



# 6 SOIL AMENDMENTS

## INTRODUCTION

This chapter discusses soil amendment practices for protection of the environment. It contains introductory information on the relationship between soil amendments and the environment. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- ◆ nutrient application
- ◆ soil conditioner application

## SOIL AMENDMENTS AND THE ENVIRONMENT

The primary role of soil amendments is to provide nutrients for crop growth or to provide materials for soil improvement. Misuse of soil amendments can result not only in damage to crops but can also cause negative impacts on the receiving soil, water, air or habitat environment. Pertinent environmental subjects related to soil amendments are listed in alphabetical order below.

### Amendments

**For the purposes of this publication, soil amendments are defined as all materials applied to the soil on farms as fertilizers and/or soil conditioners.**

→ see Legislation, page 6-8.

**Note:** The term “soil amendment” as defined in *the Code of Practice for Soil Amendments* refers to specific materials which must be managed in accordance to the *Code*.

### Micronutrients and Metals

Common sources of micronutrients and metals are manure and chemical fertilizer. Some metals are plant micronutrients while some can become contaminants (toxic to soil microorganisms or plants). The availability of these elements varies, depending on soil type and soil pH.

**Value of Micronutrients and Metals in Manure.** The major micronutrients and metals found in manure are iron, manganese, boron, chlorine, zinc, copper and molybdenum. Under both neutral soil pH and average organic matter conditions, most micronutrients in manure are available to the crop.

 Soil pH

**Micronutrients and Metals as Contaminants.** Some micronutrients and metals can pollute the soil if found at excessive levels. The metals of concern typically are arsenic, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

**Nitrogen (N)** Common sources of nitrogen are manure, chemical fertilizer and nitrogen-fixing plants like legumes and legume residues.

**Value of Nitrogen in Manure.** Manure contains nitrogen in both the inorganic and organic forms. Until the organic matter is biologically decomposed in the soil, nitrogen in the organic form remains unavailable for plant use. Nitrogen in this form is desirable since it exists as a reserve in the soil and is slowly released for plant use. Soil microbes must decompose the organic nitrogen compounds in manure before they are available to plants. The majority of the nitrogen that enters the soil following application is available during the year of application. Most of the remaining nitrogen becomes available within the five years following application.

Livestock manure loses some inorganic nitrogen in the barn and during storage as ammonia by volatilization to the atmosphere. When manure is spread onto land for crop production, some of the remaining inorganic nitrogen may also be subject to volatilization losses.

**Particle Size** The particle size of materials used as soil amendments affects the efficiency of their utilization in soil and their impact on the environment. Fine particle sized materials such as sawdust can easily be incorporated into the soil and decompose rapidly in comparison to coarser materials such as woodchips. The more rapidly an amendment decomposes, the sooner nutrients from that material are made available for plant uptake. Leaching risk increases as well.

Particle size can also play a role in the loss of soil amendments from fields. Smaller particles are easily suspended in water or wind and are therefore carried away by runoff or erosion

**Phosphorus (P)** Common sources of available phosphorus are manure and chemical fertilizer. The expression of phosphorus concentrations and rates is often confusing and can lead to serious calculation errors. Refer to Table 6.1, below.

Table 6.1      Phosphorus: Converting P to/from P <sub>2</sub> O <sub>5</sub>	
<ul style="list-style-type: none"> <li>phosphorus content in soil or plant material, either total or plant-available form, is often expressed in terms of elemental phosphorus (P)</li> <li>phosphorus application rates for commercial fertilizers are given in terms of P<sub>2</sub>O<sub>5</sub> (phosphate)</li> <li>the conversion factors are:</li> </ul>	
	$\begin{array}{rcl} \text{P}_2\text{O}_5 & = & \text{P} \times 2.291 \\ \text{P} & = & \text{P}_2\text{O}_5 \times 0.436 \end{array}$

**Value of Phosphorus in Manure.** Most phosphorus contained in manure is in the organic form. Its availability is dependent on the rate at which soil organisms break down organic matter and release plant available phosphorus.

Phosphorus is normally fixed strongly by soil particles and therefore not readily available to plants. The ability of soils to bind phosphorus varies based on certain soil properties. For example, phosphorus is generally bound more

than two times as tightly in Fraser Valley soils in comparison to Okanagan soils, due to differences in soil pH, geology, and soil characteristics. In situations where soil phosphorus levels are high, as when phosphorus has accumulated from regular manure or phosphorus fertilizer applications, the phosphorus fixing capacity of the soil can be low. On such soil, the availability of the phosphorus in manure approaches 100 %. In these cases, producers should assume that manure is as effective as chemical fertilizer in supplying phosphorus to crops. If manure is infrequently applied, producers should assume that 50 % of the total phosphorus in manure is available to the crop in the year it is applied.

**Potassium (K)** Common sources of potassium are manure and chemical fertilizer. The expression of potassium concentrations and rates is often confusing and can lead to serious calculation errors. Refer to Table 6.2, below.

Table 6.2		Potassium: Converting K to/from K <sub>2</sub> O			
•	potassium content is often expressed in terms of elemental potassium (K)				
	potassium application rates for commercial fertilizers are given in terms of K <sub>2</sub> O (potash)				
	the conversion factors are:	K <sub>2</sub> O	=	K	x 1.205
		K	=	K <sub>2</sub> O	x 0.83

**Value of Potassium in Manure.** All potassium in manure is available immediately after application.

**pH** Soil amendments have varying influences on soil pH. Many inorganic fertilizers, particularly nitrogen and sulfur based fertilizers, have an acidifying effect. Potassium and phosphorus-based fertilizers have a neutral effect on soil pH. However, phosphoric acid, a phosphorus-based fertilizer, has an acidifying effect. Organic-based soil amendments such as manure have a high buffering capacity and therefore have a neutral or alkaline effect on soil pH.

**Salts** Most soil amendments contain salts. The salt content will vary depending on the nature of the amendment. Manure, for example, contains between 10% and 13% salts on a dry weight basis. Composted manure is characterized by higher concentrations. The presence of salt in manure is often directly related to nutrient concentrations within livestock feed.

Excess application of amendments onto land can lead to negative impacts on soil quality and crop production caused by salt effects alone. Salt levels are gauged by a manure's or soil's electrical conductivity. Salt content in soil can also be expressed as exchangeable sodium percent.

In areas of low precipitation, high annual doses of manure can adversely affect many crops by increasing soil salinity. In areas of high precipitation, salts may cause short-term problems until they are leached from the root zone. In most cases the leachate does not cause a problem.

**Secondary Nutrients** **Calcium (Ca).** Common sources of calcium are lime, poultry manure and some chemical fertilizers.

**Magnesium (Mg).** Common sources of magnesium are dolomite lime, magnesium sulfate (i.e., Epsom salts) and some chemical fertilizers.

**Sulphur (S).** Manure and many chemical fertilizers are a source of sulfur.

## SOIL AMENDMENT DECISIONS: IS IT A FERTILIZER OR A SOIL CONDITIONER?

The purpose of this section is to provide information that will assist in making decisions about whether a soil amendment should be used primarily as a fertilizer or as a soil conditioner.

### Soil Amendment Sources

Numerous soil amendment sources are available to producers. These materials may or may not come from the farm.

**On-Farm Sources.** These amendments include bedding, compost, crop residue, manure, contaminated runoff, silage juice, spoiled feed, washwater, spent soilless media, spent mushroom media, and spent nutrient solution. Table 6.4, page 6-6, outlines the primary fertilizer and soil conditioner distinctions for various **on-farm** soil amendments

**Off-Farm Sources.** These are usually purchased and include chemical fertilizers, chemical conditioners such as lime, soilless media constituents such as perlite, manure from other farms, compost, woodwaste, and non-agricultural wastes such as municipal biosolids. Table 6.5, page 6-7, outlines the primary fertilizer and soil conditioner distinctions for **off-farm** soil amendments

### Is it a Fertilizer or a Soil Conditioner?

Specific soil amendments have inherent characteristics that determine whether they are to be used primarily as a fertilizer or as a soil conditioner.

**Certain materials have properties that allow them to be used as both a fertilizer and a soil conditioner. If this is the case, they should be managed primarily as fertilizers.**

**Fertilizers.** These are defined as any organic material such as manure or inorganic material of natural or synthetic origin such as granular ammonium nitrate that is added to a soil to significantly supply one or more nutrients essential for plant growth. The primary goal of fertilizer application is to provide sufficient nutrients in a balance suitable for crop use. Fertilizers counteract imbalances in the soil and replace nutrients removed by crop harvest.

Organic materials that are classified as fertilizers have a carbon to nitrogen ratio of less than 30 to 1. Table 6.3, next page, outlines criteria based on carbon to nitrogen ratio for determining whether soil amendment materials should be managed as a fertilizer or soil conditioner. Liming products are not considered as fertilizers.

**Soil Conditioners.** These are defined as any material(s) that contain limited amounts of nutrients, but are managed primarily for their beneficial impact on the biological, physical or chemical nature of the soil. They can also be used as a plant growth medium. Soil conditioners can be organic such as compost or woodwaste or inorganic such as lime or perlite.

Organic soil conditioners typically have high levels of organic matter but are not an immediate or significant source of plant nutrients and have a carbon to nitrogen ratio greater than 30 to 1. Addition of soil amendments with a high

C:N ratio may result in crop available nitrogen being tied up (immobilized). Nutrients will be temporarily tied up in the soil, unavailable for plant use unless nitrogen is added to the soil to decrease the C:N ratio.


<b>Table 6.3 Management of Soil Amendments Based on Carbon-to-Nitrogen Ratio</b>	
<b>C:N ratio</b>	<b>Management Recommendations</b>
Less than 20:1	Manage as a fertilizer
Between 20:1 and 30:1	Material has properties of a fertilizer and a soil conditioner but should be managed primarily as a fertilizer
Greater than 30:1	Manage as a soil conditioner

**Neither a Fertilizer or a Soil Conditioner?** Some products such as vegetable washwater will have very little or no fertilizer or soil conditioner value, with the result that any application is considered as disposal. Such products require MOE authorization. → see Farm Waste, page 2-13

## Contaminants in Soil Amendments

Soil amendments can have salt, pH or metal levels that will cause soil pollution. Before bringing any non-agricultural waste onto a farm operation, be aware of any regulations or restrictions related to the use of these materials. For all soil amendments, determine the biological, chemical or physical properties of the materials and determine before hand if they can be used beneficially on the farm. → see Soil Contamination, page 8-16

Producers should be aware of the provisions of the *Federal Fertilizers Act and Regulations* as they relate to the quality of fertilizers and supplements (note the definition of supplement in the Act is less inclusive than this publications definition of soil conditioner). Any products bought or sold in Canada where a claim is being made as to the contents of the product to supply plant nutrients, aid in plant growth or improve the physical condition of soil are required to be registered under the Act. The *Fertilizers Act and Regulations* requires that all regulated fertilizer and supplement products must be effective and safe for humans, plants, animals, and the environment. They must also be properly labelled.

