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Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Environmental and Economic Impact Assessments of Environmental Regulations for the Agriculture Sector

A Case Study of Hog Farming

Canada

Environmental and Economic Impact Assessments of Environmental Regulations for the Agriculture Sector

A Case Study of Hog Farming

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For

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Environmental and Economic Impact Assessments of Environmental Regulations for the Agriculture Sector: A Case Study of Hog Farming

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A

AAFC	Agriculture and Agri-Food Canada
AL	Agricultural Lowland
ALR	Agricultural Land Reserve
ANS	Ammonia Nitrogen Standard
APF	Agricultural Policy Framework
AU	Animal Unit

B

BOD	Biochemical Oxygen Demand
BMP	Beneficial Management Practice

C

CAFO	Confined Animal Feeding Operation
CDPQ	Centre de Développement du porc du Québec
CFO	Confined Feeding Operation
CSALE	Centre for Studies in Agriculture, Law and the Environment
CWA	Clean Water Act

E

EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization
EFP	Environmental Farm Plan
ELGs	Effluent Limitations Guidelines and Standards
EMB	Earthen Manure Storage Basins
EMS	Environmental Management Systems
EPA	Environmental Protection Agency (US)
ER	Environmental Regulations
EU	European Union

F

FBRN	Farm Business Registration Number
FCC	Farm Credit Canada

G

GC	Greencover Canada Program
GHG	Greenhouse gases

I

ILO	Intensive Livestock Operation
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
ISU	Iowa State University

M

MAPAQ	Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
MENV	Quebec Ministère de l'Environnement

N

NAS	Nitrogen Application Standard
NFSP	National Farm Stewardship Program
NMP	Nutrient Management Plan
NMS	Nutrient Management Strategy
NPDES	National Pollutant Discharge Elimination System
NRCB	Natural Resources Conservation Board
NWSEP	National Water Supply Expansion Program
NVZ	Nitrate Vulnerable Zones

O

OECD	Organisation for Economic Co-operation and Development

P

PAA	Agri-environmental Support Plan (Quebec)

R

ROA	Return on Assets
RIAS	Regulatory Impact Analysis Statements

S

SAF	Saskatchewan Agriculture and Food

U

UNECE	United Nations Economic Commission for Europe
US	United States
USDA	United States Department of Agriculture

Foreword

Emerging low cost competitors, such as, Brazil and Argentina, and high rates of farm subsidization in the United States and Europe are putting pressures on market prices. With the increased challenges to farm income, all factors that could affect a farm's cost structure and profitability are coming under increased scrutiny. In discussions with farm organizations and farm leaders, the impact of regulations on farm costs is an expressed area of concern with reference to competitiveness.

There is a growing concern about the impact that regulations, and specifically those regulations targeted at environmental issues, have on the competitiveness of primary agriculture. With this background, the need to carry out a thorough assessment of the role and impact of agri-environmental regulations was identified in the environmental pillar of the Agricultural Policy Framework (APF).

Empirical analysis is required to better understand the impacts of agri-environmental regulations on a farm's cost structure, and to compare differences between provinces within Canada. With this purpose in mind, Agriculture and Agri-Food Canada (AAFC) has commissioned a series of studies to increase the policy makers' and industry's understanding of the impact and role of environmental regulations in the farming sector.

A report titled "Inventory and Methodology for Assessing the Impacts of Environmental Regulations in the Agricultural Sector" which outlines the methodology for carrying out an impact assessment was released in March 2006 (available on AAFC On-Line, at www.agr.gc.ca/pol/index_e.php?s1=pub&s2=inven&page=intro). A comprehensive inventory of agri-environmental regulations was also compiled. Employing this methodology, case studies on potato and hog farming have been completed. The objective of these assessments was to estimate the impact of agri-environmental regulations imposed by all three levels of governments (Federal, Provincial and Municipal) on the cost structure and competitiveness of farms. The environmental impacts of these regulations were estimated qualitatively based on available information.

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Executive summary

Over the last several years a great deal of attention and research has been focused on the environmental impacts of livestock operations, specifically on surface water, groundwater, air quality and soil. This research and attention has led Canadian provinces to explore policy measures to address these issues. Further, the Canadian government developed the Agricultural Policy Framework which included an environmental pillar. The overall goal of the environmental component of the Agriculture Policy Framework (APF) is to position Canada as the world leader in environmentally responsible production and sustainable development of agriculture, natural resources and economy.

To achieve these goals, the APF included an objective to conduct a multi-year research study to establish the role and impact of farm level environmental regulations for primary agriculture. A cohesive inter-provincial comparison of the set of environmental regulations that are currently facing agricultural producers in Canada and the resulting competitiveness impacts across the provinces is one part of the research study. AAFC has requested that this be carried out through a series of case studies commencing with the hog sector.

The purpose of this project was to provide an ex-post economic and environmental impact assessment of environmental regulations affecting hog farms in Canada. This involved quantifying the economic impacts by estimating private benefits and costs.

The following were the lessons learned from the chapters of the research:

- In Canada there has been an increase in the concentration and density of hog operations in certain provinces, which have created environmental problems.
  - Over the past decade, there has been a decline in the number of hog operations but an increase in the average size of hog operations.
- Hog production can have an impact on various elements of the environment, specifically, water, air, soil and biodiversity. Some of these include:
  - Degraded water quality impacting animal and human health
    - Accelerated eutrophication
    - Pathogen and bacteria in water supply
    - Increased salinity of water supply
    - Depletion of dissolved oxygen in water supply

    - Reduction in aquatic life
    - Turbidity and siltation of the water supply
    - Antibiotics and hormones in the food supply
  - Toxicity of the soil at high nutrient levels
    - Impacts on soil quality from the accumulation of heavy metals
    - Decreased soil pH from long term application of hog manure
  - Increased greenhouse gas and air pollutant emissions
  - Odour and noise pollution

- These pollutants can originate at several stages of production, including production houses where animals are confined; manure storage structures such as tanks, ponds, and lagoons; and land where manure is applied (Aillery, 2005).

- All levels of governments in Canada (federal, provincial and municipal) have responded to environmental risks from agriculture with more stringent and complex regulations, although guidelines are also becoming popular at the provincial level.

- Compliance with regulations has considerable cost implications for hog producers.
  - Environmental ratios are sensitive to cost and revenue estimates.

- Total environmental cost of compliance was highest in Ontario, followed by Manitoba and lowest in New Brunswick.
  - It is important to note that manure handling costs and manure storage requirements below 240 days were considered as costs of doing business rather than environmental costs for this analysis.
  - While environmental regulations in Quebec are restrictive in comparison to other provinces, the environmental costs incurred to comply with the regulations in Quebec are relatively low. Note however, that the cost of completing an environmental impact assessment could not be included in this analysis; therefore the total cost of compliance is likely underestimated.
  - Overall, the cost of compliance was less than 0.5% of operating costs, total costs, and total revenue in all provinces.
  - An OECD (2003) study examined the ratio of manure management costs (due to regulation) to gross production costs. Taking into account different methods, the resulting ratios from the OECD study would be approximately less than 1%, similar to the results of this analysis.

- Some provinces were at a competitive advantage whether from lower costs to comply or reduced restrictiveness of the environmental regulations.
  - Saskatchewan had the best competitive advantage in terms of net income per hog before and after the implementation of regulations.
  - The higher estimated building costs in Nova Scotia put the province at the greatest competitive disadvantage in terms of net income per hog.

- With the review of the Canadian provinces, the environmental problems within each jurisdiction varied and thus the objectives of the environmental regulations varied.

- When the restrictiveness ratings were compared using research conducted by Debailleul and Boutin (2004)[1], Quebec had the most comprehensive set of environmental regulations of the provinces with the presence of regulations in all eight categories: authorization permits, impact assessments, public consultations, nutrient management plans, separation distance from watercourses, buffer strips, spreading period, and distances to control odours.
  - In contrast, Saskatchewan was at the opposite end of the spectrum with restrictiveness ratings in only three of the eight categories.
- In terms of manure storage requirements, producers in Alberta, Ontario and New Brunswick are subject to legislated minimum manure storage capacity (days of manure storage). The remaining provinces (with the exception of Quebec) have developed recommended guidelines for manure storage capacity. In Quebec, days of manure storage depend on the individual operation since required manure storage capacity is determined during the development of the agro-environmental fertilization plan.
- When the consistency of the set of environmental regulations were compared by category, it became clear that certain aspects of the regulations were consistent across the country, while others were not.
  - The environmental regulations were consistent in their objectives to protect the environment and encourage environmentally sound agricultural practices.
  - The regulations were consistent in prohibiting manure spreading on frozen or snow covered ground (with the exception of Saskatchewan and the Maritimes).
  - The regulations were inconsistent in their definitions of animal units.
  - Environmental legislation related to setbacks from water as well as separation distances differed across the provinces.
- The types of regulatory control were different across the provinces.
  - The three types of regulatory control are local, provincial and cooperative control.
  - Local and cooperative controls are more likely to create jurisdictional competitiveness issues as compliance requirements may not be consistent across a province.
- Benefits to producers and society of compliance with environmental regulations include:
  - Reduced complaints from neighbouring communities. For example, communities may experience reduced odour based on regulations that require incorporation of manure.
  - Improved water and soil quality from requirements for setbacks, buffer strips and manure application rules that would benefit both the farm operation and community.
  - If an operation was intending to expand, compliance with current regulations may speed up the approval process for building plans or applications for permits.
  - Compliance with regulations may also improve biodiversity on the farm. For example, reducing runoff can impact oxygen levels in surface water, enhancing aquatic life.
  - With good environmental regulations, society can also benefit from less pollution and improved quality of life.

1. *Refer to Table 6.2 for more detailed information.*

- Businesses can also be better off with clear standards that are enforced effectively. In particular, good environmental regulations can help industry by reducing costs for industry and business, creating markets for environmental goods and services, driving innovation, reducing business risk, increasing the confidence of investors and insurers, assisting with competitive advantage, helping to create and sustain jobs, and improving the health of the workforce and of the wider public (Network of Heads of European Environment Protection Agencies, 2005).

Overall, environmental regulations across Canada are consistent in their objectives to protect the environment and encourage environmentally sound agricultural practices. Each province faces different environmental issues which are being addressed by a variety of environmental regulations. While some regulations are consistent across the country (e.g. winter spreading restrictions), other regulations vary by province, such as the definition of animal units. The variation in environmental regulations may be attributed partially to the environmental concerns that exist within each province. For example, Quebec is concerned with the density and concentration of hog operations and has implemented environmental impact assessments and public consultations as a result.

There are benefits and costs to variation in regulation across the provinces. On one hand, the development of regulations is extremely costly and time consuming. As such, regulations should not be implemented without reason. On the other hand, consistency of regulations helps to ensure jurisdictional competitiveness. As it stands right now, some provinces have a competitive advantage with respect to complying with environmental regulations. This may be a consequence of the fact that some provinces have not experienced significant environmental concerns and as a result have less restrictive regulations. An example of this can be seen when the model results for Saskatchewan (low costs to comply and low restrictiveness of regulations) are compared to Ontario, a province with significant hog density, environmental concerns and the highest estimated cost of compliance with environmental regulations. Perhaps it would be worthwhile for provincial and federal governments to review regulations to determine which regulations can and should be applied consistently.

It is also recommended that the federal government strongly encourage provincial over municipal control of environmental regulations. Local and cooperative control can lead to inconsistent by-laws and approvals across a province. Cooperative control can be effective if provincial governments make the final decision with the entire province in mind. Consistent control of environmental regulations will reduce the jurisdictional competitiveness issues within a province. Ontario is an example where there was a mix of by-laws that increased the costs of production depending on the municipality the operation was located in. This jurisdictional competitiveness issue was resolved with the introduction of the Nutrient Management Act which supersedes municipal by-laws.

Finally, the question remains as to whether complying with environmental costs should be considered the cost of doing business, particularly for new operations entering the industry. This is particularly true when environmental regulations are proven to be effective and there are benefits to the operation from complying.

SECTION 1

Introduction and background

1.0 Introduction and background

Over the last several years a great deal of attention and research has been focused on the environmental impacts of livestock operations, specifically on surface water, groundwater, air quality and soil. This research and attention has led Canadian provinces to explore policy measures to address these issues. Predominantly, policy measures implemented globally have been regulatory and are increasing in severity and complexity (OECD, 2003).

Further, as a result of the expanding livestock industry and increasing pressure on the environment, the Canadian government developed the Agricultural Policy Framework which included an environmental pillar. The overall goal of the environmental component of the Agriculture Policy Framework (APF) is to position Canada as the world leader in environmentally responsible production and sustainable development of agriculture, natural resources and economy.

A good regulatory framework protects the health and environment of its citizens, contributes to economic growth, and promotes investments that, in turn, improve a nation's productivity and standard of living. A dysfunctional regulatory system however, hinders productivity and innovation and reduces competitiveness (RIAS Inc., 2000). We would add to the RIAS Inc. notions that protecting health and environment are not necessarily trade-offs for competitiveness and innovation and that these two objectives should be able to be accomplished simultaneously with efficient regulations that take both issues into account.

To achieve these goals, the APF included an objective to conduct a multi-year research study to establish the role and impact of farm level environmental regulations (ER) for primary agriculture. In this respect Phase-I was recently completed titled, "Inventory and Methodology for Assessing the Impacts of Environmental Regulations in the Agricultural Sector".

What is required for further strategic planning regarding agri-environmental regulations is a cohesive inter-provincial comparison of the set of environmental regulations that are currently facing agricultural producers in Canada and the resulting competitiveness impacts across the provinces. AAFC has requested that this be carried out through a series of case studies commencing with the hog sector.

1.1 Purpose and objectives

The purpose of this project is to provide an ex-post economic and environmental impact assessment of environmental regulations affecting hog farms in Canada. This will involve quantifying the economic impacts by estimating private benefits and costs.

The specific objectives of this project are as follows:

1) Description of the structure of the hog industry in Canada as it relates to environmental concerns.

2) Identify the comprehensive ER set (administered by federal, provincial and local governments) that impacts hog farms. The AAFC/Ecoressources database is used as a starting point. Any missing or new regulations identified will need to be included.
   a. Literature review on environmental and economic assessment of environmental regulations is included.
   b. A cursory review of OECD regulations was also included.

3) Review of available Federal or Provincial Regulatory Impact Analysis Statements (ex-ante RIAS) which were written to support the development of regulations that would affect hog farms including economic (private and social benefits and costs), and environmental factors.

4) Based on Phase-I report, describe how the framework will be operationalized to conduct the assessment. Describe and explain any variation if using methodology other than Phase-I.

5) Identify the data and data sources for economic and environmental impact assessment of ER set affecting hog farming required to implement 4.

6) Clearly quantify the baseline (economic and environment) for impact evaluation assessment of environmental regulations for hog farming.
   a. New farm model will be assumed for private costs, benefits and competitiveness assessment.
   b. Including any financial assistance available to comply with environmental regulations for new operations.

7) Quantify the impact of the environmental regulation set affecting hog farming in Canada by province. Quantitative assessments of economic and environmental impacts are required. However, if quantification of environmental impacts is not possible, then a qualitative assessment will be carried out:
   a. justification of assumptions and methodology used for this study supported by published literature and refereed journal articles;
   b. impacts assessment for private costs, benefits and competitiveness;
   c. qualitative assessment of social costs and benefits for ER will be based on literature review and own (Contractor's) assessment/inference based on the experience of this study;
   d. impacts assessment for environment factors such as water, air, soil, biodiversity as well as odour;

e. comparison of ex-post benefit-cost analysis estimated in this study with any ax-ante benefit-cost analysis (i.e. from a RIAS that exists) of environmental regulations affecting hog farms;

f. discussion of whether federal/provincial/local environmental regulations and policies affecting hog farming are coherent or conflict with each other.

8) Impact assessment of existing environmental regulations affecting hog farming in Canada will not be studied following step by step principles of Smart Regulation. However, study will cover whether existing environmental regulations for hog farming are effective, efficient and coherent. Compliance mechanism will NOT be assessed. Does the environmental regulation set achieve the stated objectives and goals in an efficient and effective way?

9) Lessons learnt, policy implications and recommendations based on this study for strategic planning for next generation of the Agricultural Policy Framework related to potential use of agriculture environmental regulations as one of the policy tools to achieve better economic and environmental performance.

1.2 Report outline

The literature review in Section 2.0 provides an understanding of the environmental concerns facing the hog industry and the various ways in which hog production can impact the environment (key concerns and issues with respect to water, air, soil and biodiversity). Section 3.0 reviews international environmental policy measures and introduces the regulations affecting Canadian hog operations, as well as the key cost elements of these regulations. Section 4.0 reviews studies that have assessed both the environmental and economic impact of environmental regulations on hog producers and society. Section 5.0 is an overview of the economic model developed to assess the environmental regulatory cost of compliance for a 600 sow farrow-to-finish hog operation established in each province of Canada. Section 6.0 is a discussion of the coherence/conflict of regulations in Canada across the provinces. Section 7.0 concludes with lessons learnt, policy implications and recommendations for improvements for the next stage of strategic planning for the next generation APF with respect to agriculture environmental regulations.

SECTION 2

Overview of the hog industry and related environmental concerns

2.0 Overview of the hog industry and related environmental concerns

The purpose of the overview is to understand the structure of the hog farming industry in Canada and the various ways in which hog production can impact the environment (key concerns and issues). Section 2.1 provides statistics on the Canadian hog farming industry which shed light on the increasing density and concentration of hog operations in Canada. Section 2.2 is an overview of the hog industry with respect to environmental concerns with attention paid to water, air, soil and biodiversity. Section 2.3 is a summary of the statistics and the key environmental issues in hog production.

2.1 Canadian hog farming industry

The number and strength of environmental regulations in a given province may be a reflection of the intensity of agriculture in the region and the resulting environmental problems that may occur. As such, the following paragraphs outline the trends in hog inventories and hog density, as well as the number and types of hog operations for the major hog producing provinces in Canada: Quebec, Ontario, Manitoba and Alberta. For detailed data on the graphs presented in this section, please refer to Appendix A. This section aims to provide perspective for the remainder of the research and will be particularly important for section 5.0 as background information for the coherence and conflict of environmental regulations.

2.1.1 Inventories[2]

This section provides an overview of inventory trends with a focus on sow and market hog numbers. The major hog producing provinces in Canada include Quebec, Ontario, Manitoba and Alberta as shown in Table 2.1.

The graphs (Figures 2.1 and 2.2) illustrate long term trends while the summary statistics highlight the changes over the last five years. The main conclusions that can be derived from the hog inventories are as follows:

- While Quebec has the largest number of total hogs and market hogs, it no longer has the largest number of sows in Canada. Ontario is the region with the largest number of sows.

2. *All data is sourced from Statistics Canada, Livestock and Animal Products Section.*

- Manitoba leads Canadian growth in sow (46%) and market hog (32%) numbers.

Table 2.1: Hog inventories in major hog producing provinces, 2006

HOG INVENTORIES – APRIL 1, 2006					
	BREEDING		MARKET HOGS		TOTAL HOGS
	Sows and bred gilts	Boars (six months+)	Under 20 kg	20 kg and over	
	000 head				
Canada	1,608	33	4,370	8,450	14,460
Quebec	413	6	1,231	2,500	4,150
Ontario	426	10	1,091	2,067	3,593
Manitoba	373	5	976	1,567	2,920
Alberta	215	6	600	1,178	2,000

Source: Statistics Canada, Hog Statistics, Catalogue No. 23-010-XIE, 2006.

Figure 2.1: Sows and bred gilts inventories in Quebec, Ontario, Manitoba and Alberta

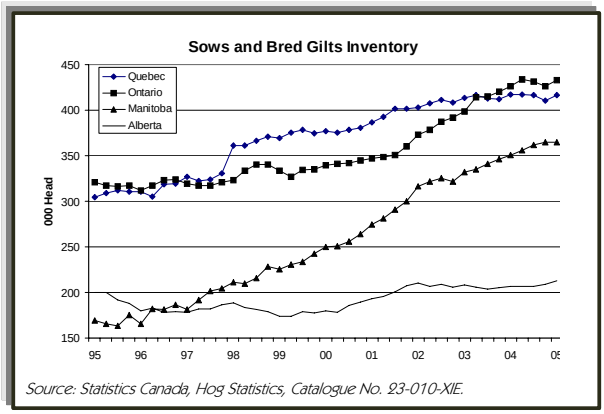
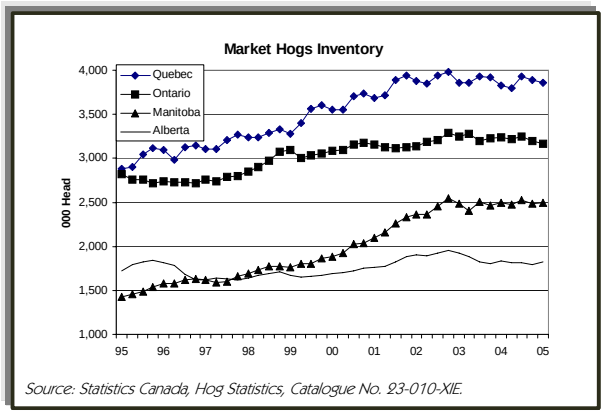


Figure 2.2: Market hog inventories in Quebec, Ontario, Manitoba and Alberta



Growth from 2000-2005

Quebec: 10%
Ontario: 28%
Manitoba: 46%
Alberta: 18%
Canada: 24%

Growth from 2000-2005

Quebec: 10%
Ontario: 3%
Manitoba: 32%
Alberta: 8%

2.1.2 Hog density[3]

Table 2.2 below compares the density of hog production by province. In addition, the table highlights the fact that hog production may be concentrated geographically within a province. In Quebec, the propensity of the industry to concentrate production in certain regions is demonstrated by the density numbers for Chaudière-Appalaches and Montérégie-Est.

3. *All data is sourced from Statistics Canada, Livestock and Animal Products Section.*

Table 2.2: Comparison of hog density by province and region, 2001

PROVINCE OR REGION	AVERAGE NUMBER OF HOGS IN INVENTORY PER HECTARE OF AGRICULTURAL CULTIVATED LAND
Alberta	0.17
Saskatchewan	0.06
Manitoba	0.40
Ontario	0.87
Quebec	2.18
Chaudière-Appalaches	5.69
Montérégie-Est	4.30
New Brunswick	0.86

Source:Debailleul and Boutin, 2004.

Overall, Quebec has the highest density of hogs within the Canadian provinces. From the data, it is apparent that the western provinces have relatively weak hog densities while Ontario and New Brunswick have moderate hog densities.

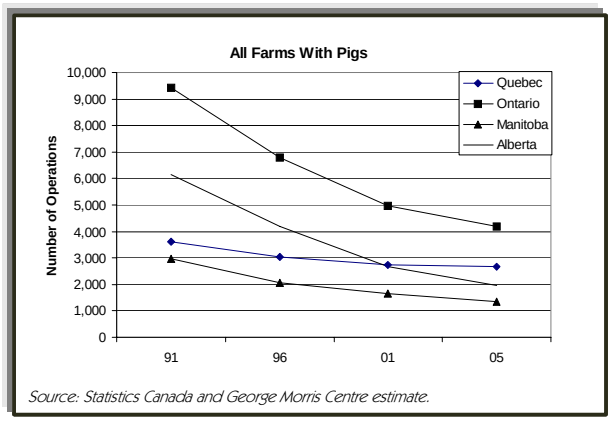
2.1.3 Numbers and types of enterprises[4]

As with the sections above, this section of the report is strictly a factual overview of trends in the number and types of hog operations. The graphs provide nearly a decade and a half of viewpoint. The summary data on operations after each graph provides a longer term perspective (96-2005) than the summary data for hog numbers (2000-2005) from section 2.1.1. This change in time frame is due to the fact that producer numbers change less rapidly than hog numbers and also because the Statistics Canada data series is provided on a five year/Census year basis.

From the tables below, there has been a significant decline in the number of operations of all types in all provinces. The only exception to that trend has been the increase in finishing operations in Quebec. As well, there has been a material increase in the average size of all operations between 1996 and 2005 with many types more than doubling. It is interesting to note that Quebec has had the slowest growth in average size of operations by a large margin, which is likely the result of the moratorium that was in place for many years.

4. *Statistics Canada's Livestock and Animal Products Section provided data on number of operations and inventories for all hog farms. This data is compiled based on the Quarterly Survey. The Agriculture Division provides a breakdown on the types of operations (farrowing, farrow to finish, finishing) in Census years (1991, 1996, 2001). The Agency defines a farrowing operation as one that has sows greater than zero; grower and finishing pigs must be less than or equal to the sum of sows holdings with 20 pigs or more. Finishing operations are defined as operations in which sows are less or equal to 5 percent of total pigs holdings with 20 pigs or more. Farrow to Finish operations are those remaining holdings with 20 pigs or more. The 2005 breakdown of types of operations is a George Morris Centre estimate based on the trends within the census data combined with the number of operations reported in the quarterly survey.*

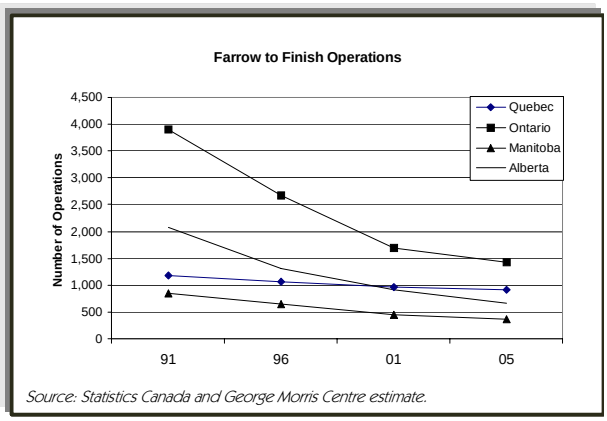
Figure 2.3: Number of operations with pigs



Change in number of operations with hogs from 1996-2005

Canada: -37%
Quebec: -12%
Ontario: -38%
Manitoba: -34%
Alberta: -53%

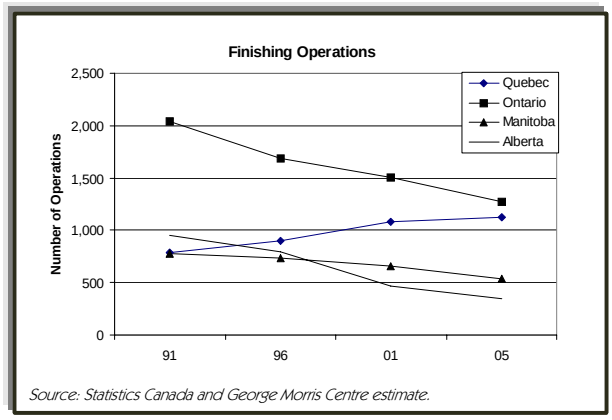
Figure 2.4: Number of farrow to finish operations



Change in number of farrow to finish operations from 1996-2005

Canada: -40%
Quebec: -14%
Ontario: -47%
Manitoba: -42%
Alberta: -49%

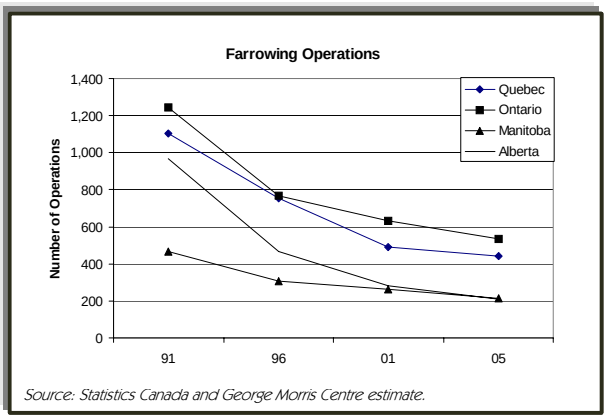
Figure 2.5: Number of finishing operations



Change in number of finishing operations from 1996-2005

Canada: -27%
Quebec: 24%
Ontario: -24%
Manitoba: -26%
Alberta: -57%

Figure 2.6: Number of farrowing operations



Change in number of farrowing operations from 1996-2005

Canada: -40%
Quebec: -42%
Ontario: -30%
Manitoba: -30%
Alberta: -55%

Table 2.3: Average size of operation (total number of pigs)

AVERAGE SIZE OF OPERATION								
	All operations		Farrowing		Farrow to finish		Finishing	
	1996	2005	1996	2005	1996	2005	1996	2005
Canada	523	1,107	405	922	1,039	2,121	589	1,278
Quebec	1,132	1,597	577	947	1,631	2,195	1,418	1,662
Ontario	418	860	316	791	725	1,333	378	1,002
Manitoba	861	2,110	835	2,107	1,600	4,112	670	1,649
Alberta	415	1,038	220	509	1,052	2,423	293	898

Source: Statistics Canada.

Table 2.4: Change in average size of operation

CHANGE IN AVERAGE SIZE OF OPERATION				
	All operations	Farrowing	Farrow to finish	Finishing
	1996-2005 % Δ	1996-2005 % Δ	1996-2005 % Δ	1996-2005 % Δ
Canada	112%	128%	104%	117%
Quebec	41%	64%	35%	17%
Ontario	106%	150%	84%	165%
Manitoba	145%	152%	157%	146%
Alberta	150%	131%	130%	206%

Source: Statistics Canada.

The major conclusions that can be derived from the statistics presented are:

- Quebec has the largest number of total hogs and market hogs.
- Quebec has by far the highest density of pig production in Canada. Ontario and New Brunswick have moderate densities while the western provinces have relatively low pig densities.
- There has been a significant decline in the number of operations of all types in all provinces. The only exception to that trend has been the increase in finishing operations in Quebec.
- There has been a material increase in the average size of all operations between 1996 and 2005 with many types more than doubling.
- Quebec has had the slowest growth in average size of operations by a large margin.

These statistics clearly demonstrate that over the past decade, the number of hog operations has fallen but the average size of operations has risen. As a result, the density and concentration of hog production within the four major hog producing provinces has increased. The continued growth in the number of hogs and increased concentration of hogs in Canada begins to illustrate why environmental issues can become a concern.

2.2 Overview of the Hog Industry with Respect to Environmental Concerns

From section 2.1 it is clear that hog production in Canada[5] is increasing, while the number of hog operations is decreasing. The data also illustrates that hog production in Canada is becoming more concentrated. With greater concentration of operations come greater risks to the environment that are specific to hog operations.

Hog production can have an impact on various elements of the environment, specifically, water, air, soil and biodiversity. The major source of environmental degradation from hog farms is waste products - manure, urine, and bedding material (Aillery, 2005). The primary pollutants associated with hog manure are nutrients (particularly nitrogen and phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds (US EPA, 2001). Hog manure is also a source of salts and trace elements, antibiotics, pesticides, and hormones. These pollutants can originate at several stages of production, including (Aillery, 2005):

- Production houses where hogs are confined;
- Manure storage structures such as tanks, ponds, and lagoons;
- Land where manure is applied.

The concentration of particular pollutants in manure varies with the type of hog, the size, maturity, and health of the individual animal, and the composition (e.g., protein content) of the feed (US EPA, 2001). Table 2.5 identifies the key pollutants from animal manure (although not specific to hog manure only), while Figure 2.6 identifies the linkages between hog production and the environment. The remaining sections go into more detail on the specific impacts from hog operations on water, air, soil and biodiversity.

Table 2.5: Key pollutants in animal manure

POLLUTANT	DESCRIPTION OF POLLUTANT FORM IN ANIMAL MANURE	PATHWAYS	POTENTIAL IMPACTS
Nitrogen	Exists in fresh manure in organic (e.g., ammonia in urea) and inorganic forms (e.g., ammonium and nitrate). Microbes transform organic nitrogen to inorganic forms that are absorbed by plants	Overland discharge Leachate into groundwater Atmospheric deposition as ammonia	Eutrophication Animal, human health effects
Phosphorus	Exists in both organic (water soluble) and inorganic forms. As manure ages, phosphorus mineralizes to inorganic phosphate compounds that are absorbed by plants	Overland discharge Leachate into groundwater (water soluble forms)	Eutrophication
Potassium	Most potassium in manure is in an inorganic form available for absorption by plants; it can also be stored in soil for future uptake	Overland discharge Leachate into groundwater	Eutrophication Increased salinity
Organic compounds	Carbon-based compounds in manure that are decomposed by surface water micro organisms. Creates biochemical oxygen demand, or BOD, because decomposition consumes dissolved oxygen in the water	Overland discharge	Depletion of dissolved oxygen Reduction in aquatic life

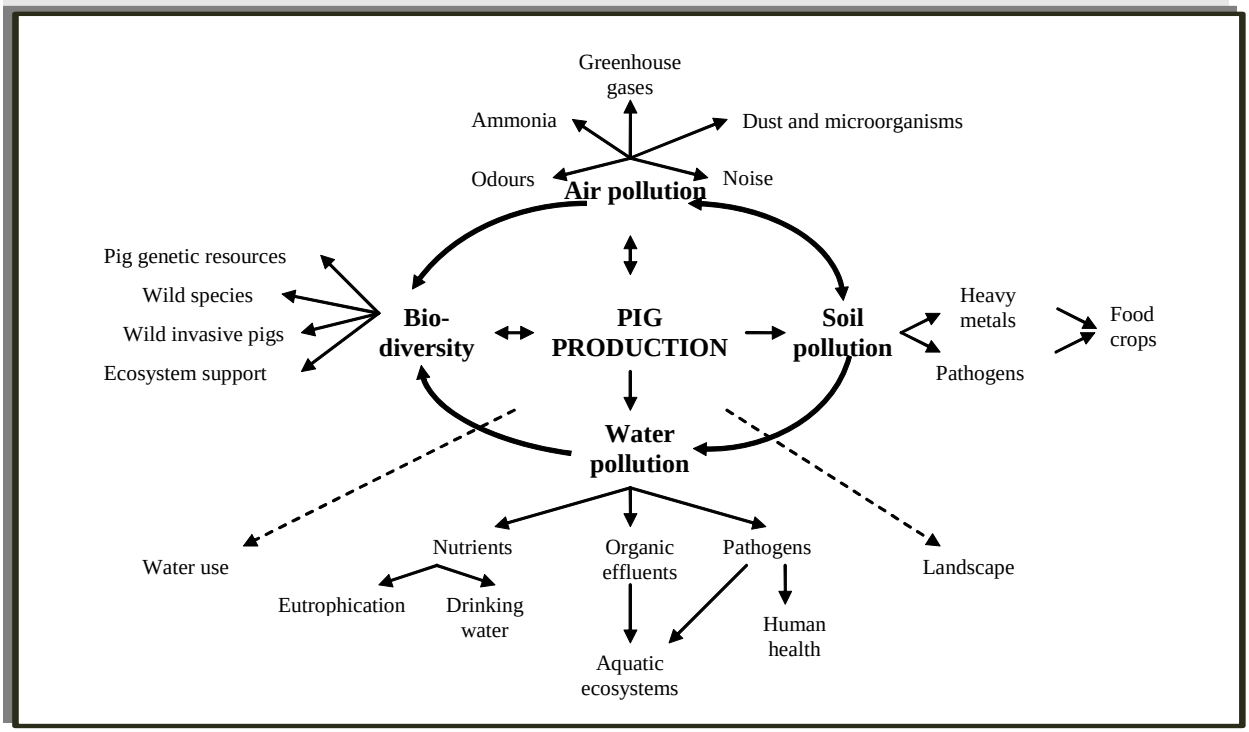
5. *As of January 2006, there were 14.5 million pigs reported on farms in Canada, up from 12.9 million in January 2000 (Statistics Canada, Pigs on Farms Quarterly).*

Table 2.5: Key pollutants in animal manure (Continued)

POLLUTANT	DESCRIPTION OF POLLUTANT FORM IN ANIMAL MANURE	PATHWAYS	POTENTIAL IMPACTS
Solids	Includes manure itself and other elements (e.g., feed, bedding, hair and corpses)	Overland discharge Atmospheric deposition	Turbidity Siltation
Pathogens	Includes range of disease-causing organisms, including bacteria, viruses, protozoa, fungi and algae. Some pathogens are found in manure, others grow in surface water due to increased nutrients and organic matter	Overland discharge Growth in waters with high nutrient, organic materials Algal by-products	Animal, human health effects
Salts	Includes soluble salts containing cations sodium and potassium (from undigested feed), calcium and magnesium; and anions chloride, sulfate, bicarbonate, carbonate and nitrate	Overland discharge Leachate into groundwater	Reduction in aquatic life Human health effects
Trace elements	Includes feed additives arsenic, copper, selenium, zinc, cadmium; and trace metals molybdenum, nickel, lead, iron, manganese, aluminum and boron (pesticide ingredients)	Overland discharge	Toxicity at high levels
Odorous, volatile compounds	Includes carbon dioxide, methane, hydrogen sulfide, and ammonia gases generated during decomposition of manure	Inhalation Atmospheric deposition of ammonia	Human health effects Eutrophication
Other pollutants	Includes pesticides, antibiotics and hormones used in feeding operations	Overland discharge	Impacts unknown

Source: US EPA, 2001.

Figure 2.7: Linkages between hog production and the environment



Source: OECD, 2003.

2.2.1 Water

Water pollution from hog operations can occur from a number of sources including organic effluents, nutrients, pathogens, bacteria, hormones and antibiotics. Also a concern is the consumption of water and the impacts to the surrounding water tables.

Organic effluents (aquatic ecosystems)

The contamination of water bodies with pollutants from hog production can occur through a variety of pathways, from both point or diffuse (non-point) sources of pollution, and transported as nutrient particles into soil and water or as organic effluents in the form of manure directly into waterways (OECD, 2003). The ecological impacts of swine manure releases to surface water can range from minor, temporary fluctuations in water quality (e.g., associated with limited surface runoff) to chronic degradation of ecosystems (e.g., associated with consistently poor management practices such as over-application), to dramatic impacts such as extensive fish or wildlife kills (e.g., acute events such as spills or toxic algae blooms) (US EPA, 2001). In some cases, individual pollutants associated with swine manure are the clear and direct cause of observable ecological effects. In other cases, ecological effects such as declines in aquatic populations are the result of complex systemic changes that are linked directly or indirectly to pollution from swine operations (US EPA, 2001).

Organic effluents usually contain nutrients and a high proportion of solids, which can enter waterways directly from pig slurry or manure storage. Rapid growth in micro-organisms causing a high biochemical oxygen demand (BOD) and consequently reducing the available oxygen to support aquatic life is a result of organic water pollution. Pig slurry has a very high BOD concentration, compared to other forms of manure[6]. Fish kills or major imbalances to aquatic ecosystems can be caused by direct discharge of organic effluents as BOD levels increase (Hooda et al., 2000 as cited in OECD, 2003).

Hog manure contains one of the lowest nitrogen to phosphorus ratios when compared to other manures. When soil can no longer retain phosphorus the risk of surface water contamination increases. Problems related to phosphorus runoff include: eutrophication[7]; overgrowth of algae and aquatic plants; reduced oxygen levels in water and subsequent changes in the species composition of the aquatic ecosystem (Bolinder et al., 1998 as cited in Desroches et al., 2001). In Ontario, British Columbia and Quebec phosphorus levels in soil receiving hog manure are a concern. British Columbia and Quebec farmers find it particularly challenging to acquire enough land for environmentally sound land application of manure (e.g. in Quebec approximately 3,000 farmers are faced with this challenge and at least six watersheds exceed crops' need for nitrogen and phosphorus by more than 1 million kg/year) (AAFC, 2000b).

Phytase is an enzyme that breaks down the phytate molecule in feed so more phosphorus is absorbed by the pig. Phytase can reduce phosphorus excretions by 25-50% when mixed into hog feed (Environmental Defense, 1999; Jacobson *et al.*, 1998).

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6. *BOD_5 in swine manure is 3.1 kg per 1000 kg live animal weight per day, compared to 3.3 for layers and 1.6 for dairy and beef (ASEA, 1998 as cited in Goss et al., 2001).*

7. *Eutrophication: The process of overfertilization of a body of water by nutrients that produce more organic matter than the self-purifications processes of the water body can overcome. Eutrophication can be a natural process or it can be accelerated by an increase of nutrient loading to a water body by human activity (Schwart et al., 1976 as cited in Government of Canada, 1991).*

Nutrients (drinking water and eutrophication)

Nutrients are naturally occurring elements that are necessary for plant growth. However, when excess nutrients enter surface waters they can stimulate overgrowth of algae and bacteria, changing ecosystems via eutrophication. Disposal of excess nutrients, mainly nitrogen and phosphorus from pig manure is the primary cause of pollution of surface water (rivers and lakes), groundwater and marine waters in pig farming areas. Nutrients in surface water and groundwater can decrease drinking water quality, increase purification costs, and in high enough concentrations, cause harm to humans (OECD, 2003; AAFC, 2000a; AAFC, 1998b; CSALE, 1996).

As the trend toward fewer but larger farms increases, the production of recoverable manure nutrients exceeds the assimilative capacity of the cropland and pasture on farms. This trend is becoming a challenge in Canada and the United States where spatial concentration of pig production has occurred more quickly than in many other OECD countries (Beaulieu, 2003; Coote and Gregorich, 2000; Gollehon et al., 2001; Kellogg et al., 2000 as cited in OECD, 2003).

Furthermore, a common practice among large-scale hog farms is to store manure in lagoons before spreading it on cropland. Contamination to water can occur from lagoons through loss of nitrogen from the surface to the atmosphere (deposited downwind in rain); through loss of nutrients from the bottom and sides to the soil and water table; by exit from a breach of the lagoon caused by heavy rains or floods; and by the residues and contaminated soil when the lagoon is decommissioned (Government of Manitoba, 2000; CSALE, 1996).

Pathogens (aquatic ecosystems, human health)

Pathogens[8] in pig manure are another source of water pollution (e.g. bacterial and parasites), which can also directly enter waterways and the air from faecal discharges, leaking slurry/manure storages, and from field application of pig manure. Fish and shellfish in aquatic ecosystems can be damaged by these pathogens, as can humans, through compromised drinking water quality (US EPA, 1999a as cited in OECD, 2003).

When manure is incorporated, pathogens may survive in the soil, particularly in cold climates. When manure is sprayed, some pathogens survive in the atmosphere and may be carried several kilometres down wind. Excess applications can contaminate streams by surface runoff or groundwater by percolation, especially if the water table is close to the surface (Government of Manitoba, 2000).

Antibiotics and hormones

Hog manure and waste water from a hog operation can have traces of many things, two of which can include hormones and antibiotics. Antibiotics and hormones can negatively impact the environment from manure when it is over applied, causing run-off and degradation of water quality. Antibiotics and hormones can be a problem with waste water when manure storage systems do not properly control manure seepage (Waste Reduction Resource Centre, 2006).

Human health concerns have arisen from antibiotics and hormones that have ended up in the food supply, which are now being considered for contributing directly to antibiotic resistance in the human population. In a study conducted on waterways near Iowa hog farms in 1999, Federal

8. *Examples of pathogens found in swine manure include: Brucella sp., Leptospira sp., Treponema sp, Clostridium tetani, Mycobacterium spp., Escherichia coli, Salmonella sp... (Strauch, 1998 as cited in Goss et al., 2001)*

Health investigators found contaminants including pathogens, metals, antibiotics commonly fed to hogs, bacteria, nitrates, and parasites. A further study conducted by the Centers for Disease Control and Prevention found that some of the bacteria discovered were resistant to antibiotics (Hudson, 2006). Growth-promoting hormones have been the subject of ongoing trade disputes between North America and the European Union. The EU is concerned that some hormones may be carcinogenic (Ahearn, 2006).

