NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WASTE UTILIZATION

(Acre)
CODE 633

DEFINITION

Using agricultural waste, such as manure and wastewater or other organic residues, on land in an environmentally acceptable manner while maintaining or improving soil, air, water, and plant resources.

PURPOSES

- To minimize water quality impacts
- To provide optimum levels of nutrients for crops, forage, fiber production, and forest products
- To improve or maintain soil structure
- To provide feedstock for livestock
- To provide a source of energy

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where agricultural wastes (including animal manure and contaminated water from livestock and poultry operations), solids and wastewater from municipal treatment plants, and agricultural processing byproducts are generated and/or utilized.

CRITERIA

General Criteria Applicable To All Purposes Named Above

Waste utilization shall strictly adhere to all federal, state, and local laws, rules and regulations governing waste management, pollution abatement, health, and safety. The owner or operator shall be responsible for securing any and all required permits or approvals related to waste utilization and shall be responsible for operating and maintaining any components in accordance with applicable laws and regulations.

Where agricultural wastes are to be applied on land not owned or controlled by the producer, the waste management plan, as a minimum, shall document the amount of waste to be transferred and shall document the person or persons responsible for the environmentally acceptable use of the waste. Records of waste utilization shall be kept a minimum of five years as discussed in **Operation and Maintenance** below.

Wastes will not be applied to frozen or snow-covered soil over 5 percent slope unless provisions are made to control runoff and pollution. Such provisions include terraces, contour buffer strips, contour stripcropping, grass or grass-legume cover, heavy residue cover or contour chisel plowing.

Application to cropland requires that cropland meet soil loss tolerances. Waste shall not be applied to cropland with slopes over 15%.

Waste may be surface applied to pastureland, hayland, or meadow crops without incorporation or injection on slopes up to 20% if the land meets soil loss tolerances and applications are made when runoff is unlikely.

No application shall occur within 200 feet of wells, sinkholes, or surface waters.

Liquid manures shall not be applied to soils with less than 10 inches of at least moderately permeable soil over fractured bedrock, sand, or gravel.

No application shall occur on organic soils with a seasonal water table within 1 foot of the surface.

On flood plains where flooding occurs more frequent than once in 10 years, only the injection or immediate incorporation application method will be used.

Waste will not be spread in an established waterway or any area where there may be a concentrated water flow, except as incidentally applied by irrigation. Waste may be applied to terrace channels if incorporated immediately after application.

Soil and plant tissue testing will be conducted according to the guidelines contained in the NUTRIENT MANAGEMENT (590) standard and specifications.

Additional criteria to safely use wastes to provide fertility for crop, forage, or fiber production

Timing of application and handling of wastes will be performed in a manner that maximizes the utilization of nutrients by crops and is consistent with the waste management system plan.

The amounts of nutrients that may be removed by the harvested portions of plants may be obtained from the *Illinois Agronomy Handbook, the USDA-NRCS Agricultural Waste Management Field Handbook*, or other approved sources.

Where municipal wastewater and solids are applied to agricultural land as a nutrient source, the single application and lifetime limits of heavy metals shall not be exceeded. The concentration of salts shall not exceed tolerances established for the crops to be grown.

Apply waste so that solids will cover no more than 25% of the leaf surface of growing crops.

Additional criteria for improving or maintaining soil structure

Apply a minimum of 2-3 dry tons/acre/year of manure, organic by products, or bio-solids to supplement low biomass-producing crops (e.g. soybeans, corn silage, canola, sunflowers, vegetable crops, etc.) or to increase soil organic matter addition after high residue producing crops. Wastes shall not be applied at rates that exceed crop nutrient requirements or salt tolerances as stated above. Wastes shall be applied at times when the waste material can be incorporated into the soil by appropriate means within 72 hours of application. Tillage may be needed to mix wastes with the soil to minimize nutrient loss and control odor. Tillage should be a part of a planned system that adequately controls soil erosion. Tillage should be on the contour, where possible.

Tilled areas shall be left in a roughened condition until immediately prior to planting.

