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AGRICULTURAL LAND APPLICATION OF BIOSOLIDS IN VIRGINIA: REGULATIONS

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Introduction

As required by the Clean Water Act Amendments of 1987, the U.S. Environmental Protection Agency (EPA) developed the regulation, The Standards for the Use or Disposal of Sewage Sludge (Title 40 of the Code of Federal Regulations [CFR], Part 503). The Part 503 rule establishes minimum requirements when biosolids are applied to land to condition the soil or fertilize crops or other vegetation grown in the soil. The Clean Water Act required that this regulation protect public health and the environment from any reasonably anticipated adverse effects of pollutants and pathogens in biosolids.

Federal regulations require that state regulations be at least as stringent as the Part 503 rule. The Biosolids Use Regulations (12 VAC 5-585, 32.1-164.5 of the Code of Virginia), which regulate the agricultural use of biosolids in Virginia, were developed by the Virginia Department of Health for contractors who land apply, distribute, or market biosolids. The Department of Environmental Quality issues Virginia Pollutant Discharge Elimination System (VPDES) permits to owners of wastewater treatment facilities that land apply their own biosolids. Local governments may enact ordinances that place further restrictions on land application practices.

The underlying premise of both the Federal and State regulations is that biosolids should be used in a manner that limits risks to human health and the environment. The regulations prohibit land application of low-quality sewage sludge and encourage the application of biosolids that are of sufficient quality that they will not adversely affect human health or the environment. Determination of biosolids quality is based on trace element (pollutant) concentrations and pathogen and vector attraction reduction.

Federal Regulations

Pollutants

The Part 503 rule prohibits land application of sewage sludge that exceeds certain limits (Table 1) for nine trace elements, including arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Such materials could not be applied to land and are not considered biosolids. The *ceiling concentration limits* are the maximum concentrations of the nine trace elements allowed in biosolids to be land applied. Sewage sludge exceeding the ceiling concentration limit for even one of the regulated pollutants is not classified as biosolids and, hence, cannot be land applied.

Pollutant concentration limits are the most stringent pollutant limits included in Part 503 for land application. Biosolids meeting pollutant concentration limits are subject to fewer requirements than biosolids meeting ceiling concentration limits. Results of the U.S. EPA's 1990 National Sewage Sludge Survey (NSSS) [U.S. EPA, 1990] demonstrated that the mean concentrations of the nine regulated pollutants are considerably lower than the most stringent Part 503 pollutant limits (Table 1).

The *cumulative pollutant loading rate* (Table 1) is the total amount of a pollutant that can be applied to a site in its lifetime by all bulk biosolids applications meeting ceiling concentration limits. No additional biosolids meeting ceiling concentration limits can be applied to a site after the maximum cumulative pollutant loading rate is reached at that site for any one of the nine regulated trace elements. Only biosolids that meet the more stringent pollutant concentration limits may be applied to a site once a cumulative pollutant loading rate is reached at that site.

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Table 1

Land applied biosolids pollutant limits (Adapted from U.S. EPA, 1995) and mean concentrations (NSSS) from National Sewage Sludge Survey (U.S. EPA, 1990).

Pollutant	CCL ^{a,b} ppm ^f	PCL ^{a,c} ppm	CPLR ^{a,d} lbs/acre	NSSS ^a ppm
Arsenic (As)	75	41	36	10
Cadmium (Cd)	85	39	35	7
Copper (Cu)	4300	1500	1340	741
Lead (Pb)	840	300	270	134
Mercury (Hg)	57	17	16	5
Molybdenum (Mo)	75	^e	^e	9
Nickel (Ni)	420	420	375	43
Selenium (Se)	100	100	89	5
Zinc (Zn)	7500	2800	2500	1202

^a Dry weight basis.

^b CCL (ceiling concentration limits) = maximum concentration permitted for land application.

^c PCL (pollutant concentration limits) = maximum concentration for biosolids whose trace element pollutant additions do not require tracking (i.e., calculation of CPLR).

^d CPLR (cumulative pollutant loading rate) = total amount of pollutant that can be applied to a site in its lifetime by all bulk biosolids applications meeting CCL.

^e The February 25, 1994 Part 503 Rule amendment deleted Mo PCL for sewage sludge applied to agricultural land but retained Mo CCL.

^f ppm = part per million.