For farms operating anaerobic digesters and importing off-farm products to supplement their energy production, please refer to the  **Guidelines for Off-Farm Inputs for Anaerobic Digestion Facilities** available from

 [www.bcfarmbiogas.ca](http://www.bcfarmbiogas.ca)

 <http://www.env.gov.bc.ca/epd/industrial/agriculture/digestion.htm>

**Table 6.4 Managing On-Farm Soil Amendment Sources as Fertilizers or Soil Conditioners**

Soil Amendment Source	Managed Primarily as		Comments (check nutrient content before land application)
	Fertilizer	Soil Conditioner	
<b>Bedding</b> with little or no manure	✗	✓	<ul style="list-style-type: none"> <li>low nutrients</li> </ul>
<b>Building Drains</b> floor or roof	✗	✗	<ul style="list-style-type: none"> <li>check chemistry of water</li> </ul>
<b>Compost</b>	✓	✓	<ul style="list-style-type: none"> <li>characterized by slow nutrient release</li> <li>often applied as both fertilizer and soil conditioner.</li> </ul>
<b>Contaminated Surface Runoff</b> water from yards, corrals	✓	✗	<ul style="list-style-type: none"> <li>low in nutrients</li> <li>usually incorporated with liquid manure</li> </ul>
<b>Crop Residue</b> green leaves or stems dry (i.e. straw or prunings)	✓ ✗	✗ ✓	<ul style="list-style-type: none"> <li>characterized by variable nutrient levels and C:N ratios</li> </ul>
<b>Inert Growing Media</b> rockwool	✗	✗	➔ Farm Waste, page 2-13
<b>Leachate</b> from manure, compost or woodwaste	?	✗	<ul style="list-style-type: none"> <li>usually incorporated with liquid manure</li> <li>variable nutrient levels</li> <li>normally acidic and high BOD</li> </ul>
<b>Manure – Liquid</b>	✓	✗	<ul style="list-style-type: none"> <li>variable nutrient levels</li> </ul>
<b>Manure – Solid</b> includes bedding containing significant amount of manure	✓	✓	<ul style="list-style-type: none"> <li>normally a fertilizer but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1</li> </ul>
<b>Milkhouse Waste</b>	✓	✗	<ul style="list-style-type: none"> <li>low in nutrients</li> <li>usually incorporated with liquid manure</li> </ul>
<b>Mortalities</b> composted not composted	✓ ✗	✓ ✗	<ul style="list-style-type: none"> <li>handle as a compost (see above)</li> </ul> ➔ Livestock Mortality Disposal, page 3-37
<b>Silage Effluent</b>	✓	✗	<ul style="list-style-type: none"> <li>high nutrients and very high BOD</li> </ul>
<b>Spent Mushroom Media</b>	✓	✓	<ul style="list-style-type: none"> <li>variable nutrient levels</li> <li>normally a fertilizer but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1</li> </ul>
<b>Spent Nutrient Solution</b>	✓	✗	<ul style="list-style-type: none"> <li>variable to low nutrient levels</li> </ul>
<b>Spent Soilless Media</b> peat/woodwaste based	✗	✓	<ul style="list-style-type: none"> <li>variable nutrient levels</li> </ul>
<b>Spoiled Feed</b>	✗	✓	<ul style="list-style-type: none"> <li>variable nutrients levels, high BOD</li> </ul>
<b>Wash water</b> from washing and grading fruit and vegetables	✗	?	<ul style="list-style-type: none"> <li>low in nutrients but may contain silt, chemical contaminants or high BOD</li> <li>apply at rates not exceeding water absorption capacity of soil to avoid runoff</li> </ul>
<b>Woodwaste (not regulated by the Soil Amendment Code of Practice)</b> fresh or composted	✗	✓	<ul style="list-style-type: none"> <li>normally high C:N ratio</li> </ul>
? means material must be tested to determine if it is a fertilizer or a soil conditioner			

**Table 6.5 Managing Off-Farm Soil Amendment Sources as Fertilizers or Soil Conditioners**

Soil Amendment Source	Managed Primarily as		Comments (check nutrient content before land application )
	Fertilizer	Soil Conditioner	
<b>Biosolids</b> Class A compost or biosolids other forms	✓ ?	✓ ?	<ul style="list-style-type: none"> <li>may exhibit slow nutrient release</li> <li>often applied as both fertilizer and soil conditioner.</li> </ul> 📖 <i>Organic Matter Recycling Regulation</i> Schedule 12
<b>Compost</b> Class A compost other forms	✓ ?	✓ ?	<ul style="list-style-type: none"> <li>may exhibit slow nutrient release</li> <li>often applied as both fertilizer and soil conditioner.</li> </ul> 📖 <i>Organic Matter Recycling Regulation</i> Schedule 12
<b>Commercial Fertilizer</b> solid or liquid organic or inorganic base	✓ ✓	✗ ✗	<ul style="list-style-type: none"> <li>may contain metals</li> <li>variable nutrient levels</li> </ul>
<b>Fish Wastes</b> Class A compost other forms	✓ ?	✓ ?	<ul style="list-style-type: none"> <li>may exhibit slow nutrient release</li> <li>often applied as both fertilizer and soil conditioner.</li> </ul> 📖 <i>Organic Matter Recycling Regulation</i> Schedule 12
<b>Food Processing Wastes</b> Class A compost other forms	✓ ?	✓ ?	<ul style="list-style-type: none"> <li>may have slow nutrient release</li> <li>often applied as both fertilizer and soil conditioner.</li> </ul> 📖 <i>Organic Matter Recycling Regulation</i> Schedule 12
<b>Liming Materials</b>	✗	✓	<ul style="list-style-type: none"> <li>may contain metals</li> <li>pH impact varies with source</li> </ul>
<b>Off-Farm Manure – Liquid</b>	✓	✗	<ul style="list-style-type: none"> <li>variable nutrient levels</li> </ul>
<b>Off-Farm Manure – Solid</b> includes bedding containing significant amounts of manure	✓	✓	<ul style="list-style-type: none"> <li>normally a fertilizer but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1</li> </ul>
<b>Off-Farm Spoiled Feed</b>	✗	✓	<ul style="list-style-type: none"> <li>variable nutrients levels, high BOD</li> </ul>
<b>Sand or Other ‘Clean’ Soil Material</b>	✗	✓	<ul style="list-style-type: none"> <li>check nutrient and metal levels</li> <li>consult Agricultural Land Commission and local government regarding bylaw requirements</li> </ul>
<b>Spent Mushroom Media</b>	✓	✓	<ul style="list-style-type: none"> <li>variable nutrient levels</li> <li>normally a fertilizer but may be used as a soil conditioner if low in nutrients and if C:N ratio greater than 30:1</li> </ul>
<b>Whey</b>	✓	✗	<ul style="list-style-type: none"> <li>normally blended with liquid manure</li> </ul> 📖 <i>Organic Matter Recycling Regulation</i> Schedule 12
<b>Woodwaste</b> fresh or composted	✗	✓	<ul style="list-style-type: none"> <li>normally high C:N ratio</li> </ul>
<b>Soil Amendments regulated by the Code of Practice for Soil Amendments</b> fly ash, lime mud, residuals from water treatment, industrial residues of wood  pulp and paper residuals	✗ ✓	✓ ✗	<ul style="list-style-type: none"> <li>consult the 📖 <i>Code of Practice for Soil Amendments</i> for regulations regarding storage, application and use of soil amendments covered by the Code.</li> </ul>
<b>All Other Organic Materials</b>	?	?	<ul style="list-style-type: none"> <li>consult MOE for authorization for materials not covered by the <i>Organic Matter Recycling Regulation</i> Schedule 12</li> </ul>
<b>All Other Inorganic Materials</b>	?	?	<ul style="list-style-type: none"> <li>consult MOE or Agricultural Land Commission for authorization</li> </ul>
? means material must be tested to determine if it is a fertilizer or a soil conditioner Class A compost or biosolids are defined in <i>Organic Matter Recycling Regulation</i>			



# NUTRIENT APPLICATION

## NUTRIENT APPLICATION ENVIRONMENTAL CONCERNS

Primary environmental concerns related to nutrient application are:

- ◆ application rate exceeding the soil's ability to assimilate nutrients resulting in water and/or soil pollution
- ◆ inappropriate method or timing that results in
- ◆ water or air pollution
- ◆ erosion or soil compaction on wet fields
- ◆ ineffective buffers or impacts caused by inappropriate placement or location (e.g., close proximity to watercourse, wrong soil type, unsuitable topography, sensitive habitat) that results in:
  - water pollution
  - nuisance odours to neighbours
  - habitat impact

For information on these concerns:

- ➔ see Crops and the Environment, page 4-1, and refer to Crop Quality
- ➔ see Impacts on Biodiversity and Habitat, page 7-8, and refer to Impacts to Biodiversity and Habitat
- ➔ see Soil Quality Factors, page 8-2, refer to Contaminants, and to Micronutrients and Metals
- ➔ see Water Quality and Quantity Factors, page 9-2, and refer to Contaminants
- ➔ see Air Quality Factors, page 10-1, and refer to Contaminants, and to Odours

## NUTRIENT APPLICATION LEGISLATION

The following is a brief outline of the main legislation that applies to nutrient application.

- ➔ see page A-1 for a summary of these and other Acts and Regulations



### **Agricultural Land Commission Act**

This Act requires that agricultural land within an Agricultural Land Reserve not be used for non-farm use unless permitted by the Act or its regulations. The *Agricultural Land Reserve Use, Subdivision and Procedures Regulation* designates the application of the following as suitable for farm use:

- ◆ fertilizers, mulches and soil conditioners
- ◆ soil amendments collected, stored and handled in accordance with the *Code* under the *Agricultural Waste Control Regulation*
- ◆ compost produced in accordance with the *Code* under the *Agricultural Waste Control Regulation*
- ◆ compost and biosolids produced and applied in compliance with the *Organic Matter Recycling Regulation*





### **Drinking Water Protection Act**

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving *more* than one single-family residence).