Application of wastes shall not be performed when soil conditions are such that equipment traffic would cause excessive compaction.

Additional criteria for providing feedstock for livestock

Agricultural wastes to be used for refeeding to livestock shall be handled in a manner to minimize contamination and preserve its feed value. Chicken litter stored for this purpose shall be covered. A qualified animal nutritionist shall develop rations that best utilize wastes.

Additional Criteria to Protect Water Quality

All agricultural wastes shall be utilized in a manner that minimizes the potential for pollution of wells, groundwater, streams or impoundments by seepage, leaching, runoff or surface scouring during flooding.

Liquid wastes shall not be applied at rates that will exceed the infiltration rates of the soil. The total amount of liquid waste applied shall not exceed the moisture holding capacity of the soil profile at the time of application.

Agricultural wastes shall not be applied to frequently flooded soils during periods when flooding is normally expected.

Manures with significant levels of nitrogen in the ammonium form should not be applied in the Fall on sands or loamy sands when soil temperature is above 50^{o}F (4 inch depth) unless a nitrification inhibitor is added. Even when using a nitrogen inhibitor, manure shall not be applied on coarse textured soils when soil temperature is above 60^{o}F 4 inch depth).

All waste products will be handled and applied in a manner which will minimize the spread of pathogens to humans, livestock, fish, and wildlife.

Application and transport of wastes must be done in a manner that will not accelerate erosion or compaction of soils.

Animal wastes shall not be applied at rates that exceed the ability of harvested crops to utilize the available nitrogen and/or phosphorus. Solid manure shall not be surface applied at rates providing more than 75 lb./ac of available P_2O_5, unless incorporated within 72 hours. Wastes may be applied based on nitrogen removed by harvested crops, until Bray P1 or Mehlich 3 levels exceed 300 lbs. P per acre (150 PPM) at a 6 2/3 inch sampling depth. When the current soil test P1 level exceeds 300 lbs. P per acre (150 PPM), **wastes should be applied to fields with lower soil P levels** and be applied based on phosphorus removed in the harvested crops. Under no circumstances shall waste be applied at rates that exceed the nitrogen requirement of the next crop.

The source(s) of waste to be field applied shall be sampled to determine nutrient content. When wastes are stored/managed in different structures, a separate analysis is needed from each structure. Sources of waste shall be sampled each time manure is spread for at least 3 years after implementation of a waste utilization plan and annually thereafter. Changes in the type of waste or storage method will require additional tests. Tests performed on samples shall be adequate to determine:

- N as TKN, NH_3 or NH_4,
- Total P,
- Total K.

For initial planning purposes, average values found in **Table IL11-5 - Suggested Average Nutrient Content of Manure** may be used. Other sources that may be used are: Midwest Plan Service document # MWPS-18, Second Edition, Tables 10-6 and 10-7; procedures found in Chapter 11 of the *USDA-NRCS Agricultural Waste Management Field Handbook*; or other approved sources.

Phosphorus runoff vulnerability will be evaluated for each field where waste is applied using the Illinois NRCS Phosphorus Assessment Procedure included in the **Appendix** of this standard. Where the total applied phosphorus exceeds crop removal rates, a calculation will be made to estimate the time it will take to reach the 300 lbs./ac threshold. A worksheet is available for this calculation in the **Appendix** of this standard.

Additional criteria for manure and organic products applied to land enrolled in CRP or similar land retirement programs

Manure and other organic by product applications shall conform to guidelines and specifications stated in previous sections of this standard and applicable program rules and regulations.

When using manure on newly enrolled fields requiring phosphorus fertilization, follow guidelines contained in CONSERVATION COVER practice standard and specifications (327). Manure shall be injected or incorporated with tillage when surface applied.

Manure applications to established stands will be injected where possible. Areas where wastes are surface applied shall be tilled only to the extent necessary for proper incorporation and re-seeded if necessary according to the participant's Conservation Plan of Operations (CPO). Single applications shall not exceed 75 Lbs. P_2O_5/Ac. Manure applications shall not occur before August 1 in order to avoid disturbance during the nesting season of ground nesting avian species.

