Agricultural Practices in the Shell River Watershed

Agricultureand Agri-FoodCanada
PrairieFarmRehabilitation Administration
Agricultureet AgroalimentaireCanada
Administrationdurétablissement agricoledesPrairies
KAP
Canada

Acknowledgements

Thisproject wasinitiatedunder an agreementbetweenKeystoneAgriculturalProducersandthe PrairieFarmRehabilitationAdministrationtodevelopanddeliver decision supportsystems for sustainableagricultural resourcedevelopment planningtomunicipalgovernmentsinManitoba.

Financial and technicalsupportforthe projectwasprovidedbyWesternEconomic Diversification,KeystoneAgricultural Producers,PrairieFarmRehabilitationAdministration, Rural MunicipalityofShellRiverandtheShellRiverTechnicalAdvisoryGroup.

Thisreport provides theRuralMunicipalityofShellRiverandtheShellRiverTechnical AdvisoryGroup withvaluable tools andknowledgethatwillassisttheminmakinginformed decisions regarding sustainableagricultural and ruraldevelopment,protectingthewater and soil resource.

Thereport waspreparedby:
JamieHewitt,MelvinKaufman,andJeffThiele.

Assistancewasprovidedby:
MavisYoung.

2001

PFRA ARAP
PrairieFarmRehabilitation Administration
Administrationdurétablissementagricole desPrairies

Western Economic Diversification Canada
Canada

KAP

RMof Shell River

Abstract

Water quality has been one of the most important topics on the prairie landscape for the last ten years. As a results of this, a technical advisory committee has been formed around the Shell River watershed in western Manitoba. The Shell River Watershed is relatively small, draining around 200,100 hectares (495,000 acres) of land. The headwaters start in the Duck Mountains and drains land from the RM's of Park North, Shell River, Hillsburg and Shellmouth-Boulton. The RM of Shell River, along with the technical advisory committee (TAC) and the other rural municipalities, wish to accurately map out the existing agricultural practices in the watershed and have an analysis of the soils and landuse data to help identify future sites for demonstration projects to promote best management practices and mitigate some agricultural effects on the Shell River.

Geographical Information Systems (GIS) is a tool that was used in the development of this project. Of the 440 dwellings in the watershed, 163 are actively farming, the majority of which are small scale mixed farms, with cattle. There were 20 livestock operations found within approximately 120 meters of the Shell River, or a waterway draining directly into the Shell River, four of which are over 100 animal units (au). It was also found that less than 9% of the soils in the watershed appears to be "at risk" of eroding. Of the soils "at risk" to erosion, there are 17 sites found along the Shell River which should be given priority for future projects promoting soil and crop management to reduce erosion and help limit the potential impact of agriculture on the Shell River.

Future steps in this project will include expanding on the existing data contained in this report by both the Shell River TAC and the RM's of Shell River and Shellmouth-Boulton. The Shell River TAC will need to expand the dataset to include field level investigations, site specific information, and water quality data. Once all of this new data has been gathered and incorporated into the decision making process, the first five initial priority areas will be identified in the Shell River watershed and demonstration projects will be implemented. The RM's of Shell River and Shellmouth-Boulton will also be expanding on this dataset to assist them in the development of a landuse planning tool for their respective RM's. This will give the RM's the ability to involve multiple levels of data in the decision making involved with siting new livestock operations, and assessing their current by-laws pertaining to siting requirements of agricultural operations.

Table of Contents

List of Tables

List of Maps

1.0 Introduction

Water quality on the prairie landscape has become one of the most important issues in the past ten years. Sporadic outbreaks of bacteria and protozoa (such as e-coli and giardia) have heightened public awareness and concern for water quality on the prairies and across Canada.

Recently, a technical advisory committee (TAC) has been formed around the Shell River Watershed to address some of the issues related to water quality. The watershed extends from the Duck Mountains, south to the Lake of the Prairies (Assiniboine River). It incorporates land from the RM's of Park North, Shell River, Hillsburg, and Shellmouth-Boulton and drains an area of 200,100 hectares (495,000 acres). The TAC recognizes that some agricultural practices can have an effect on the water quality in the watershed and wishes to identify sites for demonstration projects on priority sites. The sites will reflect best management practices for agriculture and mitigate potential negative effects of agricultural practices on the Shell River.

