A PHOSPHORUS INDEXING APPROACH FOR WISCONSIN

Pat Murphy[1]

(NRCS adopted this revised Nutrient Management Policy on April 19,1999)

NATURAL RESOURCES CONSERVATION SERVICE

REVISION OF NRCS POLICY FOR NUTRIENT MANAGEMENT

EXECUTIVE SUMMARY

In response to the growing body of evidence of the relationship between soil nutrient loadings, nutrient transport off-site, and surface and ground water quality impairment; the Natural Resources Conservation Service (NRCS) revised its policy and technical guidance for delivering nutrient management related technical assistance.

The revised policy planned for adoption by NRCS will better address both the production and environmental considerations associated with the use of nutrients in agricultural systems. Key provisions include:

- A phase in period of up to two years to enable NRCS to train its employees and implement the tools and technologies that the policy requires.
- Recognizing that existing producers will need time to modify existing plans for nutrient management to meet the requirements of the revised policy and conservation practice standard.
- Will not deny producers access to NRCS assistance, even when nutrient management cannot be achieved.
- Establishing procedures for determining acceptable nutrient application rates for nitrogen and phosphorus which consider both production and environmental protection goals.
- Continuing to rely on the land grant university system and agri-business to determine the recommended nutrient application rates needed to meet production goals.
- Imposing a phosphorus standard for the land application of animal manure when various field specific conditions exist.

---

[1] Wisconsin Department of Natural Resources

- Requiring field specific vulnerability assessments for nitrogen and/or phosphorus in watersheds identified or designated as having nutrient related water quality impairment.

- Requiring the training and certification of persons who review or approve plans for nutrient management.

- Define the required technical content of plans for nutrient management.

- Require the use of the Phosphorus Index (PI) or equivalent site vulnerability assessment tool when animal manures or other organic by-products are applied to the land.

- Encourage producers to maintain records which will demonstrate implementation of plans for nutrient management.

- Encourage periodic review to insure that the plan is current and meeting the needs of the producer. Require a thorough review and revision at least once every five years.

The revised policy and technical guidance was developed taking into consideration the significant amount of research done since the mid-1980s which disproved the long held belief that phosphorus transport was always related to soil erosion and could be controlled by effective erosion control. Science has now established a direct relationship between soluble phosphorus transport and available phosphorus levels in the soil.

The revised policy and conservation practice standard for nutrient management will place the NRCS in a position of national leadership on this issue.

are used, the planned rates of phosphorus application shall be consistent with any one of the following options:

- **Phosphorus Index (PI) Rating.** Nitrogen based manure application on Low or Medium Risk Sites, phosphorus based or no manure application on High and Very High Risk Sites.**
- **Soil Phosphorus Threshold Values.** Nitrogen based manure application on sites on which the soil test phosphorus levels are below the threshold values. Phosphorus based or no manure application on sites on which soil phosphorus levels equal or exceed threshold values.**
- **Soil Test.** Nitrogen based manure application on sites on which there is a soil test recommendation to apply phosphorus. Phosphorus based or no manure application on sites on which there is no soil test recommendation to apply phosphorus.**

** Acceptable phosphorus based manure application rates shall be determined as a function of soil test recommendation or estimated phosphorus removal in harvested plant biomass. Guidance for developing these acceptable rates is found in the NRCS General Manual, Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy), and the National Agronomy Manual, Section 503.

A single application of phosphorus applied as manure may be made 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.

When such applications are made, the application rate shall:

- not exceed the recommended nitrogen application rate during the year of application, or
- not exceed the estimated nitrogen removal in harvested plant biomass during the year of application when there is no recommended nitrogen application.
- not be made on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices, best management practices, or management activities are used to reduce the vulnerability.

Field Risk Assessment

When animal manures or other organic by-products are applied, a field-specific assessment of the potential for phosphorus transport from the field shall be completed. This assessment may be done using the Phosphorus Index or other recognized assessment tool. In such cases, plans shall include:

- a record of the assessment rating for each field or sub-field, and
- information about conservation practices and management activities that can reduce the potential for phosphorus movement from the site.