- ◆ Section 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system



### **Environmental Management Act**

The *Code* under the *Agricultural Waste Control Regulation* lists six specific requirements regarding application of agricultural wastes such as manure, compost, vegetation:

- ◆ Section 3: must be collected, stored, handled, used and disposed of in a manner that prevents pollution
- ◆ Section 11: must not be directly discharged into a watercourse or ground water
- ◆ Section 12: must be applied to land only as a fertilizer or a soil conditioner
- ◆ Section 13: must not be applied to land if .... runoff or the escape of agricultural waste causes pollution of a watercourse or ground water
- ◆ Section 14: must not be applied on frozen ground, in diverting winds, on areas having standing water, on saturated soils or at rates of application that exceed the amount required for crop growth, **if** runoff or escape of agricultural wastes causes pollution of a watercourse or ground water, **or** goes beyond the farm boundary
- ◆ Section 30: agricultural products must be managed, used and stored in a manner that prevents the escape of agricultural waste that causes pollution

The *Code of Practice for Soil Amendments* regulates the storage; sampling, application, and record keeping pertaining to specific types of soil amendments. These include:

- ◆ fly ash derived from the burning of wood, other than wood that has been immersed in marine waters
- ◆ residuals from primary or secondary treatment of liquid waste produced after 1995 from a pulp or paper mill, including domestic sewage if it is mixed with residual solids
- ◆ lime mud derived from pulp or paper mill processes or waste lime
- ◆ residuals from the treatment of water for domestic use or use in industrial processes
- ◆ industrial residue of wood that has not been treated with glue, paint, a preservative or another substance harmful to humans, animals or plants

The *Organic Matter Recycling Regulation* has further requirements related to the land application of additional defined nutrient sources such as Class A and B Biosolids and Class A and B Compost.

- ◆ Section 5: requires development of a Land Application Plan prior to application of Class A and B Biosolids and Class B Compost
- ◆ Schedule 12 lists organic materials covered by the Regulation



### **Public Health Act**

This Act prohibits activities that may cause a health hazard:

- ◆ Section 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard
- ◆ The Act has conditions under the *Public Health Act Transitional Regulation*:
  - Section 18: provides separation distance from wells to be at least
  - 30.5 m from any probable source of contamination (probable source of contamination could include nutrients from agricultural wastes or chemical fertilizers)
  - 122 m from any dumping ground



### **Wildlife Act**

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.



### **Fisheries Act**

This Act has two sections of importance regarding the application of nutrients:

- ◆ Section 36(3): prohibits the deposit of deleterious substances into watercourses (deleterious substances could include nutrients)
- ◆ Section 38(4): requires reporting infractions of Section 36



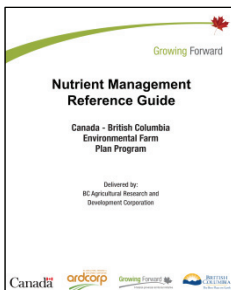
### **Species at Risk Act**

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the Species at Risk Act (known as the ‘safety net’) could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

## **NUTRIENT APPLICATION BENEFICIAL MANAGEMENT PRACTICES**

Comply with applicable nutrient management related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.



**Nutrient Management Reference Guide** is a publication that forms part of the Environmental Farm Plan series on Beneficial Management Practices. Its purpose is to optimize nutrient use and to reduce environmental impacts. The Nutrient Balance Assessment, outlined on pages 6-11 to 6-16, will indicate which producers should refer to this publication for further evaluation. It will also be of interest to producers wanting to maximize the value of both manure and inorganic fertilizers. Table 6.8, page 6-16, outlines the basic steps in nutrient management planning.

A **Nutrient Management Plan** is a technical process to optimize the relationship between farm management techniques, crop requirements, and land application for the purpose of maximizing nutrient use while minimizing environmental impact. The process attempts to balance nutrients on an individual crop or field basis as well as on a whole farm basis. The concept of a whole farm nutrient balance is shown in Figure 6.1.

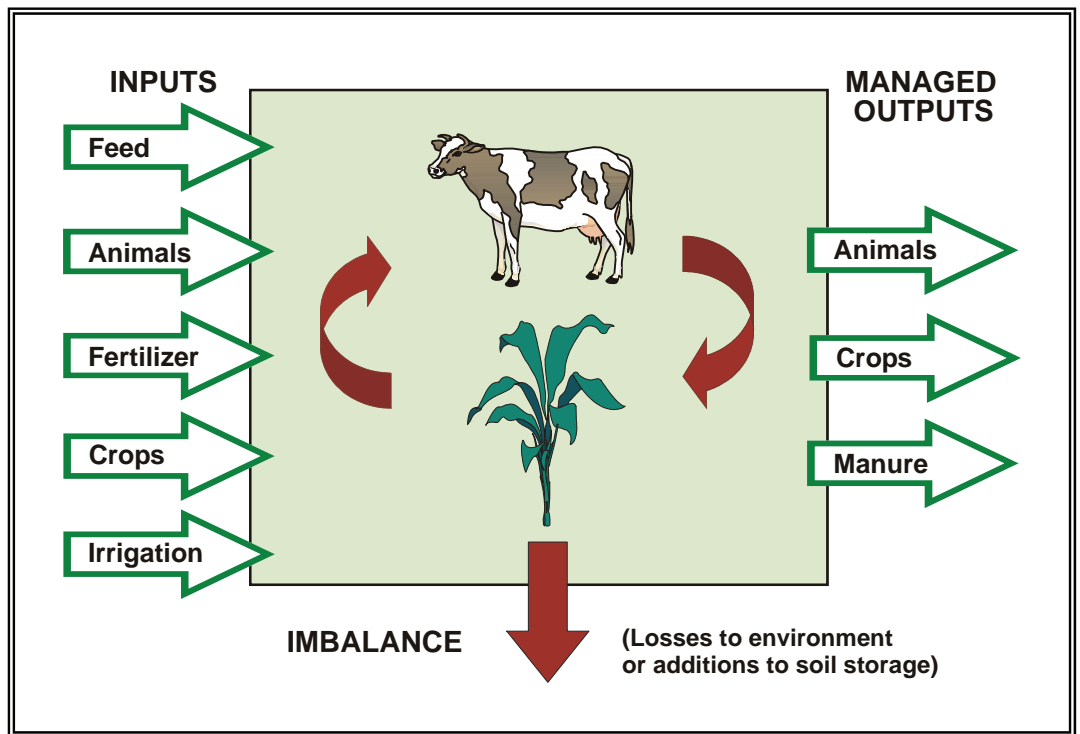


Figure 6.1 Simplified Whole Farm Nutrient Balance

### Nutrient Management Planning

For producers in any of the following four situations, completion of a Nutrient Management Plan is recommended:



- 1. Farms that may be out of Compliance with Nutrient Application Legislation.** This applies to farms that answer “No” to any of the legislative questions on the Nutrient Application Worksheet in the EFP Workbook, and the proposed action is the development of a Nutrient Management Plan.
- 2. Livestock Producers and Producers of Intensively-Managed Outdoor Horticultural Crops Located over Moderately or Highly Vulnerable Aquifers that are Used for Drinking Water.** Examples of such aquifers within the province include, but are not limited to, the Abbotsford-Sumas, Hopington, Grand Forks, Vedder River Fan aquifers and other aquifers referred to in Schedule 5 of the *Municipal Sewage Regulation*.
- 3. Significant Manure Nitrogen Generation or Use.** Producers that generate or use manure should complete one of the following two assessments:
  - ◆ Manure Assessment 1 (Worksheet #4): A Manure Nitrogen Assessment for Farms that Generate Manure (whether the manure is used as a fertilizer on that farm or not), or
  - ◆ Manure Assessment 2 (Worksheet #5): A Manure Nitrogen Assessment for Farms that Use Manure as a Fertilizer but do not Generate Manure

The objective of the assessments is to determine if manure nitrogen generation or utilization are above the values in Table 6.6, below. Farms that apply manure at rates below these values are considered to be at a low risk of causing pollution as long as the manure is being stored, handled and applied in compliance with the *Code* under the *Agricultural Waste Control Regulation*.

<b>Table 6.6 Baseline Values Used for Assessing the Requirement for a Nutrient Management Plan</b> (used in Worksheets #4, #5)	
<b>Crop Type</b>	<b>Baseline Manure Nitrogen Application Rate (kg N/ha/yr) ★</b>
Non-forage (e.g., berries, tree fruits, vegetables)	50
Forage grass (South Coastal BC)	300
Forage grass (rest of BC)	200
Forage corn	150
★ Value based on Total Manure N	

Farms that apply manure at rates above these values may also be managing their nutrients in full compliance with the Code, but the risk of over-applying nutrients and potentially causing pollution is higher. The actual risk would be specific to the farm being assessed, depending on a variety of factors including crops being grown, yield potential, topography, proximity to watercourses and climate. For farms that apply manure at rates above these values, a Nutrient Management Plan is recommended.

**4. High Soil Phosphorus.** This applies if a farm is located in a phosphorus sensitive area (areas where surface water eventually flows to a lake or pond) and soil test phosphorus levels exceed 80 ug/g in the 0 - 15 cm depth (by the Kelowna soil test method, for mineral soils). Phosphorus sensitive areas include, but are not limited to, the Okanagan Basin, Christina Lake Basin, Thompson River at Kamloops and other sensitive surface waters as defined by Schedule 5 of the *Municipal Sewage Regulation*.

-  **Soil Sampling for Nutrient Management**
-  **Understanding Different Soil Test Methods**

### **Manure Nitrogen Assessment 1: Farms that Generate Manure**

Using Worksheet #4, page 6-14, with the appropriate information from Table 6.7, next page, this assessment compares:

- ◆ the amount of manure nitrogen generated by a farm with livestock
- ◆ with the calculated baseline value required by the crops on that farm

Follow these four steps on Worksheet #4:

- ◆ **Step 1:** estimate the annual manure nitrogen excretion to be applied to the farm
- ◆ **Step 2:** calculate the manure nitrogen application for each crop area
- ◆ **Step 3:** add the manure nitrogen application values for each crop area to get application for the whole farm
- ◆ **Step 4:** a Nutrient Management Plan is recommended if the farm's manure nitrogen generation is greater than the calculated value for the farm

## Manure Nitrogen Assessment 2: Farms Use Manure but do not Generate Manure

Using Worksheet #5, page 6-15, with the appropriate information from Table 6.7, below, this assessment compares:

- ◆ the amount of manure nitrogen used by a farm without livestock
- ◆ with the calculated baseline value required by the crops on that farm

Follow these four steps on Worksheet #5:

- ◆ **Step 1:** estimate the annual manure nitrogen use for the farm
- ◆ **Step 2:** calculate the manure nitrogen application for each crop area
- ◆ **Step 3:** add the manure nitrogen application values for each crop area to get the application for the whole farm
- ◆ **Step 4:** a Nutrient Management Plan is recommended if the farm's manure nitrogen use is greater than the calculated value for the farm

**Table 6.7 Assumed Annual Manure Nitrogen Excretion Values and Manure Nitrogen Concentrations in Storage for Various Animal Types★**

Type of Animal		Use with Worksheet #4, Box 3	Use with Worksheet #5, Box 3
		Assumed Annual Manure N Excretion (kg N/animal)	Average Manure N Concentration (kg N/m <sup>3</sup> )
Beef Cattle	Cows and Bred Heifers	73	3.4
	Feeder 340 to 500 kg	52	3.4
	Yearling 230 to 340 kg	35	3.4
	Calves 50 to 230 kg	17	3.4
Dairy Cattle	Milking cow including associated replacements	200	1.6 (watery)
			2.8 (medium slurry)
			4.0 (thick slurry)
Ducks		0.40	11.8
Goats		10.5	2.9
Horses		55	3.3
Poultry	Broiler	0.25	15.8
	Layer plus associated pullets	0.67	10.9
	Hatching Egg Layer plus associated pullets	1.25	9.2
	Turkey	1.12	11.5
Sheep		6.1	2.9
Hogs	Sow – Farrow to Finish	92	3.5 <sup>Liquid</sup>
	Sow – Farrow to Wean	19	2.9 <sup>Liquid</sup>
	Grower / Finisher	10	3.5 <sup>Liquid</sup>
Veal		9.9	2.1

★ Where available, values are based on BC data. Otherwise, based on **American Society of Agricultural Engineers Manure Production and Characteristic Standards (2002 and 2003)**. If the actual farm situation differs significantly from the foregoing, the value in this table should be adjusted up or down in consultation with your Planning Advisor.

