

Livestock Decision Support Tool For The Rural Municipality of Clanwilliam



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This report provides the Rural Municipality of Clanwilliam with valuable tools and knowledge that will assist them in making informed decisions regarding sustainable agricultural and rural development, protecting the water and soil resource.

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Abstract

With the recent expansion of the livestock industry in Manitoba, local decision makers and rural municipalities are under pressure to ensure that decisions in regards to livestock operations reflect sustainability in terms of environmental, social and economic issues. A decision support tool was developed for the Rural Municipality of Clanwilliam to assist the council in making decisions regarding the livestock industry in the rural municipality.

A geographical information system (GIS) was used to integrate resource data, locations and size of livestock operations, and by-laws and regulations regarding livestock development information and spatial display the various issues and implications, such as availability of land for manure application, associated with potential livestock expansion.

Currently, there are 44 livestock operations in the Rural Municipality of Clanwilliam producing 74,663 animal units. While approximately 53% of the land base (annual cropland, forages and grasslands) of the RM is available for livestock expansion and manure application, regulations and bylaws implementing setbacks of livestock operations from watercourses and rural dwellings and communities decrease the amount of this area available for expansion. Future expansion of the livestock industry in the RM is affected by the municipal by-laws, current provincial regulations and land use. In the RM of Clanwilliam, up to 43% of the RM is available for smaller proposed livestock operations (less than 75 au), while only 12% of the municipality is available for operations greater than 200 au.

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1.0 Introduction

Agricultural development, particularly livestock expansion, is occurring rapidly in Manitoba. 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. Resource based data for land use planning, although not complete, is advanced enough to be immediately useful by local governments in their decision making. Social and economic considerations are equally important, but will require additional data and development to be integrated into local decision making.

Livestock operations occur throughout the Rural Municipality of Clanwilliam, of which the majority are beef operations. The Rural Municipality of Clanwilliam needs the ability to acquire, interpret, and distribute information to assist in making informed decisions regarding the livestock industry, while at the same time addressing environmental and community concerns.

Geographic Information Systems (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.

2.0 Project Description and Objectives

To adequately represent current livestock operations relative to land capacity and social constraints, the Rural Municipality of Clanwilliam needed to develop capabilities that allowed for the acquisition and utilization of information for use in decision making. With the collection of agricultural and residential data, demographic and resource information were incorporated into a geographic information system (GIS) and analyzed to create map products that spatially illustrate different management options to assist in the sustainable management of agriculture in Clanwilliam. Information developed will allow local decision makers to analyze current livestock regulations and operations and analyze future livestock expansion proposals.

At completion, the project delivered

- i. a methodology that supports resource based decision making the RM of Clanwilliam to deal with current and future livestock operations
- ii. a demonstrated capacity of the Rural Municipality of Clanwilliam to utilize advanced decision making tools on their decision making
- iii. reports for each participating partner that includes hard copy (tabular and map form) results of analysis
- iv. digital products and data for continued analysis by the Rural Municipality of Clanwilliam.

3.0 Methodology

3.1 Needs of the Rural Municipality of Clanwilliam

Through discussions with the Rural Municipality of Clanwilliam the following statements about the need and scope of the project were determined. The Rural Municipality of Clanwilliam wishes to have 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 will not replace the need for site specific assessment of each operation but will assist in general land use planning for the RM. Data needed to complete the project was discussed and agreed upon.

3.2 Data

Basemap features

The basemap is a digital map that all other information is plotted or corrected to. Essentially the basemap is the frame upon which the rest of the data is placed. This information included the position of roads, lakes, rivers, streams, rail lines plus other features. This information was also used in the analysis of environmental setbacks of operations and activities from water bodies, roads and other applicable features. Two separate sources of information were utilized for creating the basemap for the RM of Clanwilliam. These are the National Topographical Survey (NTS) sheets and the ortho-photos with associated quarter section grid.

The majority of the roads within the RM are less than 2 lanes with a loose surface. There is one Provincial Truck Highway (PTH 10) which travels north-south in the western part of the municipality. There are two Provincial Roads; PR 357, also known as Mountain Road, which is paved and PR 262 which is gravel ([Map 1](#)). An abandoned CNR railroad which crosses the southwest part of the RM is now part of the TransCanada Trail.

[Map 2](#) shows the size and distribution of hydro lines in the RM. New developers can use this information to determine where hydro is available and how far they may have to go to access it. Single phase hydro lines are the most common for residential and farm operations. Three phase lines are for industrial use, which may be required by some large intensive livestock operations. In [Map 3](#), areas which are within one mile of a three phase hydro line are highlighted. It is assumed that one mile would be the limit on how far one would want to go to access a three phase line.

