



Land Application of Biosolids

Rules, Regulations and Benefits

Biosolids are frequently used for land application on cropland, pastures or timberland, where they decompose and furnish N-nitrogen, P-phosphorus and K-potash to growing plants. This method offers an ecologically sound and practical alternative to domestic and industrial waste biosolids disposal rather than in landfills or by incineration.



EPA regulations, under Title 40 Code of Federal

Regulations Part 503 (40 CFR 503) - biosolids must meet Part 503 of the federal EPA standards regarding pathogen and heavy metal content, handling and application precautions, and other regulations.

Land Application of Biosolids has been practiced for Centuries in Western Europe and North America. In the US, all 50 states practice land application of biosolids and 60% of all biosolids produced are land applied. In Europe 34% of biosolids are land applied. In Germany and Netherlands- all biosolids land applied!

In Ontario and Canada, 43% are land applied, 47% incinerated, and 4% are sent to a landfill. BC- 90% of municipal biosolids land applied. 70% is used for land reclamation, 25% for agriculture and the remaining 5% is retained as compost. Quebec MOE- 1999, 80% of biosolids incinerated, 12% landfilled and 8% or .5 million tonnes was either land applied or composted.



The purpose of land application of biosolids is to supply essential plant nutrients and/or organic matter, or other constituents that will maintain crop production or soil health . These nutrients are organic and provide slow release, therefore there is less run-off possibilities.

Some application areas include:
forests, field and cereal crops,

mine reclamation, parks, sold for compost, pasture land, citrus groves



Benefits Include:

Reduction in solids handling costs

Reduction in cost of supplemental nutrients for crops

Increased crop yields-more natural nutrients

Procedures that may need to be undertaken in order to land apply biosolids

- Attain local government approval to spread or apply the material on agricultural land
- Possible approval needed from MOE Biosolids Utilization Committee if in Canada

- Specific site must be assessed and approved
- Certificate of Approval- for an "Organic Soil Conditioning Site"
- Submit Detailed proposal to EPA District office
- Obtain Permits - Part V of the Environmental Protection Act



Justification

The utilization of a waste on agricultural land must benefit soil quality or crop production, and pose minimal risk to:

- plant growth
- crop quality
- long-term land productivity
- public and animal health
- the quality of the environment.

In addition:

- the waste will supply plant nutrients and/or
- the waste has value as a soil amendment.

Some Additional Requirements may be necessary depending upon your local government regulations. Always make sure you follow federal as well as local government regulations, since regional variations may occur.

- Site Survey
- Plant Process to produce biosolids
- Waste/process Description
- Waste Analysis
- Agronomic Comments And Recommendations

Documentation - As usual, any time you do anything, there is paperwork. But, there is probably not much more paperwork that you are already doing if you are sending the biosolids out to a landfill anyhow.

- Application for a Certificate of Approval for a Waste Disposal Site
- Organic Soil Conditioning
- Site Assessment
- Maps
- Inspection Date(s)
- Source and Type of Material to be Applied
- Waste Analysis Report
- Soil Analysis Report
- Terrain Description
- Surface Physiology and Geology
- Depth to Water Table
- Direction of Shallow and Regional Groundwater Flow
- Water Wells
- Separation Distances
- Application Areas
- Crops
- Schedule of Use
- Approval of Lessee/Landowner
- Notification To Adjacent landowners (For Other Than Sewage Biosolids)
- Confirmation from Municipality (For Other Than Sewage Biosolids)
- Confirmation From Other Agencies
- Legal Company Name
- Other Information and Documentation Fees





You may be required to fill out a **Nutrient Management Strategy" (NMS)**

A "nutrient management strategy" (NMS) describes the generation, storage and destination of prescribed materials. Generators (those who generate a prescribed material), who are captured by the phase-in requirements of the regulation, must complete a nutrient management strategy for the farm unit or nonagricultural operation for the prescribed materials generated or received in the course of the operation: Regulation, Part 2.

Nutrient Management Plan" (NMP)

A "nutrient management plan" (NMP) describes for the nutrients received, or applied on the land, the management of the nutrients. If you own or control land to which nutrients are applied, and you are captured by the phase-in requirements of the regulation, then you must complete a nutrient management plan: Regulation, Part 2.

Farmer's Benefits

A typical biosolids application program has the potential to supplement the soil with:



- 135 kg per ha / 120 lbs per acre of nitrogen
- 250 kg per ha / 223 lbs per acre of total phosphorous
- 250 kg per ha / 223 lbs per acre of organic nitrogen
- 30 kg per ha / 27 lbs per acre of total potash
- 4,000 kg per ha / 3,600 lbs per acre of organic matter
- Other nutrients such as magnesium, zinc and copper

**Biosolids provide farmers with \$60 to \$160 per acre worth of fertilizer, including many essential nutrients that the farmer may not normally replenish in the soil.



Advantages and Benefits

- Improves soil properties for optimum plant growth, including texture, tilth, friability, fertility and water holding capacity.
- Improve drainage of wet clay.
- Reduce need for commercial fertilizers
- Less leachate
- Organic
- Slow release nutrients
- Enhances conditions for vegetative growth.
- Decrease the need for pesticide use
- Decrease erosion
- Easy to store, transport and use
- "Green" Grants and Awards
- *2002 CWA Recognition Awards Program



Disadvantages or drawbacks

- Lots of Paperwork
- Monitor and control
- Increased Analytical
- Time allowances for application and storage
- Weather limitations- rain or snow
- Labor Intensive
- Public opposition
- Odors
- Soil pH in the range of 5.5 to 7.5

There are some Limitations

- Nutrients
 - ⊕ The guidelines limit sewage biosolid application to fields with a soil test of less than 60 parts per million (ppm) of available phosphorous in the top 15 cm, as measured by the Olsen sodium bicarbonate extraction method
- Soil pH >6
- Heavy metal limitations
 - ⊕ 11 heavy metals in sewage biosolids of concern to agriculture. These are: arsenic, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. (Not present in food plant biosolids)
- Physical Limitations
 - ⊕ The maximum depth of a fluid sewage biosolid that can be surface applied at any one time is 1.3 cm. This depth is equivalent to an application rate of 130 m³/ha
 - ⊕ A maximum application rate of 8 tonnes per hectare every 5 years
 - ⊕ Separation distances to groundwater, surface water courses, wells and other environmentally sensitive features
 - ⊕ Weather- Rain, snow

Application only to mineral soils are defined as having less than 17% organic carbon by weight



What are Biosolids and how does it work?