Water consumption

Water plays a central role in swine operations due to its importance in pig development and growth. Water contributes to pig development through thermoregulation (as a means of cooling through evaporation during breathing), feed intake and metabolism and urinary tract and health (Gonyou, 1996). Table 2.7 illustrates the daily water requirements (i.e., disappearance) for hog operations.

Table 2.6: Daily water disappearance

	SOURCE			
Production stage	MLMMI[a]	Prairie Swine Centre[b]	North Carolina[c]	The Netherlands[d]
Breeding/gestation (L/sow/day)	15.7	15.0	26.0	10.0
Farrowing (L/sow/day)	37.4	20.0	32.0	–
Nursery[e] (L/pig/day)	3.4	3.0	3.0	1.4
Grow/Finish[f] (L/pig/day)	7.7	7.0	17.0	4.6

[a] *Manitoba Livestock Manure Management Initiative.*
[b] *Pork Production Reference Guide, 2000.*
[c] *Water Intake of Pigs, Swine News, Feb., 1999.*
[d] *The Dutch Water Consumption, Research Institute for Pig Husbandry, 1999.*
[e] *Nursery is typically from weaning to approximately 50 lbs.*
[f] *Finishing usually occurs from 55 lbs to slaughter weight (235-280 lbs).*

The water is used for drinking, cleaning facilities, sanitizing equipment and diluting manure. The quantity of water consumed by each animal depends mainly on physiological and environmental conditions such as age, life stage, temperature, humidity, activity level and water content of the feed (Kienholz et al, 2000 as cited in Desroches et al., 2001). Large-scale pig barns that use well water can lower water tables, affecting wells, ponds, and the vegetation in low-lying areas in the vicinity (Government of Manitoba, 2000). Water use for irrigation to grow the feed for confined hog operations could also has an impact on water levels (OECD, 2003).

2.2.2 Air

The production of hogs can contribute to air pollution in many different ways. The primary airborne emissions from pig farming are ammonia, methane and nitrous oxide. People living close to pig farms and those working in pig barns can also be exposed to airborne micro-organisms and dust as well as unpleasant odours and noise (ISU, 2002 as cited in OECD, 2003; Government of Manitoba, 2000).

Ammonia

Pig manure contains a significant amount of ammonia (NH_3) which is released into the air from pig housing, stored manure and the land application of manure (Sommer and Hutchings, 2001 as

cited in OECD, 2003). Although estimates of ammonia emission rates vary depending on the season, housing conditions, livestock type and other factors, pigs are possibly a significant source of ammonia pollution (OECD, 2003).

It is estimated that agricultural ammonia air emissions contribute approximately 90% to total anthropogenic gaseous ammonia emissions. It should be noted that agricultural emissions are estimated from statistics on activities and techniques using emission factors and there is a fair amount of uncertainty. However, livestock ammonia emissions are estimated to account for over 80% of agricultural emissions in the OECD (OECD, 2003). The share of pigs in total livestock ammonia emissions varies depending on the relative importance of the pig sector in national livestock production (OECD, 2003).

Pig production systems in Canada (including lagoon storage of manure and spreading of manure onto land) allow for up to 75% of the excreted nitrogen to be lost through ammonia emission. Ammonia emission increases when temperature increases. Redeposition may lead to acidification and nutrient imbalance in some ecosystems, including surface water and eutrophication of the environment with prolonged exposure.

Nitrous oxide is produced naturally in soils by the microbial process of nitrification, the oxidation of ammonia to nitrate (NO_3), and also the process of denitrification, the reduction of nitrates or nitrites (NO_2) to gaseous nitrogen (Energy Information Administration, 2006). An increased amount of NO_2 results in a grayish-brown haze (smog), which manifests in high concentrations. Better manure practices (i.e., incorporating manure immediately into the soil after field application) and improved diet may reduce ammonia emissions (OECD, 2003; AAFC, 1998b). The feed additive yucca schidigera may assist in reducing odour and ammonia emissions (Jacobson et al., 1998).

Greenhouse gases

Greenhouse gas emissions from agricultural sources can be attributed to three main gases: nitrous oxide, methane and carbon dioxide. In 2001, the net emissions of these three gases from on-farm practices was 8% of Canada's total greenhouse gas emissions (AAFC, 2005). Between 1981 and 2001, GHG emissions from on-farm practices decreased by 6%, and this decrease can largely be attributed to agricultural soils changing from a source of GHG emissions to a sink for GHG emissions (AAFC, 2005).

Swine production is a major contributor to agricultural greenhouse gas (GHG) emissions. Current research on the emission rates in swine production facilities is not extensive and generally produces high uncertainty when estimating emissions from the industry (Maycher, 2003). However, a more recent study by Lague et al. (2004) does examine GHG emissions from swine production systems in Canada. The results of the research are presented in Table 2.7. Total GHG emissions were estimated at 1,835 kT of carbon dioxide equivalent per year, which corresponds to about 3% of the total agricultural emissions.[9]

9. *In this report, the quantities of emissions are expressed in the CO_2 equivalents of the Intergovernmental Panel on Climate Change (IPCC). These equivalents consider the global warming potential of each gas. With this measure 1 tonne of N_2O is equivalent to 310 tonnes of CO_2, and 1 tonne of CH_4 is equivalent to 21 tonnes of CO_2.*

Table 2.7: Carbon dioxide, Methane and nitrous oxide emissions

SOURCE	CO_2		CH_4		N_2O	
	(kT/yr)	Percent	(kT/yr)	Percent	(kT/yr)	Percent
All	508,00	100	4,300	100	210	100
Agriculture	2,000	0.39	1,070	25	115	53
Swine (total)	298.8	0.059	55.43	1.3	1.2	0.57

Source: Lague et al, 2002 as cited in Lague et al, 2004.

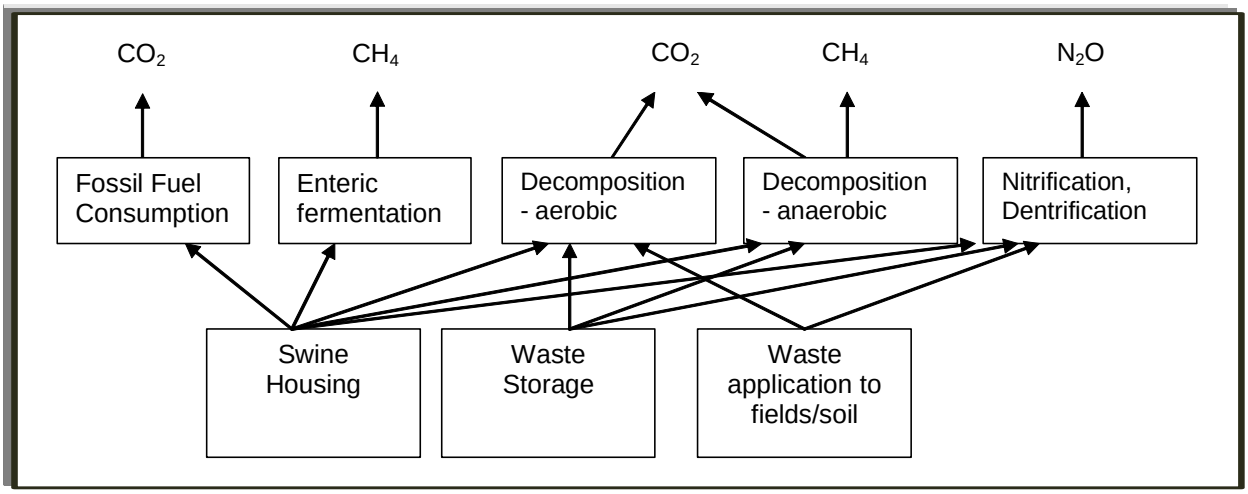
The swine industry releases carbon dioxide, methane and nitrous oxide mainly from swine housing, manure storage and the application of manure to fields. Swine housing also produces emissions from all of the biological processes, and manure and urine deposited on the floor begin to decompose and lead to nitrification (Maycher, 2003).

Decomposition can be aerobic or anaerobic. Aerobic decomposition tends to produce higher emissions of carbon dioxide and lower emissions of methane, and anaerobic emissions are the opposite. The quantity of nitrous oxide is generally higher for aerobic decomposition (Maycher, 2003).

Carbon dioxide is released from the combustion of fossil fuels that are used to heat facilities. Methane is produced from the microbial processes that decompose feed materials in a pig's large intestines. As well, the decomposition of manure during collection, storage and land application is a contributor to methane production. In 1996, the Intergovernmental Panel on Climate Change (IPCC) estimated that swine production systems in developed countries under cool climates could have united methane emissions of 1.5 and 10 kg per animal per year for enteric fermentation and manure management respectively. Most of the nitrous oxide emitted by swine production originates from manure management as the decomposition of manure can produce nitrous oxide. The procedure presented by the IPCC (1996) estimates that unit nitrous oxide emissions in North America from manure management in swine production systems (assuming liquid manure management) amount to 0.02 kg per animal per year.

Figure 2.8 highlights the processes that contribute significant levels of greenhouse gases.

Figure 2.8: Greenhouse gases



Source: Maycher, 2003.

Several studies have looked at greenhouse gas emissions depending on the type of swine operation and manure storage facilities. A study by Lague et al. (2004) evaluated methane, carbon dioxide and nitrous oxide emissions as well as odour emissions from swine operations in Quebec and Saskatchewan under liquid manure management. The objectives of the study were: to determine greenhouse gas and odour emissions from different types of swine production building and building floor designs; to determine GHG and odour emissions from two manure treatment systems; and to determine GHG and odour emissions from different types of manure storage facilities.

The study found that the most important contributor to GHG emissions from swine buildings was carbon dioxide. Methane emissions, on an animal mass basis, were much lower, and nitrous oxide was found to be almost negligible. Overall, it was found that the largest amount of carbon dioxide production was found in grower-finisher rooms, and the smallest amount was measured in gestation rooms.

Different types of manure storage facilities also produced different amounts of GHG emissions. The study looked at earthen manure storage basis (EMB), both uncovered and covered with blown chopped straw, and concrete storage tanks. For the Saskatchewan facilities, it was found that the largest amount of GHG emissions occurred from the uncovered tank storage facilities. The study results confirm that there are positive impacts on GHG emissions when blown chopped straw is used as a cover in manure storage facilities.

Dust and micro-organisms

Micro-organisms and dust are created by pig housing units and impact people living in the vicinity of pig farms as well as those working in the units. Further research is needed about the impact and transport of micro-organisms and dust originating from pig housing.

Odours

Unpleasant odours produced by pig production are an important environmental nuisance. Sources of volatile compounds and odour from livestock operations include animal confinement buildings, manure piles, manure lagoons, and land application sites, where decomposition of animal manures by microorganisms produces gases. The four main gases generated are carbon dioxide, methane, hydrogen sulfide, and ammonia (USDA, 1992; Bouzaher et al, 1993 as cited in US EPA, 2001). Odours also originate from the animals themselves. Concentration, distance from the source, wind direction and speed, and the acuteness of one's sense of smell all contribute to the magnitude of odour emitted by hog production. Odours associated with airborne particulates (hog dust), which include endotoxins, have recently been directly linked to physical and mental health problems (Government of Manitoba, 2000; AAFC, 1998b).

In the Lague 2004 research discussed in the section above, odour emissions were also measured. The research found that at the Saskatchewan sites the nursery pigs produced the highest odour, followed by the grower-finisher rooms. As well, not surprisingly, uncovered tank storage facilities produced the highest average odour emissions.

Noise

Pig farming can generate many noises, which can be disruptive to neighbours and others in the vicinity. The maximum daily exposure of noise for a worker is 85 dBA. Noise from general farming activity is typically greater than 85 dBA and can be a significant source of noise pollution. Pig

production generates noise which ranges from 66-69 dbA in a pig barn nursery, to 95-104 dbA for pig barn gestation and between 131-133 dbA for pigs in confinement during feeding (British Columbia Ministry of Agriculture, Food and Fisheries, 2004; Kirychuk, 2002).

2.2.3 Soil

Pig production can harm soil quality and productivity through the accumulation of phosphorus, heavy metals (mainly copper and zinc), sodium and other soluble salts that are present in manure. As well, the presence of phosphate in feed leads to the production of cadmium in manure, which can also have negative impacts on the soil quality (from high concentrations of metals in the soil). The OECD (2003) has found that pigs only absorb 5-15% of metal additives, and the rest is excreted. The type of pig operation (feeder, sow, nursery or farrow-to-finish barns) also impacts the concentration of metals (copper and zinc) in manures because of the different concentrations of minerals used in feed (Racz, 2001). Table 2.8 provides a range of metal content of hog manure from a study conducted on Swiss farms in 1998 (Menzi and Kessler, 1998). Data in brackets are sample values obtained in Ontario (Brown, 2000 as cited in Goss et al., 2001).

Table 2.8: Range of metal content of manure from Swiss and Ontario farms

		COPPER	ZINC	CADMIUM	LEAD
SWINE	MANURE TYPE		$\mu g\ g^{-1}$ (dry matter basis)		
Finishers	Liquid	30-376 (774)	337-2,490 (1806)	<0.08-0.51	0.9-15.8
Sows + litter	Liquid	12-1,459	146-5,832	0.06-1.3	0.34-12.8
Dry sows	Liquid	28-418	269-1,112	0.09-0.56	1.2-23.9

µg is equivalent to one-millionth of a gram.
Source: Menzi and Kessler, 1998.

Pig manure application in the case with heavy metal accumulations can lead to crop contamination, causing possible human health problems, and it can also negatively impact soil performance (Haan *et al.*, 1998 cited in OECD, 2003).

Soils with pH values less than 6.5 are sensitive to metal loadings of copper and zinc which affect crop yield and quality if metal loadings are high. Mineral supplements in feed and the source of water used to operate pig facilities also impact the amount of sodium and other soluble salts found in manure (Goss et al., 2001).

Bacterial transport is also affected by soil pH. Long-term application of manure from pigs to land can result in a decrease in soil pH (Chang et al., 1991; Bernal et al., 1992 as cited in Goss et al., 2001). This will potentially reduce bacterial transport due to an increase in the number of binding sites available for bacterial adsorption and it may also affect bacterial survival. Application of swine manure induced larger changes in soil pH when compared to the application of cattle manure (Goss et al., 2001).

2.2.4 Biodiversity

Recalling from paragraphs above, manure land application can have negative effects on biodiversity if managed improperly. Runoff from fields or storage systems can carry high numbers of

nutrients as well as bacteria if the manure has not been incorporated or the bacteria have not been subject to stress. Phosphorus runoffs can also lead to an overgrowth of algae and aquatic plants in surface water. Increased nutrients, bacteria and overgrowth of algae and aquatic plants can negatively impact aquatic biodiversity. The entire ecosystem of the waterway can change in relation to increases in nutrients, bacteria and oxygen levels. Beneficial management practices can minimize the impact hog farms have on habitat and biodiversity.

The relationship between hog production and biodiversity can also be summarized in terms of its links at the genetic, species and ecosystem levels. The utilization of the genetic stock of hog breeds, domesticated (native and exotic breeds) and wild variants, is essential in maintaining hog production. The hog industry requires genetic variants and improvements in order to: upgrade the productivity of commercial lines of hogs; develop breeds less susceptible to disease and health problems; respond to changes in consumer demands for meat products (e.g. leaner cuts); and meet environmental demands, such as developing breeds that can lower pollutant emission levels per kilogram of meat produced (OECD, 2003).

2.3 Summary of Statistics and Environmental Concerns Related to the Hog Industry

Hog farming is an important agricultural activity in Canada. The number and strength of environmental regulations in a given province may be a reflection of the intensity of agriculture in the region and the resulting environmental problems that may occur. The statistics illustrate that the number of hog farms has decreased over the past decade, but the average size of hog operations has increased. As such, the density and concentration of hog production in Canada has increased. This continued growth and concentration begins to illustrate why environmental issues are a concern.

Hog production can have an impact on various elements of the environment, specifically, water, air, soil and biodiversity. The major source of environmental degradation from hog farms is waste products - manure, urine, and bedding material (Aillery, 2005). The primary pollutants associated with animal manure are nutrients (particularly nitrogen and phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds (US EPA, 2001), particularly ammonia. Animal manure is also a source of salts and trace elements, antibiotics, pesticides, and hormones. These pollutants can originate at several stages of production, including (Aillery, 2005):

- Production houses where animals are confined;
- Manure storage structures such as tanks, ponds, and lagoons;
- Land where manure is applied.

The environmental pollutants identified in the sections above illustrate that there are a number of potential impacts to the environment from hog production. Some of these include:

- Degraded water quality impacting animal and human health
  - Accelerated eutrophication
  - Pathogen and bacteria in water supply
  - Increased salinity of water supply
  - Depletion of dissolved oxygen in water supply
  - Reduction in aquatic life

- Turbidity and siltation of the water supply
- Antibiotics and hormones in the food supply

- Toxicity of the soil at high nutrient levels
  - Impacts on soil quality from the accumulation of heavy metals
  - Decreased soil pH for long term application of hog manure
- Increased greenhouse gas and air pollutant emissions
- Odour and noise pollution

Given the multitude of environmental concerns from hog operations and the potential to impact water, air, soil and biodiversity, the level and magnitude of environmental regulations are not surprising both globally and domestically. Section 3.0 reviews environmental policy to deal with the environmental concerns addressed in this section.

SECTION 3

Environmental regulations affecting hog operations

3.0 Environmental regulations affecting hog operations

Legislation and regulation have often been the principal policy tools used by Canada and its major trading partners to achieve environmental objectives. Section 3.0 reviews international environmental policy measures (section 3.1) and introduces the regulations affecting Canadian hog operations (section 3.2), as well as the key cost elements of these regulations. Section 3.3 provides a summary of trends in environmental regulations, both nationally and globally.

3.1 Overview of international developments in environmental policy measures

The following is an overview of international developments of environmental policy measures, as reported by the OECD in 2003. Table 3.1 provides a summary of the agri-environmental policies affecting pig producers in selected countries.

- In Canada, the primary responsibility for the environmental regulation of agriculture rests with the provincial and municipal levels of government. The federal government has set standards for nutrients, bacteria and pesticides. This policy framework is typical of OECD countries and reflects the rather localized nature of environmental concerns.
- Each European Union country is responsible for meeting nitrate targets set by the Nitrates Directive. Within European Union member countries, regulations can vary from region to region, particularly where the country has designated certain areas as nitrate vulnerable zones (NVZ) e.g. France, Italy and Sweden.
- The 1972 Clean Water Act (CWA) is the major United States federal legislation that addresses water quality. It provides for the development of federal, state and local government programs for reducing and preventing the contamination of surface and groundwater.
- The localized nature of policies also makes it very difficult to summarize the environmental policy measures impacting pig producers in any one country.
- All OECD countries have had environmental regulations in place over the past decade that affect pig producers. Although changes in regulations are not shown, evidence indicates that these have become more stringent. Other forms of regulatory and legal measures (i.e. cross compliance) have been only recently introduced in a few OECD countries.

- Measures broadly classified as advisory or institutional have also been more widely used in recent years. All countries are now undertaking some form of research relating to the impact of pigs on the environment. This research has often been translated into technical assistance and advice to farms, which is often used to try and persuade farmers to voluntarily change their management practices or adopt suitable technologies. Some attempts have been made in the last few years to develop community-based measures.
- The major environmental objective of policy instruments affecting the pig sector has been to reduce the level of water pollution. Other environmental concerns addressed by policy measures include odour, ammonia emissions, greenhouse gas (GHG) emissions, landscape and biodiversity. It is important to note that a particular policy measure introduced to deal with one environmental objective may have an effect on other environmental objectives.
- The United Nations Economic Commission for Europe (UNECE, 2006) in 1999, established an emission ceiling for 2010 for four pollutants: sulphur, NOx, VOCs and ammonia. This ceiling was enacted through the Gothenburg Protocol which will aim to reduce Europe's sulphur emissions by at least 63%, its NOx emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990 levels.

Table 3.1: Agri-environmental policies affecting pig producers in selected countries

	Payments based on farm fixed assets	Payments based on resource retirement	Payments based on farming practices	Environmental taxes/ charges[2]	Tradable rights/ quotas	Regulations	Cross-compliance mechanisms	Research[3]	Technical assistance and extensions	Labeling standards certification	Community based measures	TOTAL
Netherlands		X		X	X	X		X	X	X	X	8
Denmark			X	X		X	X	X	X		X	7
Belgium		X	X	X		X		X	X			6
Germany	X		X			X		X	X		X	6
Ireland	X		X			X		X	X			5
Sweden	X		X			X		X	X			5
UK	X		X			X		X	X			5
US	X		X			X		X	X			5
CANADA						X		X	X		X	4
France	X					X		X	X			4
Italy	X					X		X	X			4
Korea	X					X		X			X	4
Australia						X		X	X			3
Japan	X					X		X				3
Norway						X	X	X				3
Switzerland						X	X	X				3
TOTAL	9	2	7	3	1	16	3	16	12	1	5	75

Notes: 1. *An 'X' indicates that a policy measure(s) exists. The table mainly captures measures at the national level and so not all sub-national measures may be identified.*
2. *In a few OECD countries, such as Sweden, commercial fertilizers and pesticides are taxed. Although pig farmers in these countries who use these products are taxed they are not included in this table.*
3. *An 'X' identifies specific research, and technical assistance and extension provided for environmental purposes. Pig producers benefit from other forms of research, and technical assistance and extension.*

Source: OECD, 2003.

The following sections present a more detailed description of international regulatory items as they relate to the hog industry. Specific attention is paid to:

- Environmental taxes and charges
- Prohibitions on discharges to water
- Distance and siting regulations
- Permits
- Environmental assessment
- Restrictions affecting the level of manure production
- Regulations controlling the quantity of manure and the way manure can be spread
- Regulations requiring on-farm budgets and fertilizer plans

3.1.1 Environmental taxes and charges

Environmental taxes and charges have been in use in countries such as Belgium, Denmark and the Netherlands. The purpose of these taxes and charges is to discourage the excess production of nutrients in manure. The taxes are normally sector wide which include, but are not exclusive to, hog producers and in some cases they are related to the total level of nutrients from all nutrient sources, rather than those specifically from animal manure. The following describes these initiatives as they relate to Belgium, the Netherlands and Denmark:

- Taxes on phosphorus (P2O5) in manure were introduced in the Netherlands in 1986.
- In Flanders, Belgium, the 1991 decree established a levy on manure surpluses defined in terms of excess manure production in relation to land availability i.e., a surplus exists if the nutrient content of farm manure production exceeds a maximum application rate per hectare.
- In Denmark, the 1991 Action Plan for Agricultural Development required the establishment of maximum nitrogen (N) quota levels for each farm from the 1994 crop season. If producers exceeded these application rates by 1-5 kgN/ha or by 5-10 kgN/ha they were simply notified of their infringement or received a warning. If they exceeded it by more than 10 kgN/ha then the infringement was handed over to the public prosecution with a demand that the producer be fined according to the established guidelines (Ambus et al., 2001 as cited in OECD, 2003).

3.1.2 Prohibitions on discharge to water

In terms of water pollution, laws prohibiting the direct discharge of animal manure to surface waters have existed in most OECD countries since the early 1970s.

- Since 1969 farmers in Sweden have been required to collect or treat waste water and silage effluents to avoid negative impacts on human health or the environment (Swedish Ministry of Agriculture, Food and Fisheries, 2000a, as cited in OECD, 2003).
- Similarly, in Ireland the Local Government Act (sometimes referred to as Water Pollution Act) 1977 specified that a person shall not cause or permit any polluting matter to enter waters. Under this Act farmers could be issued with notices requiring improvements in their farm yard to reduce pollution potential, although they are generally issued after an incident of direct discharge into a watercourse. Failure to comply can result in a fine or imprisonment (Lara et al., 2001 as cited in OECD, 2003).

- In Germany, the Water Resources Act 1996 obliges farmers to take the due care necessary according to the circumstances to prevent pollution of the water or any other negative change in its properties when implementing measures which can be connected with effects on a water body (Nies and Hackeschmidt, 1999, as cited in OECD, 2003).
- In New Zealand, Regional Councils prohibit the discharge of untreated manure to water.

3.1.3 Distance and siting regulations

- Distance and siting rules are the primary policy measures used to regulate the impact of air pollution from odours. Over time, these regulations are becoming more stringent.
- In the EU, planning controls, particularly to regulate the development of intensive indoor livestock units, are widely applied within member states in order to protect landscape quality in certain areas. Typical measures that apply through planning controls include restrictions on the siting, design and size of new buildings, including pig production units (Brouwer et al., 2000 as cited in OECD, 2003).

3.1.4 Permits

Pig producers are often required to have permits which range from discharging pollutants to operating in general.

- In New Zealand, discharges into water of treated effluent require a consent permit from the Regional Council.
- In the United States, the 1972 Clean Water Act (CWA) requires large confined animal feed-lot operations (CAFOs), operations with over 1,000 animal units (equivalent to 2,500 pigs weighing more than 25 kg) to obtain a National Pollutant Discharge Elimination System (NPDES) permit.
- In the Netherlands, pollution permits are required for ammonia and odour emissions under the Environmental Protection Act.
- In the European Union, the objective of the Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC) is to achieve integrated prevention and control of pollution arising from different activities such as energy, mineral and chemical industries. The Directive is applicable to farms with more than 2,000 places for production pigs (over 30 kg) or over 750 places for sows.
- Pig producers in Ireland with more than 4,000 units are required to hold an Integrated Pollution Control (IPC) licence, which has been mandatory for new or expanding operations with more than 1,000 units since 1996 (Lara et al., 2001 as cited in OECD, 2003).
- In Sweden, farms with more than 200 animal units are required to apply for a permit to allow them to operate.

3.1.5 Environmental assessment

- The European Union Directive on Environmental Impact Assessment (85/337/EC) has been in force for a number of years now. The purpose is to ensure that the total effects of a project on both nature and people are assessed.
- In Flanders, Belgium all livestock producers must hold an environmental licence, which ensures that the conditions of manure storage and the environmentally sound disposal of manure are being met. Furthermore, farms with more than 100 pigs older than 10 weeks are required to have an Environmental Effects Report giving a detailed description of air,

water, soil and noise pollution (Wauters et al., 1999 as cited in OECD, 2003).

- In France, livestock rearing facilities over a certain size have been required to register under the Directives on Nitrates of Agricultural Origin 1991. Farms with between 50-450 pigs must simply declare their herds while those over 450 pigs require a permit.

3.1.6 Restrictions affecting the level of manure production

There are generally three forms of regulations placed on hog producers that can directly affect the level of manure production. These include regulations that limit livestock density, which are common in Europe; measures to limit the quantity of manure produced; and restrictions placed on the expansion of livestock operations.

- Norway introduced legislation in 1975 to limit the size of livestock operations. Under these regulations, the maximum number of pigs for slaughter that could be kept was 1,400. In 1987, the maximum number of sows was limited to 70. There are also animal density regulations which require farmers to have 0.4 hectares of land (either owned or leased) per animal waste unit.
- In Switzerland, the 1991 Law on Water Protection set a limit on livestock density to three livestock units, equivalent to 45 kg P2O5/ha and 315 kg N/ha.
- Maximum livestock density limits in Sweden have been set for all production units with more than 10 animal units. For example, the number of animals per hectare may not exceed 2.2 sows in production or 10.5 fattening pigs (Swedish Ministry of Agriculture, Food and Fisheries, 2000b as cited in OECD, 2003).
- In Germany, the number of animals that a livestock farmer is able to have is regulated by a maximum allowance of between 2 and 3 manure units per hectare. One manure unit is equivalent to 80 kg N/ha and 60 kg P2O5/ha, which in turn is equivalent under the regulations to 7 fattening pigs (Hacker and Du, 1993 as cited in OECD, 2003).
- In 1986, the Netherlands established a system of manure production quotas in an effort to limit the quantity of manure produced.
- In Flanders, Belgium, the first Manure Action Plan (MAP), which came into effect at the end of 1995, set a standstill on the total level of nutrient production from animal manure at the 1992 levels of 75.1 million kg P2O5 and 169.1 million kg N.
- In Flanders, Belgium the first MAP banned new livestock farms. In Spain, the Restructuring Act stipulates minimum distances between farms and an upper limit on the size of new farms, making it difficult to set up a new farm of any size in areas which already have high pig populations, such as Catalonia (Bondt et al., 2000 as cited in OECD, 2003).
- In the United States, some states have banned the introduction of new pig production facilities and/or put a limit on the expansion of existing facilities.

3.1.7 Regulations controlling the quantity and spreading of manure

- A large number of countries impose restrictions on the quantity of manure that can be spread on land, primarily for the purposes of limiting water pollution.
- In the European Union the Nitrates Directive sets down precise limits on the quantity of nitrogen from manure that can be spread in designated areas.
- In addition to regulations on the quantity of manure than can be spread, restrictions have also been placed to control the way manure is spread.

3.1.8 Regulations on manure storage

- In Norway, regulations require that all farmers have concrete storage capacity for eight months of manure production.
- In Sweden, pig farmers in the designated NVZs with more than 10 animal units must have storage facilities for 10 months of animal manure production while farmers with less than 10 units must have storage facilities of a size corresponding to 6 months manure production.
- In Denmark, under the 1987 Aquatic Environment Action Plan all livestock farms are required to have between six to nine months storage capacity depending on an individual farm assessment before January 1, 1993.
- In Flanders, Belgium, farmers must have six months storage capacity.
- In Germany, the determination of the necessary storage capacity varies from state to state. National regulation requires that it must be greater than the capacity necessary during the longest period when application to agricultural land is prohibited unless it can be proven that the excess quantity will be disposed of in an environmentally sound fashion.
- In the four regions of the Po Valley, Italy, pig farmers must have six months storage capacity, with some possibility for reduction in specific conditions (e.g. where there are slurry treatment facilities, small farm size etc.) (Cortellini and Bonazzi, 1999 as cited in OECD, 2003).
- In Japan, the Law concerning the Appropriate Treatment and Promotion of Utilization of Livestock Manure of November 1999 banned open-air and earthen storage of livestock manure after a certain transitional period. From that point livestock farming is no longer able to practice without appropriate compost houses and clean-up facilities (FAPRC, 2001 as cited in OECD, 2003).
- Regulations have also been put in place in recent years to reduce ammonia emissions from manure storage facilities. These have been primarily introduced in northern European countries.
- In Sweden, since 1997 all farms with more than 10 animal units have been required to cover their slurry and urine pits with a stable surface crust and ensure that filling takes place below the covering.
- In Denmark, the 2001 Action Plan for Reducing Ammonia Volatilization from Agriculture required liquid manure slurry containers to be covered on all livestock farms from August 1, 2001, except if a farmer participates in an in-house control system which documents the presence of a sufficiently tight floating layer. From August 1, 2002, solid livestock manure stores not in daily use must be covered (Ambus et al., 2001 as cited in OECD, 2003).

3.1.9 Regulations requiring on-farm budgets and fertilizer plans

- Hog farmers are required to prepare and submit on-farm nutrient budgets or fertilizer plans in a number of OECD countries.
- Fertilizer budgets form an integral part of the system in Belgium, Denmark and the Netherlands, where levies are imposed on excess nutrients. However, a number of other countries also require farmers to submit plans.
- In Norway, all livestock farmers must submit an annual fertilizer plan, indicating all inputs.

3.2 CANADIAN ENVIRONMENTAL REGULATIONS AFFECTING HOG OPERATIONS

This section identifies the set of environmental regulations affecting hog producers in Canada and the key cost elements of these regulations. In order to develop a list of environmental regulations to review, the inventory database developed by Nolet (2004) of federal, provincial, and local government environmental regulations (developed in the first phase of Agriculture and Agri-Food Canada (AAFC) research) was used as a starting point. In addition, the publication by AAFC in 2002 entitled Inventory of Provincial Policy Measures Addressing Environmental Issues in Agriculture in Canada was used to select relevant statutes and regulations at the provincial level. The research team also used provincial Queen's printers to identify new regulations that were developed since the research conducted by AAFC.

In order to review the costs of compliance associated with local regulations within each of the provinces, the research team selected one representative county/municipality for each province. The selection of the representative county/municipality was based on a high concentration of pig production as indicated by 2001 Census data (Statistics Canada, 2001). Table 3.2 identifies the representative counties/municipalities chosen by province.

Table 3.2: Representative counties by province

PROVINCE	REPRESENTATIVE COUNTY/MUNICIPALITY
British Columbia	Fraser Valley Regional District, City of Chilliwack
Alberta	Red Deer County
Saskatchewan	Rural Municipality of Lake of the Rivers
Manitoba	Rural Municipality of Hanover
Ontario	Huron County, Municipality of South Huron
Quebec	Montérégie County, Rouville (Regional Municipality), Saint-Mathias-sur-Richelieu (Municipality)
New Brunswick	Kings County
Nova Scotia	Kings County
Prince Edward Island	Queen's County

Source: George Morris Centre.

To determine which by-laws might impact hog operations at the local level, the research team contacted the county/municipal offices and asked whether there were by-laws in place that would impact new hog operations in the area.

In terms of federal environmental regulations, the regulations that may apply to hog operations in Canada include the Canadian Environmental Protection Act, the Pest Control Products Act, the Water Act, and the Fisheries Act. The research team concluded that the federal regulations were largely punitive in nature, meaning that the regulations were developed to punish polluters for their negative impact on the environment. As such, the research team decided that the federal regulations were not relevant for this project for two reasons. First, the goal of the project is to evaluate the costs for a new hog operation to comply with the environmental regulations, not to evaluate the costs for an operation that did not comply with the regulations. Secondly, it is beyond the scope of this project to assume that the model hog farm results in contaminants in excess of the levels regulated by government and to make assumptions regarding the amount and types of these contaminants.

The following sections detail the regulations reviewed by province and the key cost items of these regulations. A comparison of key cost items by province is provided in the following table (Table 3.3) in order to provide an overview of the provincial and municipal regulations prior to the detailed descriptions in the following paragraphs.

The website sources for the legislation and regulations are included in Appendix B.

3.2.1 British Columbia

Provincial regulations

In BC, the Water Act, the Environmental Management Act and its Agricultural Waste Control Regulation (131/92) may impose costs on hog operations at the provincial level. To begin with, under the Environmental Management Act, the province may require the completion of an environmental impact assessment if the Minister considers that a proposed action will have detrimental environmental impact and Minister needs more information.[10] The Agricultural Waste Control Regulation (131/92) of the Environmental Management Act provides additional requirements for manure storage, setbacks, disposal of mortalities, and composting. The regulation requires that agricultural manures be applied to land only as fertilizer or soil conditioner[11] and in a manner that prevents pollution.[12] Although no specific land base requirements are established, the legislation implies that nutrients applied be in balance with the nutrient demands of the crop being grown.[13]

According to the regulation, agricultural manure must be stored in a storage facility or as field storage. These storage facilities must be at least 15 metres from any watercourse and 30 metres from a water source for domestic use.[14] These storage facilities must have sufficient capacity to store manure for the period of time needed to spread the manure as fertilizer or remove the manure.[15] The regulation states that agricultural manures must not be applied on frozen land.[16] Therefore, although the provincial legislation does not have specified minimum storage requirements, an implied minimum would be 180 days of storage capacity according to provincial experts.[17] Agricultural manure may be stored as field storage for no longer than nine months as long as the storage is setback 30 metres from watercourses and water sources and no runoff occurs.[18] In certain areas of the province, field stored manure must be covered during rainy seasons to prevent runoff.[19] The regulation also details the proper disposal of livestock mortalities and composting requirements, including information on setbacks. Finally, the regulation states that emissions from forced air ventilation systems used on farm must not cause pollution.

10. *Refer to section 78 of the Environmental Management Act.*
11. *Refer to section 12 of the Agricultural Waste Control Regulation (131/92).*
12. *Refer to section 3 of the Agricultural Waste Control Regulation (131/92).*
13. *Source: Communication from Tom Droppo, Dairy/Pork Industry Specialist, BC Ministry of Agriculture and Lands, 604-556-3144.*
14. *Refer to section 7(1) of the Agricultural Waste Control Regulation (131/92).*
15. *Refer to section 6 of the Agricultural Waste Control Regulation (131/92).*
16. *Refer to section 14 of the Agricultural Waste Control Regulation (131/92).*
17. *Source: Communication from Tom Droppo, Dairy/Pork Industry Specialist, BC Ministry of Agriculture and Lands, 604-556-3144.*
18. *Refer to section 8 of the Agricultural Waste Control Regulation (131/92).*
19. *Refer to section 9 of the Agricultural Waste Control Regulation (131/92).*

Table 3.3: Overview of provincial and municipal regulations

PROVINCIAL REGULATIONS	B.C.	ALB.	SASK.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Construction permit		✔[a]		✔[b]					✔
Environ. impact assessment	If required[c]	If required[d]		If required[e]		✔		If required[f]	If required[g]
Nutrient management plan		✔	✔	✔	✔	✔	✔		
Separation distances of facilities from water sources	✔	✔		✔	✔	✔	✔[h]		✔
Separation distances of facilities from dwellings, land boundaries and neighbours		✔		✔			✔		
Separation distances for manure spreading from water including buffers		✔		✔	✔	✔	✔[i]		✔
Winter spreading restrictions	✔	✔		✔	✔	✔			
Days of manure storage		✔			✔		✔		
Public notice		✔				✔			
MUNICIPAL REGULATIONS	**B.C.**	**ALB.**	**SASK.**	**MAN.**	**ONT.**	**QUE.**	**N.B.**	**N.S.**	**P.E.I.**
Construction permit	✔	✔	✔	✔	✔	✔	✔	✔	✔
Environ. impact assessment									
Nutrient management plan									
Separation distances of facilities from water sources				✔		✔		✔	
Separation distances of facilities from dwellings, land boundaries and neighbours	✔		✔	✔		✔		✔	
Separation distances for manure spreading from water including buffers									
Winter spreading restrictions									
Days of manure storage	✔								
Public notice			If desired[j]	✔					

[a] *In Alberta, approval by the Natural Resources Conservation Board (NRCB) is required to construct/expand large livestock operations.*
[b] *In Manitoba, permits are required under the Livestock Manure and Mortalities Regulation (42-98) for construction/expansion of confined livestock areas or manure storage facilities - sections 6(1) and 16.1(1).*
[c] *Refer to Environmental Management Act for BC - section 78. Minister may require an environmental impact assessment if proposed action is felt to potentially have detrimental environmental impacts and the minister requires more information.*
[d] *In Alberta, under the Environmental Protection and Enhancement Act, if the province considers that the potential environmental impacts of the proposed activity warrant further consideration, the province may require the person to submit an environmental impact assessment report.*
[e] *In Manitoba, the Director may require a proponent to prepare an environmental impact assessment under the Environment Act - section 11(9)c.*
[f] *If required by the Minister, an environmental impact assessment must be submitted in Nova Scotia. Refer to Environment Act - section 34.*
[g] *In PEI, an environmental impact assessment may be required by the minister in considering a proposed undertaking. Refer to Environmental Protection Act - section 9.*
[h] *Separation distances from watercourses may apply in certain protected areas.*
[i] *Grass buffer is required adjacent to watercourses in Protected Area C.*
[j] *In the Rural Municipality of Lake of the Rivers, Saskatchewan, under municipal by-laws, council may advertise any proposal that will result in an intensive livestock operation and may hold a public hearing on the proposal.*

Source: George Morris Centre.

As well, the Water Act requires registration for the diversion or use of water from a stream, and requires a licence for diversion and storage of water as well as construction or alteration of streams. Under the Water Act, the province may also require a water management plan for certain situations in order to prevent risks to water quality and conflicts between water users.

To help producers comply with the provincial legislation, Manure Management Guidelines for the Lower Fraser Valley were developed in 2001.[20] These guidelines are intended to help producers understand proper manure application practices.

Municipal regulations

The Fraser Valley Regional District is the leading hog farming region within British Columbia. While there are very few farms in the region (11 per cent of the provincial total), these farms raised over 80 per cent (138,000) of the hogs and pigs in the province in 2001.[21] The Fraser Valley Regional District includes the City of Abbotsford, the City of Chilliwack, the District Municipality of Mission, the District Municipality of Kent, the District Municipality of Hope and the Village of Harrison Hot Springs. The City of Chilliwack was selected for this analysis as representative of the county. There are several municipal by-laws which affect new hog operations in the City of Chilliwack. These by-laws include the Building Regulation Bylaw 2003, the Zoning Bylaw 2001, and the Intensive Swine Operation By-law.

The Building Regulation Bylaw 2003, No. 2970 states that no person may construct or continue construction of a building or structure unless a building permit has been issued.[22] Under Zoning Bylaw 2001, No. 2800, the City of Chilliwack is divided into zones.[23] Intensive agriculture is permitted within the Agricultural Lowland (AL) Zone. Within the AL zone, manure storage facilities must be 30 metres from the land boundaries. Animal enclosures (exceeding 10m2) must be 15 metres from the land boundaries. In addition, dwelling units and animal enclosures must be separated by a minimum distance of 15 metres. Furthermore, Zoning Bylaw 2001, No. 2800 states that buildings and structures for intensive swine production shall be sited and constructed in accordance with the Intensive Swine Operation By-law 1981, No. 191, in force from time to time.

The Intensive Swine Operation By-law[24] applies to operations with more than five feeder swine. The by-law specifies that the maximum number of swine permitted on a land parcel shall not exceed the densities specified in the by-law. According to the Intensive Swine Operation By-law, a 600 sow farrow to finish operation is equivalent to 984 animal units. As an example of the densities specified in the by-law, a maximum of 1,005 animal units is permitted on 35 acres of land. Before a permit may be issued for an intensive swine operation, the owner must seek advice from the Ministry of Agriculture and Lands or an agrologist as to the suitability of the site, the requirements for manure storage and the economics of the proposed operation. In addition,

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20. *Source: http://www.farmwest.com/index.cfm?method=pages.showPage&pageid=61*

21. *Source: BC Regional Index, 2003. Retrieved April 17, 2006 from http://www.regionalindex.gov.BC.ca/Areas/AreaDisplay.asp?areaName=Fraser%20Valley%20Regional%20District&number=5&ind=Agriculture.*

22. *Source: City of Chilliwack, Building Regulation Bylaw 2003, No. 2970, http://www.gov.chilliwack.BC.ca/main/attachments/files/363/BL%202970%20Building%20Regulation%20Bylaw.pdf. Information retrieved May 8, 2006.*

23. *The source for the Zoning Bylaw 2001, No. 2800 is the City of Chilliwack. Information was retrieved April 17, 2006 from http://www.gov.chilliwack.BC.ca/main/page.cfm?id=377.*

24. *The source for the Intensive Swine Operation By-law, No. 191 is the City of Chilliwack. Information was retrieved May 3, 2006 from http://www.gov.chilliwack.BC.ca/main/attachments/files/363/BL_191_Intensive_Swine_Operation.pdf.*

buildings and structures must be recommended by the Ministry or a consulting agrologist in relation to space requirements, layout and intensity of operation. In addition, buildings and structures must be approved as to structural suitability by a professional engineer.

