

Geographical Information Systems for Rural Land Use Planning and Livestock Policy: *Selkirk and District Planning Area*

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Abstract



Buffer Ring around Livestock Operation, St. Andrews, MB.

In certain rural areas of Manitoba, the character of the rural residential population has changed. People have built or bought houses in and around land that had been previously used for agriculture. These rural residents have put forth major investments in to their property and are very sensitive to any activity that may interfere with their “rural lifestyle” or affect the property value. Livestock production in Manitoba has undergone significant changes in recent years, both in size of operation and production methods.

In the past, livestock production, in particular hog production was generally part of a mixed farming operation. It has now become a specialized industry where operations have become much larger and more capital intensive than the farms of 30 years ago. These factors have resulted in situations where land use conflicts have and continue to occur.

Traditionally, regulatory and zoning criteria, in conjunction with manual review of land cover overlay and topographic maps have been used to select sites for livestock operations. This approach can be time consuming and expensive. An alternative approach is the development of an interactive spatial decision model to delineate optimal locations of livestock operations. A geographical information system (GIS) can be used as a decision making tool to develop policy surrounding future development and land use; including the appropriate location and separation distances of any future or expanding livestock operations within a rural municipality.



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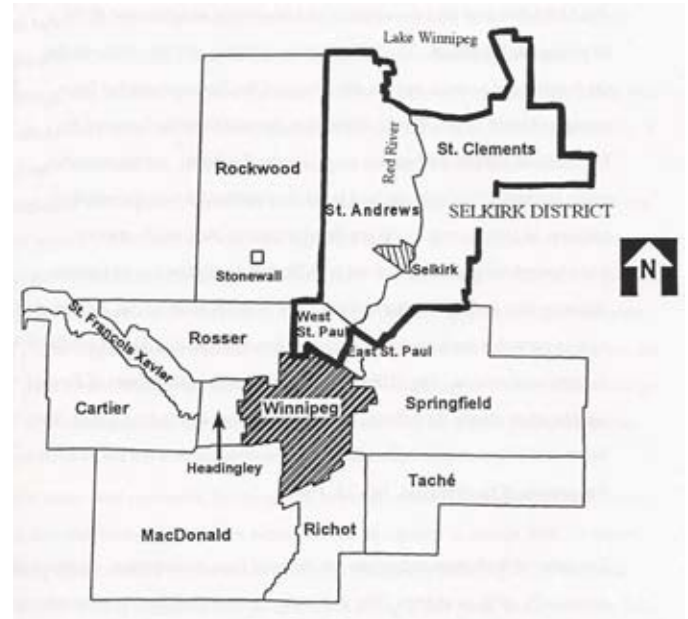


Background and Context

SDPAB

The Selkirk and District Planning Area board consists of approximately 1,580 km² and covers an area from the northern boundary of Winnipeg to the southern basin of Lake Winnipeg. Population is in excess of 32,000. It is comprised of the Town of Selkirk and the Rural Municipalities of St. Andrews, St. Clements and West St. Paul (Selkirk District Planning, 2007).

Rural areas, such as the three municipalities of St. Andrews, West St. Paul and St. Clements are experiencing social and economic restructuring with a resultant shift in emphasis from production to consumption concerns. New residents are living in the countryside and possess ideas about how its resources should be managed that often differ from those with traditional production interests.



Selkirk District Planning Area

As residential development continues to encroach upon existing livestock operations, clear policies need to be adopted by the Selkirk and District Area Planning Board that address future development which also deal with competing land use interests. It is important that the land use policies recognize the significant role of agricultural

Land Use in the Selkirk and Area Planning District						
Source: Statistics Canada, 2001 Census of Agriculture based on Census Subdivision						
Land Use Cover	RM of West St. Paul		RM of St. Andrews		RM of St. Clements	
	Area (ha)	% of RM	Area (ha)	% of RM	Area (ha)	% of RM
Annual Cropland	6338	71.8	49060	58.3	28545	32.9
Forage	247	2.8	1339	1.6	1032	1.2
Grasslands	1616	18.3	12617	15	14847	17.1
Trees	42	0.5	7125	8.5	7415	8.5
Wetlands	0	0	3206	3.8	7756	8.9
Water	146	1.7	6497	7.7	6938	8
Urban & Transport	433	4.9	4239	5	2778	3.2
Total	8822	100	84083	100	86866	100





production within the District. As shown in the chart below, the assessed value of each industry is not surprising. From these assessed values, the tax assessments are calculated and collected. It is quite clear that residential is the highest assessed value for all three municipalities. Agriculture is in a distant second for the R.M.'s of St. Clements and St. Andrews, while it is the smallest amount for the R.M. of West St. Paul. To many people, rural land is no longer seen as a resource for food production, rather it is seen as a commodity that can attract a fair price in the residential marketplace. This is certainly a dilemma for agricultural operations located within the vicinity of urban areas.