Rural Residences

Residence locations were and can be used to determine which areas are excluded from livestock expansion or manure application due to proximity of the livestock operation to rural residences. Residence locations were determined through ortho-photos, tax roles, and the assistance of RM staff. Rural dwellings include residences on abandoned yards which may still be habitable.

In the RM of Clanwilliam, there are 214 rural dwellings (Map 4). Rural communities include the town of Erickson, the seasonal recreational areas at Ditch Lake and Otter Lake and a seasonal recreation residential area at Kerr Lake (see Map 12). The northeast portion of the RM is part of the Riding Mountain National Park.

Livestock Operations

Knowing the location of existing livestock operations is essential for proper land use planning. This information is helpful in making decisions in determining the direction and scope of future expansion of the livestock industry as well as ensuring the sustainable management of existing operations. Livestock locations were determined through the use of ortho-photos, tax roles, and the assistance of RM staff. Information on operation type and size was acquired from municipal staff and producer interviews.

In the RM of Clanwilliam, several farm operations reported having more than one livestock type (for example both beef and horses). For the purpose of this study, each farm was considered a single livestock operation, regardless if more than one type of livestock was produced. In Clanwilliam, there are 51 livestock operations (Map 5). Total animal units (AU) at the time of the study was 4,916 AU. One animal unit is defined as the number of livestock required to excrete 73 kg (160 lbs) of nitrogen in a 12 month period. Beef cattle make up the majority of livestock operations and animal units in the municipality (Table 1).

Table 1. Livestock in the RM of Clanwilliam

Livestock	# of Operations Reporting	Total AU
beef	46	4600
dairy	2	—*
horses	4	—*
sheep/goats	3	—*
Total	55**	4918
# of farms reporting more than one type of livestock	4	
Total # of livestock operations	51	

*animal unit numbers are suppressed to protect producer confidentiality but are reflected in the total for the RM

**some farms reported more than one type of livestock in their operation

Landuse

The way land is presently being utilized affects decisions about manure application and facility placement. Land use can determine the possibilities or limitations for livestock expansion. For example, land that is annually cropped and in forages and grassland could be available for manure disposal. However, the amount of these lands available for manure disposal within an economical distance from an operation could also limit the size of the proposed livestock operation. Land use information was derived from satellite imagery which has a resolution of 30 m². Satellite imagery was obtained from Radarsat International in 1993. Imagery was then classified by Manitoba Remote Sensing into seven groups. These are Annual Crop Land, Forages, Grasslands, Trees, Water, Wetlands, and Urban and Transportation.

Table 2 provides the total hectares of the different land uses within the municipality from 1993 satellite imagery. In the RM of Clanwilliam 20% of the land is annually cropped. Trees and grassland each make up a third of the RM and another 4% of the RM is classified as wetlands. The majority of the trees are located towards the northeast part of the RM. The dominant land cover in the northwest, centre and southeast is grassland, interspersed with annual crops and trees. In the southwest corner, annual crop land becomes the main land use. Areas which could potentially be suitable for manure disposal (annual crop land, forages and grassland) make up 53% of the RM (Map 6).

Table 2. Land use in Clanwilliam (including Riding Mountain National Park)*

Land Use	Area (ha)	% of RM
Annual crop land	7907	20.2
Trees	13163	33.6
Water	2371	6.1
Grassland	12946	33
Wetland	1736	4.4
Forage	73	0.2
Road	980	2.5
Total	39,176 ha	

*Data derived from 1993 satellite imagery

Soils

Soils of a municipality are an important natural resource for the community. The soils database and resulting maps are important for making decisions about agriculture capability of the land, risk of leaching, and suitability for many uses including agriculture, industrial, construction and recreational. The soils for the RM of Clanwilliam have been mapped at a reconnaissance map scale of 1:126,720. The soils database contains information about soil texture, drainage, permeability, plus many other characteristics and interpretations.

Surface Texture

Soil texture strongly influences the soils ability to retain moisture, its general level of fertility and ease or difficulty of cultivation. Water moves easily through coarse-textured (sandy) soils so little moisture is retained and they dry out more quickly than fine textured (clay) soils. As well, sandy soils do not retain plant nutrients as well as clay soils and thus are lower in natural fertility. Sandy soils often are characterized by a loose or single grained structure, which is very susceptible to wind erosion. Sandy soils, because they are highly permeable, have the potential for nitrate leaching, affecting groundwater quality. Clay soils have a high proportion of very small pore spaces which hold moisture tightly and are usually fertile because they are able to retain plant nutrients. Clay soils transmit water very slowly, therefore these soils are susceptible to excess moisture conditions.