When such assessments are done, the results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

User's Guide for the Wisconsin Phosphorus Index (Draft, 12/14/99)

(Prepared by Larry Bundy and Jim Kaap)

Introduction

The proposed Wisconsin Phosphorus Index is designed to obtain a relative indication of the risk of phosphorus (P) loss in runoff on a field or site specific basis. The index considers both transport factors and phosphorus source factors at the field level and uses a multiplicative approach to arrive at the final P index rating. This approach is consistent with the original P index proposed by Lemunyon and Gilbert (1993) and includes some of the concepts in the modified P index prepared by Gburek et al. (1998).

Site Characteristics (Transport Factors)

Four site characteristics are considered to estimate the transport component of P loss in runoff. These factors and the emphasis placed on each in the index are: soil erosion (35%), runoff curve number (20%), slope (10%), and distance to surface water (35%). Input values for each of these factors are multiplied by constants to maintain the assigned factor weighting and to generate a total site characteristic value of 100 or less. For example, a soil erosion loss estimate of 20 tons/acre multiplied by the 1.7 factor would yield a near-maximum soil erosion index value of 34.

Once site characteristics in the four categories have been multiplied by the appropriate constants shown on the index worksheet, the values are added to obtain a total site characteristic value.

Management Characteristics (P Sources)

Phosphorus sources considered in the index include the Bray P1 soil test value at the site and the rates, placement and timing of fertilizer and organic sources of P. Each of the P source factors is designed to yield a value of 1.0 when P management practices consistent with the NRCS 590 nutrient management standard are followed.

The actual P soil test at the site is divided by 30 to obtain an indication of how the site's P test level compares with crop soil P requirements. At a P test value of 30 ppm, most crops grown in Wisconsin will not respond to added P. Thus the actual site P value divided by 30 indicates the relative excess or deficiency of soil P at the field location relative to crop needs. For example, if a field P soil test is 90 ppm, the resulting index value of 3 indicates that the field's P test is well above that needed for the production of most crops and has a correspondingly higher risk of P loss in runoff.

Index values for fertilizer or organic P additions are based on the rate, placement and timing of these applications. These factors reflect the greater risk of P loss at higher P application rates and with unincorporated P sources. Timing of the P applications is also considered in the index to reflect lower risks when the P sources are incorporated into the soil within one week after application and higher risks when P sources are unincorporated during the overwinter period when frozen soil and snow melt can lead to large runoff events.

For both fertilizer and organic P sources, an unincorporated application of 75 lb P_2O_5/acre would yield an index value of 1.0. The 0.01333 constant is used to obtain an index value of 1.0 under these conditions. Method/timing (M/T) factors ranging from 0.4 for injected materials to 1.0 for winter-applied unincorporated material are used to reflect management influences on the risk of P loss in runoff.

Multiple P applications using different rates and application methods or timing can be accommodated by adding the appropriate index values for all fertilizer and all organic P additions. For example, if a field receives 75 lb P_2O_5/acre as injected liquid manure, and 25 lb P_2O_5/acre as a injected starter fertilizer application for corn, the manure contribution would be 75 x 0.4 = 30, and the starter fertilizer application would yield 25 x 0.4 = 10. Adding the index values and multiplying by the constant gives (30+10) x 0.01333 = 0.532 as the fertilizer plus manure index value.

The total P source or management contribution is calculated by adding the index value based on the site's P soil test level and the index values contributed by any fertilizer or organic P additions.

Site Phosphorus Index Value

The site PI value which indicates the overall relative risk of P loss in runoff is calculated by multiplying the transport factor value for the site by the management or P source value. The multiplicative approach recognizes the fact that both transport and P source factors must interact to result in P runoff losses.

References

Gburek, W.J., A.N. Sharpley, and G.J. Folmar. 1998. Modifying the P index to account for transport pathways. Report to the SERA Transport Workgroup. USDA-ARS, University Park, PA.

Lemunyon, J.L., and R.G. Gilbert. 1993. The concept and need for a phosphorus assessment tool. J. Prod. Agric. 6:483-496.