The Intensive Swine Operation By-law also specifies the setback distances of livestock and manure storage facilities from specified uses. For 984 animal units, livestock and manure storage facilities must be 305 metres from the nearest neighbour, 475 metres from establishments (such as restaurants, churches and schools) situated within the Agricultural Land Reserve (ALR), 1,074 metres from the urban ALR boundary, 30 metres from the land boundaries and must allow 95 metres for road allowance. Liquid manure storage facilities must be constructed of an approved metal container, concrete tank or lagoon. When liquid manure is stored in a lagoon, the soil must be tested for impermeability. Manure storage facilities must be adequate to contain all the manure generated for a period of not less than 120 days or the minimum period recommended by the BC Ministry of Agriculture and Lands, whichever is greater. The recommended minimum manure storage capacity according to the provincial experts with the BC Ministry of Agriculture and Lands is 180 days.[25]

3.2.2 Alberta

Provincial regulations

In Alberta, at the provincial level, hog operations are affected by the Agricultural Operation Practices Act and its regulations as well as the Environmental Protection and Enhancement Act and the Water Act. Under the Agricultural Operation Practices Act, the Natural Resources Conservation Board (NRCB)[26] has responsibility for regulating confined feeding operations (CFOs), manure collection areas, manure storage facilities, agricultural composting facilities and any associated structures (excluding residences). Producers wishing to construct a new facility, expand or modify an existing facility, or make amendments to an existing permit are required to apply to the NRCB.[27]

The NRCB administers a one-window provincial application process for CFOs, manure collection areas and manure storage facilities. When an NRCB Approval Officer accepts a completed application, copies of the application are sent to the appropriate agencies for review and consideration. The applicant may require licences, permits and authorizations from other agencies. These could include:

- a licence under the Water Act for the diversion of water (water supply),
- a licence or approval under the Environmental Protection and Enhancement Act,
- an authorization under the Public Lands Act for activities and/or structures on public lands, among other things.

The NRCB issues permits for approvals, registrations and authorizations, and considers applications for amendments to existing permits. Registrations apply to medium sized new/expanded confined feeding operations.[28] Approvals apply to large scale new/expanded confined feeding

25. *Source: Communication from Tom Droppo, Dairy/Pork Industry Specialist, BC Ministry of Agriculture and Lands, 604-556-3144.*

26. *The Natural Resources Conservation Board (NRCB) is a regulatory agency of the Government of Alberta.*

27. *Source: Sandi Roberts, Approval Officer, Natural Resources Conservation Board, 403-340-7018 and NRCB website http://www.nrcb.gov.ab.ca/home/default.aspx.*

operations.[29] Authorizations apply when a producer wants new/expanded manure collection areas or manure storage facilities.[30] Amendments apply when a producer wants to change an existing permit issued by the NRCB.

To apply for an NRCB permit, producers must complete and submit parts 1 and 2 of the two-part NRCB Application for Approval, Registration and Authorization, and provide supporting documentation to substantiate the technical information provided. Part 1 of the application includes general information such as name, land, number of animals, etc. Upon receipt of part 1, NRCB sends a copy of the application to the relevant county and conducts a site investigation to measure distances to neighbours. Part 2 of the application consists of technical requirements.

For the 600 sow farrow-to-finish model studied in this research, approval is required rather than registration. As part of the approval or registration application, hydro-geological assessments, nutrient management plans, site plans and engineering plans may be required.[31] Furthermore, authorization is required for the construction of manure storage facilities. As part of the authorization application, hydro-geological assessments, nutrient management plans, site plans and engineering plans may be required.[32] For construction of manure storage facilities and confined feeding operations, a professional engineer may be required to certify the required documents.

In terms of nutrient management plans, a waste storage plan must be submitted in order to construct a new manure storage facility. Upon approval of the waste storage plan and facility by NRCB, the producer is not required to submit further waste storage plans as long as the integrity of the storage facility is maintained and monitoring results (if applicable) meet NRCB requirements.[33] To receive approval, the producer must also submit a waste management plan to NRCB detailing the lands available for manure spreading. If the NRCB determines that the producer has sufficient land, the only future requirement is that the producer maintains records of the amount of manure spread, spreading locations, nitrates, etc. Records must be kept by the producer for 5 years.

Approval officers at the NRCB distribute a Notice of Application to potentially directly affected parties once the application is deemed complete. Such parties may include:

- Municipal governments—municipal districts and counties.
- Other agencies—irrigation districts, regional health authorities and other agencies.
- Potentially directly affected parties—as identified under the Agricultural Operations Practices Act.

Notification can be made in many ways, including by letter or in a local newspaper. If the application requires an approval or licence under the Water Act, the NRCB and Alberta Environment may develop a joint notice of application. Costs associated with notification of affected parties under the Agricultural Operation Practices Act or under joint notification with Alberta Environ-

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28. *Refer to Agricultural Operations, Part 2 Matters Regulation (AR 257/2001) – section 3(1).*
29. *Refer to Agricultural Operations, Part 2 Matters Regulation (AR 257/2001) – section 2(1).*
30. *Refer to Agricultural Operations, Part 2 Matters Regulation (AR 257/2001) – section 4(1).*
31. *Refer to Board Administrative Procedures Regulation (AR 268/2001) – sections 2(1) and 3(1).*
32. *Refer to Board Administrative Procedures Regulation (AR 268/2001) – section 4(1).*
33. *Source: Scott Cunningham, Approval Officer, NRCB, 403-340-5795.*

ment are paid by the NRCB. However, if a separate notice is required by Alberta Environment under the Water Act, the applicant is responsible for the cost of notification.[34]

Regulation 267/2001 provides information on land application and construction standards. Manure storage must be sufficient for 270 days of storage unless the government approves a manure handling plan for fewer days of storage.[35] Livestock facilities and manure storage facilities are subject to minimum separation distances from neighbours depending on multiple factors such as livestock odour production, type of livestock, and land zoning.[36] In terms of land application, the regulation states that manure may not be spread on frozen or snow-covered land.[37] Manure may be spread on land that is direct seeded or forage without incorporation as long as the land is 150 metres from nearby residences.[38] Manure must not be applied within 30 metres of a water well, within 10 m of water body if subsurface injection, or within 30 metres of water body if incorporating within 48 hours.[39] Producers applying more than 500 tonnes of manure annually must have soil tested before land application.[40] In terms of construction standards, the regulation states that short term manure storage must be 150 metres from the nearest residence and one metre above the water table.[41] In addition, manure storage must be 100 metres from water springs and wells, and 30 metres from common bodies of water.[42] The manure storage facility or collection area must include a liner.[43] The regulation also details requirements for the construction of earthen manure storages. For example, if required, operations with earthen manure storage may have to install monitoring wells to detect leaks around the facility.[44]

Under the Environmental Protection and Enhancement Act, if the province considers that the potential environmental impacts of the proposed activity warrant further consideration, the province may require the person to submit an environmental impact assessment report.

Under the Water Act, approval may be required for an activity, operation or diversion of water. Water licences are administered by Alberta Environment in conjunction with NRCB depending on water availability and water use.[45] Typically, there is no administrative fee associated with a water licence. However, a hydrogeologic study for groundwater is required in order to be granted a water licence.[46]

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34. *Source: Natural Resources Conservation Board website. http://www.nrcb.gov.ab.ca/downloads/documentloader.aspx?id=2751.*
35. *Refer to Standards and Administration Regulation (AR 267/2001) under Agricultural Operation Practices Act – section 10.*
36. *Refer to Standards and Administration Regulation (AR 267/2001) under Agricultural Operation Practices Act – section 3(2).*
37. *Refer to Standards and Administration Regulation (AR 267/2001) – 24(4.1).*
38. *Refer to Standards and Administration Regulation (AR 267/2001) – section 24(4).*
39. *Refer to Standards and Administration Regulation (AR 267/2001) – 24(6).*
40. *Refer to Standards and Administration Regulation (AR 267/2001) – section 25.*
41. *Refer to Standards and Administration Regulation (AR 267/2001) – section 5(3).*
42. *Refer to Standards and Administration Regulation (AR 267/2001) – section 7.*
43. *Refer to Standards and Administration Regulation (AR 267/2001) – section 9.*
44. *Refer to Standards and Administration Regulation (AR 267/2001) – section 18.*
45. *Source: Jody Miller, AB Environment, Red Deer County Office, 403-340-7052.*
46. *Source: Brian Bute, BCB Engineering, Lethbridge, Alberta, 403-329-9216.*

The purpose of the Beneficial Management Practices: Environmental Manual for Hog Producers in Alberta[47] is to document management options that are environmentally sound and comply with existing regulations. The manual is not legislated but serves as a tool for producers to attain more information regarding legislation and beneficial management practices.

Municipal regulations

In Alberta, under the Red Deer County Land Use Bylaw 2000/10, the County is divided into Land Use districts.[48] The districts applicable to agriculture include Agricultural District A, Agricultural District B, Agricultural District Small Holdings, and Business Agriculture Districts. The purpose of Agricultural District A is to provide an area that will facilitate a limited range of agricultural pursuits and other uses on lands in close proximity to urban centers where such uses do not conflict with the neighbouring urban centers. The purpose of Agricultural District B is to provide for a wide range of extensive and intensive agricultural activities. The purpose of the Agricultural Districts Small Holdings is to provide for specialized agricultural uses requiring parcel sizes smaller than a quarter section, where agriculture is the principal use of the parcel. The Business Agriculture Districts facilitate agricultural uses and commercial, recreation and/or industrial uses related to agriculture uses.

According to the Land Use Bylaw, the minimum separation distance requirements for development as established by provincial regulations shall be applied to all applications for uses for confined feeding operations. As well, no development may occur unless a development permit has been issued. However, if a permit has been issued by the Natural Resources Conservation Board, Red Deer county will accept that permit for their purposes. For agricultural operations with more than 20 acres, there is no fee charged by Red Deer County for establishment of the operation.[49]

3.2.3 Saskatchewan

Provincial regulations

In Saskatchewan intensive hog production facilities are regulated by Saskatchewan Agriculture and Food (SAF), under the Agricultural Operations Act, 1996. The purpose of the legislation and associated regulation is to protect surface and ground water. As such intensive livestock operations (ILOs) are required to submit two sets of plans and a voluntary set of mass mortality plans.[50] A waste storage plan and waste management plan approved by the province are required for intensive livestock operations that involve the rearing, confinement or feeding of 300 or more animal units for more than 10 days in a 30 day period. Since the 600 sow farrow-to-finish operation modeled in this report is equivalent to 888 animal units (refer to Appendix C), the model operation will require a waste storage plan and waste management plan. The waste storage plans consist of a site plan with particular interest into the geologic ability of the site to support the development of an earthen manure storage. This is generally accomplished by hiring

47. *Source: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw5838*

48. *The source for the Land Use Bylaw information is http://www.reddeercounty.ab.ca/county_services/index.php?main_id=144. Additional contact information for the Red Deer County office is 403-350-2152.*

49. *In Red Deer County, the development permit cost is $1 for every $1000 of development cost for commercial buildings. However, agricultural operations with more than 20 acres are exempt from the fee for the development permit. Source: Laura Tedball, Red Deer County, 403-357-2387.*

50. *Source: Wendi Dehod, Environmental Engineer, Saskatchewan Agriculture and Food, 306-933-5357.*

a professional engineer, licensed to practise in Saskatchewan, to conduct a geotechnical investigation. Recently, SAF developed and disseminated the Site Characterization Manual to the engineering community. This manual provides general information and guidance on the required geologic properties to satisfy the regulations.[51]

Waste management plans consist of the manure management and average daily mortality management plans. Generally the manure management plans contain information on the maximum expected animal inventory, confinement period, manure and nutrient production volumes, estimated crop rotation, soil zone, proof of access to sufficient land to utilize the manure as a fertilizer and the method of application. All of the information is collected at the time of application. Records or submission of records/plans are not a requirement under the legislation and regulations. Although, good record keeping is a highly recommended practise. As well, manure testing is required as part of the waste management plan to estimate the nutrient level of nitrogen, phosphate, and potassium in the manure.

The mortality management plan identifies the disposal steps to be completed for the expected, daily dead stock. Due to recent public awareness on natural disasters and disease outbreaks, SAF has begun working with producers to conduct some preliminary planning around activities and disposal methods to be carried out when emergencies are encountered where significant numbers of dead animals must be dealt with at one time.

Often, all of these plans are developed in assistance with SAF – Agricultural Operation staff, at no cost to the livestock producer.

The Environmental Management and Protection Act along with its regulations were reviewed by the research team but did not generate cost items for the model hog operation.

In terms of water use, the Saskatchewan Watershed Authority (SWA) has the responsibility for administering the approval process for construction and operation of wells and other ground water works and the right to use ground water. Under the Saskatchewan Watershed Authority Act, 2005, all ground water use except domestic requires an approval. Intensive livestock operations therefore require approval. The SWA's regulatory approval process for development of a ground water source project has two parts. The proponent of a proposed ground water development is required to obtain:

(1) Ground Water Investigation Permit (fee = $10)

(2) Approval to Construct and Operate Works and Water Rights Licence to Use Ground Water

The purpose of a ground water investigation is to ensure that the ground water source can sustain the proposed development, without any adverse impacts on the source or existing ground water users. Ground water investigations are typically conducted by engineers. The cost of a ground water study is extremely site specific depending on the depth of aquifers, etc.[52] If the ground water investigation is successful, the project proponent is required to file an Application for Water Rights Licence and Approval to Construct and Operate Works under the

51. *SAF staff are able to assist producers prepare Request for Proposal documents at no cost to the producer. The producer's cost of hiring a consulting engineer can range between $8,000 and $20,000 depending on the required soils investigation or on the complexity of the design required; a cost of $10,000 is typical.*

52. *Source: Devon Mutschler, Beckie Hydrogeologists Ltd., Regina, Saskatchewan, 306-721-0846.*

Saskatchewan Watershed Authority Act. The fee for the application ranges from $125 to $400. Once all regulatory and procedural requirements have been met, the SWA may issue an Approval to Construct Works.

The Saskatchewan Watershed Authority also collects a fee based on requirements of the Information Services Corporation (formerly known as the Land Titles office). The Information Services Corporation charges the SWA to register Notice of Approval of Works on the land title of the parcels of land on which the well and its raw water pipeline are located. A fee of $60/title will be assessed for each Notice registered on land titles.[53]

In addition to the legislation, normally-accepted practices for livestock operations in Saskatchewan are outlined in the Guidelines for Establishing and Managing Livestock Operations.[54]

Municipal regulations

Under the Zoning Bylaw[55] of the Rural Municipality of Lake of the Rivers, a development permit is required before commencement of construction of intensive livestock operations or new dwelling structures on farms. Under the by-law, council may advertise any proposal that will result in an intensive livestock operation and may hold a public hearing on the proposal. Intensive livestock operations will require discretionary approval and separation distances must be observed between the intensive livestock facilities and building developments. The following table (Table 3.4) details the required separation distances for livestock facilities from building development in the Rural Municipality of Lake of the Rivers. A greater separation may be needed from any liquid manure storage lagoon involved in the operation, to residential and other developments. The criterion of a separation distance to the lagoon from a residence of 1.5 times the distance in Table 3.4 will be considered adequate.

Table 3.4: Separation distances for ILOs

DEVELOPMENT	ANIMAL UNITS				
	10-49	50-299	300-499	500-2,000	>2,000
Residence, tourist accommodation or campground	400 m	400 m	800 m	1,200 m	1,600 m
Residential subdivision, hamlet, town or village	400 m	400 m	800 m	1,200 m	1,600 m

Source: Rural Municipality of the Lake of Rivers.

3.2.4 Manitoba

Provincial regulations

The provincial legislation in Manitoba affecting hog operations includes the Environment Act and its regulations, the Water Rights Act, the Planning Act, and the Water Protection Act. Under the Environment Act, environmental plans and development licences may be required for pro-

53. *Source: Jayson Ford, Ground Water Approvals, Saskatchewan Watershed Authority, 306-694-3433.*

54. *Source: Saskatchewan Agriculture and Food, Establishing and Managing Livestock Operations Guidelines. Retrieved May 24, 2006 from http://www.agr.gov.sk.ca/docs/livestock/beef/production_information/Livestock_Guidelines05.pdf.*

55. *Rural Municipality of the Lake of Rivers. Received faxed copy of zoning by-law. Contact: Mervin Guillemin, Administrator, 306-642-3533.*

posed developments. For the purposes of assessing the environmental impact of proposed developments, the province may require an environmental impact assessment report as part of the environmental plan.

The Livestock Manure and Mortalities Management Regulation[56] of the Environment Act identifies various approvals, land application restrictions, and construction standards that are applicable in Manitoba. To begin with, a permit is required for building manure storage facilities and confined livestock areas.[57] As part of the application for the manure storage permit, the province may require an evaluation of the site's soil.[58] If the province deems it necessary, a collection basin may be required as part of confined livestock areas. Before applying manure to land for a growing season, producers must submit manure management plans for the growing season to the Director (applies to operations with 300 or more animal units).[59] Manure management plans for the growing season must be submitted to Manitoba Conservation by July 10 for fall spreading and by February 10 for spring spreading. Manure management plans indicate the parcel(s) of land that will receive manure, the crop(s) to be grown, the amount of nutrients required to grow the crop(s), and the amounts of nutrients available in the manure.[60] In addition, every time producers want to spread manure, they must submit soil tests to Manitoba Conservation and upon approval, producers may spread manure.[61] If an operation has 300 animal units or greater, a permit is also required for disposal of mortalities by burial. After 2010, registration for liquid/semi-solid manure storage will be required.[62] Legislation related to land application includes a prohibition of winter spreading between November 10th and April 10th unless the operation has less than 400 animal units.[63]

Agricultural manure must be stored in a storage facility or as field storage. Manure storage facilities must be 100 metres from wells, drainage ditches, surface watercourse, and boundaries of operation.[64] Field storage of solid manure must be 100 metres from any watercourse, spring, or well.[65] If necessary, producers may be required to construct dikes around field storage. In terms of earthen manure storage requirements, if a plastic or compacted clay liner is not installed, then the sides and bottom of facility must be disced and compacted. If plastic or compacted clay liner is installed, then it must be placed over stable floor and dike that are to be compacted. Dike and floor protection constructed of concrete or approved material are required at the access ramp, point of discharge, and overflow channel. Dikes must be seeded to grass within one year of construction.

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56. *In 1998, the Manitoba government passed the Livestock Manure and Mortalities Management Regulations MR 42/98, under the Environment Act. On March 30, 2004 the amendment MR52/04 to the Livestock Manure and Mortalities Management Regulations MR 42/98 came into effect. Source: Tone Ag Consulting website. 2005. http://www.toneag.com/manureman.html*
57. *Refer to Livestock Manure and Mortalities Regulation (42-98) – sections 6(1) and 16.1(1).*
58. *Refer to Livestock Manure and Mortalities Regulation (42-98) – sections 6(3) a and b.*
59. *Refer to Livestock Manure and Mortalities Regulation (42-98) – sections 13(1) and 13(4).*
60. *Source: Tone Ag Consulting website. 2005. http://www.toneag.com/manureman.html.*
61. *Source: Marc Trudelle, Manitoba Conservation, 204-945-3789. Also, refer to Livestock Manure and Mortalities Regulation (42-98) – section 13(5).*
62. *Refer to Livestock Manure and Mortalities Regulation (42-98) – section 16.3(2).*
63. *Refer to Livestock Manure and Mortalities Regulation (42-98) – section 14(1).*
64. *Refer to Livestock Manure and Mortalities Regulation (42-98) – schedule A.*
65. *Refer to Livestock Manure and Mortalities Regulation (42-98) – section 7(2).*

In terms of land application of manure, the regulation specifies minimum setback distances of manure spreading from water sources depending on the manure application method and whether a permanent buffer strip exists.[66] Producers with injection or low-level application followed by immediate incorporation without a buffer strip must be setback 20 metres from lakes and 8 metres from rivers, creeks and large unbermed drains. Producers with high level broadcast or low-level application without incorporation and without a buffer strip must be setback 35 metres from lakes and 15 metres from rivers, creeks and large unbermed drains. Producers with injection or low-level application followed by immediate incorporation with a buffer strip must be setback 15 metres (consisting of 15 metres of vegetated buffer) from lakes and 3 metres (consisting of 3 metres of vegetated buffer) from rivers, creeks and large unbermed drains. Producers with high level broadcast or low-level application without incorporation but with a buffer strip must be setback 30 metres (including 15 metres of vegetated buffer) from lakes and 10 metres (including 3 metres of vegetated buffer) from rivers, creeks and large unbermed drains.

Composting manure and mortalities must be 100 metres from any watercourse and from the operation's boundaries. In addition, producers may need to install monitoring wells and collect water samples if required by the director. Annually, producers with more than 300 animal units are required to submit an analysis report of water from the operation's livestock drinking water source.

Under the Water Rights Act, producers require a licence for the use or diversion of water for agricultural purposes if they require more than 25,000 litres per day for the production of primary agricultural products, not including the use of water for irrigation purposes. The model operation for this analysis uses approximately 45,000 litres of water per day[67] and would therefore require a water licence. To obtain a licence, a producer must submit an application to the Water Licensing Section of Manitoba Natural Resources, Water Resources Branch. An initial office review of the application is then carried out to determine if the required volume is available from the indicated source. If the water supply is available, a licence is issued specifying allowable annual withdrawal rates. Additional conditions may be attached such as a requirement for monitoring water use rates and reporting of information (Manitoba Agriculture, Food and Rural Initiatives, 2001b).

Under the Planning Act, conditions may be imposed on the approval for the use of livestock operations. The following measures may be imposed: requiring covers on manure storage facilities; requiring shelter belts to be established; and requiring the owner of the affected property to enter into a development agreement. In addition, development permits and approval are required for the construction of small and large livestock operations.

The Water Protection Act was introduced in the Manitoba Legislature in March 2004 and was proclaimed on January 1, 2006, bringing the legislation into effect (Manitoba Wildlands, 2006). Regulations under the Act are currently being developed. The main purpose of the Act is to protect water from nutrients that may arise from the over-application of fertilizers, livestock manure and municipal wastewater sludge to adjacent lands beyond the amounts reasonably required for the benefit of crops and other plants within the immediate growing season (Manitoba Water

66. *Refer to Livestock Manure and Mortalities Regulation (42-98) – schedule C.*

67. *Source: Prairie Swine Centre.*

Stewardship, 2005). The Act and its regulations will likely impact the amount of land available for application of nutrients as well as the siting of municipal wastewater lagoons, manure storage facilities, and septic fields (Williamson, 2005).

In addition to the legislation, producers may need to comply with the Farm Practices Guidelines for Hog Producers in Manitoba in order to be eligible for financial assistance programs. For example, the requirements for the Canada-Manitoba Environmental Farm Plan workbooks and the Canada-Manitoba Farm Stewardship Program are based on legislation and the Farm Practices Guidelines.[68] The guidelines describe manure management systems and practices designed to protect the environment, reduce the risk of pollution, and minimize the odours experienced by neighbours. The guidelines are being reviewed and an updated version of the guidelines will be released in 2006. The guidelines state that manure storage facilities must be sufficient for at least 200 days of manure storage. Most earthen manure storage structures are built to provide storage for more than 400 days.[69]

Municipal regulations

The Rural Municipality of Hanover is subject to Zoning Bylaw 2061 and Hanover Bylaw 2077.[70] Under the Zoning Bylaw 2061, new livestock operations cannot exceed 600 animal units, unless the operation receives approval from the Livestock Technical Review Committee. The model hog operation for this research consists of a 600 sow farrow-to-finish operation which is equivalent to 750 animal units in Manitoba. In addition, livestock production operations are not allowed on land parcels of less than 40 acres. For livestock operations with more than 250 animal units, the site area must be 160 acres. Manure cannot be stored with 100 metres of any watercourse, body of water, sinkhole, spring or well. The zoning bylaw also specifies separation distances for livestock facilities and manure storage from dwellings. For operations with more than 250 animal units, barns must be located at least 400 metres from nearby dwellings. Earthen manure storage facilities must be located at least 500 metres from nearby dwellings. Finally, producers must send notice to neighbours if constructing a new livestock operation.

By-law 2077 specifies building and permit fees related to the construction of farm buildings and manure storage. The fees for agricultural manure storage facilities amount to $1.00 per animal unit. The fees for farm buildings are based on a tiered pricing system, subject to minimum fees. The fee for the first $5,000 of construction valuation is $35. The fee for each additional $1,000 of construction value is $2.50.

3.2.5 Ontario

Provincial regulations

In Ontario, hog producers may be subject to the provincial Nutrient Management Act. Under the Nutrient Management Act and its regulations, the requirements for compliance vary according to the size of the operation as determined by nutrient units.[71] New and expanding livestock operations with less than 300 nutrient units must complete an approved certified Nutrient Manage-

68. *Source: David Hay, Agricultural Sustainability Specialist, Manitoba Agriculture, Food and Rural Initiatives, 204-759-4050.*

69. *Source: http://www.gov.mb.ca/agriculture/livestock/publicconcerns/cwa01s13.html*

70. *To gather information on bylaws in Manitoba, the research team contacted the Rural Municipality of Hanover office at 204-326-4488 as well as Rick Fieldbrandt at 204-326-8656.*

ment Strategy (NMS)[72] and are subject to construction and siting standards, and setbacks from wells and surface water. New and expanding operations with greater than 300 nutrient units or those within 100 metres of a municipal well must have an approved certified NMS as well as a certified Nutrient Management Plan (NMP)[73]. These operations are subject to construction and siting standards, setbacks from wells and surface water, record keeping and soil testing, and priority land application and setback standards. Existing large operations with more than 300 nutrient units must be registered farm operations with NMSs and NMPs kept on the farm. These operations are also subject to construction and siting standards, setbacks from wells and surface water, record keeping and soil testing, and priority land application and setback standards.

In terms of land application of manure, the regulations state that liquid manure may not be applied within 150 metres from the top of the bank of surface water if the maximum sustained slope of the land is 25% or greater.[74] The regulations regarding setbacks from wells state that agricultural source materials may not be applied to land within 15 metres of a drilled well (with depth of at least 15 metres and watertight casing) or within 30 metres of any other well or within 100 metres of a municipal well.[75] As well, nutrients may not be applied to a field adjacent to surface water unless there is a vegetated buffer zone in the field that lies between the surface water and where the nutrients are applied.[76] In addition, the regulation states that no person can use a high trajectory irrigation gun capable of spraying liquid more than 10 metres to apply manure or non-agricultural source materials to land except if the material being applied is an aqueous solution or suspension containing more than 99% water by weight.[77]

Manure storages must be 15 metres from a drilled well (with depth of at least 15 metres and watertight casing), or 30 metres from any other well or 100 metres from a municipal well.[78] Manure storage facilities must be sufficient to contain 240 days of manure.[79] As well, in order to construct or expand a permanent liquid nutrient storage facility, the services of professional engineer must be retained.[80] For individuals completing a NMP, soil and manure sampling is required as part of the plan. Every owner or operator of an operation which requires a nutrient management strategy or nutrient management plan must keep the following records of the operation: copies of the NMP and NMS; record of the annual update to the NMS or NMP; site characterization if required; and the annual report of the operation.[81]

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71. *A nutrient unit is a defined as the amount of nutrients that give the fertilizer replacement value of the lower of 43 kilograms of nitrogen or 55 kilograms of phosphate (Nutrient Management Act, 2002). A nutrient unit is not the same as a livestock unit or an animal unit.*
72. *A Nutrient Management Strategy (NMS) describes generation, storage and destination of prescribed material. Source: Presentation by Sharon Johnston, Policy Analyst, OMAFRA, March 2005.*
73. *A Nutrient Management Plan (NMP) details how all nutrients are to be applied to a given land base.*
74. *Refer to Regulation 267/03 – section 42.1.*
75. *Refer to Regulation 267/03 – section 43.*
76. *Refer to Regulation 267/03 – section 44(1).*
77. *Refer to Regulation 267/03 – section 49.*
78. *Refer to Regulation 267/03 – section 63.*
79. *Refer to Regulation 267/03 – section 69.*
80. *Refer to Regulation 267/03 – section 65.*
81. *Refer to Regulation 267/03 – section 110.*

The regulation also details winter spreading restrictions. For land which is subject to flooding or land where water collects during a rainstorm or thaw and flows directly into surface water, manure may not be applied during the period beginning on December 1 of one year and ending on March 31 of the following year or at any other time when the soil is snow-covered or frozen.[82]

For land other than that described above (i.e. subject to flooding and water collection), application of liquid manure from December 1 to March 31, when the land *is not* snow-covered or frozen, must be done by injection, spreading and incorporation within the same day or surface application if covered by crop/crop residue which covers 30% of the land surface. In addition, application must be setback 20 metres from the top of a bank of surface water and materials must not be applied within 100 metres from the top of a bank of surface water if the slope is greater than 3%.[83]

For land other than that described above (i.e. subject to flooding and water collection), application of liquid manure, when the land *is* snow-covered or frozen, must be done by injection or by spreading and incorporation within 6 hours. In addition, application must be setback 20 metres from the top of a bank of surface water and materials must not be applied within 100 metres from the top of a bank of surface water if the slope is greater than 3%.[84]

The research team also reviewed the Environmental Assessment Act,[85] the Lakes and Rivers Improvement Act, the Ontario Water Resources Act, and the Environmental Protection Act; however, these regulations did not contain specific cost items for hog producers. In the future, hog operations will likely be impacted by the proposed Clean Water Act.

Municipal regulations

In Ontario, there are nine municipalities within Huron County. The Municipality of South Huron has been selected for this analysis as representative of the county. In order to construct a hog operation in the Municipality of South Huron, producers require building permits and must also pay a development charge.[86] Otherwise, local bylaws related to manure management are superseded by the Nutrient Management Act for new hog operations with greater than 5 nutrient units.[87]

3.2.6 Quebec

Provincial regulations

At the provincial level, hog operations in Quebec are affected by the Environment Quality Act and its regulations. The Environment Quality Act states that no person shall undertake any con-

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82. *Refer to Regulation 267/03 – section 47.*

83. *Refer to Regulation 267/03 – section 48 (2).*

84. *Refer to Regulation 267/03 – section 48 (3).*

85. *The Environmental Assessment Act does not apply to agricultural operations. Source: Ministry of Environment – conversation with personnel from the Environmental Assessment Act department on December 6, 2006.*

86. *The building permit cost is $300 for the first $5,000 in value and $10 per $1,000 of value thereafter. The development charge is $0.024/ft^2 up to 3,000 ft^2, 0.75% x $0.024/ft^2 up to 5,000 ft^2, 0.50% x $0.024/ft^2 up to 10,000 ft^2, 0.25% x $0.024/ft^2 up to 20,000 ft^2 and 1% x $0.024/ft^2 thereafter. Source: Eleanor Raider, Municipality of South Huron, 519-235-0310.*

87. *Source: Municipality of South Huron, Nutrient Management By-law, http://www.town.southhuron.on.ca/.*

struction or operation without following the environmental impact assessment and review procedure and obtaining an authorization certificate from the government.[88]

The Agricultural Operations Regulation of the Environment Quality Act specifies detailed requirements for agricultural operations in terms of approvals, land application requirements and construction standards. Operations with liquid manure whose annual phosphorus production is greater than 1600 kg or operations with spreading sites whose cumulative area is greater than 15 hectares must have agro-environmental fertilization plans before spreading fertilizers.[89] Record keeping pertaining to doses, spreading periods and methods is required.[90] These operations are also subject to manure analysis annually.[91] Operators of raising sites with liquid manure and annual phosphorus production of more than 1600 kg also require a phosphorus report. The phosphorus report must be updated annually relating to the analysis of livestock waste and the soil of cultivated parcels.[92]

Producers must file a project notice signed by an agrologist for new raising sites with liquid manure management. Confirmation from an engineer may be required to ensure that storage is of sufficient size.[93] In instances where a new raising site will generate annual phosphorus production of greater than 3,200 kg, the projects shall be subject to an authorization certificate.[94]

Land application legislation specifies that producers are prohibited from spreading manure within the shoreline of a watercourse, swamp, lake or pond and within one metre of an agricultural ditch.[95] Manure may not be spread between October 1st and April 1st or on ground that is frozen or snow-covered.[96] Spreading of manure with mobile or stationary spreading equipment designed to project manure at a distance of more than 25 metres is prohibited. Livestock manure from liquid manure must be spread with low-ramp equipment, which projects manure at a maximum height of one metre above ground over a distance of not more than two metres.[97]

Livestock and manure storage facilities must be 15 metres from a watercourse, lake, swamp, natural marsh or pond.[98] Manure storages must not be equipped with overflow drains or sump drains.[99] Storages must be equipped, on the entire outer perimeter, with a drain placed level with or below floor/bottom.[100]

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88. *Refer to Environment Quality Act – section 31.1.*
89. *Refer to Agricultural Operations Regulation – section 22.*
90. *Refer to Agricultural Operations Regulation – section 27.*
91. *Refer to Agricultural Operations Regulation – section 28.*
92. *Refer to Agricultural Operations Regulation – section 35.*
93. *Refer to Agricultural Operations Regulation – section 39.*
94. *Refer to Agricultural Operations Regulation – section 42.*
95. *Refer to Agricultural Operations Regulation – section 30.*
96. *Refer to Agricultural Operations Regulation – section 31. Note that fertilizers may be spread after 1 October on ground that is not frozen or covered with snow if the agrologist who designed the agro-environmental fertilization plan specifies a new prohibition period. In addition, if the fertilizers to be spread are from livestock waste, the proportion of that waste must be lower than 35% of the annual volume produced by the raising site.*
97. *Refer to Agricultural Operations Regulation – section 32.*
98. *Refer to Agricultural Operations Regulation – section 6.*
99. *Refer to Agricultural Operations Regulation – section 11.*
100. *Refer to Agricultural Operations Regulation – section 12.*

Under the Regulation Respecting Environmental Impact Assessment and Review of the Environment Quality Act, in order to construct livestock operations with more than 600 animal units in the case of liquid manure or 1,000 animal units in the case of semi-solid or solid manure, producers must complete the environmental impact assessment and review procedure as well as the certificate of authorization.[101] The Minister shall make the environmental impact assessment statement public upon receipt. The proponent of the project must then publish a notice in a daily and a weekly newspaper circulated in the region where the project is likely to be carried out, as well as in a daily newspaper in Montréal and in Québec City. The proponent must also, within 21 days following the publication of the first notice, publish a second notice in a weekly newspaper circulated in the same region.[102] In addition, any person, group or a municipality may, until 45 days after the date when the Minister made the environmental impact assessment statement public, apply to the Minister for the holding of a public hearing in connection with such a project.[103]

The objectives of the Groundwater Catchment Regulation are to promote the protection of groundwater intended for human consumption and to govern groundwater catchment in order to prevent the catchment from causing nuisance to neighbours or negatively impacting ecosystems. The regulation has special provisions for farming areas. The spreading of manure and fertilizer waste is prohibited less than 30 metres from any groundwater catchment work intended for human consumption. The spreading of manure and fertilizer waste is also prohibited within the bacteriological protection area of a groundwater catchment site where such water is considered vulnerable. [104] Under the regulation, a municipality may prohibit the spreading of manure, compost or fertilizer waste in defined portions of the supply area of a catchment work supplying a drinking water distribution system if the concentration in nitrates of water from a groundwater catchment site exceeds amounts set by the regulation.[105] The construction of raising facilities and manure storage facilities is prohibited less than 30 metres from any groundwater catchment work intended for human consumption or in the bacteriological protection area of a groundwater catchment site.[106] Storage of manure and fertilizer waste on the ground is prohibited less than 300 m from any groundwater catchment work intended for human consumption and in a bacteriological protection area of a groundwater catchment site where such water is considered vulnerable.[107]

Municipal regulations

Montérégie County in Quebec is comprised of fourteen regional municipalities and five independent cities. The regional municipality of Rouville was selected for this analysis due to the relatively high concentration of animal units in the region (Statistics Canada, 2003). Within the regional municipality of Rouville, there are eight municipalities including Ange-Gardien, Saint Césaire, Marieville, Richelieu, Sainte-Angele-de-Monnoir, Saint-Mathias-sur-Richelieu, Saint-Paul-d'Abbotsford, and Rougemont. By-law No. 184-03 applies to hog operations in the regional

101. Refer to Regulation Respecting Environmental Impact Assessment and Review – section 2 (o).

102. Refer to Regulation Respecting Environmental Impact Assessment and Review – section 6.

103. Refer to Regulation Respecting Environmental Impact Assessment and Review – Schedule B.

104. Refer to Groundwater Catchment Regulation – section 26.

105. Applies if the concentration in nitrates of water exceeds 5 mg/L for 2 consecutive controls.

106. Refer to Groundwater Catchment Regulation – section 29.

107. Refer to Groundwater Catchment Regulation – section 30.

municipality except for three municipalities (Ange-Gardien, Saint Césaire, and Marieville). These three municipalities have their own by-laws related to hog operations which are similar in nature to By-law No. 184-03. [108]

The purpose of By-law No. 184-03 is to control certain agricultural activities in the regional municipality, to establish separation distances, and to limit new operations in sensitive areas (e.g. along the Yamaska and Richelieu rivers). In six of the eight municipalities (all municipalities except Ange-Gardien and Saint Césaire), producers wishing to construct or modify hog facilities must apply to the regional municipality for authorization. The by-law also establishes separation distances based on the number of animal units, odour potential, base distances, type of manure (solid or liquid), type of project, usage, etc.[109]

Since June 2006, there have been additional temporary measures (other than By-law No. 184-03) that apply to four municipalities in the region (Marieville, Richelieu, Sainte-Angele-de-Monnoir and Saint-Mathias-sur-Richelieu). These temporary measures are expected to be in force for approximately four to six months. These temporary measures are not described within By-law No. 184-03 but state that no modifications to or construction of farm operations can occur within 3 km of the Richelieu river. In addition, separation distances have been doubled in these four municipalities.[110]

Building permits are issued by the individual municipalities, not the regional municipality.[111] The municipality of Saint-Mathias-sur-Richelieu within the regional municipality of Rouville was selected as the case study for this analysis. The cost of a building permit within the municipality of Saint-Mathias-sur-Richelieu is $2,000 for a building with construction costs exceeding $800,000.[112]

3.2.7 New Brunswick

Provincial regulations

The provincial environmental legislation impacting hog operations in New Brunswick includes the Livestock Operations Act and its regulations as well as the Clean Water Act and corresponding regulations.

To begin with, under the Livestock Operations Act, producers cannot carry on a livestock operation unless they hold a valid livestock operation licence.[113] The licence may be subject to a site development plan, manure nutrient management plan, land application practices, separation distances, storage of waste water and manure, and setbacks. The specifics of the Act's requirements are detailed in Regulation 99-32. The regulation states that a person applying for a livestock operation licence shall provide: a site development plan for the proposed livestock site; a description of the manure system; a manure nutrient management plan signed by an agrologist

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108. Personal communication with Francis Provencher, Rouville MRC, 450-460-2127.

109. Source: Rouville MRC, By-law No. 184-03. Retrieved August 16, 2006 from http://www.mrcrouville.qc.ca/UserFiles/File/Documents_PDF/rci184-03.pdf.

110. Personal communication with Francis Provencher, Rouville MRC, 450-460-2127.

111. Personal communication with Francis Provencher, Rouville MRC, 450-460-2127.

112. Source: Municipality of Saint-Mathias-sur-Richelieu, 450-658-2841.

113. Refer to Livestock Operations Act – section 3.

which includes the level of available nutrients in the soil and manure; and a copy of any watercourse alteration permit that is required under the Clean Water Act and its regulations.[114] Furthermore, the regulation states that livestock facilities must be 20 metres from the boundary of the land parcel and must be at least the minimum separation distance from dwellings.[115] The calculation of minimum separation distance depends on the manure type, storage system, and type of livestock. Producers must have sufficient capacity to store 210 days of manure unless a manure nutrient management plan has been approved by the government.[116] The Clean Water Act specifies various production restrictions based on the area and zone of the province within which the operation conducts agricultural activities.

Municipal regulations

Within Kings County, New Brunswick, the Town of Sussex has been chosen for this analysis. The by-laws affecting hog operations in the Town of Sussex include the Zoning By-law, No. 1350-04 and the Building By-law, No. 151-99. Under the Zoning By-law, the municipality is divided into different zones, one of which is rural or agricultural.[117] Under the Building By-law, no person shall commence or continue any work unless a building permit has been issued.[118]

3.2.8 Nova Scotia

Provincial regulations

Provincially, hog operations in Nova Scotia are regulated by the Environment Act and its regulations. Under the Environment Act, individuals must receive approval for undertakings. Approval may require environmental impact assessment reports, focus reports, or environmental monitoring and rehabilitation studies if required by the Minister.

Nutrient management planning in Nova Scotia, at the provincial level, is voluntary.[119]

In addition to the legislation, hog producers in Nova Scotia must comply with the Manure Management Guidelines, 2006[120] and the Siting and Management of Hog Farms in Nova Scotia Guidelines[121] in order to be eligible for financial assistance.

Municipal regulations

The relevant by-laws in Kings County, Nova Scotia include the Land Use By-law and the Building By-law. Under the Land Use By-law, new buildings including manure storage facilities must be located at least 300 feet from wells, watercourses, or dwellings on adjacent properties.[122] In

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114. Refer to Regulation 99-32 – sections 5 and 8 (iii).

115. Refer to Regulation 99-32 – section 12.

116. Refer to Regulation 99-32 – section 13.

117. Source: Town of Sussex, Zoning By-law, http://www.sussex.ca/towndocuments/1350-04.doc

118. Building permit fees are $1.00 per $100 of estimated cost for projects of up to $1,000 in value; $10.00 plus $2.00 per $1,000 of estimated cost for projects over $1,000 and up to $100,000; and $208.00 plus $1.00 per $1,000 of estimated cost for projects over $100,000. Source: Town of Sussex, Building By-law, http://www.sussex.ca/towndocuments/151-99.doc.

119. Source: Henry Vissers, Pork Nova Scotia.

120. Source: http://www.gov.ns.ca/nsaf/rs/envman/manureguide_2006lowres.pdf

121. Source: http://www.gov.ns.ca/nsaf/rs/envman/hogsite.shtml#link2

addition, new livestock operations must have manure disposal plans approved by the province. The manure disposal plan is essentially a letter from the Nova Scotia Department of Agriculture, Fisheries and Aquaculture indicating that the operation meets the Manure Management Guidelines established by the province. In order to meet the guidelines, producers must have either a nutrient management plan or seven months of manure storage.[123] As such, as long as producers in the province construct manure storage facilities with a capacity of at least seven months, a nutrient management plan is not required. Therefore, nutrient management planning has not been included as a cost item in Nova Scotia in the models in section 5.

Under the Building By-law, a building permit is required for all new developments. Fees for the construction of new barns are $20 plus 4.4 cents per square foot on all usable floor area.

3.2.9 Prince Edward Island

Provincial regulations

The provincial legislation that governs the operation and construction of livestock facilities in PEI includes the Planning Act and the Environmental Protection Act. According to the Planning Act and its regulations, no person shall commence the construction of any building or structure without first obtaining a development permit issued by the Minister.

The Environmental Protection Act specifies the approvals that individuals require, as well as details regarding the establishment of buffer strips, and rules regarding containment of manure. First, individuals must submit a proposal for any undertaking. As part of the proposal, an environmental impact assessment may be required by the Minister. In addition, individuals require a permit for alteration of watercourses or land within 10 metres of watercourses.

