Guidelines For Manure Management For Prince Edward Island

Table of Contents

Ministers' Message

These **"Manure Management Guidelines for Prince Edward Island"** recognize the importance of the livestock industry to the social and economic well-being of Prince Edward Island. The guidelines support the principle that livestock operations have an important role to play in Island society and hence have a right to establish, operate and expand in accordance with reasonable and acceptable standards.

These guidelines consider the needs and concerns of all residents of Prince Edward Island to ensure that they can continue to enjoy a good quality of life. At the same time, the guidelines recognize the importance of the long-term sustainability and protection of the Province's natural land, air and water resources. They are a key element toward our goal of ensuring sustainable resource land use on Prince Edward Island.

The assistance and participation of all groups and individuals who were involved in the development of these guidelines is gratefully acknowledged.

These guidelines come into effect on January 7, 1999.

Eric Hammill
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Preface

Principles

The following principles guided the development of these guidelines:

- That Prince Edward Island is a rural agricultural province and that livestock operations have a right to establish, operate and expand in accordance with reasonable, environmentally acceptable and economically sustainable management practices;
- That the primary purpose and best use of prime agricultural land should be for agriculture;
- That non-farm residents and business owners must be aware that there will be certain sights, sounds and smells associated with normal livestock production practices;
- That the environmental assessment process recognize the right of livestock operations to establish, operate and expand when they are deemed to be in compliance with these guidelines and other relevant land use and environmental protection legislation.

1. Introduction

The "Manure Management Guidelines in Prince Edward Island" gives direction for recommended manure management practices as well as serving as a guideline for anyone concerned with the establishment and operation of new livestock confinement facilities, expansion of existing livestock facilities or changes in land use in the rural area. It is the successor to the *Draft 1986 Guidelines for Manure Management and Separation Distances in P.E.I.*

In order to reduce the potential for environmental problems involving livestock agriculture, the concept of Minimum Separation Distance (MSD) between livestock facilities and other non-compatible land uses is included as a major component of the guidelines. The guidelines are intended to compliment programs and statutory requirements under the Environment Protection Act, Public Health Act, Fisheries Act and other Acts that relate to agricultural use and the development of land and the enforcement of environmental quality.

These Guidelines utilize a two-part approach to promote proper land use siting and livestock manure management. It is intended that livestock farming operations have sufficient land base available for the recycling of manure nutrients as well as provide reasonable separation distances between the livestock operation and neighbours to reduce nuisance conflicts.

The guidelines encourage environmental sustainability by emphasizing the recycling of manure on land through the adoption of management techniques that promote the removal of manure nutrients by the crops grown. The guidelines also provide practical information to assist producers in further reducing environmental problems.

1.1 Current Concerns

The agricultural community and rural residents generally acknowledge that even with the best management, there are odours associated with livestock production. The increasing size and number of livestock operations in conjunction with expanded residential land use in the rural areas has greatly increased the potential for environmental conflicts between non-compatible land uses. Both government and livestock producers are concerned about nuisance odours and the water pollution potential associated with the storage and utilization of livestock manures.

1.2 Purpose of the Guidelines

These guidelines describe manure management systems and practices which will reduce the risk of pollution and minimize odours.

The purpose of these guidelines are:

- to assist livestock producers in their efforts to prevent pollution and minimize odour
- to provide a standard which may be used in determining normal, acceptable farming practices
- to provide information to the general public and officials who want to evaluate livestock, operations for their potential effects on the environment and surrounding land uses.
- to provide government with a basis for evaluation of livestock operations

1.3 The Intended User

The Manure Management Guidelines are intended to be used by all livestock producers, provincial and municipal officials, land use planners, residential developers, owners of recreation areas and the general public who are concerned with the siting, design and management of expanding and new livestock facilities, or the management of existing facilities.

Producers planning new livestock facilities or changes in existing operations are encouraged to develop a farmstead operation and management plan based on the Guidelines. The Guidelines can also assist producers and the livestock industry in improving manure management strategies.

1.4 Overview of Permits and Approvals Process

1.4.1 Development/Building Permits

All new livestock developments, expansions or modification of existing livestock operations, change of use of buildings for livestock housing and construction of manure storage facilities may require a development/building permit from the authority having jurisdiction in accordance with the Planning Act Regulations or the municipality's regulations. Note: Where a project requires environmental approval and/or an entrance way permit, the building permit will not be issued until the approval and/or the entrance permit is issued. The fees for the Development Permit may vary depending on the location, size and type of the farm structure. The applicant should allow six to eight weeks for a decision on the building permit application.

1.4.2 Entrance Way Permit (if applicable)

All new development along an arterial highway and/or a seasonal road requires and Entrance Way Permit in accordance with the Roads Act, Highway Access Regulations. There is an application fee.

For proposals located in municipalities with official plans and by-laws application must be made to the Department of Transportation & Public Works. For proposals that are not located in municipalities application must be made to the Department of Community

Services & Attorney General at the nearest Regional Services Center.

If a highway access culvert is required and/or to be relocated, there is a fee.

1.4.3 Sewage Disposal Permit (if applicable)

A sewage disposal permit is required for any construction, reconstruction or installation of a sewage disposal system for the collection and treatment of human waste and/or milk parlor waste water in accordance with the Sewage Disposal Regulations, Environmental Protection Act. The licensed sewage contractor makes application to the Department of Community Services & Attorney General for a permit. There is a permit fee.

1.4.4 Water Well Permit (if applicable)

A well permit is required for high capacity wells and/or for wells which are constructed or located in areas which vary from the provisions of the Water Well Regulations, Environmental Protection Act. Application is made to the Groundwater Section of the Department of Technology & Environment.

1.4.5 Plumbing/Electrical Permits

All plumbing and electrical work require a permit in accordance with provincial regulations. For further information on fees, consult the Department of Community Services & Attorney General at the nearest Regional Services Center.

1.4.6 Environmental Approval

New commercial livestock operations and significant livestock expansions to existing livestock operations require an approval pursuant to Section 9 of the Environmental Protection Act. There is no application fee.

2. Summary of Guidelines

This section provides a summary of the Guidelines for Manure Management that are found throughout the "Guidelines for Manure Management for Prince Edward Island" document. For more information on the topic areas please refer to the sections as noted. Definitions are located in Appendix A.

For the purpose of clarification in this document, the word "shall" is used when there is existing legislation such as a by-law or regulations under an Act. The word "must" is used when there is a requirement such as Departmental policy or a Minister's order. The word "should" is used to indicate a recommended practice (ie: guideline). *Italicized* sentences indicate a direct quote from an act, by-law or regulation. Underlined print within a sentence is used to highlight an existing regulation or requirement. Bold print within a sentence is used to highlight the word(s), or the sentence itself.

The following steps should be followed when preparing a development proposal for an expanding or for a new livestock operation.

- Become familiar with the planning process and requirements of the Province and/or Municipality.
- Determine whether local planning regulations will permit future growth.
- Have a manure management plan to demonstrate that the operation will not be a source of trouble in the future.
- Inform local area residents about the project, respond to concerns, and ensure misconceptions do not exist.

Selecting a Manure Storage System {4.4}

From an environmental viewpoint the manure storage should be able to provide;

- Protection of groundwater and surface water
- Minimum odour levels
- An adequate storage capacity (liquid - 7 months, solid - 2 months plus field storage)
- Minimum nutrient losses during storage and handling

Siting for Manure Storages {4.5}

- Storage should be easily accessible to pumping and field spreading equipment.
- Locate storage in a well drained area and divert surface water away from the manure storage.
- Maintain a minimum separation distance of 90m (300 ft.) between a manure storage and a neighbours well. Increased separation distance may be recommended for specific soils, see Appendix B.
- Provide a grassed separation area between the manure storage and any watercourse or well, or provide containment of run off from the storage.
- Leachate, manure and manure contaminated liquid from a manure storage must not enter a watercourse.

Manure Storage Capacity {4.7}

- A liquid manure storage facility should be sized to contain a minimum of 210 days of manure production and accumulated precipitation.
- A solid manure storage facility should be sized to contain a minimum of 60 days storage capacity at the barn and supplemented with field storage.
- On November 1st of each year, the reserve manure storage capacity should be capable of containing the manure produced plus accumulated precipitation during the following 210 days for liquid manure and 60 days for solid manure.
- Liquid manure storages should be designed to have a freeboard (excess capacity) of 300mm (1 ft) to allow for variations in manure accumulation.

Design and Construction of Concrete or Metal Tanks {4.9}

- All manure storage structures must be designed and constructed in accordance with the latest editions of the National Building Code of Canada, and the Canadian Farm Building Code.
- The concrete base of the storage must be a minimum of 0.5m (20") above bedrock unless an alternative methodology can be used to protect the ground water.
- The base of the storage must be 0.5m (20") above the level of the high water table.
- A building permit, issued by the authority having jurisdiction, may be required for concrete or metal tank manure storages.
- Plans for the manure storage must be stamped by the engineer who is taking responsibility for the design.
- Plans must be submitted and approved by the **Department of Technology and Environment** prior to the beginning of construction.
- The manure storage must be constructed according to the approved plans.
- Upon completion of the project, a Certificate of Inspection must be signed by the design engineer and submitted to the **Department of Technology and Environment**.
- An emergency plan should be available for a major spill of liquid manure.

Design and Construction of Earthen Storages {4.10}

- The concrete base of the storage must be a minimum of 0.5m (20") above bedrock unless an alternative methodology can be used to protect the ground water.
- The base of the storage must be 1 m (40") above the level of the high water table.
- A building permit, issued by the authority having jurisdiction, may be required for all earthen manure storages.
- Plans for the manure storage must be stamped by the engineer who is taking responsibility for the design.
- Plans must be submitted and approved by the **Department of Technology and Environment** prior to the beginning of construction.
- The manure storage must be constructed according to the approved plans.
- Upon completion of the project, a Certificate of Inspection must be signed by the design engineer and submitted to the **Department of Technology and Environment**.
- An emergency plan should be available for a major spill of liquid manure.

Design and Construction of Solid Manure Storages {4.11}

- Solid (stacked) manure should be stored on a concrete pad.
- Systems such as vegetative filter strips or constructed wetlands may be considered for treatment and absorption of runoff from solid manure storages.
- Runoff should be collected, stored and handled as if it were liquid manure.
- Plans for solid manure storages should be prepared by experienced persons.
- Plans for solid manure storages should be approved by the Department of Technology and Environment in consultation with

the Department of Agriculture and Forestry prior to beginning construction.

Field Manure Piles {4.12}

- The solid manure pile should be located on a suitable site.
- The solid manure pile should maintain recommended minimum separation distances between watercourses, wells, residences, lakes, ponds, and be placed to avoid runoff into a public road ditch.
- The solid manure pile should not be located in areas subject to surface runoff or flooding.
- Up-slope surface water should be diverted away from the pile.

Composting of Manure {4.1.3}

- The site is located a minimum of 90 meters (300 ft) from a watercourse or a well used for domestic purposes,
- Windrows are not located on coarse textured soils,
- All clean surface water is diverted away from the composting site.

Feedlot Runoff {4.15}

- Uncontaminated surface water should be diverted away from cattle exercise yards and feedlots.
- Contaminated runoff from cattle exercise yards and feedlots should be contained and handled as a liquid manure or treated in an approved treatment system.
- Systems such as vegetative filter strips or constructed wetlands may be considered for treatment and absorption of runoff from livestock feedlots.
- The recommended minimum separation distance between a new exercise yard or feedlot and a watercourse or domestic well is 90m (300ft.).
- A 30m (100 ft.) minimum separation distance is recommended between a new exercise yard or feedlot and a highway ditch or right-of-way.
- Existing exercise yards or feedlots should establish and maintain a minimum 20m (65 ft.) separation from a watercourse. If the slope is 9% or greater, then a 30 m (100 ft.) separation distance should be maintained.

Safety Recommendations for Liquid Manure Storages {4.16}

- Liquid and semi-solid manure storages must be designed and constructed according to the structural and safety requirements of the Canadian Farm Building Code.
- Effective gas traps shall be provided in all liquid manure lines between the livestock building and outside liquid manure storage.
- A sign warning of dangerous gases shall be installed at every access to a liquid manure storage tank or under floor manure transfer chamber.
- A permanent safety fence or wall extending to not less than 1.5m (5 ft.) above adjacent grade shall be provided around all liquid manure storages without fixed covers.
- Locked child proof gates are required at all entrance ramps and pumping ramps.
- Safety railing or floor grill shall be required on all manure hopper openings larger than 100mm (4 inches) in width
- Ladders shall not be installed in closed manure tanks.
- Covers providing access to liquid manure storage tanks shall be permanently secured with safety chains.

Manure Odour During Spreading {5.2.1} {5.2.2}

- Producers should attempt to incorporate the manure the same day it is spread.
- Incorporation of manure should occur within 48 hours after application, unless applied to hay or pasture land or exceptional circumstances exist.
- Irrigation equipment is not recommended for manure application due to excessive odour production and high nitrogen loss.
- Manure should not be spread during the period of June 20 to September 8 unless it is absolutely necessary.
- During the period of June 20 to September 8, manure should only be applied for the fertilization of hay, pasture land, summer fallow land or to establish cover crops.
- Manure applied to summer fallow and for establishing cover crops should be incorporated within 48 hours.

Manure Spreading {5.3} {5.3.1} {5.3.6}

- Minimum setback distances for manure spreading are recommended in Table 3 .
- The slope of the land should be considered when spreading manure.
- Sloping land should be maintained with a reasonable amount of crop cover to provide protection against manure runoff.
- Winter application is not recommended because of the high potential for runoff and surface water pollution as well as high nutrient losses due to these factors.

Soil and Crop Implications {5.4.2.}

- Manure should not be applied to soil that has a moisture content greater than its field moisture holding capacity.

Environmental Impact Assessment Process (EIA) {6.3}

- New commercial livestock operations and significant livestock expansions to existing livestock operations require an approval pursuant to Section 9 of the Environmental Protection Act. There is no application fee.

Minimum Separation Distance (MSD) {7.1} {7.2}

- All **new livestock operations** should comply with the Minimum Separation Distance recommendations in Section 7 of the Manure Management Guidelines document.
- As a general rule where the majority of residents and businesses within the minimum separation distance (MSD) are in agreement with the **new livestock operation**, the MSD requirements could be varied.
- Where residences and businesses currently exist within the minimum separation distance of **an expanding livestock operation**, the owner of that operation can expect to receive approval to expand provided the operation complies with these guidelines and other relevant land use and environmental protection legislation. The views of residents and businesses that are within the MSD of an expanding farm operation will be given due consideration during the review process.
- The Department of Agriculture and Forestry will be consulted and provide recommendations on development/building permit applications involving commercial livestock operations.

Implementation of Minimum Separation Distance (MSD) {7.3}

- The applicant completes the MSD Data Sheet and Sketch Sheet and submits them to the appropriate building permit office (municipal or Provincial government) for determination of separation distances and to initiate the building permit process.
- MSD applies when an application is made for a new livestock facility or change of use of a livestock facility.
- MSD applies only to livestock and poultry facilities.
- The direction of the prevailing winds, the presence of berms or other forms of screening do not affect the calculated MSD.
- Variances to the MSD may be considered based on site specific circumstances.
- Minimum Separation Distance may be reduced by 25% if prevailing summer winds are favorable to reducing odour nuisance.
- Municipal and Provincial officials must consult P.E.I. Department of Agriculture and Forestry staff when considering a variance application. Conditions that meet the intent, if not the precise distance of MSD, or that mitigate environmental impacts, will receive further consideration. Such conditions may include unique topography and/or micro-climate which mitigate nuisance, visual screening, and unique management/technology.
- Distance to the neighbouring buildings is measured as the shortest distance between that portion of the assessed barn used for livestock housing or the manure storage and the building.

3. Manure Management

3.1 Introduction

Sections 3, 4 and 5 deal with many of the management factors that must be considered when handling, storing and using livestock manure. Section 3 describes the different types of manure, and the importance of the proper utilization of manure. Section 4 deals with the storage of manure and Section 5 deals with the land application of manure.