Wisconsin Phosphorus Index (Revised draft 12/14/99)
(Developed by L. Bundy, B. Shaw, P. Murphy & J. Kaap on 9/27/99)

I. Site Characteristics (Transport Factors)

A. Soil Erosion ___ Ton/acre/year x 1.7 = ____
(actual value up to 20 t/ac/yr)

B. Runoff Curve Number ___ RCN x 0.2 = _____
(Actual RCN of field)
(50-100)

C. Slope ____ % Slope x 0.625 = ____
(Actual % slope)
(Most fields:0-16% slopes)

D. Distance to Surface Water (350 ft. – Dist., ft.) x 0.1 = _____
(Actual distance up to 350 ft)

Total Site Characteristics Value = A+B+C+D = _____
(Maximum: 100pts)

II. Management Characteristics (P Sources)

E. Soil Test P ____ ppm P/30 = _____
(Actual Bray P1 value)

F. Fertilizer P Application Rate & Method/Timing

1. (Actual P rate, lb P_2O_5/acre) = _____
2. (Choose 1 Appl. Method/Timing Factors)

	M/T Factors
a. Placed w. planter or injected 2" deep or more:	0.4
b. Incorporated < 1 week after application	0.6
c. Incorporation > 1 week after application or no incorporation after appl. in May-Oct.	0.8
d. Incorporated > 1 week after application or no incorporation after appl. in Nov.- April	1.0

(Fert. Appl. Rate) x (Fert. Appl. M/T Factor) x 0.01333 = _____

G. Organic P Rate

1. (Actual P rate, lb P_2O_5/acre) = _____
2. (Choose 1 Appl. Method/Timing Factors)

	M/T Factors
a. Placed w. planter or injected 2"deep or more	0.4
b. Incorporated < 1 week after application	0.6
c. Incorporated > 1 week after application or no incorporation after appl. in May – Oct.	0.8
d. No incorporation > 1 week after application or not incorporated after application in Nov. – May	1.0

(Org. P Appl. Rate) x (Org. P M/T Factor) x 0.0133 = _____

Total Management Value = E +F+G = _____

PI = Site (Transport) x Management (P Source) = _____

Major Environmental Issues and Wisconsin Livestock Agriculture

(Draft 11/19/99)

Coastal Zone Act- Passed in 1990 to protect US coastal waters from sedimentation and environmental degradation. Administered by the National Oceanic and Atmospheric Administration (NOAA). NOAA utilized the scientific research branch of the Environmental Protection Agency (EPA) to establish the following definitions for agricultural livestock operations:

Small Livestock Operations- 28 to 97 Animal Units (AU) dairy, 50 to 300 AU beef. These operations must implement some form of Nutrient Management (including reducing soil loss to tolerable levels), upgrade design capacity of barnyard runoff control practices to withstand 25 yr./24 hr. storm event (current design requires 10 yr./24 hr. design capacity).

Large Livestock Operations- greater than 97 dairy or 300 beef animals. Large livestock operations must: contain all runoff from barnyard areas; no winter spreading of manure is allowed; must implement phosphorus based nutrient management (not specifically defined by the legislation).

Until now, Wisconsin has chosen not to move ahead with implementation of the Coastal Management Zone because of lack of funding and limited enforceability by NOAA. The EPA's Clean Water Action Plan has prominently positioned the Coastal Management Zone Program within their rules and will limit federal 319 Clean Water Act funds to states that do not comply with the Coastal program. Wisconsin will negotiate with NOAA to integrate the Coastal Management Program into ongoing redesign of the Nonpoint Source Water Quality Program in the most reasonable way that we can.

USDA/EPA Animal Feeding Operation (AFO) Joint Strategy- EPA's Clean Water Action Plan called for more consistent enforcement of permitting of livestock operations as defined by the Clean Water Act.

Large Animal Feeding Operations: greater than 1000 AU (AU=1000 lb. live weight equivalent). Wisconsin currently permits all large livestock operations and is considered in full compliance with this requirement. Some other states are not currently requiring permits for large operations and EPA has threatened to issue permits in states that do not implement their own program. Large Animal Feeding Operations are defined as "point sources" of pollutants by federal code and are require to obtain pollutant discharge permits like other point sources such as paper mills and wastewater treatment plants.

Animal Feeding Operations, 300-999 AU with Prohibited Conditions- prohibited conditions are defined as:

- Direct discharge into waters of the nation via a "man made conveyance"
- Feedlots, of this size, where waters of the nation flow through the lot and livestock come into direct contact with the waters.

