



Iowa Water Environment  
Association

**Biosolids Land  
Application Field  
Guide**

**Iowa Water  
Environment  
Association  
2nd Edition 2011**





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## DEFINITIONS

**Agronomic Rate** – Amount of nitrogen (or other nutrient) which can be utilized by the crop to be grown.

**Biosolids** – Primarily organic solids produced by waste water treatment processes that are beneficial for recycling on land as a soil conditioner and nutrient source for plant growth.

**Cumulative Pollutant Loading Rate** – Maximum amount of an inorganic pollutant that can be applied to an area of land.

**Food Crops** – Crops consumed by humans, including fruits, vegetables, and tobacco.

**Incorporation** – Biosolids are applied to the soil surface and later mixed with the soil using tillage equipment.

**Injection** – Biosolids are placed directly under the soil surface during application.

**Land with a High Potential for Public Exposure** – land the public uses frequently, including public contact site and reclamation site in a populated area.

**Land with a Low Potential for Public Exposure** – land the public uses infrequently, including agricultural land, forest, and reclamation site in an unpopulated area.

**Pathogens** – Organisms that can produce an infection or disease in a susceptible host.

**Vector** – Insects, rodents, birds, and other animals capable of transporting pathogens from one organism to another.



## Checklist Prior to Biosolids Application

### Program Administrator

- Determination of Class I or II biosolids per IAC 567 - 67?
- Is the proposed site in the approved 5 year plan?
- Have the pathogen reduction and vector attraction reduction requirements been met?
- Is there a current Pathogen Reduction and Vector Attraction Reduction Certification Statement on file?
- Are metals below the allowable ceiling concentrations?
- Has biosolids available N,P and K been determined?
- Have soil tests been conducted on the application site to determine soil pH (6.0 or above)?
- Has the biosolids application rate for this site been set so as not to exceed the crop agronomic rate? **OR** Will biosolids be applied at less than 2 tons per acre?
- Is the site slope <9% (or <5% (frozen ground)?
- Does the farmer understand restrictions after application?
- Has emergency spill plan been developed and materials on hand?

### Biosolids Applicator

- Is the application equipment in good mechanical condition and ready to go?
- Has the equipment been calibrated and do you know how many loads per acre are required to meet the application rate for the current site?
- Have you marked out the required application setback distances and restrictions for waterways, tile intakes, well heads, ponds, and occupied residences for the current site?
- Are all farmer/landowner requirements, such as "please don't apply when it's muddy", being observed?
- Review emergency spill plan and place copy in application vehicle.



## Checklist After Biosolids Application

### Program Administrator

- Have all daily application logs been reviewed and filed?
- Have cumulative metals loadings been calculated and recorded (if applicable)?
- Has a site application report been completed and provided to the farmer/landowner?
- Has the biosolids application data been prepared for the annual report?

### Biosolids Applicator

- Have the daily application logs been completed accurately?
- Was the actual target application rate met?
- Was the biosolids incorporated within 48 hours as required (if applicable)?
- Was the application site left in good condition and appearance and all setback markers picked up?
- Is the application equipment in good repair and ready for the next site?



### **Management Practices for Class I Biosolids**

- a. May be applied to lawn or home garden
- b. Shall be applied at the agronomic nitrogen (or other nutrient) uptake rate
- c. An information sheet shall be provided to a person who receives Class I biosolids in a container for application to the land
- d. Recommended to follow Class II requirements regarding slope, frozen ground, flooding, etc.

### **Management Practices for Class II Biosolids**

- a. Shall not be applied to a lawn or a home garden.
- b. Class II biosolids not meeting Class I trace element requirements are subject to cumulative pollutant loading rates (see page 6).
- c. Biosolids shall not be applied to the land if it is likely to adversely effect a threatened or endangered species or its designated critical habitat.
- d. Biosolids shall be applied at the agronomic nitrogen (or other nutrients) uptake rate.
- e. Biosolids shall only be applied to soils classified as acceptable throughout the top five feet. Biosolids shall not be applied to soils classified as sand, loamy sand and silt based on USDA soil classifications.