General farmstead appearance can have a bearing on the attitude of the community. Visual screening of manure storages has positive results. Good sanitation and fly control around buildings and manure storages are important. Maintaining good public relations with neighbours and the community at large is important in avoiding conflicts.

Consideration of neighbours is an important aspect of manure management. Manure should be stored and spread in such a way as to be of the most value as a fertilizer, cause the least inconvenience to neighbours and minimize the potential for causing environmental problems.

Locating buildings and manure storages in accordance with Minimum Separation Distance recommendations will significantly reduce the detection of odours off-property. (See Section 7)

3.2 Manure Types

Manure is a valuable by-product of a livestock operation. It provides a source of crop nutrients and organic matter, valuable in sustaining soil productivity. The physical characteristics of manure may be described according to its solids content. Manure may be handled as a liquid, slurry or semi-solid and as a solid.

Liquid manure is produced when little or no bedding is used. It contains less than 5 percent solids. The manure, as excreted, typically has a solids content from 9 to 12 percent. The additional liquid comes from washing floors and equipment and spillage from waterers.

Semi-solid (Slurry) manure contains from 5 to 20 percent solids.

Solid manure has sufficient bedding added so it is stackable. It contains a solids content greater than 20 percent. To produce a solid, the liquid is drained off or absorbed into the bedding material.

3.3 Manure as a Fertilizer

Several major benefits are associated with the proper management of livestock manure. Manure is a valuable organic source of crop nutrients, particularly nitrogen, phosphorous and potassium, and several secondary micro-nutrients. When recycled to the land, manure reduces the need to purchase commercial fertilizers. Soil quality improves with added organic matter. Please refer to Section 5 for more information on land application of manure.

When considering manure as a fertilizer the important characteristics are:

- nitrogen content;
- phosphorus content;
- potassium and sulphur content;
- organic matter content, and
- micro-organisms

3.3.1 Nitrogen: The nitrogen in manure exists in two forms, organic nitrogen which forms the largest portion, and ammonium nitrogen. Organic nitrogen is not available for use by plants until it mineralizes to the nitrate form, the same form as the nitrogen in some commercial fertilizers. The rate of mineralization will depend upon the composition of the manure, soil type, temperature and moisture content. Generally, 30 to 50 percent of the nitrogen will be mineralized during the first cropping season with the balance mineralized during the next three years.

As the soil warms in spring, the nitrogen undergoes a conversion from the ammonia form to the nitrate form. Nitrate-nitrogen is dissolved in water and can move away from the root zone in the soil. This process is known as leaching.

When manure is handled and spread on land, some of the nitrogen in the manure will be released to the atmosphere as ammonia gas. Typical nitrogen losses for various methods of spreading are listed in Appendix C.

To maximize the fertilizer value, manure must be stored and handled to reduce nitrogen losses. Nitrogen can be conserved by using the following practices:

- transfer the manure from the barn to storage as often as possible, especially during the summer;
- use transfer systems such as bottom loading storages that minimize contact between the manure and the air;
- use storage facilities with a minimum of exposed surface area, or cover the manure storage to reduce contact with air; and
- when spreading, minimize exposure time by incorporating the manure into the soil as quickly as possible. Most nitrogen losses occur within the first 24 hours after the manure is spread.

3.3.2 Phosphorous: The phosphorus in manure exists in both the organic and inorganic forms, but unlike nitrogen, phosphorus is not released to the air. As with nitrogen, the inorganic form is readily available to be used by plants, but the organic form is not available until the phosphorus is mineralized. Phosphorus is not leached from the root zone unless very high levels build up in the soil.

Surface waters can be polluted if runoff occurs from fields where the manure has not been incorporated.

3.3.3 Micro-organisms: Manure contains large numbers of micro-organisms. The micro-organisms that carry or cause diseases are known as pathogens. The easiest transfer of pathogens from animals to people is through direct contact. Consumption of contaminated products which are uncooked, such as vegetables irrigated with manure is one example. The potential for disease transmission is reduced when pathogens are rapidly destroyed by drying and exposure to sunlight. Disease transmission risk is also largely reduced when manure is incorporated into soil.

3.3.4 Organic Matter: The application of manure to crop land can help maintain soil organic material, improve soil tilth and control soil erosion. When fields are cropped, a portion of the organic matter is removed from the field. The use of commercial inorganic fertilizers does not replenish the lost organic material. Depending on the soil type, a steady depletion of soil organic matter can result in a soil structure that is more susceptible to erosion. Repeated long-term application of manure at reasonable rates will improve the soil condition and water-holding characteristics as a result of the regular addition of organic matter.

4. Manure Storage

4.1 Introduction

Section 4 deals with planning and design of new manure storages, composting, collection and treatment of runoff, safety requirements, and odour management around the barn and manure storage.

Due to the nature of our climate as well as our seasonal cropping systems, it is necessary to store manure for various periods of time. The length of manure storage time depends on many factors. The storage capacity should allow for 7 months of liquid manure accumulation to efficiently utilize the manure for crop production. A solid manure storage should allow for a minimum of 60 days accumulation of manure in combination with field storage.

4.2 Existing Manure Storages

Existing livestock operations that have adequate manure storage facilities and are not causing environmental concerns are deemed to be in compliance with these guidelines. However, existing livestock operations that do not have adequate manure storage facilities, and are causing pollution of surface water or groundwater or other environmental concerns, are deemed to be in non-compliance with these guidelines. These manure storages should be upgraded with a new or expanded manure storage facility.

4.3 Planning a New Manure Storage

A well planned manure storage system is needed to realize the potential value of manure and to avoid pollution problems. Manure storage structures or location must be designed and operated to contain manure, other wastes, and contaminated runoff in an environmentally sound manner. The facility must be sized to hold wastes until they can be safely used as a fertilizer. The design of the storage will depend upon the location, soil type, the size required, the characteristics of the manure and the methods of filling and emptying the manure storage.

4.4 Selecting a Manure Storage System

A manure storage system should be able to provide:

- Protection of groundwater and surface water,
- Minimum odour levels,
- Capacity that ensures manure can be stored until it can be efficiently used on the land,
- Minimum nutrient losses during storage and handling.

Choice of the most appropriate system will also involve a consideration of the following:

- The moisture content of the manure,
- Safety and security of persons and livestock,
- Labour efficiencies and costs of complete systems, (including capital costs and operating costs),
- The quality and adaptability of equipment and systems to meet present and future needs,
- The location of the storage in relation to streams and watercourses, wells, neighbours, roads, etc.,
- Size and type of spreading equipment to complete the job in as few days as possible, both to minimize the duration of odours

and to proceed with other field operations.

4.5 Siting For Manure Storages

The storage should be located close enough to the barns to allow for convenient filling and still permit future expansion of the facilities. It should be accessible to pumping and field spreading equipment. To avoid collecting surface run-off and to reduce volume requirements, the storage should be located in a well drained area and surface water should be diverted away from the area, if necessary. Do not construct manure storages near streams, watercourses or a well. Provide an effective vegetative strip between a manure storage and a watercourse. **Leachate, manure and manure contaminated liquid from a manure storage must not enter a watercourse.**

The minimum separation distance between a manure storage and a neighbour's well depends on several factors including the type of storage, soil type, depth to bedrock, etc. **The base distance of 90 m (300 ft.) should be increased by the multiplication factor for various soil types as noted in Appendix B, Column 4.** Also the Minimum Separation Distances recommended in Section 7 should be followed to minimize odour nuisance.

The soil, bedrock and groundwater conditions should be evaluated by a qualified professional to ensure that the site is suitable for the type of storage planned. Refer to sections 4.7 to 4.11 for further information on manure storage design.

4.6 Types of Manure Storage Structures

Manure can be handled as a solid, semi-solid or a liquid, depending upon the chosen system of animal management and individual operator preferences. Many alternatives differ simply in their degree of automation. The consistency of fresh manure is often changed within the handling system by such things as the addition of bedding, dilution water or natural air drying. The moisture content of manure affects its consistency, and hence is the most important single factor when considering the selection of handling equipment and storage facilities.

Solid Manure: Livestock manure can be handled as a solid if sufficient bedding is added. Manure transfer to long term storage adjacent to the livestock facility usually includes the use of either a conventional continuous chain barn cleaner, a shuttle cleaner, tractor with loader, ram or compressed air pump system.

Solid manure should be stored on a curbed, concrete pad. Runoff from solid manure should be contained within the storage itself or collected in a separate liquid holding structure of suitable material to achieve an expected hydraulic conductivity of $1x10^{-7}$ cm/sec. Systemssuch as vegetative filter strips or constructed wetlands may also be considered for treatment of runoff from solid manure storages. Runoff from livestock feedlots should be handled in a similar manner as runoff from a solid manure pile.

Storage of solid manure may be possible in open field piles under certain conditions. Refer to Section 4.12 for more information on field manure piles.

Semi-solid (Slurry) Manure: In many modern livestock facilities where bedding is limited, manure is produced that is neither a liquid nor a solid. The resulting thick semi-solid manure does not flow as readily as liquid manure, nor will it pile in a similar manner as solid manure. In order to handle semi-solid manure, specialized storages and handling equipment must be utilized.

Semi-solid manure is most commonly transferred to long term storage with the aid of a ram orcompressed air pump, or by gravity flow in a large pipe. Storages are bottom loaded if filled in this manner. This results in the formation of a crust on the surface of the manure which aids in minimizing odours. **Semi-solid manure is stored in a structure designed to retain the entire volume of manure and has the same storage capacity requirements as liquid manure.**

Semi-solid manure storages may be either designed as a liquid manure storage or designed to permit tractor access. If tractor access is used , the storage must have a concrete floor, curbs and access ramp, to allow easy access by the manure removal equipment.

Liquid Manure: Liquid manure is a fast efficient way of handling large volumes of manure. It is produced when there is little or no bedding used. Sometimes the manure is diluted with waste water to increase the moisture content to make it suitable for pumping (over 90 % moisture). Liquid manure is moved into storage through pipes by gravity or by pumps. **Liquid manure storages are usually open top circular concrete structures, in ground or partially above ground. If a structural roof is required, the storage is usually rectangular in shape.**

4.7 Manure Storage Capacity

Sustainable use of manure should include a total crop management system and all the nutrients used on the farm over the long term. Crop requirements can be met with a combination of commercial fertilizers, manure and residual soil nutrients. The manure storage volume should allow for the farm operator to spread manure on land at optimal times for maximum nutrient utilization.

The liquid manure/slurry storage facility should be sized to contain a minimum of seven months (210 days) of manure production and accumulated precipitation. The in-barn manure storage is included in the total manure storage capacity. A solid manure storage should be sized to contain a minimum of 60 days storage capacity at the barn and supplemented with field storage. If field storage is not an option, then a 210 day storage at the barn is recommended. This will permit some flexibility in timing the manure removal so that spreading in unsuitable weather and/or field conditions can be avoided.

A bedded manure pack within a barn is considered to be a solid storage manure system.

The volume of manure produced must be determined in order to calculate storage requirements. The volume of manure produced depends on many factors including; the management practices, type and number of animals, storage time, water spillage, wash water used, type of feed and feeding equipment, and the amount of bedding used. To estimate manure storage requirements, evaluate an existing operation that is similar to the planned facility or use the animal manure production information in Table 1 for guidance.

Seasonal Capacity: Liquid and semi-solid manure storages should have, on November 1st of each year, manure storage space available to contain, without losses of solids or liquids to the environment, the manure produced and accumulated precipitation during the following 210 days.

Solid manure storages should have, on November 1st of each year, without losses of solids or liquids to the environment the manure produced and accumulated precipitation during the following 60 days when suitable field piling is available, otherwise 210 days storage is required.

Minimum Freeboard: Liquid and semi-solid manure storage should have some reserve capacity to allow for normal variations in manure production or greater than normal precipitation during the storage period. **A freeboard of 300 mm (1 foot) should be maintained at all times.**

4.8 Subsurface Evaluations For Manure Storages

The subsurface conditions at the proposed manure storage site must be evaluated in order to determine which storage types will be permitted and if there will be any special design or construction requirements.

The first step in the planning of a subsurface investigation should be an examination of the relevant maps from "The Prince Edward Island Soil Survey, 1988". These maps should complement but not take the place of a detailed subsurface investigation. The level of survey detail, accuracy, limits of the soil map and purity of map unit components should be considered in assessing information about any area. Pre-printed maps are available at a scale of 1:10000 from the Provincial Department of Agriculture and Forestry, Research Station, Charlottetown, P.E.I.

Appendix B indicates possible concerns (if any) related to the siting of manure handling/storage facilities for each of the thirty-five (35) mineral soil types from the P.E.I. Soil Survey, 1988. The eight (8) non-soil organic (peat) map units are not included as they would definitely be unsuitable for the construction of such a facility. Where the dominant soil type presents increased risk for pollution of surface and groundwater, then the recommended separation distances to wells should be increased by the factor indicated in Appendix B, Column 4.

Test Pits: At each proposed manure storage site, a sufficient number of test pits should be dug with a backhoe or excavator to permit an adequate description of the subsurface conditions (soil types, depths to bedrock or water table). Test pits should be located in consideration of the proposed design and dimensions of the storage structure and should be logged by qualified geotechnical personnel. Test pits should extend to a depth of at least 1 m (3.3 feet) below the base of the proposed storage.

Variable subsurface conditions may require several test pits in order to adequately characterize the subsurface conditions. Test pit locations and elevations should be accurately established and shown on a site plan for the proposed storage.

TABLE 1

MANURE PRODUCTION RATES			
CLASS OF ANIMAL	**MANURE PRODUCTION Liter per animal per day**	**REQUIRED STORAGE**	
		Liter per animal per day Liquid Manure	**Liter per animal per day Solid Manure including bedding**
BEEF CATTLE			
Cows and bred heifers	28.0	36.0**	34.0
Calves (225 kg)	14.0	18.0**	17.0
Yearlings (to 350 kg)	21.0	26.0**	23.0
Heavy (to 500 kg)	28.0	36.0**	34.0
DAIRY CATTLE			
Calves (0-3 months)	5.4	5.4	
Calves (3-6 months)	7.1	9.9	
Heifers (6-15 months)	14.2	19.8	17.0
Heifers (15-24 months)	21.2	31.1	22.6
Cows (550 kg)	45.3	62.3	
Open Pen Housing			56.6
Free Stall Housing		67.9	48.1
Tie Stall housing			50.9
SWINE			
18-91 kg (8-22 wks)	5.1	7.1*	7.1
4-11 kg (3- 6 wks)	1.1	1.6*	
11-23 kg (6- 9 wks)	2.3	3.1*	
23-34 kg (9-12 wks)	3.4	4.8*	
34-57 kg (16-20 wks)	5.1	7.1*	
57- 80 kg (16-20 wks)	7.4	10.2*	

80-91 kg (20-22 wks)	9.1	12.7*	
Dry Sow	11.3	15.9*	13.6
Nursing Sow and litter			
Wean at 3 weeks	15.6	21.8*	
Wean at 6 weeks	19.5**	27.5*	
CHICKENS			
Boiler (0 - 1.8 kg)	0.08		
Laying Hen (1.8kg)	0.14		0.14
TURKEYS			
Broiler (0- 14wks)	0.13		
Growing Hen (0- 22wks)	0.18		
Growing Tom (0-28wks)	0.28		
Breeder	0.34		
SHEEP			
Ewe	2.8	6.8	4.3
HORSES			
Adult Horse	26.0		55.0

***** This value is calculated by multiplying manure production by a factor of 1.4 to allow for spillage from waterers, floor washing, and dilution water where required.
****** Estimated
Adapted from: Canadian Farm Buildings Handbook (1988)

4.9 Design and Construction of Concrete or Metal Tanks

Liquid manure storages may be of several types. The most common are: in-ground open circular concrete tanks, in-ground rectangular concrete tanks, covered and uncovered, and earthen pits (lagoons).

In-ground concrete tanks are more costly than earthen storages. However, they are impermeable and are more suitable for use in locations having sandy soils or a high water table level. A covered manure storage will not generally release odours except when it is being emptied. Less nutrients are lost when a covered storage is used. Concrete tanks require proper design to withstand all earth, hydrostatic, and ice pressures, as well as live loads.