Wisconsin currently addresses these types of situations through the NR 243 Notice of Discharge (NOD) program. EPA will may not accept NR243 as a "functionally equivalent" program because implementation is currently based on receiving a complaint from the public and is not enforceable unless cost-sharing is available to the livestock operation.

Any livestock operation, including those with less than 1000 AU, may be permitted if the permitting authority determines that an operation, or an aggregate of operations significantly contribute to nonattainment of the designated use for a water body. Again Wisconsin currently utilizes the NR 243 NOD program to address these situations. EPA could enforce, in these settings, with watershed permits and is developing enforcement authority under the concept of Total Maximum Daily Loads (TMDL's) in watershed which have been listed as impaired on Wisconsin's 303(d) report to EPA, although such enforcement has never occurred in Wisconsin.

The AFO Joint Strategy establishes a goal that ALL livestock operations will have a Comprehensive Nutrient Management Plan (CNMP) by 2009. The CNMPO would be mandatory for permitted operations

and voluntary for all other AFO's. Wisconsin currently requires Nutrient Management Plans for all permitted livestock facilities. The current Wisconsin NRCS Nutrient Management Standard is largely in compliance with the CNMP as proposed, but some revisions will be necessary to meet newly revised NRCS nutrient policy guidelines. Under the current standard, nutrient management plans are based on nitrogen, whereas under the new policy nutrient management plans will be based on nitrogen or phosphorus, depending on conditions. Wisconsin also will need to strengthen record keeping requirements and does not address feed management to reduce phosphorus content of manure.

Comprehensive Nutrient Management Plans shall consider:

Feed Management- -research indicates implementing feed management can reduce the phosphorus content of manure by 10-50% without affecting productivity. Producers voluntarily implementing feed management can reduce cropland acres needed to spread manure, especially in areas where phosphorus based nutrient management is critical to meet surface water quality criteria.

Manure Handling and Storage- construct structures to recognized engineering standards (NRCS 313 Waste Storage Structure for Wisconsin) and divert clean water from manure storage areas.

Land Application of Manure- land apply manure as a fertilizer source. Nutrient application rates should not exceed the capacity of the crops to utilize these nutrients in order to prevent pollution. Timing and methods of manure application should be planned to prevent land spread manure from entering surface or ground waters. NRCS 590, Nutrient Management Standard, is currently recognized as the reference for manure handling in Wisconsin.

Land Management- soil conservation measures shall be in place on all land where manure is applied such that soil erosion is at or below tolerable (T) rates. Other conservation practices, such as buffer strips near surface waters, may be necessary in some areas.

Record Keeping- AFO operators should keep records of the where, when and the amount of manure applied by field. Soil and manure testing for nutrient content is required by the 590 Nutrient Management Standard. The final version of the AFO Strategy indicated that AFO operators are responsible to maintain records of manure that leaves their farm and corporations that contract with farmers to raise livestock can be held accountable for the management of manure produced by the contract grower.

Other Manure Treatment Options- adopt other technologies to treat and or dispose of manure such as solids separation, waste water recycling, manure composting and treatment. These technologies have not become widely adopted within the livestock industry likely due to cost. In general these technologies concentrate the nutrient content of the waste making transport of the nutrients more cost effective. Many of these alternatives would require significant investment of capital in higher levels of technology.

Wisconsin's response to the AFO Strategy has been to propose a "Functionally Equivalent" program based on the following concepts:

• Develop strategies to voluntarily address farms with 300 to 999 AU that meet the criteria for "prohibited conditions" or "impact caused by an aggregation of operations".

• Utilize the Wisconsin Nonpoint Source Watershed Program to restore waters listed as impaired on the Wisconsin 303(d) report to EPA.

• Implement the Agricultural Performance Standards developed as a part of the DNR/DATCP Program Redesign :

- No overflow of manure storage structures
- No unconfined manure piles in the water quality management area
- No direct runoff from a feedlot or stored manure into the waters of the state.
- No unlimited access by livestock to waters of the state in a location where high concentrations of animals prevent the maintenance of adequate sod cover.

