Guidelines to Applying Animal Liquid Waste to Subsurface and Surface Drained Cropland

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Liquid animal manures are a valuable source of nutrients and organic matter for crop production and can be applied by a variety of methods including spray irrigation, land surface spreading, and shallow subsurface injection. Because of their low solids and nutrient content, liquid animal manures are usually applied at relatively high volumes, but it is generally recommended that it not be applied at rates that exceed the soil infiltration rate, nor exceed the amount needed to bring the soil to field water holding capacity (Johnson and Eckert, 1995). Even when similar guidelines are followed, liquid manure discharges from agricultural drains has been reported in soils with subsurface drainage due to macropore flow (Geohring et al., 2001).

What Does Manure in Tile Water Look Like?

Manure:Water Solutions at Varying Ratios. Photo courtesy of Bonnie Ball-Coelho, Ontario, Canada

Application of liquid animal manures to soils with subsurface drainage has been linked to contamination of the effluent with nutrients (Cook and Baker, 2001; Geohring

Liquid Effluent Contaminating Surface Water Photo Courtesy of Rick Wilson, OEPA

et al., 2001; Stamm et al., 2002, Hoorman, 2004a, Hoorman, 2004b), particulate organic matter (Barkle et al., 1999), estrogens (Burnison et al., 2003), bacteria (Bicudo and Goyal, 2003; Cook and Baker, 2001; Dean and Foran, 1992; Jamieson et al., 2002; Joy et al., 1998), and veterinary antibiotics (Kay et al., 2004).

These findings are not universal, however, as liquid animal manures can be applied without any detectable adverse effects on water quality. For instance, Randall et al. (2000) noted no difference in nitrogen, phosphorus, or fecal indicator bacteria losses in drainage water when they compared plots that received liquid dairy manure to those that received equivalent amounts of mineral fertilizer. The fact that liquid animal manures can be safely land applied in some instances, but can cause contamination of subsurface drainage water under different circumstances, suggests a complex system that needs to be better managed. Soil properties such as soil texture, initial water content, and tillage history, as well as the amount of manures applied, application method, water content of manures, and the amount and timeliness of rainfall after application may all play a role in determining the fate of the applied material.

For more information on managing liquid animal wastes, see the fact sheet: *Understanding the Application of Liquid Animal Wastes to Subsurface and Surface Drains.*

Preferential Flow Workshop

A workshop on Liquid Animal Manure Application on Drained Cropland: Preferential Flow Issues and Concerns was conducted in Columbus, Ohio on November 9-10, 2004. One objective of this workshop was to initiate a cooperative, multi-state effort to integrate state guidelines into regional guidelines for mitigating liquid manure discharges from artificially drained cropland which are outlined below:

Regional Guidelines for Mitigating Liquid Manure Discharges:

Task: Initiate cooperative, multi-state efforts to integrate state guidelines and recommendations for mitigating liquid manure discharges from artificially drained cropland to develop regional guidelines.

Four major recommendations were made:

1) Observation and Monitoring of Subsurface Drain Inlets and Outlets

Any land application site where subsurface (tile) drains discharge into ditches or streams should be considered a high-risk field, and should be monitored carefully before, during, and after a manure application event. Applicators should apply, observe and monitor drain outlets, evaluate the results, and make adjustments, as needed, to develop and maintain a site-specific manure application plan. Do not apply manure to subsurface (tile) drained fields when the drains are flowing.

Regular observation and monitoring of subsurface drains is required to prevent surface contamination of liquid animal wastes. Photo courtesy of Jon Rausch, OSU Extension

A suggested schedule for observation and monitoring:

a) Check outlets to see if drains are flowing before starting liquid manure application.

b) Check outlets 10-20 minutes after start of any liquid manure application.

c) One time during each 20,000 gallon application, and once each hour, if application rate is >20,000 gal/hr. State and regional rates may vary.

d) Stop application immediately if discharge and/or discoloration observed.

e) Develop and implement a contingency plan. Observation and Monitoring of Subsurface Drain Inlets and Outlets is based on Ontario, Canada guidelines.