Above ground tanks are either circular silo types or rectangular structures. Depending on the size, the silo structures are generally more expensive than in-ground concrete tanks. Above ground tanks may be the only choice when soil conditions do not permit the use of in-ground structures. The above ground storages may be constructed from preformed concrete panels, cast-in-place concrete or glass lined steel panels.

The following are general requirements for the design and construction of **new or modified non-earthen manure storages:**

- All manure storage structures must be designed and constructed in accordance with the latest editions of the National

Building Code of Canada, and the Canadian Farm Building Code.

- the concrete base of the storage must be a minimum of 0.5m (20") above bedrock unless an alternative methodology can be used to protect the ground water.
- The base of the storage must be 0.5m (20") above the level of the high water table.
- A building permit, issued by the authority having jurisdiction, may be required for concrete or metal tank manure storages.
- Plans for the manure storage must be stamped by the engineer who is taking responsibility for the design.
- Plans must be submitted and approved by the **Department of Technology and Environment** prior to the beginning of construction.
- The manure storage must be constructed according to the approved plans.
- Upon completion of the project, a Certificate of Inspection must be signed by the design engineer and submitted to the **Department of Technology and Environment**.
- An emergency plan should be available for a major spill of liquid manure.

4.10 Design and Construction of Earthen Storages

The following are general requirements for the design and construction of **new or modified earthen manure storages:**

- The earthen base of the storage must be a minimum of 1 m (40") above bedrock unless an alternative methodology can be used to protect the ground water.
- The base of the storage must be 1 m (40") above the maximum water table elevation
- A building permit, issued by the authority having jurisdiction, may be required for earthen manure storages.
- Plans for the manure storage must be stamped by the engineer who is taking responsibility for the design.
- Plans must be submitted and approved by the **Department of Technology and Environment** prior to the beginning of construction.
- The manure storage must be constructed according to the approved plans.
- Upon completion of the project, a Certificate of Inspection must be signed by the design engineer and submitted to the **Department of Technology and Environment**.
- An emergency plan should be available for a major spill of liquid manure.

In order to ensure that an earthen manure storage is capable of minimizing potential surface or groundwater pollution, the following minimum design and construction standards should be used.

Seepage Control Using Natural Soil:The floor and side slopes of the storage may be constructed in suitable native soil or lined with a minimum of 600 mm (2 ft.) of compacted soil mined from an approved source. To ensure effective sealing of the soil surface, natural soil used as a liner must satisfy the minimum grain size distribution requirements specified in Table 2. Liner soil should be placed in maximum 150 mm (6 in.) layers and compacted to at least 98% of the material's Standard Proctor Maximum Dry Density. The maximum expected in-place, hydraulic conductivity of natural soil liners should be $1x10^{-7}$ cm/sec. for liquid swine manure and $1x10^{-6}$ cm/sec. for dairy manure. Field and laboratory testing must be carried out by qualified geotechnical personnel during construction of the storage and liner.

TABLE 2: SOIL GRAIN SIZE DISTRIBUTION REQUIREMENTS FOR EARTHEN LIQUID MANURE STORAGES UTILIZING NATURAL SOIL LINERS.

Soil Grain/Sieve Size	Percent of Soil Passing Through Sieve by Weight	
	Cattle Manure Storage	Swine Manure or Contaminated Runoff
75 mm (3 in.)	100%	100%
0.075 mm (#200)	minimum of 60%	minimum of 60%
0.002 mm	minimum of 5%	minimum of 15%

Seepage Control Using a Synthetic Liner: If the storage is sited on soils which do not meet the requirements of Table 2 or where suitable natural soil is unavailable, the storage should be lined with a flexible membrane, concrete or equivalent material. Protect synthetic liners with a granular cover layer in accordance with the recommendations of the liner manufacturer. A leak detection system is recommended in combination with a synthetic liner.

Side Slopes Stability: To allow for long term slope stability and to facilitate placement of liners and cover material, inside slopes should not be steeper than 1.5:1 (horizontal:vertical) in undisturbed soil or 2:1 where a compacted soil liner exists. Outside slopes should not be steeper than 3:1 and should be seeded with grass and maintained. To ensure structural stability and prevent leakage, embankments (berms) built up with fill must be placed in maximum 300 mm (12 in.) layers and compacted to at least 98% of the material's Standard Proctor Maximum Dry Density.

Berm Width: Berms should have a top width not less than 2.4 meters (8 ft.) in order to provide sufficient stability to the berm as well as access for agitation and pumping equipment.

Depth to Bedrock: The bottom of an earthen storage should be a minimum of 1.0 m (3.3 ft.) above bedrock.

Depth to Water Table: The bottom of an earthen storage should be a minimum of 1.0 m (3.3 ft.) above the maximum water table elevation.

Distance to Subsurface Drains: The lateral distance from an earthen manure storage to a subsurface drain should be a minimum of 15 meters (50 ft.).

Agitator Pads: Concrete pads should be installed below inlets and at agitation/pump out points to reduce the loss of soil fines and erosion of the bottom.

4.11 Design and Construction of Solid Manure Storages

Solid (stacked) manure should be stored on a concrete pad, either with or without a roof. Any runoff from the solid manure storage should be collected, stored and handled as if it were liquid manure. Systems such as vegetative filter strips or constructed wetlands may also be considered for treatment of runoff from solid manure storages.

New manure storages that do not have a concrete slab base should have a minimum of 0.5 m (20") of compacted earth (95% Standard Proctor Maximum Dry Density) so as to provide an expected hydraulic conductivity of $1x10^{-7}$ cm/sec to prevent leachate from entering the groundwater. Refer to Table 2 for recommended particle size analysis.

In order to contain the manure and prevent runoff, an earthen dyke in combination with a 1.2m (4 ft) reinforced concrete wall is recommended. By sloping the floor to one corner opposite the entrance ramp, excess liquids can be removed by a vacuum tanker. Emptying the storage is usually done with a front end loader. Up slope surface water should be diverted away from the storage.

In addition to the above, the following are general requirements for the design and construction of solid manure storages:

- A building permit, if required, shall be issued by the Authority having jurisdiction
- Plans for the manure storage should be prepared by an experienced person and in all cases approved by the Department of Technology and Environment in consultation with the Department of Agriculture and Forestry prior to beginning construction.
- The manure storage must be constructed according to approved plans.

4.12 Field Manure Piles

The field storage of solid manure without effluent containment on a soil base may be permitted under the following conditions:

- The manure pile should be located on a suitable site which will reduce the potential for surface water and groundwater contamination.
- The manure pile should maintain minimum separation distances of 300 m (984 ft) to a public water source, 90 m (300 ft)from all watercourses, lakes, ponds, natural wetlands, residence(s), residential wells and the manure pile should be placed to avoid runoff into public road ditches.
- The manure pile should not be located in areas where there is accumulated runoff or areas that are subject to water ponding or flooding.
- Up slope surface water should be diverted away from the pile.

4.13 Composting of Manure

Composting is a biological process in which microorganisms aerobically convert organic materials such as manure into a soil like

material called compost. It is the same process that decays leaves and other organic debris in nature. Composting merely controls conditions so that materials decompose faster.

Composting and the uses of compost offer several potential benefits including improved manure handling, enhanced soil tilth, and reduced environmental risk. The composting process produces heat, which drives off moisture and destroys pathogens and weed seeds. During the composting process the volume of waste will be reduced by up to 50 per cent. With good management it produces a minimum of odors.

Compost is quite different from the original materials that it was derived from. It is free of unpleasant odors, is easy to handle, and stores for long periods of time. The rate at which manure will compost depends on:

- the moisture content
- temperature
- level of oxygen available
- size of manure particles, and
- relative quantities of carbon and nitrogen available to the microorganisms for use as food.

An adequate supply of oxygen is required throughout the pile. To achieve this, maintain the compost pile at forty to fifty per-cent solids and mix the material on a regular basis. This process can be carried out using either a windrow system, aerated static piles or an in-vessel system, as described below.

Windrow composting involves the placement of manure on an all-weather surface in long rows. Typically the rows are one to two meters (three to six feet) high and two to five meters (six to sixteen feet) at the base. The piles are turned periodically to mix and introduce air and rebuild bed porosity. This helps to insure that all the material is uniformly composted. Although mixing can be accomplishedwith regular farm equipment, the use of specialized equipment is usually more efficient. Windrow composting is relatively simple and inexpensive and usually takes one to four months, depending on the frequency of turning.

Aerated static piles are aerated directly with forced air systems to speed up the process. The in-vessel system confines the composting material within a building or container and uses forced air and mechanical turning to speed up the composting process. These systems are expensive but could be practical on larger operations. The nutrient value of the compost will vary and may require testing before spreading.

When managed properly, the composting process is aerobic and the release of odours should be minimal and the product will have an earthy odour. If conditions are not controlled and the manure pile begins to decompose anaerobically, very strong odours can be produced and the process can take a much longer period of time.

To ensure that pollution is not created at the composting site, it is recommended that:

- The site is located a minimum of 90 meters (300 ft) from a watercourse or a well used for domestic purposes,
- Windrows are not located on coarse textured soils,
- All clean surface water is diverted away from the composting site.

See Appendix D for further information on composting.

4.14 Constructed Wetlands

A constructed wetland for waste water treatment is a man-made marsh designed, built and operated to copy the processes found in natural wetland ecosystems. These systems utilize wetland plants, soils and their associated microorganisms to remove contaminants from waste water, runoff from livestock exercise yards and manure storage areas. The reuse, or reclamation, of wastewater using constructed wetland technology also provides an opportunity to create or restore valuable wetland habitat for wildlife and environmental enhancement.

Constructed wetland technology can improve water quality through a variety of biological processes that naturally occur in wetland environments. Microorganisms that live on aquatic plants and in soils transform organic matter and nutrients present in wastewater effluent into types of nutrients that support a diverse community of aquatic pond life. Plants also play an active role in taking up available nitrogen, phosphorous and other compounds from wastewater as well as increasing the oxygen level and pH level in a variety of wastewater solutions.

Constructed wetlands for treatment of agricultural liquid wastes under Canadian conditions are being demonstrated and monitored in several provinces including Prince Edward Island. Preliminary information obtained from the P.E.I. research has indicated the biological loadings, and a number of chemical compounds have decreased to mostly acceptable levels while treating runoff from a

manure storage area and second rinse milk house waste water.

4.15 Exercise Yard (Feedlot) Runoff

The following are general recommendations for the siting and management of exercise yards and feedlots.

- Uncontaminated surface water should be diverted away from cattle exercise yards and feedlots.
- Contaminated runoff from cattle exercise yards and feedlots should be contained and handled as a liquid manure or treated in an approved treatment system.
- The recommended minimum separation distance between a new exercise yard or feedlot and a watercourse or domestic well is 90 m (300 ft.). A 30 m (100 ft.) minimum separation distance is recommended for a highway ditch or right-of-way.
- Existing exercise yards or feedlots should establish and maintain a 20 m (65 ft.) separation area from a watercourse. If the slope adjacent to the watercourse is 9% or greater, then a 30 m (100 ft.) separation distance should be maintained.

4.16 Safety Requirements for Liquid Manure Storages

Liquid and semi-solid manure storages must be designed and constructed according to the structural and safety requirements of the Canadian Farm Building Code.

To minimize the possibility of a serious accident:

- A sign warning of dangerous gases shall be installed at every access to a liquid manure storage tank or under-floor manure transfer chamber.
- A permanent safety fence or wall extending to not less than 1.5m (5 ft.) above adjacent grade shall be provided around all liquid manure storages without fixed covers.
- Locked child proof gates are required at all entrance ramps and pumping ramps.
- Safety railing or floor grill is required on all manure hopper openings larger than 100mm (4 ins.) in width.
- Ladders shall not be installed in closed manure tanks.
- Covers providing access to liquid manure storage tanks shall be permanently secured with safety chains.
- Effective gas traps shall be provided in all liquid manure lines between the livestock building and outside liquid manure storage.
- Minimize the volume of manure stored in the barn.
- If animals are housed directly above the manure storage, remove them while agitating and pumping or run the exhaust fans at full capacity.
- Install continuously running exhaust fans so that they draw air out of any manure sumps or holding tanks in the building.

4.17 Odour Management in Barns

The amount of odour produced by a barn depends to a large extent on the design and management of the barn. A clean barn is the product of proper barn design, good management practices and healthy animals. A properly designed and managed ventilation system is also an essential component.

The manure handling system in the barn also affects odour production. Systems that minimize the anaerobic decomposition of the manure have the least odour production. This is accomplished by either removing the manure from the barn as frequently as possible or by creating aerobic conditions for the manure.

Straw based systems are still frequently used in cattle operations. The use of straw and other bedding material can maintain aerobic conditions if enough material is used and the bedding is frequently changed. Most barns with liquid manure systems are designed with shallow pits that are emptied frequently.

Other systems are available that have better odour control than shallow pits, such as solid/liquid separation, in barn composting or modification of exhaust air, however the equipment and labour costs have made these systems impractical on most P.E.I. farms.

4.18 Manure Storage Odour Control

Manure storage odours are generally associated with open liquid manure storages. Since most liquid manure is stored anaerobically, the gases formed during the anaerobic decomposition process can create odour problems when released to the air.

Odour control focuses on manure management options as well as location in respect to neighbours. Separation distance is often the

most practical way of avoiding odour complaints. Separation allows the dilution of odours to reasonable levels before they reach sensitive neighbours. However, adequate separation distance is sometimes difficult to find in Prince Edward Island due to the smaller farm land base and the residential development that exists in many rural communities.

Odour management approaches that have been used to assist with control of odours from open storages are:

- Avoid using sites that will be subject to the movement of odours toward neighbours
- Use of covers to prevent the movement of air over the surface of the manure. Good quality barley straw applied to the open manure surface with a straw blower to a depth of 150 mm (6 inches) has provided effective odour control for an extended period of time.
- Use of the "molehill" type of transfer/storage system. This system consists of a pump which transfers the semi-solid or solid manure through an underground pipeline. The manure is forced up, into the bottom of the manure pile. The outer surface of the mushrooming pile forms a crust which provides an effective means of odour control.
- Planting trees or constructing earth berms around open storages to reduce the movement of air over the manure surface, thereby reducing the amount of odour released. The trees will also reduce the visual impact of the storage.
- Locating the inlet to the storage below the surface of the manure so that the surface is not disturbed when the liquid manure is added.
- Emptying the storage in late spring reduces odour production during the hot summer months.
- Using biological mixtures to reduce the release and formation of odourous gases has been reported by users of this material to have had some success in reducing manure odours. The limited research, done to date, on these types of products has been inconclusive.

5. Land Application of Manure

5.1 Manure a Sustainable Resource

Spreading manure on land is a highly desirable method of recycling a natural, organic by-product of livestock production. A sustainable agricultural system should include manure as a fertilizer for crop production. Manure is readily available with a minimal input of energy and can significantly decrease crop production costs.

Most livestock operations are surrounded by large areas of productive agricultural land. To prevent damage to crops, minimize the risk of pollution and obtain the maximum benefit of the manure as a fertilizer, manure application rates should match the crop nutrient requirements. Too much of a good thing can lead to problems. Manure is an excellent fertilizer which poses an environmental risk only when mismanaged.

Animal manure can be a valuable soil amendment. When properly managed, it not only acts as a source of plant nutrients, but also helps improve soil tilth, structure, aeration and water-holding properties through the addition of organic matter.

The goals of every livestock producer should be to:

- maximize the utilization of the manure nutrients by crops;
- minimize the nuisance created by spreading manure;
- minimize the risk of polluting surface and groundwater.

5.2 Minimize Odour During Spreading

5.2.1 Equipment Selection For Liquid Manure

The amount of odour released during manure spreading depends on the exposure of the manure to the air. More care in the timing and location of spreading will be necessary when the spreading equipment creates more air exposure of the manure.

Surface application has traditionally been undertaken with manure tankers that spray the manure into the air. This equipment is relatively inexpensive and easily adapted to most situations. The negative aspects of manure tankers can be minimized as follows:

- discharge the manure as close to the ground as possible with dribble bars to minimize exposure of the manure to the atmosphere; and,
- incorporate the manure into the soil as soon as possible.