Soils in the RM consist mainly of loamy textured glacial till. About 61% of the RM has a fine loamy soil texture (Table 3). Areas of clayey textured soils occur around Erickson and south and southeast of Otter Lake, making up about 12% of the RM. Organic soils occur in the north and northeast part of the RM. About 6% of the RM has a sandy texture, the majority occurring in the northwest part of the RM ([Map 7](#)).

Table 3. Surface soil texture in Clanwilliam*

Surface Soil Texture	Area (ha)	% of RM
Organic	2254	5.8
Sands	2326	6
Coarse loamy	1914	4.9
Fine loamy	23538	60.9
Clayey	4524	11.7
Eroded Slopes	40	0.1
Water	1901	4.9
Unclassified	2172	5.6
Total	38,669 ha	

*Area has been assigned to the dominant surface texture in each soil polygon

Slope

Slope describes the steepness of the landscape surface. It is an important factor in erosion and drainage. The steeper the slope gradient, the greater the potential for water erosion. Runoff of surface applied manure may be a concern in fields with steep slopes. To reduce the potential for water erosion, adequate soil cover must be maintained through the use of perennial forages or through the reduction or elimination of tillage in annual crop production.

In the northern part of Clanwilliam, land surface is sharply hummocky to hilly, with slopes in some areas ranging from 9-15% (Map 8). Approximately 50% of the RM has a hummocky topography with slopes ranging from 5 - 9%, mostly located in the southern portion of the RM. Another 34% of the RM has a more level relief (less than 5% slope)(Table 4).

Table 4. Surface slope in Clanwilliam*

Slope range	Area (ha)	% of RM
0-2 %	4308	11.1
2-5 %	8702	22.5
5-9 %	17792	46
9-15 %	3554	9.2
15-30 %	178	0.5
>30 %	61	0.2
Water	1901	4.9
Unclassified	21723	5.6
Total	38,669 ha	

*Area has been assigned to the dominant slope in each soil polygon

Water Erosion Risk

In the soils database using such data as slope length, slope gradient, and soil erodibility, a risk for water erosion has been calculated. Areas are rated as having severe, high, moderate, low or negligible risk for erosion. Areas with a high and severe risk need special practices (ie. minimum tillage or high residue cover in early spring) to mitigate erosion risk. The main concern for manure disposal in areas with high to severe risk of erosion is the potential for nutrients in runoff to affect surface water quality. Management practices to reduce the potential for contaminated runoff include applying manure in spring and fall at rates reflecting soil test recommendations, reducing applications rates, applying manure by injection, incorporating manure into the soil as soon as possible, leaving adequate residue cover on the soil surface (50-65% cover) and selecting deep-rooted, high residue or high nitrogen use crops.

Map 9 shows the risk of water erosion in the RM of Clanwilliam. About 49% of the RM is considered to have a severe risk for erosion, another 14% has a high risk (Table 5). These areas require the above mentioned management practices for manure disposal to reduce the risk. There is moderate risk on 4% of the RM and another 23% has low to negligible risk of water erosion.

Table 5. Water Erosion Risk in Clanwilliam*

Water Erosion Risk	Area (ha)	% of RM
Negligible	6487	16.8
Low	2255	5.8
Moderate	1611	4.2
High	5216	13.5
Severe	19026	49.2
Water	2172	5.6
Unclassified	1901	4.9
Total	38668	

* Based on the weighted average USLE predicted soil loss within each polygon, assuming a bare unprotected soil.

Agricultural Capability

When considering a site for a livestock operation, the productivity of the surrounding land available for manure disposal is important. Manure application rates will depend on the type of vegetation grown (different crops have different nutrient requirements) and the ability of the land to produce vegetation. Less productive soils will require a lower application rate to prevent leaching of nutrients.

Using the Seven Class Canada Land Inventory System, land is classed according to its agricultural capability. Classes 1 to 3 represent prime agricultural land, Class 4 land is marginal for sustained cultivation, Class 5 land is capable of perennial forages and improvement is feasible, Class 6 land is capable of producing native forages and pasture but improvement is not feasible, and Class 7 is considered unsuitable for dryland agriculture. Improvements could include removal of scrub or trees, removal of stones, drainage, altering soil structure, or dyking.