<sup>Liquid</sup> For swine, it is assumed that the manure is in the liquid form. Manure nitrogen concentrations can be extremely variable in liquid systems. The values for liquid manure in this table are based on uncovered manure storage facilities. For farms in high rainfall areas with covered manure storage, multiply the manure nitrogen concentration values by 1.5 or get a manure analysis done and use the on-farm value.

# Worksheet #4 Manure Nitrogen Application Assessment for Farms that Generate Manure Workbook Question 217

**Question:** Proceed through the following worksheet calculations to assess whether or not a Nutrient Management Plan (NMP) would be recommended for this farm.

## Information:

Type of animal (Refer to Table 6.7\*)

**Reset** Number of animals

Portion of manure remaining on the farm after manure export (value between 0 and 1)

Assumed annual N excretion per animal place (Refer to Table 6.7\*)   kg N/animal

## Calculations:

Step 1 Estimate the manure N excreted and remaining on farm, using Equations below:

**Equation:**

Number of animals	x	portion of manure left	x	Annual N Excretion/ animal place (kg)	=	Annual N Excreted and remaining on Farm (kg)
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x   x   kg/Animal =   kg N

Step 2 Calculate annual baseline manure N application for crops grown on farm, using Equation below:

**Equation:**

Area Manure Spread on (ha)	x	Manure N Application Rate (kg N/ha)	=	Manure N Application for Farm (kg)
----------------------------	---	-------------------------------------	---	------------------------------------

non-forage area	<input type="text" value="6"/>	ha x	<input type="text" value="50"/> kg N/ha =	<input type="text" value="0"/> <input type="text" value="10"/> kg N
forage grass (Fraser Valley) area	<input type="text" value="7"/>	ha x	<input type="text" value="300"/> kg N/ha =	<input type="text" value="0"/> <input type="text" value="11"/> kg N
forage grass (rest of BC) area	<input type="text" value="8"/>	ha x	<input type="text" value="200"/> kg N/ha =	<input type="text" value="0"/> <input type="text" value="12"/> kg N
forage corn area	<input type="text" value="5"/> <input type="text" value="9"/>	ha x	<input type="text" value="150"/> kg N/ha =	<input type="text" value="750"/> <input type="text" value="13"/> kg N

Step 3 Calculate Annual Baseline Manure N application for whole farm (Sum of boxes 10 to 13) =   kg N

## Answer:

Step 4 Is the annual N excretion remaining on the farm   less than   the baseline application value?

a NMP is recommended

or  a NMP is Optional

A Nutrient Management Plan (NMP) is suggested to optimize nutrient utilization and protect the environment.

**Note:** \*Refer to Tables in BC Environmental Farm Plan Reference Guide



## Worksheet #5    Manure Nitrogen Application Assessment for Farms that Use Manure but do not Generate Manure    Workbook Question 217

**Question:** A vegetable farm orders 100 m<sup>3</sup> of broiler manure for application onto 10 ha of vegetable crop land.

Proceed through the following worksheet calculations to assess whether or not a Nutrient Management Plan (NMP) would be recommended for this farm.

### Information:

<b>Reset</b>	Type of animal	<input type="text" value="Poultry Broiler"/>	<b>1</b>
	Manure Volume	<input type="text" value="100"/>	<b>2</b>
	Average manure N concentration	<input type="text" value="15.8"/>	<b>3</b>

m<sup>3</sup>  
kg N/m<sup>3</sup>

### Calculation:

Step 1 Estimate total N content of manure supply, using Equation below:

Manure Volume (m <sup>3</sup> )	x	Assumed manure N concentration (N/m <sup>3</sup> )	=	Total N content (kg)
------------------------------------	---	---	---	-------------------------

<input type="text" value="100"/>	<input type="text" value="2"/>	m <sup>3</sup>	x	<input type="text" value="15.8"/>	<input type="text" value="3"/>	kg N/m <sup>3</sup>	=	<input type="text" value="1,580"/>	<input type="text" value="4"/>	kg N
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Step 2 Calculate manure N application value for crops grown on farm, using Equation below.

Area Manure Spread on (ha)	x	Manure N Application Rate (kg N/ha)	=	Manure N Application for Crop (kg)
-------------------------------	---	--	---	---------------------------------------

non-forage area	<input type="text" value="10"/>	<input type="text" value="5"/>	ha x	<input type="text" value="50"/>	kg N/ha	=	<input type="text" value="500"/>	<input type="text" value="9"/>	kg N
forage grass (Fraser Valley) area		<input type="text" value="6"/>	ha x	<input type="text" value="300"/>	kg N/ha	=	<input type="text" value="0"/>	<input type="text" value="10"/>	kg N
forage grass (rest of BC) area		<input type="text" value="7"/>	ha x	<input type="text" value="200"/>	kg N/ha	=	<input type="text" value="0"/>	<input type="text" value="11"/>	kg N
forage corn area		<input type="text" value="8"/>	ha x	<input type="text" value="150"/>	kg N/ha	=	<input type="text" value="0"/>	<input type="text" value="12"/>	kg N

Step 3 Annual Baseline Manure N application for whole farm =   kg N

### Answer:

Step 4 Is the manure N content   less than   the baseline application value?

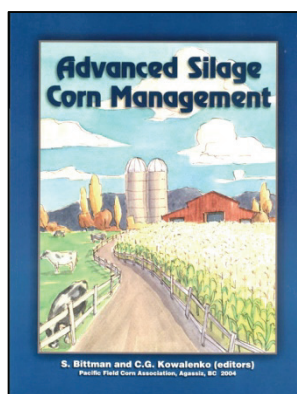
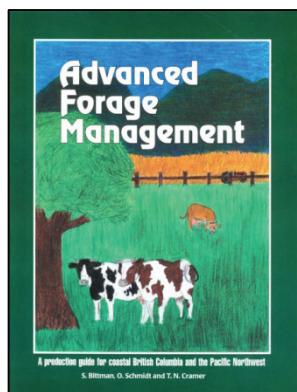
   **NMP is recommended**

For this vegetable farm example, the estimated N content of the manure brought onto the farm is greater than the calculated annual baseline application of manure N for the farm.

A Nutrient Management Plan (NMP) is suggested to optimize nutrient utilization and protect the environment.

Table 6.8 Steps to Develop a Nutrient Management Plan	
<b>1. Determine On-Farm Nutrient <sup>a</sup> Levels</b>	<ul style="list-style-type: none"> <li>determine the quantity produced during the year</li> <li>determine the nutrient concentration of various inputs and outputs on a seasonal basis</li> <li>determine the pH and the concentration of micronutrients and salts in inputs and outputs</li> <li>calculate the total and plant-available portion of N, P and K</li> </ul>
<b>2. Determine Field Soil Nutrient Levels</b>	<ul style="list-style-type: none"> <li>sample the soil and obtain soil test lab reports that predict the amounts of N, P and K that will be available to plants during the growing season (yearly for annual crops and every third year for perennial crops)</li> <li>determine the pH as well as micronutrient and salt concentrations (every three to six years)</li> </ul>
<b>3. Determine Annual Crop Nutrient Requirements</b> (for each field or greenhouse crop)	<ul style="list-style-type: none"> <li>determine the type of crop and estimate expected yield and quality reasonable for the soil and climate</li> <li>calculate the annual amount of N, P and K required and the time of year required</li> </ul>
<b>4. Determine Field Annual Nutrient Balance</b> Determine the annual application <sup>b</sup>	<ul style="list-style-type: none"> <li>determine the amount of nutrients that need to be supplied (for N, P and K) for each field by using the following equation</li> </ul>
<b>Determining Nutrients to be Supplied</b>	
<b>Nutrients to be supplied = plant requirement + assumed nutrient loss <sup>c</sup> – soil provided nutrients</b>	
<ul style="list-style-type: none"> <li>adjust the amount of nutrients to be supplied based on previous years effectiveness monitoring <sup>d</sup></li> <li>base nutrient application for each field on the most environmentally limiting nutrient <sup>e</sup></li> </ul>	
<b>5. Determine Off-Farm Nutrient Supplementation</b> If on-farm nutrient sources are not sufficient to meet crop nutrient needs, supplementation will be necessary. Off-farm nutrient supplements can include chemical fertilizers, manure from other farms, and selected organic matter <sup>f</sup> sources.	<ul style="list-style-type: none"> <li>determine the nutrient concentration of all off-farm nutrient sources</li> <li>determine the amount of supplements that will be required (for N, P and K) for each field on the basis of plant nutrient requirements by using the following equation</li> </ul>
<b>Determining Off-Farm Nutrient Supplements to be Supplied</b>	
<b>Off-farm nutrient supplements to be supplied = nutrients required from the nutrient balance – farm supplied nutrients applied</b>	
<b>6. Determine Nutrient Application Strategy</b> Determine when and how all nutrients will be applied	<ul style="list-style-type: none"> <li>determine the timing, rate, and method of application by field for each application event</li> <li>determine the buffer requirements for each application by field → see Buffers, page 11-4</li> </ul>
<b>7. Determine Farm Nutrient Balance</b> Determine if there is a surplus or deficit of farm nutrients	<ul style="list-style-type: none"> <li>when a surplus of ‘farm nutrients’ occurs, other sites will be needed to utilize the surplus</li> <li>when a deficit of ‘farm nutrients’ occurs, recalculate nutrient application strategy to maximize nutrient value of manure</li> <li>if a deficit remains after recalculation, then make a determination of the source of supplemental off-farm nutrients and the amount required</li> </ul>
<sup>a</sup> <b>On-Farm Nutrient Sources:</b> are materials generated on the farm such as manure, silage or milk house effluent, yard water, compost, and crop residue <sup>b</sup> <b>Annual Application:</b> is the sum of nutrients required for all crops grown (i.e. multiple harvests) in a field/greenhouse throughout the calendar year <sup>c</sup> <b>Assumed Nutrient Losses:</b> these are the predicted losses of nutrients to soil, water and air that result from the use of specific nutrient sources and application equipment under specific climatic, soil and crop conditions. These losses should be managed so as not to cause pollution. <sup>d</sup> <b>Effectiveness Monitoring:</b> is an assessment of previous year’s crop yield and quality relative to certain environmental indicator, such as changes in soil and water quality <sup>e</sup> <b>Environmentally Limiting Nutrient:</b> is the nutrient which is most likely to cause an environmental impact if applied at rates above crop requirement, such as phosphorus near Interior lakes <sup>f</sup> <b>Selected Organic Matter:</b> are those materials identified in Schedule 12 of the <i>Organic Matter Recycling Regulation</i>	

## Forage Nutrients





**Annual and Perennial Forage Crop Nutrient Uptake.** Basic plant growth characteristics and structure play a role in nutrient uptake and soil management. Annual crops by their nature generally have shorter nutrient uptake periods than perennial crops. For example, a perennial forage grass may take up nutrients for as long as 240 days while an annual corn crop will take up nutrients for less than 80 days.