Irrigation equipment is not recommended for manure application due to excessive odour production and high nitrogen losses.

Incorporation of Manure: The longer the interval between spreading and incorporation, the greater the nitrogen losses and the greater the potential for odours to create a nuisance for neighbours.

Producers should attempt to incorporate the manure the same day it is spread. **Incorporation should occur within 48 hours after application, unless applied to hay or pasture land or exceptional circumstances exist.**

The success of any method of application depends largely upon the abilities of the operator. With proper management, each system can be used in a manner that prevents pollution, minimizes odour and applies manure at a rate that matches the crop requirements.

5.2.2 Public Relations

Neighbours are less likely to complain if they understand the problems of odour control. They will also be more tolerant if they are aware that a genuine effort is being made by the producer to minimize the odours, not only in land application but also with storage as discussed previously.

If at all possible, inform your neighbours of your intentions to spread and attempt to accommodate them by spreading at times when odours are least likely to be a problem. Maintaining good communication with neighbours is important in avoiding conflicts. Most people will recognize good intentions and will not have unreasonable expectations.

When spreading manure, maintain separation distances that are reasonable for the type of equipment in use, consider the weather conditions, and choose an appropriate time to spread. Showing consideration for one's neighbours is important for good public relations.

When using a public roadway to transport manure to the fields, it is important for the operator to use proper equipment to avoid spills and leaks occurring on the roadway. If manure or dirt is deposited on the roadway, the owner/operator should remove it as soon as possible. (Refer to P.E.I Roads Act)

Manure should not be spread during the period of June 20th to September 8th unless it is absolutely necessary. During this period, manure should only be applied for the fertilization of hay, pasture land, summer fallow land or to establish cover crops. Manure applied to summer fallow land or for establishing cover crops should be incorporated within 48 hours.

Where possible, consider the following factors when deciding on where and when to spread:

- Manure spread in cool or cold weather will create less odour than manure spread in warm weather.
- The best time to spread is early in the day when air near the ground will tend to become warm and rise, carrying the odours upward where they will be diluted. The manure will dry during the day and less odour will be released by evening.
- Wind direction and speed are critical. Wind will help to dilute the odours by increased mixing with the air. Caution must be used to avoid situations where winds will carry odours directly toward a neighbour.
- On calm, humid days, rapid drying of the manure and dilution of the odours will not occur. A gentle breeze may carry the undiluted odours toward neighbours.
- The presence of trees and windbreaks will help to mix and dilute the odours by creating turbulence.
- Be considerate when using fields a short distance upwind of neighbours and try to spread only when weather conditions are ideal (cool and windy weekday morning).

5.3 Manure Spreading

5.3.1 Recommended Setbacks For Spreading Manure

The slope of the land must be considered when spreading manure. As the slope increases, so does the chance that manure may run off and so application rates should be reduced and distances from watercourses increased. Sloping land should be maintained with a reasonable amount of crop cover to provide protection against manure runoff.

In order to reduce the risk of runoff entering surface waters or wells, a separation area is necessary to absorb the runoff and prevent it from traveling down a slope. The effectiveness of the separation area depends upon factors such as soil conditions and application rate. Good judgment must be used in all cases to ensure that runoff cannot enter water sources.

It should be understood that due to extenuating circumstances, such as weather, it may not always be possible to meet the time limits for spreading manure.

Recommended minimum setback distances for spreading are illustrated in Table 3. These are minimum distances to be used in conjunction with good management practices.

TABLE 3: RECOMMENDED SETBACKS FOR SPREADING MANURE

	Surface Applied	
Distance From	**No Incorporation**	**Incorporation Within 48 Hours**
Active Recreational Area, Restaurant, Motel (Except June 20 to September 8)	Spread to Property Line	Spread to Property Line
Residences and Businesses (See Section 5.2.2)	Spread to Property Line	Spread to Property Line
*Active Recreational Area, Restaurant, Motel (June 20 to September 8)	180 m (590 ft.)	90 m (295 ft.)
**Flowing watercourse where slope of land adjacent to the watercourse is less than 5%	30 m (100 ft.)	10 m (33 ft.)
**Flowing watercourse where slope of land adjacent to the watercourse is greater than 5%	60 m (200 ft.)	30 m (100 ft.)

*** With permission of the owner of the active recreational area, restaurant, motel, etc., the above recommended spreading setbacks may be decreased as agreed upon.**

****Distances based on soil without perennial forage crops or with minimal trash cover. Where a perennial forage crop or good trash cover is present, distances may be reduced by one-half.**

5.3.2 Water and Soil Pollution

Both commercial fertilizer and manure can cause pollution if not properly managed. By spreading manure in accordance with these Guidelines, the risk of water pollution is minimized.

Although livestock are efficient in converting feed to body tissue, a portion of the nutrients in the feed are not used by the animal and are excreted in the manure. The nutrient content of the manure depends upon the animal age, the feed type and the manure management system as described below.

Animal Age - Manure constituents are the feed products remaining after digestion by the animal. As animals grow, their ability to convert the nutrients in the feed to body tissue changes. Animals that are actively growing will utilize some nutrients more efficiently than mature animals.

Feed Type - If a ration is unbalanced, the animal will not be able to use all of the nutrients, and excess nutrients will be excreted. Altering the animal's diet to closely match its needs in each growth phase (phase feeding) is becoming increasingly popular in hog production. In addition, enzymes and specific amino acids can be used to modify rations for increased feed efficiency and reduce nitrogen and phosphorous in the manure.

Manure Management System - The amount of nutrients lost depends on how the manure is stored and spread. The amount of water added by washing, or the amount of straw or shavings added as bedding will also change the manure properties.

The methods of handling, storing and spreading manure also affect the final nutrient content. Nutrients such as nitrogen, phosphorus and potassium not used by the animal are returned to the soil where they are used by the crop. However, when proper management is not used in spreading manure, erosion, runoff and leaching may transfer the nutrients away from the soil and into water sources, causing pollution.

Surface water pollution can be caused by nutrients running off the fields and moving into ditches, etc. Consequently, the risk of surface water pollution increases with practices such as winter spreading, when manure moisture is not immediately absorbed by the soil. Runoff can be minimized by using good management practices that include:

- proper application rates,
- rapid incorporation,
- maintaining good surface trash cover,
- maintaining a grassy separation area along watercourses.

Manure in surface water will affect the following water quality characteristics: turbidity, color, suspended solids, levels of nitrate or ammonia, phosphorus, potassium and microbes. The organic material in the manure will decompose and consume the dissolved oxygen in the water. Excess settled solids and nitrogen compounds can kill aquatic life forms. The nutrients in the manure may increase the growth of aquatic plants that can disrupt the ecosystem of the water body. Bacteria and viruses may be introduced, increasing the potential for spreading diseases. The presence of excessive nitrates in drinking water can create a health hazard for humans and reduce the performance of livestock. It is therefore important to ensure that manure storages are secure and that land spreading is performed at proper rates.

Groundwater pollution is usually due to the downward movement of leachable substances (nitrogen, phosphorous) through the soil. If the amount of nitrogen added to the soil consistently exceeds the amount of nitrogen removed by the crops, then nitrogen will accumulate in the soil. In coarse textured soils, water movement through the soil can rapidly leach excessive nitrate downwards into the underlying groundwater. Annual soil testing is recommended as an effective and economical method of protecting groundwater sources.

Over application of manure to soils can also result in the build up of nutrients in the soil. When the nutrient concentrations become too high, nutrients such as nitrate (the most water soluble form of Nitrogen) can move through the soil to groundwater as mentioned above. Also, prolonged over-application of manure can lead to an imbalance in the soil chemistry which will result in reduced crop yields. High concentrations of manure are toxic to plants.

5.3.3 Sensitive Groundwater Areas

In some areas, soil and groundwater conditions may be sensitive to agricultural practices which involve the application of either inorganic or organic (manure) fertilizers. The degree of sensitivity depends on the type and depth of the overburden above an aquifer and the type of vegetation at the soil surface.

Where very permeable soils such as coarse sands or gravels immediately overlay an aquifer or where the overburden above an aquifer is very shallow, nutrients applied to the soil surface may leach rapidly downward beyond crop rooting depths and quickly reach the aquifer. In addition, since these areas tend to be well drained, crop vegetation is often relatively sparse and plant uptake of nutrients is low.

Where such sensitive groundwater conditions exist, manure and inorganic fertilizer applications should be avoided or greatly reduced from those rates recommended in Section 5.4, Application Rate. Consult a professional agronomist for site specific recommendations in these sensitive areas before applying manure.

5.3.4 Factors Affecting Manure Application System Selection

Accuracy and uniformity of manure application become more important when manure is used as the only source of fertilizer. An under-application could reduce yields; an over-application could cause lodging or delayed maturity which creates problems with harvesting and potential environmental contamination. When manure is not uniformly spread, some areas of the field may receive too much fertilizer, while other parts of the field may not receive enough. Unless the manure can be applied accurately at the specified rate, many crops will not be able to utilize the full value of the manure as a fertilizer.

5.3.5 Soil Compaction

The system should minimize soil compaction unless manure spreading can be scheduled for periods when fields are dry. The compaction caused by tankers can be minimized by using large flotation tires.

5.3.6 Seasonal Considerations

Manure will gradually decompose in the soil zone. As decomposition occurs, nutrients from the manure become available for use by the plant. These nutrients, however, also become susceptible to losses through leaching or runoff.

Spring is the best time to apply manure, since the crop will be able to use the nutrients as they become available. Soil compaction can be a problem in spring, however, since the land is often not dry enough to handle the heavy wheel loads involved with certain types

of spreading methods.

Fall application will usually result in the loss of more nutrients than spring application if the manure is not incorporated into the soil. Fall applied manure to winter cover crops will be well utilized. Fall application usually results in more time available for spreading. In addition, the soil is often quite firm and if compaction does occur, winter freezing and thawing can reduce the damage.

Summer application is suitable for pastures and forage crops. Because summer is the time when neighbours are most active outdoors, spreading at this time of year requires extra consideration regarding odour production. Refer to 5.3.1 and Table 3 for spreading setbacks.

Winter application of manure should not occur because of the high potential for runoff and surface water pollution as well as high nutrient losses due to these factors. If winter spreading is necessary, apply only if the potential for surface runoff is minimal. Apply to stubble fields with good trash cover or fields in perennial forage crops. Increase setback distances from watercourses and wells.

5.3.7 Spreading Agreements

Livestock operations which do not have sufficient land base to effectively utilize the manure for growing crops should enter into written agreements with other land owners for the land application of manure for the purpose of growing crops. **Spreading agreements should have a minimum duration of two years.** Spreading agreements should reference the manure management practices outlined in these guidelines.

5.4 Manure Application Rate

Nitrogen is usually the nutrient that limits manure application rate, however with long term application, phosphorous may become the limiting factor. The rate of application will ultimately be determined by the rate at which the nutrients are used by the crop and by the reserves of nitrogen or phosphorous in the soil. The fertility of a field should be determined by soil testing. Depending on how the manure has been handled, the nutrient content of the manure can vary widely. The manure should, therefore, be tested for nutrient content as well. The application rate can be calculated from this information together with knowledge of the method of application, timing and soil conditions.

The application rate is often based on estimated soil and manure nutrient levels. These inaccuracies may lead to application rates lower or higher than required. A moderate over-application will not immediately lead to pollution problems or crop damage, especially during dry periods. With excessive application rates, nitrogen and phosphorous will generally accumulate in the soil and this accumulation can be detected through subsequent soil fertility tests. If an accumulation occurs, the rate of application should be reduced accordingly. Recording the manure spreading time and rate on each field is one way to avoid long-term over-application and ensure accurate records if needed.

5.4.1 Nutrient Losses During Storage and Application

The nutrient content of manure (particularly nitrogen) declines with time during collection, storage and land application. This is due to such processes as ammonia volatization, as well as leaching and surface runoff of all soluble forms of nutrients (particularly nitrate). Proper management can reduce losses, maximize the nutrient value of the manure and minimize potential soil and water pollution. This includes using proper facilities for storage and handling, applying manure to cool, moist soil in fall or early spring and incorporating it immediately (or applying it by subsurface injection). A summary of typical values of nutrient losses from various sources is presented in Appendix C.

5.4.2 Soil and Crop Implications

There is considerable variation in the amount of nitrogen required by different crops. Forage crops such as alfalfa can utilize much more nitrogen than annual cereal crops. Alfalfa is a deep rooted plant and is therefore capable of withdrawing nitrates which may have leached out of the soils near the surface.

The soil characteristics of the field where manure will be spread should be known. On sandy soils, time the spreading of manure to maximize use of the nutrients by the crop. The application rate on clay soils may be limited by the rate at which the liquid manure can infiltrate into the soil. Limit the application rate of liquid manure to avoid ponding. **Manure should not be applied to soil that has a moisture content greater than its field capacity**. The soil is at field capacity if free water is visible when a handful of soil is squeezed.

The yield potential and the nitrogen requirement is considerably higher on heavier textured clay soils than on well-drained sandy

soils. In addition, the risk of groundwater pollution by the leaching of nitrates is lower on heavy textured soils than on sandy soils. The allowable manure application rate is therefore higher on heavier textured soils.

5.4.3 Calculating the Application Rate

The application rate of manure should not exceed the amount necessary to meet the crop nitrogen requirements. These guidelines present two methods of calculating application rates:

- an estimated land base area using typical nutrient production rates; and,
- a detailed method using site specific manure and soil test results.

5.4.4 Estimate of Land Base Required

This method provides an estimated land base for manure based on typical rates of nitrogen and phosphate excreted by livestock. Variations in management practices from farm-to-farm can result in wide ranges in manure nutrient values. In addition, the nutrient levels remaining in the soil after a crop can also vary. Because of this the detailed method following is the preferred method of determining the manure application rate.

Often the manure and soil test results are not available. The estimated land base is therefore very useful in many situations.

Use **Worksheet #1** and the information in Tables 4, 5 and 6 to calculate the estimated manure application rate. For crops not listed in Table 6, or in low or highly productive soils where the crop yields and nitrogen utilization may vary from the values assumed in Table 6, an adjustment will have to be made in the application rate. For unusual site - specific conditions consult with a professional agrologist for detailed recommendations.

EXAMPLE WORKSHEET 1 ESTIMATE THE LAND BASE REQUIRED		
STEP 1:	Enter the number of livestock places or barn capacity.	
	350 sows, farrow-finish	
STEP 2:	Determine the annual nutrient production for one animal (N or P_2O_5) from Table 4	
	(Nitrogen)	*91 kg*
STEP 3:	Enter the fraction of nitrogen retained after storage and application from Table 5	
	For phosphate the fraction is 1.0.	
	(Earthen Storage, Broadcast & Incorporate)	*0.48*
STEP 4:	Determine the nutrient utilization (N or P2O5) for the crop under consideration,	
	Table 6.	
	(Grass-Hay 70%)	*75 kg/ha*
STEP 5:	Calculate the land base required. Multiply steps 1, 2, and 3, then divide by step 4.	
	(350 x 91 x 0.48 ÷ 75)	*204 ha*

TABLE 4. ANNUAL LIVESTOCK NUTRIENT PRODUCTION

Livestock		Annual Nitrogen Production (kg.) by one animal	Annual Phosphate Production (kg.) of (P_2O_5) by one animal
Dairy			
	Milking cows, including associated livestock	145 kg.	68 kg.
Beef *			
	Beef cows, inc. associated livestock	87	67
	Feeders, 100 day backgrounder	33	20
	200 day backgrounder	36	22
	Summer pasture	44	27
	Short keep	58	35
	Long keep	51	31
Hogs			
	Sows, farrow to finish	91	68
	Sows, farrow to weaning	24	18
	Sows, farrow to nursery	18	14
	Weanlings	01	01
	Feeders	10	08
Chickens			
	Broilers	0.43	0.24
	Roasters	0.66	0.42
	Layers	0.73	0.39
	Pullets	0.24	0.14
	Broiler Breeder Pullets	0.24	0.18
	Broiler Breeder Hens	0.73	0.51
Turkeys			
	Broilers	0.60	0.46
	Heavy Toms	1.04	0.73
	Heavy Hens	0.60	0.43
Horses			
	Mares, including associated livestock	97	73
Sheep			
	Ewes, including associated livestock	15	11

	Feeder lambs	07	05
		Annual Nitrogen Production per 1,000 kg Live Animal Weight	**Annual Phosphate Production per 1,000 kg Live Animal Weight**
Other Livestock (except poultry)		180	136
Other Poultry		540	409
Adapted from Manitoba and Ontario data. * See Appendix G for descriptions			

TABLE 5: NITROGEN STORAGE AND APPLICATION RETENTION FACTOR

Storage Method	**Application Method**		
	Injection	**Broadcast & Incorporate Within 24 Hrs**	**Broadcast & Not Incorporated**
I. Liquid Manure and Semi-Solid Systems			
Enclosed	0.83	0.68	0.43
Open (except Earthen)	0.78	0.64	0.4
Earthen	0.59	0.48	0.3
II. Solid Manure Systems			
Daily Scrape		0.60	0.38
Manure Pack		0.56	0.35
Open Lot		0.40	0.25

Values in Table 5 are for spring application. Multiply above values by 0.8 for fall application

5.4.5 Use of Manure in Nutrient Management Plans

The efficient utilization of manure nutrients requires on-farm sampling and laboratory analysis to determine the exact nutrient content. Use **Worksheet 2A or 2B** when the results of representative soil or manure tests are available.