In the RM of Clanwilliam, about 51% of the land is rated as Class 3 and another 13% is rated as Class 2 (Table 6). These areas are prime agricultural land with topography being the main limiting factor. Class 4 land makes up 8% of the RM and another 12% is Class 5. Organic soils, which make up approximately 6% of the RM, are very poorly drained and have little or no capability for agriculture in their natural state ([Map 10](#)).

Table 6. Agricultural capability in the RM of Clanwilliam

Class	Area (ha)	% of RM
Class 2	4888	12.6
Class 3	19750	51.1
Class 4	3147	8.1
Class 5	4565	11.8
Class 6	40	0.1
Class 7	22	0.1
Organic	2184	5.6
Water	1901	4.9
Unclassified	2173	5.6
Total	38669	

4.0 Analysis and Discussion:

4.1 Manure Disposal Sensitivity

There are certain characteristics of soil and landscape which may be unsuitable for manure disposal if no mitigation practices are carried out. Areas with coarse textured soils, high or severe risk of erosion, wetlands or intermittent water bodies, may pose problems for surface or ground water contamination from manure. These areas need a more detailed on-site evaluation so recommendations can be made for manure disposal methods to reduce the potential for nutrient contamination of surface water and groundwater from manure. For example, in areas with high or severe risk for erosion, a reduction of application rates and maintaining adequate residue cover is required. [Map 11](#) shows areas where increased scrutiny is necessary before manure is applied. This map is not meant as a restriction to manure disposal, only to illustrate areas which could have sensitivity for manure disposal. With the appropriate manure disposal method, application rate, farming practices etc, the potential for nutrient contamination of surface water and groundwater can be greatly reduced or eliminated.

4.2 Municipal By-Laws

Zoning and by-laws are tools used by the municipality to control and direct development of livestock industry to the betterment of the community as a whole. The RM of Clanwilliam has created several Recreation and Residential Zones near Otter, Kerr and Dirt Lake as well as near the Town of Erickson ([Map 12](#)). As well, the RM has created its own bylaws regarding minimum distance new or expanding livestock operations and manure storage facilities can be located from zoned areas and rural residences. A summary of the setback requirements for the RM of Clanwilliam is found in Table 7.

Provincial regulations also affect the development and operation of livestock operations. Confined livestock areas that are greater than 10 animal units must be located at least 100 m from any surface watercourse or water body. As well, manure storage facilities must be located at least 100 m from any surface watercourse, sinkhole, spring or well.

Table 7: By-laws of the RM of Clanwilliam

Animal Unit Range	Setback of livestock operations and lagoons from:		
	waterways & water	rural dwellings	residential/recreational
5-75	328 ft	600 ft	600 ft
76-100	328 ft	1/4 mile	1/2 mile
101-150	660 ft	1/4 mile	1/2 mile
151-200	660 ft	1/2 mile	1/2 mile
201--	660 ft	1/2 mile	1 mile

* AU (animal unit) range according to municipal by-laws

Maps 13-17 show the area available for siting new or expanding livestock operations according to the AU (animal unit) range. Rural dwellings and residential and recreational areas in the municipality are buffered according to the setback requirements stipulated in the by-laws (Table 7). Also shown in these maps are the 100 m (328 ft) setbacks from water bodies and water ways, as required by provincial regulations. No confined livestock area or manure storage facility can be located within this zone. For livestock operations producing over 100 AU, the municipality has increased the setback to 200 m (660 ft) from water bodies and water ways. Table 8 summarizes the amount of land available for expansion in hectares and percentage of the RM land base for the various animal unit ranges. The amount of land available is calculated using only land classified as annual crop land, forages or grassland.

Map 13 illustrates the area in which new or expanding livestock operations 5-75 AU in size could be located. Approximately 16,802 ha (or 43% of the RM) is available for new or expanding livestock operations of this size (Table 8).

Map 14 shows the areas in which new or expanding livestock operations 76-100AU in size can be located. For this animal unit range setback distance from rural dwelling has been increased. The total available area for operations of this size is 12,662 ha or 33% of the RM (Table 8).

In Map 15, for new or expanding livestock operations 101-150 AU, the setback distances from rural dwellings and residential and recreational areas remain the same but the buffered areas around permanent water courses and water bodies is increased to 660 ft. This reduces the total area available by almost another 2,000 ha, leaving only 28% of the RM available (Table 8).