Nutrient uptake in annual forage crops is not constant, but typically follows an S-shaped curve with very low uptake for a period of about 30 days, then increases sharply until flowering, then decreases rapidly with maturity. In a perennial forage crop the curve may be elongated, or in the case of a forage grass or grass/legume mix there will be several periods of varying uptake in response to multiple cuttings. Figure 6.2, below, illustrates such patterns.

Forage grasses are generally subject to a range of harvesting options, which include variations in numbers of cuts, times of cutting, and cutting height. Each of these influences the effectiveness of a grass crop to take up nutrients.

**Harvest Date.** The time of harvest plays a critical role in nutrient uptake for perennial forages such as grass. Perennial forages produce dry matter and protein in response to cutting frequency, cutting height and grazing practices. These factors can be varied to achieve either maximum dry matter yields or maximum protein yield.

-  **Advanced Forage Management**
-  **Advanced Silage Corn Management**

For annual crops harvested at maturity, such as corn, harvest date does not affect nutrient uptake. However, if annual crops are planted late and harvested at an immature stage the full potential nutrient uptake will not be achieved. If the crop was fertilized for mature yields and harvested at an immature stage, there may be excess nutrients remaining in the soil after harvest.

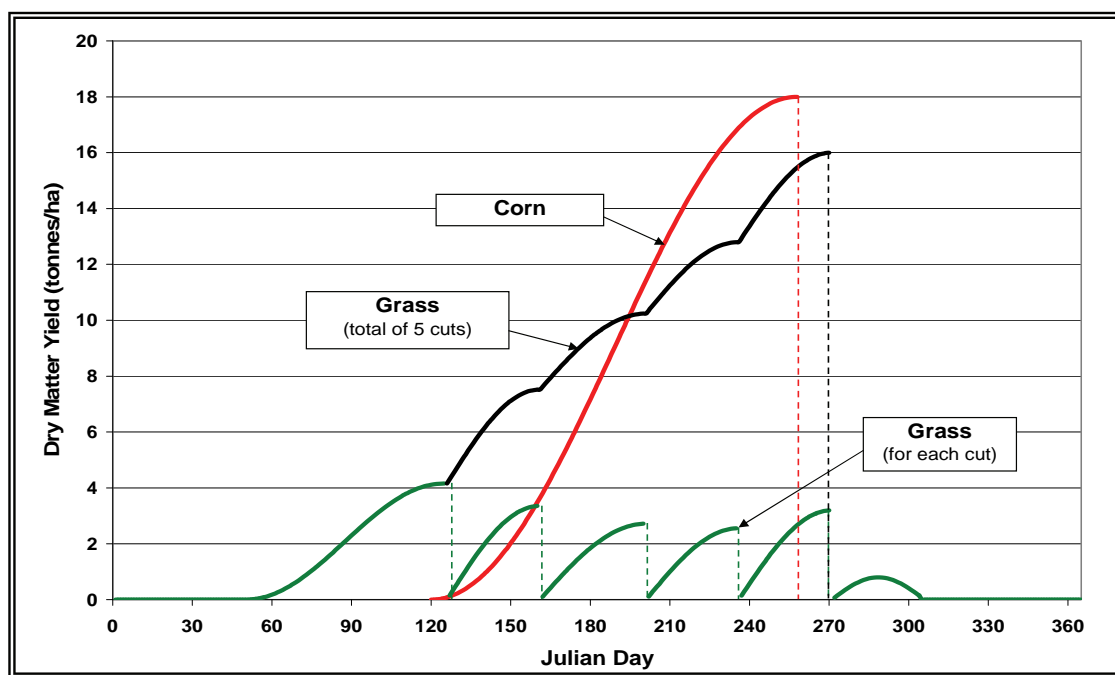



Figure 6.2 Generalized Dry Matter Accumulation versus Time of Year

## Horticultural Crop Nutrients

Nutrient uptake by horticultural crops varies with the type of crop grown. Some tree fruit and berry crops require most of their nutrients in the spring and early summer. Some vegetable crops take up large amounts of nutrients later in the summer and early fall. Manage nutrient applications so that they are available when required to both maximize crop growth and to minimize any potential for leaching.





## Nutrient Application

**Rate.** Apply nutrients at rates that do not exceed a crop's nutrient requirement. This can be calculated based on soil fertility levels, expected yields and nutrient content for a specific crop.

 **Soil Sampling for Nutrient Management**

 **Soil Sampling in Fertilizer Banded Fields**

Implement the following practices when determining nutrient application rates:

- ◆ if manure is the primary nutrient source, determine the rate of application by using the procedures in the  **Nutrient Management Reference Guide** publication
  - approximate nitrogen application rates for high-yielding crops are given in Tables 6.9 and 6.10, next page
- ◆ for liquid nutrient sources such as liquid manure, liquid fertilizer or liquids applied by chemigation, apply at rates that do not exceed the soil's infiltration capacity
- ◆ to reduce surface sealing from manure application, one-time application rates should not exceed 50 m<sup>3</sup>/ha of slurry or 50 tonnes/ha of solid manure, if the manure is not incorporated into the soil immediately after application
- ◆ for application of solid and liquid nutrient sources, rates, methods, and timing should not contribute to crop smothering. Refer to  **Nutrient Management Reference Guide** publication for calibration
- ◆ if plants are grown in soilless media with water-soluble fertilizers such as in greenhouses, base nutrient application rates on nutrient levels in plant drainage water, foliar analysis, or electrical conductivity
  -  **Preparing a Complete Nutrient Solution**
  -  **On-Site Testing of Growing Media and Irrigation Water**
- ◆ for application of solid organic, inorganic, slow-release, or rapid-release fertilizers, do not apply at rates that exceed the soil's or soilless media's ability to assimilate salts
  - crops will be damaged by high rates of nutrient availability or release
  - to avoid salt toxicity or physical damage to plants, limit nutrient application rates of specialized fertilizer products to the manufacturer's or industry's recommended rate or less
  - in areas where the risk of leaching or runoff is high due to excessive rainfall or irrigation, adjust application rates to reduce that risk
    - ➔ see Irrigation, page 9-18
    - ➔ see Runoff, page 9-42

To determine the effectiveness of nitrogen management, soil test for nitrogen after harvest, before heavy rains begin in the fall. Target values for a 0-30 cm sample depth are 15 µg/g N or less for grass and 20 µg/g or less for annual croppd land. A Nutrient Management Plan is suggested if values exceed 30 µg/g for grass, or 45 µg/g for annual croppd land.

**Table 6.9 Percentage Manure to Apply at Various Times of the Year in Coastal Regions**

Crop	Typical Annual Nitrogen Uptake <sup>a</sup> (kg N/ha)	Suggested Manure Application as a Percentage of Annual Crop Uptake <sup>b</sup>				
		Feb & March	April & May	June to Aug	Sept & Oct	Nov to Jan
Perennial Grass	260 to 400	up to 25 %	up to 100 %	up to 50 %	up to 25 %	up to 5 %
Silage Corn	190 to 250	0 %	up to 100 %	up to 20 %	0 %	0 %
Berries	50 to 100 <sup>c</sup>	up to 30 %	up to 100 %	0 % <sup>d</sup>	0 %	0 %
Vegetables	80 to 185 <sup>c</sup>	up to 10 %	up to 100 %	up to 100 %	up to 10 %	0 %
Cover Crop <sup>e</sup>						
Emerged before Aug 15	100 to 140	0 %	0 %	up to 60 %	up to 100 %	up to 10 %
Emerged before Sept 15	40 to 60	0 %	0 %	0 %	up to 100 %	up to 20 %
Emerged after Sept 15	20 to 35	0 %	0 %	0 %	0 %	0 %

<sup>a</sup> For high yielding crop – better estimates of actual uptake can be obtained by completing a Nutrient Management Plan

<sup>b</sup> Maximum total nitrogen (from manure and chemical fertilizer) applied to the soil not to exceed the crop's annual uptake (i.e., the sum of percent applied for each time period through the year not to exceed 100%)

<sup>c</sup> Maximum nitrogen application depends on type of berries or vegetables

<sup>d</sup> For new plantings, up to 100% of that year's nutrient need may be applied from June to August

<sup>e</sup> Includes relay crops – post-harvest nitrate test should be below 20 µg/g (0-30 cm) if fertilizing a fall-planted cover crop

**Table 6.10 Percentage Manure to Apply at Various Times of the Year in Interior Regions**

Crop	Typical Annual Nitrogen Uptake <sup>a</sup> (kg N/ha)	Suggested Manure Application as a Percentage of Annual Crop Uptake <sup>b</sup>				
		Feb & March	April & May	June to Aug	Sept & Oct	Nov to Jan
Perennial Grass <sup>c</sup>	200 to 400	up to 5 %	up to 100 %	up to 75 %	up to 50 %	0 %
Silage Corn	150 to 200	0 %	up to 100 %	20 %	0 %	0 %
Cereals (Spring Planted)	50 to 150	0 %	up to 100 %	0 %	0 %	0 %
Cereals (Fall Planted)	50 to 150	up to 5 % <sup>d</sup>	up to 100 %	up to 100 %	0 %	0 %
Berries, Tree Fruits and Grapes	50 to 100 <sup>e</sup>	0 %	up to 100 %	0 % <sup>f</sup>	0 %	0 %
Vegetables	80 to 185 <sup>e</sup>	0 %	up to 100 %	up to 100 %	0 %	0 %
Cover Crop <sup>g</sup>						
Emerged before Aug 15	100 to 140	0 %	0 %	up to 60 %	up to 100 %	0 %
Emerged before Sept 1	40 to 60	0 %	0 %	0 %	up to 100 %	0 %

<sup>a</sup> For high yielding crop – better estimates of actual uptake can be obtained by completing a Nutrient Management Plan

<sup>b</sup> Maximum total nitrogen (from manure and chemical fertilizer) applied to the soil not to exceed the crop's annual uptake (i.e., the sum of percent applied for each time period through the year not to exceed 100%).