Rural Non-Farm Development.

Residential Encroachment

Non-agricultural activity is encroaching upon agricultural producers and their land, leading to inefficient and incompatible land use and a drop in the viability of agricultural production due to increases both in property tax rates and costs of services (Caldwell, 2003). The subdivision of agricultural land produces fragmented lands, which in turn reduces the viability of agricultural production. Some municipalities have done little to support the protection of farmland. The loss of an acre

Full Assessed Value in \$ for the Selkirk and District Planning Area			
Source: Manitoba Assessment			
Type	R.M. of St. Andrews	R.M. of St. Clements	R.M. of West St. Paul
Residential	593,510,888 (78%)	526,197,777 (83%)	249,136,355 (80%)
Commercial	42,844,753 (6%)	27,106,384 (4%)	27,115,476 (6%)
Industrial	15,580,769 (2%)	8,780,984 (1%)	19,197,169 (5%)
Agricultural	107,543,538 (14%)	75,237,115 (12%)	16,816,807 (3%)
Total	716,635,195	637,322,260	312,265,807

associated with a rural residential lot is significant, but it pales in comparison to the restrictions associated with that lot (Caldwell, 2003). Each residential lot has the potential to restrict more than 300 acres from a livestock operation. This is based on the type of livestock, manure system and size of barn as determined using the minimum setback requirements for livestock operation outlined by Manitoba





Agriculture recommended criteria for siting livestock operations.

Facts of the Case

Manitoba Livestock Industry

Between 1990 and 2000, the number of hog farms in Manitoba has declined by more than 50 percent from 3,150 to 1,450, while the average number of hogs per farm has more than tripled. The number of head has increased from 388 to 1290 (Pork in Manitoba: Manitoba Agriculture, 2006). Manitoba has more than 5 million hectares of land suitable for agricultural production and has seen significant change in recent years. Cattle production has decreased while hog production has increased more than sevenfold from 870 000 in 1975 to 6.7 million currently (Pork in Manitoba: Manitoba Agriculture, 2006). Production has been increasing at 13 percent annually for several years, with Manitoba now being the third largest pork producing province with about 24 percent of the total Canadian pork production. There are 16,000 to 17,000 people employed by the hog industry in Manitoba. The economic benefits have been estimated at \$2 billion (Royal LePage, 2004).

The intensification of agriculture often leads to conflict within rural communities (Caldwell, 1999). As livestock facilities have become larger, more geographically concentrated, many people living in proximity to these facilities have expressed concerns related to odour and water quality. In response to this conflict provincial and municipal governments are forced into the midst of the issue and are often pressured to develop criteria to assist with the establishment of new facilities and to regulate existing situations (Caldwell, 2003). The resulting approaches include a mix of legislation, policy, local by-laws and recommendations concerning management.

Although several politicians have welcomed and encouraged the dramatic growth of Manitoba's hog industry, citizens and non-governmental groups are becoming increasingly skeptical of hog development within their localities (Vandean, 2003). Municipal governments, too, are examining hog barn development and/or expansion proposals with increased scrutiny while ensuring that more public input and consultations take place. It is very difficult to find a single industry in Manitoba that has sparked more public resistance and opposition than the intensification of the Manitoba hog industry.

Key reasons to protect farmland include:

- To protect the capacity of farmer to produce food
- To address the issue of food security
- To protect the role of agriculture in the local and national economy
- To protect farmland as a resource for future generations



Trying to minimize land use conflicts with regards to intensive livestock operations is a difficult task. Increased emphasis on environmental quality has placed new demands on livestock producers to ensure their production practices are in harmony with the natural environment (Jain et al., 1995). Several citizens are urging their local and provincial governments to increase the level of regulations and control the location of new livestock operations.