For land adjacent to a watercourse or wetland, owners must establish and maintain buffer strips on non-forested land. Buffer zone widths also depend on proximity to intensive livestock operation and slopes of land. Buffer strips must be 10 metres in width if land use is agricultural. Buffer strips must be 20 metres in width if the slope is 5% or greater.[124] Agricultural crops may not be planted in buffer zones; however perennial grasses are allowed in certain cases. In addition, no person shall plant row crops on agricultural land within 200 metres of a watercourse or wetland unless headlands have perennial grass cover that was established in the previous year. Containment of livestock manure must be either earthen berm, physical barrier, or self-contained holding facility to ensure no runoff is discharged into watercourses. No intensive livestock operations (buildings, manure storage, feeding areas, exercise yards) are allowed within 90 metres of watercourse or wetland boundary.[125]

Nutrient management planning in PEI is not mandatory and therefore has not been included as a cost item in the models in section 5.[126]

In addition to the legislation, the Guidelines for Manure Management for PEI describe manure management systems and practices which will reduce the risk of pollution and minimize odours.

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122. Applies to commercial livestock operations.

123. Source: Brian MacCulloch, Nova Scotia Department of Agriculture, Fisheries and Aquaculture, 902-679-6006.

124. Refer to Environmental Protection Act – section 11.

125. Refer to Environmental Protection Act – section 11.

126. Source: Marc Schurman, Schurman Farm Ltd & Spring Valley Farm Market Ltd., 902-836-4271.

The purpose of the guidelines is to provide a standard which may be used in determining normal, acceptable farming practices. To be eligible for financial assistance for manure storage facilities under the Canada-PEI Agriculture Stewardship Program, hog producers must comply with the guidelines.[127]

PEI producers also have access to a publication entitled Best Management Practices: Agricultural Waste Management[128] which provides practical information on achieving environmental objectives and managing agricultural manure.

Municipal regulations

In Queen's County in PEI, there are no applicable by-laws other than building/development permits.[129] Building/development permits for hog operations cannot be issued unless approved by the Department of Agriculture, Fisheries and Aquaculture.[130]

3.3 Summary of environmental regulations affecting hog operations

The policy measures implemented both internationally and domestically affecting pig production have predominantly been regulatory and increasing in scope and complexity (OECD, 2003). Guidelines are becoming more common in Canada. Internationally, there is a variety of policy measures designed to protect the environment, ranging from taxes to environmental assessments.

In Canada, environmental regulations vary in strength and scope by province. In general, the provincial regulations focus on protecting water quality and controlling nutrient levels in soil and water. Largely, the regulations detail requirements for manure storage capacities, setbacks, minimum separation distances, permits, and nutrient management planning. These requirements have different cost implications for pig producers by province.

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127. There are other BMPs under the Canada-PEI Agricultural Stewardship program for which it is not necessary that producers are in compliance with the Guidelines for Manure Management. The only BMPs for which producers must be in compliance with the guidelines to be eligible for funding are manure storage facilities and covered feedlots. Source: Ron DeHaan, Sustainable Agriculture Resources Manager, PEI Ministry of Agriculture, Fisheries and Aquaculture, 902-368-5642.

128. Source: http://www.gov.pe.ca/photos/original/af_bmp_wastemgt.pdf

129. Source: Brian Beaton, Agriculture Information Officer – Intern, PEI Department of Agriculture, Fisheries and Aquaculture, 902-368-4145.

130. Source: Roxanne Larter, PEI Department of Community and Cultural Affairs, 902-368-5280.

SECTION 4

Review of the impacts of environmental regulations

4.0 Review of the impacts of environmental regulations

The purpose of section 4.0 is to review the impacts of environmental regulations, particularly on society. The social costs and benefits of environmental regulations are discussed in Section 4.1. Section 4.2 reviews studies that have assessed both the environmental and economic impact of environmental regulations on hog producers in other jurisdictions. Section 4.3 summaries sections 4.1 and 4.2.

4.1 Social costs and benefits of environmental regulations

The presence of large hog farms can be a "social" nuisance for neighbouring communities. Hog farms are often associated with unpleasant odours and some studies have found that hog farms can have the effect of lowering neighbouring property values (Ready and Abdalla, 2003, Palmquist et al, 1997, and Mubarek et al, 1999).

In the absence of environmental regulations and policies, market imperfections may impose externalities on individuals in society. An externality exists whenever the welfare of some agent, either a firm or a household, directly depends not only on his or her activities, but also on activities under the control of some other agent (Tietenberg, 1992). In the case of a hog farm, the odour pollution created by its day to day processes may negatively impact its neighbour's ability to enjoy the outdoors, or, it may affect the community's ability to attract new residents or tourists to the area. The hog farm may therefore impose an external cost on the community.

The effects of this external cost on the hog industry can be seen in Figure 3.1, which represents the market for hogs. The demand for hogs is shown by the demand curve D and the private marginal cost of producing hogs (not including the cost of pollution control and damage) is depicted by MC_p. The social marginal cost is depicted by MC_s, and it includes both the pollution externality and the marginal cost of producing hogs.

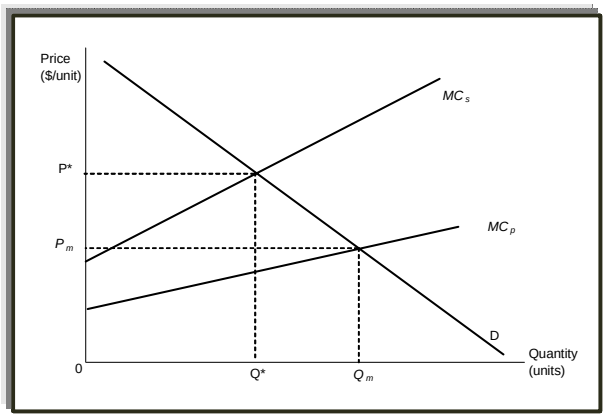
If the hog industry were left to its own devices, it would seek to produce Q_m. Although this choice, in a competitive setting, maximizes private producer surplus, it is not efficient since the net benefit to society is maximized at Q^*, not Q_m.

Potentially harmful consequences of economic activities on the environment constitute an externality. For example, an operation that pollutes the air, water, or land imposes a cost on society. Producers may not always have an economic incentive to minimize the "external" costs of pollu-

tion. Based on Figure 4.1, Tietenberg (1992) draws a number of conclusions about market allocations of commodities generating pollution externalities:

1. *The output of the commodity is too large.*
2. *Too much pollution is produced.*
3. *The prices of products responsible for the pollution are too low.*
4. *As long as costs are external, no incentives to search for ways to yield less pollution per unit of output are introduced by the market.*
5. *Recycling and reuse of the polluting substances are discouraged since release into the environment is inefficiently cheap.*

Figure 4.1: Market allocations with pollution



In this example, environmental policies are introduced to raise incentives for farms to minimize externalities. This is mainly accomplished in two ways: either by internalizing the environmental costs so polluters make their own decisions regarding their consumption of environmental inputs, or by imposing a limit on the level of environmental pollution (Jaffe *et al.*, 2004).

There has been some debate on whether or not polluting farms (or firms in general), and society as a whole, can benefit from environmental policies. The Porter hypothesis asserts polluting farms (and firms in general) can benefit from environmental policies, arguing that well-designed environmental regulations stimulate innovation, which, by increasing either productivity or product value, leads to private benefits. As a consequence, environmental regulations benefit both society and regulated firms (Ambec and Barla, 2005).

Some policy makers have been very receptive to this point of view, but it has also been criticized by economists. Traditionally, economists believe that environmental regulations have a negative impact on polluting farms. Several reasons justify this hypothesis, the most obvious being that regulations almost always require farms to allocate some input (labor, capital) to pollution reduction, which is unproductive from a business perspective (Ambec and Barla, 2005).

A report by the Network of Heads of European Environment Protection Agencies lends support to the Porter Hypothesis. The report states that good environmental policies and regulations can benefit industry and society in many ways. Society can benefit from less pollution and waste and improved quality of life. Businesses can also be better off with clear standards that are enforced effectively.

In particular, good environmental regulations can help industry and society in the following manners (Network of Heads of European Environment Protection Agencies, 2005):

- Reduce costs for industry and business
  - Regulations in areas such as energy efficiency and waste reduction can deliver cost savings and help companies develop more attractive products.
- Create markets for environmental goods and services
  - The world market for environmental goods and services is currently worth about 435 billion euros and is expected to grow. As well, Michael Porter, of Harvard University,

was instrumental in showing that countries with high environmental standards often have market-leading firms and record better economic performance than those with lower standards.

- Drives Innovation
  - The commercial success of some industries, particularly those providing clean technology and waste management, depend on high environmental standards.
- Reduces business risk and increases confidence in the investment of market and insurers
  - Financial benefits can be seen in the results of companies that manage environmental issues well, and pension funds that invest in them. Research by the Environmental Agencies of England and Wales found that in 52 out of 60 studies, there was a close link between environmental governance and financial performance.
- Assist competitive advantage and help create competitive markets
  - Good regulation can have a positive impact through stimulating dynamic responses, innovation and better practices, and according to the World Bank Report on Competitiveness and Environmental Standards (1994), "higher environmental standards in industrial countries have not tended to lower their international competitiveness".
- Helps create and sustain jobs
- Improves the health of the workforce and of the wider public
  - A report by the World Bank (Doing Business in 2005) stated that "economic growth is only one benefit of better business regulation. Human development indicators are higher as well. Governments can use revenues to improve their health and education systems, rather than support an overblown bureaucracy. Businesses spend less time and money on dealing with regulations and chasing after scarce sources of finance. Instead, they spend their energies on producing and marketing their goods. Second, the government spends fewer resources regulating and more providing basic social services."
- Protects the natural resources on which business and the public depend, for example the protection of water, soil, air and biodiversity.

The purpose of environmental regulations is to correct for negative externalities that decrease social welfare. The introduction of environmental regulations can result in increased costs to producers, but can also generate positive social and economic benefits. When preparing regulations, governments often try to balance the costs with the benefits and to maximize social welfare. Public policy theory states that "the value of environmental benefits derived from any policy or regulation should exceed the net direct and indirect cost it imposes" (Zering, 1999). Social costs can include things such as the government cost of implementing and enforcing the policy as well as impacts to employment, income, and the tax base when regulations result in reduced economic activity.

Social benefits that are created by environmental regulations are not as tangible as costs and are not as easily calculated, but they can be discussed anecdotally or valued using non-market techniques. Often the social benefits from environmental regulations include improved health and enjoyment of natural resources. Examples of how environmental regulations can positively impact society include (but are not limited to) the following:

- Regulations on manure management can positively impact society through improved water quality control. Regulations may reduce the probability of harmful bacteria infiltrat-

ing the drinking water system.

- Regulations on odour management can positively impact society through improved odour control. This results in a greater enjoyment of the outdoors and a reduction in nuisance complaints.
- Regulations on air pollution reduce illness and improve the overall health of the public.
- Regulations on buffer strips and woodland areas protect biodiversity. These types of regulations protect breeding areas, traffic corridors, and the habitats of a variety of wildlife, and also provide aesthetic benefits.
- Regulations on siting distances positively impact society through odour control and protection of water sources.

According to Environment Canada (2006), reducing air pollution has direct economic impacts as well as indirect economic impacts that stem from the human health and environmental effects of air pollution. Regulations aimed at reducing air pollution would lead to significant benefits to the socio-economic well-being of Canadians. These benefits would be realised through the reduction in illness and mortality, which would improve the productivity of the working class and decrease health care costs. As well, air pollution reductions have the potential to directly increase the productivity of the forestry, agriculture, fishing, and tourism industries by decreasing environmental damages suffered by these industries (Environment Canada, 2006).

Environment Canada's assertions regarding possible social benefits from environmental regulations are reiterated by a report from the United States Office of Management and Budget (2003). The report concludes that environmental regulations are well worth the costs they impose on industry and consumers due to the significant public health improvements and other benefits to society generated by the regulations.

Hietala-Koivu *et al*. (2004) examines how the loss of biodiversity can impose social costs on the environmental landscape. The report suggests that field boundaries such as buffer strips play an important aesthetic and ecological role in the management of biodiversity in agricultural landscapes. In particular, Marshall and Moonen (as cited in Hietala-Koivu *et al*., 2004) described the aesthetic roles of buffer strips as:

- agronomic (stock fencing and land ownership)
- water protection (pollution and erosion control)
- nature conservation (refuge, corridors for movement, feeding and breeding)
- recreation

The social benefits from environmental regulations are difficult to quantify, even with improvements in non-market valuation techniques. Quite often, they have a subjective value, such as aesthetic pleasure, or enjoyment of the natural resources, and sometimes they have a quantifiable benefit such as reduced illness and health care costs. Due to the difficulties associated with measuring and valuing social benefits, they are often undervalued and sometimes not fully considered. However, as discussed above, environmental regulations do contribute positively to social welfare, and should be considered as part of the whole package when environmental regulations are being analyzed.

4.2 STUDIES THAT HAVE ASSESSED THE IMPACT OF ENVIRONMENTAL REGULATIONS

Objective three of this research was to review available Federal or Provincial Regulatory Impact Analysis Statements (ex-ante RIAS) which were written to support the development of regulations that would affect hog farms including economic (private and social benefits and costs), and environmental factors.

As part of the literature review, the Provincial Gazettes were reviewed for RIAS statements. Unfortunately, no documentation was found as they have only recently started to publish RIAS statements on-line. As such, people at two of the provincial Gazettes were contacted, and their recommendation was to call the Department/Ministry that was responsible for the Regulations/ Acts. When contacted, the Departments/Ministries indicated that they were not aware of any type of impact analysis - either economic or environmental - that have been completed at the provincial level and are publicly available. As a result, no specific RIAS statements were reviewed for this research; however, the literature was reviewed for economic and environmental studies that have assessed the impact of environmental regulations on hog farms.

There is an extensive literature base of studies that have looked at the economic impact of environmental regulations for hog production. Fewer studies link the economic impacts with the environmental impacts. For the purpose of this research, the literature review has been limited to those studies that look at both economic and environmental impacts of regulations affecting hog farms.

In 2002, the US Environmental Protection Agency (EPA) signed the Final Rule on Concentrated Animal Feeding Operations (CAFOs). The rule was based on the revision and update of the two primary regulations that ensure that manure, wastewater, and other process waters generated by concentrated animal feeding operations do not impair water quality (US EPA, 2001). The regulations affected by the rule include the National Pollutant Discharge Elimination System (NPDES) permitting requirements for CAFOs and the Effluent Limitations Guidelines and Standards (ELGs) for CAFOs (US EPA, 2003).

During the revision process, a great deal of research was conducted on the environmental benefits of the proposed regulations as well as their economic impact on livestock operations and state and federal governments. These assessments were based on several alternative regulatory scenarios. As part of the final rule, the Environmental Protection Agency (EPA) released information on the costs and economic impacts and environmental benefits of the regulatory changes, which are examined in greater detail in the following paragraphs.

The costs and economic impacts included assessments of the impact of the regulations on CAFOs as well as on state and federal governments. The impact on CAFOs was estimated using costs for nutrient management planning, facility upgrades, land application, and technologies for balancing on-farm nutrients (US EPA, 2003). EPA estimated the total compliance cost for large CAFOs at US$283.2 million per year (pre-tax, $2001), of which US$24.9 million was the estimated cost for the hog industry (~9%). Costs to medium CAFOs were estimated at US$39.1 million per year, of which US$9.5 million was the hog industry (~24%). Costs to medium and small operations that are designated as CAFOs were estimated at $3.8 million per year, of which US$0.4 million was the hog industry (~10.5%) (EPA, 2003). Table 4.1 summarizes the total annualized compliance costs to CAFOs.

Table 4.1: Annual pre-tax cost of the rule, US$2001

SECTOR	# OPERATIONS		AGGREGATE INCREMENTAL COSTS			
	Large CAFOs	Medium CAFOs	Total	Large CAFOs	Medium CAFOs	Designated CAFOs
	(Number)		($2001, millions, pre-tax)			
Fed cattle	1,766	174	88.2	85.8	1.9	0.5
Veal	12	230	0.0	<0.1	<0.1	0.0
Heifer	242	7	6.3	3.8	2.4	0.1
Dairy	1,450	1,949	151.1	128.2	22.0	0.9
Hogs	3,924	1,485	34.8	24.9	9.5	0.4
Broilers	1,632	520	20.5	16.8	2.4	1.3
Layers: dry	729	26	7.5	7.2	0.1	0.2
Layers: wet	383	24	8.9	8.4	0.5	<0.1
Turkeys	388	37	8.7	8.1	0.3	0.3
TOTAL	10,526	4,452	326.0	283.2	39.1	3.8

Notes: May not add due to rounding.
Number of operations do not include designated facilities.
Source: US EPA, 2001.

In addition, the EPA estimated that the administrative cost to federal and state governments to implement the rule would be US$9 million per year. Overall, the total monetized social costs of the final regulations were approximately US$335 million annually (EPA, 2003).

The environmental benefits of the final rule were also estimated for large CAFOs. The EPA developed estimates of the pollutant reductions for small and medium CAFOs, but analysis of the monetized value of the associated water quality improvements were not completed when the report was published (US EPA, 2003). The determination of the environmental benefits of the final rule was based on seven studies which examined the following aspects of environmental pollutants:

- Society's valuation of improvements in surface water quality
- Improvements in shellfish harvesting
- Incidences of fish kills
- Reduced groundwater contamination
- Reduced public water treatment costs
- Reduced livestock mortality from nitrate and pathogen contamination of livestock drinking water
- Reduced eutrophication and pathogen contamination of coastal and estuarine waters

Table 4.2 shows the annualized benefits projected to result from the changes to the regulations based on the seven studies described above.

Table 4.2: Annualized benefits of effluent limitations guidelines/standards for large CAFOs

TYPES OF BENEFITS	TOTAL FOR ALL CAFOs (Millions of US$2001)
Recreational and non-use benefits from improvements in water quality in rivers, streams and lakes	166.2 to 298.6
Reduced fish kills	0.1
Improved shellfish harvests	0.3 to 3.4
Reduced nitrate contamination of private wells	30.9 to 45.7
Reduced eutrophication and pathogen contamination of coastal and estuarine waters	Not monetized [0.2]
Reduced public water treatment costs	1.1 to 1.7
Reduced livestock mortality from nitrate and pathogen contamination of livestock drinking water	5.3
Reduced pathogen contamination of private and public underground sources of drinking water	Not monetized
Reduced human and ecological risks from antibiotics, metals, hormones, salts	Not monetized
Improved soil properties	Not monetized
Reduced cost of commercial fertilizers for non-CAFO operations	Not monetized
TOTAL BENEFITS	**204.1 to 355.0 + non-monetized benefits**

Source: US EPA, 2003.

Overall, the economic value of the environmental benefits was comparable to the estimated costs of the rule. The monetized benefits of the final rule ranged from $204 million to $355 million annually, whereas the total social costs of the final rule were estimated at approximately $335 million annually.

The most recent study conducted by Aillery et al in 2005 investigates the potential economic and environmental tradeoffs between air and water quality when the animal sector is required to take potentially costly measures to abate pollution (Aillery, 2005). The research also examines whether a coordinated approach to environmental legislation would improve the economic and environmental impacts of the laws.

Environmental regulations in the United States separately address and attempt to improve the various aspects of environmental quality such as water, air, soil, and biodiversity. For instance, water quality is controlled by the Clean Water Act, air quality is governed by the Clean Air Act, and biodiversity is addressed through the Endangered Species Act. When legislation is introduced or modified, the relationship between water, air, and soil quality and biodiversity may not be accounted for within the statutes and regulations. For instance, regulations to restrict animal farm emissions to water might inadvertently increase emissions to the air, and vice versa (Aillery, 2005). As such, uncoordinated policies that independently address different pollution issues can result in unnecessary and unanticipated economic and environmental costs (Aillery, 2005).

The study consisted of three scenarios within a hog farm economic model to determine the consequences of compliance with environmental regulations based on policy design. The three scenarios included (Aillery, 2005):

- A nitrogen application standard (NAS) as part of a nutrient management plan required by the 2003 Confined Animal Feeding Operation (CAFO) regulations under the Clean Water Act;
- A hypothetical ammonia nitrogen standard (ANS) based on available emission abatement technologies; *and*
- A coordinated policy that meets both land application and ammonia emission standards (NAS + ANS).

Relative to the individual policies, the coordinated policy lowered farm profits. Hog enterprise profits declined by 15.7% and total farm profits decreased by 13.9% relative to the baseline decisions which were made in the absence of any regulatory constraints. As well, production decreased approximately 3%. However, the coordinated policy reduced ammonia nitrogen by about 30% relative to the levels under the CAFO regulations alone, and eliminated excess nutrient applications (Aillery, 2005). These results are shown in Table 4.3.

Table 4.3: Production, profits and emissions under nitrogen application standard (NAS), ammonia nitrogen standard (ANS), and both

ITEM	BASE UNITS	NAS		ANS BASE		NAS + ANS	
	Units	Units	% change	Units	% change	Units	% change
Hogs (mil. cwt)	119.10	117.96	-0.96	118.26	-0.70	115.61	-2.93
Total profits (mil. US$)	3,700	3,487	-5.77	3,426	-7.40	3,187	-13.87
Hog enterprise profits (mil. US$)	3,047	2,837	-6.89	2,805	-7.93	2,568	-15.72
Ammonia N – total (1,000 tons)	361.3	360.2	-0.30	256.4	-29.02	250.9	-30.55
Excess N – soil (1,000 tons)	137.7	0.0	-100.00	246.4	78.95	0.0	-100.00

Source: Aillery, 2005.

Overall, the results implied that applying one policy after the other would result in higher costs than applying both simultaneously. As such, the research determined that air and water quality regulations would be most cost effective if implemented simultaneously (Aillery, 2005).

A study by deVos et al. (2003) examined the cost effectiveness of 81 alternative manure management systems for a swine finishing operation in reducing three pollutants associated with livestock manure. These three pollutants included ammonia, nitrogen and phosphorus. Specifically, the purpose of this study was to evaluate the economic-environmental tradeoffs stemming from manure management decisions for a swine finishing operation. They used a whole farm approach and measured the trade-offs through an optimization model that identified the farm return-maximizing solutions for a model farm while varying the type of manure management practices in place.

Their study found that under the profit-maximizing system, the levels of nitrogen, ammonia and phosphorus could not be reduced by more than half from the current levels of manure produced. Reducing manure production would require a reduction in hog production. However, the study reported that reducing the current manure residual levels by 50 percent could be done at fairly reasonable costs, depending on the residual to be reduced. For example, a 50 percent reduction in phosphorus could be achieved by including phytase in the rations at a cost of approximately 3 percent of farm returns.

Overall, phosphorus was found to be the least expensive manure residual to reduce through manure management system changes, while nitrogen was the most expensive. For ammonia, it was found that, in the case of small reductions of ammonia, the abatement costs were the lowest of the three residuals. However, the costs rise significantly as the desired reduction of ammonia increases.

They also concluded that farm size was an important factor in determining the overall abatement cost, and this could have serious implications for smaller swine enterprises. As well, attempting to reduce more than one of the manure residuals simultaneously could be complicated by the effects of alternative manure management systems on ammonia and nitrogen levels. For example, a system that minimizes gaseous losses of nitrogen increases the nitrogen content of the manure and therefore increases the likelihood that the excess nitrogen may move into waterbodies.

In general, it is difficult to compare national studies which estimate the costs of environmental regulations because the studies use different cost-bases and costing principles (OECD, 2003). However, in 2003, the OECD released a study that consistently assessed the impact of manure management regulations on competitiveness within the hog sector using regulations from five countries: Australia (New South Wales), Denmark, Korea, Netherlands and the United States (Iowa). To eliminate differences in cost-bases and cost principles, the study used Danish factor cost and costing principles as the base for comparison.

The cost assessment was based on the physical and regulatory requirements imposed on pig producers. The study identified the requirements for manure storage capacity, manure spreading as well as the administrative and control costs associated with permits, environmental impact assessments, manure accounting, etc. The study produced estimates of the share of environmental costs relative to total production costs (OECD, 2003). The study estimated the costs of manure regulations for three representative hog farm sizes: 125 animal units, 249 animal units and 500 animal units[131]. This study found that farm size was a factor in the impact of regulations on costs. The following paragraphs describe the results of the OECD study related to the 500 animal units since the farm size is most relevant to this report.

For the study, all capital costs were annualized assuming a 6% interest rate with depreciation periods. Costs of manure storage and application were taken from those published by the Danish Agricultural Advisory Service in 2001. All manure was assumed to be slurry and according to the Danish Institute of Agricultural Sciences the 500 animal unit operation produced 7,857 tonnes of manure annually (OECD, 2003).

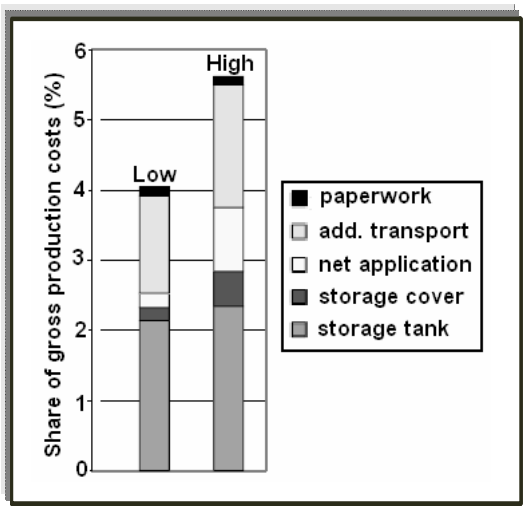
The variables within manure management regulations considered in this study were: additional transportation, net application, paperwork, storage tank, and storage cover. Transportation was the cost of delivering manure to the point of application. It was also assumed that the 500 animal unit operation did not have sufficient land for application and thus required additional transport for application of 40% of the manure on a farm five kilometres away from the storage tank. Net application was the cost of manure application (equipment, etc.) minus the value of the manure in terms of nitrogen content (1 tonne manure = 5.3 kg nitrogen and the value was reduced by 20% in the case of simple or conventional equipment). The cost of paperwork was calculated by best estimates of local advisory centres on the time required to fulfil requirements of nutrient planning/accounting/trading and environmental impact assessments. The environmental

131. In the OECD 2003 study, one animal unit is approximately, but not exactly, 1 sow and 22 piglets per year.

impact assessments were treated as investments and depreciated over a 10 year period. Finally the cost of manure storage and covers depended on the storage capacity required and cover type. In the case of the Iowa (United States) storage was assumed to be tanks because lagoons account for less than 11% of facilities and it was assumed that an environmental impact assessment was not required (OECD, 2003).

The study found that the relative cost of manure management for the 500 animal unit operation ranged from approximately 3.2% of gross production cost in Australia to approximately 8.5% in the Netherlands (OECD, 2003). The results for Iowa (United States), which was the median of the five countries, are shown in Figure 4.2 below.

Figure 4.2: Manure management costs of Iowa (United States) regulations on a 500 animal unit operation



Source: OECD, 2003.

The authors concluded that differences in manure regulations were not likely to create a location shift in hog production at the international level. They further concluded that the differences in manure management regulations and the costs associated with them did not explain basic differences in hog production competitiveness. The costs associated with these regulations were reported to be relatively marginal compared with basic factor costs such as labour and capital, and more variable factors such as exchange rates (OECD, 2003).

The 2003 pig sector study was part of a larger project aimed at understanding the linkages between agriculture, trade and the environment (OECD, 2005). A 2005 OECD report draws on the three sector studies (pork, dairy and arable) to make conclusions on the implications of further trade liberalization on the environment and for the industries. The OECD concluded that "competition-induced pressure to lower production costs will encourage further intensification in all countries." However, production may slow or even fall in Europe and Asia where environmental risks are highest, in terms of pressure on the land base (OECD, 2005).

From the synthesis of all three sector studies the OECD developed a list of implications for agricultural policies pertaining to trade liberalization and environmental regulations:

- Increased trade liberalization would reduce environmental pressures by reducing the barriers of resource allocation between commodity sectors. In addition, support in terms of information and human capital investments are mechanisms to encourage environmentally benign agricultural systems.
- Trade liberalization and good agri-environmental policies are required to enhance welfare, observing the fact that it is challenging to create rules that support national environmental objectives and minimize disruption to global trade.
- Clearly defined agri-environmental objectives will enhance policy efficacy and transparency.
- Agri-environmental programs should be targeted.
- Cross-compliance may be less cost-effective than targeted agri-environmental programs because often those receiving payments aren't necessarily on the most environmentally sensitive land.

- Flexibility of programs is necessary to accommodate farms with different natural and human resources.
- Sub-national agri-environmental programs can be cost effective because they accommodate the needs of a region.
- Increased focus on appropriate research and development including appropriate development of indicators for monitoring and evaluation.

(List adapted from OECD, 2005)

4.3 Summary of the impacts of environmental regulations on society

With good environmental regulations, society can benefit from less pollution and improved quality of life. Businesses can also be better off with clear standards that are enforced effectively. In particular, good environmental regulations can help industry and society in the following manners (Network of Heads of European Environment Protection Agencies, 2005):

- Reduce costs for industry and business
- Create markets for environmental goods and services
- Drives Innovation
- Reduces business risk and increases confidence in the investment of market and insurers
- Assist competitive advantage and help create competitive markets
- Helps create and sustain jobs
- Improves the health of the workforce and of the wider public
- Protects the natural resources on which business and the public depend, for example the protection of water, soil, air and biodiversity.

Thus, it is possible for both private industries, in this case hog operations and society to receive some benefits from the implementation of good environmental policies.

A review of the literature which examined the economic and environmental impacts of regulations highlighted the various ways in which regulation can impact the environment and the economics of pig production. The US study which estimated the impact of the CAFO rule, determined the social cost to comply for the livestock industry and government (administrative costs), as well as social environmental benefits. The environmental benefits were based on:

- Society's valuation of improvements in surface water quality
- Improvements in shellfish harvesting
- Incidences of fish kills
- Reduced groundwater contamination
- Reduced public water treatment costs
- Reduced livestock mortality from nitrate and pathogen contamination of livestock drinking water
- Reduced eutrophication and pathogen contamination of coastal and estuarine waters

Overall, the economic value of the environmental benefits was comparable to the estimated costs of the rule. The monetized benefits of the final rule ranged from $204 million to $355 million annually, whereas the total social costs of the final rule were estimated at approximately $335 million annually.

In 2003, the OECD released a study that consistently assessed the impact of manure management regulations on competitiveness within the hog sector using regulations from five countries: Australia (New South Wales), Denmark, Korea, Netherlands and the United States (Iowa). The cost assessment was based on the physical and regulatory requirements imposed on hog producers. The study identified the requirements for manure storage capacity, manure spreading as well as the administrative and control costs associated with permits, environmental impact assessments, manure accounting, etc. The study found that the relative cost of manure management for the largest operation considered (500 animal units) ranged from approximately 3.2% of gross production cost in Australia to approximately 8.5% in the Netherlands. The authors concluded that differences in manure regulations were not likely to create a location shift in hog production at the international level. They further concluded that the differences in manure management regulations and the costs associated with them did not explain basic differences in hog production competitiveness.

SECTION 5

Economic model

5.0 Economic model

Section 5.0 is an overview of the economic model developed to assess the environmental regulatory cost of compliance for a 600 sow farrow-to-finish hog operation established in each province of Canada. The section starts with an introduction to the concept of modeling environmental regulations for the same farm in each province (section 5.1), followed by a description of the evaluation framework (section 5.2). Section 5.3 identifies the input variables and calculations used in the model and includes a discussion of the environmental and financial ratios used to compare the provinces. Section 5.4 describes the cost data collected for compliance in each of the provinces. Section 5.5 outlines available national and provincial financial assistance programs eligible to cover the costs of compliance identified in Section 5.4. Environmental loan programs are also reviewed. Section 5.6 presents the results of the model and section 5.7 presents the summary and conclusions of the analysis.

5.1 Introduction

To evaluate the impact of environmental regulations on agricultural producers, the ÉcoRessources research (Nolet, 2004) recommended the use of a technical economic model, applicable to different jurisdictions. The recommended model is consistent with the approach used by the Organization for Economic Co-operation and Development (2003) for comparing regulations across countries. The ÉcoRessources report also recommended the use of financial ratios to evaluate the potential impact of a set of environmental regulations on producers. The suggested ratios were:

- standard financial ratios
- environmental costs over total costs *and*
- environmental costs over total revenue

The rationale is that the ratios provide an estimation of the impact of regulations on producers' financial health, performance and competitiveness and allow comparison to benchmarks in industry or between jurisdictions.

To represent environmental compliance in each province, agricultural engineering experts (including those from the Prairie Swine Centre), construction companies, government, industry, and academic sources identified what structures, equipment, and operational requirements

would be required to comply with the regulations in the respective provinces. The environmental cost of compliance (as described in section 5.4) was simulated through the model to determine the difference in fixed and variable costs, on both a total and a per-head basis, of the alternative compliance requirements. The following sections describe the model and analysis in more detail.

5.2 Evaluation framework

The evaluation framework used for this analysis was a computer simulation model of an efficient-scale hog production facility developed by the George Morris Centre and the Prairie Swine Centre. The purpose of the model was to simulate the economic and financial impact of complying with the regulations as defined in section 3.0 above (for example changes in capital), on a 600 sow farrow-to-finish operation. The 600 sow operation was chosen as it is an applicable sized operation for most provinces[132] in Canada and provides the best means for comparison.

5.2.1 Description of the representative hog farm

The following bullets detail the specifications of the representative farm model developed.

- 600 sow farrow-to-finish operation
- Steady state pig inventory[133]:

Grow-finish pigs	3,400
Weanling pigs	2,122
Boars and gestating sows[134]	544
Nursing sows	84
Gilts[135]	22
Total	**6,172 animals**

Source: Prairie Swine Centre, 2006

- For information on animal unit equivalencies by province for the model operation, refer to Appendix C.
- 400 day earthen manure storage

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132. It should be noted that the size of the hog market in Newfoundland would not sustain an operation of this size and was therefore not included in this evaluation.

133. Steady state refers to the average number (occupancy) of pigs per phase for any given day. For example, there are 13,759 pigs weaned/year, which equates to 264 pigs weaned/week, combined with an eight week nursery cycle translates into an average inventory of 2,112 pigs. It is important to note that pig spaces will differ from occupancy due to downtime in the cycle as well as varied rates of growth. For example, in the farrowing rooms, 4 pairs of rooms are required to accommodate the expected 3-week weaning, due to the downtime between cycles for washing, drying and disinfecting the rooms. In growout, pigs within a weekly group tend to be marketed over a 4 to 5 week period. Therefore, 3 to 4 growout rooms will have started marketing pigs while the final room in the cycle is still being emptied.

134. The average gestation length of a sow is 114 days and average non-reproductive days between a cycle is five days therefore 119 days in total for an individual sow. Assuming an 88% farrowing rate we require 32 matings/week in order to achieve 28 farrowing/week. The 32 required matings/week multiplied by the 17-week production cycle provides a sow inventory of 544 sows. Note: this does not include replacement gilts.

135. The 22 replacement gilts are the average number of gilts in the gilt pool for any given day throughout the year. The average culling rate is 40% annually, therefore approximately 218 gilts are brought into the herd annually which represents approximately 4-5 gilts entering the breeding herd on a weekly basis. The sow:boar ratio is zero, as this operation is assumed to be 100% artificial insemination.

- Water supplied through rural water pipeline in addition to a cistern handling two days supply of water
- Three-phase power on-site
- Heating in winter months supplied via natural gas
- Standby generator provides backup electrical service

Farrowing:

- Farrow 28 litters per week
- Pigs are weaned at three weeks of age
- 2 foot deep manure channels under slats for manure storage
- Negative pressure ventilation

Nursery:

- Produce 260 pigs per week to 11 weeks of age (8 week nursery)
- Allowance of 3.75ft^2 per pig
- 16 pens per room with 16 pigs/pen
- One feed bin per room
- Fully slatted floor
- 2 feet deep manure channels under slats for manure storage
- Negative pressure ventilation

Growout:

- Produce 254 pigs per week
- Average market weight of 115kg at 175 days of age
- Allowance of 9.3 ft^2 per pig.
- Fully slatted floor
- 2 feed bins per room
- 2 feet deep manure channels under slats for manure storage
- Negative pressure ventilation

5.2.2 Representative farm model

The representative farm model was developed using the research farm in Elstow, Saskatchewan as the benchmark. Therefore, all provinces will be compared to Saskatchewan.

The representative farm, as described in section 5.2.1, was modeled in Alberta, Saskatchewan (baseline), Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and PEI. Unfortunately, due to a lack of building cost data, the representative farm could not be modeled in British Columbia. It was also determined that the hog market in Newfoundland would not sustain an operation of this size and therefore the province was not included in the evaluation.

Environmental costs of compliance were based on expenses related to provincial and municipal environmental regulations. In order to assess expenses associated with municipal regulations, one representative county/municipality was selected for each province. The selection of the representative county/municipality was based on a high concentration of pig production as indicated by 2001 Census data (Statistics Canada, 2001). The county/municipalities selected are outlined in Table 3.2.

5.3 Assumptions and Input Variables

There were two key assumptions made in this analysis. The first was that the operation was a newly established hog facility in 2006 and that the operation was fixed at 600 sows, farrow-to-finish. The second was that compliance with the regulations was the least cost option for the most efficient management decision, given the size of the operation.

By inputting key variables for production, labour, manure, feed costs, capital costs and revenue into the model, the model is able to calculate revenues, capital asset value, feed costs, variable costs, manure handling, labour and fixed costs as well as the environmental and financial ratios (described in more detail below). The specific input variables and calculations used in the model are detailed below (refer to file "AAFC Model – Total Cost of Compliance – REVISED FINAL VERSION – 121306 KE & BS" for actual data used):

Production information

Input variables

- Number of sows
- Litters/sow/year
- Pigs born alive/litter
- Pre-weaning mortality
- Wean to finisher mortality
- Culling rate/sows
- Replacement value/sow

Calculations

- Total pigs born alive/year
- Total number of pigs weaned/year
- Total number of pigs marketed/year

Total pigs born alive per year were calculated by multiplying the number of sows (600) by the number of litters per sow per year (2.43) by the number of pigs born alive per litter (10.5). The total number of pigs weaned per year was calculated using the total number of pigs born alive per year (15,288) multiplied by one minus the pre weaning mortality rate (mortality rates varied by province). The total number of pigs marketed per year was based on the number of pigs weaned per year multiplied by one minus the wean to finisher mortality rate. Production information by province is included in Appendix F.

Labour information

Input variables

- Total staff required
- Total labour cost/year
- Management salaries (% of total labour)
- Base labour rate/hour

Calculations

- Number of sows/staff

- Total labour cost/hog

The number of sows per staff was calculated by dividing the total number of sows (600) by the total staff required (5). Total labour cost per hog was calculated as total labour cost per year (varied by province) divided by the number of pigs marketed per year (varied by province). Refer to Appendix F for detailed information on labour costs by province.

Manure production

Input variables

- Breeding herd (gallons/day)
- Wean-finisher (gallons/day)
- Manure handling (dollars/gallon)
- Manure application rate (gallons/acre)
- Manure revenue/acre

Calculations

- Total manure production (gallons/day)
- Total manure production (gallons/year)
- Total manure handling cost/year
- Total number of acres required/year[136]
- Total manure cost/hog

Total manure production measured in gallons per day (9,225) was equal to the number of gallons per day produced by the breeding herd (2,239) and the wean-finishers (6,986). Total manure production in gallons per year was total manure production in gallons per day (9,225) multiplied by 365 days. Overall, total manure production per year for the model operation was 3,367,125 gallons. Manure handling costs measured in dollars per gallon were collected using expert opinions and online sources. Manure handling costs per gallon varied by province from 0.9 cents per gallon in PEI to 2 cents per gallon in Quebec.[137] Total manure handling costs per year amounted to total manure production (3,367,125 gallons per year) multiplied by manure handling cost in dollars per gallon (varied by province). The number of acres required by the model operation (510 acres) was based on total manure production of 3,367,125 gallons per year divided by an application rate of 6,600 gallons per acre. Total manure cost per hog was based on total manure handling costs per year divided by the number of pigs marketed per year. Detailed manure production information by province is included in Appendix F.

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136. The number of acres used in the model is 510. The number of acres required is a direct result of the manure application rate. Agronomically 6,600 gallons/acre best matches crop nutrient requirements for trials conducted in western Canada. This assumes average N, P, K, S levels. In addition, many provinces have in place or are considering a P based application rate that will directly impact the manure application rate.

137. Note that manure handling costs in Quebec were calculated using annual production of 3,367,125 gallons (15,307 cubic metres). A load of manure was assumed to contain 12 cubic metres. Therefore, 1,276 loads were required. Assuming that 1.5 loads could be completed in an hour, the total number of hours of manure spreading amounted to 850 hours. A cost of $80/hour was assumed generating a total cost for manure handling in Quebec of $68,031 or 2 cents per gallon.

Variable production costs

Input variables

- Barn supplies
- Maintenance and repairs
- Management and consultant fees
- Marketing and transportation
- Miscellaneous
- Office supplies[138]
- Utilities (heat, power, phone)[139]
- Veterinary supplies and fees

Calculations

- Total variable costs/hog
- Total variable costs/year

Total variable costs per hog were calculated by summing the input variables listed above. Veterinary supplies and fees differed by province. Total variable costs per year were calculated by multiplying the total variable costs per hog by the total number of pigs marketed per year. For further information on variable costs by province, refer to Appendix F.

Fixed costs

Input costs

- Property tax
- Insurance

Calculations

- Total fixed costs/hog
- Total fixed costs/year

Total fixed costs per hog were calculated by summing the input costs above (property taxes and insurance costs. Total fixed costs per year were calculated by multiplying total fixed costs per hog by the total number of pigs marketed per year. For further information on variable costs by province, refer to Appendix F.

Feed costs

Input costs

- Feed cost/hog

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138. Office supplies are a variable cost of production, as they are influenced by the number of hogs within the operation. In particular, office supplies relate directly to record keeping which depends on the number of hogs.

139. Utilities are a variable cost of production. With regard to utilities, the number of hogs within an operation will influence items like ventilation rate and manure production (and subsequent transfer). Therefore utility rates change as inventory changes within the barn.

Calculations

- Total feed cost/year

Total feed costs per year were calculated by multiplying feed cost per hog by total number of pigs marketed per year. Total feed costs by province are shown in Appendix F.

Capital costs

Input variables

- Building cost (per sow place)/gestation
- Building cost (per sow place)/farrowing
- Building cost (per pig place[140])/nursery
- Building cost (per pig place)/finisher

- Number of sow places/gestation
- Number of sow places/farrowing
- Number of sow places/nursery
- Number of sow places/finisher

- Manure storage (total cost)

- Land cost
- Permit application
- Site development

- Manager's residence[141]
- Management and commissioning fees[142]

Land costs were based on 150 acres of purchased land.[143] The remainder of land required for manure spreading was assumed to be owned by neighbouring farms. Costs per acre for land were based on Farm Credit Canada (FCC) farmland values data.[144] Farmland values were based on the counties selected for this analysis (refer to Table 3.2).[145]

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140. A pig place is defined as the space required to house a single pig. Within a specific room it also encompasses area occupied by penning, feeders and alleyways. It can be defined as the following areas: Gestation stall or farrowing crate; Nursery - 3.75ft^2; Growout - 9.3ft^2.