<sup>c</sup> For grass legume mixes reduce the application of nitrogen in proportion to legume content


<sup>d</sup> Feb & March application in the year following planting

<sup>e</sup> Maximum nitrogen application depends on crop type (i.e. raspberries vs. blueberries or potatoes vs. broccoli)

<sup>f</sup> For new plantings up to 100% of that year's nutrient need

<sup>g</sup> Includes relay crops – post-harvest nitrate test should be below 20 µg/g (0-30 cm) if fertilizing a fall-planted cover crop

**Timing.** Implement the following practices when selecting optimum timing for nutrient application:

- ◆ for annual and perennial crops that grow from early spring through late fall, apply nutrients in multiple applications (e.g., Tables 6.9 and 6.10, pages 6-19)
- ◆ in areas of high rainfall or high leaching risk (e.g., coarse soils), apply nutrients in multiple applications
- ◆ match nutrient application to the developmental stage and rate of growth of the crop
  - plants at the beginning and end of their growth cycle require fewer nutrients than during active growth stages
  - apply nutrients prior to the period of rapid uptake
- ◆ leave at least three weeks between applications of manure to reduce the risk of soil surface sealing (allows the soil microbes to break up the manure)
- ◆ To avoid the transfer of pathogens to crops, berry and vegetable growers should maximize the time between manure application and the crop harvest
- ◆ manure should be well incorporated into the soil and kept from contacting non-root vegetables
- ◆ apply manure prior to planting vegetables
- ◆ apply manure prior to bloom on berries
- ◆ do not apply nutrients on excessively wet soils and soils which are cold, frozen or snow covered as these soils are less likely to absorb nutrients (spreading on frozen or saturated soil may be considered a *Code* under the *Agricultural Waste Control Regulation* violation)
- ◆ apply first application of manure to grassland in the Coastal region between T-sum 200 and 300 (see  information box below)



One method to determine when a first application of fertilizer or manure to grassland in the Coastal region is appropriate is the **T-sum Calculator**. For information on this method, refer to the Pacific Field Corn Association - Farmwest web page at [www.farmwest.com](http://www.farmwest.com) (Climate Tab)

Manure or other fertilizer application is not acceptable during certain times of the year if there is a low potential for nutrient utilization by the crop or if there is potential for negative environmental impact. Refer to Monthly Manure Spreading Practice Tables 6.11 and 6.12, pages 6-21 and 6-22. These tables summarize the considerations to be taken into account for nutrient application for various months for Coastal and Interior regions of the province.



Table 6.11 MONTHLY MANURE SPREADING PRACTICES IN THE COASTAL REGION				
September & October	November to January	February & March	April to August	
Environmental Risks of Contaminating Surface and Drinking Water				
Moderate rainfall hence moderate risk.	High rainfall hence high risk.	Moderate rainfall hence moderate risk.	Moderate to low risk.	
Spreading Practices	NO SPREAD PERIOD	Spreading Practices	Spreading Practices	
Spreading on grassland to meet crop nutrient needs for this time of year is acceptable. (See Table 6.9, page 6-19)	<b>MID NOVEMBER TO END OF JANUARY</b> Spreading on any crop is not acceptable due to the extreme risk to surface and/or ground water.	For grassland and well established cover crops, it is generally recommended that the first application of manure as a fertilizer should occur near or after the Tsum <sub>200</sub> * has been reached and at a rate which meets crop nutrient needs. (See Table 6.9, page 6-19) <i>* Find information on the Tsum at <a href="http://www.farmwest.com">www.farmwest.com</a></i>	According to crop and soil conditions, apply manure throughout the growing season to meet crop nutrient uptake. (See Table 6.9, page 6-19)	
When cropping after corn, cover crops or grassland planted after September 1 should not receive manure unless the need for nitrogen has been proven by a soil test. There is usually enough nitrogen remaining in the soil for a cover crop or newly seeded grass.	<b>SHOULDER PERIOD</b>		Avoid spreading on wet fields or saturated soils.	
Not acceptable to spread on bare land (harvested corn, vegetables, berries, etc.) or cover crops that emerged after September 15 <sup>th</sup> .	Spreading is not acceptable between mid-October to mid-November unless: <ul style="list-style-type: none"> <li>grass is actively growing (mean daily temperature above 5°C),</li> <li><b>AND</b></li> <li>soil is trafficable with no significant rain forecast for next 5 days.</li> </ul>	Spreading on berry or vegetable crops to meet crop nutrient needs for this time of year is acceptable after mid-February. (See Table 6.9, page 6-19)	Manure applications should be planned to ensure that storage facilities will be as close to empty as possible by October.	
Solid manure with high carbon-nitrogen ratios may be spread and incorporated into the soil as a soil conditioner. Manure should not be managed as a soil conditioner unless a manure test confirms a carbon-nitrogen greater than 30 to 1.	If spreading, apply only on grass fields which are not subject to flooding and/or runoff and only at rates matched to crop nutrient needs. (See Table 6.9, page 6-19)	Not acceptable to spread manure on bare land. Spreading can only occur if planning to plant a crop in the near future.	To avoid food safety concerns, do not spread manure on berry fields between flowering and harvest or on vegetable fields after planting.	
Manure not to be spread within 8 m or more of ditches or watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.	Manure not to be spread within 10 m or more of ditches or watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.	Manure not to be spread within 8 m or more of ditches or watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.	Manure not to be spread within 5 m or more of wet ditches or wet watercourses, or 3 m or more from dry ditches or dry watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.	

Table 6.12 MONTHLY MANURE SPREADING PRACTICES IN THE INTERIOR REGION			
September & October	November to February	March to May	June to August
Environmental Risks of Contaminating Surface and Drinking Water			
Low rainfall hence low risk.	Extreme risk of runoff at snow-melt hence high risk.	Moderate to high risk of runoff hence moderate to high risk.	Moderate to high peak rainfall events hence moderate risk.
Spreading Practices	NO SPREAD PERIOD	Spreading Practices	Spreading Practices
Spreading on crops is acceptable if soil is not frozen, as most of the manure nutrients will be available for the crop next spring. (See Table 6.10, page 6-19)	<b>Spreading on any land is not recommended due to the extreme risk of snowmelt runoff and surface water contamination.</b>	Not acceptable to apply manure: to fields that are subject to flooding or runoff; or to soils that are frozen, saturated or snow covered; or to bare land in March.	According to crop and soil conditions, apply manure throughout the growing season to meet crop nutrient uptake. (See Table 6.10, page 6-19)
Not acceptable to spread on bare land (harvested corn, vegetables, berries, etc.) or cover crops that emerged after September 1 <sup>st</sup> .		If field access is possible, avoid wet soils which could compact and lead to poor nutrient utilization or poor crop growth.	Avoid spreading on wet fields, saturated soils or fields prone to flooding.
Avoid wet areas.		Meet crop nutrient needs for this time of year if conditions are acceptable to spread. (See Table 6.10, page 6-19)	Manure applications should be planned to ensure that storage facilities will be as close to empty as possible by October.
Manure not to be spread within 8 m or more of ditches or watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.		Manure not to be spread within 8 m or more of ditches or watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.	To avoid food safety concerns, do not spread manure on berry fields between flowering and harvest or on vegetable fields after planting.
		Manure not to be spread within 5 m or more of wet ditches or wet watercourses, or 3 m or more from dry ditches or dry watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.	Manure not to be spread within 5 m or more of wet ditches or wet watercourses, or 3 m or more from dry ditches or dry watercourses (suggested) – increase buffer width to avoid any contaminated runoff based on soil, soil cover conditions, slopes greater than 5%, and sensitivity of area being protected.

## Nutrient Materials Selection

In determining which materials should be used to supply a crop's nutrient requirements, highest priority should be given to on-farm sources such as animal manures. Consider supplementation with off-farm manure sources only to top up deficiencies from the on-farm source.

Particularly in fields where soil phosphorus levels are high and manure is to be applied annually, consider replacing some of the manure nitrogen with chemical nitrogen fertilizer. Chemical fertilizers can provide a faster, more predictable release of nitrogen than manures, especially if the weather is cold and wet, and it is often easier to ensure a more uniform spread of chemical fertilizer than manure. Reducing manure application rates to soils with high phosphorus levels will reduce the risk of phosphorus contaminating adjacent surface waters.

### Soil Sampling for Nutrient Management

**Highly Soluble vs. Slow Release Nutrient Sources.** Soil type is a primary consideration in determining application rates and nutrient sources. Fine-textured soils such as clays have higher nutrient holding capacities and thus are better suited to receive higher application rates of highly soluble nutrient sources than medium and coarse-textured soils such as silts and sands. On coarse-textured soils, apply highly soluble nutrients at lower rates but at more frequent intervals.

Alternatively, consider using slow-release nutrient sources such as polymer-coated urea or compost. These nutrient sources are most suitable in areas of high rainfall or where leaching risk is greater such as would be the case for coarse soils.

**Particle Size.** Incorporate small-sized nutrient material into the soil or apply only to sites with vegetative cover that prevents erosion losses by wind or runoff flow. The advantage of using finely-sized soil amendments is that nutrients are available quicker.

**Contaminants.** Investigate contaminant levels whenever applying chemical fertilizers or other off-farm nutrient sources.

→ see Soil Contamination, page 8-15

## Nutrient Application Methods

When selecting chemical fertilizer or manure application equipment, accurate and uniform placement, as well as the capability to calibrate for desired application rate is essential. Ensure nutrients are not applied beyond the target crop by taking into account the spread width of broadcast applicators.

**Manure Application.** The advantages and disadvantages of various manure spreading methods are shown in Table 6.13, next page. Choose methods that provide uniform placement and which achieve the desired rate of application. Methods that ensure accurate placement on the soil surface or within the crop canopy require smaller buffer distances to sensitive areas.

To reduce damage to crops from manure smothering or soil compaction, place manure under the canopy in as a dilute a consistency as possible. As well, use high flotation tires and low soil disturbance equipment.