5.4.6. Nutrient Management Strategies

The proportion of nitrogen and phosphorus in manure seldom matches crop nutrient requirements. If manure is applied to just meet the crop nitrogen requirements, there will normally be an excess of phosphorus applied. When the same land receives annual applications of manure based on the manure supplying all the nitrogen requirements, there could be a buildup of phosphorus in the soil. Annual soil tests should be carefully monitored to ensure there is no risk of pollution or nutrient imbalances.

When manure is applied to just meet the crop phosphorus requirements, there will be a shortfall in the nitrogen available to the crop. It is therefore necessary to add supplemental inorganic nitrogen to make up this shortfall.

There is limited information available with respect to the crop response to manure phosphorus. Crop response to phosphorus is dependant on the method of application since phosphorus is not as mobile in the soil as nitrogen. When fertilizing with manure for the first time, care should be exercised to ensure that sufficient phosphorus is applied. In general, 50% of the total phosphorous in manure is available to plants in the first year. To ensure enough phosphorous is available to a growing crop, add 14 to 17 kg./ha of P_2O_5 as a starter fertilizer with the seed. Check the fertilizer recommendations of specific crops for any seed placed fertilizer

restrictions.

A recommended nutrient strategy is to apply manure to supply approximately 75 percent of the crop nitrogen requirements. The remaining 25 percent is then supplied with inorganic nitrogen applied with the seed. This has the added advantage of providing a "pop-up" effect to young plants, due to the close proximity of nitrogen to the roots of the seedling plants. Although there may still be a moderate excess of phosphorus using this nutrient management strategy, annual soil testing will indicate if there is a concern over time.

TABLE 6: FERTILIZER RECOMMENDATIONS FOR CROPS (ACTUAL KG/HA)

Crop with Soil Test Groups From M+ to H	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Barley	50	50 - 25	50 - 25
Carrots	100	150 - 100	150 - 100
Cole Crops	150	200 - 150	150 - 100
Corn	60	45 - 0	75 - 50
Corn - Sweet	130	130	130
Fall Rye	20	45 - 30	45 - 30
Field Peas	20	60 - 40	40 - 25
Grass - Hay (Over 70% Grass)	75	40 - 15	75 - 40
Grass/Pasture (Over 70% Grass)	75	40 - 15	75 - 40
Legume/Hay (Over 60% Legume)	20	70 - 40	140 - 75
Legume/Pasture (Over 60% Legume)	20	40 - 15	140 - 75
Mixed Grain	40	40	30
Mixed Hay	50	40 - 15	75 - 40
Potatoes (Kennebec)	100	200 - 135	135
Potatoes (Russet Burbank)	180	200 - 135	135
Potatoes (Shepody)	160	200 - 135	135
Potatoes (Yukon)	155	200 - 135	135
Rutabaga	45	150 - 90	90 - 45
Soy Beans	20	60 - 40	40 - 25
Wheat	60	45 - 30	60 - 30
Winter Wheat	20	45 - 30	30

Source - PEI Department of Agriculture and Forestry , Soil and Feed Testing Laboratory, Crop Rate Table Listing(1998).

5.4.7 Soil and Manure Testing

Soil and manure testing requires forethought and planning. Set a schedule for borrowing the necessary equipment and taking samples. Follow the recommended procedures below to be sure that the samples are truly representative. Schedule the soil sampling well in advance of spreading to be certain that the laboratory results will be available on time. Soil sampling equipment is usually available from the laboratory that will analyze the samples.

There are several different options for liquid manure sampling. The first option is to collect representative manure samples while the

manure is being spread. Collect samples from the beginning, the middle and the end of the manure spreading, since the manure consistency generally changes during the time when the manure is emptied from the tank. Keep samples covered and cool, fill only 75% full to allow space for gas expansion. Although the analysis of the samples will not be available for planning the manure spreading for that year, the results will be valid for planning the spreading in subsequent years.

The second and preferred option is to sample manure from the storage before the manure spreading begins. Probes for collecting manure samples from manure storages are commercially available and consist of a long tube with a removable plug at the bottom end. With the bottom of the tube open, the tube is lowered slowly into the liquid manure to enclose a column of liquid. When filled, the bottom of the tube is plugged and the column of liquid can be removed. By sampling at a number of locations in the storage, representative samples of the manure can be collected and sent to a laboratory for analysis.

Another alternative is to use a nitrogen meter, that will provide a reasonably accurate estimate of the ammonium nitrogen in the manure. These meters provide results immediately, and while not as accurate as laboratory analysis, are better than published average values of manure fertilizer content.

EXAMPLE WORKSHEET 2 A **LIQUID MANURE APPLICATION RATES - DETAILED METHOD (APPLIED TO MEET CROP NITROGEN REQUIREMENTS)**		
STEP 1:	Enter the manure nitrogen content using the results of manure testing.	
	Manure Nitrogen Content	
	Ammonium N	*2.4* kg/1000 L
	Organic N	*1.0* kg/1000 L
STEP 2:	Select the ammonium application retention factor from Table 7 based on the method of application.	
	Ammonium Retention Factor (Table 7)	*0.80*
	(Spring Broadcast and Incorporate within two days)	
STEP 3:	Calculate the amount of ammonium nitrogen available. Multiply the ammonium N (Step 1) by the loss factor (Step 2).	
	Available Ammonium Nitrogen (2.4 x 0.80)	1.92kg/1000 L
STEP 4:	Calculate the amount of organic nitrogen available. Multiply the Organic N (Step 1) by 0.25.	
	Available Organic Nitrogen (1.0 x 0.25)	*0.25* kg/1000 L
STEP 5:	Calculate the total amount of nitrogen available. Add the available ammonium nitrogen (Step 3) to the available organic nitrogen (Step 4).	
	Total Nitrogen Available (1.92 + 0.25)	*2.17* kg/1000 L
STEP 6:	Enter the crop nitrogen requirements using either the results of soil tests or the fertilizer recommendations from Table 6.	
	Crop Nitrogen Requirements (Table 6)	*50*kg N/ha
	(Barley)	
STEP 7:	Calculate the manure application rate based upon the crop nitrogen requirements. Divide the recommended nitrogen application (Step 6) by the total available nitrogen (Step 5).	
	Manure Application Rate (50 ÷ 2.17) x 1000	*23,000*L/ha
NOTE:	When manure is the only source of nitrogen there is normally an excess of phosphorus	

NOTE:	When manure is the only source of nitrogen there is normally an excess of phosphorus applied. If applying manure annually to the same fields using this management practice, annual soil tests must be carefully reviewed to ensure phosphorus does not build up to levels that could cause pollution or nutrient imbalances.

EXAMPLE WORKSHEET 2B		
LIQUID MANURE APPLICATION RATES - DETAILED METHOD (APPLIED TO MEET CROP PHOSPHATE REQUIREMENTS)		
STEP 1:	Enter the phosphate (P_2O_5) content using the results of manure testing. If phosphorus (P) is reported, multiply P by 2.29 to obtain P_2O_5. If results are reported in mg/kg or ppm, divide by 1000 to obtain kg/1000L.	
	Manure Phosphorus Content	1310 mg/kg
	Manure Phosphate content	
	(1310 mg/kg x 2.29 ÷ 1000)	3.0 kg/1000 L
STEP 2:	Calculate Phosphate Available (3.0 x 0.5)	1.5 kg/1000 L
STEP 3:	Enter the crop phosphate requirements using either the results of soil tests or the fertilizer recommendations from Table 6.	
	Crop Phosphate Requirements (Table 6)	25 kg P_2O_5/ha
	(Barley)	
STEP 4:	Calculate the manure application rate based upon the crop phosphate requirements. Divide the recommended phosphate application (Step 2) by the manure phosphate content(Step 1).	
	Manure Application Rate (25 ÷ 1.5) x 1000	16,700 L/ha
Note:	When manure is applied to just meet the crop phosphate requirements there will normally be a shortfall of nitrogen to meet the crop nitrogen requirements. It is therefore necessary to add supplemental nitrogen when using this management practice.	

TABLE 7: AMMONIUM NITROGEN APPLICATION RETENTION FACTOR		
Application Method	**Ammonium Nitrogen**	**Retention Factor**
	Spring Application	Fall Application
Injection	0.98	0.80
Broadcast & Incorporate within 2 days	0.80	0.65
Broadcast & Incorporate within 3 days	0.70	0.55
No Incorporation	0.50	0.40
Broadcast on forages	0.65	0.50

6. Environmental Impact Assessment (EIA) Process

6.1 Livestock Unit

A term called **"Livestock Unit"** is used to equate all livestock types in terms of **relative odour intensity.** Therefore different livestock types can be accommodated in one table (See Table 8).

6.2 Commercial Livestock Operations - Minimum Size

A commercial livestock operation is defined as any livestock operation where:

- The livestock facility has the capacity to accommodate the equivalent of 40 or more dairy cows plus replacements. (See Table 8 below)
- The manure production from the livestock facility exceeds 2,400 liters per day.

TABLE 8: EXAMPLE OF MINIMUM NUMBER OF LIVESTOCK THAT REQUIRES AN ENVIRONMENTAL APPROVAL FOR NEW AND EXPANDED OPERATIONS.

LIVESTOCK OPERATION	NUMBER OF LIVESTOCK
Beef Cow and bred heifers	80 Animals
Beef Calves (to 225 kg.) and Yearlings (to 350kg)	135 Animals
Beef Feeder	80 Animals
Dairy Cows plus replacements	40 Milking Cows plus replacements
Sows, Farrow to wean	160 Sows
Sows, Farrow to finish	50 Sows
Feeder Hogs (18 - 100 kg.)	400 Hogs at one time
Poultry (Broilers)	28000 Broilers
Poultry (caged layers)	16000 Layers
Turkey (10kg)	8000 Toms
Horse and offspring	60 Mares
Adult sheep	800 Ewes

6.3 Environmental Impact Assessment (EIA) Process

Construction of livestock facilities and manure storage facilities may require approval in accordance with Section 9 of the Environmental Protection Act. The Application should be forwarded to the Environmental Impact Assessment Section, Department of Technology & Environment. The Department of Agriculture and Forestry will be consulted on all new and expanded livestock operations. New or major expansions to commercial livestock operations require an Environmental Review Document. The complexity of the Environmental Review Document may vary depending on the size and nature of the proposed project and on surrounding land uses.

The Environmental Review Document is expected to:

- give a detailed description of the project and the existing environment,
- identify positive impacts of proposal and describe ways of minimizing the risk of negative impacts, if any,
- address groundwater and surface water concerns,
- outline a manure management plan including land application and nutrient utilization,
- outline an odour management plan,

- identify impacts on surrounding land uses, if any, and describe mitigation plans,
- outline waste water disposal plans (milk house waste water, washrooms, etc.)
- outline a solid waste management plan including dead stock, plastics, feed bags, etc.

Providing notification and information to the public is an integral part of the environmental impact assessment and approval process and an appropriate level of public information should be included in all assessments depending on the size and nature of the undertaking and the complexity of surrounding land uses. It is strongly recommended that once a proponent has carefully planned his/her new or expanded commercial livestock operation and has considered the environmental and community related issues in the surrounding area, that they initiate communication with neighboring residents and businesses. In order to avoid the spreading of inaccurate information that can raise unnecessary concerns or false expectations, it is vital that the community be advised at an early stage in the planning process. It is understood that you may not be able to satisfy everyone's wishes but you will satisfy most people through the information sessions.

For commercial livestock development proposals, the occupied residences and businesses in the surrounding community (a radius of 1 km is a useful guide) should be notified. Public information sessions are a valuable public information tool and are recommended A written description of the project should be distributed to the community. The project description should include relevant information from the environmental review document related to manure storage and handling, odour control, surface water control, manure spreading plans, steps to be taken to protect groundwater and surface water, and such other information as may be appropriate. Where a public information session is held, it can take the form of an open house at the proponent's residence or on the site of the project. Representatives from the Department of Technology and Environment & the Department of Agriculture and Forestry will be in attendance and will receive concerns either verbally at the session or in writing within a reasonable period of time. Another alternative is to visit neighbours to explain the project and receive comments on the project, including informing them of the opportunity to provide written comments to the Department of Technology and Environment. These written comments and /or concerns will be forwarded to the Minister for consideration concerning the approval of the project and for the placement of conditions deemed necessary for the protection of the environment or to reduce the impact of the operation on other residents or occupiers of the community. If the proposed operation complies with the guidelines, the livestock operation can expect to receive approval.

It should be understood that the environmental approval process recognizes that Prince Edward Island is primariily a rural agricultural province and that livestock operations have a right to establish, expand and operate in accordance with reasonable, environmentally acceptable and economically sustainable management practices. At the same time the process does consider the needs and concerns of other residents of the community and should provide assurance that they can continue to enjoy a good quality of life in rural areas of P.E.I.

7. Siting to Reduce Odour Nuisance

7.1 Minimum Separation Distance (MSD) Method

This section deals with the recommended minimum separation distances between livestock barns and manure storages and other non-agricultural uses. Separation between livestock facilities and neighbours are intended to compensate for normal odour production, thereby reducing potential conflicts. An appropriate separation distance in a rural area will vary with the nature of the odour source as well as the sensitivity to those odours by the neighbouring land use.

As a general rule where the majority of residents and businesses within the minimum separation distance (MSD) are in agreement with the **new livestock operation**, the MSD requirements could be varied.

Where residences and businesses currently exist within the minimum separation distance of an **expanding livestock operation**, the Minimum Separation Distance (MSD) does not apply. The owner of that operation can expect to receive approval to expand provided the operation complies with all other requirements of these guidelines and other relevant land use and environmental protection legislation. The views of residents and businesses that are within the MSD of an expanding farm operation will be given due consideration during the review process.

7.2 Application of Minimum Separation Distance (MSD) in Land Use Planning.

The Minimum Separation Distance is an important planning tool for government agencies and municipalities. Municipalities should, as part of their development policies, require that the minimum distances obtained from the tables be considered in the siting of livestock operations.

The Minimum Separation Distances shall be applied to all new livestock facilities, and/or change of use of a livestock facility, and

should be considered in expanding livestock operations locating in the rural area.

All development permits issued in a rural area by the Province must include the following statement: "This permit has been issued in a geographic area that does not have land use zoning. The area may include existing or future residential, agriculture, commercial, industrial, forestry, tourism, fishing, aquaculture or institutional uses which may influence the use of the site for which the permit has been issued".