2) Liquid Manure Applied to Subsurface Drained Fields

The available water holding capacity of the upper 8 inches of the soil (Table 1) provides the approximate maximum volume of water that can be applied before water, manure and nutrients may begin to move through the soil profile. Liquid application rates need to be less than this amount to prevent surface water contamination. Manure application rates may need to be adjusted the day manure is applied to avoid reaching and/or exceeding the available holding capacity of the soil. Field/soil conditions the day of application will dictate the maximum application volume that can be applied. Suggested guidelines are listed below:

Field prone to flooding. Photo courtesy of Norm Widman, NRCS

a) Liquid manure should not to be applied on soils that are prone to flooding, as defined by the National Cooperative Soil Survey (or in the Flooding Frequency Soil List posted in Section II eFOTG), during the period when flooding is expected. Manure can be applied if incorporated immediately or injected below the soil surface during periods when flooding is not expected.

b) Avoid applying manure when rainfall is predicted, eminent, or after a rainfall event. After a rainfall event, the site should be allowed to drain to field capacity, and then longer so that the soil has the capacity to absorb additional water or liquid animal wastes. As part of the manure application recordkeeping, maintain a log of weather forecasts and actual weather conditions 24 hours before and after a manure application event.

Avoid applying liquid animal wastes to saturated soils. Photo courtesy of Rick Wilson, OEPA.

c) Liquid manure should not be applied to subsurface drained cropland if the drains are flowing.

d) Identify subsurface drain outlets, and control or regulate discharge prior to application, or have on-site means of stopping the discharge from subsurface drains (e.g., recommend drainage control structures, tile stops, or tile plugs). Use caution not to back-up water where it may impair the functioning of an adjacent subsurface drainage system. If subsurface drains are flowing prior to liquid manure application, liquid manure should not be applied

e) Develop a contingency plan to handle situations when liquid manure discharges to ditches or streams. Once manure discharge is observed, stop application, and block the drain outlets to prevent manure from reaching surface water.

Control Structures and Tile Stops can be utilized if properly installed to reduce surface water contamination. Tile plugs are less effective.

f) Application rates should be adjusted to consider the most limiting factor and include the ability of the soil to accept, store and hold liquid manure, water and nutrients and the ability of the plants to utilize these nutrient. See Table 2: Determining the Most Limiting Manure Application Rate and Table 3: Winter Application of Manure.

g) Liquid manure should be applied in a manner that will not result in ponding, or runoff to adjacent property, drainage ditches, or surface water regardless of crop nutrient need; and should be uniformly applied at a known rate. Liquid animal waste applications using irrigation or surface application equipment tend to have a greater problem with ponding.

Apply manure away from ditches and streams. Photo courtesy of Norm Widman, NRCS

h) For Ohio, do not apply at rates (volume) that exceed the lesser of the AWC (See Table 1 & 2) in the upper 8 inches or an effective rate of 13,000 gallons/acre per application. Smaller multiple rates of applications allow the soil to absorb liquid animal wastes better than one large application. State and regional rates may vary on acceptable application rates.

The effective rate is used for application equipment with concentrated flows. For example, for an injection toolbar with four (4) nozzles on 30 inch spacing, each knife and nozzle has a concentrated flow in a small area. The effective rate is calculated as the volume of manure applied per area for one (1) nozzle. Assume the application rate is 10,000 gallons per acre. Using an injection toolbar with 30 inch knife spacing, assuming 6 inch of lateral movement, the effective rate is 50,000 gallons per or five times higher than the application rate in that concentrated zone of application.

For the most effective application, liquid animal wastes should be applied shallow and uniformly into the soil surface.

i) Prior to manure application, use surface tillage to disrupt the continuity of worm holes, macropores and root channels (preferential pathways) to reduce the risk of manure reaching drain lines, or till the surface of the soil 3-5 inches deep to a condition that will enhance absorption of the volume of liquid manure being applied. This is especially important if shallow drains are present (< 2 feet deep). Any pre-application tillage should leave as much residue as possible on the soil surface to minimize soil erosion.

Till the soil 3-5 inches deep or 3 inches below the depth of injection to disrupt macropores.

j) If liquid injection is used, inject only deep enough to cover the manure with soil. Till the soil at least 3 inches below the depth of injection prior to application, or control outflow from all drain outlets prior, during, and after manure application.