**Banded Nutrients.** For intensively managed row crops such as vegetables, nursery plants, and orchard trees, apply nutrients either in circles around the base of the trees or in bands along the crop row.

**Broadcast Nutrients.** Broadcast methods of application are suitable for crops such as grass or annually planted vegetables.

**Grazing Animals.** If grazing livestock are managed at appropriate stocking densities and for appropriate durations, manure deposited by the animals should be evenly distributed and at rates that do not exceed crop requirements.

Implement the following practices:

- ♦ manage for uniform manure distribution by regularly moving water supplies and supplemental mineral and feed sources
  - ♦ ensure livestock are moved frequently to avoid overgrazing and to evenly distribute manure for both rotational and conventional grazing systems
- ➔ see Outdoor Livestock Areas, page 3-7



 **Advanced Forage Management** and  **Rangeland Handbook for BC**


Table 6.13 Liquid Manure Application Methods by Order of Preference		
Method	Advantages	Disadvantages
<b>1. Band Applicator with or without Soil Aerator</b> (e.g., Sleighfoot or Aerway SSD)	<ul style="list-style-type: none"> <li>easy calibration</li> <li>uniform application</li> <li>accurate placement</li> <li>low ammonia loss</li> <li>fertilizer value maximization</li> <li>wider spreading window</li> <li>nitrous oxide release minimization</li> </ul>	<ul style="list-style-type: none"> <li>higher cost</li> <li>slow application</li> <li>crop damage from wheels if applied when crop is tall</li> <li>soil compaction from tanker</li> </ul>
<b>2. Injector</b>	<ul style="list-style-type: none"> <li>easy calibration</li> <li>uniform application</li> <li>accurate placement</li> <li>fertilizer value maximization</li> <li>fast application (with hose reel or umbilical systems)</li> <li>ammonia and odour reduction</li> </ul>	<ul style="list-style-type: none"> <li>high nitrous oxide release (under saturated conditions)</li> <li>only suitable for some soil and crop conditions</li> <li>higher cost</li> <li>slow application (with tanker system)</li> <li>low application rate difficult to achieve</li> <li>short application window</li> <li>soil compaction from tanker</li> </ul>
<b>3. Splash Plate</b>	<ul style="list-style-type: none"> <li>easy calibration</li> <li>lower cost</li> <li>low nitrous oxide release</li> </ul>	<ul style="list-style-type: none"> <li>soil and crop compaction</li> <li>short application window</li> <li>high ammonia loss</li> <li>non-uniform application</li> </ul>
<b>4. Irrigation Gun</b>  <b>Not recommend for use due to odour, calibration, uniformity and placement problems</b>	<ul style="list-style-type: none"> <li>lower cost</li> <li>fast application</li> <li>low nitrous oxide release</li> </ul>	<ul style="list-style-type: none"> <li>difficult to calibrate</li> <li>non-uniform application</li> <li>inaccurate placement</li> <li>high risk of runoff</li> <li>short application window</li> <li>high ammonia loss</li> <li>high risk of pathogen, aerosol and odour drift</li> </ul>

**Table 6.14 Solid Manure Application Methods by Order of Preference**

Method	Advantages	Disadvantages
<b>1. Spinning Disks</b>	<ul style="list-style-type: none"> <li>• easy calibration</li> <li>• accurate placement</li> <li>• fast application</li> </ul>	<ul style="list-style-type: none"> <li>• need dry manure</li> <li>• high dust production</li> </ul>
<b>2. Flail Broadcast</b>	<ul style="list-style-type: none"> <li>• can spread variable moisture content</li> </ul>	<ul style="list-style-type: none"> <li>• inaccurate placement</li> <li>• non-uniform application</li> </ul>
<b>3. Dump and Grade</b> <b>Not recommend for use due to poor uniformity</b>	<ul style="list-style-type: none"> <li>• low cost</li> </ul>	<ul style="list-style-type: none"> <li>• cannot be calibrated</li> <li>• non-uniform application</li> <li>• difficult to control rate</li> </ul>

**Fertigation.** The application of nutrients through an irrigation or nutrient circulation system is known as fertigation. Fertigation uses the same principles for determining rate and timing of application as any other nutrient application method. Ensure that nutrients are applied only to the target crop and that watercourses are totally avoided. In addition, check the system for leaks on a regular basis.

 **Chemigation Guidelines for British Columbia**


 **Plug and Bedding Plant - Water, Media and Nutrition**

 **Preparing a Complete Nutrient Solution**

## Nutrient Application Equipment Calibration

In order to manage nutrients effectively, both manure and fertilizer spreaders need to be maintained and calibrated to ensure uniform distribution. Calibration is a determination of the amount of solid or liquid applied to a given area for a specific piece of application equipment. To properly calibrate a manure spreader, it is important to know the capacity of the unit, the distance traveled, the spreading band width, and the time it takes to unload the spreader at a chosen tractor speed. When calibrating for solid manure, the manure density must also be known.

Uniformity is the evenness of application across the band spreading width from the beginning to end of each pass. To test uniformity, place buckets, tarps or some other form of collection system at a variety of locations in areas over which the manure is to be spread. The volume or weight of manure can then be measured, and an average can be calculated. A generally acceptable level of uniformity is when all samples are within 15% of the average within the direct spreading area (an area not influenced by previous or subsequent overlapping passes). Minor uniformity problems can be overcome by varying the entry point or direction of travel when spreading manure in a particular field.

 **Choosing and Calibrating Manure Application Equipment**

## Risk of Pollution During Nutrient Application

**Surface Water.** Any nutrients that enter a watercourse can degrade water quality and impact fish and fish habitat. Select application rates and management practices that keep nutrients out of watercourses.

The rate at which liquid infiltrates into the soil is important in evaluating the risk of runoff. Poorly drained soils become saturated quickly with the result that precipitation can no longer enter the soil, leading to increased stormwater flows. Water ponding on any soil surface is an indication that the liquid is being applied faster than it can infiltrate into the soil. In addition, runoff risks are greater on sloping land. In certain conditions, even a small amount of rain can

create runoff problems. If runoff due to site and weather conditions occurs, stop application, or reduce the application rate. Enlarge buffers to address persistent runoff events. → see Buffers, page 11-4

If liquid manure is pumped through pipes over or within 10 m of a watercourse, secondary containment on the pipes is suggested to prevent any leakage from entering the watercourse. Where possible pipes should be located 10 m or more (suggested) away from a watercourse.

Manure application should not occur within:

- ◆ 3 m or more of a bank or a slope leading to a dry ditch or dry watercourse (suggested)
- ◆ 5 m or more of a bank or a slope leading to wet ditch or wet watercourse (suggested)
- ◆ at least 30.5 m from any well (*Public Health Act*)

Commercial fertilizer application should not occur within:

- ◆ 1 m or more of a bank or a slope leading to a dry ditch (suggested)
- ◆ 3 m or more of a bank or a slope leading to wet ditch or any watercourse (suggested)
- ◆ at least 30.5 m from any well (*Public Health Act*)

In certain circumstances, setback distances to watercourses for manure and commercial fertilizer may need to be increased to avoid contaminated runoff.

The determination of an appropriate setback should be based on:

- ◆ soil texture, porosity and moisture
- ◆ soil cover conditions
- ◆ slope toward a watercourse, particularly if slope exceeds 5%
- ◆ sensitivity of the watercourse

**Spring Runoff.** In areas of the province where soils are frozen and where snow accumulates during the winter months, snowmelt has the potential to enter adjacent watercourses. Do not apply manure to frozen or snow covered land if manure can be carried with the melt water and contribute to water contamination.

**Subsurface Drains and Macropores.** Fields with effective subsurface drainage systems pose a particular pollution risk. Liquid wastes applied to the soil can find its way through macropores in the soil (e.g., cracks, worm holes and mouse or mole holes) into drains and eventually to watercourses. This risk applies to any drained field regardless of slope or its proximity to a watercourse.

→ see Drainage Water Quality, page 9-40

Where lowland fields with clays or silt loams have had drainage systems installed at some time in the past, the pipes may still work even if a modern system has not been installed. Where the risk of macropore flow to watercourses is elevated, implement the following practices:

- ◆ do not spread manure on grass or bare fields when fields are wet and tile drains are running
- ◆ cultivate bare fields to break up macropores shortly before spreading manure (within 7 days)
- ◆ reduce one-time manure application rates, depending on soil conditions



- ◆ if contamination still occurs, it may be necessary to block the outflow or contain the contaminated drain water and apply to fields as irrigation water when the tile drains are not running

**Greenhouse/Nursery Container Beds.** Check drainage discharge water from greenhouse floor drains or from under nursery container beds and capture and recirculate any contaminated water.

**Ground Water.** In the presence of coarse-textured sandy or gravelly soils or fractured bedrock aquifers, the movement of nutrients and pathogens to ground water is accelerated, creating the potential for pollution. Timing and rate of manure or fertilizer application are important. Follow a nutrient management plan for manure and fertilizer applications in areas over moderately or highly vulnerable aquifers that are used for drinking water. → see Table 6.6, page 6-12 To avoid the risk of contaminating wells from macropore or runoff flow, implement the following practices:

- ◆ maintain a 30.5 m manure or chemical fertilizer “no-spread-zone” around well sites (*Public Health Act*)
- ◆ protect the well by constructing a secure berm to divert runoff flows away from the well head, and ensure that the well and well casing are properly constructed and maintained

**Weather.** Applications in adverse weather conditions will increase the risk of manure leaving target areas, which may cause pollution. Implement the following practices:

- ◆ avoid spreading in diverting winds
- ◆ avoid spreading during heavy rains or if significant rain (i.e. greater than 10 mm of rain or its equivalent in snow) is forecast any of the next 3 to 5 days

**Soil, Crop or Crop Residue.** Implement the following practices to reduce the risk of nutrient loss (by surface sealing, ponding, runoff flow and leaching) during and after application:

- ◆ apply to an actively growing crop, cover crop or significant crop residue
- ◆ apply to soil that is free of surface and subsurface compaction

**Air.** A large portion of the total ammonia and odour emissions from manure occur during land application. The control strategies that can be used include timing and method of spreading.

Choosing an appropriate time to spread manure can go a long way in minimizing complaints due to odour. Using the following as general guidelines, spread manure:

- ◆ as soon as is appropriate to land to reduce methane emissions
  - ◆ when prevailing winds blow away from close urban areas or neighbouring residences
  - ◆ on cool days to reduce the rate of odour release
  - ◆ prior to an expected light rainfall or before irrigation
  - ◆ early in the day to take advantage of increased wind velocities later in the day to dilute odours
  - ◆ midweek, rather than on weekends or holidays, as this time is less likely to be a nuisance to neighbours pursuing outdoor activities
- see Nutrient Application, page 6-20, and refer to Timing

Rapid-cover manure application techniques may ultimately be the best solution in long-term reduction of odour complaints and concerns. Such methods of application are more costly than conventional practices but will maximize returns from the manure as a fertilizer in nutrient savings and won't release as many odours or gaseous emissions.