Additional criteria for providing a source of energy

All energy producing components of the system shall be included in the overall waste management plan. Provisions for utilization of the by-products shall be identified.

Where the residues of energy production are to be land-applied for crop nutrient use or soil conditioning, the criteria listed above shall apply.

CONSIDERATIONS

The effect of Waste Utilization on the water budget should be considered, particularly where a shallow ground water table is present or in areas prone to runoff. Limit waste application to the volume of liquid that can be stored in the root zone.

Minimize the impact of odors of land-applied wastes by making application at times when temperatures are cool and when wind direction is away from neighbors.

Agricultural wastes contain pathogens. Wastes should be utilized in a manner that minimizes the disease potential to humans or animals.

Priority areas for land application of wastes should be on flat or gentle slopes located as far as possible from waterways. When wastes are applied on sloping land or land adjacent to waterways, other conservation practices should be installed to reduce the potential for offsite transport of waste.

It is preferable to apply wastes on pastures and hayland soon after cutting or grazing and before re-growth has occurred.

Reduce nitrogen volatilization losses associated with surface applications of wastes by incorporating within 24 hours.

Consider using techniques that modify the chemistry of animal manure to enhance the producer's ability to manage manure nutrients effectively.

Waste application to land must comply with NRCS specifications, state laws, or local ordinances, whichever is most restrictive.

PLANS AND SPECIFICATIONS

Plans and specifications for Waste Utilization shall correspond to this standard and shall describe the requirements for practice application to achieve its intended purpose. The waste management plan shall account for the utilization or other disposal of all animal wastes produced, and all waste application areas shall be clearly indicated on a plan map.

Site-specific plans and specifications based on this standard that include:

- a description of the size and type of livestock present, including quantity of organic materials produced during the planning period,
- a brief description of the manure storage and handling system including application equipment needed to apply the organic nutrients,
- a description of nutrients in the manure and available to the crop based on storage type, application method, and other factors affecting nutrient availability,
- crop nutrient needs based on the crop rotation and expected yields including any adjustments based on credits from other sources,
- a schedule of application to include per-acre annual rates, frequency of application (if applied more than once in a year to the same field), application method, and amounts of N, P_2O_5 and K_2O available to plants at the prescribed rate. Include an accounting of total waste utilization compared to the total volume of waste available,
- a map identifying the fields and acreage covered by the plan,
- where agricultural waste application rates are expected to increase soil P levels, estimate the number of years for a field to reach a soil test P of 300 lbs./ac. See **Appendix C** of this standard for a worksheet to facilitate the calculation.
- an identification of critical areas where special attention will be required when applying agricultural waste including: areas where organic nutrients will not be applied (e.g. setbacks from water bodies); areas where immediate incorporation or incorporation within 24-72 hours will be necessary; areas where wintertime applications should be minimized or eliminated; and areas where Soil Test P levels are above 300 lbs. P/acre.

OPERATION AND MAINTENANCE

Soil testing shall be at least every 4 years, using methods outlined in the *Illinois Agronomy Handbook.* Tests performed shall be adequate to determine:

- water pH,
- plant-available phosphorus,
- plant-available potassium,
- organic matter (recommended).

Application rates shall be based on nutrient content of wastes and indicated soil nutrient levels after one full year of implementation. The owner/operator is responsible for recomputing application rates at least yearly, or whenever significant changes in the waste management system plan are implemented.

Application equipment shall be calibrated at least once per year to achieve the planned application rates. The owner or operator shall be responsible for maintaining application equipment in good working condition.

Sufficient information on type of nutrients applied, application methods, timing, and rates must be maintained by the producer to verify adherence to the standards of this practice.

Records shall be kept for a minimum of five years and shall include when appropriate:

- quantity and nutrient content of manure and other agricultural waste produced,
- soil test results,
- dates, amounts, and locations of waste applications where land applied, and the dates and amounts of waste removed from the system due to feeding, energy production, or export from the operation,
- waste application methods,
- crops grown and yields (both yield goals and measured yield),
- other tests, if needed, such as determining the nutrient content of the harvested product,
- calibration of application equipment.