Surface applications of liquid animal wastes to grass hay crops are better than applications to alfalfa fields due to the differences in roots. Photo courtesy of Jon Rausch, OSU

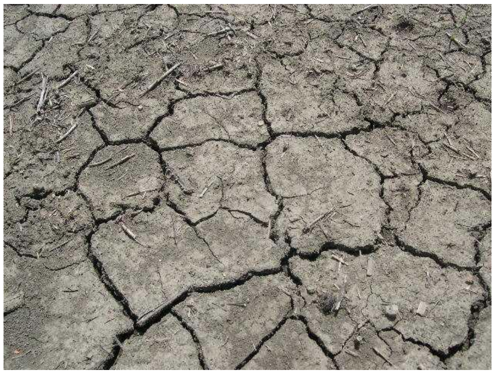
k) For perennial crops (hay or pasture), or continuous no-till fields where tillage is not an option, all subsurface drain outlets from the application area should be monitored and if manure laden flow should occur, that flow should be captured. If subsurface drains are flowing prior to liquid manure application, liquid manure should not be applied. Crops with deep tap root systems (alfalfa) tend to have more problems than hay crops with fibrous roots (grass) because liquid animal wastes may flow along the tap roots to subsurface drains and outlet to surface water.

l) Repair broken drains and blowholes prior to application, and follow recommended/required minimum setback requirements (setback distances vary from state to state) for surface inlets. See Table 4 for Ohio Setback Distances.

Repair broken drains and blowholes prior to application. Photo courtesy of Frank Gibbs, NRCS

n) Bare/crusted soils may require some tillage to improve infiltration and absorption of the applied liquid. Clay soils with a high shrink to swell capacity tend to have large deep cracks during dry conditions. These soils may need tillage to disrupt the macropores or a lower initial application rate applied to the soil to make the cracks smaller. Determine the most limiting application rate based on the field conditions and other limitations (may vary from state to state).

These criteria may be waived if the producer can verify there is no prior history of manure discharge via subsurface drains, or if a system is in place to capture the discharge. However, if there is a discharge, the



A Paulding clay soil with high shrink swell capacity may need tillage or smaller initial liquid applications to close the cracks. Photo courtesy of Jim Lopshire, OSU

producer is liable for damages and is at risk of being classified as a Concentrated Animal Feeding Operation (CAFO). (Hoorman et al., 2005a; Rausch et al.; 2005)

3) Liquid Manure Applied to Systematic Surface Drained Fields

Fields or areas of fields that have systematic “surface drainage” systems (e.g., shallow surface drains spaced 100 – 200 feet apart – NRCS Surface Drainage-Field Ditch Practice Standard 607) are considered concentrated flow areas. However, if special precautions are taken, manure can be applied in the surface drains with minimal risk of surface runoff. This does not apply to the collector surface drains (mains, ditches, etc.) or drains bordering the fields. The following special manure application techniques shall be used:

a. Till the soil surface at least 3 to 5 inches deep <u>prior</u> to liquid manure surface application. Pre-till within 7 days of application.

b. Surface-apply liquid manure <u>uniformly</u> over the entire soil surface on the freshly tilled soil (3-5 inches) to allow the liquid manure to be absorbed into the soil surface.

Till soil 3-5 inches deep prior to application.

c. For fields with no subsurface drainage, liquid manure can be injected directly without prior tillage. If subsurface drainage is present as well as surface drains, then the above recommendations for subsurface drained cropland apply as well.

d. Manure application rates should be adjusted to consider the most limiting factor and include the ability of the soil to accept, store and hold liquid manure, water and nutrients. The Nitrogen and Phosphorus Application Criteria for Manure, Organic By-Products and Bio-solids contained in NRCS Nutrient Management Standard 590 are to be followed to limit material transport and leaching. (Hoorman et al., 2005a; Rausch et al., 2005)

4) Other General Management Criteria

a. Maximize liquid manure storage structures available holding capacity through frequent manure applications under optimal weather conditions. Do not let manure storage structures get too full. Contact custom manure applicators several months in advance of the targeted application date. At a minimum, start making arrangements to apply liquid animal wastes when the structure is 50% full.