- ◆ on ploughed land, follow the spreading of manure closely with a disc or tiller
- ◆ on perennial forages, consider using a sleigh foot attachment or an attachment that combines a dribble bar with a soil aerator
- ◆ make more frequent manure applications at lower application rates using sleighfoot or shallow injection equipment for more efficient use of nitrogen

➔ see Nutrient Application, page 6-23, and refer to Nutrient Application Methods

### **Nutrient Application Impact on Climate Change**

The nitrogen from manure and fertilizer can be converted into the greenhouse gas nitrous oxide (N<sub>2</sub>O) during periods where the soil is saturated or will become saturated within a short time period as a result of the on set of fall / winter rains or rise in watertables due to subirrigation.

- ◆ avoid spreading manure or fertilizers in conditions where soil is saturated
- ➔ see Climate Change Factors, page 12-1

### **Crop Monitoring and Nutrient Application**

Monitor plant health and nutritional status throughout the growing period on an ongoing basis. Implement the following practices:

- ◆ record all application amounts, conditions, practices, and crop results to assess effectiveness of nutrient application strategies
- ◆ under highly intensive crop production systems (i.e., greenhouses), monitor pH and electrical conductivity of the rooting medium weekly to determine plant nutritional status throughout the growing period

# SOIL CONDITIONER APPLICATION



Refer to previous Table 6.4, page 6-6, and Table 6.5, page 6-7, for decisions regarding the use of soil amendments as a soil conditioner.

## SOIL CONDITIONER APPLICATION ENVIRONMENTAL CONCERNS

Primary environmental concerns related to soil conditioner application are:

- ◆ inappropriate method or timing that results in
- ◆ soil compaction on wet fields
- ◆ soil erosion on fields left bare after incorporation of soil conditioners
- ◆ water pollution caused by runoff of soil conditioners
- ◆ damage to the crop, leading to poor nutrient uptake or soil erosion
- ◆ uneven application
- ◆ application rate exceeding the soil's ability to assimilate certain soil conditioner components (i.e. salts, pH, carbon-nitrogen ratio, contaminants) that results in
  - water and/or soil pollution
  - nutrient imbalances, plant toxicity and poor growth
- ◆ over-application of nutrients when managing as a soil conditioner that results in water pollution
- ◆ applications to unsuitable location (e.g., proximity to watercourse, soil type, topography, sensitive habitat) or ineffective buffers that results in
- ◆ water pollution
- ◆ odour/nuisance to neighbours
- ◆ habitat impact

For more information on these concerns:

- ➔ see Crops and the Environment, page 4-1
- ➔ see Impacts on Biodiversity and Habitat, page 7-8, refer to Farm Activities and Impacts
- ➔ see Soil Quality Factors, page 8-2, refer to all sections
- ➔ see Water Quality and Quantity Factors, page 9-2, refer to all sections
- ➔ see Air Quality Factors, page 10-1, refer to Odours

# SOIL CONDITIONER APPLICATION LEGISLATION

The following is a brief outline of the main legislation that applies to soil conditioner application.

➔ see page A-1 for a summary of these and other Acts and Regulations



## **Agricultural Land Commission Act**

This Act requires agricultural land within an Agricultural Land Reserve not be used for non-farm use unless permitted by the Act or its regulations. The *Agricultural Land Reserve Use, Subdivision and Procedures Regulation* designates the application of the following as farm use:

- ◆ mulches and soil conditioners
- ◆ soil amendments collected, stored and handled in accordance with the *Code* under the *Agricultural Waste Control Regulation*
- ◆ compost produced in accordance with the *Code* under the *Agricultural Waste Control Regulation*
- ◆ compost produced and applied in compliance with the *Organic Matter Recycling Regulation*



## **Drinking Water Protection Act**

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving *more* than one single-family residence).

- ◆ Section 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system



## **Environmental Management Act**

The *Code* under the *Agricultural Waste Control Regulation* lists specific requirements regarding application of agricultural wastes (manure, compost, vegetation, etc):

- ◆ Section 3: agricultural wastes must be collected, stored, handled, used and disposed of in a manner that prevents pollution
- ◆ Section 11: agricultural wastes must not be directly discharged into a watercourse or ground water
- ◆ Section 12: agricultural wastes must be applied to land only as a fertilizer or a soil conditioner
- ◆ Section 13: agricultural wastes must not be applied to land if .... runoff or the escape of agricultural waste causes pollution of a watercourse or ground water
- ◆ Section 14: agricultural wastes must not be applied on frozen ground, in diverting winds, on areas having standing water, on saturated soils or at rates of application that exceed the amount required for crop growth, **if** runoff or escape of agricultural wastes causes pollution of a watercourse or ground water, **or** goes beyond the farm boundary
- ◆ Section 30: agricultural products must be managed, used and stored in a manner that prevents the escape of agricultural waste that causes pollution

The *Code of Practice for Soil Amendments* regulates the storage, sampling, application, and record keeping pertaining to specific types of soil amendments. These include:

- ◆ fly ash derived from the burning of wood, other than wood that has been immersed in marine waters
- ◆ residuals from primary or secondary treatment of liquid waste produced after 1995 from a pulp or paper mill, including domestic sewage if it is mixed with residual solids
- ◆ lime mud derived from pulp or paper mill processes or waste lime
- ◆ residuals from the treatment of water for domestic use or use in industrial processes
- ◆ industrial residue of wood that has not been treated with glue, paint, a preservative or another substance harmful to humans, animals or plants

The *Organic Matter Recycling Regulation* has further requirements related to the land application of additional defined nutrient sources such as Class A and B Biosolids and Class A and B Compost.

- ◆ Section 5: requires development of a Land Application Plan prior to application of Class A and B Biosolids and Class B Compost
- ◆ Schedule 12 lists organic materials covered by the Regulation



### **Public Health Act**

This Act prohibits a person from willingly causing a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard.

The Act has conditions under the *Public Health Act Transitional Regulation*:

- ◆ Section 18: provides separation distance from wells to be at least
  - 30.5 m from any probable source of contamination (probable source of contamination could include soil conditioners)
  - 122 m from any dumping ground



### **Wildlife Act**

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.



### **Fisheries Act**

This Act has two sections of importance with respect to the application of soil conditioners:

- ◆ Section 36(3): prohibits the deposit of deleterious substances into watercourses (deleterious substances could include soil conditioners)
- ◆ Section 38(4): requires reporting infractions of Section 36



### **Species at Risk Act**

This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, inland waters (i.e., all watercourses), territorial sea of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

# SOIL CONDITIONER APPLICATION

## BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable soil conditioner application related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

**Certain materials have properties that allow them to be used as both a fertilizer and a soil conditioner. If this is the case, they should be managed primarily as fertilizers.**

If intending to apply an amendment primarily as a soil conditioner, ensure the product meets all of the following conditions:

- ◆ does not fit the criteria of a “fertilizer”  
→ see Is it a Fertilizer or a Soil Conditioner?, page 6-4
- ◆ can be managed to improve physical, biological and chemical soil properties
- ◆ has been checked for contaminant levels

### Soil Conditioner Application



**Rate.** Apply soil conditioners in a manner that satisfies all the following criteria:

- ◆ at rates that correct a soil’s deficiency for specific chemical, physical or biological characteristics
  - ◆ at rates within the soil’s capacity to assimilate the specific soil conditioner
  - ◆ at rates that will not lead to crop toxicity or smothering
  - ◆ at rates that do not potentially cause loss of the soil conditioner to the environment by leaching or runoff
  - ◆ for high moisture soil conditioners such as crop wash water, at rates that do not exceed the soil’s infiltration capacity
- 📖 **Soil Liming - Understanding Your Soil Test Recommendation**  
📖 **Use Caution When Bringing Non-Agricultural Waste or Products onto Your Farm**  
📖 **BC Agricultural Composting Handbook** and see Using Compost chapter

**Timing.** Apply soil conditioners at the appropriate time of year that will avoid the following situations:

- ◆ high risk of runoff caused by excessive rainfall or irrigation  
→ see Irrigation, page 9-18  
→ see Runoff, page 9-42
- ◆ soil compaction on fields where moisture conditions are above field capacity  
→ see Soil Management, page 8-7  
→ see Drainage, page 9-36



**Methods.** Optimal methods of application and placement of soil conditioners are dependent on the crop being grown and the reason for applying the material. Implement the following practices:

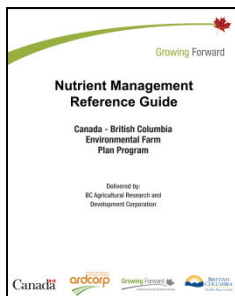
- ◆ for most field crops such as annual vegetables and forages, broadcast soil conditioners uniformly and incorporate into the soil as soon as possible
- ◆ for soil conditioners applied as "mulches" to improve water conservation or to alter soil conditions within the target crop's rooting zone, use equipment that will uniformly and adequately cover the primary rooting area (e.g., sawdust placed around blueberry plants)
- ◆ for perennial crops for which certain soil conditioners such as lime cannot be incorporated regularly, implement the following practices:
  - reduce the annual application rate to avoid toxicity
  - increase the frequency of application to compensate for reduced rate
    - ➔ see Nutrient Application Methods, page 6-23
    - ➔ see Soil Management, page 8-7

**Application Equipment Calibration.** To achieve the desired result with any soil conditioner, calibrate application equipment to ensure that the actual rate of application and placement of material match the intended rate and placement.

 **Nutrient Management Reference Guide**

**Materials Selection.** Give the highest priority to using on-farm materials for soil conditioning. If such materials are not available, select the soil conditioner that will best achieve the desired outcome.

- ➔ see Tables 6.4 and 6.5, pages 6-6 and 6-7, for a list of frequently-used soil conditioners



**Crop Monitoring.** Because of their low nutrient content, soil conditioners (particularly ones high in organic matter) are frequently applied at high rates. To assess the effectiveness of application strategies, record all applications, conditions, practices, and crop results.

## Risk of Pollution During Soil Conditioner Application

Although most soil conditioners present a reduced risk of pollution when compared with fertilizers, take the following precautions:

- ◆ since many soil conditioners have a high percentage of plant fibre and are very light when dry, they are easily wind blown
  - when applied to land, work them into the soil as soon after application as possible
  - establish and maintain an adequate buffer between soil conditioner application areas and sensitive areas to prevent nuisance or pollution risks ➔ see Buffers, page 11-4