – 468 X 74 ; Side slopes – 1:1

Liquid Depth: 1.5 ft (60,642 cubic feet x 7.48 gal/cu ft = 453,602 gallons)

Sludge Depth: 4.5 ft (166,941 cubic feet x 7.48 gal/cu ft = 1,248,719 gallons)

Total: 6.0 ft (227,583 cubic feet x 7.48 gal/cu ft = 1,702,321 gallons)

IV. WASTE ANALYSIS DATA: Date of Analysis: 7/31/01

A. – Nitrogen Concentration²:

Liquid: 5.9 lbs. PAN/1000 gal X liquid volume/1000 = 2,676 lbs. PAN

Sludge: 14.3 lbs. PAN/1000 gal X sludge volume/1000 = 17,857 lbs. PAN

Total PAN to be applied: 20,533 lbs PAN

divided by 1,702.32 Total Volume/1000

= 12.06 lbs PAN/1000 Mixed Volume Concentration

x 27.15 = 327.4 lbs per acre-inch

B. – Copper Concentration:

Liquid: 3.59 ppm X liquid volume = 1,628,431 ppm Cu – gallons

Sludge: 104 ppm X sludge volume = 129,860,776 ppm Cu – gallons

Total Copper to be applied = 131,489,207 ppm Cu – gallons

divided by 1,702,321 Total Volume

= 77 ppm Copper Mixed Volume Concentration

C. – Zinc Concentration:

Liquid: 8.24 ppm X liquid volume = 3,737,680 ppm Zn – gallons

Sludge: 174 ppm X sludge volume = 217,277,106 ppm Zn – gallons

Total Zinc to be applied = 221,014,786 ppm Zn – gallons

divided by 1,702,301 Total Volume

= 130 ppm Zinc Mixed Volume Concentration

¹ 1 cubic foot = 7.48 gallons

² 1 lb/1,000 gal = 27.15 lbs/ac-in

DSWC Copper and Zinc Projection Worksheet (Con't)

Example

V. LAND APPLICATION OF WASTE – Lagoon # 1

Table A – Nitrogen

1	2	3	4	5	6	7	8	9	10	11
Field #	Crop	Soil Type	Realistic Yield Estimates	Nitrogen Lbs Per Acre Max.	Nitrogen Lbs Per Acre Planned	Usable Acres	Pan Amount Applied (lbs) <small>6 x 7</small>	PAN Per Ac-In <small>(from IV-A)</small>	Ac-Ins Applied <small>8 / 9</small>	Application Amount (Inches) <small>10 / 7</small>
1	Corn	No	115	138	75	14.0	1050	327.4	3.21	0.23
2	Fes	Go	4	200	50	5.6	280	327.4	0.86	0.15

Total PAN: _____

Table B – Copper Levels

1	2	3	4	5	6	7	8
Date of Last Soil Test	Field #	Waste Cu Applied (ppm) <small>(from IV - B)</small>	Application Amount (Inches) <small>(from V - A)</small>	Conversion Factor ¹	Cu Index Adjustment <small>3 x 4 x 5</small>	Soil Test Cu Index	New Soil Cu Index <small>6 + 7</small>
1/1/01	1	77	0.23	6.297	111.5	45	156.5
1/1/01	2	77	0.15	6.297	72.7	32	104.7

Table C – Zinc Levels

1	2	3	4	5	6	7	8
Date of Last Soil Test	Field #	Waste Zn Applied (ppm) <small>(from IV - C)</small>	Application Amount (Inches) <small>(from V - A)</small>	Conversion Factor ²	Zn Index Adjustment <small>3 x 4 x 5</small>	Soil Test Zn Index	New Soil Zn Index <small>6 + 7</small>
1/1/01	1	130	0.23	3.193	95.4	65	190.4
1/1/01	2	130	0.15	3.193	62.2	115	177.2

¹ Copper Index conversion factor = {(0.00835) * (27.15 thousand gals/ac-in)} / .036 = 6.297

² Zinc Index conversion factor = {(0.00835) * (27.15 thousand gals/ac-in)} / .071 = 3.193