The operation and maintenance plan shall include the dates of periodic inspections and maintenance of equipment and facilities used in waste utilization. The plan should include what is to be inspected or maintained, and a general time frame for making necessary repairs.

REFERENCES

Illinois Department of Agriculture, 8 Illinois Administrative Code, Part 900: Livestock Waste Regulations, Springfield, Illinois, November 12, 1998.

Midwest Plan Service, Livestock Waste Facilities Handbook, MWPS-18, 1985.

Sharply, A.N., "Determining An Environmentally Sound Soil Phosphorus Value", Journal Of Soil and Water Conservation, 1996.

Sharpley, A.N., T. Daniel, T. Sims, J. Lemunyon, R. Stevens, and R. Parry. "Agricultural Phosphorus and Eutrophication," U.S. Department of Agriculture, Agricultural Research Service, ARS-149, 42 pp., 1999.

University of Illinois, Illinois Agronomy Handbook, 1999-2000 edition.

USDA-NRCS, Ag Waste Field Handbook, 1992.

USDA-NRCS, Field Office Technical Guide, Iowa, 1995.

USDA-NRCS, Field Office Technical Guide, Wisconsin, 1999.

APPENDIX A

ILLINOIS PHOSPHORUS ASSESSMENT PROCEDURE

Use and Interpretation of the Illinois Phosphorus Assessment Procedure

Background:

Phosphorus (P) loading to surface water can accelerate eutrophicaction. The availability of other nutrients and light penetration into the water column will also influence the response of waterbodies to phosphorus. Land managers who desire to minimize transport of phosphorus need a practical assessment procedure to assist them in making decisions concerning the applications of phosphorus-containing materials.

Factors such as: the amount of erosion and runoff; the form, amount, and distribution of phosphorus in the soil: and fertilizer and manure application rate, timing and placement determine P loss from agricultural fields and the resulting P loading to water resources. Most phosphorus compounds found in soils have low water solubility. Consequently, P loss from agricultural land was once thought to be primarily associated with soil erosion. In many cases, sediment-bound P is still the dominant form in which P losses from agricultural fields occur. Over the past decade, research has shown that phosphorus can be lost in runoff in dissolved forms. High dissolved P concentration in runoff is more frequently observed where soil P levels are high particularly near the soil surface. High soil P levels, however, do not automatically equate to high dissolved P in runoff. As stated earlier, numerous factors interact to create the potential for P losses from agricultural fields. Many of the basic processes that govern P transport are known. It is difficult, however, to know at any given site which factor(s) influence P loss rates proportionally more than others. Insufficient data exist in Illinois to definitively guide landowners as to which factors in a specific field contribute the most to P losses. There are indications, however, that where solution P losses from crop fields are dominant, high soil P concentration at the surface are likely the most dominant factor.

The purpose of this guide is to (1) help land managers identify factors in agricultural fields known to contribute to “P” runoff loss and, (2) identify practices that can reduce phosphorus loss from agricultural fields. The factors most commonly associated with both dissolved and sediment-bound P loss are presented. For each factor, guidance is provided to help land managers estimate the relative potential for P transport to surface water. It is important to realize that the procedure is not a predictive tool for P loading. It is merely a tool for assessing the relative potential for phosphorus transport.

Use of Assessment:

When possible, land managers should adopt management practices that minimize phosphorus loss risk factors. If phosphorus containing materials need to be applied to fields that have medium or high risk potentials, recommended management practices should be used to reduce the risk of phosphorus transport.

Examples of Practices to Reduce Phosphorus Risk Potential

Soil Erosion Control:

- Use residue management and/or structural practices to reduce sheet and rill erosion.
- Install filter strips, riparian forest buffers, contour buffer strips, field borders, or wetlands

Minimize Connectivity to Water Bodies:

- Install water and sediment control basins to reduce quantity of sediment transported offsite.
- Install conservation buffers adjacent to water resources to create nutrient application setbacks.