7.3 Implementation of Minimum Separation Distance (MSD)

- The applicant completes the MSD Data Sheet and Sketch Sheet and submits them to the appropriate building permit office (municipal or Provincial government) for determination of separation distances and to initiate the building permit process.
- The Department of Agriculture and Forestry will be consulted and provide recommendations on permit applications involving commercial livestock operations.
- MSD applies when an application is made for a new livestock facility or change of use of a livestock facility.
- MSD applies only to livestock and poultry facilities. It is not used to calculate separation distances from uses such as kennels, apiaries, greenhouses, mushroom farms, stockyards, assembly yards, or slaughterhouses.
- MSD shall apply to all dwellings, institutions, commercial or industrial establishments and other types of buildings that may be used or occupied by people.
- The direction of the prevailing winds, the presence of berms or other forms of screening do not affect the calculated MSD.
- The minimum separation distance may be reduced by up to 25% if prevailing summer winds are favorable to reducing odour nuisance.
- Further variances to the MSD may be considered based on site specific circumstances.
- Provincial officials must consult P.E.I. Department of Agriculture and Forestry staff when considering a variance application. Conditions that meet the intent, if not the precise distance of MSD, or that mitigate environmental impacts, will receive further consideration. Such conditions may include unique topography and/or micro-climate which mitigate nuisance, visual screening and unique management/technology.
- Distance to the neighbouring buildings is measured as the shortest distance between that portion of the assessed barn used for livestock housing or the manure storage and the neighbouring buildings.
- Distance to zoned areas is measured as the shortest distance between the part of the barn occupied by livestock or manure storage and the nearest zone boundary.
- Distances to the nearest side lot line, rear lot line, and nearest road allowance are measured between the closest point of the part of the barn occupied by livestock or manure storage and the lot line or road allowance.
- MSD does not apply to the dwelling(s) owned by the owner of the new or expanding livestock operation.

MINIMUM SEPARATION DISTANCE

DATA SHEET

USE: To determine the minimum separation distance for livestock and poultry facilities within agriculture areas.

PURPOSE: To permit the orderly development of livestock operations within agricultural areas, and to reduce the potential for environmental conflicts between livestock or poultry operations and non-compatible land uses.

The following information is to be completed as it relates to the livestock operation.

Farm Name/Owner _____

Address _____

Postal Code_____

Phone: (___) _____ - _____

Fax: (___) _____ - _____

This project consists of:

☐ New livestock or poultry facilities.

☐ Modifications to existing livestock or poultry facilities .

☐ Manure storage.

☐ Rebuilding (ie. after fire).

☐ Other _____

Use the table below to list the type and maximum number of livestock or poultry housed at any time on the property:

	HOUSING NUMBERS	
Type of Animal Housed/Fenced	**Existing Operation**	**Final Operation**
e.g. chicken broiler	20000	25000

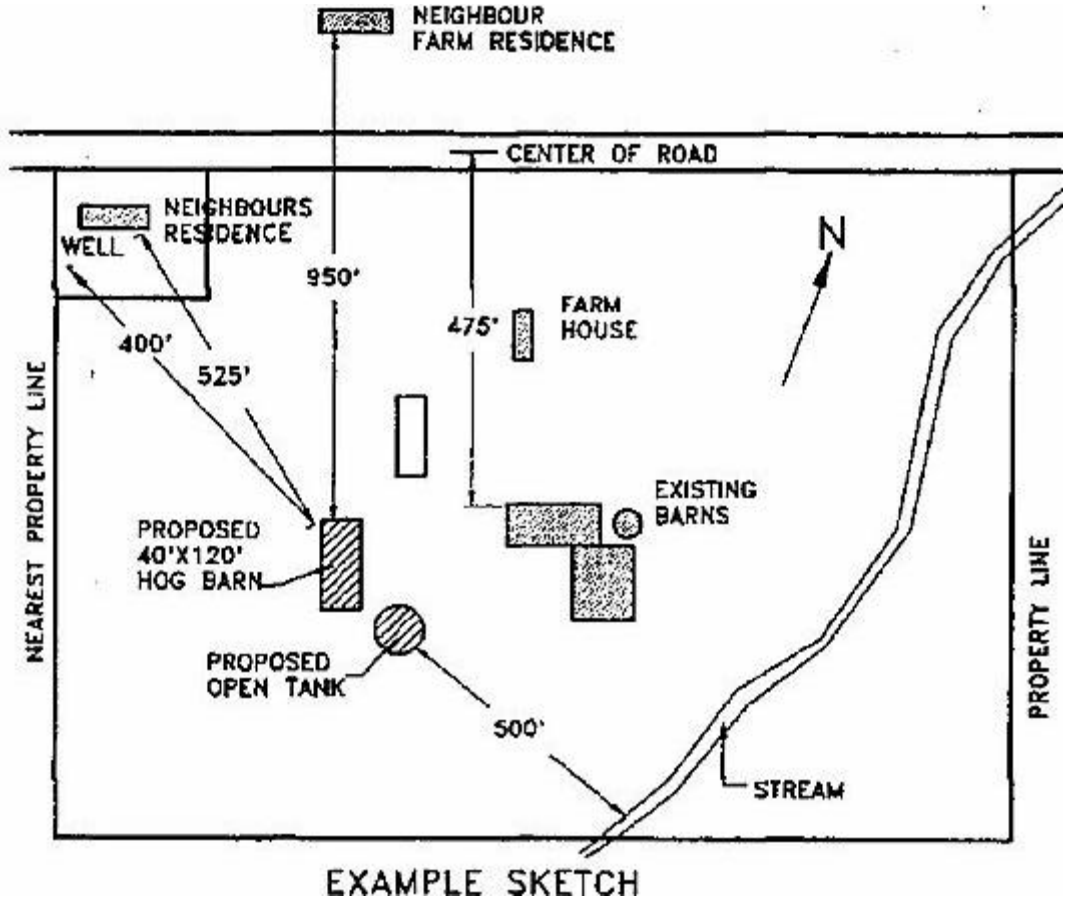
Manure Storage Information

Dry Manure Collection	**Dry Manure Storage**	**Liquid Manure Collection**	**Liquid Manure Storage**
☐ Stable Cleaner/Belts	☐ Manure Pack	☐ Stable Cleaner, Alley Scraper	☐ Full Storage Under Slats
☐ Tractor Scraper	☐ Roofed Solid Storage	☐ Flush System	☐ Open Concrete or Steel Storage
☐ Manure Pack in Barn	☐ Open Solid Storage with Concrete Runoff Tank	☐ Flow Gutter,	☐ Open Earthen Storage
☐ _____	☐ Open Solid Storage With Earthen Runoff Tank	☐ Fully-Slatted Floors	☐ Covered Concrete Storage
	☐ Open Solid Storage	☐ Full Storage Under Slats	☐ _____
	☐ _____	☐ _____	

SKETCH:

The following items must be shown on the property sketch (below):

- Location of all lot lines.
- North direction
- Location and size of all existing and proposed buildings on the property.
- Distances in meters (or feet) from proposed structures to public roads and neighbouring dwellings.
- Location and distance in meters (or feet) of subject structures to all streams, ditches, severances, etc.
- Locations of all manure tanks, pads and earthen storages.
- Location and distances in meters (or feet) from subject structures to nearest zoned areas, if applicable.
- Locate and identify (drilled) water wells
- Current use of lands/buildings adjacent to property.
- Any other unusual siting conditions.



EXAMPLE SKETCH

Draw Sketch Below: (If necessary, please attach additional drawings for clarification)

MINIMUM SEPARATION DISTANCE (MSD) CALCULATION FORM

Calculation of Livestock Units						
Type of Livestock /Poultry	**Number of Existing Livestock / Poultry**	**Number of Existing** Livestock Units (See Table 9) (b)	**Number of Livestock/Poultry to be added (c)**	**Number of Livestock Units to be added (See Table 9) (d)**	**Total Number of Livestock/Poultry (a) + c)**	**Total Livestock Units (See Table 9) (b) + (d)**
		Total 1		**Total 2**		**Total 3**

1) Procedure for Calculation of Existing / Additional Livestock Units

Existing Livestock (a) *divide by* Animals per Livestock Unit (See Table 9) =
Existing Livestock Units (b)

Proposed increase in livestock (c) *divide by* Animals per Livestock Unit (See Table 9) = No. of Livestock Units after expansion (d)

Does the number of livestock fall within the normal range of livestock housing numbers for the structures as outlined in the Canadian Agri-food Research Council Codes of Practice? Yes ____ No ____

If not, please justify_____

2) Calculation of Percentage Increase (Refer to above Calculations)

No. of Livestock Units after expansion (Total 2) *divide by* Existing Livestock Units (Total 1) and **x** by 100 = % increase (_____)

3) Calculation of Factors

Refer to Table 9 for Factor A by Animal Type
Factor A: _____

Total Livestock Units (Total 3 from above) and obtain Factor B from Table 10
Factor B: _____

Percent Increase from above and obtain Factor C from Table 11
Factor C: _____

Type of Manure System (Solid=0.7, Liquid=0.8)
Factor D: _____

4) Building Base Distance: (Meters)

Factor A x Factor B x Factor C x Factor D = **Base Distance 'F': _____**

5) Manure Storage Base Distance: (Meters)

Take Base Distance 'F' and refer to Table 12 **Base Distance 'S': _____**

6) Minimum Separation Distance may be reduced by 25% if prevailing summer winds are favorable to reducing odour nuisance.

MINIMUM SEPARATION DISTANCE REQUIREMENTS LIVESTOCK FACILITIES/MANURE STORAGE FACILITIES (Meters)

Land Use / Property Lines	**Factor**	**Livestock Building "F" x Factor**	**Manure Storage "S" x Factor**
Non Zoned Areas and Agriculture or Agriculturally Related Commercial Use, Recreational or Industrial zones.	1.0		
*Areas zoned in accordance with official plans and by-laws of a municipality, except areas zoned agricultural.	2.0		
**Property Lines: Nearest Side or Rear Lot Line	0.05		
Public Road Boundary	0.10		

* Upon recommendation of the Municipal Council, Factor 2.0 may be decreased, at the discretion of the Minister responsible for the Environmental Protection Act.

** This distance may be decreased with the agreement of the adjacent property owner.

TABLE 9: FACTOR 'A' (Barn Odour Potential).and Animals per Livestock Unit (based on

housing capacity).

	Animals per Livestock Unit			Factor A:
BEEF	1	Beef Cow [1]	(barn confinement)	0.7
	1	" "	(barn with yard)	0.8
	2	Beef Feeders	(barn confinement)	0.7
	""		(barn with yard)	0.8
CHICKEN	125	Caged layers	(manure stored in barn)	1.0
	125	Caged Layers	(daily manure removal)	0.8
	125	Chicken Breeder Layers		0.8
	200	Chicken Broilers/Roasters...		0.65
	500	Pullets (replacement layers)		0.7
DAIRY	1	Milking Cow [1, 2]	(tie- stall)	0.65
	1	""	(free-stall)	0.7
	2	Dairy Heifers	(barn confinement)	0.7
	2	""	(tie- stall)	0.8
DUCK	100	Ducks		0.7
EMU	5	Emu		0.7
FOX	40	Adult fox[4]		1.1
GOAT	4	Adult Goats [(3)]		0.7
	10	Feeder Goats		0.7
HORSE	1	Horse [3]		0.65
MINK	80	Adult Mink [4]		1.1
RABBIT	40	Adult Rabbits [4]		0.8
SHEEP	4	Adult Sheep [3]		0.7

	10	Feeder Lambs (>20 kg)		0.7
SWINE	5	Sows/Boars		1.0
	20	Weaners (4-30 kg) [5]		1.0
	4	Feeder Hogs (30-120 kg)		1.0
TURKEY	50	Meat Turkeys (>10 kg)		0.7
	75	Meat Turkeys (5-10 kg)		0.7
	75	Turkey Breeder Layers		0.8
	100	Meat Turkeys (< 5kg)		0.7
	500	Pullets (replacement breeders)		0.7
VEAL	6	White Veal		1.0
	3	Real Veal (<300 kg)		0.8

Notes: For all other animals/poultry use 1 livestock unit per 450 kg housed at one time (A=0.8).

[1] Includes calf to 150 kg.

[2] A dairy farm usually has milking cows , dry cows, heifers and calves. Multiply the number of milking cows by 1.5 to account for the followers when they are all kept on the same farm.

[3] Includes offspring until weaned.

[4] Includes offspring to market size.

[5] Multiply number of sows by 2.4 to determine the number of weaners.

TABLE 10: FACTOR 'B' (FINAL LIVESTOCK UNITS).											
Livestock Units		**Factor B**	**Livestock Units**		**Factor B**	**Livestock Units**		**Factor B**	**Livestock Units**		**Factor B**
5	-	107	95	-	313	500	-	578	1600	-	821
6	-	119	100	-	318	520	-	585	1650	-	829
7	-	129	110	-	327	540	-	592	1700	-	836
8	-	138	120	-	335	560	-	598	1750	-	844
9	-	145	130	-	343	580	-	605	1800	-	851
10	-	152	140	-	350	600	-	611	1850	-	858
12	-	164	150	-	357	620	-	617	1900	-	865
14	-	175	160	-	366	640	-	623	1950	-	872
16	-	183	170	-	374	660	-	629	2000	-	879
18	-	191	180	-	383	680	-	635	2100	-	892
20	-	198	190	-	392	700	-	640	2200	-	905
22	-	205	200	-	400	720	-	646	2300	-	917
24	-	210	210	-	409	740	-	651	2400	-	929
26	-	216	220	-	418	760	-	656	2500	-	941
28	-	221	230	-	426	780	-	661	2600	-	952
30	-	225	240	-	435	800	-	666	2700	-	963
32	-	230	250	-	444	850	-	679	2800	-	974
34	-	234	260	-	452	900	-	690	2900	-	985
38	-	241	280	-	470	1000	-	713	3200	-	1015
40	-	245	290	-	478	1050	-	723	3400	-	1034
45	-	253	300	-	487	1100	-	733	3600	-	1053
50	-	261	320	-	501	1150	-	743	3800	-	1071
60	-	275	360	-	522	1250	-	762	4200	-	1105
65	-	281	380	-	531	1300	-	771	4400	-	1121
70	-	287	400	-	540	1350	-	780	4600	-	1136
75	-	293	420	-	548	1400	-	789	4800	-	1152
80	-	298	440	-	556	1450	-	797	5000	-	1166
85	-	304	460	-	564	1500	-	805	7500	-	1326
90	-	309	480	-	571	1550	-	813	10000	-	1455

TABLE 11: FACTOR 'C' (Percentage Increase).								
Percentage Increase		**Factor C**	**Percentage Increase**		**Factor C**	**Percentage Increase**		**Factor C**
0-50	-	0.70	120	-	0.86	280	-	1.03
55	-	0.72	130	-	0.88	300	-	1.04
60	-	0.73	140	-	0.90	325	-	1.05
65	-	0.75	150	-	0.91	350	-	1.06
70	-	0.76	160	-	0.92	375	-	1.07
75	-	0.77	170	-	0.94	400	-	1.08
80	-	0.78	180	-	0.95	425	-	1.09
85	-	0.79	190	-	0.96	450	-	1.10
90	-	0.81	200	-	0.97	500	-	1.11
95	-	0.82	220	-	0.99	550	-	1.12
100	-	0.83	240	-	1.00	650	-	1.13
110	-	0.85	260	-	1.02	700	-	1.14
Note: For new livestock farms or if the % increase is greater than 700 percent, use Factor C = 1.14								

TABLE 12:SITING DISTANCES FOR MANURE STORAGES (meters).

Column 1: Roofed or covered storages for manure, runoff, and milkhouse washwater. Includes any covered or roofed concrete, steel or earthen storages, in-barn solid manure packs, and storages under fully slatted floors.

Column 2: Open solid manure pile on a concrete slab. Includes the runoff storages (concrete or earthen) used for capturing seepage liquids from solid manure storage or runoff liquids from yards. If yards are scraped into runoff storage, use column 3 when runoff storage is a concrete or steel tank and column 4 when runoff storage is earthen. Milkhouse washwater, may be added to runoff storage.

Column 3: Open concrete or steel tanks used for storing liquid manure, milkhouse washwater, or yard runoff where yard is scraped into storage.