In 1978 the EPA established pretreatment specifications (40 CFR Part 403) that require industries to limit the concentrations of certain pollutants, including trace elements and organic chemicals, in wastewater discharged to a treatment facility. An improvement in the quality of biosolids over the years has largely been due to pretreatment and pollution prevention programs (Shimp, et al., 1994).

Organic chemicals

Part 503 does not regulate organic chemicals in biosolids because the chemicals of potential concern have been banned or restricted for use in the United States; are no longer manufactured in the United States; are present at low concentrations based on data from EPA's 1990 NSSS (U.S. EPA, 1990); or because the limit for an organic pollutant identified in the Part 503 risk assessment is not expected to be exceeded in biosolids that are land applied (U.S. EPA, 1992a). Restrictions will be imposed for agricultural use if testing of certain toxic organic compounds verifies that biosolids contain levels that could cause harm to human health or the environment.

Pathogen reduction

Federal and state regulations require the reduction of potential disease-causing microorganisms, called pathogens (e.g., viruses, bacteria and parasitic worms) and vector (e.g., rodents, birds, insects that can transport pathogens away from the land application site) attraction properties. Biosolids intended for land application are normally treated by chemical or biological processes that greatly reduce the number of pathogens and odor potential in sewage sludge. Two levels of pathogen reduction, Class A and Class B, are specified in the regulations.

The goal of Class A requirements is to reduce the pathogens (including *Salmonella* sp., bacteria, enteric viruses, and viable helminth ova) to below detectable levels. Class A biosolids can be land applied without any pathogen-related site restrictions. *Processes to further reduce pathogens* (PFRP) treatment, such as those involving high temperature, high pH with alkaline addition, drying, and composting, or their equivalent are most commonly used to demonstrate that biosolids meet Class A requirements.

The goal of Class B requirements is to ensure that pathogens have been reduced to levels that are unlikely

to cause a threat to public health and the environment under specified use conditions. *Processes to significantly reduce pathogens* (PSRP), such as digestion, drying, heating, and high pH, or their equivalent are most commonly used to demonstrate that biosolids meet Class B requirements.

Because Class B biosolids contain some pathogens, certain site restrictions are required. These are imposed to minimize the potential for human and animal contact with the biosolids until environmental factors (temperature, moisture, light, microbial competition) reduce the pathogens to below detectable levels (Table 2). The site restriction requirements in combination with Class B treatment are expected to provide a level of protection equivalent to Class A treatment. All biosolids that are land applied must, at a minimum, meet Class B pathogen reduction standards.

Vector attraction reduction

The objective of vector attraction reduction is to prevent disease vectors such as rodents, birds, and insects from transporting pathogens away from the land application site. There are ten options available to demonstrate that land-applied biosolids meet vector attraction reduction requirements. These options fall into either of the following two general approaches: 1) reducing the attractiveness of the biosolids to vectors with specified organic matter decomposition processes (e.g., digestion, alkaline addition) and 2) preventing vectors from coming into contact with the biosolids (e.g., biosolids injection or incorporation below the soil surface within specified time periods).

Categories of biosolids quality

The quality of biosolids (i.e., pollutant concentrations, pathogen levels, and vector attraction reduction control) determines which land application requirements must be met. There are three categories of biosolids quality that are discussed below and described in Table 3.

Biosolids that meet the Part 503 PCLs, Class A pathogen reduction, and a vector attraction reduction option that reduces organic matter are classified as *exceptional quality* or EQ biosolids. In general, EQ biosolids can be applied as freely as any other fertilizer or soil amendment to any type of land. Virginia requires additional recordkeeping for distribution of bulk quantities and specific labeling information for bagged products marketed under a registration filed with the Virginia Department of Agriculture and Consumer Services.

Pollutant concentration (PC) biosolids meet the same low pollutant limits (PCLs) as EQ biosolids, but PC biosolids usually meet Class B rather than Class A pathogen reduction requirements. Biosolids meeting Class A pathogen reduction requirements plus one of the practices designed to prevent vectors from coming into contact with biosolids also are PC biosolids.

Cumulative pollutant loading rate (CPLR) biosolids, unlike EQ or PC biosolids, require tracking of the cumulative metal loadings to ensure adequate protection of public health and the environment.