Proper management of manure storage capacity is critical to preventing surface water contamination. Photo courtesy of Mark Fritz, SWCD

b. Size manure application equipment to meet equipment and labor (time) constraints. Make arrangements early to hire custom applicators (one year in advance is preferred) if your equipment application needs are inadequate.

c. Calibrate equipment frequently and follow a regular repair/maintenance schedule. Knowing and applying the effective application rate is critical to preventing surface water contamination.

d. Modify crop rotations to fully utilize manure nutrients during the growing season. In some cases this may mean growing wheat or a grass hay crop to allow application in the summer. Plant cover crops after harvest to hold available soil and manure nutrients. Growing winter cover crops may give the applicator a larger window of opportunity for applying manure and save money on fertilizer applications. (Hoorman et al., 2005a).

Conclusion and Summary

Improved management is a key issue in greatly reducing the potential of preferential flow of liquid manure to surface water. While climate and some environmental conditions cannot be controlled, producers can better manage and control when and how they apply liquid manure. These recommended guidelines are intended to help producers apply liquid manure in a manner that minimizes the potential for impacting water resources through the downward movement of manure into subsurface (tile) drains. These recommendations incorporate the best available knowledge. (Hoorman, et. al., 2005b)

These guidelines include four major recommendations: 1) Observing and monitoring of subsurface drain inlets and outlets, 2) Thirteen guidelines for liquid manure application to subsurface drained fields, 3) Four guidelines for liquid manure application to systematic surface drained fields, and 4) Four General Management guidelines. To avoid over-application of liquid manure, the maximum available water holding capacity of the soil (Table 1) must be considered. This will help to determine the most limiting liquid manure application rate for Ohio applicators (Table 2). Additional rules apply in Ohio for the winter application of manure (Table 3). Finally, Table 4 covers Ohio manure application setback distances for Non-CAFO operations.

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Maximum Available Water Holding Capacity of Soils

Table 1: Available Water Capacity (AWC) Practical Soil Moisture Interpretations for Various Soils Textures and Conditions to Determine Liquid Waste Volume Applications not to exceed AWC. Note: Manure application rates need to be less than AWC to prevent runoff.

This table shall be used to determine the AWC (upper 8 inches) at the time of application and the liquid volume in gallons that can be applied not to exceed the AWC. To determine the AWC in the upper 8 inches use a soil probe or similar device to evaluate the soil to a depth of 8 inches.

Available Moisture in the Soil	Sands and Loamy Sands	Sandy Loam and Fine Sandy Loam	Very Fine Sandy Loam, Loam, Silt Loam, Silty Clay Loam, Clay Loam, Sandy Clay Loam	Sandy Clay, Silty Clay, Clay
< 25% Soil Moisture Amount to Reach AWC	Dry, loose and single-grained; flows through fingers. 20,000 gallons/ac	Dry and loose; flows through fingers. 27,000 gallons/ac	Powdery dry; in some places slightly crusted but breaks down easily into powder. 40,000 gallons/ac	Hard, baked and cracked; has loose crumbs on surface in some places. 27,000 gallons/ac
25-50% or Less Soil Moisture Amount to Reach AWC	Appears to be dry; does not form a ball under pressure. 15,000 gallons/ac	Appears to be dry; does not form a ball under pressure. 20,000 gallons/ac	Somewhat crumbly but holds together under pressure. 30,000 gallons/ac	Somewhat pliable; balls under pressure. 20,000 gallons/ac
50 - 75 % Soil Moisture Amount to Reach AWC	Appears to be dry; does not form a ball under pressure. 10,000 gallons/ac	Balls under pressure but seldom holds together. 13,000 gallons/ac	Forms a ball under pressure; somewhat plastic; slicks slightly under pressure. 20,000 gallons/ac	Forms a ball; ribbons out between thumb and forefinger. 13,000 gallons/ac
75% to Field Capacity Amount to Reach AWC	Sticks together slightly; may form a weak ball under pressure. 5,000 gallons/ac	Forms a weak ball that breaks easily, does not stick. 7,000 gallons/ac	Forms ball; very pliable; slicks readily if relatively high in clay. 11,000 gallons/ac	Ribbons out between fingers easily; has a slick feeling. 7,000 gallons/ac
100% Field Capacity	On squeezing, no free water appears on soil, but wet outline of ball on hand.	On squeezing, no free water appears on soil, but wet outline of ball on hand.	On squeezing, no free water appears on soil, but wet outline of ball on hand.	On squeezing, no free water appears on soil, but wet outline of ball on hand.
Above Field Capacity	Free water appears when soil is bounced in hand.	Free water is released with kneading.	Free water can be squeezed out.	Puddles: free water forms on surface