Reduce Runoff Potential:

- Terrace fields to reduce slope length.
- Contour strip cropping, contour buffer strips, cover crops, crop rotations that include meadow and/or small grains, and crop residue management.

Lower Soil Test Phosphorus:

- Sample soils on high testing fields to determine vertical distribution of the phosphorus.
- If phosphorus is concentrated in the top two inches of soil, invert the soil (e.g. moldboard plow) where soil erosion will not be a problem.
- Avoid stratification by placing phosphorus materials beneath the top two inches of the soil surface.

Practice Nutrient Management:

- Apply no more than maintenance levels of phosphorus when soil test P reaches the levels described in the Illinois Agronomy Handbook, Chapter 11.

PHOSPHORUS RISK ASSESSMENT PROCEDURE

Risk Factor	Phosphorus Risk Potential		
	Low	**Medium**	**High**
1. Soil Erosion	**<= "T"**	**> "T" - <= 2"T"**	**> 2"T"**
2. Connectivity to Water. Does runoff from the application area enter a waterway, tile inlet, or surface drain outlet into a perennial surface water body e.g. stream, pond, lake, or wetland? If so what is the distance from the application area to the water body.	**> 1000'**	**<= 1000' – 200'**	**< 200'**
3. Runoff Potential	**See "Runoff Matrix" Below**		
4. Soil Test Phosphorus Levels 0 - 6 2/3" sample depth	**<35 lbs. P/ac**	**35-70 lbs. P / ac**	**> 70 lbs. P/ac**
5. P Inputs	**See "P Inputs Matrix" Below**		

Phosphorous Risk Assessment - Site Characteristic Definitions:

1. SOIL EROSION – Sheet and rill erosion as measured by the most current version of the Revised Universal Soil Loss Equation (RUSLE).

2. CONNECTIVITY TO WATER – Defines the potential for P to be transferred from the site to a perennial stream or water body. The more closely connected the runoff is from the field via concentrated flow (from a defined grassed waterway or surface drain) to a perennial stream or water body the higher the potential for of P transport.

3. RUNOFF CLASS – Represents the effect of the Hydrologic Soil Group (A, B, C, D) on runoff. This factor represents the site's runoff vulnerability. See the Solution Runoff Class Matrix below.

4. SOIL "P" TEST (BRAY P1 or Mehlich 3) – The soil test procedure using the Bray P1 extraction, or other extraction test calibrated to Bray P1, that provides an index of plant available P expressed in lbs. P/ac (PPM X 2 = lbs./ac where soil samples are obtained to the 6 2/3" depth).

5. P INPUTS - Represents the combined effect of application method and application rate on the potential for phosphorus to be transported in runoff in both dissolved and sediment-bound phases. Phosphorus application rate is expressed in terms of the University of Illinois maintenance phosphorus recommendations applicable to crops/yields grown on the site being evaluated. See the "P Inputs Matrix" below. Phosphorus may be in the form of commercial fertilizer or organic materials such as manure, animal waste lagoon supernatant, wastewater from municipal or agricultural sources or nonagricultural biosolids such as sewage sludge or landscape waste. When using the "P Input Matrix, it is assumed that soil incorporation is performed prior to runoff events. Instances where incorporation is typically not performed prior to runoff events will be considered as non-incorporated surface applications.

Solution Runoff Class Matrix

Hydrologic Soil Group			
A	**B**	**C**	**D**
Low	Medium	High	High

P INPUT MATRIX

	Application Rate		
Application Method	**<= UI Recommendations**	**>UI – 150% UI**	**>150% UI**
Incorporation or Injection > 3" below surface	Low	Low	Low
Shallowly incorporated surface applications <3 inches	Low	Medium	High
Non-incorporated surface applications	Medium	High	High

The table below identifies specific risk factors that may present in a given field. No attempt should be made to "average" the factors and assign a composite rating for the field. It is recognized that the risk factors do not act independently to influence phosphorus loss from agricultural fields and P loading into water resources. Simple averaging however, assumes that all risk factors have the same amount of influence. Attempts to objectively weight some factors more or less than others would be desirable but difficult without supporting data. The phosphorus assessment procedure is not a process based or empirical model. The procedure was developed as a conservation planning tool. The tool is designed to provide guidance to select and plan conservation measures that will lower the potential for phosphorus loss from agricultural fields and P loading into water resources.