Through consultation with RM's and the technical advisory committee, the collection of rural residential and farm information within the watershed was identified as necessary to assist in narrowing the focus and identification of potential demonstration sites and promote sustainable agriculture and best management practices. The RM's of Shell River and Shellmouth-Boulton are interested in the development of a tool for municipal landuse planning and future development of bylaws pertaining to the siting of intensive livestock operations.

Geographic Information Systems (GIS) is a relatively new tool, that will assist the project by providing information to local decision makers (RM's and land owners) in a map format, with some analysis that can identify areas for projects or development. GIS allows users to spatially display information and create maps in an accurate and timely fashion. It serves as a resource management tool, as well as an educational tool, helping to inform the public as to the scope of the Shell River project.

2.0 Project Description and Objectives

The main objective of this project is to gather information in the Shell River watershed. This includes an analysis of the existing landuse practices and soils information for the watershed, as well as identifying locations of residences and identifying the type of agricultural operations that exist in the watershed. This will serve as the basis of data to help identify potential locations for future sustainable agricultural projects. After this preliminary analysis using GIS, the data will be built upon further by the TAC and will include water quality sampling, ground-truthing, and aerial surveys. Lastly, the data will be expanded on in the RM's of Shell River and Shellmouth-Boulton to serve as a siting tool for future intensive livestock operations and landuse planning.

The deliverables at the conclusion of the project will include:

i) a methodology that supports resource based decision making by local governments and the Shell River Technical Advisory Board on focusing efforts in sustainable agricultural projects in sensitive areas.

ii) demonstrated capacity among participating local governments to utilize advanced decision making tools on their decision making

iii) reports for each participating local government that includes hard copy (tabular and map form) results of analysis

iv) digital products and data for continued analysis by the Shell River Technical Advisory Board and the Rural Municipalities of Shell River and Shellmouth-Boulton.

3.0 Methodology

3.1 Determine the scope of the project for the Shell River watershed

Through discussions with the Technical Advisory Board (TAC) and the RM's of Hillsburg, Park North, Shell River and Shellmouth-Boulton the scope of the project was outlined. The TAC decided that to make informed decisions and recommendations, the general locations of rural residences and farm information (such as locations of livestock over-winter feedlot and barn sites) in relation to the Shell River was needed. Combining this data with the landuse and soils data will give the TAC and RM's an overall picture of existing agricultural practices in the watershed and a basis upon which to identify potential sites for demonstration projects.

3.2 Data Collection

Basemap features

The basemap serves as the foundations upon which all other data will be gathered and corrected to. This information includes the watershed boundary, streams, lakes, and infrastructure. Two sources of basemap features were used in this project, the National Topographic Survey (NTS) data, and the provincial ortho-photos. The NTS data served as the backdrop for the watershed's water bodies, water courses, and roads. The ortho-photos were used to pick out residences and livestock operation points.

Residence and Livestock Operation location

An essential component of the data includes the location of rural residences and livestock operations. Data was collected in consultation with RM councillors, and reflects the knowledge base of the councillors. The location of residences and livestock operations is useful to help narrow the focus of potential demonstration sites, as it provides information on the types agricultural operations and practices in the watershed and locations of residences in relation to the Shell River and its tributaries.

Landuse

The way land is presently being utilized offers us a glimpse into some of the agricultural practices of the area. Land use information is derived from satellite imagery obtained from RadarSat International in 1994 which has a resolution of 30 m. The imagery was classified by Manitoba Remote Sensing and grouped into seven classes: Annual Crop Land, Forages, Grasslands, Trees, Water, Wetlands, and Urban and Transportation.

Soils

The soil database is important for making decisions about agricultural capability, risk of erosion, and the suitability for many uses including agriculture, industrial, construction, and recreational. Soils information, at a scale of 1:126,720 based on the Reconnaissance Soil Survey of Grandview, report no. 9 (1959), was acquired from the Land Resource Unit of Agriculture and Agri-Food Canada, and contains information about soil texture, drainage, permeability and many other characteristics and interpretations.

4.0 Analysis and Discussion

Watershed and General Hydrology

The Shell River watershed is a fairly small watershed, confined between two larger watersheds, the Assiniboine River Watershed to the west and the Valley River Watershed to the east. The head waters of the Shell River start in the Duck Mountains and terminates in the south end of the Lake of the Prairies in Aessissippi Provincial Park (Map 1). It drains an area of 200,100 hectares (495,000 acres), half of which is in the Duck Mountain Provincial Forest (Table 1). Most of the Shell River's tributaries are smaller creeks and streams. The Bear Creek, at the southern end of the watershed, is the largest tributary draining agricultural lands.