DRAFT VIII for Comment 09/01/99

Phosphorus Management Strategy Evaluation Tool

The current NRCS 590 Nutrient Management Standard has been accepted by Wisconsin's natural resource protection agencies as the definition of the minimum acceptable requirements for the application of plant nutrients to cropland in Wisconsin. The 590 standard states within the purposes section that "implementation of this standard will minimize the entry of nutrients into surface and groundwater". It should be recognized that minimizing the entry of nutrients into Wisconsin's water resources might not provide an adequate level of protection to meet water quality standards. As a result, WPDES permit requirements and other water quality programs may require more stringent management practices than the minimum requirements established in the Wisconsin NRCS 590 Nutrient Management Standard (03/99).

The purpose of this tool is to recommend nutrient management strategies (including best management practices and caps on phosphorus soil test levels) to achieve water quality goals in watersheds degraded by Nitrogen and Phosphorous delivery. The assessment can be done in the field, or remotely using USGS topographic maps, soil survey maps, and aerial photographs. The permittee and DNR staff will negotiate the final nutrient management plan to meet the specific needs of the receiving water and the cropland receiving land spread manure.

This tool is based on research (Critical Areas of Phosphorous Export From Agricultural Watersheds, Gburek, Sharpley, Folmar 1998) which indicates that the most significant source of nutrients delivered to surface waters is a zone within 300 feet of surface waters or areas of concentrated flow which deliver directly to surface waters. In this tool, the assessment zone has been extended to a 400 width for an added margin of safety. The assessment zone represents the hyrologically active area where each precipitation event is most likely to generate a runoff return to surface waters or areas of concentrated flow. The assessment zone width can be modified to less than 400 feet if the actual surface runoff flow patterns are documented (see 1 below). The assessment zone is a nonregulatory component of the tool and should not be confused with the manure spreading setback recommendations contained in Table 2.

This tool is intended for use in conjunction with WPDES permit language where phosphorous management is a condition of nutrient management plan approval. DNR or the permittee may propose the use of a more detailed planning and modeling techniques, where necessary, to meet water quality goals for a water body. The minimum requirements of NRCS 590 Nutrient Management Standard are assumed to be in effect including soil loss at or below tolerable rates; winter manure spreading restrictions on slopes exceeding 9% (12% with strips/waterways) and manure incorporation time limits.

The recommended best management practices found in Table 2 are intended as guidance for negotiation of Nutrient Management Plan criteria between the permittee and the DNR permit drafter. The general nature of this evaluation and the specific protection needs of individual water bodies dictate that permit drafters use discretion in applying this tool.

INSTRUCTIONS

1) Review each field where manure will be spread. Determine if surface waters, including wetlands and sinkholes, or areas of channelized flow exist within, or adjacent to the field (see definitions below Table 1). Sketch a boundary at 400 ft. around the surface water and/or areas of channelized flow to define the primary nutrient delivery zone. The width of the Primary Nutrient Delivery Zone may be decreased if a detailed analysis of surface water flow patterns is completed.

2) Within the identified primary nutrient delivery zone(s) for the field, determine the predominant soil map unit from the soil survey. Predominant soil map unit is defined as the soil map unit having the most acreage within the Primary Nutrient Delivery Zones identified for the field. If there are equal amounts of several map units, the following tie breaker should be used in the following order: a) the soil map unit with the steeper slope, b) the soil map unit with the worst drainage conditions as defined by the soil survey (shallowest seasonal/year around groundwater table). If a further tiebreaker is needed, then use the soil hydrologic group in the following order: D, C, B, A.

Enter the predominant soil map unit on the Nutrient Transport Potential Worksheet for the field being evaluated. Enter the slope class for the predominant soil map unit on the worksheet and determine the score. Score is the number found at the top of the column in Table 1 that matches the slope class of the predominant soil map unit identified for the field.

Now determine the field's Runoff Class. For the predominant soil map unit determine the Hydrologic Group (A,B,C,D) using Sec. II of the NRCS Field Office Technical Guide. Also evaluate the depth to groundwater for the predominant soil map unit using the Estimated Soil Properties Significant to Engineering table in the NRCS soil survey. Enter the score from the top of the appropriate column on worksheet under Runoff Class. Using these values determines the most restrictive condition and enters the score from the top of the top of the appropriate column in Table 1 onto the worksheet. Most restrictive is again defined as the definition which occurs farthest to the right within the Table 1 based on the Hydrologic Group an/or groundwater depth.