141. It is quite common on pork production units of 600 sows and greater to have a manager's residence located on the same site as the hog operation. As such it is important to be included in the overall cost of the facility.

142. In this instance, a professional construction management firm is hired to oversee the project. They are responsible for financial administration, preparation and review of tender documents and bids, negotiating with and screening suppliers and contractors, coordinating all construction site activities, quality control. The project manager is also responsible for ensuring that all relevant municipal, provincial and federal regulations and standards are satisfied by the project. Commissioning costs include the cost of purchasing breeding stock and operating the barn until the commissioning date. The commissioning date was defined as the first day of the month following the month in which a significant revenue stream occurred.

143. Except for Manitoba where municipal bylaws require operations with more than 250 animal units to have 160 acres.

144. Source: FCC Farmland Values Online. http://www.fcc-fac.ca/en/onlineservices/flv_online_service_e.asp?main=1&sub1=farmlandvaluesonline.

145. Note: Quebec farmland values were based on Rouville regional municipality.

Permit application costs were based on information submitted by experts and information provided by municipalities. Ontario and PEI permit costs were based on the number of square feet for the model operation (87,116 square feet).[146] Site development costs were based on information submitted by experts. Manager's residence and management and commissioning fees varied across the provinces.

Calculations

- Total building cost/gestation
- Total building cost/farrowing
- Total building cost/nursery
- Total building cost/finisher
- Total building cost
- Total manure storage cost
- Total construction costs

Total building costs for the gestation and farrowing barns were calculated by multiplying the building cost per sow for the gestation or farrowing barns by the number of sow places in the gestation or farrowing barns respectively. Similarly, total building costs for the nursery and finishing barns were calculated by multiplying the building cost per pig place for the nursery and finishing barns by the number of pig places in the nursery and finishing barns respectively. Total building cost was calculated by summing the building costs for the gestation, farrowing, nursery and finishing barns. Manure storage costs were based on costs submitted by experts in each province.[147]

Total construction costs included total building cost and total manure storage cost as well as land costs, permit applications, site development costs, manager's residence costs, and management and commissioning fees.

Input variables

- Depreciation (years)
- Salvage value
- Long-term interest rate
- Short-term interest rate
- Purchases made on credit

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146. PEI permit application cost was estimated to be \$0.10 per ft^2 by the PEI contact. In Ontario, building permit costs and development charges are based on a tiered cost system depending on building costs and square feet. Source: Municipality of South Huron, Ontario, 1-877-204-0747.

147. In Quebec, manure storage costs were based on research conducted by Centre de Référence en Agriculture et Agroalimentaire du Québec (CRAAQ). The CRAAQ research stated a manure storage cost (based on 365 days of storage) of \$145/head for gestation/farrowing, \$28/pig place for nursery, and \$54/pig place for finishing. These costs were multiplied by the number of sows in gestation/farrowing (678), the number of nursery pig places (2,080), and the number of finishing pig places (3,683) assumed in the model to attain a total manure storage cost of \$355,432. Source: CRAAQ, Porcherie – coûts de construction – AGDEX 722/440, February 2005.

This analysis uses the annuity cost method of calculating the amortized value of capital assets according to methods described in the American Agricultural Economics Association (2000). As such, there is no need to distinguish between whether the asset is financed or owned. To calculate the fixed cost of interest and depreciation for the facilities, the input variables above were used to calculate amortized[148] values of the costs of the facilities. The model amortized total construction costs over 20 years using a 7% long-term interest rate and 10% salvage value.

The model also calculated operating interest on feed costs, manure handling costs, and variable costs using a 5.5% short-term interest rate and assuming that 25% of purchases were made on credit.

Revenue

Input variables

- Average weight (kgs)
- Average index
- Average bonus
- Average pool price ($/ckg)
- Salvage value for sows (%)
- Salvage value for sows ($'s)

Calculations

- Total market hog sales/hog
- Total cull sow sales/hog[149]
- Total sales/hog
- Total sales/year

Total market hog sales per hog were calculated in several stages. First, the average weight was multiplied by the average pool price. Second, the average index was divided by 100. The outcomes of these two stages were then multiplied together and the average bonus was added to their product.

Total cull sow sales per hog were calculated by multiplying the number of sows (600) by the cull rate for sows (40%) and by the salvage value for sows (varied by province) and then by dividing that outcome by the number of pigs marketed per year (varied by province).

Total sales per hog were calculated by adding total market hog sales per hog and total cull sow sales per hog. Total sales per year were calculated by multiplying total sales per hog by the number of pigs marketed per year.

Using the data from the input variables and calculations, the following financial and environmental ratios were calculated: total operating, total costs, gross margin, net earnings, EBITDA[150], ROA[151], EBITDA/Sales and net income per hog and total environmental costs of compliance.

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148. Amortization is defined as the reduction of the value of an asset by prorating its cost over a period of years. Source: http://dictionary.laborlawtalk.com/amortization.

149. This facility is 100% artificial insemination. Therefore boars are not utilized, resulting in no cull boar sales.

150. EBITDA: Earnings before Interest, Taxes, Depreciation and Amortization.

Total operating costs included feed costs, total variable costs, manure handling, and labour. Total costs included total operating costs and total fixed costs. Gross margin was calculated by subtracting total operating costs from total revenue. Net income was calculated as total revenue minus total costs. EBITDA was equivalent to net income plus interest and depreciation and property taxes. ROA was calculated as net income divided by the total value of assets. EBITDA/ Sales were calculated by dividing EBITDA by total revenue. Net income per hog was calculated by dividing net income by the number of pigs marketed. The calculation of total environmental costs is discussed in section 5.4.2.

The specific environmental ratios estimated were as follows:

- Environmental cost/total operating costs
- Environmental cost/total costs
- Environmental cost/total revenue

5.4 Environmental Cost of Compliance Data Collection

In order to comply with environmental regulations, hog producers may face additional production costs. The legislation in Section 3.2 was reviewed in order to determine the various types of expenses that would be required for hog operations to comply with the provincial and municipal regulations in each province. These environmental costs were used in the model (as described above) to determine and compare the costs of compliance by province.

To determine the environmental costs associated with the regulations in each province, the research team collected data from construction companies, agricultural engineers, government, industry, and academic sources. Sources for the data have been included in Appendix D.

In order to collect data on environmental costs, the research team created a letter specific to each province describing the project and the required information (refer to Appendix E for a sample letter (Quebec)). The composition of the letter included the specifications of the representative hog model developed for the research and identified a list of regulations believed to impact the hog industry in the respective province. The contacts were asked to fill out only those items that would be applicable for compliance in their jurisdiction (assuming the least cost option for the most efficient management of a 600 sow farrow-to-finish hog operation). Unfortunately, due to a lack of available data, British Columbia has not been included in the economic modeling (refer to section 5.4.1).

Manure storage and manure handling costs are difficult to assess as these costs can be considered requirements of doing business, rather than environmental costs. In order to assess the marginal impact of environmental regulations for the model operation, costs related to the normal costs of doing business were taken into account and additional costs resulting from environmental regulations were subsequently determined. For example, manure storage costs consist of costs resulting from normal business practices and costs imposed by environmental regulations. Upon consultation with a regulatory expert on agricultural operations in Saskatchewan, it was determined that minimum manure storage capacity must be 240 days in order for the operation to receive government approval.[152] Therefore, manure storage capacity was assumed to be 240

151. ROA: Return on Assets. A measure of a company's profitability, equal to a fiscal year's earnings divided by its total assets, expressed as a percentage.

152. Source: Andy Jansen, Manager, Agricultural Operations, Inspection and Regulatory Management Branch, Saskatchewan Agriculture and Food, 306-787-5465.

days as a baseline and if environmental regulations required additional days of storage, then the portion of costs resulting from the additional days of storage was classified as environmental costs. Manure handling costs were assumed to result from the normal costs of doing business. This is due to the difficulty of separating manure spreading costs into normal costs of doing business and environmental costs. An important point that helps to justify this assumption is that the regulations related to manure handling, such as winter spreading and minimum separation distances, do not require manure storage capacity beyond 240 days.

In addition, it is important to recognize that environmental costs may be one-time or annual costs. For example, soil testing fees are annual costs whereas manure storage facilities are one-time costs. In order to properly account for environmental costs, one-time environmental costs have been amortized before being applied in the model. One-time environmental costs were amortized using estimates of the initial value, salvage value, and useful life of the asset, as well as market interest rates to reflect the opportunity cost of capital. Initial values for environmental costs as well as useful life, salvage values and interest rates are presented in Appendix G. The long-term market interest rate was estimated at 7%.[153] The useful life of the asset and salvage values varied depending on the environmental cost being considered. For example, nutrient management plans have zero salvage value and generally remain relevant for 3-5 years before they must be updated and renewed. Experts were contacted to verify the renewal periods of nutrient management plans by province. The model assumed that physical assets such as manure storage facilities and wells had a 10% salvage value and useful life of 20 years.[154] Buffer strips were amortized over 10 years[155] with zero salvage value. Overall, all environmental costs presented in this report (with the exception of the initial values in Appendix G) are amortized values.

5.4.1 Caveats related to data collection

When collecting the environmental costs the research team determined that setback costs could not be incorporated into the model because of the site specific nature of the distances from water sources, residential dwellings and property boundaries.

The hog industry in British Columbia is relatively small in terms of hog numbers, marketings, and number of farms compared to other western provinces. Producer numbers for BC hog operations have been in steady decline for several years. According to the BC Ministry of Agriculture and Lands, at last count there were approximately 36-38 licenced hog producers in the province (Droppo, 2006). With current land values in such areas as the Fraser Valley routinely selling for $40,000 to $50,000 per acre, it is a rare occurrence to find any producer looking to establish a new farrow-to-finish operation of the size described in our representative model or to find a producer that is seriously considering a significant expansion of an existing operation. The primary limiting factor is gaining access to a large enough land base that is affordable for the purpose of applying manure. With the lack of any major construction or expansion in the BC hog industry, very little building cost data was available. As a result, this analysis will qualitatively discuss environmental costs in BC but the province will not be included in the provincial model comparison.

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153. Calculated using the average of the chartered banks' prime interest rate from 2001-2006 + 2%. Source: Bank of Canada.

154. Remaining values for buildings, silos, tile drains, and so forth are difficult to estimate in any general fashion because they are often specific to a particular operation. A common approach is to assume a fairly long useful life and a minimal salvage value. Source: American Agricultural Economics Association, 2000.

155. Selection of a useful life of 10 years was based on the previous GreenCover program requirements that buffers be maintained for a minimum of 10 years.

Although data has been collected for Alberta, the environmental cost of buffer strips was left blank in the information letter from the contact. Since Alberta does legislate separation distances between manure spreading and watercourses, the model farm should incur costs related to buffer strips. As such, the model assumes that the cost of buffer strips in Alberta is the same as in Manitoba.

The collection of cost data for Quebec was more complicated than some of the other provinces. In 2002, the Quebec government extended a moratorium on new or expanding hog farms throughout most of the province. Although the moratorium has been lifted, there was very little cost data available regarding the new farms and as such some information is missing for the province.

For Quebec, building site development costs and engineering costs were not available. The model assumes that these costs are equivalent to those in Ontario. This assumption will not significantly affect the model due to the apparent consistency of engineering costs across Canada. Building site development costs in Quebec may be slightly different than Ontario, but the overall effect on the model is not material. Data was also not available on the cost of an environmental impact assessment in Quebec due to the fact that, in recent years, farmers have not applied for permits of that magnitude.[156] Environmental impact assessments are required for operations with more than 600 animal units. The professional fees required to conduct an environmental impact assessment may be quite high. Therefore, the estimate of environmental costs in Quebec may be underestimated.

Further to that, our contact (Michel Morin of the Centre de développement du porc du Québec (CDPQ)[157]) identified that a 600 sow farrow-to-finish operation would not be approved in the province of Quebec because of the municipal restrictions on building sizes. However, we were not able to collect the necessary information required to split up the operation to understand the additional economic costs from having to establish multiple sites. Therefore, the Quebec estimates are grossly underestimated as they represent a single site operation that would not necessarily be approved in the province of Quebec.

Environmental costs in all provinces may also be underestimated due to the lack of reliable estimates for the cost of groundwater studies across the country. In order to obtain water licences and construct wells for agricultural operations, producers must retain the services of an engineer or hydrogeologist to conduct a ground water study. Groundwater studies assess the sustainability of water resources given the requirements of a proposed livestock operation. There are generally three components of a ground water study. First, there is an exploration component to find water. Second, the well must be installed. Third, the engineers must run a pump test and write up the ground water report. While the components of a ground water study are relatively consistent across sites, the costs are not. For example, in Saskatchewan the cost of exploration may range from $5,000 to $50,000. The cost of well installation may range from $5,000 to $70,000. The cost of the pump test and report is approximately $10,000 to $15,000.[158] Overall, groundwater

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156. Source: Jean Tanguay, La Co-op Fédérée, 418-257-2189 and Denis Boutin, Ministère du Développement durable, de l'Environnement et des Parcs, 418-521-3950 x 4462.

157. Refer to Appendix D for complete contact information.

158. Source: Dave Kent, Clifton Associates Ltd., Saskatchewan, 306-721-7611. In addition, Devon Mutschler, Beckie Hydrogeologists Ltd., Saskatchewan, 306-721-0846 said that it is nearly impossible to provide an average cost for a groundwater study because it depends on the depth of the aquifer, how much work has previously been conducted in the area, etc. He said the cost could range from $75,000 to $200,000.

study costs are very site specific. As such, it was not possible to incorporate the cost of groundwater studies in the following analysis. As a result, environmental costs of compliance may be underestimated.

5.4.2 Comparison of environmental costs by province

Due to a lack of building costs data, BC is not included in the provincial model comparison of environmental costs. However, this section begins with a qualitative discussion of environmental costs in BC in order to provide an understanding of the costs of compliance in the province. Subsequently, the environmental costs of compliance used in the model are presented for the remaining provinces.

Environmental costs in BC[159]

In BC, existing regulations do not specifically require any plans, buffer strips, or monitoring measurements. Therefore, the least cost option is zero for these environmental costs.

The BC Code of Agricultural Practice for Waste Management requires that agricultural wastes be applied to land only as fertilizer or a soil conditioner[160] and in a manner that prevents pollution[161]. Although no specific land base requirements are established, the legislation implies that nutrients applied be in balance with the nutrient demands of the crop being grown.

The biggest environmental cost for hog producers in the Fraser Valley would be purchasing or renting enough land to apply manure on. Current land values are in the $40,000 to $50,000 range per acre, and land rental costs range from $300 to $600 per acre.

If all the manure produced is applied to land and application rates are based on nitrogen, acceptable stocking densities would be in the range of 1.2 to 2.0 sow places per acre. Using a stocking density of 1.5 sow places per acre, a 600-sow farrow-to-finish operation would require 400 acres of land. At $40,000 per acre, this would cost $16 million to purchase. The least cost option would be to not purchase or rent the land but rather to enter into a contractual agreement with other farmers (i.e. cash crop producers) to allow for manure application on their land. With increasing fertilizer costs, this option may be much more feasible. For a large scale operation, it could still be very challenging to find enough land for application.

In the Fraser Valley, it is reasonable to assume that part of the crop rotation would be perennial grass, and manure could be applied at various times between March and October. The growing season in the Fraser Valley Region is much longer than what exists in the Prairie provinces. Although BC legislation does not have specified minimum storage requirements, an implied minimum would be 180 days of storage capacity. Earthen manure storage would not be recommended in the province. In all likelihood, the vast majority of storage would be under barns so the costs would be integrated into the overall building costs.

For a 600-sow farrow-to-finish operation, the estimated construction costs pertaining to manure storage are in the range of[162]:

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159. Source: BC Ministry of Agriculture and Lands. Primary contact: Tom Droppo, 604-556-3144. Other contributors included Geoff Hughes-Games, Orlando Schmidt, Gustav Rogstrand, and John Luymes.

160. Refer to section 14.

161. Refer to section 3.

- $0.51/cu.ft. for a 10 ft deep earthen manure storage;
- $0.65/cu.ft. for a 10 ft deep concrete lined lagoon;
- $2.50/cu.ft. for an 8 ft deep uncovered concrete tank;
- $3.40/cu.ft. for an 8 ft deep concrete covered tank; and
- $3.80/cu.ft. for an 8 ft deep concrete tank covered with a wood post frame roof, which is the most common storage type for hog farms in BC.

When calculating the total storage construction costs, it is important to size the uncovered alternatives for the additional storage volume required for rain water. An approximate 25-year, 6-month average (October to March) for the Fraser Valley is 5.12 feet of rain water.

Environmental costs in remaining provinces

The total cost of environmental compliance by province for the model operation is shown in Table 5.1. The model operation would experience the highest costs of environmental compliance if situated in Ontario followed by Manitoba.

Table 5.1: Total cost of environmental compliance per year, by province

	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Total cost of compliance ($/year)	2,393	3,652	4,539	5,299	3,188	2,098	2,667	2,600

The total cost of environmental compliance was comprised of many environmental costs including permits, nutrient management plans, land application practices, siting and construction standards and miscellaneous items. The following paragraphs discuss these specific environmental costs which are then presented in table format in Tables 5.2 and 5.3.

The cost of environmental permits varied by province. Ontario, Alberta, Saskatchewan and Nova Scotia had minimal costs associated with environmental permits. In Quebec, New Brunswick and PEI, legislation regarding environmental impact assessments increased compliance costs. In New Brunswick and PEI, the costs of environmental impact assessments were estimated as $283 per year and $944 per year, respectively as shown in Table 5.2. Note that the cost of environmental impact assessments in Quebec is unknown but assumed to be a significant cost item. Furthermore, public consultations required in Quebec imposed an approximate cost of $283 annually as shown in Table 5.2. In Alberta, although public consultations are also required, the Natural Resources Conservation Board (NRCB) pays for notification of affected parties. In Manitoba, the public consultation process occurs in the form of review by the Livestock Technical Review Committee. The purpose of the Technical Review process is to assist with the exchange of information between the proponent, the municipal council, and rural residents.[163] The technical review cost amounted to $142 per year. Across the provinces, administrative fees associated with water rights licences were minimal. Overall, given available data, the cost of environmental permits was highest in PEI, New Brunswick and Quebec.

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162. These statistics were calculated based on expected manure production from a 600-sow farrow-to-finish operation according to the B.C. Environmental Farm Planning (EFP) Handbook.

163. Source: Manitoba Agriculture, Food and Rural Initiatives, Preparing a Livestock Operation Proposal, http://www.gov.mb.ca/agriculture/livestock/pork/swine/bah08s02.html.

In terms of nutrient management planning, Ontario had the highest total cost of compliance, amounting to $3,451 per year. The annual cost of nutrient management planning in Quebec, Saskatchewan and Manitoba ranged from $900 to $2,000. In Alberta and New Brunswick, the model operation experienced relatively small costs associated with developing and maintaining nutrient management plans, typically spending less than $500 annually. Nutrient management planning is voluntary in Nova Scotia and PEI and therefore no costs have been applied in Table 5.2.

Table 5.2: Estimated costs of environmental permits and nutrient management plans

COST ITEM	COST ($/YEAR)							
	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Environmental permits							47	
Technical review			142					
Water rights licence	19	0	9		0			
Water withdrawal permit				0		5		
Environmental impact assessment					*	283		944
Public consultations		0			283			
Application to watershed authority	6							
Nutrient management plans								
Agro-environmental fertilization plan					159			
Phosphorus statement					250			
Nutrient management plan				1,951		488	0	
Waste storage plan	0	366						
Waste management plan	0							
Manure management plan	1,000		756					
Mandatory rotation legislation and amendments								122
Ongoing record keeping and plan maintenance	0		1,200	1,500	500			0

**No data was available regarding the cost of environmental impact assessments in Quebec.*

The provinces of Alberta, Manitoba, Ontario, Quebec, New Brunswick[164] and PEI have legislation governing the handling of manure including winter spreading restrictions and minimum separation distances/buffers of manure spreading from water sources. In contrast, Saskatchewan and Nova Scotia provide guidelines but do not legislate these practices. Environmental legislation associated with manure application is therefore less stringent in Saskatchewan and Nova Scotia. Unfortunately, the model does not capture the environmental costs associated with manure spreading (refer to Table 5.3) due to the difficulties associated with distinguishing between the costs of doing business and the environmental costs as discussed in section 5.4.

The cost of establishing buffer strips was relatively consistent across the provinces, typically ranging from $300 to $500 per year as shown in Table 5.3. Engineering costs associated with designing and constructing manure storage facilities were also similar across the provinces averaging approximately $1,000 annually.

Given the methodology described in section 5.4, the only province legislating manure storage days beyond 240 days was Alberta which requires 270 days of manure storage. The portion of the total cost of manure storage due to environmental legislation was calculated as 30 days. This

164. Note that grass buffer is required adjacent to watercourses in Protected Area C in New Brunswick.

amounted to an environmental cost of $1,738 annually. Since the remaining provinces legislated less than or equal to 240 days of manure storage, the cost of manure storage in those provinces was assumed to be a cost of doing business rather than an environmental cost.

Other costs of manure testing, soil testing and training courses are also presented in Table 5.3. Note that the model operation incurred an additional cost of $142 annually in Alberta for monitoring wells.

Table 5.3: Land application, siting, construction and miscellaneous expenses

COST ITEM	COST ($/YEAR)							
	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Land application								
Portion of manure spreading (custom application) cost which is attributed to regulations	0	0	0	0	0	0	0	0
Buffer strips – ESTABLISHMENT*	0	0	0	38	68	0	0	14
Buffer strips – LAND REPLACEMENT**		156	156	393	350	138		276
Opportunity cost of not being able to use the land		187	187	77		0		100
Siting and construction standards								
Locating tiles, tile removal			n/a		n/a	n/a	189	n/a
Hired services geo-technical or prof. engineer	378	944	472	378			283	0
Design services professional engineer	425	94	944	944	1,322	944	1,416	944
Portion of manure storage cost which is attributed to regulations	0	1,738	0	0	0	0	0	0
Other								
Soil testing		25	260	0	28			
Manure testing	200	0	254	0	228	240	244	200
Training courses	366	0	159	18	0	0	488	0
Monitoring wells		142						

* *Buffer strip establishment costs include site preparation, the plants (grasses, wildflowers, shrubs, trees), planting, replanting and maintenance.*

** *Buffer strip land replacement costs include the costs of purchasing additional land to compensate for the acreage converted to buffer strips. For example, in New Brunswick, it was assumed that 1.5 acres were converted to buffers. Land values were approximately $1,000 per acre in King's County. As such, the total cost of land replacement was $1,500. When amortized over 10 years using a 7% interest rate and 10% salvage value, the cost of land replacement on an annual basis was $138.*

5.4.3 Construction costs

In addition to the environmental cost items, the contacts were asked to provide estimates of project development and construction costs for the model 600 sow farrow-to-finish operation. The construction costs required included: building cost (dollars per sow or pig place) for the gestation, farrowing, nursery, and finishing barns; manure storage construction cost; building permit application costs; and building site development costs. Appendix F presents background information on the model including the building costs collected for each of the provinces.

5.5 Financial assistance for hog operations in Alberta, Manitoba, Ontario and Quebec

To understand the true cost of compliance for the model hog operation, it was necessary to identify any financial assistance that may be available to the operation to help with the environmental compliance costs. The top four hog producing provinces (Alberta, Manitoba, Ontario and Quebec) were reviewed for financial assistance programs that covered any of the identified costs in Tables 5.1, 5.2 and 5.3. Section 5.5 outlines available financial assistance programs as well as any environmental loan programs.

National programs

There are three national programs that were created in Canada to cover 30 different beneficial management practices (BMPs). These programs standardize much of the environmental costs across Canada and are called the National Farm Stewardship Program (NFSP), Greencover Canada (GC), and the National Water Supply Expansion Program (NWSEP). The possible sources of financial assistance for the representative hog operation are outlined below.

National Farm Stewardship Program (NFSP)

This program is a voluntary cost-share program to encourage producers to improve management of farms through the adoption of beneficial management practices (BMPs) to reduce risks to water and air quality, improve soil productivity and enhance wildlife habitat. The maximum federal contribution per legal farm entity with a unique Farm Business Registration Number (FBRN) is up to $30,000. The NFSP will typically cover either 30% or 50% up to the program caps. The NFSP requires operations to have an Environmental Farm Plan in place to be eligible for financial assistance.

Greencover Canada (GC)

This program is an initiative to help producers improve land management practices, promote sustainable land use, protect water quality, reduce greenhouse gas emissions, enhance biodiversity and wildlife habitat, and expand the land base covered with perennial forage and trees. The maximum federal contribution per legal farm entity is $20,000. GC is set to cover 50% of expenses up to the program caps. The BMPs for Greencover will be covered under the NFSP program in some provinces. The combined federal contribution between NFSP and GC will be no more than $30,000. The GC program requires operations to have an Environmental Farm Plan in place to be eligible for financial assistance.

National Water Supply Expansion Program (NWSEP)

The objective of the National Water Supply Expansion Program is to provide assistance to the agricultural community across Canada to help reduce the risk of future water shortages, and to meet the everyday growing needs of a vibrant Canadian agricultural sector, through the planning and development of secure, healthy and reliable water resources (Agriculture and Agri-Food Canada, 2006b). There are three tiers of projects that are eligible for funding through NWSEP. The first tier includes on-farm water infrastructure. For this tier, the federal government will contribute up to one third of eligible project costs to a maximum of $5,000 per project. The program maximum is $15,000 per applicant. The second tier involves multi-user water supplies and the federal government will provide up to one-third of eligible costs. The third tier involves strategic initiatives. Cost sharing arrangements for this tier are determined on a project-by-project basis.

Available Financial Assistance for Model Operation

Ontario, Manitoba and Alberta

The model farm would not be eligible for financial assistance under the National Farm Stewardship program or the Greencover program in Ontario, Manitoba or Alberta in the first year of operations. This is due to the fact the model farm is assumed to be established on a vacant piece of land. The facilities for the model farm are also newly constructed. As such, the farm does not have environmental risks that can be identified in the action segments of its Environmental Farm Plan (EFP). In other words, to be eligible for financial assistance, the farm would need to have existing environmental risks that could be identified in the EFP. If environmental risks were present, the EFP would include proposed actions to reduce/remedy the risk. In the case of the model operation, there are no environmental risks and therefore the model farm is not eligible for financial assistance under the NFSP or GC.[165]

The NFSP and GC programs are designed to promote BMPs on existing operations. It is expected that new facilities being built and designed should comply with environmental regulations and meet today's standards. Therefore, financial assistance is not provided for new operations. After the operation has been in business for one year or more, the farm may be eligible for financial assistance, depending on the nature of the project.

While new operations may not be eligible for financial assistance under the NFSP and GC programs, it is important to recognize that funding would be available to existing older operations.

In contrast to the National Farm Stewardship and Greencover Canada programs, new operations are eligible for funding under the National Water Supply Expansion Program in Ontario and Manitoba. Of the environmental costs experienced by the model farm operation, groundwater studies would be eligible for financial assistance under the NWSEP.[166] The program provides funding for consultative services to prepare hydrogeological/hydrological surveys, reports, or conduct investigations. It is worth noting that the receipt of financial assistance depends on available funding and program priorities. While it was not possible to incorporate the cost of groundwater studies in the model for this analysis (refer to section 5.4.1), it should be acknowledged that new operations could apply for financial assistance to receive one-third of the costs of the groundwater studies up to a maximum federal contribution of $5,000.

In Alberta, the Canada Alberta Farm Water Program (CAFWP) delivers tier 1 of the National Water Supply Expansion Program and provides financial and technical assistance towards the cost of long-term on-farm water supply developments. This supply can relate to domestic use, livestock watering, fish farming and small scale irrigation. The CAFWP expired on March 31, 2006 and therefore, Alberta does not currently provide any funding for groundwater studies.[167]

Quebec

Producers in Quebec with a completed and reviewed Agri-environmental Support Plan (PAA)

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165. Sources: Andy Graham, Ontario Soil and Crop Improvement Association, 1-800-265-9751 and Dale Timmerman, Prairie Farm Rehabilitation Administration, 1-204-822-7271.

166. Sources: Stan McFarlane, Head, District Water Programs, Prairie Farm Rehabilitation Administration, 204-268-3233 and Andy Graham, Ontario Soil and Crop Improvement Association, 1-800-265-9751.

167. As of October 23, 2006, the federal and provincial governments were negotiating details surrounding a new program. Source: Canada Alberta Farm Water Program, 780-422-9167.

can apply for assistance to implement the beneficial management practices listed in their action plan through the Prime-Vert program, which has been harmonized with the National Farm Stewardship Program, and is being delivered by the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). The Prime-Vert program is currently in effect from April 2006 to March 2009. However, there is a restriction on the program which states that new operations are not eligible for financial assistance. Since the model farm is a new operation, it is not eligible for funding under the Prime-Vert program. However, existing older operations would be eligible for funding.

In Quebec, the Canada-Quebec Water Supply Expansion Program (CQWSEP) aims to ensure water quality and an adequate supply of water for agricultural purposes, support infrastructure projects to supply water to producers and encourage optimal water use (CDAQ, 2006). The assistance program delivers three tiers of assistance. For tier 1 related to on-farm infrastructure, the program in Quebec covers a third of eligible costs up to $5,000 per project, up to a maximum of $15,000 per applicant during the program. Since funding is limited, priority will be given to regions and types of production which were identified in a study sponsored by AAFC on agricultural water needs as having water supply problems.[1] The regions are Montérégie, Lanaudière Île-d'Orléans, Basses-Laurentides and îles-de-la-Madeleine. It is important nonetheless to point out that the program will continue to be open to producers of all kinds in all regions of Quebec (CDAQ, 2006).

Water consumption

Although all four provinces have different programs in place, there has been no funding available provincially or federally to obtain the authorized permits or licences to consume water.

Loan programs

Enviro-Loan

Federally, Farm Credit Canada (FCC) offers a loan program, the Enviro-Loan, for agricultural producers who wish to environmentally improve their agricultural operations. The Enviro-Loan provides financing for the construction, improvement or expansion of manure management facilities. Producers and value-added agricultural businesses that intend to make environmentally focused improvements (including shelterbelts, buffer zones, odor control technologies and composting facilities and structures) are eligible for a loan. Specific features of the Enviro-Loan include:

- Pre-approved credit for financing any environment related project or upgrade.
- Funds are available when needed.
- Principal payment is not required until the project is complete - for up to 18 months from the start of construction.
- Accrued interest during project construction can be capitalized back into the loan.
- Once the project is complete, the loan can be converted to any other FCC fixed rate loan.

There was nothing specific from the enviro-loan that could be incorporated into the representative farm model as the model already accounts for long and short term interest.

There were a number of other loans that could be available to producers that were not specific to environmental initiatives and were therefore not included in the representative farm model.

Some examples include Secure Rate Development Loans, Farm Credit Canada's Construction Loan and Flexi-Farm Loan. In Manitoba, the province offered a Young Farmer Rebate as well as an Operating Credit Guarantee, while in Alberta there was an Alberta Farm Loan program.

In summary, although the National Farm Stewardship Program and Greencover Canada program offered financial assistance for environmental initiatives (that would cover the cost of compliance for environmental regulations in some cases), new operations were not eligible for funding. It is important to recognize that funding would be available to existing older operations. However, new operations would be eligible for funding under the National Water Supply Expansion Program. [168]

Although the Enviro-loan was available from FCC, there was nothing specific (for example a reduced interest rate) that could be incorporated into the representative farm model.

5.6 Results of Empirical Testing by Province

As identified in Section 5.2, the representative farm model was developed using the research farm in Elstow, Saskatchewan. Therefore, comparisons were made using the Saskatchewan model as the baseline. The following sections describe the model results across the provinces with references to the Saskatchewan baseline. Section 5.6.1 and 5.6.2 present the results of the analysis by comparing differences in input variables and returns across the provinces. Section 5.6.3 is a discussion of the environmental cost of compliance and environmental ratios across the provinces.

5.6.1 Comparison of provincial input variables

Of the eight provinces analyzed the following results emerged when the input variables were compared across the provinces and to the Saskatchewan baseline model. The numeric results are presented in Appendix F.

- Saskatchewan, Alberta, Manitoba and PEI had the highest total number of pigs weaned per year and pigs marketed per year.
- Mortality rates were slightly higher in Ontario, Quebec, New Brunswick and Nova Scotia (1% higher for pre-weaning and wean to finisher mortality) when compared to the western provinces and PEI, due to a higher incidence of disease.
- Labour costs were highest in Alberta due to the low unemployment rate (there is a labour shortage due to the high demand for labour in the oil patches).
  - When compared to Saskatchewan, Alberta's labour costs were 60% higher
- Manure handling costs were highest in Quebec.
  - When compared to Saskatchewan, Quebec's manure handling costs were more than double Saskatchewan's (109% higher).
  - Manure handling costs varied due to different custom application rates. Custom application rates across Canada vary from 1 cent per gallon in Saskatchewan and PEI to 2 cents per gallon in Quebec.

168. Note that program details were being negotiated in Alberta as of October 23, 2006. Until negotiations are complete, no funding for tier 1 of the NWSEP is available in Alberta.

- Total variable costs per hog and per year were highest in Quebec due to higher veterinary experiences because of higher incidence of disease.
  - When compared to Saskatchewan, Quebec's variable costs per hog were approximately 3% higher per hog.
  - Total variable costs per year were highest in Alberta.
    - Alberta's variable costs per year were 1% higher than Saskatchewan's.
- Feed costs were highest in New Brunswick (higher feed costs for weight gain), due to differences in feed rations. In Saskatchewan rations are based on barley, feed wheat, and peas whereas Central and Eastern Canada typically have a corn based ration which is more expensive.
  - When compared to Saskatchewan, New Brunswick's feed costs were approximately 30% higher.
- Manure storage costs were substantially higher in Quebec than in any of the other provinces. When compared to some of the eastern provinces (PEI, NS) the costs were more than double, a result of the environmental regulations in place and high construction costs in Quebec.
  - When compared to Saskatchewan, Quebec's manure storage costs were approximately 163% higher.
- Agricultural land costs were highest in Ontario and Quebec.
  - Ontario's land costs were almost 10 times as high as Saskatchewan's.
- Permit applications were highest in Saskatchewan, while site development fees were highest in Alberta.
  - Alberta's site development fees were twice that of Saskatchewan's.
- Total building costs were highest in Nova Scotia due to the substantially higher costs per sow place and pig place.
  - When compared to Saskatchewan, Nova Scotia's cost per sow place was 173% higher for gestation and 298% higher for farrowing. When compared on a per pig place basis, Nova Scotia was 203% higher for the nursery and 33% higher for finishing when compared to Saskatchewan.
- Total construction costs were highest in Nova Scotia due to high building costs.
  - When compared to Saskatchewan, Nova Scotia's total construction costs were 64% higher.
- Average weight and index was highest for Alberta at 92.6 kilograms and 111.0 respectively, just modestly higher than Saskatchewan.
- The average bonus was highest in Eastern Canada at $6.67, 184% higher than Saskatchewan.
- Average pool price was highest for Quebec at $1.52/ckg, but total sales per hog were highest for Alberta at $154.90/hog.
  - When compared to Saskatchewan, Quebec's pool price was 7% higher and Alberta's total sales per hog were 5% higher.

5.6.2 Comparison of provincial model returns

Of the eight provinces analyzed the following results emerged when the returns were compared across the provinces and to the Saskatchewan baseline model. The input variables and returns are presented in Appendix F.

- Alberta had the highest total revenue of the provinces analyzed with just under $2.1 million.
  - When compared to Saskatchewan, Alberta's total revenue was 5% higher.
- Nova Scotia had the largest total assets, largely because of the higher building costs.
  - When compared to Saskatchewan, Nova Scotia's total assets were 59% higher.
- Total fixed costs were highest in Nova Scotia, largely because of the interest and depreciation on the facilities.
  - When compared to Saskatchewan, Nova Scotia's fixed costs were 43% higher.
- Gross margins were highest in Manitoba (1% higher than Saskatchewan), while net income (revenue minus costs) was highest for Saskatchewan at $228,627. Quebec, Ontario, New Brunswick and Nova Scotia had negative net income.
  - The lowest net income per hog occurred in Nova Scotia at -$14.18/hog, while Saskatchewan had the highest at $17.13/hog.
- The results indicated that the Saskatchewan model was in the best financial position prior to the introduction of environmental compliance, with the highest net income per hog. This was a function of lower overall costs. Nova Scotia had the lowest net income per hog because of high fixed costs.
- Financial assistance was not available under the National Farm Stewardship Program (NFSP) and Greencover Canada (GC) programs for a new operation due to the fact that the operation does not have environmental risks. It is worth noting that older existing operations would be eligible for financial assistance. However, new operations are eligible for financial assistance for groundwater studies under the National Water Supply Expansion Program (NWSEP).

5.6.3 Total cost of environmental compliance and environmental ratios

In Table 5.1, the total cost of environmental compliance is the estimated cost to comply with all regulatory requirements (using the data from Tables 5.2 and 5.3 above) at the municipal and provincial level (recall that federal regulations are largely punitive in nature and result in cost implications after contamination has occurred and were therefore not included in these estimates). The three ratios of interest for this analysis were: Environmental Cost/Total Operating Costs, Environmental Cost/Total Costs and Environmental Cost/Total Revenue. These results of the ratio calculations are included in Table 5.4.

Total cost of environmental compliance was highest for Ontario, largely due to the nutrient management plans required. Note that the cost of environmental compliance in Quebec may be underestimated due to the lack of data on the cost of environmental impact assessments.

Environmental ratios

- Environmental costs as a function of total operating costs were highest in Ontario at 0.38% and lowest in New Brunswick at 0.14%.

- Environmental costs as a function of total costs were highest in Ontario at 0.26% and lowest in New Brunswick at 0.10%.
- For environmental costs over total revenue, the highest ratio occurred in Ontario (0.27%) and the lowest ratio occurred in New Brunswick (0.11%).

Saskatchewan had the most competitive advantage before and after implementing the cost of compliance for environmental regulations when the net income per hog was compared across the provinces as shown in Appendix F. The results of the analysis indicated that the net income per hog in Saskatchewan before environmental compliance was $17.13/hog and dropped to $16.95/hog after compliance was taken into account. The next closest province was Manitoba at $11.91/hog before compliance and $11.57/hog after.

Overall, the environmental cost ratios across Canada were less than 0.5%. When different methods were taken into account, this result was relatively consistent with results of the 2003 OECD study discussed in section 4.2. The OECD (2003) generated ratios of manure management costs to gross production costs which ranged from approximately 3.2% in Australia to approximately 8.5% in the Netherlands. However, the OECD study included manure handling and manure storage costs which made up a significant portion of environmental costs. If these costs were excluded from the OECD report, the resulting ratios would be approximately less than 1%, similar to the results of this analysis.

Table 5.4: Environmental ratios by province

	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
				Percentage				
Environmental cost/total oper. costs	0.19	0.26	0.35	0.38	0.22	0.14	0.18	0.18
Environmental cost/total costs	0.14	0.18	0.24	0.26	0.15	0.10	0.12	0.13
Environmental cost/total revenue	0.12	0.18	0.23	0.27	0.16	0.11	0.13	0.13
				($/year)				
Total costs of compliance	2,393	3,652	4,539	5,299	3,188	2,098	2,667	2,600
Total operating costs (excl. cost of compl.)	1,274,483	1,386,756	1,305,535	1,378,115	1,459,358	1,521,511	1,504,475	1,406,150
Total operating (incl. cost of compliance)	1,276,049	1,386,781	1,307,249	1,379,615	1,460,114	1,521,751	1,504,719	1,406,350
Total costs (excl. cost of compliance)	1,747,687	1,973,008	1,856,556	2,003,910	2,125,930	2,066,131	2,179,586	1,928,508
Total costs (incl. cost of compliance)	1,750,080	1,974,922	1,861,094	2,009,209	2,129,118	2,068,228	2,182,253	1,931,108
Total revenue	1,976,314	2,077,523	2,015,545	1,967,401	1,985,879	1,994,375	1,994,375	2,037,176

5.7 Summary and observations

The ÉcoRessources report recommended the use of financial ratios to evaluate the potential impact of a set of environmental regulations on producers. The suggested ratios were:

- standard financial ratios
- environmental costs over total costs and
- environmental costs over total revenue

The three ratios calculated for this analysis were: Environmental Cost/Total Operating Costs; Environmental Cost/Total Costs and Environmental Cost/Total Revenue. The rationale was that the ratios provide an estimation of the impact of regulations on producers' financial health, performance and competitiveness and allow the comparison to benchmarks in industry or between jurisdictions.

The evaluation framework used for this analysis was a computer simulation model of an efficient-scale hog production facility. The 600 sow farrow-to-finish operation was chosen as it is an applicable sized operation for most provinces in Canada and provides the best means for comparison.

To represent environmental compliance in each province, agricultural engineering experts, construction companies, government, industry, and academic sources identified what structures, equipment, and operational requirements would be required to comply with the regulations in the respective provinces. The environmental cost of compliance was simulated through the model to determine the difference in fixed and variable costs, on both a total and a per-head basis, of the alternative compliance requirements.

Since the model was based on the Elstow research farm, the Saskatchewan results were used as the baseline for comparison. The results indicated that the Saskatchewan model was in the best financial position prior to the introduction of environmental compliance, with the highest net income per hog. This was a function of lower overall costs. Nova Scotia had the lowest net income per hog because it had the highest fixed costs.

Total environmental cost of compliance was highest in Ontario followed by Manitoba and lowest in New Brunswick. Given the restrictiveness of environmental regulations in Quebec, it is important to explain why the costs of compliance in Quebec are relatively low compared to the other provinces. For this analysis, manure handling and manure storage costs (below 240 days) were not included as environmental costs. Manure handling and manure storage costs in Quebec are high relative to other provinces (refer to Appendix F). However, when these costs are excluded, environmental costs in Quebec are relatively small. For example, nutrient management planning in Quebec is less costly than in some other provinces (e.g. Ontario). It is also worth noting that environmental costs in Quebec are underestimated due to the lack of data on the cost of environmental impact assessments in the province. Saskatchewan had the most competitive advantage before and after implementing the cost of compliance for environmental regulations in terms of net income per hog.

The overall implications of complying with environmental regulations varied across the provinces, implying some provinces were at a competitive advantage whether from lower costs to comply or reduced restrictiveness of the environmental regulations, like in the case of Saskatchewan. For example, the range of calculated ratios for environmental cost/total cost went from a low of 0.10% (New Brunswick) to a high of 0.26% (Ontario).

With environmental costs at less then 0.5% of costs (total and operating) and revenues for all provinces, annual compliance costs do not appear to have a significant impact on the cost of doing business for hog operations in Canada, given the assumptions and caveats of the model. It is important to recognize that for this analysis manure handling costs and the manure storage costs (below 240 days) were not included as environmental costs but were assumed to be the costs of doing business. It should also be noted that the capital costs associated with environ-

mental compliance are significant when incurred, but when annualized, the cost impacts are reduced substantially. Another important caveat to this analysis is that the environmental ratios are sensitive to cost and revenue estimates.