Table 1: Breakdown of the Shell River watershed by area

Rural Municipality	Land Base of Watershed		
	Hectares	Acres	%
Duck Mountains	101,174	250,001	50.6
Hillsburg	27,654	68,333	13.8
Park North	21,351	52,758	10.7
Shell River	20,788	51,367	10.4
Shellmouth-Boulton	29,128	71,975	14.6
Total	200,095	494,434	

Residence and Farm Information

As illustrated on Map 2, there are a total of 440 single family dwellings distributed fairly evenly throughout the Shell River Watershed, except for the area within the Duck Mountain Provincial Forest, where no residences are found. Of the 440 dwellings, 163 (37%) are active farm operations, and 205 (47%) are rural dwellings (Table 2). The village of Merridale and the towns of Inglis and San Clara are also located in the watershed, with the town of Roblin located on the edge of the watershed.

Table 2: A breakdown by RM of residence types in the Shell River Watershed

Residence	Rural Municipality				Totals
	Park North	Shell River	Shellmth- Bltn	Hillsburg	
Abandoned	7	10	2	25	**44**
Farm Dwelling	24	34	59	46	**163**
Mobile Home	1	0	2	1	**4**
Other	2	0	2	5	**9**
Seasonal	3	0	2	0	**5**
Rural Dwelling	53	62	57	33	**205**
No Information	0	0	0	10	10
Totals	**90**	**106**	**124**	**120**	**440**

Note: Other refers to cemeteries, institutional, and commercial locations.

Of the 163 farm operations, 140 raise livestock of some type, most of which (87%) are beef cattle (Map 3, Table 3). The majority of livestock farms in the watershed are small in size and scale, with only 38 (27%) over the 100 animal unit size. An animal unit is defined in terms of nitrogen production in manure excreted by livestock. The number of animals to excrete 73 kg of nitrogen in a 12 month period is the equivalent of 1 animal unit (Manitoba Agriculture and Food, 1998). Animal Units show the relative scale of manure being produced by livestock in the watershed. The average livestock operation in the watershed is 95.8 animal units, which is equivalent to around 80 cow/calf pairs, or 120 feeder cattle per operation.

Table 3: Livestock operations found within the Shell River watershed

Primary Livestock Operations	Rural Municipality				Totals
	Park North	Shell River	Shellmth-Bltn	Hillsburg	
Beef	19	26	38	40	**123**
Dairy	0	1	0	0	**1**
Hogs	0	1	0	0	**1**
Horses	5	1	2	2	**10**
Poultry	0	0	0	1	**1**
Sheep	0	0	2	0	**2**
Other	0	0	1	1	**2**
Totals	**24**	**29**	**43**	**44**	**140**

Note: Other includes Elk and Buffalo operations

The close proximity of livestock operations and over-winter pens to water courses can negatively impact on water quality. This can occur when runoff waters flow off of over-winter pens and feedlots and directly into the Shell River or a tributary. The runoff water can carry with it soluble nutrients (eg. nitrates), bacteria, and sediments into the river/stream. This can result in the nutrient, bacteria, and sediment levels in the water chemistry to be artificially elevated. The results of this project found 20 livestock operations within 120 meters of a tributary of the Shell River, or the Shell River itself. Of the 20 operations located within 120 meters of a water course, four were found to be over 100 animal units in size (Table 4). These operations should be assessed further by ground-truthing to determine whether or not impacts on the Shell River are occurring and where needed help producers come up with solutions, if required. Solutions could include implementing retention ponds for run-off coming from feedlots and over-winter pens, or redirecting most of the run-off water around livestock pens.

Most of the livestock operations in the watershed are located more than 300 meters from the major tributaries and the Shell River. This suggests that most livestock operations found in the Shell River watershed would have little to no effect on the water quality of the Shell River. Current siting requirements for newly constructed manure storage areas (such as over-winter pens and feedlots) is to be located a minimum of 328 feet (100 meters) from a surface watercourse (Manitoba Agriculture and Food, 1998).