3) Evaluate the Phosphorous soil test levels (Bray-1) for the field being analyzed. Enter the score from the top of the appropriate column in Table 1 onto the worksheet. The soil sampling and analysis used shall be in accordance with University of Wisconsin recommendations outlined in A-2100 Soil Sampling For Testing and A-2809 Soil Test recommendations For Field, Vegetable and Fruit Crops. The soil test value used for ranking will be the same average soil test value that would be used to make fertilizer recommendations according to guidance contained in A-2809.

4) Determine the Hydrologic Proximity. For each field determine: if it is located within the 400 feet, or less of a surface water and/or; the percent of field area which has been identified as falling within a primary nutrient delivery zone. Determine the Nutrient Transport Potential Score by; matching the fields percent within the primary nutrient delivery zone, or distance to surface waters with the definitions of Hydrologic Proximity found in Table 1. Enter the score for the most restrictive condition from the top of the appropriate column in Table 1 and enter on the worksheet.

5) To determine the phosphorus management recommendations for the field, multiply the points entered from Table 1 for Slope Class, Runoff Class, Soil Test Level and Hydrologic Proximity by the multiplier found on the worksheet and enter each in the right hand column. Add the resulting values to determine the Phosphorus Management Strategy Evaluation Tool score.

6) Compare the Phosphorus Management Strategy Evaluation score against the values found in Table 2, Recommended Actions to Protect Water Quality, and determine the relative threat to water quality posed by the field (low, moderate, high, critical). Enter the relative threat on the worksheet and document whether the current field management meets the Best Management Practices/Nutrient Management Actions recommended by the tool.

Table 1 Nutrient Transport Potential

Nutrient Transport → Potential Score	(0.0)	(1.0)	(2.0)	(3.0)	(4.0)
Predominant Slope Class * (1.0)		A or unclassified (0-2%)	B (3 to 6 %)	C (7-12%)	D,E,F (13 % and above)
Runoff Class** (1.0)		Hydrologic Group A and/or GW>5'.	Hydrologic Group B and/or GW 3-5'.	Hydrologic Group B or C and/or GW 1-3'	Hydrologic Group D and/or GW 0-1'
P Soil Test*** Level (Bray-1) (1.0)	< 20 ppm.	20-40 ppm.	>40 - <75 ppm.	75-150 ppm.	>150 ppm.
Hydrologic Proximity **** (2.0)	Internally drained - **fields that are >80% internally drained are only required to implement a Nutrient Management Plan to meet crop Nitrogen uptake.**	Located > 400' from surface water and/or < 20% of area contributes directly to areas of channelized flow.	Located ≥ 200' and ≤400' from surface water and/or 20-50% of area contributes directly to areas of channelized flow.	Located >50 and <200' from surface water and/or >50% and < 80% of area contributes directly to areas of channelized flow.	Located 50' or less from surface water and/or 80% or more of area contributes directly to areas of channelized flow.