In Map 16, the areas in which new or expanding livestock operations 151-200 AU in size cannot be located are shown. The area available for livestock operations of this size is reduced to only 4,989 ha or 13% of the RM (Table 8).

For operations greater than 200 AU (Map 17), in which setbacks from zoned areas is doubled to one mile, there is 4,655 ha (12%) available in the RM for development (Table 8).

Table 8: Total area available for new or expanding livestock operations (according to municipal by-laws and land use maps).**

AU Range*	Available Area (ha)**	% of RM
5-75	16802	43%
76-100	12662	33%
101-150	10669	28%
151-200	4989	13%
200-	4655	12%

*AU range according to municipal by-laws

** Available area for new or expanding livestock operations was calculated using only annual crop land, forages or grassland as classified from satellite imagery (1993).

5.0 Summary and Conclusions

With the growth of the livestock industry in Manitoba and the increase in concern for the environment, municipal councillors are under pressure to make informed decisions that address environmental, social and economic issues. By having information on land resources, current location of residences and livestock operations, and infrastructure information available in a useable form, councillors will be able to make wise decision regarding the livestock industry in their municipality.

Currently in the RM of Clanwilliam, there are 51 livestock operations, the majority of which raise beef cattle. The total animal units produced in the municipality by the livestock operations, at the time of this study was 4,918 AU.

Land available for manure disposal would be annual crop land, forages and grassland. In Clanwilliam, these lands makes up about 53% of the RM. However the total available area of these lands for application will be reduced by the buffered areas that are recommended to be kept around water courses, sinkholes, springs, wells and residential property lines during manure disposal. Manure disposal practices should also take into account the soil and landscape characteristics to eliminate the risk for manure contamination of surface waters and groundwater. Approximately 53% of the land in the municipality has a high to severe risk of water erosion. In these areas, management practices include limiting applications rates to soil test recommendations, applying manure by injection, incorporating manure as soon as possible, leaving adequate residue cover on the soil surface (50-65% cover) and selecting deep-rooted, high residue or high nitrogen user crops. Areas with sandy soils are highly permeable and have the potential for nitrate leaching into the groundwater. In the RM, approximately 6% of the land have a sandy texture. Recommended management practices in these areas include shallow injection, spring application, limiting rates to 65 kg of N/ha on annual crop land, and conducting deep soil sampling (to a depth of 4 ft) to monitor movement of nitrated and other nutrients.

In the RM of Clanwilliam, there is room for expansion of the livestock industry although the area available for siting livestock operations reduces with increasing size of proposed livestock operation. Municipal by-laws require minimum setback distances between new or expanding livestock operations and rural residences, communities and zoned areas. The available area remaining outside these buffered zones is further reduced by land use, with wetlands and treed areas considered unsuitable for siting of a livestock operation. In the RM of Clanwilliam, up to 43% of the municipality is available for smaller proposed livestock operations (less than 75 AU) while only 12% of the municipality is available for operations greater than 200 AU.

This report does not replace the need for site specific assessment of each operation but will assist in generalized land use planning for the whole RM. Potential new or expanding livestock operators can use the GIS maps to show the areas available for establishment. Once a site which satisfies the municipal by-laws and provincial regulations has been determined for a new or expanding livestock operation, a more detailed and on-site evaluation will still need to be carried out to determine if the chosen site is suitable for manure storage facility, and to determine the availability and suitability of land for manure disposal. This can be done through the technical review process that is available to the municipality. Through technical reviews, provincial and

federal specialists provide analysis and recommendations on site suitability for the proposed livestock operation.

5.1 Future direction:

Using GIS as a tool for displaying, integrating and interpretation of information has immediate value for the RM of Clanwilliam in planning for livestock operations. An improved ability to bring information together in an easily understood format not only assists in decision making, but will also facilitate public input into decisions through discussions generated when collecting information, promoting the sustainable development of agriculture and livestock expansion in Clanwilliam. The RM may also be able to use GIS in their day to day operations (road maintenance, drainage, etc) and when planning for future development, be it agricultural or industry.

Information and data obtained in this study will remain in the hands of the RM of Blanchard. Upgrading data will be the responsibility of the municipality. Analysis can be provided by groups with technical expertise such as consulting companies or government agencies (such as PFRA).

6.0 Acknowledgments

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7.0 Data Sources

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Livestock operations, Residence, Business, Recreational and Urban areas, Municipal By-laws: RM of Clanwilliam, Erickson, Manitoba

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