Biosolids are microbial bodies that contain carbon (C), oxygen (O), hydrogen (H), nitrogen (N), sulfur (S) and phosphorus (P).

Decomposition by Soil organisms-This produces carbon dioxide (CO₂), water (H₂O) and humus (organic matter). Release or mineralization, of N as ammonium (NH₄N), P and S as sulfate occurs. The ammonium nitrogen may also be oxidized to produce nitrate (NO₃). These can be taken up by plants and reused.

**Mineralization, cation exchange, anion exchange, retention and soil pH adjustment may affect the availability of elements in the biosolids



Nitrogen demand of some crops

Agricultural Crops	Nitrogen Demand
Winter wheat, Winter barley	90
Winter triticale	80
Winter rye	90
Corn (in SW Ont.) ³	170
Corn (in other counties) ³	100
Soybeans	0
Field beans, peas	10
Sweet corn	90
Carrots	



****Nitrogen (N) is the most yield-limiting nutrient in Corn production**

****Rate of biosolids, not to exceed 135 kg of nitrogen/ha over five yr. period for crops, or a 4-yr period for sod.**

Nutrient Removal by Crops

Table 1. Estimated nutrient removals by row and/or grain crops in product removed from fields for sale or feeding

Crop	Removal			
	Yield	N	P	K
	unit	(pounds/yield unit)		
Barley	bushel	0.96	0.016	0.19
Buckwheat	pound	0.02	0.003	0.002
Corn, grain	bushel	0.90	0.20	0.24
Oat	bushel	0.64	0.11	0.15
Popcorn	pound	0.016	0.003	0.004
Rye	bushel	1.18	0.15	0.27
Grain sorghum	pound	0.014	0.004	0.004
Soybeans ¹	bushel	—	0.37	1.20
Sunflower	pound	0.026	0.004	0.006
Wheat	bushel	1.26	0.26	0.24

¹Nitrogen (N) is fixed by bacteria in soybean nodules. When N is available in the soil, the soybean plant will use the soil N.

Source

Buchholz, D.D., 1983. *Soil Test Interpretations and Recommendations Handbook*, Department of Agronomy, University of Missouri.

Application Rates

Application rates may vary depending upon soil conditions, regional limitations, climate and crop. Make sure to check all with your local regulations.

Example of Biosolids Application



TABLE 2 TYPICAL BIOSOLIDS APPLICATION SCENARIOS

Type of Site/Vegetation	Schedule	Application Frequency	Application Rate
Agricultural land			
Corn	April, May, after harvest	Annually	5 to 10 dry tons per acre
Small grains	March-June, August, fall	Up to 3 times per year	2 to 5 dry tons per acre
Soybeans	April-June, fall	Annually	5 to 20 dry tons per acre
Hay	After each cutting	Up to 3 times per year	2 to 5 dry tons per acre
Forest land	Year round	Once every 2 - 5 years	5 to 100 dry tons per acre
Range land	Year round	Once every 1 - 2 years	2 to 60 dry tons per acre
Reclamation sites	Year round	Once	60 to 100 dry tons per acre

Source: U.S. EPA, 1994.

- Typical corn crop needs 120 lbs N per acre
- If Biosolids ~ 3% nitrogen -up to 5.4 dry tons per acre if used to supply all the nitrogen needed by the crop (i.e., no other nitrogen fertilizers used.)

Note- Different crops have different nutrient loading requirements.**

Additional Example

Grass Hay

If the biosolids have 3 percent N per dry ton, then they have 60 pounds N per ton. If 40 percent of the N is available the first year, then the application rate in dry tons of biosolids will be as follows:

$$160 \text{ pounds N} \div (0.4 \times 60 \text{ pounds N/ton}) = 6.6 \text{ tons/acre}$$

If you use the medium potassium concentration of Table 2, the 6.6 tons of dry biosolids will supply 35 pounds K per acre (42 pounds K₂O per acre). This is less than is needed for 4 tons of grass hay, so you must apply more K.



Guides or Publications

- MOE Fact Sheet: Application of Sewage Sludge to Agricultural Land (PIBS 608b)
- 1996 Guidelines for the Utilization of Biosolids and Other Wastes On Agricultural Land
- Interim Guidelines for the Production and Use of Aerobic Compost in Ontario-MOE November 1991
- Class Environmental Assessment for Municipal Water and Wastewater Projects
- OMAFRA Publications
 - Publication 29: Drainage Guide for Ontario
 - Publication 296: Field Crop Recommendation
 - Publication 360: Fruit Crop Recommendation
 - Fact Sheet AGDEX 540: Land Application of Sewage Biosolids for Crop Production
 - Report -Analytical Results, Findings, and Recommendations of the 1995 OMAFRA Sewage Biosolids Field Survey

<http://www.ene.gov.on.ca/water.htm>

<http://www.cwwa.ca/legislation/faqs/links.htm>