Nutrients

Federal regulations specify that biosolids may only be applied to agricultural land at or less than the rate

Table 2

Class B biosolids application land use restrictions (VDH, 1997).

Root crops, where biosolids remain on land surface:		
	≥ 4 mos. prior to soil incorporation	Harvest 20 months after application
	< 4 mos. prior to soil incorporation	Harvest 38 months after application
Food crops that touch biosolids or soil		Harvest 14 months after biosolids application
Other food, feed or fiber crops		Harvest 30 days after application
Turf		Harvest 1 year after application when the turf is placed on land with high potential for public exposure
Grazing animals		
	Lactating (milking) animals	No grazing prior to 30 days after application
	Non-lactating animals	No grazing prior to 60 days after application
Public access to land		
	High access potential	Restricted to 1 year after application
	Low access potential	Restricted to 30 days after application

required to supply the nitrogen (N) needs of the crops to be grown. This “agronomic rate” is “designed: (1) to provide the amount of N needed by the food crop, feed crop, fiber crop, or vegetation grown on the land; and (2) to minimize the amount of N in the biosolids that passes below the root zone of the crop or vegetation grown on the land to the ground water (40 CFR 503.11 (b)).” Agronomic rate may also be based on crop phosphorus (P) needs if it is determined that excessive soil P poses a threat to water quality. By signing the land application agreement with a biosolids contractor, the farmer is obligated to make every reasonable attempt to produce a crop on sites receiving biosolids that matches the agronomic rate applied.

Site suitability

Site physical characteristics that influence the land application management practices include: topography; soil permeability, infiltration, and drainage patterns; depth to groundwater; and proximity to surface water. Federal, state, and local regulations, ordinances or guidelines place limits on land application based on these physical characteristics. Potentially unsuitable

areas for biosolids application include: 1) areas bordered by ponds, lakes, rivers, and streams without appropriate buffer areas; 2) wetlands and marshes; 3) steep areas with sharp relief; 4) undesirable geology (karst, fractured bedrock) if not covered by a sufficiently thick layer of soil; 5) undesirable soil conditions (rocky, shallow); 6) areas of historical or archeological significance; and 7) other environmentally sensitive areas, such as floodplains.

State Regulations

The Virginia Department of Health Biosolids Use Regulations were enacted to establish site-specific management practice standards more demanding than the Part 503 rule. The regulations define standards of practice to ensure that biosolids use does not compromise the public health or the environment. Discharge of improperly treated and unacceptable quality sewage sludge could result in pollution of surface and ground water, contamination of soil and exposure of the public to infectious agents. Some of the state requirements that are more stringent than those in the 503 Rule include:

Table 3

Summary of requirements for different quality bulk biosolids.

Biosolids Type	Ceiling Concentration Limit	Other Pollutant Limits	Pathogen Class	Vector Attraction Reduction ^a	Siting Restrictions	Track Added Pollutant	Required Management Practices
Exceptional Quality (EQ)	Yes	Pollutant Conc Limits	A	Treatment Options	No	No	No ^b
Pollutant Concentration (PC)	Yes	Pollutant Conc Limits	A or B	Any Option	No ^a Yes ^b	No	Yes ^c
Cumulative Pollutant Loading Rate (CPLR)	Yes	Cumulative Pollutant Loading Rate	A or B	Any Option	Yes	Yes	Yes

^a The eight vector attraction reduction treatment options that reduce the attractiveness of the biosolids to vectors by further decomposition of the volatile solids. Two additional management options (incorporation and injection) prevent vectors from coming into contact with the biosolids.

^b EQ biosolids can be applied as freely as any other fertilizer or soil amendment to any type of land. Virginia requires additional recordkeeping for distribution of bulk quantities and specific labeling information for bagged products marketed under a registration filed with the Virginia Department of Agriculture and Consumer Services. EQ biosolids are exempt from Part 503 general requirements and management practices.

^c Management practices are required when biosolids do not meet EQ criteria either because they meet vector attraction reduction through soil injection or incorporation.

Infrequent (once every three years) agronomic rate application is encouraged by imposing additional nutrient management planning and monitoring requirements on land amended with agronomic rates of biosolids on a frequent (annual) basis. Biosolids may be applied frequently (annually) at “below agronomic rates” without additional monitoring as long as residual nutrients are accounted for in the management plan. These practices have been specified in order to control the buildup of soil phosphorus and residual nitrogen. Infrequent application also reduces the addition of trace elements to the soil, thus increasing the time that biosolid applications take to reach the cumulative pollutant loading rate.