Phosphorus Risk Potential	
Risk Factor	**Site value**
Soil Erosion	
Proximity to water	
Solution Runoff Potential	
Soil Test Phosphorus	
Phosphorus Inputs	

References:

- Sharpely, A.N., Determining An Environmentally Sound Soil Phosphorus Value, Journal Of Soil and Water Conservation, 1996.
- Sharpley, A.N., T. Daniel, T. Sims, J. Lemunyon, R. Stevens, and R. Parry. 1999. Agricultural Phosphorus and Eutrophication. U.S. Department of Agriculture, Agricultural Research Service, ARS-149, 42 pp.

APPENDIX B

RECOMMENDED MANAGEMENT PRACTICES TO REDUCE NITROGEN AND PHOSPHORUS LOSSES

Nitrogen:

1. Set realistic yield goals and follow University of Illinois' nitrogen recommendations.
2. Take credit for nitrogen from **all** sources: previous legume crop, incidental nitrogen contained in diammonium phosphate (DAP) and other fertilizers, manure applications, etc.
3. Determine nitrate loss potential using **Table 1** (following this Appendix). Use this as a guideline to determine application timing for fields with various soil textures. (More detailed information on total nitrogen loss potential is available in the University of Illinois Agricultural Experiment Station Bulletin 784, Nitrogen-Loss Potential Ratings for Illinois Soils.)
4. In fields where spring applications are not usually troublesome, apply the majority of the nitrogen shortly before or after planting.
5. For fall applications, use a nitrification inhibitor or wait until the soil has cooled down to 50^{o} F. Even when applying a nitrification inhibitor, do not apply nitrogen until soil has cooled to 60^{o} F. Probable dates when these soil temperatures are expected are contained in the *Illinois Agronomy Handbook*. In most cases, fall nitrogen applications should not begin prior to the third week in October.
6. Use adequate levels of phosphorus, potassium, and other nutrients to ensure optimum yields and nitrogen use efficiency.
7. Conduct a post-harvest evaluation of the nitrogen program:
   - Compare actual yields vs. yield goal;
   - Evaluate factors affecting yields and nitrogen use efficiency;
   - Consider using plant tissue analyses and an end-of-season corn stalk nitrate test to evaluate plant nitrogen sufficiency;
   - Refine nitrogen rates for future years.
8. Review each nutrient management plan annually to determine if changes in the nutrient budget are needed.
9. Calibrate application equipment annually, at minimum, to ensure uniform distribution of material at planned rates.
10. Use filter strips and riparian forest buffers to intercept nutrients transported surface runoff to the stream. (Note: these practices will have minimal effect in areas with extensive subsurface drainage.)
11. Avoid applying nitrogen around environmentally sensitive areas such as sinkholes, wells, gullies, ditches, surface inlets, or rapidly permeable areas.
12. Use cover crops, such as rye, to capture residual nitrogen after harvest and prevent nitrogen from being lost between harvest and planting of the next crop.
13. Utilize water table management to reduce artificial drainage when it is not needed for crop growth or field operations.

14. Utilize water table management to reduce artificial drainage when it is not needed for crop growth or field operations.
15. Outlet tiles into constructed wetlands to remove a portion of the nitrogen before tile effluent discharges into lakes or streams.