Table 2: Determining the Most Limiting Manure Application Rates-Subsurfaced Drained (Ohio-NRCS Conservation Practice Standard 633: Waste Utilization (June 2003))

Field Situation and Time of Year	Limiting Application Rate criteria				
	Nitrogen	P205 4/	K20	Tons/Ac Gallons/Ac	AWC Table
(April – June) Subsurface Drained or High N Leaching Potential	1/Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	13,000 gal.	Upper 8”
(April – June) **Pasture > 20% or Cropland > 15%** Subsurfaced Drained or High N Leaching Potential	Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons 5,000 gal. – unless contoured strips or incorporated immediately	Upper 8”
(July – Sept.) **No Growing Crop** Subsurface Drained or High N Leaching Potential	2/ 50 lbs/ac as applied N	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	13,000 gal.	Upper 8”
(July – Sept.) **With a Growing Cover Crop** Subsurface Drained or High N Leaching Potential	3/ Next year’s crop needs as applied N	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	13,000 gal.	Upper 8”
(July – Sept.) **No Growing Crop** **Cropland > 15%** Subsurfaced Drained or High N Leaching Potential	2/ 50 lbs/ac as applied N	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons or 13,000 gal.	Upper 8”
(Oct. – March) Subsurface Drained or High N Leaching Potential	3/ Next year’s crop needs as applied N.	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	13,000 gal	Upper 8”
(Oct. – March) **Pasture > 20% or Cropland > 15%** Subsurfaced Drained or High N Leaching Potential	3/ Next year’s crop needs as applied N	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons 5,000 gal. – unless contoured strips or incorporated immediately	Upper 8”
Frozen or Snow Cover Subsurface Drained or High N Leaching Potential	3/ Next year’s crop needs as applied N	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons 5,000 gal. – unless contoured strips or incorporated immediately	

Conservation standard practices are reviewed and updated periodically. To obtain a current version of this standard, contact the Natural Resources Conservation Service office or website (www.oh.nrcs.usda.gov).

Table 2: Determining the Most Limiting Manure Application Rates- Not Subsurface Drained (Ohio-NRCS Conservation Practice Standard 633: Waste Utilization (June 2003))

Field Situation and Time of Year	Limiting Application Rate criteria				
	Nitrogen	P205 4/	K20	Tons/Ac Gallons/Ac	AWC Table
(April – June) Not Subsurface Drained	1/Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac		Upper 8”
(July – Sept.) No Subsurface Drained	1/ Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac		Upper 8”
(Oct. - March) Not Subsurface Drained	1/ Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac		Upper 8”
(April - June) Not Subsurfaces Drained Pasture > 20% or Cropland > 15%	1/ Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons 5,000 gal. – unless contoured strips or incorporate	Upper 8”
(July – Sept.) Not Subsurfaced Drained Pasture > 20% or Cropland > 15%	1/ Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac		Upper 8”
Frozen or Snow Cover Not Subsurface Drained	1/ Next year’s crop needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons < 50% Solids; 5 wet tons > 50% solids; Liquid Manure 5000 gallons/ acre	
(Oct. – March) Not Subsurfaced Drained Pasture > 20% or Cropland > 15%	1/ Crop Needs factoring N losses	Crop Needs or Crop Removal < 250 Lbs/ac	Crop Needs or Crop Removal < 500 Lbs/ac	5/ 10 wet tons 5,000 gal. – unless contoured strips or incorporated immediately	Upper 8”

1/ Crop Needs factoring N losses – Maximum total nitrogen applied to meet the succeeding crop’s recommended NITROGEN requirements for non-legume crops or 150 lbs/ac NITROGEN for the succeeding legume crop. **Considers loss of N through application method and time of year.**

2/ 50 lbs/ac as applied N – Nitrogen application limited to 50 lbs/ac based on the addition of the NH4 or NH3 (ammonium/ammonia) content of the manure + 1/3 of the organic nitrogen content the manure as applied. **Considers no losses due to application method or time of year.**

3/ Next year’s crop needs as applied N – Maximum total nitrogen applied to meet the succeeding crop’s recommended NITROGEN requirements for non-legume crops or 150 lbs/ac NITROGEN for the succeeding legume crop. **Considers no losses due to application method or time of year.**

4/ Under special conditions and criteria the rate of P205 application can be increased to 500 lbs/acre see (Nutrient Management Standard 590).