Biosolids loading rate can be limited by soil pH when biosolids containing appreciable amounts of lime are applied. High soil pH values caused by excessive liming can result in micronutrient deficiencies in crops grown in such soils. The soil pH should be no greater than 6.5 for Coastal Plain soils and 6.8 for soils in other regions of the state for sensitive crops.

The Virginia Department of Conservation and Recreation may require the preparation of a complete nutrient management plan or soil conservation plan if sites exhibiting a soil test phosphorus concentration of ≥ 55 ppm phosphorus (Mehlich I analytical test procedure or the equivalent) pose significant erosion potential based on site soils and topography. Such sites are not good candidates for biosolids application without additional management practices.

Specified best management practices (BMPs) must be used if biosolids are applied to slopes greater than five percent between November 16 of one year and March 15 of the following year. Biosolids should be directly injected into soils on sites exhibiting erosion

potential unless other BMPs are used to minimize soil erosion and the potential of nonpoint runoff. Biosolids may not be applied to site slopes exceeding 15 percent. Biosolids must be directly injected or incorporated within 48 hours if: 1) applied on sites with less than 60 percent uniform residue cover within any portion of the site, or 2) applied to soils during periods when soils may be subject to frequent flooding.

Biosolids may only be applied to snow-covered ground if the snow cover does not exceed one inch and if the snow and biosolids are incorporated within 24 hours of application. Liquid sludges may not be applied to frozen ground. Dry or dewatered biosolids may be applied to frozen ground only if the site slope is 5 percent or less, a 200 foot vegetative buffer is maintained from surface water courses, and the entire application site has uniform vegetative coverage of at least 60 percent.

The State Regulations specify minimum distances to land application areas from occupied dwellings, water supply wells or springs, property lines, perennial streams and other surface waters, intermittent streams/drainage ditches, improved roadways, rock outcrops and sinkholes, and agricultural drainage ditches (Table 4). Standard buffer distances to perennial streams and other surface waters must be doubled if site slopes are greater than 7 percent and when applied between November 16 and December 21.

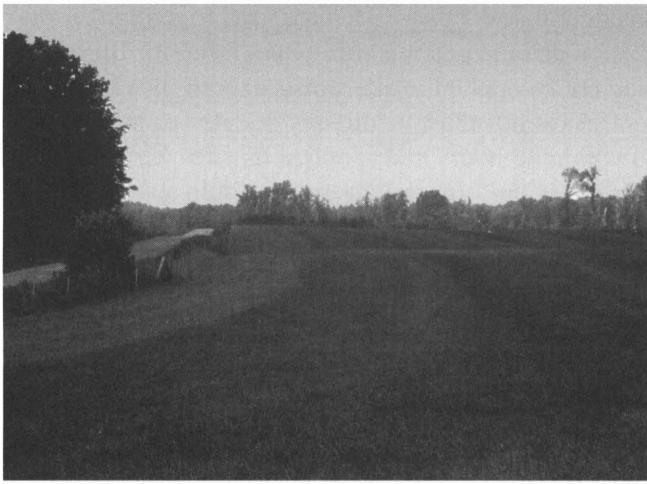
Application sites should possess good tilth, moderate to high surface infiltration rates and moderate to slow subsoil permeability. The Virginia BURs require at least 18 inches to bedrock or restrictive layers and to seasonal water table, and a soil pH of 6.0 or higher at the time of application if the cadmium concentration in the biosolids is greater than 21 ppm.

Table 4
Minimum distances (feet) to land application area.

Adjacent feature	Surface Application ^a	Incorporation	Winter ^b
Occupied dwellings	200	200	200
Water supply wells or springs	100	100	100
Property lines	100	50	100
Perennial streams and other surface water, except intermittent streams	50	35	100
Intermittent streams/drainage ditches	25	25	50
All improved roadways	10	5	0
Rock outcrops and sinkholes	25	25	25
Agricultural drainage ditches with slopes equal to or less than 2%	10	5	10

^a Not plowed or disced to incorporate within 48 hours.

^b Application occurs on average site slope greater than 7% during period between November 16 of one year and March 15 of the following year.



Vegetative buffer strips separate biosolids from edge of field, drainage ditches, rock outcrops, etc.