Column 4: Open earth-sided or earth-sided storage with a concrete floor to be used for storing liquid manure or yard runoff when yard is scraped into storage .

MANURE STORAGE BASIC DISTANCE 'S'				
	Column 1	**Column 2**	**Column 3**	**Column 4**
Minimum Base Distance 'F' for the Building(m)	**Covered Storage Systems (m)**	**Open Solid and Runoff Storage Systems (m)**	**Open Liquid Tank and Runoff Storage Systems (m)**	**Earthen Liquid and Runoff Storage Systems (m)**
40	40	55	119	324
45	45	60	123	326
50	50	65	128	328
55	55	70	132	331

60	60	74	136	333
65	65	79	140	335
70	70	84	144	337
75	75	89	149	340
80	80	94	153	342
85	85	99	157	344
90	90	104	161	346
95	95	108	166	348
100	100	113	170	351
105	105	118	174	353
110	110	123	178	355
115	115	128	182	357
120	120	133	187	360
125	125	138	191	362
130	130	142	195	364
135	135	147	199	366
140	140	152	204	368
145	145	157	208	371
150	150	162	212	373
160	160	172	220	377
170	170	181	229	382
180	180	191	237	386
190	190	201	246	391
200	200	210	254	395
210	210	220	263	399
220	220	230	271	404
230	230	239	280	408
240	240	249	288	413
260	260	269	305	422
280	280	288	322	430
300	300	307	339	439
320	320	327	356	448
360	360	366	389	466
380	380	385	406	475
400	400	404	423	484
420	420	424	440	492
440	440	443	457	501
480	480	482	491	519
500	500	502	508	528
550	550	550	550	550

8. Appendices

Appendix A

Definitions

Agricultural Area

Any rural area on Prince Edward Island, including areas within municipalities, that are zoned agriculture.

Agricultural Operation

An operation that is carried out by a farmer in expectation of gain or reward and for the purpose of producing agricultural products or services; an agricultural operation includes, but not limited to

- clearing, draining, irrigating and cultivating land
- raising or keeping livestock, including poultry and horses
- raising or keeping fur-bearing animals, honey bees, game birds and game animals
- producing agricultural, horticultural, or silvicultural crops, including non-food crops
- operating agricultural machinery and equipment, including noise-scare devices
- preparing a farm product for distribution from the farm gate, including cleaning, grading and packaging
- on-farm processing of farm products for the purpose of preparing farm products for wholesale or retail distribution and consumption
- applying fertilizers, soil conditioners and pesticides, including ground and aerial application
- storing, using or disposing of organic wastes for farm purposes
- operating pick-your-own farms, road-side farm produce stands, and farm tourist operations as part of the farm operation, and
- any other agricultural activity or process prescribed by regulations

Agriculturally Related Commercial Uses

Uses directly related to agriculture and necessary in close proximity to farm operations, such as animal husbandry services, produce or grain storage facilities, or farm machinery outlets.

Agricultural Liquid Waste

A liquid produced on the farm, that requires management and cannot be directly discharged into a natural watercourse and includes waste water, contaminated runoff and silage juices.

Agriculture

Land used for agricultural operation.

Animal Wastes

Livestock or poultry excreta and associated feed losses, bedding, wash water, and other production by-products.

Berm

An artificial mound constructed from compacted soil that may be used for such purposes as buffering, retaining agricultural liquid waste, agricultural waste and diverting or stopping surface water.

Buffer Zone

"Buffer zone" means a grassed or treed area situated adjacent to a watercourse or wetland that can be effective in the filtration, adsorption or assimilation of sediment, nutrients, bacteria, pesticides, or other contaminants contained in surface runoff water. Buffer zones also provide valuable habitat and travel corridors for a wide variety of wildlife species.

Commercial Livestock Operation

Any livestock operation where the facility has the capacity to accommodate the equivalent of 40 or more dairy cows plus replacements or manure production exceeds 2400 liters per day.

Composting

The biological degradation or breakdown of organic matter by a managed process.

Domestic Water Supply

A supply of water used for normal household requirements, including sanitation, human consumption and food preparation.

Dwelling

A building, or portion thereof, designed, arranged or intended for people to live in.

Earthen Storage

A structure constructed primarily of soil materials serving as a liquid or semi-solid manure storage for livestock facilities.

Enclosure

An "enclosure" is defined as any area, yard, field or building in which livestock can be confined.

Expanding Operations

An existing agricultural operation that is increasing the number of livestock / poultry in reasonable proximity to the existing livestock/poultry operation.

Groundwater

Any flowing or standing water below the surface of the earth.

Housing Numbers

Total livestock/poultry capacity for the facility at any one time based on recognized Codes of Practice for livestock space requirements.

Liquid Manure

Livestock or poultry manure that typically contains less than 5 per cent solids.

Livestock

Includes any farm animals and/or poultry reared for commercial purposes.

Livestock Operation

A "livestock operation" is defined as any enclosure (i.e. yard and/or building) where animals are kept for the purpose of rearing, confinement or feeding. Manure storage from these animals is deemed to be part of the operation. This does not include pastures or grazing areas.

Livestock Unit

Equivalent values for various types of animals including poultry, based on manure production and production cycles and is used to equate all types of livestock in terms of relative odour intensity.

Major Expansion

Major expansion is defined as the expansion of a commercial livestock operation whereby the livestock numbers or the manure production increases by 50% or more

Manure(s)

Waste material excreted from animals which include livestock, poultry, farmed game and fur bearing animals, and can be classed as a fertilizer or soil conditioner when applied to land in accordance with these guidelines.

Manure Storage Facility

Includes a structure, reservoir, catch basin, lagoon, cistern, gutter, tank or bermed area which can contain agricultural waste and agricultural liquid waste prior to its use or disposal. It does not include a vehicle or any mobile equipment used for transportation or land application of livestock wastes.

Minimum Separation Distance

A setback or buffer established between a livestock facility and adjacent land uses. Recommended minimum separation distances are found in Section 7

Non Agricultural Development

Any development that does not pertain to an agricultural operation.

Public Buildings

Permanent facilities which house significant numbers of people for extended periods of time (e.g. schools and hospitals).

Recreational Area

Any area used for recreation purposes.

Retention Pond

Means a structure to collect agricultural liquid wastes.

Roadway

Includes a street, road, lane or any other way open to public use but does not include a private right of way on a private lot.

Semi-Solid Manure (Slurry)

Manure that contains between 5 per cent and 20 per cent solids.

Separation Area

"Separation area" means a grassed or treed area situated adjacent to a watercourse or wetland that can be effective in the filtration, adsorption or assimilation of sediment, nutrients, bacteria, pesticides, or other contaminants contained in surface runoff water. Separation areas also provide valuable habitat and travel corridors for a wide variety of wildlife species.

Setbacks

Means the horizontal distance between a lot line or a zoning boundary and buildings, structures, and/or areas.

Solid Manure

Means agricultural waste that has 20 per cent or more solids and will not flow when piled.

Tillable Hectares

Land, including pasture, that can be worked or cultivated.

Undertaking

"Undertaking includes any construction, industry, operation or other project or any alteration or modification of any existing undertaking which will or may (a) cause the emission or discharge of any contaminant into the environment, (b) have an effect on any unique, rare or endangered feature of the environment, (c) have a significant effect on the environment or necessitate further development which is likely to have significant effect on the environment, or (d) cause public concern because of its real or perceived effect or potential effect on the environment".

Watercourse

"Watercourse" means any permanent stream, brook, river, lake, pond, bay, estuary or ocean. The term also refers to any intermittent stream, brook or spring with a definable sediment bed and/or continuous defined banks, which maintains continuous flow during any 72 hour period during the period between June 1 and October 31.

Wetlands

"Wetlands" includes all freshwater and tidal areas that are or may be submerged or periodically submerged under fresh or salt water, including all bodies of water or areas commonly referred to as marshes, salt marshes, swamps, sloughs, bogs, beaches, and flats. (PEI EPA)

Zoned Areas

Areas within Municipalities that have their own Official Plans and Bylaws.

Appendix B

Possible Concerns Related to the Siting of Manure Handling / Storage Facilities by Soil Map Unit			
Soil Map Unit Symbol	**PEI Soil Survey Map Unit**	**Concern (if any)**	**Base distance to wells is 90 metres (300 ft.). Use X factor for recommended separation distance to neighbours well.**
Al	Alberry	Generally none, possibility of shallow bedrock.	X 2 only if subsurface investigation confirms presence of shallow bedrock.
Bp	Baptist Point	Poorly drained, permanently wet (high water table)	X 1.5 may be unsuitable for development
Br	Brackley	Seasonally high water table	X 1.5
Bu	Bunbury	High permeability soil	X 1.5
Cp	Carey point	Seasonally high water table	X 1.5 may be unsuitable for development
Ch	Charlottetown	Generally none, possibility of shallow bedrock.	X 2 only if subsurface investigation confirms presence of shallow bedrock.

Chd	Charlottetown Bedrock phase	Shallow bedrock	X 2
Cr	Crapaud	Poor surface drainage	X 1.5 may be unsuitable for development
Cu	Culloden	High permeability soil	X 1.5
Cud	Culloden Bedrock phase	Shallow bedrock	X 2
Db	Dunblane	Generally none	
Df	Dunstaffnage	Possibility of high permeability soil	X 2 only if subsurface investigation confirms presence of high permeability soils.
Du	Duvar	Generally none	
Eg	Egmont	Generally none	
Em	Emyvale	Shallow bedrock	X 2
Fp	Fifteen Point	Generally none	
Go	Gowanbrae	Generally none	
Ha	Haliburton	Generally none	
Hab	Haliburton Brook	Generally none	
He	Hebron	Poor surface drainage	
Ki	Kildare	High permeability soil	X 1.5
Lr	Locke Road	Poorly drained	
Ma	Malpeque	Generally none	
Mg	Margate	Generally none	
Mp	Mossy Point	Seasonally high water table	X 1.5 may be unsuitable for development
Mr	Munn Road	Generally None	
Ne	Newton	Generally None	
Ol	O'Leary	Generally None	
Or	Orwell	Poorly drained, high water table	X 2 may be unsuitable for development
Rp	Rocky Point	Poorly drained, high water table	X 2 may be unsuitable for development
Sp	Salt Grass Point	Seasonally high water table	X 1.5 may be unsuitable for development
Ti	Tignish	Generally None	
Ui	Uigg	Seasonally high local water table	X 1.5 may be unsuitable for development
Wp	West Point	Slow surface drainage, seasonally high water table	X 1.5
Wn	Winsloe	Slow surface drainage,	X 1.5

		seasonally high water table, possibility of shallow bedrock	
Wf	Wolfe Inlet	Generally None	
Wi	Wood Island	Seasonally high groundwater table	X 1.5 may be unsuitable for development

Appendix C

NITROGEN RETENTION SUMMARY (Percent Retention)	
LIQUID SYSTEMS	
Storage[1]	
Enclosed	85
Open	80
Earthen	60
Application	
Broadcast	50
Broadcast & Incorporate Within 24 hours	80
Injection	98

SOLID SYSTEMS	
Storage[1]	
Daily Scrape	75
Manure Pack	70
Open Lot	50
Application	
Broadcast	50
Broadcast & Incorporate Within 24 Hours	80

[1]Losses can very widely depending on climatic and management factors. The values in this table are based on typical practices.

Nitrogen losses after fall applications will be approximately 20 percent greater than spring or summer applications.

Appendix D

Alternate Methods of Manure Treatment and Utilization

Introduction

The purpose of a treatment system is to convert the manure to a more stable product. The treatment process may be designed to solve odour problems, recover nutrients or energy from the manure, increase the fertilizer value, reduce the volume, or decrease the pollution potential of the manure. In environmentally sensitive areas, such as Holland, manure management practices are strictly regulated and enforced to minimize odour and pollution problems. In these circumstances, treatment systems can be justified economically. In countries where fuel is very expensive or not readily available, the energy recovered from methane gas production is worth the labour investment.

For the majority of livestock producers in Prince Edward Island, most odour problems can be solved by a combination of good management and the separation of livestock farms from residential areas. Manure can be easily disposed on the available crop land. As long as energy and feed prices are relatively low, the most cost-effective treatment system is storage of the manure, followed by spreading the manure on cropland. In the future, however, there may be circumstances where another method of treatment is desirable. This section will present some of the treatment systems that have been studied and provide a brief outline of the feasibility and possible benefits of each system.

Biological Treatment

Aerobic Processes*:* The aerobic processes that may have some application in Prince Edward Island are; storage aeration, pre-storage aeration, and composting.

Storage Aeration**:** Storage aeration is used to maintain the manure in an aerobic state. When manure has sufficient amounts of oxygen present, very little odour is produced, and a significant amount of nitrogen can be removed from the manure by microorganisms. Where the land base available for spreading is limited, it may be necessary to try to reduce the nitrogen content of the manure before it is spread on the land. However, in Prince Edward Island, the manure has value as a source of nutrients for plants, and the land base is large enough to spread all the manure produced without risk of pollution.

During the summer, liquid manure can be treated aerobically by using mechanical aeration equipment. Mechanical aerators operate by either pumping air bubbles into the manure, or by spraying the manure into the air. A high energy input is required to supply enough oxygen to the manure and keep the manure well mixed, and as with all mechanical equipment, a certain amount of maintenance is required to keep the system functional. The energy costs and labour requirements needed to keep a large volume of manure aerobic are high. Generally, total aeration is only used when the manure is to be spread in

an area where odour control is important and soil incorporation is not possible. It is not practical to aerate manure that has been collected and stored under anaerobic conditions during the winter. Aeration is only feasible when the storage is emptied in the spring and fall, and aeration is used as a method of odour control during the summer. In Prince Edward Island, storage aeration systems are only used

in the treatment of municipal liquid waste. The cost of aerating the manure and maintaining the equipment are high. It is usually less expensive to control odours by building the livestock operation with adequate separation distance and/or by using a covered storage of limited size.

Pre-Storage Aeration**:** An alternative method of controlling odours from stored liquid manure is pre-storage aeration. A treatment tank is used to hold seven days of manure production. The manure is partially decomposed under warm, aerobic conditions, and then transferred to the long term storage. Although the manure is held anaerobically in the long term storage, the odour level is reduced because the manure is partially decomposed. The success of this system under Prince Edward Island conditions is unproven.

Composting**:** Composting is an alternate method of manure treatment and utilization. Refer to Section 4.13 for a description of the composting process. The following chart shows the benefits and drawbacks of on-farm composting.

BENEFITS AND DRAWBACKS OF ON-FARM COMPOSTING	
Benefits of composting	**Drawbacks of composting**
Excellent soil conditioner	Time and money involved
Saleable product	Land required for operations
Improves manure handling	Possibility of odours
Improves land application	Weather interferes with composting
Lowers risk of pollution and nuisance complaints	Diversion of manure and crop residues from crop land
Pathogen destruction	Potential loss of nitrogen in manure
Bedding substitute	Slow release of nutrients in compost
May reduce soil borne plant diseases	
Possible revenue from processing	

***Anaerobic Processes*:** With controlled anaerobic treatment processes, such as anaerobic lagoons and anaerobic digesters, the temperature and the nutrient levels of the manure are regulated so that only desirable gases and end products are produced. Whenever manure is stored in a pit or a pile, the manure decomposes anaerobically, but because the process is not controlled, many different gases can be formed. The type of gases and end products formed by the anaerobic decomposition will depend upon the temperature and characteristics of the manure.

***Anaerobic Lagoons*:** Anaerobic lagoons are often confused with earthen manure storages. Lagoons are carefully designed and managed to maintain optimum loading rates, retention time and temperature of the manure to maintain a balance between the acid-forming and methane-forming bacteria. Earthen storages are simply basins designed to store the manure between periods of land application. Lagoons have been used successfully in warmer climates, but in Prince Edward Island where low temperatures occur for much of the year, the methane-forming bacteria become inactive, and the rate of decomposition is slow, with the result that lagoons fill rapidly with solids that do not become stabilized. During the spring when the manure temperature begins to increase, the acid-forming, rather than the methane-forming bacteria become active and begin to decompose the manure accumulated over the winter. When this occurs, the system is unbalanced and offensive odours are produced.