Number of Pig Farms and Average Number of Pigs per Farm, Manitoba and Canada, 1981-2000

Year	Number of Pig Farms, Manitoba	Average Number of Pigs per Farm, Manitoba	Average Number of Pigs per Farm, Canada
1981	5098	172	177
1986	3563	301	268
1991	2969	434	345
1996	2064	861	523
2000	1430	1354	884

Source: Statistics Canada, 2001

Lessons Learned

Tensions between modern agricultural uses and residential uses in rural areas are a common problem throughout North America and are becoming more and more apparent in Manitoba. The expansion of ex-urban residential development in predominantly agriculturally-based municipalities has added to the population base and the potential for conflicts (Royal LePage, 2004). This new population of people have different values and expectations of the rural lifestyle. The probability of conflicts and complaints has increased where the nature of agriculture has intensified, and at the same time where the adjacent rural population is less directly connected to this new farm economy (Royal LePage, 2004). This is particularly evident in the Selkirk District Planning Area. There are a number of livestock operations within close proximity of rural residential developments. Development is encroaching closer and closer to these operations. A great deal of planning is required for the site selection process for new residential developments.

Provincial / Municipal Approaches

The development of a response to “Intensive Livestock Operations”

Context

All municipal governments in Manitoba must adopt a development plan by January 1, 2008. A livestock operation policy must be included in all development plans. The livestock operation policy must identify areas in the municipality where expansion or development of livestock operations may be allowed; may be allowed up to a maximum size; or will not be allowed (Manitoba Agriculture, 2006). Municipalities may choose to restrict or prohibit livestock operations based on social and environmental factors including the following*:

- Proximity to water bodies or flood prone areas
- Agricultural capability of soils (no livestock operations are permitted on soils determined by detailed soil survey to be Class 6, Class 7 or unimproved organic soils.
- Proximity to urban or settlement centres, rural residential areas and designated recreational areas or parks.

*Source: (Manitoba Agriculture, 2006)



reflects the respective powers and responsibilities held by the province and municipalities. Both, to a certain degree, are constrained in the types of actions that may be taken. Not only are there legal impediments, but there are also philosophical differences on how the issue should be approached.

Manitoba Responses

The siting of large livestock facilities in Manitoba is essentially a municipal responsibility but with considerable support from the province. In individual municipalities, where zoning by-laws are in place, the establishment of a new barn must conform with the zoning by-law and in certain circumstances, a conditional use permit is required. Prior to the issuance of a conditional use permit, the municipality may require the completion of certain background materials and studies and the decision of the municipality is final with no appeal opportunities. There are examples of applications which have been approved and examples of applications that have been denied. Clearly however, the public meetings associated with a conditional use permit have the potential to be contentious, but do provide the opportunity for considerable input and review prior to the establishment of a new barn. Although provincial support exists for municipalities, current experience indicates that some municipalities are well prepared for new construction while others are in the midst of trying to come to grips with this issue.

Next Steps

Land Use Conflicts (GIS)

The implementation of a GIS as a spatial decision support system as a tool for rural land use planning is something that has yet to be explored in many planning districts and municipalities throughout the province (MacDonald et al., 2001).

The raw spatial data required to properly use these systems to their potential is becoming increasingly available at an acceptable cost. However, the spatial layers are often used solely for inventory purposes and the potential for using GIS as a land use planning tool is overlooked. The implementation of a land use system model can provide for accurate land use planning (Craw et al., 1999).

Resource based data for land use planning, although not complete, is advanced enough to be immediately useful by local

Concerns

**Environmental concerns* -The impact of agriculture on water quality is a concern in many rural communities. While the cause of an e-coli outbreak at Walkerton, Ontario in 2000 and the associated loss of human life has not been firmly established many have placed the blame on livestock farming.

**Economic issues* - Concern over large livestock facilities and related environmental concerns can have an impact on real estate values. As a result, in many instances municipalities have been lobbied to restrict the establishment and operation of livestock operations.

**Socio-political issues* - Opposition to large livestock barns often sounds like "NIMBYSIM" (not in my back yard) and can lead to intense emotional debate and conflict. This emotion can complicate the best intentions of involving the community in policy development, implementation and ongoing monitoring.

*Source: (Caldwell, 1999)



governments in their decision making. Local governments and other decision makers are under pressure to make decisions on livestock operations which must reflect sustainability in terms of environmental, social and economic issues.

Why GIS

GIS is a relatively new tool that can assist local governments in making sustainable resource development decisions regarding the livestock industry. GIS allows the user to spatially display information and produce maps in an accurate and timely fashion. Using this tool can help local governments and planning districts find the appropriate solutions to resolve complicated resource planning issues and to ensure the sustainable development of the livestock industry.