Despite the cost of compliance for environmental regulations, there may also be benefits to producers of compliance, some of which are social benefits that benefit both the farming operation and community. Some of these potential benefits (although not easily quantified) may include: reduced complaints from neighbouring communities due to reduced odour as a result of regulations that require separation distances; improved water and soil quality from requirements for setbacks, buffer strips and manure application rules. If an operation was intending to expand, compliance with current regulations may speed up the approval process for building plans or applications for permits. Compliance with regulations may also improve biodiversity on the farm. For example, reducing runoff can impact oxygen levels in surface water enhancing aquatic life.

In addition, there are also benefits to a farm business from environmental regulations as described in Section 4.1. Recall that benefits (of good environmental regulation) can include: reduced costs for industry and business, markets for environmental goods and services, increased innovation, reduced business risk, increased confidence of investors and insurers, assistance in competitive advantage, helping to create and sustain jobs, and improving the health of the workforce and wider public (Network of Heads of European Environment Protection Agencies, 2005).

Finally, with the development of Environmental Farm Plans or following provincial guidelines for beneficial management practices (although not specifically legislated), producers may have the benefit of access to financial assistance. However, it is important to note that although there were many programs both nationally and provincially that offer financial assistance for environmental initiatives (that would cover the cost of compliance for environmental regulations in some cases), new operations were not eligible for funding under the National Farm Stewardship Program (NFSP) and Greencover Canada (GC) program.[169] New operations would be eligible for financial assistance for groundwater studies through the National Water Supply Expansion Program (NWSEP). Although the Enviro-loan was available from FCC, there was nothing specific (for example a reduced interest rate) that could be incorporated into the representative farm model.

169. It is important to note that existing older operations would be eligible for financial assistance.

SECTION 6

Coherence/conflict of regulations

6.0 COHERENCE/CONFLICT OF REGULATIONS

Section 6.0 investigates the consistency and/or conflict of the provincial/municipal agri-environmental regulations that were reviewed and used in the provincial models (recall that federal regulations are largely punitive in nature and were therefore not included for this evaluation – refer to section 3.2 for a further explanation). This section examines the objectives of the main agri-environmental regulations, compares the restrictiveness of these regulations, and assesses the differences in requirements across the provinces (Section 6.1). The analysis also compares the provincial approaches to regulation and whether the regulations of the hog industry are provincially controlled, municipally controlled, or a combination of both (Section 6.2). Section 6.3 presents a summary and the conclusions from the section.

6.1 COMPARISON OF LEGISLATION ACROSS PROVINCES

It is important to realize that the number and strength of environmental regulations in a province may be a reflection of the intensity of agriculture in the region and the resulting environmental problems that may occur. Section 2.1 outlined the trends in hog inventories and hog density, as well as the number and types of hog operations for the major hog producing provinces (Quebec, Ontario, Manitoba and Alberta). The main conclusions derived from the statistics were as follows:

- Quebec has the largest number of total hogs and market hogs. However, while Quebec used to have the largest number of sows, it has now been surpassed by Ontario.
- Quebec has by far the highest density of pig production in Canada. Ontario and New Brunswick have moderate densities while the western provinces have relatively low pig densities.
- There has been a significant decline in the number of operations of all types in all provinces. The only exception to that trend has been the increase in finishing operations in Quebec.
- There has been a material increase in the average size of all operations between 1996 and 2005 with many types more than doubling.
- Quebec has had the slowest growth in average size of operations by a large margin.

These statistics clearly demonstrate that over the past decade, the number of hog operations has fallen but the average size of operations has risen. As a result, the density and concentration of hog production within the four major hog producing provinces has increased. As the intensity of agricultural production increases, one would typically expect the number and strength of environmental regulations to also increase. Throughout the provinces the environmental regulations are fairly reflective of the intensity of agricultural production. For example, the provinces with the largest number of hogs (Quebec, Ontario, Manitoba and Alberta) also tend to have more environmental regulations controlling agricultural operations. Not only are the regulations more numerous, they are also more detailed and restrictive. The sections below compare environmental regulations across Canada and provide insight into the coherence and conflict of the regulations across the country.

As background information for the coherence and conflict of environmental regulations across Canada, it is important to understand the objectives of the legislation by province. Provincial governments create legislation with a focus on preventing and reducing the environmental problems in their jurisdictions. The environmental problems within each jurisdiction vary and thus the objectives of the environmental regulations are different. The following paragraphs highlight the environmental concerns in each of the provinces and the purposes of the principal agri-environmental regulations controlling hog operations.

In BC, water quality and urbanization of agricultural land are key environmental concerns. There is a risk of increased contamination of surface and groundwater resulting from high fertilization of soils and heavy applications of manure from intensive livestock operations, and the concentration of production on a smaller land base (Agriculture and Agri-Food Canada, 1997). An excess of nutrients and other contaminants entering surface and groundwater in the Lower Fraser Valley has resulted in reduced water quality. During high risk periods, runoff from manured fields and uncovered manure piles has been a significant source of excess nutrients and other contaminants in surface and ground water (Farmwest.com, 2001). The provincial government frequently issues manure spreading advisories to provide guidance to farmers regarding the Agricultural Waste Control regulation under the Environment Management Act. The objectives of the legislation are outlined in Table 6.1.

Alberta is facing significant pressures on its water resources. Population growth, drought, and agricultural and industrial development have put stress on the province's water supply and water systems (Alberta Government, 2004). Pollution from agriculture is a concern in some parts of Alberta, as it is in the rest of the world. In operations that are not properly managed, precipitation falls on the land and washes into the local watershed or water basin (lake or river), potentially carrying with it chemicals from fertilizers or pesticides or fecal coliform bacteria from animal manure (Alberta Environment, 2002). The Agricultural Operation Practices Act and its corresponding regulations aim to ensure that agricultural producers are managing manure properly as described in Table 6.1.

The primary legislation regulating the livestock industry in Saskatchewan is the Agricultural Operations Act (refer to Table 6.1). All intensive livestock operations, regardless of size, are required to ensure that water resources are protected (Saskatchewan Agriculture and Food, 2006).

The gradual but steady increase in nitrogen and phosphorus contributions to water systems over the past several decades is one of the single, largest water quality challenges facing Manitoba (Manitoba Water Stewardship, 2006a). In Manitoba, studies have shown that since the early 1970s, phosphorus loading has increased by about 10% to Lake Winnipeg and nitrogen loading

has increased by approximately 13% (Manitoba Water Stewardship, 2006a). Similar problems have arisen in many other streams, rivers, and lakes in the province. As such, nutrient and water management are the primary areas of environmental concern for Manitoba. The main legislation for controlling agricultural operations in Manitoba is the Livestock Manure and Mortalities Management Regulation (42/98) under the Environment Act. The purpose of the regulation is described in Table 6.1. The Manitoba Water Protection Act and its regulations, upon finalization, will affect agricultural operations in the near future.

Similar to Manitoba, the province of Ontario is concerned with nutrient management. Over the past two decades, the development of intensive livestock operations that produce large quantities of manure increased the risk of contamination of water systems. The most serious event was the contamination of drinking water with E. coli bacteria that led to seven deaths in Walkerton in May 2000. In 2002, the government passed the Nutrient Management Act and its General Regulation setting out the legal requirements for the storage and handling of manure and other nutrients (refer to Table 6.1).

In Quebec, the intensification of agriculture over the past several decades has been marked by the concentration of production and an increase in farm size and specialization, technological progress, and use of off-farm inputs (Boutin, 2005). While this modernization of farming has been supported by agricultural programs and policies, it has increased pressure on resources and has seriously affected the environment through water contamination, soil degradation, and habitat and biodiversity deterioration (MENV, 2003 as cited in Boutin, 2005). Therefore, the primary concern with hog farming in Quebec is the concentration and density of hog operations. In response to this issue, the Quebec government extended a moratorium on new or expanding hog farms throughout most of the province in 2002. In addition, the government implemented the Agricultural Operations Regulation in 2002. The objectives of the regulation are detailed in Table 6.1. The moratorium on hog expansion in Quebec was lifted in December 2005.

Environmental issues in the Atlantic provinces in many respects resemble those in Ontario and Quebec (i.e. water quality and soil quality) but on a smaller and more localized scale (Agriculture and Agri-Food Canada, 1997). The objectives of provincial legislation in the Maritimes focus on the protection of the environment (as shown in Table 6.1).

Table 6.1: Objectives of environmental regulations by province

PROVINCE	PRIMARY LEGISLATION CONTROLLING HOG OPERATIONS	OBJECTIVES OF THE LEGISLATION
British Columbia	Agricultural Waste Control Regulation (131/92) under the Environmental Management Act, Health Act	To describe practices for using, storing and managing agricultural waste that will result in agricultural waste being handled in an environmentally sound manner
Alberta	Agricultural Operation Practices Act and corresponding regulations	The legislation lays out clear manure management standards for all farming and ranching operations in Alberta. It also provides producers and other stakeholders with a one-window process for siting new and expanding confined feeding operations (CFOs)*
Saskatchewan	Agricultural Operations Act	The Agricultural Operations Act regulates all livestock operations within the province for surface and ground water quality protection**

Table 6.1: Objectives of environmental regulations by province (Continued)

PROVINCE	PRIMARY LEGISLATION CONTROLLING HOG OPERATIONS	OBJECTIVES OF THE LEGISLATION
Manitoba	Livestock Manure and Mortalities Management Regulation (42-98) under the Environment Act	The purpose of this regulation is to prescribe requirements for the use, management and storage of livestock manure and mortalities in agricultural operations so that livestock manure and mortalities are handled in an environmentally sound manner
Ontario	Nutrient Management Act	The purpose of this Act is to provide for the management of materials containing nutrients in ways that will enhance protection of the natural environment and provide a sustainable future for agricultural operations and rural development
Quebec	Agricultural Operations Regulation under the Environment Quality Act	The object of this regulation is to protect the environment, particularly water and soil against pollution caused by certain agricultural activities
Nova Scotia	Environment Act	The purpose of this Act is to support and promote the protection, enhancement and prudent use of the environment
New Brunswick	Livestock Operations Act	The primary purpose of the Livestock Operations Act was to facilitate the development of the livestock industry, with recognition of the needs of the rural community and the protection of the environment***
Prince Edward Island	Environmental Protection Act	The purpose of this Act is to manage, protect and enhance the environment

* *Purpose not defined in the Act and its regulations. Source: Alberta Agriculture, Food and Rural Development, 2004.*
** *Purpose not defined in the Act and its regulations. Source: Saskatchewan Agriculture and Food, 1998.*
*** *Purpose not defined in the Act and its regulations. Source: New Brunswick Department of Agriculture, Fisheries and Aquaculture, 2006.*

Table 6.2 is a starting point for the comparison of the strength of environmental regulations across the provinces. The table, cited in Debailleul and Boutin (2004), categorizes the environmental regulations of each province (except for BC, Nova Scotia and PEI) according to their restrictiveness. The authors established eight criteria to represent the presence of environmental regulations. The criteria are based on procedures to evaluate the establishment/expansion of farming operations and procedures to control the effluents from pig production. The criteria based on the first set of procedures include authorization permits, impact assessments, public consultations, and nutrient management plans. The criteria related to controlling effluents include separation distances from watercourses, buffer strips, spreading period restrictions, and distances to control odours. For each province, each type of environmental regulation criteria is rated as most restrictive, fairly restrictive, or least restrictive.

Using the ratings in the table below, there are several observations that can be made about the restrictiveness of environmental regulations in Canada. To begin with, Quebec has the most comprehensive set of environmental regulations as demonstrated by the presence of regulations in each of the eight criteria. In contrast, Saskatchewan appears to be on the opposite end of the spectrum with restrictiveness ratings in only three of the eight categories. By category, authorization permits and nutrient management plans appear to be areas of priority in Canada as demonstrated by the fact that these two criteria are rated as fairly restrictive or most restrictive for all of the selected provinces.

Table 6.2: Restrictiveness of environmental regulations by province, 2004

PROV.	Authorization permits	Impact assessments	Public consultation	Nutrient management plans	Separation distances from watercourses	Buffer strips	Spreading period	Distances to control odours
Alb.	♦♦	n/a	♦♦♦	♦♦	♦♦	♦♦	♦♦	♦♦♦
Sask.	♦♦	n/a	♦	♦♦	n/a	n/a	n/a	n/a
Man.	♦♦	n/a	n/a	♦♦	♦♦♦	♦♦♦	♦♦	n/a
Ont.	♦♦	n/a	n/a	♦♦♦	♦♦	♦♦	♦	♦♦♦
Que.	♦♦♦	♦♦	♦	♦♦♦	♦	♦	♦♦	♦♦
N.B.	♦♦♦	n/a	n/a	♦♦	♦♦♦	♦♦	n/a	♦♦♦

Legend[170]: ♦ *least restrictive regulations.*
♦♦ *fairly restrictive regulations.*
♦♦♦ *most restrictive regulations.*

Source: Adapted from Debailleul, 2004 as cited in Debailleul and Boutin, 2004.

In addition, Table 6.2 provides an indication of areas of priority within each province. For example, Manitoba's focus appears to be on the prevention of water pollution as evidenced by the most restrictive criteria being the separation of facilities/storages from watercourses and the presence of buffer strips. The focus on water pollution control is likely due to the concern over rising levels of nutrients in Manitoba's lakes, rivers and streams. In Alberta, public consultation and distances to control odours are the most restrictive aspects of provincial environmental legislation.

Building upon the results presented in Table 6.2 above, the following paragraphs aim to analyze elements of the criteria individually according to the information collected during the review of environmental regulations by province in section 3.2. This analysis includes all of the nine provinces selected for this research study.

Table 6.3 compares the permits/authorizations required by province (including municipal bylaws) and also states whether environmental impact assessments are required. In addition, the table details the requirements for public notice and nutrient management plans by province. Note that permits/authorizations, assessments and plans vary depending on the specifics of the hog operation and site. Also, it is important to recognize that the legislation often applies to activities and operations in general rather than agriculture-specific operations. This table attempts to capture all possible requirements that may need to be met by hog producers.

According to environmental legislation in each of the provinces, any permits or authorizations related to pig production require governmental approval before the proposed projects may begin. In Alberta and New Brunswick, the procedures for proposed livestock operations are quite rigorous. In New Brunswick, producers must obtain site development plans, descriptions

170. *This classification relating to the restrictiveness of regulations refers to a qualitative appreciation of the measures in place. The level of restrictiveness is therefore evaluated for each measure by a comparison of the constraints imposed by the various regulations. This grouping is therefore a relative appreciation. This means that, among the various jurisdictions examined, the authors have ordered the measures according to the requirements imposed. In most cases, three clear categories could be established. However, if some of the measures refer only to two categories (e.g. nutrient management plans), it is because none of the jurisdictions had measures sufficiently different to establish three categories and in these cases the authors limited classification to two categories: fairly restrictive and most restrictive. What is important to understand from this table is that it presents a relative appreciation of the various measures. Source: Denis Boutin, Ministère du Développement durable, de l'Environnement et des Parcs, 418-521-3950 x 4462*

of manure systems, nutrient management plans, and soil and manure analysis as part of the application for a livestock operation licence. In Alberta, the construction/expansion of confined feeding operations and manure storage is subject to hydro-geological assessments, site plans, nutrient management plans, engineering plans, and the signature of a professional engineer. In Quebec, proposed projects are subject to project notice or authorization certificates. Projects subject to authorization certificates involve the construction or expansion of livestock raising sites in which annual phosphorus production is greater than 3200 kg.[171] Annual phosphorus production of 3200 kg corresponds to approximately 80 animal units (Debailleul, 2004). According to the Agricultural Operations Regulation in Quebec, applications for authorization certificates must include agro-environmental fertilization plans, the plans and specifications of storage, if applicable, and the information related to the reclamation of livestock manure or to their disposal.

Quebec pork producers are more likely to be subject to environmental impact assessments than producers in other provinces. This is due to the fact that environmental legislation in all of the provinces (except Quebec) states that as part of the approval process for proposed undertakings, proponents may be required to complete an environmental impact assessment. However, the legislation is general in nature and does not apply specifically to agricultural operations. In contrast, the Environment Quality Act and its corresponding regulations for Quebec state that environmental impact assessment and review procedures (as well as authorization certificates) apply to the construction/expansion of buildings in a livestock operation whose total number will equal or exceed 600 animal units kept in the case of liquid manure production or 1,000 animal units in the case of semi-solid or solid manure production.

In several provinces, it is necessary for new and expanding hog operations to notify the public and neighbours regarding proposed development. In Alberta, upon the receipt of an application for registration or an amendment of a registration, approval officers must notify the owners or occupants of land within the greater of ½ mile or the minimum separation distance of the parcel of land on which the confined feeding operation is to be located. Under the zoning by-law of the Rural Municipality of Lake of the Rivers, Saskatchewan, council may advertise any proposal that will result in an intensive livestock operation and may hold a public hearing on the proposal. In the Rural Municipality of Hanover, Manitoba, producers must send notice to neighbours if constructing a new livestock operation under municipal by-laws. In Quebec, for developments where an environmental impact assessment statement is required (developments with 600 animal units kept in the case of liquid manure production or 1,000 animal units in the case of semi-solid or solid manure production), the Minister shall make the environmental impact assessment statement public upon receipt. The proponent of the project must then publish a notice in a daily and a weekly newspaper circulated in the region where the project is likely to be carried out, as well as in a daily newspaper in Montréal and in Québec City. The proponent must also, within 21 days following the publication of the first notice, publish a second notice in a weekly newspaper circulated in the same region. In addition, any person, group or a municipality may, until 45 days after the date when the Minister made the environmental impact assessment statement public, apply to the Minister for the holding of a public hearing in connection with such a project.

The environmental legislation regarding nutrient management plans is coherent across the provinces in that most of the provinces require producers to create plans specifying how they will

171. For expansions, the increase in annual phosphorus production must be greater than 500 kg for the project to be subject to an authorization certificate.

manage nutrients and particularly manure within their operations. The specifics of the plans vary quite widely across the provinces. Some provinces such as Quebec and Ontario require one plan that encompasses all aspects of nutrient management. Other provinces such as Saskatchewan require separate plans for different elements of nutrient management such as manure storage and manure management. In British Columbia, Nova Scotia and PEI, nutrient management plans are voluntary.

Table 6.3: Permits, impact assessments, public notice, and nutrient management plans by province

PROVINCE	REQUIRED PERMITS/AUTHORIZATIONS, IMPACT ASSESSMENTS, PUBLIC NOTICE, AND NUTRIENT MANAGEMENT PLANS
British Columbia	◆ Environmental impact assessment for proposed undertakings (not agriculture specific) if required by the Minister ◆ Registration or licence for diversion/use of water ◆ Water management plan (if required) ◆ Soil testing if liquid manure is stored in a lagoon (municipal by-law) ◆ Building permit (municipal by-law)
Alberta	◆ Approval or registration for expansion/construction of confined feeding operations from Natural Resources Conservation Board (NRCB) ❖ Hydro-geological assessments ❖ Nutrient management plans unless applicant proves sufficient land ❖ Site plans ❖ Engineering plans ❖ Certification of professional engineer ◆ Authorization for expansion/construction/modification of manure storage facilities ❖ Hydro-geological assessments ❖ Nutrient management plans ❖ Site plans ❖ Engineering plans ❖ Certification of professional engineer ◆ Environmental impact assessment report for proposed undertakings (not agriculture specific) if required ◆ Notification of neighbours ◆ Approval or registration for diversion of water or activity/operation impacting water ◆ Specific application for confined feeding operations (Red Deer County by-law) ◆ Development permit (Red Deer County by-law) – producers may be exempt from development permit fee if granted approval from Natural Resources Conservation Board
Saskatchewan	◆ Waste storage plan for intensive livestock operation ◆ Waste management plan for intensive livestock operation ❖ Manure testing for nitrogen, phosphate and potassium ◆ Development permit (Rural Municipality of Lake of the Rivers by-law) ◆ Discretionary approval (Rural Municipality of Lake of the Rivers by-law) ◆ Advertisements and public hearing if desired by municipal council (Rural Municipality of Lake of the Rivers by-law)

Table 6.3: Permits, impact assessments, public notice, and nutrient management plans by province (Continued)

PROVINCE	REQUIRED PERMITS/AUTHORIZATIONS, IMPACT ASSESSMENTS, PUBLIC NOTICE, AND NUTRIENT MANAGEMENT PLANS
Manitoba	◆ Environmental plans for proposed development ❖ Environmental impact assessment for proposed undertakings (not agriculture specific) if required by Director ◆ Development licence ◆ Manure management plan ❖ Soil nutrient analysis reports for manure management plan ◆ Manure management plan for growing season ◆ Permit for expansion/construction of manure storage facilities ❖ Soil analysis if required ◆ Permit for expansion/construction of confined livestock area ◆ Registration for liquid/semi-solid manure storage required after 2010 ◆ Licence may be required for use/diversion of water for agricultural purposes if more than 25,000 litres/day excluding water used for irrigation ◆ Development approval for small and large scale livestock operations ◆ Approval for conditional use of small and large scale livestock operations ◆ Approval from Livestock Technical Review Committee (Rural Municipality of Hanover by-law) ◆ Notice to neighbours (Rural Municipality of Hanover by-law) ◆ Building and permit fees (Rural Municipality of Hanover by-law)
Ontario	◆ Nutrient Management Strategy ◆ Nutrient Management Plan ❖ Soil and manure analysis ◆ Building permit and development charge (municipal by-laws)
Quebec	◆ Environmental impact assessment and review (applies to construction/expansion for operations with 600 AU and liquid manure or 1000 AU with semi-solid/solid manure ◆ Authorization certificate ◆ Agro-environmental fertilization plan ❖ Manure analysis for nutrient levels ◆ Project notice for new/modified raising sites or manure storage facilities ❖ Signed by agrologist ◆ Public notice through advertisements and public hearing
New Brunswick	◆ Livestock operation licence ❖ Site development plan in relation to proposed livestock site ❖ Description of manure system ❖ Manure nutrient management plan signed by agrologist ❖ Soil and manure testing for nutrient levels as part of the manure nutrient management plan ◆ Fertilizer management strategy signed by agrologist ❖ Soil and fertilizer testing required for fertilizer management strategy ◆ Registration for agricultural land ◆ Water withdrawal permit ◆ Environmental impact assessment registration ◆ Building permit (municipal by-law)
Nova Scotia	◆ Approval required for commencing work or undertaking ◆ Environmental impact assessment for proposed undertakings (not agriculture specific) if required ◆ Focus report if required ◆ Environmental monitoring and rehabilitation studies if required ◆ Manure disposal plan (Kings County municipal by-law) – essentially producers are required to have either a nutrient management plan or seven months of manure storage ◆ Building permit (Kings County municipal by-law)

Table 6.3: Permits, impact assessments, public notice, and nutrient management plans by province (Continued)

PROVINCE	REQUIRED PERMITS/AUTHORIZATIONS, IMPACT ASSESSMENTS, PUBLIC NOTICE, AND NUTRIENT MANAGEMENT PLANS
Prince Edward Island	◆ Proposal required for undertaking ◆ Development permit (Planning Act and its regulations) ❖ Building/development permit – subject to approval from Department of Agriculture, Fisheries and Aquaculture[a] ◆ Environmental impact assessment if required (not agriculture specific) ◆ Manure management plan (according to manure management guidelines)

[a] *Source: Roxanne Larter, PEI Department of Community and Cultural Affairs, 902-368-5280.*

Minimum manure storage requirements are legislated provincially in only three of the nine provinces examined in this analysis. The provinces with legislated minimum manure storage capacities include Alberta, Ontario, New Brunswick. Note that in BC, manure storage capacity is legislated by municipal by-laws in Chilliwack. In the remaining provinces, minimum manure storage capacities may be recommended by manure management guidelines or by government officials. For a majority of the provinces, a range of 200 days to 270 days of manure storage capacity is legislated or recommended by government. Therefore, the minimum manure storage requirements or recommendations by province are very coherent across the country as shown in Table 6.4. In BC, Saskatchewan, Manitoba, Quebec, Nova Scotia, and PEI, there is no provincial legislation detailing minimum manure storage requirements. In Manitoba, Nova Scotia and PEI, minimum manure storage capacities outlined in Table 5.4 are recommended by provincial manure management guidelines. In Quebec, manure storage requirements are determined for individual hog operations during the establishment of agro-environmental fertilization plans. In Saskatchewan, although not legislated, 400 days of earthen manure storage is considered the standard practice and is recommended by government officials.[172] In BC, the City of Chilliwack Intensive Swine Operation By-law states that manure storage facilities must be adequate to contain all the manure generated for a period of not less than 120 days or the minimum period recommended by the BC Ministry of Agriculture and Lands, whichever is greater. The recommended minimum manure storage capacity according to the BC Ministry of Agriculture and Lands is 180 days.[173]

Table 6.4: Minimum manure storage requirements by province

	B.C.	ALB.	SASK.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Min. manure storage capacity (days)	180*	270	400*	200*	240	n/a	210	210*	210*

* *Not legislated. Minimum manure storage capacity recommended by government officials or provincial manure management guidelines.*

Note that in Manitoba livestock operations with 300 animal units and greater must store all manure over winter for application the following year. These storage structures must be big enough to store manure for at least 200 days. Most earthen manure storage structures in Manitoba are built to provide storage for more than 400 days.[174]

172. *Source: Saskatchewan Agriculture and Food, Frequently Asked Questions regarding Livestock Operations. Retrieved May 18, 2006 from http://www.agr.gov.sk.ca/docs/livestock/beef/backgrounding/FAQReLvstkOperations.pdf.*

173. *Source: Communication from Tom Droppo, Dairy/Pork Industry Specialist, BC Ministry of Agriculture and Lands, 604-556-3144.*

174. *Source: Manitoba Agriculture, Food and Rural Initiatives. 2005. Livestock Manure Storage. Retrieved September 14, 2006 from http://www.gov.mb.ca/agriculture/livestock/publicconcerns/cwa01s13.html.*

A comparison of minimum setback distances for manure storages and livestock facilities from water sources, ditches, dwellings and land boundaries is provided in Table 6.5.

From the table, it is evident that the different provinces have diverse requirements for the setback of manure storage facilities from water. For example, in Saskatchewan and Nova Scotia, there are no requirements in the provincial legislation stating that manure storages and livestock facilities must be setback from water. In contrast, Manitoba has stringent provincial regulations specifying that manure storages must be 100 metres from water sources. These separation distances are restated in the municipal by-laws of the Rural Municipality of Hanover, Manitoba. In Red Deer County, Alberta, the municipal by-laws state that the minimum separation distances from the provincial regulations apply to confined feeding operations. A similar situation exists in Ontario where municipal bylaws are superseded by the Nutrient Management Act. Although not regulated at the provincial level, setback distances from water in Nova Scotia are regulated by municipal by-laws. In Nova Scotia, municipal by-laws in Kings County legislate that new buildings including manure storage facilities must be located at least 300 feet from wells, watercourses, or dwellings on adjacent properties.[175]

At the provincial level, Alberta, Manitoba and New Brunswick specify separation distances of facilities from dwellings and land boundaries. British Columbia, Saskatchewan, Manitoba, Quebec, and Nova Scotia use municipal by-laws to legislate separation distances from dwellings and land boundaries. For example, in Saskatchewan, the zoning by-law for the Rural Municipality of the Lake of Rivers provides separation distances for livestock facilities from building development. For the 600 sow farrow-finish model (888 AU in Saskatchewan) used for the purposes of this research, livestock facilities in the municipality must be located 1200 m from nearby residences and liquid manure storage lagoons must be 1800 m from residences (as discussed in section 3.2.3).

Table 6.5: Minimum setbacks of manure storages and livestock buildings

PROV.	SETBACK DISTANCES OF MANURE STORAGE AND LIVESTOCK FACILITIES IN METRES (M) FROM:			
	Water sources	Agricultural ditch	Dwellings	Land boundaries
B.C.	Manure storage facilities must be 15 m from watercourses and 30 m from water source for domestic use		Livestock and manure storage facilities must be 305 m from the nearest neighbour (municipal by-law)	Livestock and manure storage facilities must be 30 m from the land boundaries (municipal by-law)
Alb.	Manure storage facilities must be 100 m from wells and springs and 30 m from common bodies of water		Separation distances based on calculation	

175. *In addition, Nova Scotia guidelines recommend that hog facilities and manure storages be located 100 metres from watercourses and off-farm wells, 50 metres from land boundaries, 50 metres from public roads, 300 to 1000 metres from off-farm dwellings (depending on number of animal units), and 600 to 1000 metres from non farm developments (depending on number of animal units).*

Table 6.5: Minimum setbacks of manure storages and livestock buildings (Continued)

PROV.	SETBACK DISTANCES OF MANURE STORAGE AND LIVESTOCK FACILITIES IN METRES (M) FROM:			
	Water sources	Agricultural ditch	Dwellings	Land boundaries
Sask.			Livestock facilities must be 1200 m from residence for operations with 500-2000 AU (municipal by-law) Liquid manure lagoons must be 1800 m from residence for operations with 500-2000 AU (municipal by-law)	
Man.	Manure storage facilities must be 100 m from wells, sinkholes, surface watercourses, springs (also applies under municipal by-law)	Manure storage facilities must be 100 m from drainage ditches	Livestock barns with more than 250 AU must be 400 m from dwellings (municipal by-law) Earthen manure storage must be 500 m from dwellings (municipal by-law)	Manure storage facilities must be 100 m from land boundaries
Ont.	Manure storage facilities must be 15 m from a drilled well (with depth of 15 m and watertight casing), 30 m from any other well, and 100 m from municipal wells			
Que.	Livestock and manure storage facilities must be 15 m from watercourses (also applies to lakes, swamps, ponds marshes)		Separation distances based on calculation	
N.B.	Separation distances from watercourses may apply in certain protected areas		Separation distances based on calculation	Livestock facilities must be 20 m from land boundaries
N.S.	300 ft from well, watercourse, (municipal by-law)[a]		300 ft from dwellings (municipal by-law)[b]	n/a[c]
P.E.I.	Livestock and manure storage facilities must be 90 m from watercourses (also applies to wetlands)[d]			n/a[e]

[a] *Nova Scotia guidelines also recommend 100 m from off-farm well.*
[b] *NS guidelines recommend between 300 to 1000 m depending on number of animal units.*
[c] *NS guidelines recommend 50 m from land boundaries.*
[d] *PEI Manure Management Guidelines state that the minimum separation distance between a manure storage facility 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 should be increased by a multiplication factor depending on the soil type.*
[e] *As per PEI guidelines, minimum separation distances are based on a calculation.*

In addition to differences in setbacks, environmental legislation across the provinces varies in terms of minimum separation distances for manure spreading as shown in Table 6.6.

Table 6.6: Legislation regarding separation distances for manure spreading from water including buffers

PROVINCE	MINIMUM SEPARATION DISTANCES/BUFFERS FOR MANURE SPREADING ADJACENT TO WATER SOURCES: METRES (M)
British Columbia	◆ n/a[a]
Alberta	◆ Spreading must be 30 m from water well, 10 m from water body if subsurface injection and 30 m from water body if incorporating within 48 hours
Saskatchewan	◆ n/a[b]
Manitoba	◆ For injection or low-level application with immediate incorporation and without a buffer, separation from lake must be 20 m and separation from rivers, creeks and drains must be 8 m. ◆ For high-level broadcast or low-level application without incorporation and without a buffer, separation from lake must be 35 m and separation from rivers, creeks and drains must be 15 m. ◆ For injection or low-level application with immediate incorporation and with a buffer, separation from lake must be 15 m of vegetated buffer and separation from rivers, creeks and drains must be 3 m of vegetated buffer. ◆ For high-level broadcast or low-level application without incorporation and with a buffer, separation from lake must be 30 m (including 15 m buffer) and separation from rivers, creeks and drains must be 10 m (including 3 m buffer)
Ontario	◆ Agricultural source materials may not be applied to land within 15 m of a drilled well (with depth of at least 15 m and watertight casing) or within 30 m of any other well or within 100 m of a municipal well. As well, nutrients may not be applied to a field adjacent to surface water unless there is a vegetated buffer zone in the field that lies between the surface water and where the nutrients are applied
Quebec	◆ Spreading must be 3 m from shoreline of watercourse, lake, swamp or pond and 1 m from agricultural ditches
Nova Scotia	◆ Under the Clean Water Act, no manure may be spread in Zone A or Protected Area C. Grass buffers are required adjacent to watercourses in Protected Area C
New Brunswick	◆ n/a[c]
Prince Edward Island	◆ Buffer strips must be 10 m in width or 20 m in width if slope is greater than 5% and within 50 m of upland boundary of buffer zone. For existing ILO where slope of land within 20 m of watercourse boundary is 9% or less, buffer strips must be at least 20 m wide. For existing ILO where slope of land within 30 m of watercourse boundary is greater than 9%, buffer strips must be at least 30 m wide[d] ◆ No fall tillage within buffer zone

n/a - not applicable as there was nothing specific outlined in the legislation.

[a] *Lower Fraser Valley Guidelines suggest that manure not be spread closer than 10 metres from ditches and streams when spread on established grassland or bare land. No guidelines are given for spreading on cover crops, fall seeded grassland or berry crops.*

[b] *SK guidelines recommend minimum separation distances for manure spreading of 100 metres from domestic groundwater supply on land not controlled by the operator, 30 metres from watercourses to which runoff will not flow on land not controlled by the operator, and between 30 and 300 metres (depending on incorporation or injection) from watercourses to which runoff will flow on land not controlled by the operator.*

[c] *NS guidelines state that manure should not be applied within 30 metres of an existing well on clay loam or loam soil, and not within 60 metres on sand or gravel soil. In addition, manure should not be applied within 3 metres of ditches and within 5 metres of brooks, rivers and lakes.*

[d] *For manure spreading with no incorporation, PEI guidelines recommend a minimum separation distance from watercourses where the slope is less than 5% of 30 m and if the slope is more than 5%, the distance should be 60 m. For manure spreading with incorporation within 48 hours, PEI guidelines recommend a minimum separation distance from watercourses where the slope is less than 5% of 10 m and if the slope is more than 5%, the distance should be 30 m.*

Another similarity among all jurisdictions is that they strongly discourage spreading manure on frozen or snow covered land. Spreading period restrictions by province are compared in Table 6.7.[176]

Table 6.7: Comparison of manure spreading period restrictions by province

PROV.	MANURE SPREADING RESTRICTIONS	ADDITIONAL INFORMATION
B.C.	No spreading on frozen land or saturated soils	
Alb.	No spreading on frozen or snow-covered land	
Sask.	n/a	
Man.	No winter spreading between Nov 10 and Apr 10	Does not apply to operations with more than 300 AU but less than 400 AU until November 2010 unless mean slope of land is 12% or more Does not apply to operations with less than 300 AU unless mean slope of land is 12% or more
Ont.	No person shall apply materials to land during the period from December 1 to March 31 or at any other time when the soil of the land is snow-covered or frozen unless: 1. Liquid agricultural source materials and application is done during period from Dec 1 - Mar 31 when the land is not snow-covered or frozen and application is done by injection, spreading and incorporation within the same day, or surface application if the land is covered by a living crop/crop residue that covers at least 30% of the land surface, and setback from water is 20 m + or 100 m + if slope is greater than 3% 2. Liquid agricultural source materials and application is done when land is snow-covered or frozen and application is done by injection, spreading and incorporation within 6 hours, and setback from water is 20 m + or 100 m + if slope is greater than 3%	
Que.	No spreading on frozen or snow covered land. Fertilizers may only be spread between Apr 1 and Oct 1 of each year	Fertilizers may be spread after Oct 1 on ground that is not frozen or covered with snow if agrologist specifies new prohibition period and proportion of waste is less than 35% of annual volume produced by raising site
N.B.	n/a	
N.S.	n/a[a]	
P.E.I.	n/a[b]	

[a] *Guidelines for NS state that producers should avoid spreading manure on snow or frozen ground.*
[b] *Guidelines for PEI state that winter application of manure should not occur; if winter spreading is necessary, producers should apply only if the potential for surface runoff is minimal.*

A major difference among the environmental legislation is the great variety of definitions for animal units in each of the provinces (Holley, 2002). Table 6.8 outlines the factors used to determine the number of animal units by province. Note that New Brunswick has no determination of animal units.

176. This analysis does not include restrictions on the spreading of biosolids.

Table 6.8: Determination of animal units by province

TYPE OF LIVESTOCK	FACTOR USED TO DETERMINE THE NUMBER OF ANIMAL UNITS (# PIGS PER ANIMAL UNIT)							
	B.C.[a]	ALB.[b]	SASK.[c]	MAN.[d]	ONT.[e] (nutrient unit)	QUE.[f]	N.S.[g]	P.E.I.[h]
Farrow-finish	n/a	0.56	n/a	0.8	n/a	n/a	1	n/a
Farrow-wean	n/a	1.5	n/a	3.2	n/a	n/a	4	n/a
Farrow-nursery	n/a	n/a	n/a	4	n/a	n/a	n/a	n/a
Feeders/growers/finishers	4*	5	6	7	6	5	10	4
Weaners	n/a	18.2	20	30	20	25	50	20
Boars and sows	4*	5	3	5	3.5	4	5	5
Gilts	4*	5	4	n/a	5	n/a	n/a	n/a

* *An animal unit shall include 4 swine (excluding weaning pigs to a maximum weight of 22 kg) according to City of Chilliwack Zoning Bylaw 2001, No. 2800, Fraser Valley Regional District, BC.*

[a] *Source: City of Chilliwack, Zoning Bylaw 2001, No. 2800. Retrieved April 17, 2006 from http://www.gov.chilliwack.BC.ca/main/page.cfm?id=377.*

[b] *Source: Agricultural Operations Regulation (AR 257/2001) http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts8524 and personal communication with Trevor Wallace, Project Leader, Nutrient Management Strategy, Alberta Agriculture, Food and Rural Development, 403-340-5339.*

[c] *Source: Frequently asked questions regarding livestock operations, Saskatchewan Agriculture and Food Livestock Development Branch http://www.agr.gov.sk.ca/docs/livestock/beef/backgrounding/FAQReLvstkOperations.pdf.*

[d] *Source: Development of the Animal Unit, Manitoba Agriculture, Food and Rural Initiatives, http://www.gov.mb.ca/agriculture/livestock/pork/swine/bah11s04.html and personal communication with Petra Loro, Livestock Environment Specialist, Manitoba Agriculture, Food and Rural Initiatives, 204-945-3869.*

[e] *Source: Nutrient Management Protocol, Part 3 - Nutrient Units, http://www.omafra.gov.on.ca/english/nm/regs/nmpro/nmpro03j05.htm#swine.*

[f] *Source: Manitoba Agriculture, Food and Rural Initiatives, 2001a. http://www.gov.mb.ca/agriculture/livestock/pork/swine/bab02s03.html.*

[g] *Source: Siting and Management of Hog Farms in Nova Scotia, http://www.gov.ns.ca/nsaf/rs/envman/hogsite.shtml#link2.*

[h] *Source: Manure Separation Distance Datasheet, http://www.gov.pe.ca/photos/original/af_manureodour.pdf.*

Animal unit calculations are often necessary to determine whether an operation is an intensive livestock operation (ILO). Intensive livestock operations are often subject to more restrictive environmental regulations than operations of smaller size. For example, in Saskatchewan, a waste storage plan and waste management plan approved by the province are required for intensive livestock operations that involve the rearing, confinement or feeding of 300 or more animal units for more than 10 days in a 30 day period.

Since different provinces have different definitions of animal units as defined by legislation or guidelines, the number of animal units for the 600 sow farrow-finish operation used as a model for this analysis varies by province as shown in Appendix C.

6.2 Comparative Provincial Approaches to Regulation

In considering Canada's provinces, it is useful to categorize the regulation of intensive livestock operations as either provincially controlled, municipally controlled or a combination of provincial and municipal partnership to regulate the industry (Speir et al., 2003). Table 6.9 highlights the type of control method by province. As well, the following sections outline the various approaches and discuss the potential for conflict as a result of the regulatory structure.

Table 6.9: Provincial comparison of control methods

LOCAL CONTROL	PROVINCIAL CONTROL	COOPERATIVE CONTROL
British Columbia	New Brunswick	Manitoba
Nova Scotia	Prince Edward Island	Saskatchewan
	Quebec	
	Ontario	
	Alberta	

Source: Speir et al., 2003.

Local control

The provinces of British Columbia and Nova Scotia rely primarily on local governments to approve intensive livestock operations through their planning and construction permit processes (Speir et al., 2003). Nova Scotia treats the control and regulation of livestock operations as a land use issue to be dealt with by municipalities or planning areas (Speir et al., 2003). The provincial government provides guidance to producers on livestock production and manure storage (Speir et al., 2003). It is left to the municipalities to develop their own bylaws for intensive livestock operations. A similar situation exists in British Columbia.

Overall, municipal level regulation can create stark differences within a single province (Speir et al., 2003). One county may encourage the establishment of intensive livestock operations while a neighbouring jurisdiction may attempt an outright ban (Speir et al., 2003). In Ontario, prior to the creation of the Nutrient Management Act, 2002, the responsibility for the regulation of livestock operations rested with local governments. As a result, more than 50 local governments established bylaws on livestock operations with considerable variation among them (Speir et al., 2003). For example, the Township of South Perth had no minimum manure storage requirement while the neighbouring Township of Lucan Biddulph had a 365 day manure storage requirement (Speir et al., 2003). The Nutrient Management Act establishes universal standards and avoids the potential for conflict between municipalities.

Provincial control

In New Brunswick, PEI, Quebec, Ontario and Alberta, livestock operations are controlled by provincial governments. In New Brunswick, the Livestock Operations Act regulates new and existing livestock facilities. Similarly, in PEI, livestock enterprises are controlled by the Environmental Protection Act. The Guidelines for Manure Management for Prince Edward Island also contain a list of permit and approval processes that must be completed by the proponent of a new livestock development (Speir et al., 2003). In 2002, Quebec revised its environmental protection regulations pertaining to agricultural operations and to underground water catchment for human consumption (Speir et al., 2003). These two regulations under the Environment Quality Act are the key components of the environmental regime applicable to livestock operations in the province (Speir et al., 2003). Very few powers are delegated to municipalities with regard to livestock operations (Speir et al., 2003). As discussed above, Ontario recently transferred primary responsibility for livestock operations from the municipality to the provincial level through the implementation of the Nutrient Management Act.

In Alberta, prior to 2002, producers wishing to expand or build new hog operations had to obtain development approvals from the municipal governments of the location of the operation. How-

ever in 2002, the process was changed and approvals are now obtained from the Natural Resources Conservation Board (NRCB), who now administers the Agricultural Operation Practices Act. The province changed its approval process from a municipal decision process to the NRCB and a provincial decision process to build consistency in the approval decisions, instead of decisions being made by many various stakeholders and to avoid the trend in decisions being made based on social opposition throughout the province.

The approval process under NRCB had challenges and growing pains. However, the NRCB is now offering a more efficient process with a 'one window' approach to the application system, where the technical review of a completed application is undertaken by all of the relevant provincial agencies at the same time so that approvals can be issued at one time.

It is worth noting that while the NRCB has provincial control of the approval of agricultural operations, municipalities do have some remaining authority. For instance, municipalities may designate areas where livestock operations are not allowed. Producers wishing to appeal municipal restrictions may apply to the appeal process within the NRCB.[177]

Cooperative control

In Manitoba, the ultimate authority with which to regulate land use lies with regional municipalities' Planning and Municipal Acts. Municipalities have the authority to develop by-laws that regulate the location and operation of livestock production operations. Municipalities use the Planning Act to establish local land use plans for residential, commercial and agricultural uses, and can use the plans to identify where prime agricultural land exists and where livestock operations can be developed.