Phosphorus:

1. Perform soil test regularly (minimum of every four years) and follow University of Illinois' recommendations for application rates.
2. Do not maintain excessively high phosphorus soil test levels, especially in areas prone to phosphorus transport.
3. Use variable rate applications to increase the precision of phosphorus applications and to maintain rates needed for optimal crop production.
4. In areas where phosphorus losses occur primarily from surface runoff, incorporate or inject phosphorus beneath the soil surface.
5. Control soil erosion to 'T' or less.
6. Utilize agronomic practices that optimize crop production to maximize phosphorus utilization.
7. Use filter strips or riparian forest buffers to reduce offsite transport of particulate phosphorus.
8. Avoid applying nutrients when soils are frozen or covered with ice or snow.
9. Fall applications of phosphorus that are not incorporated into the soil should not be applied on slopes greater than 5% unless runoff control measures such as heavy residue cover, contour mulch tillage, contour strip cropping, or terraces have been applied.
10. Minimize surface runoff of water by reducing compaction, maintaining high crop residue levels, installing runoff control structures such as terraces, etc.
11. Avoid stratification on soils that are susceptible to runoff and erosion.

Table 1. Nitrogen Risk Assessment

Nitrate loss potentials based on soil texture, timing, and nitrification inhibitors			
Application Timing[1]	Soil Texture[2]		
	Coarse	Medium	Fine
Fall with an inhibitor > 60° F	High	High	High
Fall with an inhibitor < 60° F	High	Medium	Medium
Fall without an inhibitor > 50° F	High	High	High
Fall without an inhibitor < 50° F	High	Medium	Medium
Spring without an inhibitor	Medium	Medium	Medium-Low
Spring with an inhibitor	Medium-Low	Low	Low
Spring split applied or sidedress	Medium-Low	Low	Low

Foot notes:

1. Temperatures refer to soil temperature measured at a depth of 4 inches. For this assessment, inhibitors refer to nitrification inhibitors.
2. Soil Texture: Coarse - sand, loamy sand, sandy loam
   Medium - silt, silt loam, loam
   Fine - silty clay loam, silty clay, clay, clay loam, sandy clay, loam, sandy clay

When developing recommendations to be included in a nutrient management plan, the planner needs to use the results of the assessment above with knowledge of locally significant transport processes.

For example, in large areas of northern and central Illinois, nitrates are detected in surface water resources at concentrations above 10 part per million. Soils in much of the region only have a moderate nitrogen loss potential. The presence of extensive tile drainage, however, increases the risk of nitrate transport to surface water resources.

By contrast, in southern Illinois, there are large areas of level, poorly drained soils. The climate is warmer and there is more rainfall than in northern and central Illinois. The conditions favor the formation of nitrate. The loss of nitrate, however, is primary to the atmosphere due to denitrification.

APPENDIX C

PROCEDURE TO CALCULATE THE BRAY P1 OR EQUIVALENT SOIL BUILDUP

This procedure is to be used to estimate the number of years for a field to reach a soil test P of 300 Lbs./acre, when more P is being added than the crops can utilize. The calculations will only provide an estimate. Due to the variability of soils to fix phosphorus, soil tests need to be used to monitor the level of "P" build-up.

STEP 1. DETERMINE HOW MANY LBS./AC OF P_2O_5 IS ADDED PER YEAR.
Add together all the P_2O_5 added from manure/biosolids and from commercial fertilizer sources.

Crop (List the crops in the rotation)	P_2O_5 LbsAc From Manure/Biosolids	P_2O_5 Lbs/Ac From Commercial Fertilizer	Total for the Crop Year(Manure/Biosolids + Commercial)
1.			
2.			
3.			
4.			
5.			
Totals			

Average Lbs/Ac of P_2O_5 applied per year = Total Divided by Years = _________Lbs/Ac/Yr

Step 2. Determine the Average Lbs./Ac of P_2O_5 removed each year.
Refer to the Illinois Agronomy Handbook to determine crop removal rates for each crop and year. Add all the excess rates for each year and divide by the number of years in the rotation. This will equal the "Average P_2O_5 Crop Excess Per Year".

Crops in Rotation	P_2O_5 Added from Step 1	P_2O_5 Removed	P_2O_5 Excess
1.			
2.			
3.			
4.			
5.			
Totals			

The Total Excess divided by the number of years between P application= __________ average Lbs./Ac (Excess) P_2O_5 /Year.