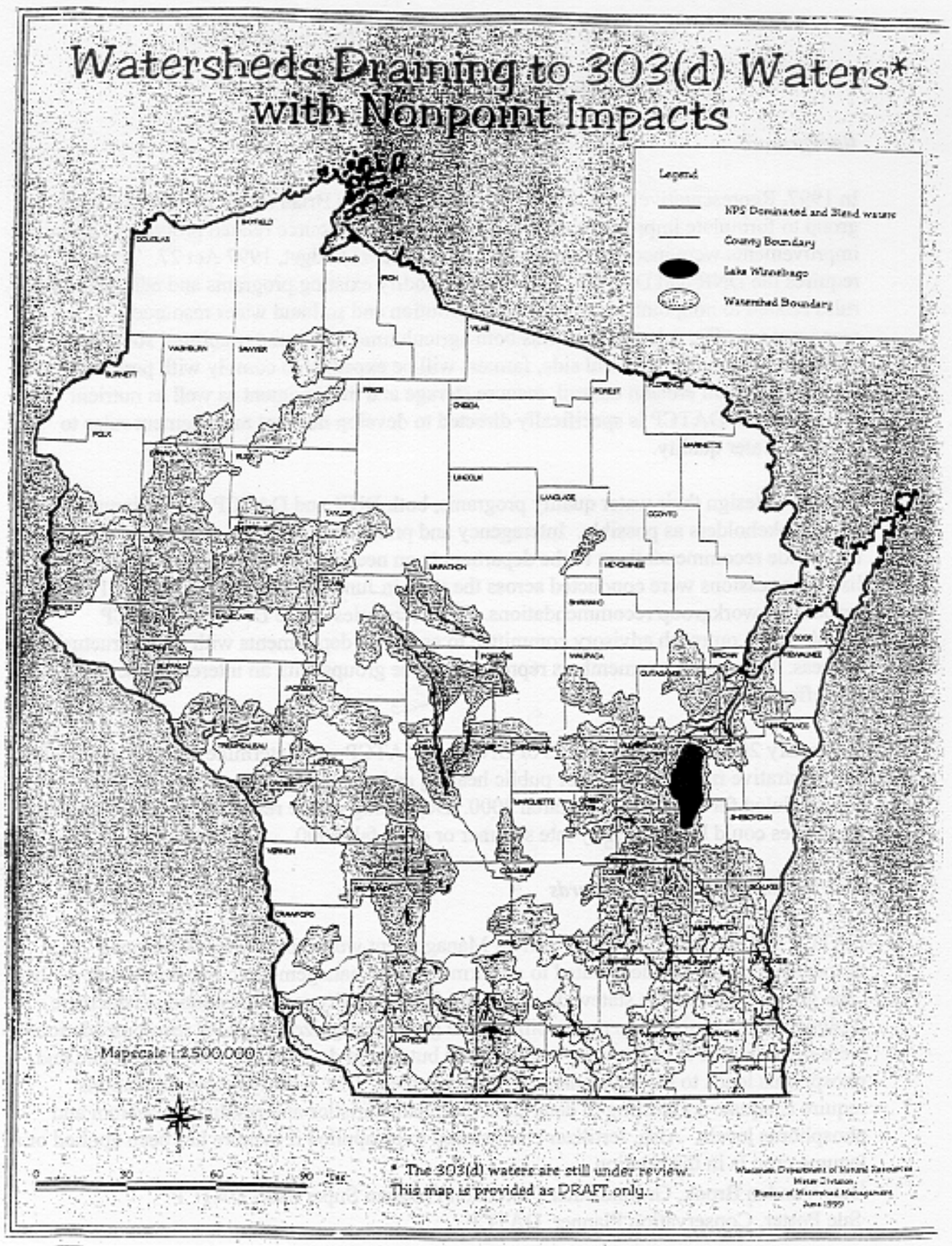
DEFINITIONS

Primary Nutrient Delivery Zone is defined as cropland areas within 400 ft. of: 1) A surface water and/or; 2) An area of channelized flow. All calculations of Predominant Slope Class, Runoff Class, and Hydrologic Proximity are to be made within areas defined as Primary Nutrient Delivery Zones on a field by field basis.

Areas of Channelized flow are defined as: 1) Water features identified as Intermittent, Drainage End and Drainage Ditches on the NRCS soil survey map which are not likely to have a bed and bank; 2) Upland draws identifiable on USGS contour maps as distinct upslope deflections in 3 or more successive contour lines within a field, or contiguous fields; 3) Areas of ephemeral gully erosion, constructed waterways/ditches, visible during a field inspection or upon review of aerial photography.

Surface Water is defined as perennial and intermittent streams or lakes, ponds and reservoirs identified which are likely to have a defined bed and bank by: 1) The NRCS soil survey maps; 2) USGS quadrangle maps; 3) Wetlands identified by spot symbol on the NRCS soil survey/USGS topographic map or NRCS wetland inventory.

Internally drained fields are defined as fields where surface runoff from 80% or more of the field's surface area does not leave the area defined by the field boundaries. These fields typically contain several depressional areas within the field's boundary. Depressional areas which have been drained by ditching an/or surface tile inlets are NOT considered internally drained. Wetlands or sinkholes within a field are considered surface waters and should have a Primary Nutrient Delivery Zone delineated around them.


Watersheds Draining to 303(d) Waters*
with Nonpoint Impacts
Legend
NPS Dominated and Blend waters
County Boundary
Lake Winnebago
Watershed Boundary
Mapscale 1:2,500,000
0
30
60
90
EMILE
* The 303(d) waters are still under review.
This map is provided as DRAFT only..
Wisconsin Department of Natural Resources
Water Division
Bureau of Watershed Management
June 1999