Although, regional municipalities have the final decision as to whether an application is approved, the provincial departments of Agriculture, Natural Resources, Environment and Rural Development provide assistance in the process through a technical review of the application by a Technical Review Committee. The purpose of the technical review is to provide the municipal council and other stakeholders with information regarding the application with respect to local and provincial land use policies, Farm Practices Guidelines for each commodity, if the application ensures compliance with the Livestock Manure and Mortalities Management Regulation, siting and location issues, water issues and any other information that the municipal council may request. Thus, the province maintains an ongoing role to compliment the activities of the local planning body (Speir et al., 2003).

In addition, Saskatchewan uses a cooperative approach to regulation. Pursuant to Saskatchewan's Agricultural Operations Act and its regulations, any proponent of a new or expanded intensive livestock operation must receive approval for a manure management plan and a manure storage plan (Speir et al., 2003). At the municipal level, bylaws control the development of livestock operations through siting, zoning and building permit phases and also issue permits or approvals for heavy hauling once the operation begins (Speir et al., 2003). In issuing its approvals for manure storage and manure management plans, the Saskatchewan Department of Agriculture and Food refers plans to various other departments including the Department of

177. Source: Scott Cunningham, Approval Officer, NRCB, 403-340-5795.

Municipal Government and the local rural municipality for their input (Speir et al., 2003).[178] As such, Saskatchewan facilitates cooperation between provincial and local governments.

However, the cooperative model of regulation also has its shortcomings. While cooperation between governments is facilitated, the final decision is always made by a specific level of government. Therefore, conflict may arise due to the divergent views of the various levels of government who provided input into the approval process. For example, John Maltman, a swine specialist at Manitoba Agriculture, Food and Rural Initiatives, suggested that the current approval process in which municipalities have the ultimate decision creates an inconsistent approval process. Maltman stated that although a Technical Review may find that the application is in 100% compliance, this will not guarantee acceptance, and vice versa. This inconsistency is due to the fact that some municipalities are against livestock operation development and some welcome the development; there are areas of the province that recognize the economic benefit of the development and those that have effectively issued moratoriums on the development.

6.3 Summary and Conclusions

The purpose of Section 6.0 was to investigate the consistency and/or conflict of the provincial/municipal agri-environmental regulations that were reviewed and used in the provincial models, and to determine if the environmental regulatory set affecting hog operations in Canada were effective, efficient and coherent.

Governments create legislation with a focus on preventing and reducing environmental problems in their jurisdictions. With the review of the Canadian provinces, the environmental problems within each jurisdiction varied and thus the objectives of the environmental regulations varied. However, in a general sense the local and provincial[179] regulations focused on a similar theme of protecting water quality and controlling nutrient levels in soil and water. For the most part, the regulations detailed requirements for manure storage capacities, setbacks, minimum separation distances, permits and nutrient management plans. What varied across the jurisdictions was the restrictiveness of the regulations, which was often directly related to hog density and intensity of environmental issues experienced in the area.

The provincial comparison of legislative requirements provided insight into the objectives and restrictiveness of regulations across the provinces. The objectives of the legislation often translated into more restrictive requirements for certain aspects of the operations. For example, Manitoba focused on improving water quality which was apparent in the stringent regulations surrounding separation distances of livestock and manure storage facilities from water sources. Provinces concerned with nuisances to neighbours such as Alberta had public consultations to ensure there were no problems surrounding the establishment of a livestock facility.

When the restrictiveness rating were compared, Quebec had the most comprehensive set of environmental regulations of the provinces with the presence of regulations in all eight categories: authorization permits, impact assessments, public consultations, nutrient management plans, separation distance from watercourses, buffer strips, spreading period, and distances to control odours. In contrast, Saskatchewan was at the opposite end of the spectrum with restrictiveness

178. *Note that the Department of Agriculture and Food is not required to follow the recommendations of the other agencies in issuing its approval.*

179. *Federal regulations are punitive in nature, so weren't relevant for the purpose of this evaluation.*

ratings in only three of the eight categories. When the consistency of the set of regulations were compared by category, it became clear that certain aspects of the regulations were consistent across the country, while others were not. The following observations were made:

- Authorization permits and nutrient management plans were the priority in Canada as these two criteria were rated fairly restrictive or most restrictive for all of the provinces.
  - Any permits or authorizations related to pig production required government approval before the proposed projects could begin in all the provinces compared.
  - Note that permits/authorizations, assessments and plans varied depending on the specifics of the hog operation and site.
    - The legislation often applied to activities and operations in general rather than agriculture-specific operations.
- A notable difference across the provinces was that in Alberta, Saskatchewan (if desired by municipal council), Manitoba and Quebec, it was necessary for new and expanding hog operations to notify the public and neighbours regarding proposed development.
- Quebec was the only province that required an impact assessment for agriculture; most other provinces indicated impact assessments *may* be required if deemed necessary and were not specific to agriculture.
- The minimum manure storage requirements or recommendations by province were consistent across the country, with most provinces requiring 200 or more days. However, the days storage were legislated provincially in only three (Alberta, Ontario, and New Brunswick) of the nine provinces compared.
  - Note that in BC, manure storage capacity is legislated by municipal by-laws in Chilliwack.
  - BC had the lowest number of recommended days at 180 and Saskatchewan had the highest at 400 days.
- It was evident that the various provinces had diverse requirements for the setback of manure storage and livestock facilities from water. Also noticeable was the level of government (provincial or local) that controlled the setback distance.
- In addition to differences in setbacks, environmental legislation across the provinces varied in terms of minimum separation distances for manure spreading.
  - What was consistent across the provinces was that most provinces indicated manure could not be spread on frozen or snow covered land.
- A major difference among the environmental legislation was the great variety of definitions for animal units in each of the provinces.

These requirements have different cost implications for pig producers by province. From Section 5, it was determined that New Brunswick and Saskatchewan had the lowest costs of compliance, while Ontario and Manitoba had the highest costs. Note that the compliance costs in Quebec may be underestimated due to the lack of data on the cost of environmental impact assessments. These key factors impacting compliance costs (such as nutrient management plans and environmental impact assessments) were also some of the major differences across the provinces in terms of regulatory requirements.

When the regulatory control of intensive livestock operations was categorized as either provincially controlled, municipally controlled or a combination of provincial and municipal partner-

ship, it became apparent that this was the greatest potential source of conflict and inconsistency across the provinces. British Columbia and Nova Scotia use local control. Municipal level regulation can create stark differences within a single province and can create jurisdictional competitiveness issues as hog operations within the same province may have to comply with different by-laws and regulations depending on their municipality.

Provincial control was used by New Brunswick, PEI, Quebec, Ontario and Alberta. With provincial control, very few powers were delegated to municipalities with regard to livestock operations and a consistent set of regulations are established across a single province. This establishes a level playing field (in terms of competitiveness) for operations within the same province.

Finally, Manitoba and Saskatchewan use cooperative control. While cooperation between governments is facilitated, the final decision is always made by a specific level of government. Therefore, conflict is likely to arise due to the divergent views of the various levels of government who provided input into the approval process and can create an inconsistent approval process. Once again, this can create jurisdictional competitiveness impacts if two municipalities have different views on approvals within the same province.

While the municipal/provincial comparison is useful, there may be elements of the requirements that are unobservable in reading through the legislation. For example, the regulatory process of receiving approval to construct a livestock facility may require a significantly longer time period in one province over another. As well, the governments may use guidelines when establishing requirements for financial assistance and therefore, despite the fact that a requirement is not legislated, compliance with guidelines may be required to gain access to financial assistance.

SECTION 7

Summary, conclusions and recommendations

7.0 Summary, conclusions and recommendations

The purpose of the final section of this project was to incorporate the information from sections 2.0-6.0 to provide Agriculture and Agri-food Canada with lessons learnt, policy implications and recommendations for improvements for the next stage of strategic planning for the next generation Agriculture Policy Framework with respect to agriculture environmental regulations.

7.1 Summary of research results

The purpose of this project was to provide an ex-post economic and environmental impact assessment of environmental regulations affecting hog farms in Canada. This involved quantifying the economic impacts by estimating private benefits and costs.

The specific objectives of the project and the corresponding results are outlined in the paragraphs below:

To describe the structure of the hog industry in Canada as it relates to environmental concerns.

It is important to realize that the number and strength of environmental regulations in a province may be a reflection of the intensity of agriculture in the region and the resulting environmental problems that may occur. Section 2.1 outlined the trends in hog inventories and hog density, as well as the number and types of hog operations for the major hog producing provinces (Quebec, Ontario, Manitoba and Alberta). The main conclusions derived from the statistics were as follows:

- Quebec has the largest number of total hogs and market hogs. However, while Quebec used to have the largest number of sows, it has now been surpassed by Ontario.
- Quebec has by far the highest density of pig production in Canada. Ontario and New Brunswick have moderate densities while the western provinces have relatively low pig densities.
- There has been a significant decline in the number of operations of all types in all provinces. The only exception to that trend has been the increase in finishing operations in Quebec.
- There has been a material increase in the average size of all operations between 1996 and 2005 with many types more than doubling.

- Quebec has had the slowest growth in average size of operations by a large margin.

Hog production can have an impact on various elements of the environment, specifically, water, air, soil and biodiversity. The major source of environmental degradation from hog farms is waste products - manure, urine, and bedding material (Aillery, 2005). The primary pollutants associated with animal manure are nutrients (particularly nitrogen and phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds (US EPA, 2001), particularly ammonia. Animal manure is also a source of salts and trace elements, antibiotics, pesticides, and hormones. These pollutants can originate at several stages of production, including (Aillery, 2005):

- Production houses where animals are confined;
- Manure storage structures such as tanks, ponds, and lagoons;
- Land where manure is applied.

The environmental pollutants identified in Section 2.0 illustrate that there are a number of potential impacts to the environment from hog production. Some of these include:

- Animal and human health effects from a degraded water quality
  - Accelerated eutrophication
  - Pathogen and bacteria in water supply
  - Increased salinity of water supply
  - Depletion of dissolved oxygen in water supply
  - Reduction in aquatic life
  - Turbidity and siltation of the water supply
  - Antibiotics and hormones in the food supply
- Toxicity of the soil at high nutrient levels
  - Impacts on soil quality from the accumulation of heavy metals
  - Decreased soil pH for long term application of hog manure
- Increased greenhouse gas and air pollutant emissions
- Odour and noise pollution

To identify the comprehensive ER set (administered by federal, provincial and local governments) that impacts hog farms.

The policy measures implemented both internationally and domestically affecting pig production have predominantly been regulatory and increasing in scope and complexity (OECD, 2003). Guidelines are becoming more common in Canada. Internationally, there is a variety of policy measures designed to protect the environment, ranging from taxes to environmental assessments.

In Canada, environmental regulations vary in strength and scope by province. In general, the provincial regulations focus on protecting water quality and controlling nutrient levels in soil and water. Largely, the regulations detail requirements for manure storage capacities, setbacks, minimum separation distances, permits and nutrient management plans. These requirements have different cost implications for pig producers by province.

In the four major hog producing regions, the density and concentration of hog production is increasing. As the intensity of agricultural production increases, one would typically expect the number and strength of environmental regulations to also increase. Throughout the provinces

the environmental regulations are fairly reflective of the intensity of agricultural production. For example, the provinces with the largest number of hogs (Quebec, Ontario, Manitoba and Alberta) also tend to have more regulations controlling pig production. Not only are the regulations more numerous, they are also more detailed and restrictive.

Given the multitude of environmental concerns from hog operations and the potential to impact water, air, soil and biodiversity, the level and magnitude of environmental regulations are not surprising both globally and domestically.

To conduct a qualitative assessment of social costs and benefits for ER will be based on literature review and own (Contractor's) assessment/inference based on the experience of this study.

There has been some debate on whether polluting farms (or firms in general), and society as a whole, can benefit from environmental policies. The Porter hypothesis asserts that polluting farms (and firms in general) can benefit from environmental policies, arguing that well-designed environmental regulations stimulate innovation, which, by increasing either productivity or product value, leads to private benefits. As a consequence, environmental regulations would benefit both society and regulated firms (Ambec and Barla, 2005).

A report by the Network of Heads of European Environment Protection Agencies lends support to the Porter Hypothesis. The report states that good environmental policies and regulations can benefit industry and society in many ways. Society can benefit from less pollution and improved quality of life. Businesses can also be better off with clear standards that are enforced effectively. In particular, good environmental regulations can help industry and society in the following ways (Network of Heads of European Environment Protection Agencies, 2005):

- Reduce costs for industry and business
  - Regulations in areas such as energy efficiency and manure reduction can deliver cost savings and help companies develop more attractive products.
- Create markets for environmental goods and services
  - The world market for environmental goods and services is currently worth about 435 billion euros and is expected to grow. As well, Michael Porter, of Harvard University, was instrumental in showing that countries with high environmental standards often have market-leading firms and record better economic performance than those with lower standards.
- Drives innovation
  - The commercial success of some industries, particularly those providing clean technology and manure management, depend on high environmental standards.
- Reduces business risk and increases the confidence of investors and insurers
  - Financial benefits can be seen in the results of companies that manage environmental issues well, and pension funds that invest in them. Research by the Environmental Agencies of England and Wales found that in 52 out of 60 studies, there was a close link between environmental governance and financial performance.
- Assist competitive advantage and help create competitive markets
  - Good regulation can have a positive impact through stimulating dynamic responses, innovation and better practices, and according to the World Bank Report on Competitiveness and Environmental Standards (1994), "higher environmental standards in industrial countries have not tended to lower their international competitiveness".

- Helps create and sustain jobs
- Improves the health of the workforce and of the wider public
  - A report by the World Bank (Doing Business in 2005) stated that "economic growth is only one benefit of better business regulation. Human development indicators are higher as well. Governments can use revenues to improve their health and education systems, rather than support an overblown bureaucracy. Businesses spend less time and money on dealing with regulations and chasing after scarce sources of finance. Instead, they spend their energies on producing and marketing their goods. Second, the government spends fewer resources regulating and more providing basic social services."
- Protects the natural resources on which business and the public depend such as water, soil, air and biodiversity.

Thus, it is possible for both private industries, in this case hog operations, and society to receive some benefits from the implementation of good environmental policies.

To review available Federal or Provincial Regulatory Impact Analysis Statements to support the development of regulations that would affect hog farms.

Objective three of the research was to review available Federal or Provincial Regulatory Impact Analysis Statements (ex-ante RIAS) which were written to support the development of regulations that would affect hog farms including economic (private and social benefits and costs), and environmental factors.

As part of the literature review, the Provincial Gazettes were reviewed for RIAS statements. Unfortunately, no documentation was found as they have only recently started to publish RIAS statements on-line. As such, people at two of the provincial Gazettes were contacted, and their recommendation was to call the Department/Ministry that was responsible for the Regulations/ Acts. When contacted, the Departments/Ministries indicated that they were not aware of any type of impact analysis - either economic or environmental - that have been completed at the provincial level and that are publicly available. As a result, no specific RIAS statements were reviewed for this research; however, the literature was reviewed for economic and environmental studies that have assessed the impact of environmental regulations on hog farms.

To review the literature for environmental and economic assessments conducted on the impacts of environmental regulations for livestock operations.

There is an extensive literature base of studies that have looked at the economic impact of environmental regulations for hog production. Fewer studies link the economic impacts with the environmental impacts. For the purpose of this research, the literature review has been limited to those studies that looked at both economic and environmental impacts of regulations affecting hog farms.

A review of the literature which examined the economic and environmental impacts of regulations highlighted the various ways in which regulation can impact the environment and the economics of pig production. The most comprehensive study was the US EPA study which estimated the impact of the Confined Animal Feeding Operation rule. The study determined both the social cost to comply for the livestock industry and government (administrative costs), as well as social environmental benefits. The environmental benefits were based on:

- Society's valuation of improvements in surface water quality
- Improvements in shellfish harvesting
- Incidences of fish kills
- Reduced groundwater contamination
- Reduced public water treatment costs
- Reduced livestock mortality from nitrate and pathogen contamination of livestock drinking water
- Reduced eutrophication and pathogen contamination of coastal and estuarine waters

Overall, the economic value of the environmental benefits was comparable to the estimated costs of the rule. The monetized benefits of the final rule ranged from $204 million to $355 million annually, whereas the total social costs of the final rule were estimated at approximately $335 million annually.

In 2003, the OECD released a study that consistently assessed the impact of manure management regulations on competitiveness within the hog sector using regulations from five countries: Australia (New South Wales), Denmark, Korea, Netherlands and the United States (Iowa). The cost assessment was based on the physical and regulatory requirements imposed on hog producers. The study identified the requirements for manure storage capacity, manure spreading as well as the administrative and control costs associated with permits, environmental impact assessments, manure accounting, etc. The study found that the relative cost of manure management for the largest operation considered (500 animal units) ranged from approximately 3.2% of gross production cost in Australia to approximately 8.5% in the Netherlands. The authors concluded that differences in manure regulations were not likely to create a location shift in pig production at the international level. They further concluded that the differences in manure management regulations and the costs associated with them did not explain basic differences in pig production competitiveness.

To describe how the framework will be operationalized to conduct the assessment.

The evaluation framework used for this analysis was a computer simulation model of an efficient-scale hog production facility. The 600 sow farrow-to-finish operation was chosen as it is an applicable sized operation for most provinces in Canada and provides the best means for comparison.

There were two key assumptions to the model, the first was that the operation was a newly established hog facility in 2006 and that the operation was fixed at 600 sows, farrow-to-finish. The second was that compliance with the regulations was the least cost option for the most efficient management decision, given the size of the operation.

To identify the data and data sources for economic and environmental impact assessment of ER set affecting hog farming.

To understand environmental compliance in each province, agricultural engineering experts, construction companies, government, industry, and academic sources identified what structures, equipment, and operational requirements would be required to comply with the regulations in the respective provinces. The environmental cost of compliance was simulated through the

model to determine the difference in fixed and variable costs, on both a total and a per-head basis, of the alternative compliance requirements.

To clearly quantify the baseline (economic and environment) for impact evaluation assessment of environmental regulations for hog farming.

Since the model was based on the Elsow research farm, the Saskatchewan results were used as the baseline for comparison. The results indicated that the Saskatchewan model was in the best financial position prior to the introduction of environmental compliance, with the highest net income per hog. This was a function of lower overall costs.

To quantify the impact of the environmental regulation set affecting hog farming in Canada by province. Quantitative assessments of economic and environmental impacts are required.

The ÉcoRessources report recommended the use of financial ratios to evaluate the potential impact of a set of environmental regulations on producers. The suggested ratios were:

- standard financial ratios
- environmental costs over total costs *and*
- environmental costs over total revenue

The three ratios calculated for this analysis were: Environmental Cost/Total Operating Costs; Environmental Cost/Total Costs and Environmental Cost/Total Revenue. The rationale was that the ratios provide an estimation of the impact of regulations on producers' financial health, performance and competitiveness and allow the comparison to benchmarks in industry or between jurisdictions.

Total environmental cost of compliance was highest in Ontario, followed by Manitoba and lowest in New Brunswick.

Given the restrictiveness of environmental regulations in Quebec, it is important to explain why the costs of compliance in Quebec are relatively low compared to the other provinces. For this analysis, manure handling and manure storage costs (below 240 days) were not included as environmental costs. Manure handling and manure storage costs in Quebec are high relative to other provinces (refer to Appendix F). However, when these costs are excluded, environmental costs in Quebec are relatively small. For example, nutrient management planning in Quebec is less costly than in some other provinces (e.g. Ontario). It is also worth noting that environmental costs in Quebec are underestimated due to the lack of data on the cost of environmental impact assessments in the province.

Saskatchewan had the most competitive advantage before and after implementing the cost of compliance for environmental regulations when net income per hog was compared across the provinces. The results of the analysis indicated that net income per hog in Saskatchewan before environmental compliance was $17.13/hog and dropped to $16.95/hog after compliance was taken into account. The next closest province was Manitoba at $11.91/hog before compliance and $11.57/hog after.

The overall implications of complying with environmental regulations varied across the provinces, implying some provinces were at a competitive advantage whether from lower costs to comply or reduced restrictiveness of the environmental regulations, like in the case of Saskatch-

ewan. For example, the range of calculated ratios for environmental cost/total cost went from a low of 0.10% (New Brunswick) to a high of 0.26% (Ontario).

To conduct a qualitative impacts assessment for environment factors such as water, air, soil, biodiversity as well as odour.

Despite the cost of compliance for environmental regulations, there may also be benefits to producers of compliance, some of which are also social benefits (not quantified). For example, reduced odour based on regulations that require incorporation of manure may reduce complaints from neighbouring communities. There may be improved water and soil quality from requirements for setbacks, buffer strips and manure application rules that would benefit both the farm operation and community. If an operation was intending to expand, compliance with current regulations may speed up the approval process for building plans or applications for permits. Compliance with regulations may also improve biodiversity on the farm. For example, reducing runoff can impact oxygen levels in surface water, enhancing aquatic life. In addition, there are also benefits to a farm business of good environmental regulations as described in Section 4.1.

To assess available financial assistance for new operations

With the development of Environmental Farm Plans or following provincial guidelines for beneficial management practices (although not specifically legislated), producers may have the benefit of access to financial assistance. However, it is important to note that although there were many programs both nationally and provincially that offer financial assistance for environmental initiatives (that would cover the cost of compliance for environmental regulations in some cases), new operations were not eligible for funding under the National Farm Stewardship Program (NFSP) or Greencover Canada (GC) program. However, older operations would be eligible for assistance related to beneficial management practices under these two programs. New operations are eligible to receive financial assistance under the National Water Supply Expansion Program (NWSEP) for groundwater studies.[180] There are also enviro-loans that can help to finance environmental initiatives on farms.

To compare the ex-post benefit-cost analysis estimated in this study with any ax-ante benefit-cost analysis (i.e. from a RIAS that exists) of environmental regulations affecting hog farms.

A comparison could not be conducted as no RIAS were located.

To assess if existing environmental regulations for hog farming are effective, efficient and coherent and to determine if the environmental regulation set achieve the stated objectives and goals in an efficient and effective way.

Governments create legislation with a focus on preventing and reducing environmental problems in their jurisdictions. With the review of the Canadian provinces, the environmental problems within each jurisdiction varied and thus the objectives of the environmental regulations varied. However, in a general sense the local and provincial[181] regulations focused on a similar theme of protecting water quality and controlling nutrient levels in soil and water. For the most

180. Note that program details were being negotiated in Alberta as of October 23, 2006. Until negotiations are complete, no funding for tier 1 of the NWSEP is available in Alberta.

181. Federal regulations are punitive in nature, so weren't relevant for the purpose of this evaluation.

part, the regulations detailed requirements for manure storage capacities, setbacks, minimum separation distances, permits and environmental plans. What varied across the jurisdictions was the restrictiveness of the regulations, which was often directly related to hog density and intensity of environmental issues experienced in the area.

The provincial comparison of legislative requirements provided insight into the objectives and restrictiveness of regulations across the provinces. The objectives of the legislation often translated into more restrictive requirements for certain aspects of the operations. For example, Manitoba focused on improving water quality which was apparent in the stringent regulations surrounding separation distances of livestock and manure storage facilities from water sources. Provinces concerned with nuisances to neighbours, such as Alberta, had public consultations to ensure there were no problems surrounding the establishment of a livestock facility.

When the restrictiveness rating were compared, Quebec had the most comprehensive set of environmental regulations of the provinces with the presence of regulations in all eight categories: authorization permits, impact assessments, public consultations, nutrient management plans, separation distances from watercourses, buffer strips, spreading period, and distances to control odours. In contrast, Saskatchewan was at the opposite end of the spectrum with restrictiveness ratings in only three of the eight categories. When the consistency of the set of regulations were compared by category, it became clear that certain aspects of the regulations were consistent across the country, while others were not. The following observations were made:

- Authorization permits and nutrient management plans were the priority in Canada as these two criteria were rated fairly restrictive or most restrictive for all of the provinces.
  - Any permits or authorizations related to hog production required government approval before the proposed projects could begin in all the provinces compared.
  - Note that permits/authorizations, assessments and plans varied depending on the specifics of the hog operation and site.
    - The legislation often applied to activities and operations in general rather than agriculture-specific operations.
- A notable difference across the provinces was that in Alberta, Saskatchewan (if desired by municipal council), Manitoba and Quebec, it was necessary for new and expanding hog operations to notify the public and neighbours regarding proposed development.
- Quebec was the only province that required an impact assessment for agriculture; most other provinces indicated impact assessments *may* be required if deemed necessary and were not specific to agriculture.
- The minimum manure storage requirements or recommendations by province were consistent across the country, with most provinces requiring 200 or more days. However, the days storage were legislated provincially in only three (Alberta, Ontario, and New Brunswick) of the nine provinces compared.
  - Note that in BC, manure storage capacity is legislated by municipal by-laws in Chilliwack.
  - BC had the lowest number of recommended days at 180 and Saskatchewan had the highest at 400 days.
- It was evident that the various provinces had diverse requirements for the setback of manure storage facilities from water. Also noticeable was the level of government (provincial or local) that controlled the setback distance.

- In addition to differences in setbacks, environmental legislation across the provinces varied in terms of minimum separation distances for manure spreading.
  - What was consistent across the provinces was that most provinces indicated manure could not be spread on frozen or snow covered land.
- A major difference among the environmental legislation was the great variety of definitions for animal units in each of the provinces.

These requirements have different cost implications for hog producers by province. From Section 5, it was determined that New Brunswick had the lowest cost of environmental compliance, while Ontario had the highest costs. Environmental impact assessments, nutrient management planning, manure storage requirements above 240 days, geotechnical investigations/engineering costs were the key factors impacting the environmental compliance costs. These key factors impacting costs were also some of the major differences across the provinces in terms of regulatory requirements and consistency (which led to the differences in cost to comply). It is important to note that manure handling costs and manure storage requirements below 240 days were considered as costs of doing business rather than environmental costs for this analysis.

When the regulatory control of intensive livestock operations was categorized as either provincially controlled, municipally controlled or a combination of provincial and municipal partnership, it became apparent that this was the greatest potential source of conflict and inconsistency across the provinces. British Columbia and Nova Scotia use local control. Municipal level regulation can create stark differences within a single province and can create jurisdictional competitiveness issues as hog operations within the same province may have to comply with different by-laws and regulations depending on their municipality.

Provincial control was used by New Brunswick, PEI, Quebec, Ontario and Alberta. With provincial control, very few powers were delegated to municipalities with regard to livestock operations and a consistent set of regulations were established across the province. This establishes a level playing field (in terms of competitiveness) for operations within the same province.

Finally, Manitoba and Saskatchewan use cooperative control. While cooperation between governments is facilitated, the final decision is always made by a specific level of government. Therefore, conflict is likely to arise due to the divergent views of the various levels of government who provided input into the approval process and can create an inconsistent approval process. Once again, this can create jurisdictional competitiveness impacts if two municipalities have different views on approvals within the same province.

While the municipal/provincial comparison is useful, there may be elements of the requirements that are unobservable in reading through the legislation. For example, the regulatory process of receiving approval to construct a livestock facility may require a significantly longer time period in one province over another. As well, the governments may use guidelines when establishing requirements for financial assistance and therefore, despite the fact that a requirement is not legislated, compliance with guidelines may be required to gain access to financial assistance.

7.2 Conclusions and recommendations

The conclusions of this report are based on the lessons learned from the chapters. The recommendations are intended for the planning of the next generation of the Agricultural Policy Framework to achieve better economic and environmental performance.

Lessons learned:

- In Canada there has been increase in the concentration and density of hog operations in certain provinces, which have created environmental problems.
- Governments have responded with more stringent and complex regulations. Guidelines are also becoming popular domestically.
- Environmental impact assessments, nutrient management planning, manure storage requirements above 240 days, geotechnical investigations/engineering costs were the key factors impacting the environmental compliance costs.
  - These key factors impacting costs were also some of the major differences across the provinces in terms of regulatory requirements and consistency (which led to the differences in costs to comply).
- Total environmental cost of compliance was highest in Ontario followed by Manitoba and lowest in New Brunswick.
  - While environmental regulations in Quebec are restrictive in comparison to other provinces, the environmental costs (given the exclusion of manure handling and manure storage costs) incurred to comply with the regulations in Quebec are relatively low. For example, nutrient management planning in Quebec is less costly than in some other provinces (e.g. Ontario). Note however, that the cost of completing an environmental impact assessment could not be included in this analysis; therefore the total cost of compliance is likely underestimated.
- With environmental costs at less then 0.5% of costs (total and operating) and revenues for all provinces, annual compliance costs do not appear to have a significant impact on the cost of doing business for hog operations in Canada, given the assumptions and caveats of the model. It is important to note that manure handling costs and manure storage requirements below 240 days were considered as costs of doing business rather than environmental costs for this analysis. As well, it should be noted that the capital costs associated with environmental compliance are significant when incurred, but when annualized, the cost impacts are reduced substantially. Another important caveat to this analysis is that the environmental ratios are sensitive to cost and revenue estimates.
- Overall, the environmental cost ratios across Canada are less than 0.5%. In comparison, the OECD (2003) study generated ratios of manure management costs to gross production costs which ranged from approximately 3.2% in Australia to approximately 8.5% in the Netherlands. However, the OECD study included manure handling and manure storage costs which made up a significant portion of environmental costs. If these costs were excluded from the OECD report, the resulting ratios would be approximately less than 1%, similar to the results of this analysis.
- Some provinces were at a competitive advantage whether from lower costs to comply or reduced restrictiveness of the environmental regulations.
  - Saskatchewan had the most competitive advantage before and after implementing the cost of compliance for environmental regulations in terms of net income per hog.
  - The higher fixed costs in Nova Scotia put Nova Scotia at the greatest competitive disadvantage in terms of net income per hog.
- Extent of regulation was directly related to hog density and areas that have experienced environmental issues.

- With the review of the Canadian provinces, the environmental problems within each jurisdiction varied and thus the objectives of the environmental regulations varied.
- When the restrictiveness rating were compared using research conducted by Debailleul and Boutin (2004).[182] Quebec had the most comprehensive set of environmental regulations of the provinces with the presence of regulations in all eight categories: authorization permits, impact assessments, public consultations, nutrient management plans, separation distances from watercourses, buffer strips, spreading period, and distances to control odours.
  - In contrast, Saskatchewan was at the opposite end of the spectrum with restrictiveness ratings in only three of the eight categories.
- When the consistency of the set of regulations were compared by category, it became clear that certain aspects of the regulations were consistent across the country, while others were not.
- The types of regulatory control were the greatest potential source of conflict across the provinces.
  - The three types of control were local, provincial and cooperative control.
  - Local and cooperative controls are more likely to create jurisdictional competitiveness issues as compliance requirements may not be consistent across a province.
- Benefits to producers and society of compliance with good environmental regulations include:
  - Reduced complaints from neighbouring communities. For example, communities may experience reduced odour based on regulations that require incorporation of manure.
  - Improved water and soil quality from requirements for setbacks, buffer strips and manure application rules that would benefit both the farm operation and community.
  - If an operation was intending to expand, compliance with current regulations may speed up the approval process for building plans or applications for permits.
  - Compliance with regulations may also improve biodiversity on the farm. For example, reducing runoff can impact oxygen levels in surface water, enhancing aquatic life.
  - With good environmental regulations, society can also benefit from less pollution and improved quality of life.
  - Businesses can also be better off with clear standards that are enforced effectively. In particular, good environmental regulations can help industry by reducing costs for industry and business, creating markets for environmental goods and services, driving innovation, reducing business risk, increasing the confidence of investors and insurers, assisting with competitive advantage, helping to create competitive markets, helping to create and sustain jobs and improving the health of the workforce and wider public (Network of Heads of European Environment Protection Agencies, 2005).

Overall, environmental regulations across Canada are consistent in their objectives to protect the environment and encourage environmentally sound agricultural practices. Each province faces different environmental issues which are being addressed by a variety of environmental regulations. While some regulations are consistent across the country (e.g. winter spreading restrictions), other regulations vary by province, such as the definition of animal units. The variation in environmental regulations may be attributed partially to the environmental concerns that exist

182. Refer to Table 6.2 for more detailed information.

within each province. For example, Quebec is concerned with the density and concentration of hog operations and has implemented environmental impact assessments and public consultations as a result.

There are benefits and costs to variation in regulation across the provinces. On one hand, the development of regulations is extremely costly and time consuming and as such, regulations should not be implemented without reason. On the other hand, consistency of regulations helps to ensure jurisdictional competitiveness. As it stands right now, some provinces have a competitive advantage with respect to complying with environmental regulations. This may be a consequence of the fact that some provinces have not experienced significant environmental concerns and as a result have less restrictive regulations. An example of this can be seen when the model results for Saskatchewan (low costs to comply and low restrictiveness of regulations) are compared to Ontario, a province with significant hog density, environmental concerns and the highest estimated cost of compliance with environmental regulations. Perhaps it would be worthwhile for provincial and federal governments to review regulations to determine which regulations can and should be applied consistently.

It is also recommended that the federal government strongly encourage provincial over municipal control of environmental regulations. Local and cooperative control can lead to inconsistent by-laws and approvals across a province. Although cooperative control can be effective if provincial governments make the final decision with the entire province in mind. Consistent control of environmental regulations will reduce the jurisdictional competitiveness issues within a province. Ontario is an example where there was a mix of by-laws that increased the costs of production depending on the municipality the operation was located in. This jurisdictional competitiveness issue was resolved with the introduction of the Nutrient Management Act which supersedes municipal by-laws.

Finally, the question remains as to whether complying with environmental costs should be considered the cost of doing business, particularly for new operations entering the industry. This is particularly true when environmental regulations are proven to be effective and there are benefits to the operation from complying.

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APPENDIX A

Hog statistics

SOW INVENTORIES				
Date	Que.	Ont.	Man.	Alb.
Jan-95	304.4	320.8	169.6	200.0
Apr-95	308.7	317.1	165.8	199.7
Jul-95	311.7	316.7	163.8	191.6
Oct-95	310.5	317.5	175.2	188.0
Jan-96	310.8	311.8	166.0	180.1
Apr-96	305.0	317.3	182.4	183.2
Jul-96	318.9	323.4	181.2	178.5
Oct-96	319.5	323.6	186.4	179.2
Jan-97	326.9	319.3	181.0	178.7
Apr-97	322.6	317.5	192.0	182.1
Jul-97	324.1	317.3	201.5	182.4
Oct-97	330.6	320.6	204.5	186.4
Jan-98	361.1	323.5	211.5	188.7
Apr-98	361.4	333.8	209.6	183.9
Jul-98	366.2	340.1	215.9	181.2
Oct-98	370.8	340.1	228.6	178.9
Jan-99	369.7	333.4	225.1	174.0
Apr-99	375.3	326.9	230.4	173.7
Jul-99	378.0	334.1	233.7	179.2
Oct-99	374.7	335.2	242.3	177.4
Jan-00	377.0	339.3	249.8	179.9
Apr-00	375.4	340.7	250.9	178.1
Jul-00	378.3	341.5	255.8	185.7
Oct-00	380.9	344.5	264.1	189.5
Jan-01	386.6	347.3	274.3	193.4
Apr-01	392.5	348.4	281.1	195.2
Jul-01	401.6	351.0	290.8	200.9
Oct-01	401.2	360.5	300.3	207.6
Jan-02	402.8	373.1	316.7	210.1
Apr-02	407.3	378.2	322.0	207.0
Jul-02	411.3	387.6	325.7	209.0
Oct-02	408.2	391.7	321.5	206.0
Jan-03	413.5	398.7	332.3	208.0
Apr-03	416.5	414.3	334.8	206.0
Jul-03	412.4	415.1	341.3	203.5
Oct-03	412.2	419.9	346.3	205.0
Jan-04	417.2	425.8	351.0	206.9
Apr-04	416.8	433.3	356.0	207.0
Jul-04	416.5	431.7	362.0	207.0
Oct-04	410.5	425.9	365.0	209.1
Jan-05	416.5	433.2	365.0	212.8
Apr-05	417.3	428.7	370.2	214.4
Jul-05	416.3	430.0	366.6	216.8
Oct-05	410.8	432.1	367.0	216.3
Jan-06	414.1	427.0	372.0	213.1
Apr-06	413.0	425.6	372.5	215.4

MARKET HOG INVENTORIES				
Date	Que.	Ont.	Man.	Alb.
Jan-95	2,882.5	2,821.8	1,422.3	1,719.9
Apr-95	2,899.4	2,756.8	1,457.7	1,794.9
Jul-95	3,041.6	2,757.2	1,493.2	1,826.2
Oct-95	3,118.4	2,718.0	1,538.7	1,843.4
Jan-96	3,097.6	2,739.4	1,575.6	1,810.5
Apr-96	2,988.1	2,727.0	1,582.3	1,778.3
Jul-96	3,123.7	2,724.6	1,622.3	1,685.4
Oct-96	3,150.5	2,716.8	1,631.0	1,616.9
Jan-97	3,108.3	2,760.5	1,616.0	1,617.1
Apr-97	3,100.9	2,738.3	1,588.8	1,643.3
Jul-97	3,206.5	2,790.7	1,597.9	1,629.1
Oct-97	3,269.6	2,798.8	1,657.9	1,615.8
Jan-98	3,237.5	2,853.3	1,695.6	1,643.6
Apr-98	3,241.2	2,906.7	1,728.9	1,671.4
Jul-98	3,285.3	2,975.2	1,772.4	1,689.8
Oct-98	3,326.6	3,073.8	1,771.2	1,707.0
Jan-99	3,277.8	3,092.7	1,767.6	1,670.4
Apr-99	3,403.9	3,006.3	1,804.1	1,653.8
Jul-99	3,561.9	3,033.2	1,801.7	1,659.1
Oct-99	3,600.6	3,052.1	1,863.3	1,667.2
Jan-00	3,549.1	3,087.0	1,889.8	1,693.0
Apr-00	3,554.2	3,097.1	1,924.5	1,700.5
Jul-00	3,708.5	3,160.7	2,031.5	1,722.8
Oct-00	3,731.1	3,176.5	2,032.3	1,753.2
Jan-01	3,688.7	3,159.4	2,099.3	1,762.2
Apr-01	3,718.4	3,123.7	2,163.7	1,767.9
Jul-01	3,885.0	3,112.0	2,257.5	1,819.6
Oct-01	3,937.5	3,126.9	2,336.0	1,887.1
Jan-02	3,880.2	3,139.2	2,363.6	1,905.9
Apr-02	3,846.8	3,183.9	2,361.9	1,892.9
Jul-02	3,934.4	3,208.9	2,451.3	1,924.0
Oct-02	3,983.4	3,288.7	2,545.3	1,958.1
Jan-03	3,859.8	3,250.0	2,485.2	1,924.3
Apr-03	3,857.1	3,273.6	2,408.2	1,886.6
Jul-03	3,931.0	3,192.9	2,501.7	1,819.4
Oct-03	3,916.2	3,228.4	2,466.7	1,807.8
Jan-04	3,826.1	3,232.7	2,494.3	1,835.9
Apr-04	3,796.9	3,215.2	2,477.7	1,816.0
Jul-04	3,927.0	3,247.3	2,521.7	1,816.2
Oct-04	3,888.1	3,193.3	2,488.2	1,794.1
Jan-05	3,857.2	3,166.1	2,499.7	1,825.6
Apr-05	3,841.9	3,260.8	2,534.4	1,804.0
Jul-05	3,957.9	3,284.4	2,588.1	1,796.6
Oct-05	3,938.4	3,277.3	2,537.8	1,817.1
Jan-06	3,825.2	3,151.7	2,522.8	1,800.7
Apr-06	3,731.3	3,157.2	2,542.4	1,778.4

ALL FARMS WITH PIGS				
	Quebec	Ontario	Manitoba	Alberta
1991	3,614	9,429	2,969	6,148
1996	3,040	6,777	2,064	4,173
2001	2,743	4,972	1,668	2,677
2004	2,680	4,200	1,360	1,970

FARROWING OPERATIONS				
	Quebec	Ontario	Manitoba	Alberta
1991	1,104	1,244	467	966
1996	755	769	305	469
2001	491	633	262	284
2004	440	535	214	209

FINISHING OPERATIONS				
	Quebec	Ontario	Manitoba	Alberta
1991	785	2,040	776	950
1996	902	1,683	731	792
2001	1,077	1,505	661	466
2004	1,122	1,271	539	343

FARROW TO FINISH OPERATIONS				
	Quebec	Ontario	Manitoba	Alberta
1991	1,173	3,910	844	2,071
1996	1,059	2,677	644	1,317
2001	968	1,695	456	911
2004	916	1,432	372	670

Notes: 2004 numbers based on George Morris Centre estimate.
Source: Statistics Canada and George Morris Centre estimate.