With the collection of agricultural and residential data, demographic and resource information can be incorporated into a GIS and analyzed to create map products that spatially illustrate different management options to assist in the sustainable management of agriculture. Information developed will allow local decision makers to analyze current livestock regulations and operations and analyze future livestock expansion proposals.

The Selkirk and District Planning Area developed a decision support tool for land use planning capable of spatially illustrating options, issues, and information relevant to decisions for livestock development within the provincial and municipal regulatory frameworks. This product did not replace the need for site specific assessment of each operation but has assisted in general land use planning for the RM. Data needed to complete the project was discussed and agreed upon.

Cutting Edge Manitoba Example

In the Selkirk District Planning Area, a livestock inventory was conducted to determine the total number of operations, type of operation and number of animal units at each operation. Once the data was entered in to a GIS and linked with the base data, calculations were made to help develop accurate livestock and land use policies.

All of the livestock operations that contained between 10 and 100 A.U. were selected. A 530m buffer ring was placed around all of these operations to show the recommended minimum distance from livestock operations to surrounding residences. The distances

Example: Iowa

The State of Iowa Department of Natural Resources has developed an interactive web based GIS. On the interactive map, clicking on various icons layers displays a pop-up description that has additional data stored. The interactive map has the location of livestock operations that are separated in to different categories based on animal units. There are also land use types, soil types, elevation and stream networks. This interactive dataset is highly powerful and is extremely useful for land use planning and siting of livestock operations. Accurate calculations can be made to help develop effective land use policy. Iowa is a clear leader in utilizing spatial decision making tools for land use planning. This interactive map can be viewed at: <http://csbweb.igsb.uiowa.edu/imgate/introduction/home.asp>

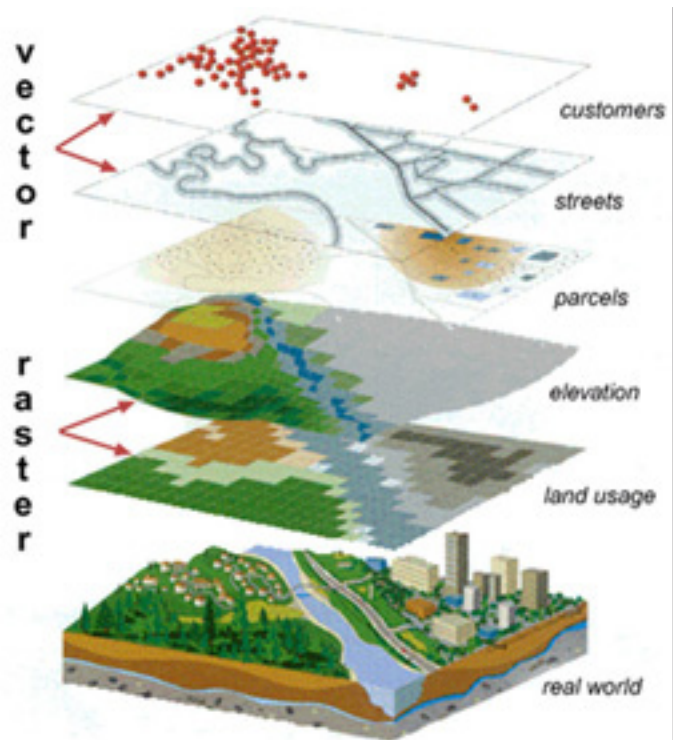




were determined by using the Recommended Criteria for Siting Livestock Operations from Manitoba Agriculture. Rings were placed around the remaining livestock operations and the chart below was used to determine the size of the ring. The rings were also color coded from light to dark red. The lighter the shade of red, the smaller the buffer ring, while the darker shade of red represents a larger buffer ring.

Another layer with a series of buffers placed around all of the dwelling units. This showed an interesting relationship to the previous layer.

Once all of the layers were turned on, it became more obvious as to where agricultural zones need to be protected and where future livestock expansion and development should take place. A dashed line was drawn around the areas that were analyzed as being the most suitable for future development or expansion. This GIS analysis provided for accurate and effective policy creation for the new Development Plan. The creation of concentric buffers around each livestock operation is a simple calculation. It is possible



GIS Layers

What is GIS?

“A system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data, which are spatially referenced to the Earth” (Longley et al., 2001).