**Management Practices  
for Class II Biosolids (continued)**

- f. Soil pH shall be maintained above 6.0, unless:
  - 1. Crops prefer soils with lower pH conditions
  - 2. Biosolids meet Class I trace element concentrations
  - 3. Site does not exceed calcium carbonate equivalent levels according to sound farm management practices
- g. If the soil loss exceeds soil loss limits established by the County Soil Conservation District, the biosolids shall be injected on the contour or incorporated within 48 hours. Biosolids shall not be applied to ground with slope greater than 9% unless approved by IDNR.
- h. Avoid application on frozen or snow-covered ground. If necessary, limit to land areas of less than 5% slope.
- i. If applied to land subject to flooding more than once in ten years, the biosolids shall be injected or incorporated within 48 hours.
- j. Provide written notice to IDNR prior to initial application.





**Maximum Trace Element Concentrations**

Trace Element	Current Values	Class I Monthly Average Concentration (mg/kg) <sup>1</sup>	Class II Ceiling Concentration (mg/kg) <sup>1</sup>	Cumulative Loading Rate (lbs/acre) <sup>2</sup>
Arsenic		41	75	36
Cadmium		39	85	34
Copper		1500	4300	1335
Lead		300	840	267
Mercury		17	57	15
Molybdenum		None	75	None
Nickel		420	420	373
Selenium		100	100	89
Zinc		2800	7500	2490

<sup>1</sup> Dry Weight Basis; mg/kg = ppm

<sup>2</sup> Applies to Class II Biosolids not meeting Class I



## Allowable Slopes & Required Setbacks

Agricultural Application			
Criteria Class II Sludge	Surface Application	Incorporated	Injected
Allowable Slopes (2)	<9%	<9%	<9%
Allowable slopes when frozen (2)	<5%	<5%	<5%
Distance to wells (1)	200 ft.	200 ft.	200 ft.
Distance to residences (1)	200 ft.	200 ft.	200 ft.
Distance to an open waterway, lake, sinkhole or tile intake located downgradient (2)	200 ft.	>35 ft.	>35 ft.
Criteria Class I Sludge	Surface Application	Incorporated	Injected
Distance from open waterway	200 ft.	>35 ft.	>35 ft.

(1) Separations distances may be reduced to a minimum of 35 feet with written agreement of both the owner and occupant and an approved farm management plan which addresses soil erodibility, harvest residuals, buffer strips, and other sound farm management practices.

(2) Unless approved by IDNR.



### Land Use Restrictions—Class II Biosolids

You must wait 30 days after application to do the following:

- 1) Harvest food crops, feed crops and fiber crops
- 2) Allow animals to graze
- 3) Allow public access with a low potential for public exposure

**Other restrictions after application:**

- 1) Food crops with harvested parts that touch the biosolids/soil mixture shall not be harvested for 38 months after application.
- 2) Public access to land with a high potential for public exposure shall be restricted for 1 year after application of biosolids.
- 3) Turf grown on land where biosolids is applied shall not be harvested for one year after application when the harvested turf is placed on land with a high potential for public exposure.

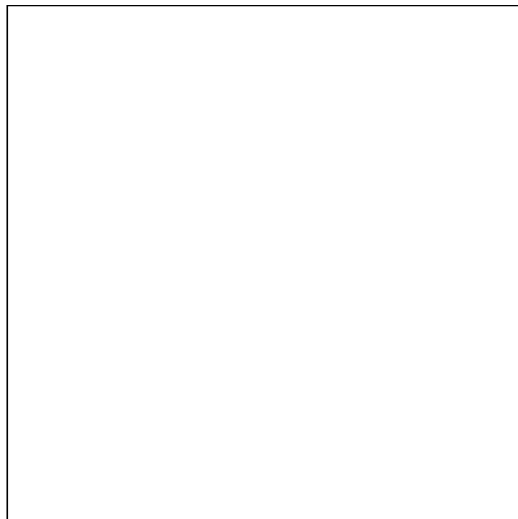
**NOTE: No Land Use Restrictions for Class I Biosolids**



## Recommended Application Practices

- Develop site layout based on field size (acres) or dimensions (length x width)
- Include setback areas from waterways, intakes, wells, etc.
- Show field entrances, staging/loading areas, and travel lanes
- Determine target application rate (tons or gallons per acre)
- Calculate the required drive speed for the target application rate.
- Include any special instructions

### Sketch of Site, Setbacks, Entrances, etc.



### Field Calibration Procedures

- Apply one load with known volume (gallons for liquid) or weight (tons for dewatered).
- Determine the coverage area of this application in square feet (spread width x length).
- Divide the coverage area by 43,560 sq.ft./acre to determine the acreage covered per load.
- Divide the volume or weight of one load by the acreage covered to determine application rate in gal/acre or wet tons/acre.
- See page 17 for formulas and conversions.