Table 4: Number of livestock operations (over-winter sites) located within 120 meters and 300 meters of the Shell River and its tributaries

Number of Operations	Buffer Zone from the Shell River and Tributaries	Animal Units
16	120 meters	10-100
4	120 meters	> 100
34	300 meters	10-100
11	300 meters	>100

Soils and Landuse

Approximately half of the watershed's soils are unclassified by the digital 1:126,720 soils data. The unclassified areas are located in the Duck Mountain, out of the prime agricultural zones (Map 4). The upper half of the watershed's classified soils consist mainly of luvisol, glacial till deposits (dominated by the Waitville series) laid out along the Shell River, with glacio-fluvial deposits at major bends in the river (dominated by the Leary series). The bottom half of the watershed consists mainly of orthic dark gray and orthic black, moranial till soils (dominated by the Erickson and Newdale series). Most of the classified portion of the watershed is covered with fine loamy soils, most of which are classified as a severe risk for water erosion (Maps 4 and 5 and Tables 5 and 6). The Waitville, Erickson, and Newdale series are all loamy textured soils, while the Leary series is a sandy textured soil. The combination of the mostly loamy textured soils, with the largely sloped landscape of the Shell River valley, is the reason for the soils in the watershed having a severe risk of erosion, if not properly managed.

Table 5: Summary of surface textures in the Shell River Watershed

Surface Texture	Total Land (ha)	Land (%)
Clayey	4,577	2.3
Fine Loamy	67,410	33.7
Coarse Loamy	3,318	1.7
Sand	5,346	2.7
Organic Sand	10	<0.01
Organic	5,443	2.7
Water	2,261	1.1
Unclassified	102,209	51.1
Eroded Slopes	9,514	4.8

Table 6: Summary of water erosion risk of soils in the Shell River Watershed

Water Erosion Risk	Total Land (ha)	Land (%)
Negligible	11,126	5.6
Low	4,607	2.3
Moderate	2,511	1.3
High	11,061	5.5
Severe	66,312	33.1
Water	2,261	1.3
Unclassified	102,209	51.1

Note: Water erosion risk classes were determined using the universal soil loss equation (USLE) and reflect the erosion risk based on bare unprotected soil.

Landuse data shows that the head waters of the Shell River are dominated by forested areas as well as wetlands and smaller water bodies in the Duck Mountains (Map 6). South of the Duck Mountains, the Shell River watershed is predominantly under agricultural landuse practices such as annual cropland, forages and grassland pastures. Overall, 50% of the total watershed's land base is treed with an additional 17% of the watershed in permanent cover (Grasslands and Forages). Annual crop land only accounts for 14% of the total watershed area (Table 7).

Table 7: Summary of landuse in the Shell River Watershed

Land Use Cover	Total Land (ha)	Land (%)
Annual Crop Land	28,092	14.04
Forage	4,324	2.16
Grassland	31,789	15.89
Trees	106,780	53.37
Water	9,906	4.95
Wetlands	16,626	8.31
Unclassified Land	2,470	1.27

Although there is a high percentage of soils in the watershed with a severe risk of water erosion (33.14%, or 66,312 ha) as shown in Map 5, 75% (50,091 ha) of the soils at a severe risk of erosion are already under permanent cover and being managed to protect against soil erosion. The remaining 16,221 hectares of soil classified as a severe risk of erosion are presently under annual crop production, accounting for only 8.1% of the total watershed's soil and land base. Without proper crop and soil management of these "at risk" areas under annual crop production, the soils are at risk of eroding. Of the "at risk soils" comprising 8.1% of the Shell River watershed, there are 17 sites situated along the Shell River which constitutes 373 hectares (920 acres) and should be given priority for demonstration projects (Map 7 and Table 8). This is based on the fact that these sites are most likely to directly affect water quality on the Shell River through soil erosion. The 17 sites along the Shell River should be investigated further by ground-truthing and where necessary a soil and crop management plan should be developed in

conjunction with producers, that will promote best management practices such as buffer strips of grass and trees, minimum tillage practices, and possibly conversion to forages for permanent cover. This would limit soil erosion from agricultural fields and reduce impacts on the Shell River.