Step 3. Determine the Estimated Soil Test P (in Lbs. P/acre) Increase Per Year.
Divide the Average Lbs. /Ac (Excess) P_2O_5 (from Step 2) by 9 = Estimated soil test P increase in Lbs./Ac/Yr.
________/9=__________

Step 4. Determine How Many Years To Increase Soil Test P Levels to 300 Lbs./Ac or other established threshold

Step 4a. 300 Lbs./Ac minus current soil test P = lbs./ac available to reach 300 Lbs./Ac. 300-__________=
Step 4b. Divide Available Lbs./Ac calculated in (Step 4a) by (Step 3) = Years to Reach 300 Lbs/Ac. Soil test P.
(Step 4a)_______________/(Step 3)_____________=______________Estimated years to reach 300 lbs. P/ac.

Step 5. Repeat for the necessary fields.

EXAMPLE

The following example illustrates how to use the procedure to estimate the rate of soil test P increase.

A producer applies and incorporates 6,000 gallons of liquid hog manure to the field every other year prior to planting corn.

The waste is obtained from a pit beneath a Growing/Finishing barn. The liquid is determined to contain 35 Lbs. P_2O_5/1000 gallons.

The field is used to produce corn and soybeans and their respective proven yields are 150 and 50 Bu./ac. The corn removes 64 lbs. P_2O_5/ac. the soybeans remove 42 lbs. P_2O_5/ac. The existing soil test "P" for this field is 200 lbs./ac.

This procedure is to be used to estimate the number of years for a field to reach a soil test P of 300 Lbs./acre, or other threshold, when more P is being added than the crops can utilize. The calculations will only provide and estimate. Due to the variability of soils to fix phosphorus, soil tests need to be used to monitor the level of "P" build-up.

Step 1. Determine how many Lbs./Ac of P_2O_5 is added per year.

Add together all the P_2O_5 added from manure/biosolids and from commercial fertilizer sources.

Crop (List the crops in the rotation)	P_2O_5 LbsAc From Manure/Biosolids	P_2O_5 Lbs/Ac From Commercial Fertilizer	Total for the Crop Year (Manure/Biosolids + Commercial)
1. Corn	210	0	210
2. Soybeans	0	0	0
3.			
4.			
5.			
Totals	210	0	210

Average Lbs/Ac of P_2O_5 applied per year = Total Divided by Years = *210/2*= 105 Lbs/Ac/Yr

Step 2. Determine the Average Lbs./Ac of P_2O_5 removed each year.
Refer to the Illinois Agronomy Handbook to determine crop removal rates for each crop and year. Add all the excess rates for each year and divide by the number of years in the rotation. This will equal the "Average P_2O_5 Crop Excess Per Year".

Crops in Rotation	P_2O_5 Added	P_2O_5 Removed	P_2O_5 Excess
1. Corn	105	64	41
2. Soybeans	105	42	63
3.			
4.			
5.			
Totals	210	106	104

The Total Excess divided by the number of years between P application= *104/2*= 52 average Lbs./Ac (Excess) P_2O_5 /Year.**Step 3. Determine the Estimated Soil Test P (in Lbs. P/acre) Increase Per Year.**

Divide the Lbs. P_2O_5/Ac excess (from Step 2) by 9 = Estimated soil test P increase in Lbs./Ac/Yr.
52/9= Approximately 6 lbs. increase in soil test P each year.

Step 4. Determine How Many Years To Increase Soil Test P Levels to 300 Lbs./Ac or other established threshold

Step 4a. 300 Lbs./Ac minus current soil test P = lbs./ac available to reach 300 Lbs./Ac. 300 -200 =100
Step 4b. Divide Available Lbs./Ac calculated in (Step 4a) by (Step 3) = Years to Reach 300 Lbs/Ac. Soil test P.
100/6 = 16 years estimated to reach 300 lbs. P/ac

STEP 5. REPEAT FOR THE NECESSARY FIELDS.