Sources of legislation

PROVINCE	STATUTE/REGULATION/BY-LAW	SOURCE
British Columbia	Building Regulation Bylaw 2003, No. 2970	http://www.gov.chilliwack.BC.ca/main/attachments/files/363/BL%202970%20Building%20Regulation%20Bylaw.pdf
	Zoning Bylaw 2001, No. 2800	http://www.gov.chilliwack.BC.ca/main/page.cfm?id=377
	Intensive Swine Operation By-law, No. 191	http://www.gov.chilliwack.BC.ca/main/attachments/files/363/BL_191_Intensive_Swine_Operation.pdf
	Environmental Management Act	http://www.qp.gov.BC.ca/statreg/stat/E/03053_00.htm
	Regulation 131/92	http://www.qp.gov.BC.ca/statreg/reg/E/EnvMgmt/131_92.htm
	Water Act	http://www.qp.gov.BC.ca/statreg/stat/W/96483_01.htm
	Manure Management Guidelines for the Lower Fraser Valley	http://www.farmwest.com/index.cfm?method=pages.showPage&pageid=61
Alberta	Land Use Bylaw 2000/10	http://www.reddeercounty.ab.ca/county_services/index.php?main_id=144
	Agricultural Operations Practices Act	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts8699?opendocument
	Regulation 257/2001	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts8524?opendocument
	Regulation 268/2001	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts8523?opendocument
	Regulation 267/2001	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts8525?opendocument
	Environmental Protection and Enhancement Act	http://www.qp.gov.ab.ca/documents/Acts/E12.cfm?frm_isbn=0779727215
	Regulation 276/2003	http://www.qp.gov.ab.ca/documents/Regs/2003_276.cfm?frm_isbn=0779740416
	Water Act	http://www.qp.gov.ab.ca/documents/Acts/W03.cfm?frm_isbn=0779727428
	Beneficial Management Practices: Environmental Manual for Hog Producers in Alberta	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw5838
Saskatchewan	Zoning Bylaw	Rural Municipality of the Lake of Rivers. Received faxed copy of zoning by-law. Contact: Mervin Guillemin, Administrator, 306-642-3533
	Agricultural Operations Act	http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/A12-1.pdf
	Regulation 1	http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/A12-1R1.pdf

APPENDIX B

PROVINCE	STATUTE/REGULATION/BY-LAW	SOURCE
Saskatchewan (Cont'd)	Environmental Management and Protection Act	http://www.qp.gov.sk.ca/documents/english/Statutes/Statutes/e10-21.pdf
	Regulation 1	http://www.qp.gov.sk.ca/documents/english/Regulations/Regulations/e10-21r1.pdf
	Establishing and Managing Livestock Operations Guidelines	http://www.agr.gov.sk.ca/docs/livestock/beef/production_information/Livestock_Guidelines05.pdf
Manitoba	Zoning Bylaw 2061	Contact: Rural Municipality of Hanover office, 204-326-4488.
	Hanover Bylaw 2077	Contact: Rural Municipality of Hanover office, 204-326-4488.
	Environment Act	http://www.canlii.org/mb/laws/sta/e-125/20051114/whole.html
	Regulation 42-98	http://web2.gov.mb.ca/laws/regs/pdf/e125-042.98.pdf
	Water Rights Act	http://web2.gov.mb.ca/laws/statutes/ccsm/w080e.php
	Planning Act	http://web2.gov.mb.ca/laws/statutes/ccsm/p080e.php
	Water Protection Act	http://web2.gov.mb.ca/laws/statutes/ccsm/w065e.php
	Farm Practices Guidelines for Hog Producers in Manitoba	http://www.gov.mb.ca/agriculture/livestock/pork/swine/bah00s00.html
Ontario	Nutrient Management Act	http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/02n04_e.htm
	Regulation 267/03	http://www.e-laws.gov.on.ca/DBLaws/Regs/English/030267_e.htm
	Environmental Protection Act	http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90e19_e.htm
	Ontario Water Resources Act	http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90o40_e.htm
	Lakes and Rivers Improvement Act	http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90l03_e.htm
	Environmental Assessment Act	http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90e18_e.htm#P551_44798
Quebec	By-law No. 184-03	http://www.mrcrouville.qc.ca/UserFiles/File/Documents_PDF/rci184-03.pdf
	Environment Quality Act	http://www.canlii.org/qc/laws/sta/q-2/20051216/whole.html
	Agricultural Operations Regulation	http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=3&file=/Q_2/Q2R11_1_A.htm
	Regulation Respecting Environmental Impact Assessment and Review	http://www.canlii.org/qc/laws/regu/q-2r.9/20051216/whole.html
	Groundwater Catchment Regulation	http://www.canlii.org/qc/laws/regu/q-2r.1.3/20060412/whole.html
New Brunswick	Zoning By-law, No. 1350-04	http://www.sussex.ca/towndocuments/1350-04.doc
	Building By-law, No. 151-99	http://www.sussex.ca/towndocuments/151-99.doc
	Livestock Operations Act	http://www.gnb.ca/0062/PDF-acts/l-11-01.pdf
	Regulation 99-32	http://www.gnb.ca/0062/PDF-regs/99-32.pdf
	Clean Water Act	http://www.gnb.ca/0062/PDF-acts/c-06-1.pdf
	Regulation 2000-47	http://www.gnb.ca/0062/PDF-regs/2000-47.pdf

PROVINCE	STATUTE/REGULATION/BY-LAW	SOURCE
New Brunswick (Cont'd)	Regulation 2001-83	http://www.gnb.ca/0062/PDF-regs/2001-83.pdf
	Agricultural Land Protection and Development Act	http://www.gnb.ca/acts/acts/a-05-11.htm
Nova Scotia	Land Use By-law	http://www.county.kings.ns.ca/comdev/lub/default.htm
	Building By-law, #72	http://www.county.kings.ns.ca/general/bylaws/pdfs/bylaw072.pdf
	Environment Act	http://www.gov.ns.ca/legislature/legc/index.htm
	Regulation 44/2003 Environmental Assessment Regulations	http://www.gov.ns.ca/just/regulations/regs/envassmt.htm
	Manure Management Guidelines 2006	http://www.gov.ns.ca/nsaf/rs/envman/manureguide_2006lowres.pdf
	Guidelines for Siting and Management of Hog Farms in Nova Scotia	http://www.gov.ns.ca/nsaf/rs/envman/hogsite.shtml#link2
Prince Edward Island	Environmental Protection Act	http://www.gov.pe.ca/law/statutes/pdf/e-09.pdf
	Lands Protection Act	http://www.gov.pe.ca/law/statutes/pdf/l-05.pdf
	Planning Act	http://www.iijcan.org/pe/laws/sta/p-8/index.html
	Guidelines for Manure Management for PEI	http://www.gov.pe.ca/af/agweb/index.php3?number=72025&lang=E
	Best Management Practices: Agricultural Waste Management	http://www.gov.pe.ca/photos/original/af_bmp_wastemgt.pdf

APPENDIX C

Animal units for model operation by province

PROVINCE	ANIMAL UNITS
British Columbia	984[a]
Alberta	1,071
Saskatchewan	888
Manitoba	750
Ontario	857
Quebec	927
New Brunswick	n/a
Nova Scotia	600
Prince Edward Island	1,086

[a] *Animal unit calculation was obtained from municipal regulations for Chilliwack, BC. Source: Intensive Swine Operation By-law, No. 191. Information was retrieved October 26, 2006 from http://www.gov.chilliwack.BC.ca/main/attachments/files/363/BL_191_Intensive_Swine_Operation.pdf.*

APPENDIX D

Cost of compliance data sources

PROVINCE	SOURCE
British Columbia	Tom Droppo (team of respondents); BC Ministry of Agriculture and Lands, 604-556-3144 Norag Red Deer* (Steve), 1-866-893-3302, cell 306-260-7973
Alberta	Ian Hodgkinson, DGH Engineering, 204-334-8846
Saskatchewan	Andy Jansen, Saskatchewan Agriculture and Food, 306-787-5465 Dennis Hodgkinson, DGH Engineering, 204-334-8846 Daryl Possberg, Big Sky, 306-682-5041 Brad Marceniuk, Saskatchewan Agriculture and Food, 306-933-5098 Wendy Dehod, Saskatchewan Agriculture and Food, 306-933-5357
Manitoba	Sheldon Stock, Hytek Ltd, 204-424-2313 Denis Veilfaure, Hytek Ltd
Ontario	Murray Elliot, Fred Groenestege Construction Brethour et al., 2004
Quebec	Michel Morin, Centre de développement du porc du Québec (CDPQ) 419-650-2440 x 123 Jean Tanguay, La Co-op Fédérée, (418) 580-4539 Denis Boutin, Ministère du Développement durable, de l'Environnement et des Parcs, 418-521-3950 x 4462
New Brunswick	Dwight Balzer, New Brunswick Ministry of Agriculture, 506-453-2457
Nova Scotia	Carl Esau, Agri Engineering Solutions Inc., 902-662-3438 Henry Vissers, Pork Nova Scotia, 902-895-3659.
Price Edward Island	Marc Schurman, Schurman Farm Ltd & Spring Valley Farm Market Ltd., 902-836-4271; Marc did two major expansions in 1998 and 2001

APPENDIX E

Sample letter sent to Quebec

March 2, 2006

Dear ***:

The George Morris Centre, the Prairie Swine Centre Inc and Stoddart Services Group Inc are currently conducting research for Agriculture and Agri-food Canada entitled, *Environmental and Economic Impact Assessments of Environmental Regulations for the Agriculture Sector: A Case Study of Hog Farming*. The purpose of the study is to provide an ex-post economic and environmental impact assessment of environmental regulations affecting hog farms in Canada.

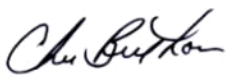
To complete this study, the research team needs to have an understanding of the environmental costs to comply with the regulations currently in place in Quebec. We are hoping that you can provide some of the required information. The following pages outline the specifications of the representative hog model developed for this research and the corresponding regulations that are believed to impact the hog industry in Quebec. For regulations and costs at the county level, Montérégie County has been selected as representative of the province. A table has been provided with the anticipated cost items for compliance for a newly established hog facility. Where possible, please provide an estimate of the cost of compliance. For the purpose of this research, assume that compliance is the least cost option for the most efficient management decision for the size (assume fixed at 600) and type of operation outlined below.

In addition to the environmental cost items, we also require an understanding of project development costs in Montérégie County, Quebec. Estimates have been provided for the 600 sow farrow-to-finish operation in Elstow, Saskatchewan. Please indicate if the costs to establish the facility in Montérégie County would be higher (?), lower (?), or about the same (No change = N/C) to represent the same facility (detailed instructions are provided below).

Please complete and return the information by March 8, 2006 to the George Morris Centre by fax (519-837-8721) or by email to cher@georgemorris.org. Should you have any questions regarding the information requested, please contact Cher Brethour at (519) 822-3929 ext.207 or via email at cher@georgemorris.org.

The George Morris Centre research team thanks you in advance for your time and cooperation.

Sincerely,



Cher Brethour
Sr. Research Associate – Env
George Morris Centre

Representative hog operation specifications

- 600 sow farrow-to-finish operation equivalent to approximately 1,044 animal units in Quebec
- 400 day earthen manure storage
- Water supplied through rural water pipeline in addition to a cistern handling two days supply of water
- Three-phase power on-site
- Heating in winter months supplied via natural gas
- Genset provides backup electrical service
- Steady state pig inventory:

Grow-finish pigs	3,400
Weanling pigs	2,122
Boars and gestating sows[183]	544
Nursing sows	84
Gilts[184]	22
Total	**6,172 animals**

Farrowing:

- Farrow 28 litters per week
- Pigs are weaned at three weeks of age
- 2 feet deep manure channels under slats for manure storage
- Negative pressure ventilation

Nursery:

- Produce 260 pigs per week to 11 weeks of age (8 week nursery)
- Allowance of 3.75ft^2 per pig
- 16 pens per room with 16 pigs/pen
- One feed bin per room
- Fully slatted floor
- 2 feet deep manure channels under slats for manure storage
- Negative pressure ventilation

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183. The average gestation length of a sow is 114 days and average non-reproductive days between a cycle is five days therefore 119 days in total for an individual sow. Assuming an 88% farrowing rate we require 32 matings/week in order to achieve 28 farrowing/week. The 32 required matings/week multiplied by the 17-week production cycle provides a sow inventory of 544 sows. Note: this does not include replacement gilts.

184. The 22 replacement gilts are the average number of gilts in the gilt pool for any given day throughout the year. The average culling rate is 40% annually, therefore approximately 218 gilts are brought into the herd annually which represents approximately 4-5 gilts entering the breeding herd on a weekly basis. The sow:boar ratio is zero, as this operation is assumed to be 100% artificial insemination.

Growout:

- Produce 254 pigs per week
- Average market weight of 115kg at 175 days of age
- Allowance of 9.3 ft^2 per pig
- Fully slatted floor
- 2 feed bins per room
- 2 feet deep manure channels under slats for manure storage
- Negative pressure ventilation

Potential cost items from regulations impacting quebec:

The following bullets outline the anticipated cost items to comply with environmental regulations in Quebec.

- Bylaws (Montérégie County)
  - Development permit
    - Including soil and groundwater testing
  - Other permits as required
- Environment Quality Act and the Agricultural Operations Regulation
  - Environmental impact assessment
  - Agro-environmental fertilization plan
  - Certificate of authorization
  - Manure testing for nutrient levels
  - Project notice signed by agrologist for new buildings/storage
  - Low ramp equipment for liquid manure spreading
  - Buffer/runoff control within 3 m of shoreline of watercourse/pond/lake/swamp or within 1 m of agricultural ditch
  - Farm buildings constructed with watertight floor to prevent manure reaching ground
  - Manure storages and removal equipment (liquid and solid) must be watertight
  - Manure storages must not be equipped with overflow drains or sump drains. Storages must be equipped, on entire outer perimeter, with drain placed level with or below floor/bottom
  - Removal or elimination of solid manure piles in fields
  - Any land application requirements
- Other

The following table is a list of environmental compliance options. Please fill out only those items that would be applicable for compliance in Montérégie County, Quebec. As identified above, please estimate the least cost option for the most efficient management of the hog operation as described above.

COST ITEM	SIZE	COST
Environmental permits (please indicate type) ($)		
Plans		
Nutrient management plan ($)		
Waste storage plan ($)		
Waste management plan ($)		
Manure management plan ($)		
Ongoing record keeping and plan maintenance ($/acre)		
Land application		
Custom application or application equipment (please circle)		
Buffer strips + set backs/set asides - ESTABLISHMENT ($/acre established)		
Buffer strips + set backs/set asides - LAND REPLACEMENT ($/acre replaced)		
Opportunity cost of not being able to use the land for crop production? – specify crop rotation ($/acre)		
Remote control system ($)		
Sitting and construction standards		
Locating tiles, tile removal ($/site)		
Hired services geo-technical, or professional engineer ($)		
Design services professional engineer ($)		
Earthen liquid storage ($/cu ft)		
Concrete-covered concrete tank ($/cu ft)		
Open concrete tank ($/cu ft)		
Installation of secondary containment ($)		
Synthetic liner costs ($/sq ft)		
Compacted soil liner ($/sq ft)		
Manure testing		
Training courses		
Other:		

In addition to the environmental cost items from above, we also require an understanding of project development costs in your province. In the table below, estimates have been provided for the 600 sow farrow-to-finish operation in Elstow, Saskatchewan. If the exact facility was estab-

lished in Montérégie County, Quebec, please indicate estimated building costs for the facility. In the case of manure storage, also include the estimated size (given the regulations in place).

Additional data requirements

	SASKATCHEWAN*		PROVINCE	
COST ITEM	Size	Cost ($)	Size	Cost ($)
Building cost ($/pig place)				
Gestation barn		500		
Farrowing barn		800		
Nursery barn	3.25 ft^2	165		
Finishing barn	8.0 ft^2	300		
Manure storage construction ($/cubic yard)				
Building permit application ($)		35,000		
Building site development ($)		135,000		

**Elstow, Saskatchewan, 2006.*

The George Morris Centre research team thanks you for your time and cooperation.

Background information on model

This appendix includes all of the input variables used in the model. The input variables are then used to generate the returns of the operation by province.

Input variables

ESTIMATED BUILDING COSTS BY PROVINCE	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Building cost (per sow place)/gestation	550	590	1,500	1,050	1,400	1,300	1,500	550
Building cost (per sow place)/farrowing	880	945		2,700			3,500	880
Building cost (per sow place)/nursery	165	195	170	190	230	175	500	182
Building cost (per pig place)/finisher	300	350	305	350	380	325	400	330
Number of sow places/gestation	566	566	566	566	566	566	566	566
Number of sow places/farrowing	112	112	112	112	112	112	112	112
Number of pig places/nursery	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080
Number of pig places/finisher	3,683	3,683	3,683	3,683	3,683	3,683	3,683	3,683
Total manure storage cost	135,000[a]	170,100[b]	188,870	59,000[c]	355,432[d]	200,000[e]	100,000	110,000[f]
Additional site work if not clay soil to escavate shale and replace with clay								54,448
Land cost[g]	66,300	218,550	197,280	638,700	541,350	132,900	235,200	274,050

[a] *Earthen liquid storage. Source: Prairie Swine Centre.*
[b] *Earthen liquid storage.*
[c] *Note: Ontario's manure storage cost is lower than the other provinces because some of the manure storage cost is included with the building costs of the barn. Concrete storage.*
[d] *Assumes 365 days of concrete manure storage.*
[e] *Since the model assumes a new farm, the operation falls under the Livestock Operations Act in New Brunswick and must build concrete manure storage.*
[f] *Concrete manure storage.*
[g] *Land costs by province are based on FCC Farmland Values Data online. The land cost per acre represents the average land value for cultivated land (all crops) by the municipalities/counties selected for this analysis. The assumption of the model is that 150 acres of land are purchased (except for Manitoba where 160 acres are purchased due to municipal by-laws).*

ESTIMATED BUILDING COSTS BY PROVINCE	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Building permit application ($)	35,000	0[a]	2,813	26,153	2,000[b]	25	1,000	8,712[c]
Building site development ($)	85,000	170,000	100,000	100,000	100,000[*]	30,000[d]	62,500[e]	135,000
Manager's residence	115,000	132,250	115,000	125,000	125,000	115,000	115,000	115,000
Management and commissioning fees	850,000	875,000	850,000	900,000	900,000	875,000	875,000	850,000
Total building cost/gestation[f]	311,300	333,940	1,017,000	594,300	949,200	881,400	849,000	311,300
Total building cost/farrowing	98,560	105,840		302,400			392,000	98,560
Total building cost/nursery	343,200	405,600	353,600	395,200	478,400	364,000	1,040,000	377,520
Total building cost/finisher	1,104,900	1,289,050	1,123,315	1,289,050	1,399,540	1,196,975	1,473,200	1,215,390
Total building cost	1,857,960	2,134,430	2,493,915	2,580,950	2,827,140	2,442,375	3,754,200	2,002,770
Total construction costs[g]	3,144,260	3,700,330	3,947,878	4,429,803	4,850,922	3,795,300	5,142,900	3,549,980
Total construction costs (excluding land)	3,077,960	3,481,780	3,750,598	3,791,103	4,309,572	3,662,400	4,907,700	3,275,930

[*] *Indicates that information was not available on site development costs in Quebec. As such, the cost was estimated using Ontario figures.*
Sources: Prairie Swine Centre, expert contacts.

[a] *Agricultural producers with more than 20 acres are exempt from the development permit fee for Red Deer County.*
[b] *Source: Municipality of Saint-Mathias-sur-Richelieu, 450-658-2841. For new buildings with construction costs exceeding $800,000, the building permit cost is $2,000.*
[c] *Building permit cost is approximately $0.10/ft^2. The model operation consists of 87,116 ft^2.*
[d] *Building site development costs are very variable depending on the site.*
[e] *Building site development varies between $50,000 and $75,000.*
[f] *Total building cost/gestation is calculated by multiplying the building cost per sow place for the gestation barns by the number of sow places in the gestation barns. A similar methodology is used for the farrowing, nursery and finishing barns.*
[g] *Total construction costs are comprised of manure storage cost, additional site work, land cost, building permit application, building site development, manager's residence, management and commissioning fees and total building cost.*

PRODUCTION INFORMATION	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Number of sows	600	600	600	600	600	600	600	600
Litters/sow/year	2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.43
Pigs born alive/litter	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Pre-weaning mortality	10.0%	10.0%	10.0%	11.0%	11.0%	11.0%	11.0%	10.0%
Wean to finisher mortality	3.0%	3.0%	3.0%	4.0%	4.0%	4.0%	4.0%	3.0%
Culling rate/sows	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Replace value/sow	$400.00	$400.00	$400.00	$400.00	$400.00	$400.00	$400.00	$400.00
Total pigs born alive/year	15,288	15,288	15,288	15,288	15,288	15,288	15,288	15,288
Total number of pigs weaned/year	13,759	13,759	13,759	13,759	13,759	13,759	13,759	13,759
Total number of pigs marketed/year	13,346	13,346	13,346	13,346	13,346	13,346	13,346	13,346

Source: Prairie Swine Centre.

LABOUR INFORMATION	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Total staff required	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total labour cost/year	$197,340	$315,744	$197,340	$256,542	$256,542	$217,074	$217,074	$217,074
Management salaries (% of total labour)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Base labour rate per hour	$10	$16	$10	$13	$13	$11	$11	$11
Number of sow/staff	120	120	120	120	120	120	120	120
Total labour cost/hog	$14.79	$23.66	$14.79	$19.64	$19.64	$16.62	$16.62	$16.26

Source: Prairie Swine Centre.

MANURE PRODUCTION	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Breeding herd (gallons/day)	2,239	2,239	2,239	2,239	2,239	2,239	2,239	2,239
Wean-finisher (gallons/day)	6,986	6,986	6,986	6,986	6,986	6,986	6,986	6,986
Manure handling (dollars/gallon)	$0.010	$0.014	$0.011	$0.015	$0.020	$0.015	$0.015	$0.009
Manure application rate (gallons/acre)	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600
Manure revenue/acre	$20.00	$20.00	$20.00	$20.00	$20.00	$20.00	$20.00	$20.00
Total manure production (gallons/day)	9,225	9,225	9,225	9,225	9,225	9,225	9,225	9,225
Total manure production (gallons/year)	3,367,125	3,367,125	3,367,125	3,367,125	3,367,125	3,367,125	3,367,125	3,367,125
Total manure handling cost/year	**$32,493**	**$47,140**	**$36,618**	**$50,507**	**$68,031**	**$50,507**	**$50,000**	**$30,600**
Total number of acres required/year	510	510	510	510	510	510	510	510
Total manure cost/hog	$2.43	$3.53	$2.74	$3.87	$5.21	$3.87	$3.83	$2.29

Sources: Prairie Swine Centre, expert contacts, GMC estimates.

VARIABLE PRODUCTION COSTS	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Barn supplies	$1.95	$1.95	$1.95	$1.95	$1.95	$1.95	$1.95	$1.95
Maintenance and repairs	$3.62	$3.62	$3.62	$3.62	$3.62	$3.62	$3.62	$3.62
Management and consultant fees	$1.58	$1.58	$1.58	$1.58	$1.58	$1.58	$1.58	$1.58
Marketing and transportation	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50
Miscellaneous	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Office supplies	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25
Utilities (heat, power and phone)	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50
Veterinary supplies and fees	$3.50	$3.75	$3.50	$4.00	$4.25	$3.75	$3.75	$3.50
Total variable costs/hog	$23.95	$24.20	$23.95	$24.45	$24.70	$24.20	$24.20	$23.95
Total variable costs/year	**$319,647**	**$322,983**	**$319,647**	**$319,368**	**$322,633**	**$316,102**	**$316,102**	**$319,647**

Source: Prairie Swine Centre.

FIXED COSTS	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Property tax	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50
Insurance	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75	$3.75
Total fixed costs/hog	$5.25	$5.25	$5.25	$5.25	$5.25	$5.25	$5.25	$5.25
Total fixed costs/year	**$70,069**	**$70,069**	**$70,069**	**$68,576**	**$68,576**	**$68,576**	**$68,576**	**$70,069**

Source: Prairie Swine Centre.

FEED COSTS	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Feed cost/hog	$53.84	$56.42	$55.82	$58.72	$63.26	$71.29	$70.04	$62.98
Total feed costs/year	**$718,535**	**$752,975**	**$745,041**	**$767,018**	**$826,369**	**$931,200**	**$914,902**	**$840,576**

Source: Prairie Swine Centre.

INTEREST AND DEPRECIATION INFORMATION	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Depreciation (years)	20	20	20	20	20	20	20	20
Salvage value	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Long-term interest rate	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Short-term interest rate	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Purchases made on credit	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%

Source: Prairie Swine Centre.

REVENUE	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
Average weight (kgs)	92.0	92.6	92.4	91.0	90.0	87.5	87.5	87.5
Average index	109.42	111.00	108.77	108.20	107.00	110.70	110.70	110.70
Average bonus	$2.35	$2.01	$2.35	$1.50	$3.50	$6.67	$6.67	$6.67
Average pool price ($/ckg)	$1.427	$1.474	$1.458	$1.493	$1.520	$1.485	$1.485	$1.485
Salvage value for sows	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Salvage value for sows	$73.00	$76.76	$74.46	$74.24	$74.94	$75.26	$75.26	$75.26
Total market hog sales/hog	$146.00	$153.52	$148.91	$148.47	$149.88	$150.52	$150.52	$150.52
Total cull sow sales/hog	$1.31	$1.38	$1.34	$1.36	$1.38	$1.38	$1.38	$1.35
Total sales/hog	$147.31	$154.90	$150.25	$149.84	$151.52	$151.90	$151.90	$151.87
Total sales/year	**$1,966,111**	**$2,067,319**	**$2,005,342**	**$1,957,197**	**$1,975,675**	**$1,984,171**	**$1,984,171**	**$2,026,973**

Source: Prairie Swine Centre.

Returns

The following table uses the input variables above to generate returns for the model operation by province.

	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
REVENUE				$/YEAR				
Market hogs	1,948,591	2,048,897	1,987,472	1,939,380	1,957,690	1,966,109	1,966,109	2,008,910
Cull sows	17,520	18,422	17,870	17,817	17,985	18,062	18,062	18,062
Manure sales[a]	10,203	10,203	10,203	10,203	10,203	10,203	10,203	10,203
Building cost (per pig place)/finisher	**1,976,314**	**2,077,523**	**2,015,545**	**1,967,401**	**1,985,879**	**1,994,375**	**1,994,375**	**2,037,176**
CAPITAL ASSET VALUE				$/YEAR				
Facilities	3,144,260	3,700,330	3,947,878	4,429,803	4,850,922	3,795,300	5,142,900	3,549,980
Sow inventory	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total value of assets	**3,384,260**	**3,940,330**	**4,187,878**	**4,669,803**	**5,090,922**	**4,035,300**	**5,382,900**	**3,789,980**
FEED COSTS				$/YEAR				
	718,535	752,975	745,041	767,018	826,369	931,200	914,902	840,576
VARIABLE COSTS				$/YEAR				
Replacement gilts	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Barn supplies	25,471	25,471	25,471	25,471	25,471	25,471	25,471	25,471
Maintenance and repairs	47,285	47,285	47,285	47,285	47,285	47,285	47,285	47,285
Management and consultant fees	20,638	20,638	20,638	20,638	20,638	20,638	20,638	20,638
Marketing and transportation	84,903	84,903	84,903	84,903	84,903	84,903	84,903	84,903
Miscellaneous	653	653	653	653	653	653	653	653
Office supplies	3,266	3,266	3,266	3,266	3,266	3,266	3,266	3,266
Utilities (heat, power and phone)	84,903	84,903	84,903	84,903	84,903	84,903	84,903	84,903
Veterinary supplies and fees	45,717	48,983	45,717	52,248	55,514	48,983	48,983	45,717
Total variable costs	**408,837**	**412,102**	**408,837**	**415,368**	**418,633**	**412,102**	**412,102**	**408,837**
Manure handling	**32,493**	**47,140**	**36,618**	**50,507**	**68,031**	**50,507**	**50,000**	**30,600**

[a] *Neighbouring farms pay model operation for manure as a replacement for chemical fertilizers.*

	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
LABOUR				$/YEAR				
	98,670	157,872	98,670	128,271	128,271	108,537	108,537	108,537
FIXED COSTS				$/YEAR				
Interest and depreciation: facilities	304,466	358,311	382,282	428,948	469,726	367,507	497,998	343,752
Management salaries	98,670	157,872	98,670	128,271	128,271	108,537	108,537	108,537
Insurance	50,049	50,049	50,049	48,983	48,983	48,983	48,983	50,049
Property tax	20,020	20,020	20,020	19,593	19,593	19,593	19,593	20,020
Total fixed costs	**473,204**	**586,252**	**551,020**	**625,795**	**666,572**	**544,620**	**675,111**	**522,358**
Operating interest	15,948	16,668	16,369	16,952	18,054	19,165	18,934	17,600
Total operating costs[a] (excl. cost of compliance)	1,274,483	1,386,756	1,305,535	1,378,115	1,459,358	1,521,511	1,504,475	1,406,150
Total operating (including cost of compliance)	1,276,049	1,386,781	1,307,249	1,379,615	1,460,114	1,521,751	1,504,719	1,406,350
Total costs (excluding cost of compliance)	**1,747,687**	**1,973,008**	**1,856,556**	**2,003,910**	**2,125,930**	**2,066,131**	**2,179,586**	**1,928,508**
Total costs (including cost of compliance)	**1,750,080**	**1,974,922**	**1,861,094**	**2,009,209**	**2,129,118**	**2,068,228**	**2,182,253**	**1,931,108**
Gross margin	701,831	690,766	710,010	589,285	526,521	472,864	489,900	631,026
Net income	228,627	104,514	158,990	-36,509	-140,052	-71,756	-185,212	108,668
EBITDA[b]	553,112	482,845	561,291	412,032	349,267	315,344	332,380	472,440
ROA[c]	6.76%	2.65%	3.80%	-0.78%	-2.75%	-1.78%	-3.44%	2.87%
EBITDA/sales	28.0%	23.2%	27.8%	20.9%	17.6%	15.8%	16.7%	23.2%
Net income per hog	**17.13**	**7.83**	**11.91**	**-2.80**	**-10.72**	**-5.49**	**-14.18**	**8.14**
Financial assistance	0	0	0	0	0	0	0	0
Total cost of compliance	***2,393***	***3,652***	***4,539***	***5,299***	***3,188***	***2,098***	***2,667***	***2,600***

Sources: Prairie Swine Centre, expert contacts.

[a] *Operating costs include feed costs, total variable costs, manure handling, and labour.*

[b] *Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA).*

[c] *Return on Assets (ROA).*

Initial values, useful life, interest rate and salvage values of environmental costs

The following table presents the initial values for environmental costs. In other words, these data are the one-time and annual environmental costs before amortization.

COST ITEM	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
				Cost				
Environmental permits							500	
Technical review			1,500					
Water rights licence	200[a]	0[b]	100		0[c]			
Water withdrawal permit				0[d]		50		
Environmental impact assessment		n/a[e]			*[f]	3,000[g]		10,000[h]
Groundwater study	n/a[i]	n/a[j]						

* *No data was available regarding cost of environmental impact assessment in Quebec.*

[a] *Water rights licence can cost between $100 and $300 depending on the desired volume of water.*

[b] *Typically there is no cost for a water licence from the Alberta Ministry of Environment, Red Deer County office unless the application is very complex. Source: Jody Miller, AB Environment, Red Deer County Office, 403-340-7052.*

[c] *Quebec does not have water rights licences. Source: Richard Lauzier, MAPAQ, 450-248-3321 x 24.*

[d] *There is a $75 administration fee for takers of a significant amount of water (i.e. irrigation). This fee would not really apply to hog producers.*

[e] *The environmental impact assessment consists of a small engineering soils report. Given that a hydrogeologic study will be conducted by engineers, the engineering soils report will likely be included as part of the cost.*

[f] *A 600 sow farrow-finish operation equates to approximately 1100 animal units. Above 600 animal units, producers need an environmental impact assessment. Nobody has tried to ask for a permit with such a study. This assessment might cost a lot in professional fees. Source: Jean Tanguay, Co-op Fédérée, 418-257-2189 or cell 418-580-4539.*

[g] *Hydrologist required.*

[h] *If the estimated cost of the undertaking is less than $2.5 million but more than $1 million, environmental impact assessment fee is $2,500. If the estimated cost of the undertaking is more than $2.5 million, environmental impact assessment fee is $10,000. Since PEI construction cost is approximately $3.5 million, the fee is $10,000.*

[i] *A hydrogeologist is required to conduct a groundwater study in order for an operation to be granted a water licence. The hydrogeologist determines the aquifer capacity, well capabilities, cost of drilling the well, and any number of required observation wells. Due to the site-specific nature of the ground water study costs, these costs have been left out of the analysis for all provinces.*

[j] *Alberta Environment would require a groundwater study conducted by a hydrogeologist in order to grant a water licence. Source: Jody Miller, AB Environment, Red Deer County Office, 403-340-7052. Due to site-specific nature of ground water study costs, these costs have been left out of the analysis.*

COST ITEM	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
				Cost				
Public consultations		0[a]			3,000[b]			
Application to watershed authority	63[c]							
Nutrient management plans								
Agro-environmental fertilization plan ($)					650[d]			
Phosphorus statement ($)					250[e]			
Environmental farm plan ($)								
Nutrient management plan ($)				8,000		2,000[f]	0[g]	
Waste storage plan ($)	0[h]	1,500						
Waste management plan ($)	0[i]							
Manure management plan ($)	1,000		3,099					
Mandatory rotation legislation and amendments of ($)								500
Mortality management plan ($)	0[j]							

[a] *Costs associated with notification of affected parties under Agricultural Operations Practices Act or under joint notification with Alberta Environment are paid by the NRCB. Source: NRCB website. In terms of public consultations, the minimum that is required is an ad in the newspaper. NRCB will pay for the ad. Source: Scott Cunningham, Approval Officer, NRCB, 403-340-5795.*

[b] *Source: Jean Tanguay, La Co-op Fédérée, cell 418-580-4539.*

[c] *Application to Saskatchewan Watershed Authority can cost between $25 and $100 dollars depending on the number of people proposing to use the water.*

[d] *Source: Jean Tanguay, La Co-op Fédérée, cell 418-580-4539.*

[e] *A phosphorus report is required yearly by the Agricultural Operations Regulation in Quebec. AGECO (2005) estimates the cost of phosphorus report to be between $200 and $300. Source: Denis Boutin, Ministère du Développement durable, de l'Environnement et des Parcs, (418) 521-3950 x 4462.*

[f] *Cost ranges from $1500 - $2500.*

[g] *Originally, the total cost of nutrient management planning in Nova Scotia was $9,000 and was distributed between four different categories as completed by a producer on behalf of Henry Vissers, Pork Nova Scotia. Upon later follow-up, a correction was made by Henry Vissers. He stated that nutrient management plans in Nova Scotia are voluntary. At the municipal by-law level, there is a requirement that new operations have a manure disposal plan. To meet the requirements for a manure disposal plan, producers must either have a nutrient management plan or have at least 7 months of manure storage. Therefore, a nutrient management plan is not a requirement at the municipal level as long as sufficient manure storage is constructed. As such, there is no cost requirement for nutrient management planning in Nova Scotia.*

[h] *Often developed in assistance with Saskatchewan Agriculture and Food staff at no cost to the producer.*

[i] *Often developed in assistance with Saskatchewan Agriculture and Food staff at no cost to the producer.*

[j] *Often developed in assistance with Saskatchewan Agriculture and Food staff at no cost to the producer. Mass mortality plans are voluntary.*

COST ITEM	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
				Cost				
Ongoing record keeping and plan maintenance ($/year)	0		1,200	1,500[a]	500[b]			0[c]
Land application								
Portion of manure spreading (custom application) cost which is attributed to regulations	0	0	0	0	0	0	0	0
Buffer strips + set backs/set asides - ESTABLISHMENT ($/acre established)	0	0*	0	270[d]	480[e]	0		100[f]
Buffer strips + set backs/set asides - LAND REPLACEMENT ($/acre replaced)		1,700*	1,700[g]	4,275[h]	350[i]	1,500[j]		3,000[k]
Opportunity cost of not being able to use the land		187*	187[l]	77[m]		0		100

* *Indicates that information was not available on buffer strip costs in Alberta. As such, the costs were estimated using Manitoba data.*

[a] *$10/acre record keeping x 150 acres. Source: George Morris Centre.*

[b] *Annual maintenance of agro-environmental fertilization plan is $500 for large farm. Maintenance is $400 annually for average farm and $300 annually for small farm. This does not include manure and soil sampling and analysis. Source: Jean Tanguay, La Co-op Fédérée, 418-257-2189 or cell 418-580-4539.*

[c] *Marc Schurman initially completed a record keeping cost of $2/acre. Since NMP and EFP are voluntary, there are no mandatory costs for record keeping.*

[d] *Based on 150 acres and assuming 0.6% of acres are converted to buffers. Establishment cost ranges from $250 per acre established to $350 per acre established.*

[e] *To establish a 10 m buffer in hay (including preparation and erosion control system), the cost is $400 per 100 metres. Assume 0.6% of 150 acres is buffers = 1 acre. 1 acre = 4047 sq. metres. Buffer = 10 m x 100 m = 1000 sq metres = 1/4 acre. 1000 sq metres = 1/4 acre. $400 = 1/4 acre. $1600 = 1 acre. Therefore, assume establishment costs of $1600/acre. However, the above cost assumes a 10 m buffer strip which is recommended by MAPAQ but is not legislated. Legislation requires that buffers be 3 metres from shoreline. Therefore, multiply $1600 by 3/10 to determine legislated establishment cost = $480/acre. Note that the high establishment costs for buffers in Quebec are due to the hydrologic control systems that are being implemented as part of buffer establishment.*

[f] *Assume 0.6% of 150 acres is converted to buffers = 1 acre x $100/acre = $100.*

[g] *17 acres.*

[h] *Based on 150 acres and assuming that 0.6% of acres are converted to buffers. Cost of land replacement ranges from $2,500/acre replaced to $7,000/acre replaced.*

[i] *MAPAQ is considering compensating farmers at a rate of $350/acre for implementing buffers. The proposal for the government consists of a pilot study to pay $350/acre per year for two years and determine if that is an appropriate amount. In the end, they hope to pay every year for a longer period of time. Source: Richard Lauzier, MAPAQ, 450-248-3321 x 24.*

[j] *Assume buffer of 1.5 acres. 1.5 acres x $1000/acre = $1500. $1,000/acre is King's County Land cost according to Dwight Balzer, NB Agriculture.*

[k] *Assume 0.6% of 150 acres is buffers = 1 acre x $3,000/acre = $3,000.*

[l] *$10-12/acre x 17 acres.*

[m] *Based on 150 acres and assuming 0.6% of acres are converted to buffers. Opportunity cost ranges from $55/acre/yr to $115/acre/yr. Used average cost to calculate $77/year.*

COST ITEM	SASK.	ALB.	MAN.	ONT.	QUE.	N.B.	N.S.	P.E.I.
				Cost				
Siting and construction standards								
Locating tiles, tile removal ($/site)			n/a		n/a	n/a	2,000	n/a
Hired services geo-technical or profess. engineer ($)	4,000	10,000	5,000	4,000	14,000*	10,000	3,000	
Design services professional engineer ($)	4,500	1,000	10,000	10,000			15,000	10,000
Manure storage cost	135,000	170,100	188,870	59,000[a]	355,432	200,000	100,000	110,000
Other								
Soil testing		25[b]	260	0[c]	28[d]			
Manure testing	200	0[e]	254	0[f]	228[g]	240[h]	1,000	200
Management time			0[i]					
Training courses	1,500[j]		650[k]	75[l]			2,000	
Monitoring wells		1,500						
Other						n/a[m]		

* *Indicates that information was not available on engineering costs in Quebec. As such, the costs was estimated using Ontario figures.*

[a] *Note that manure storage cost in Ontario is low due to the fact that some of the manure storage construction costs are included in the building costs.*
[b] *$25/sample according to Norwest Labs. GMC assumption of 1 soil test per year.*
[c] *Part of NMP cost.*
[d] *28/sample including sampling. Source: Jean Tanguay, Co-op Fédérée, cell 418-580-4539. George Morris Centre assumption of 1 soil test per year.*
[e] *No requirement for manure testing under Agricultural Operations Practices Act. Source: Matt Oryschak, Environmental Program Specialist, AB Agriculture, 780-422-1791.*
[f] *Part of NMP cost.*
[g] *$38/manure sample x 6 samples.*
[h] *6 samples x $40/sample = $240.*
[i] *Sheldon Stott estimated management time at $10,000. Unsure whether the time is attributed specifically to environmental costs, therefore have removed the $10,000 from this analysis.*
[j] *Usually 2 week course. $1500/person. Assume 1 person.*
[k] *NMP Planner Certification.*
[l] *25/course x assumption of 3 courses.*
[m] *Originally, Henry Vissers completed a miscellaneous cost of $5,000 in response to the survey questionnaire. Upon later follow-up, Henry could not remember what the $5,000 was for - therefore the cost was removed as a line item as per Henry Vissers, NS Pork.*

COST ITEM	DISCOUNTING			
	Type of cost	Interest rate	Number of years	Salvage value
Environmental permits	One-time	7%	20	0
Technical review	One-time	7%	20	0
Water rights licence	One-time	7%	20	0
Water withdrawal permit	One-time	7%	20	0
Environmental impact assessment	One-time	7%	20	0
Public consultations	One-time	7%	20	0
Application to watershed authority	One-time	7%	20	0
Nutrient management plans				
Agro-environmental fertilization plan ($)	One-time	7%	5[a]	0
Phosphorus statement ($)	Annual[b]			
Nutrient management plan ($)	Depends on province	7%	5 years in Ont.[c] 5 years in N.B.[d]	0
Waste storage plan ($)	Depends on province	7%	5 years in Alb.[e]	0

[a] *Agro-environmental fertilization plan means a plan that determines, for each parcel in an agricultural operation and each annual growing season (maximum of 5 years), the crop grown and the spreading limits for fertilizers. Source: Agricultural Operations Regulation under the Environment Quality Act.*

[b] *The phosphorus balance report is a report which is required yearly by the Quebec regulation (Agricultural Operations Regulation).*

[c] *In Ontario, a nutrient management strategies and plans cease to be in force for an agricultural operation on the fifth anniversary of the day on which the strategy was approved or prepared. Source: Nutrient Management Act, Regulation 511/05.*

[d] *Livestock Operations Act licences cannot be issued for longer than 5 years. As such, the nutrient management plan should be revised on the renewal of the licence (again not more than 5 years) or at such time as there is a change of herd size, landbase or crops under production. Source: Dwight Balzer, NB Agriculture.*

[e] *Producers must submit a waste storage plan when apply for approval to construct a manure storage facility. Once storage is approved, no more waste storage plans are required as long as the integrity of the facility is maintained and monitoring results (if applicable) meet NRCB standards. As such, the George Morris Centre will assume that waste storage plans occur one-time and will amortize the cost over 5 years given the likelihood that farm size and acreage will not change within five years.*

Initial values, useful life, interest rate and salvage values

COST ITEM	DISCOUNTING			
	Type of cost	Interest rate	Number of years	Salvage value
Waste management plan ($)	Depends on province	7%	5 years in Alb.[a]	0
Manure management plan ($)	Depends on province	7%	Annual cost in Sask. 5 years in Man.[b]	0
Mandatory rotation legislation and amendments of ($)	One-time	7%	5	0
Ongoing record keeping and plan maintenance ($/year)	Annual			
Land application				
Portion of manure spreading (custom application) cost which is attributed to regulations	Annual			
Buffer strips + set backs/set asides - ESTABLISHMENT ($/acre established)	One-time	7%	10[c]	0
Buffer strips + set backs/set asides - LAND REPLACE-MENT ($/acre replaced)	One-time[d]	7%	20	10%
Opportunity cost of not being able to use the land	Annual			
Siting and construction standards				
Locating tiles, tile removal ($/site)	One-time	7%	20	0
Hired services geo-technical or profess. engineer ($)	One-time	7%	20	0
Design services professional engineer ($)	One-time	7%	20	0
Portion of manure storage cost which is attributed to regulations (annualized)	One-time	7%	20	10%

[a] *For a new operation, a waste management plan is required for the first year of operation. After that, producers must keep records of manure spreading, but otherwise waste management plans are not required. As such, the George Morris Centre will assume that waste management plan occurs one-time and will amortize the cost over 5 years given the likelihood that farm size and acreage will not change within five years.*

[b] *In Manitoba, producers are required to submit manure management plans annually. Contact for Manitoba (Sheldon Stott) provided initial cost for manure management plan of $3,099 and annual record keeping costs of $1,200 per year. Therefore, GMC assumption is that when developing the first plan there is an expense of $3,099 and then every year, the cost to update that plan is $1,200. Therefore, GMC will amortize $3,099 over 5 years given assumption that farm size and acreage will not change within five years.*

[c] *Based on previous GreenCover program where buffers were to be established for 10 years.*

[d] *Except for Quebec which is based on annual land replacement payment for farmers.*

COST ITEM	DISCOUNTING			
	Type of cost	Interest rate	Number of years	Salvage value
Other		7%		
Soil testing	Annual			
Manure testing	Depends on province	7%	Annual cost in all provinces except N.S. 5 years in N.S.[a]	0
Training courses	One-time	7%	5[b]	0
Monitoring wells	One-time	7%	20	0

[a] *According to clarification from Henry Vissers, Pork Nova Scotia, $1,000 per year for manure testing seems too high and he thought that it would be more appropriate to amortize the $1,000 over 5 years.*
[b] *GMC assumption - training courses are likely related to nutrient management planning. Therefore, assume same useful life as for average nutrient management plan.*