RECOMMENDED CRITERIA FOR SITING LIVESTOCK OPERATIONS					
Animal Units (A.U.)	Maximum Number of Residences Within 1 Mile ²	Minimum Distance ² (m)			
		From Single Residence		From Designated ³ Residential or Recreational Area	
		To Earthen Storage	To Buildings ⁴	To Earthen Storage	To Buildings
10 - 100	18	200	100	800	530
101 - 200	16	300	150	1200	800
201 - 400	14	400	200	1600	1070
401 - 800	12	500	250	2000	1330
801 - 1600	10	600	300	2400	1600
1601 - 3200	8	700	350	2800	1870
3201 - 6400	6	800	400	3200	2130
6401 - 12800	4	900	450	3600	2400
1280 +	2	1000	500	4000	2670

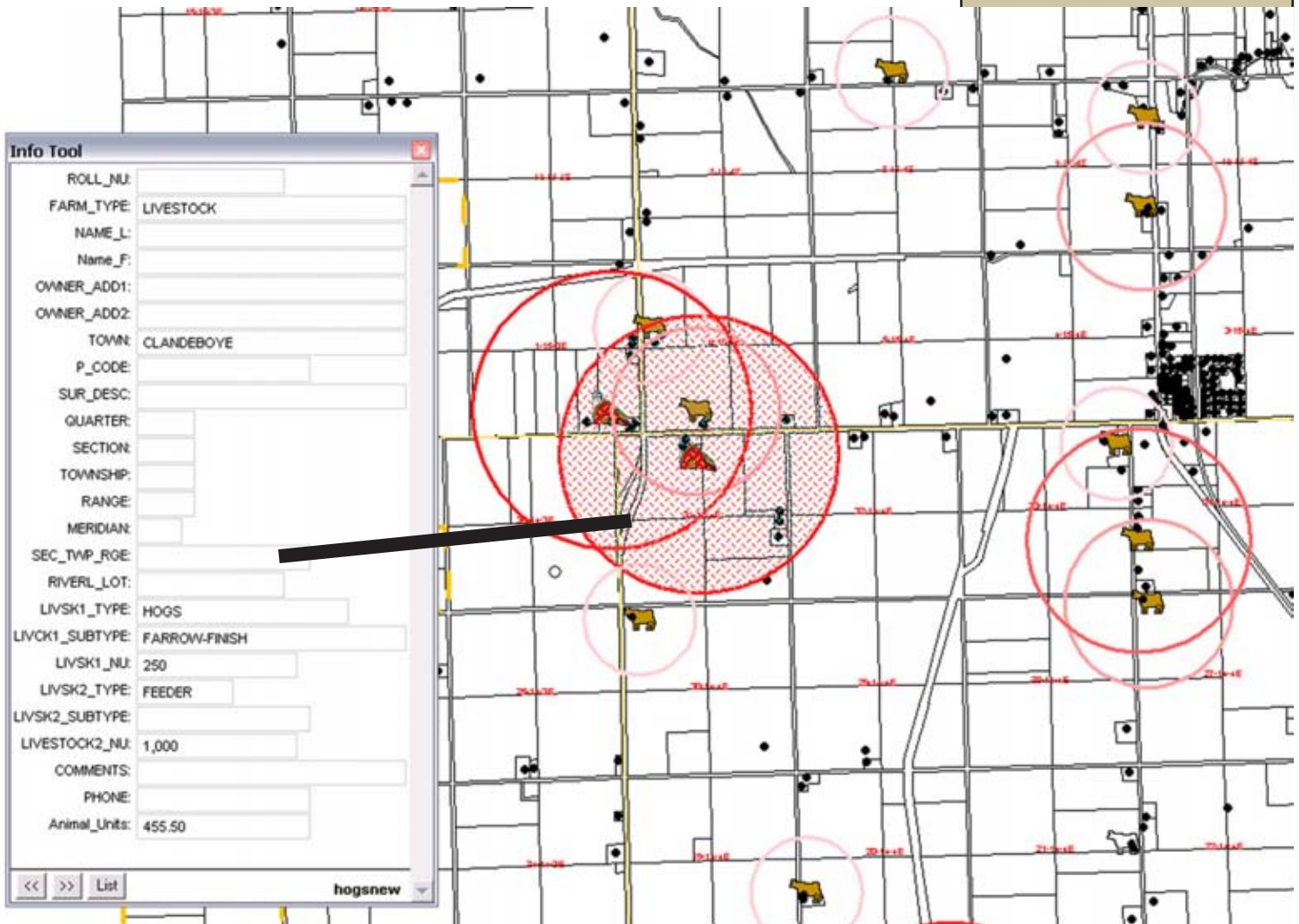
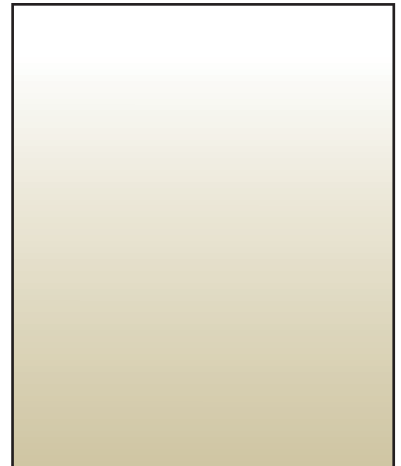
¹Number of residences within one mile of the center of the facility applies only to new facilities. Expansions of existing facilities and the proponent's residence are excluded.
²These separation distances apply to new and expanding operations; see Appendix C for imperial units.
³Officially designated areas in a development plan or basic planning statement.
⁴The distance to buildings includes barns and non-earthen manure storage such as above or below grade structures which may be covered or uncovered.