(Photograph courtesy of Nutri-Blend, Inc.)

Commonly Asked Questions

Who can provide information about the permitting process for land application?

Guidelines for obtaining approval for land application of biosolids are available from field offices of the State Department of Health, Office of Environmental Health Services.

What are the normal steps for approval of land application of biosolids in a Virginia county?

- 1 Contractor proposes land application to landowner and farmer(s), secures agreement, and submits a complete, site specific permit application to the Virginia Department of Health (VDH). The VDH notifies the local government of the permit application and requests comment.
- 2 When the application is for a new permit for sites in a county, a public informational meeting is held at which agronomic, health and environment, regulatory, and logistical land application issues are addressed by representatives of the VDH, the biosolids' contracting company, and, often, Virginia Tech/Virginia Cooperative Extension (VCE). Speakers representing other state agencies that participate in the biosolids use program (i.e., Virginia Department of Conservation and Recreation [VDCR], and Virginia Department of Environmental Quality [VDEQ]) sometimes make presentations at these meetings.
- 3 Biosolids' contractor addresses comments concerning the permit application with the local government and VDH. The following steps may be included in the permit review process to further address specific controversial issues:
 - a County public hearing before the Board of Supervisors may be held. VDH, Virginia

Tech/VCE, the biosolids contractor and (sometimes) VDCR and VDEQ are represented at these meetings to provide information to the Board to assist them in making decisions regarding biosolids use in their county. The county has the option to permit land application according to VDH state regulations, deny land application outright, or permit land application with additional local regulations (ordinances). The state permit will be issued in cases where the contractor is in compliance with the existing special use ordinance.

- b If the county does not deny the permit but includes additional ordinance items, the contractor agrees to or declines the offer to apply biosolids according to the provisions stated in the ordinance.
- 4 The VDH approves or rejects the permit application following the public meeting or receipt of local government and other agency comments. (Staff of the Department of Conservation and Recreation review the permits' nutrient balance sheets and nutrient management plans.) The existing permit may be modified during this process.
- 5 The biosolids contractor begins the land application program according to the permit requirements, regulations and ordinances.

Who is responsible for collecting information, obtaining approval, and properly applying the material?

Usually, sewage treatment plant personnel or biosolids application contractors.

Who is responsible for recordkeeping and reporting?

Persons who prepare biosolids for land application must provide information necessary to demonstrate compliance with the state and federal regulations to the land applicators. The persons who apply the biosolids to the land are responsible for obtaining from the preparer information necessary to demonstrate compliance with the rule.

Who assumes liability for improper management of biosolids?

The generator of the biosolids is liable for the material if its utilization results in a health or environmental problem. The Part 503 Rule requires that the treatment works will be held accountable if it uses a contractual applicator who does not change the quality of the biosolids for land application since the EPA considers that the treatment works still retains control over the quality of the material. Therefore, municipalities may wish to monitor contract haulers and/or land applicators carefully. Conversely, the contractor should not be placed into a contractual responsibility for land

applying biosolids that are not acceptable to nearby residents.

What additional agreements are recommended?

Farmers have the right to negotiate additional restrictions and agreements with the biosolids' contractor above and beyond the stipulations set forth in the state regulations and local ordinances. Written agreements are useful because they force farmers to think through specific ways in which the land application program will impact their normal operations, such as location of fields that will receive biosolids, separation or buffer distances between land application and water resources, crop rotations employed, time period during which spreading will take place, identification of entrances and exits for transportation of biosolids, method of application, restrictions on spreading when soil is too wet or subject to compaction or runoff, etc.

How can good biosolids management be ensured?

Regulatory officials have the authority to inspect operations, review records, sample applied biosolids, and generally respond to complaints concerning public health or public nuisances. EPA may pursue enforcement actions when necessary to address violations, whether willful or the result of negligence. Private citizens may pursue civil remedies against a violator under the Clean Water Act in the absence of a government enforcement action.

Further information can be found in the following Virginia Cooperative Extension fact sheets on agricultural land application of biosolids in Virginia: VCE Publication 452-301, Production and characteristics (Evanylo, 1999b); VCE Publication 452-303, Managing biosolids for agricultural use (Evanylo, 1999d), and VCE Publication 452-304, Risks and concerns (Evanylo, 1999c).

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