Applicator Capacity (gallons or tons)	Coverage Area (square feet)	Application Rate (gallons or tons/acre)	Drive Speed (mph)



## Emergency Spill Procedures

- In the event of a spill, park the truck and assess the situation.
- If on a roadway, set up cones, reflectors, etc. to divert traffic around the spill.
- Contact the appropriate plant personnel and authorities and report:
  - Location and time of spill
  - Estimated amount of biosolids spilled
  - Potential for off-site movement
  - Actions taken
- Commence clean-up activities according to emergency spill plan.

### Emergency Contact Numbers:

Designated Spill Coordinator:
IDNR Emergency Response (24 hr): 515-281-8694
IDNR Field Offices: F.O. #1: 563-927-2640 F.O. #2: 641-424-4073 F.O. #3: 712-262-4177 F.O. #4: 712-243-1934 F.O. #5: 515-725-0268 F.O. #6: 319-653-2135
EPA Emergency Response (24 hr): 913-281-0991



## Crop Nitrogen Recommendations

Crop Category	lb. N/acre
Corn on recently manured soils	0-90
Corn after established alfalfa	0-30
2nd year corn after alfalfa	0-60
Corn after corn	150-200
Corn after soybeans	100-150

To determine the N requirements for Oats and Wheat multiply the proven yield times the crops N requirement factor.

Oat: Proven yield x 0.75 = lb. N/acre needed

Wheat: Proven yield x 1.3 = lb. N/acre needed

## Nitrogen Recommendations For Forage Grasses

Forage Type	lb. N/acre
Cool season tall grass	100-120
Bluegrass	60-80
Sorghum-sudan	80
Legume grass*	40
Warm season grass	90

\*Only if legume is less than one-third of stand

Source: ISU Extension Integrated Crop Management and Pesticide Application Field Records, Revised Sept. 2009; ISU Extension A General Guide for Crop Nutrient and Limestone Recommendations in Iowa, Revised Nov. 2002.



### Nutrient Removal By Various Crops

		Pounds/unit of Yield	
Crop	Unit of Yield	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Corn	bu	0.375	0.3
Corn silage	bu grain equivalent	0.55	1.25
Corn silage	Ton 65% moisture	3.5	8
Soybean	bu	0.8	1.5
Oat and straw	bu	0.4	1
Wheat	bu	0.6	0.3
Alfalfa	Ton	12.5	40
Red Clover	Ton	12	35
Trefoil	Ton	12	35
Bromegrass	Ton	9	47
Orchardgrass	Ton	14	68
Tall fescue	Ton	12	66
Timothy	Ton	9	32
Perennial ryegrass	Ton	12	34
Sorghum-sudan	Ton	12	38
Switchgrass	Ton	12	66
Reed canarygrass	Ton	9	47

Source: ISU Extension *Integrated Crop Management and Pesticide Application Field Records*, Revised Sept. 2009; ISU Extension *A General Guide for Crop Nutrient and Limestone Recommendations in Iowa*, Revised Nov. 2002.





### Value of Biosolids Worksheet

Dry tons applied ÷ acres = Dry tons per acre

Available Nitrogen lbs/dry ton x Dry tons/acre = Pounds Nitrogen (N)/acre

Phosphorous lbs/dry ton x Dry tons/acre = Pounds Phosphorous (P)/acre

Potassium lbs/dry ton x Dry tons/acre = Pounds Potassium (K)/acre

Commercial price of N \$/lb x lbs N/acre = Value of N in \$/acre

Commercial price of P \$/lb x lbs P/acre = Value of P in \$/acre

Commercial price of K \$/lb x lbs K/acre = Value of K in \$/acre

N value \$/acre + P value \$/acre + K value \$/acre = Value of biosolids \$/acre

\*\* May also include value for tillage and micronutrients (e.g. zinc)



## Benefits of Biosolids Land Application

- Biosolids provide primary nutrients (nitrogen, phosphorous, & potassium).
- Biosolids provide secondary nutrients (calcium, iron, magnesium, zinc).
- Biosolids has been shown to increase crop yields.
- Biosolids help maintain nutrients in the root zone.
- Nitrogen in biosolids is released slowly over the growing season and following season.
- Biosolids have a lower cost than commercial fertilizer.
- Land application of biosolids provides beneficial re-use of a valuable resource.
- Biosolids add organic matter to the soil, which:
  - Improves soil structure and quality
  - Improves water infiltration
  - Improves water holding capacity

### Sources:

1. *Fact Sheet on Land Application and Composting of Biosolids*, Water Environment Federation, May 2010.
2. *Applying Biosolids: Issues for Virginia Agriculture*, David Faulkner, USDA/Natural Resources Conservation Service, April 2001.