to perform further calculations and produce even more accurate results pertinent to land use planning and the creation of livestock policy.

Conclusion

Future areas for rural residential development could be identified based on low potential for agriculture (i.e. for poor soil conditions, proximity to natural hazards or other physical constraint). Lands where the degree of fragmentation is such that there is limited potential for agricultural production can also be identified very accurately through



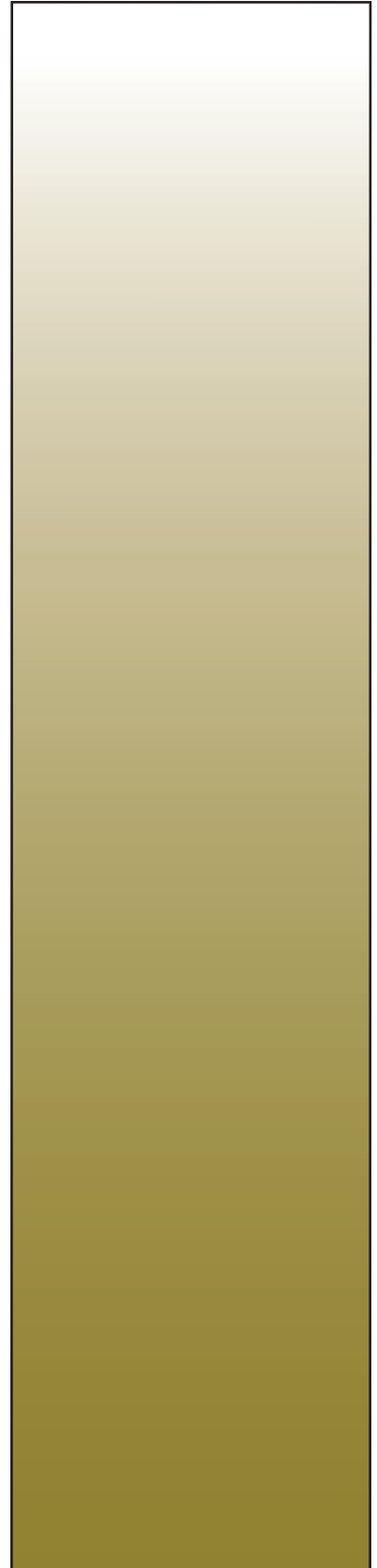
Livestock Operations in St. Andrews, MB. - Buffers placed around each operation based on number of animal units and type of operation using Manitoba Agriculture's recommended criteria for siting livestock operations



the use of a GIS (Jain et al., 1995).

The recent moratorium placed on hog-barn expansion and construction in Manitoba hurts the sustainability of the local farms and communities. It is important to develop buffers between residential and existing agriculture parcels, particularly when involving livestock. A GIS can be developed to assist with siting evaluation of Intensive Livestock Operations to ensure that they are developed in sustainable manner and are compatible with the surrounding rural area. A GIS can be used to identify areas where future livestock operations and residential development should take place.

With the rise of residential development in the rural areas, more and more homes are encroaching upon agricultural land, in particular livestock operations and/or manure spreadfields. A lack of buffering between residential and agricultural land exists. Clear policies and planning are needed to establish accurate buffers to try minimize land use conflicts. Effective land use policy and administration depends on accurate information. Investment in digital mapping and land use information will pay off now and into the future.





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