5/ Wet tons refers to the weight of the manure as it is applied – include solids and moisture weight.

Table 3: Winter Application of Manure (From Ohio-NRCS Conservation Practice Standard 633: Waste Utilization (June 2003))

Application on frozen and snow covered soil is not recommended. However, if manure application becomes necessary on frozen and snow cover soils, only limited quantities of manure shall be applied to address waste storage limitations until non frozen soils are available for manure application. These situations need to be documented in the CNMP and in the producer records. If winter application becomes necessary, applications are to be applied only if **ALL** the following criteria are met:

a. Application rate is limited to 10 wet tons/acre for solid manure more than 50% moisture and 5 wet tons for manure less than 50% moisture. For Liquid manure the application rate is limited to 5,000 gallons/acre.

b. Applications are to be made on land with at least 90% surface residue cover (e.g. good quality hay or pasture field, all corn grain residue remaining after harvest, all wheat residue cover remaining after harvest).

c. Manure shall not be applied on more than 20 contiguous acres. Contiguous areas for application are to be separated by a break of at least 200 feet. Utilize those areas for manure application that are the furthest from streams, ditches, surface water, etc (areas that present the least runoff potential and are furthest from surface water).

d. Increase the application setback distance to 200 feet "minimum" from all grassed waterways, surface drainage ditches, streams, surface inlets, water bodies. This distance may need to be further increased due to local conditions.

e. The rate of application shall not exceed the rates specified in Table 2: Determining the Most Limiting Manure Application Rates for winter application.

f. Additional winter application criteria for fields with significant slopes more than 6% (fields exceeding 6% are to be identified in the CNMP). Manure shall be applied in alternating strips 60 to 200 feet wide generally on the contour, or in the case of contour strips on the alternating strips.

Table 4: Ohio Manure Application Setback Distances for Non-CAFO Operations (From Ohio-NRCS Conservation Practice Standard 633: Waste Utilization (June 2003))

Type of Sensitive Setback Area	Setbacks Based on Methods of Manure Application		
	Surface Application	Winter Application Frozen or Snow Covered Soils 7/	Surface Incorporation W/I 24 Hours OR Direct Injection
Residences / Private Wells down slope from the application area.	100 ft.	200 ft.	100 ft.
- Sinkholes	300 ft.		100 ft.
- Pond or Lake	- 35ft. Vegetative Barrier 1/, with the remaining 100 ft. setback in non-vegetative Setback 2/	- 35ft. Vegetative Barrier 1/, with the remaining 200 ft. setback in non-vegetative Setback 2/	- 35ft. Vegetative Barrier 1/
- Streams - Ditches - Surface Inlets	- 35ft. Vegetative Barrier 1/, OR - 100 ft. setback in non-vegetative Setback, OR - 35 ft. in non-vegetative setback 3/	200 ft.	None
Grassed Waterway	35 ft.	200 ft.	None
Field Surface Drains	35 ft. 4/	200 ft.	None
Public Wells	300 ft.	300 ft.	100 ft.
Developed Springs	300 ft. upslope	300 ft. upslope	300 ft. upslope
Public Surface Drinking Water Intake	300 ft.	300 ft.	300 ft.

1/ Permanent vegetation consisting of grass, grass/legume mix, trees/shrubs, or trees/shrubs and grass/legumes. Measured from top of bank.
2/ Includes 100 ft. total setback. The setback must include a minimum of 35 ft. of vegetative cover from top of bank with the remainder of the 100 feet with no vegetative requirement. The setback is measured from the top of bank.
3/ Applies if the manure application area has at least 50% vegetative/residue cover at the time of application.
4/ No setback is required for field drains if the **Additional Criteria to Protect Water Quality, Item 5** is applied from this standard.
5/ CAFO's must follow the setbacks defined in the Ohio Department of Agriculture (ODA) rules regarding manure application. See **Table 5-ODA Setbacks – Appendix A Table 1 of rule 901:10-1-14: Land Applications Restrictions and Setbacks.**
6/ Excludes sludge that is regulated by the Ohio Environmental Protection Agency (OEPA) and septage regulated by the Ohio Department of Health.
7/ See Additional Criteria to protect Water Quality, Item 7, for the special manure application criteria on frozen and snow covered fields.