Table 8: Summary of soils rated as "severe risk" of erosion and not under permanent cover

Priority Areas	Total Land (ha)	Land (%)
High Priority	373	0.2
Lower Priority	15,848	7.9

Note: High Priority was given to the soils along the Shell River

Analysis of the livestock information and the landuse information reveals that there is approximately 13,500 animal units in total found in the Shell River watershed. This translates to an estimated 985,500 kg (2.169 million pounds) of nitrogen being excreted in the manure per year. Spreading the manure at a rate of 90 kg of total N per hectare (recommended spread rate for annual cropland with medium to heavy surface texture soils, Manitoba Agriculture and Food, 1998), would require 10,950 hectares of annual crop land. Assuming that all of the spread fields are located within the watershed, there is more than an adequate amount of land base within the watershed to support the spreading of all the manure in a sustainable manner, as there is a total of 28,092 hectares of annual crop land in the watershed. There is also an additional 36,000 ha of forage and grasslands in the watershed that could be available for manure application (Table 7).

5.0 Summary and Conclusions

Of the 440 dwellings in the watershed, 163 of them are actively farming today. The majority of these farms are mixed farms with grains and small herds of livestock, most of which are cattle. With only 20 livestock operations found in close proximity to the Shell River and its tributaries, the impact from overwinter sites is expected to be limited. Further assessment at the field level is needed to determine if any of the 20 operations in close proximity to the Shell River and tributaries are affecting the water quality through runoff problems. Where these problems exist solutions should be identified with the landowner and implemented. Likewise, there may be minor influences on water quality from grain farming, as 17 sites along the Shell River are not under permanent cover and are at a severe risk of erosion. With proper cropping and soil management practices these sites can also be mitigated to have little impact on the Shell River's water quality and protect against soil erosion. It is important to note that although the data indicates some areas of potential impacts, the data cannot be used to assess the extent of the impacts. This can only be done by combining the existing data with field level inspections and working with the producers in the watershed.

The collection and analysis of the data demonstrates how GIS can be used to initially narrow the focus and efforts in identifying priority areas for the Shell River TAC to consider in setting up future project sites. The information contained in this report will be passed on to the Shell River TAC, as well as, to all of the rural municipalities participating in the project. As a follow up to this work, the Shell River TAC will be assessing and ground-truthing sites and locations to determine future projects in protecting water quality and promoting agricultural best management practices in the watershed.

5.1 Future Steps

The next step in this project is to expand the existing data and analysis with water quality sampling results, field level inspections and aerial flights. This will allow the Shell River TAC to further narrow the focus of potential demonstration sites for project work in summer 2002. It will also help to identify other areas of concern in the watershed, outside of agricultural issues. This could include fish barrier structures, logging activities, and any others identified in the investigations. After accomplishing this task, the TAC will need to identify 5 priority sites for demonstration projects from the list of potential sites and concerns. Working with all stakeholders involved in each of these 5 demonstration sites (landowners, etc.) the development of a remedial project will be decided on and implemented during the summer of 2002.

There is also the need to expand the existing data contained within this report for the RM's of Shell River and Shellmouth-Boulton, in order to develop a landuse planning tool for each RM. This will allow the two RM's the ability to identify areas potentially suitable for agricultural expansions and to investigate revisions and development of RM by-laws pertaining to agricultural livestock operation expansions.

6.0 Data Sources

Animal Unit Information: Farm Practices Guidelines for Hog Producers in Manitoba, Manitoba Agriculture and Food, 1998.

Land Use: Satellite imagery obtained from RSI. Landsat TM (30 m pixel resolution) 1994. Classification from the Manitoba Remote Sensing Centre. Winnipeg, Manitoba.

Livestock, and Residence, information: RM's of Hillsburg, Park North, Shell River, and Shellmouth-Boulton, Manitoba.

Orthophotos: Linnet Geomatics International Inc., Winnipeg, Manitoba. 1:60,000 (1994 for Park North and the northern half of Shell River and Hillsburg/ 1995 for southern Shell River and Hillsburg and Shellmouth-Boulton).

Soils: Ehrlich W.A., Pratt L.E. and Leclaire F.P. 1959. Reconnaissance Soil Survey of Grandview Map Sheet Area. Report No. 9 1:126,720. Canada-Manitoba Soil Survey. Winnipeg, Manitoba.

Topographic Data: Geomatics Canada, National Topographic Survey sheets (62N02, 62N03, 62N04, 62N05, 62N06, 62N07, 62N10, 62N11, 62N12, and 62K14) 1:50,000. Sherbrooke, Quebec.

Watershed Boundary: PFRA Gross Watershed Boundaries (Version 1.0) 1:50,000. PFRA, Regina, Saskatchewan. July 1997.