## IDNR/EPA Contact Information

<p><b><u>Central Office</u></b>          Iowa Department of Natural Resources          Wastewater Section          502 E 9th Street          Des Moines, IA 50319-0034          Phone: (515) 281-5918          FAX: (515) 281-6794</p>	<p><b><u>Field Office #1</u></b>          Iowa Department of Natural Resources          Field Office #1          909 West Main Suite #4          Manchester, IA 52057          Phone: (563) 927-2640          FAX: (563) 927-2075</p>
<p><b><u>Field Office #2</u></b>          Iowa Department of Natural Resources          Field Office #2          2300 15th Street SW          Mason City, IA 50401          Phone: (641) 424-4073          FAX: (641) 424-9342</p>	<p><b><u>Field Office #3</u></b>          Iowa Department of Natural Resources          Field Office #3          1900 North Grand Ave, Suite E17          Spencer, IA 51301          Phone: (712) 262-4177          FAX: (712) 262-2901</p>
<p><b><u>Field Office #4</u></b>          Iowa Department of Natural Resources          Field Office #4          1401 Sunnyside Lane          Atlantic, IA 50022          Phone: (712) 243-1934          FAX: (712) 243-6251</p>	<p><b><u>Field Office #5</u></b>          Iowa Department of Natural Resources          Field Office #5          401 SW 7th, Suite 1          Des Moines, IA 50309          Phone: (515) 725-0268          FAX: (515) 725-0218</p>
<p><b><u>Field Office #6</u></b>          Iowa Department of Natural Resources          Field Office #6          1023 West Madison Street          Washington, IA 52353-1623          Phone: (319) 653-2135          FAX: (319) 653-2856</p>	<p><b><u>EPA Region 7</u></b>          WWPD/WENF          Environmental Protection Agency          901 North Fifth Street          Kansas City, KS 66101          Phone: (913) 551-7003          FAX: (913) 551-7066</p>



### Formulas / Conversions

Area Covered (acres) = Length (ft) x Width (ft) ÷ 43,560 sq. ft./ acre

Application Rate (gallons or tons/acre) = Gallons or Tons Applied ÷ Area (Acres)

Dry Pounds per 1000 Gallons = 1000 x 8.34 x % solids/100

Dry Tons per Wet Ton = Wet Tons x % solids/100

#### **Nutrient Calculation (from lab analysis)**

Lbs. per Dry Ton = % x 20 or ppm x .002

Lbs. per 1000 Gallons (on Wet Basis) = % x 83.4 or ppm x .00834



## References/Resources

Environmental Protection Agency – Part 503 Biosolids

Rule:

<http://www.epa.gov/owm/mtb/biosolids/503pe/index.htm#pubs>

Iowa Administrative Code – Environmental Protection Commission [567] – Chapter 67

<http://www.legis.state.ia.us/asp/ACODocs/DOCS/2-11-2009.567.67.pdf>

Iowa Water Environment Association Web Page:

<http://www.iawea.org/>

National Biosolids Partnership:

<http://www.wef.org/biosolids/>

Applying Biosolids: Issues for Virginia Agriculture:

<ftp://ftp-fc.sc.egov.usda.gov/Economics/tools/CropHay/Applying%20Biosolids.pdf>

NRCS Web Soil Survey:

<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

Iowa State University Extension:

Nitrogen Fertilizer Recommendations for Corn:

<http://www.extension.iastate.edu/publications/pm1714.pdf>

Soybean Nutrient Requirements:

[http://extension.agron.iastate.edu/soybean/production\\_soilfert.html](http://extension.agron.iastate.edu/soybean/production_soilfert.html)

North Dakota State University – Soybean Soil Fertility:

<http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf1164w.htm>

University of Missouri Extension – Lab Analysis of Manure:

<http://extension.missouri.edu/publications/DisplayPub.aspx?P=EQ215>





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<http://www.iawea.org/>