***Anaerobic Digesters*:** Anaerobic digesters are used to produce and recover methane gas from the decomposition of manure. Digesters consist of a large, airtight tank with devices for controlling the input of fresh manure into the tank, mixing the manure, maintaining the correct temperature, and drawing off methane gas and components of the digested manure. Methane production is affected by the temperature, loading rate, mixing, digestion time, and characteristics of the manure. To optimize the amount of methane produced by a digester, all the factors mentioned above must be carefully controlled. The control of these factors can be accomplished by a lot of labour or by mechanization. Unfortunately, both approaches are costly when compared with the value of the methane gas recovered. The methane produced by anaerobic digestion has a low energy level per unit volume, making storage expensive, so its use is limited to stationary applications such as space heating.

Although in the past there has been considerable interest in methane gas production, the system is not economically viable for Prince Edward Island. The high capital costs for equipment combined with the high management requirements make this system impractical. At present, other energy forms such as electricity are less expensive and much more versatile.

Physical Treatment

***Refeeding*:** There have been attempts made to recover some of the nutrients and energy contained in hog manure by feeding them back to livestock. Some form of treatment is required to improve animal acceptability, destroy pathogens and reduce odours. These forms of treatment include dehydration, treatment with formaldehyde and formalin, fermentation and aerobic treatment. While there have been situations on experimental farms where liquid wastes have been reefed to swine, there is considerable debate regarding the value of this practice on commercial hog farms. Generally, refeeding is most successful when the manure from monogastric species such as swine, is reefed to a ruminant species such as cattle. The handling of recycled manure presents problems, since most feeding systems are designed for dry rations. The risk of disease transmission makes the possibility of future acceptance unlikely until an improved process is developed.

***Dehydration*:** Dehydration is a process that can be used for odour control. Dry manure does not support the growth of either microorganisms or insects such as flies. As well, dry manure can be used as a soil conditioner, in much the same way as composted manure. The problem with dehydration is that the costs associated with moisture removal are high and can not be fully recovered from the sale of the final product.

***Solids Separation*:** There are several benefits for separating the solid and the liquid portions of hog manure. In some manure handling systems, it is sometimes desirable to recycle the liquids for flushing. Another reason for separation of the solids from the liquid manure is to allow the use of different treatment processes. Removing the solids can serve a similar function to pre-storage aeration. The remaining liquid is less concentrated and therefore will produce less odour when it decomposes. Depending upon the degree of separation, the solids may be dry enough to be composted, and the remaining liquid will be easier to handle when spreading on the land or aerating. The disadvantage of solids separation is the need for two separate manure handling systems.

Separation can be done using filters or screens, or by allowing the solids to settle in a large tank or basin while removing the liquids from the top. Mechanical equipment is available, including centrifuges, cyclone separators, stationary and vibrating screens, in a variety of sizes. Depending upon the flow rate and the type of mechanical equipment used, up to 50 percent of the solids can be removed. Settling basins can remove up to 95 percent of the solids, depending upon the design.

A method of separation that has been used in other areas of Canada is to transfer the fresh liquid manure to a covered concrete tank where the solids are separated by settling. Conventional manure pumps are then used to agitate and remove the solids. The liquids are transferred from the concrete tank to an uncovered earthen manure storage. This system has the benefit of using low cost, open storage for the large volume of liquids having a low nuisance potential, and a higher cost, covered storage for the smaller volume of highly concentrated manure which can produce the most offensive odours. However, the effectiveness of this method of separation for odour control has not been quantified.

Appendix E

Existing Legislation

Livestock producers and the public should understand how the provincial, federal and municipal regulations affect livestock operations. Existing livestock operations are expected to follow practices that are environmentally friendly. In an existing operation where an environmental problem has been identified, an upgrading of existing facilities and/or management practices may be required.

The following steps should be followed when preparing a development proposal for an expanding or new livestock operation:

- become familiar with the planning process and requirements of the province and or municipality,
- determine whether local planning regulations will permit future growth,
- have a manure management plan to demonstrate that the operation will not be a source of trouble in the future.
- inform local area residents about the project, respond to concerns and ensure no misconceptions exist since producers who develop good relations with the public are more likely to have their proposals accepted.

Environmental Protection Act

The Environmental Protection Act allows the province to take such actions as it considers necessary in order to manage, protect, and enhance the environment.

Section 20 states:

"Except as permitted by the regulations or by the Minister in writing, no person shall:

- *discharge, or cause, or permit to be discharged,*
- *being the owner or person having control of a contaminant, discharge or cause or permit to be discharged, a contaminant into the environment"*

Section 21 states:

"Every person that, without permission of the Minister, discharges a contaminant into the environment shall:

- *immediately notify the Department; and*

- *take such action as the Minister may direct*

  - to investigate and define the extent, nature and impact of the contaminant,
  - to repair, restore and remedy the environment or to confine and contain the effects of the contaminant".

The definition of a *"contaminant"* includes any solid, liquid, gas, waste, odour or combination of them;

- *which is foreign to, orin excess of the natural constituents of the environment into which it is being introduced,*
- *which will or may adversely affect, either directly or indirectly, the natural, physical, chemical, or biological quality of the environment,*
- *which is injurious to the health and safety of a person or be damaging to a property, or to plant and animal life,*
- *which interferes, or is likely to interfere, with the comfort, well being, livelihood or enjoyment of life of a person.*

Pollution of surface water or groundwater by manure nutrients, bacteria, etc., or the pollution of the atmosphere by excessive odours from a livestock operation or by manure spreading may be included under Sections 20 and 21 of the Environmental Protection Act.

Section 7 and 7.1 gives the Minister of Technology and Environment the authority to issue an order to stop a person or corporation from discharging a contaminant into the environment. The same section also describes the powers of enforcement officers.

Section 9 states that no person shall initiate any undertaking unless that person files a written proposal with the Department and obtains from the Minister written approval to proceed with the proposed undertaking. This section may require the proponent of new or expanding commercial livestock facilities to first provide an Environmental Impact Statement and notify the public of the proposal and provide opportunity for comment (See Section 9)

P.E.I. Roads Act

Section 37 (3) of the P.E.I. Roads Act *"prohibits any dirt, filth or rubbish of any nature whatsoever, or any material, object or thing which is offensive to the general appearance being put or placed on any portion of the right-of-way of any road or street".*

When using a public roadway to transport manure to the fields, it is important for the operator to use proper equipment to avoid spills and leaks occurring on the roadway. If manure or dirt is deposited on the roadway, the owner/operator should remove it as soon as possible.

Springtime weight restrictions apply to the transportation of manure on highways.

P.E.I. Planning Act

The Planning Act Regulation (12) states that "*no person shall without first obtaining a building permit issued by the Minister;*

- *Commence the construction of any building or structure,*
- *change the location of any building or structure,*
- *make any major structural alterations or to change the interior or exterior dimensions of any building or structure".*

The Planning Act Regulations may specify conditions to the building permit as well as require certain specified separation distances between buildings and right-of-ways, property lines, etc.

Federal Fisheries Act

The Federal Fisheries Act states *"it is illegal to harmfully alter, disrupt, or destroy fish habitat. It is also unlawful to deposit or to permit the deposit of, a substance in waters frequented by fish, which is deleterious to fish, fish habitat or the use of fish by persons".*

Municipal By-Laws

Municipalities that have adopted Official Plans have the authority to regulate land use within their jurisdiction. Usually there is some form of zoning for various uses. Conditions may exist for buffer strips, covered manure storages, direct injection of manure and any other requirement that the community council considers necessary to prevent conflicts from occurring.

Appendix F

LIST OF TABLES

Appendix G

Terms Used When Determining Animal Unit Values For Beef Cattle

Cow/Calf Operation: 180 - 270 kg. Calf

100 Day Backgrounder:

Weigh in 180 - 270 kg. Average 225 kg.
Weigh out 250 - 340 kg. Average 295 kg.
Average weight - 260 kg.
Days on feed 100

200 Day Backgrounder:

Weigh in 180 - 270 kg. Average 225 kg.
Weigh out 320 - 410 kg. Average 365 kg.
Average weight 295 kg.
Days on feed 200

Summer Pasture:

Weigh in 250 - 340 kg. Average 295 kg.
Weigh out 410 kg.
Average weight 350 kg.
Days on feed 125

Short Keep:

Weigh in 410 kg.

Weigh out 600 - 648 kg. Average 625 kg.
Average Weight 485 kg.
Days on feed 90

Long Keep:

Weigh in 250 - 340 kg. Average 295 kg.
Weigh out 600 - 648 kg. Average 625 kg.
Average weight 410 kg.
Days on feed 180

EXAMPLE WORKSHEET 1

ESTIMATE THE LAND BASE REQUIRED

STEP 1: Enter the number of livestock places or barn capacity._____

STEP 2: Determine the annual nutrient production for one animal (N or P_2O_5) from Table 4

(Nitrogen) _____

STEP 3: Enter the fraction of nitrogen retained after storage and application from Table 5. For phosphate the fraction is 1.0.

(Earthen Storage, Broadcast & Incorporate) _____

STEP 4: Determine the nutrient utilization (N or P_2O_5) for the crop under consideration, Table 6.

(Cereals, nitrogen) _____

STEP 5: Calculate the land base required. Multiply steps 1, 2, and 3, then divide by step 4.

_____

EXAMPLE WORKSHEET 2 A

LIQUID MANURE APPLICATION RATES - DETAILED METHOD (APPLIED TO MEET CROP NITROGEN REQUIREMENTS)

STEP 1: Enter the manure nitrogen content using the results of manure testing.

Manure Nitrogen Content

Ammonium N _____kg/1000 L

Organic N _____kg/1000 L

STEP 2: Select the ammonium application retention factor from Table 7 based on the method of application.

Ammonium Loss Factor (Table 7) _____

STEP 3: Calculate the amount of ammonium nitrogen available. Multiply the ammonium N (Step 1) by the loss factor (Step 2).

Available Ammonium Nitrogen _____kg/1000 L

STEP 4: Calculate the amount of organic nitrogen available. Multiply the Organic N (Step 1) by 0.25.

Available Organic Nitrogen _____kg/1000 L

STEP 5: Calculate the total amount of nitrogen available. Add the available ammonium nitrogen (Step 3) to the available organic nitrogen (Step 4).

Total Nitrogen Available _____kg/1000 L

STEP 6: Enter the crop nitrogen requirements using either the results of soil tests or the fertilizer recommendations from Table 6.

Crop Nitrogen Requirements (Table 6) _____kg N/ha

STEP 7: Calculate the manure application rate based upon the crop nitrogen requirements. Divide the recommended nitrogen application (Step 6) by the total available nitrogen (Step 5) and multiply by 1000.

Manure Application Rate _____L/ha

NOTE: When manure is the only source of nitrogen there is normally an excess of phosphorus applied. If applying manure annually to the same fields using this management practice, annual soil tests must be carefully reviewed to ensure phosphorus does not build up to levels that could cause pollution or nutrient imbalances.

EXAMPLE WORKSHEET 2B

LIQUID MANURE APPLICATION RATES - DETAILED METHOD (APPLIED TO MEET CROP PHOSPHATE REQUIREMENTS)

STEP 1: Enter the phosphate (P_2O_5) content using the results of manure testing. If phosphorus(P) is reported, multiply P by 2.29 to obtain P_2O_5. If results are reported in mg/kg or ppm, divide by 1000 to obtain kg/1000L.

Manure Phosphorus Content _____mg/kg

Manure Phosphate content _____kg/1000 L

STEP 2: Enter the crop phosphate requirements using either the results of soil tests or the fertilizer recommendations from Table 6.

Crop Phosphate Requirements (Table 6) _____P_2O_5/ha

STEP 3: Calculate the manure application rate based upon the crop phosphate requirements. Divide the recommended phosphate application (Step 2) by the manure phosphate content (Step 1) and multiply by 1000.

Manure Application Rate _____ L/ha

Note: When manure is applied to just meet the crop phosphate requirements there will normally be a shortfall of nitrogen to meet the crop nitrogen requirements. It is therefore necessary to add supplemental nitrogen when using this management practice.

EXAMPLE MSD WORKSHEET For minimum separation distance (MSD) calculation for a new 1000 hog feeder barn.				
Step 1:		Type of livestock:		**Feeder Hogs**
Step 2:	(a)	Existing number of livestock		**0**
Step 3:	(b)	Number of Existing Livestock Units		**0**
Step 4:	(c)	Number of Livestock to be added		**1000**
Step 5:	(d)	Number of livestock units to be added, divided by 4 as in Table 9		**250**
Step 6:		Total number of livestock (a+c)		**1000**
Step 7:		Total Livestock Units (b+d)		**250**
Step 8:		Calculation of percentage increase = d/b multiplied by 100 = % increase		-
Step 9:		**Calculation of Factors;**		
		Animal Type (See Table 9)	**Factor A**	**1**
		Total livestock units (See Table 10)	**Factor B**	**444**
		New - Factor C = 1.14 (See Table 11)	**Factor C**	**1.14**
		Type of manure system (liquid)	**Factor D**	**0.8**
Step 10:		**Building Base Distance: (meters)**		
		Factor A x Factor B x Factor C x Factor D	***Base Distance F**	**405m**
Step 11:		**Manure Storage Base Distance (meters)**		
		Find Base Distance F in Table 12	***Base Distance S**	**423m**
Step 12:		**Minimum Separation Distance may be reduced by 25% if prevailing summer winds are favorable to reducing odour nuisance.**		
		***Distance F = 405 meters and *Distance S = 423 meters (open liquid manure tank)**		

Land use/property lines	Factor	Building (F x Factor)	Storage (S x Factor)
Non Zoned Areas and Areas zoned for Agriculture or Agriculturally Related Commercial Use, Passive Recreational of Industrial	1.02	405m	423m
Areas zoned in accordance with official plans and by-laws of a municipality, except areas zoned Agriculture	2.0	810m	846m
Property Lines: Nearest Side or Rear Lot Line	0.05	20m	21m
Public Road Boundary	0.10	40m	42m

EXAMPLE MSD WORKSHEET For minimum separation distance (MSD) calculation of an expansion from 50 milk cows (tie-stall) to 100 milk cows (free stall)				
Step 1:		Type of livestock:		**Milk Cows**
Step 2:	(a)	Existing number of livestock (Multiply the number of milking cows by 1.5 to account for the followers)		
Step 3:	(b)	Number of Existing Livestock Units		**75**
Step 4:	(c)	Number of Livestock to be added		**75**
Step 5:	(d)	Number of livestock units to be added		**75**
Step 6:		Total number of livestock (a+c)		**150**
Step 7:		Total Livestock Units (b+d)		**150**
Step 8:		Calculation of percentage increase = d/b multiplied by 100 = % increase		**100%**
Step 9:		**Calculation of Factors;**		
		Animal Type (See Table 9)	**Factor A**	**0.7**
		Total livestock units (See Table 10)	**Factor B**	**357**
		% increase (From Table 11)	**Factor C**	**0.83**
		Type of manure system (liquid)	**Factor D**	**0.8**
Step 10:		**Building Base Distance: (meters)**		
		Factor A x Factor B x Factor C x Factor D	***Base Distance F**	**166m**
Step 11:		**Manure Storage Base Distance (meters)**		
		Find Base Distance F in Table 12	***Base Distance S**	**229m**
Step 12:		**Minimum Separation Distance may be reduced by 25% if prevailing summer winds are favorable to reducing odour nuisance.**		
		***Distance F = 166 meters and *Distance S = 229 meters (open liquid manure tank)**		

Land use/property lines	Factor	Building (F x Factor)	Storage (S x Factor)
Non Zoned Areas and Areas zoned for Agriculture or Agriculturally Related Commercial Use, Passive Recreational of Industrial	1.0	166m	229m
Areas zoned in accordance with official plans and by-laws of a municipality, except areas zoned Agriculture	2.0	332m	458m
Property Lines: Nearest Side or Rear Lot Line	0.05	8m	12m
Public Road Boundary	0.1	17m	24m

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