Agricultural Land Use and Management in the Westlake Watershed

Submitted by

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and

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A. Executive Summary

The Westlake watershed is approximately 121,100 ha in size and is located in the Parkland Region of Manitoba, northwest of Winnipeg. An Integrated Watershed Management Plan (IWMP) is being developed for this watershed by the Alonsa Conservation District (ACD) in collaboration with Manitoba Water Stewardship and numerous other stakeholders.

Understanding changes in agricultural land use is essential for the development of the integrated watershed management plan. The overall objective of this report is to examine risks to key watershed resources by analyzing the physical characteristics of the landscape with consideration for how specific agricultural activities may be influencing them. This analysis also assists in identifying where soil and water management efforts could be directed to help address priority issues or identified risks within the watershed.

An assessment at a watershed scale provides a snapshot in time of the various agricultural activities in the Westlake Watershed. Census of Agriculture data, temporal in nature, illustrates influences from external factors like weather, government programs and policies, market drivers, and technology to land use and land management decisions and the community response to those interactions. Such events, with an examination of a watershed's physical resource characteristics and risks, assist to develop an understanding of potential impacts on the basin's water quality, and identify opportunities for future sustainable land use strategies. This is particularly important to the Westlake IWMP where public consultation identified eight key categories of concern: Surface Water Quantity, Drinking Water Quality, Surface Water Quality, Soil Salinity/Loss/Erosion, Fisheries, and Development Impacts.

Ag-Profiling examines variables from 2006 Census of Agriculture database depicted over three subwatershed regions, including farm area, type of farm, cropping practices, tillage practices, fertilizer and pesticide use, financial activity, and livestock numbers. The same variables from the 2006 Census of Agriculture data were used to examine 5-year changes in agricultural activities to the study area. Land cover data, derived from 1993, 2002, and 2006 satellite imagery, was analyzed to document temporal changes to land cover. Using soils data and modeling, environmental indicators were developed for Agricultural Capability, Wind and Water Erosion Risks, Soil Drainage, and Slope characteristics. These were examined in combination with the annual cropland identified in the 2006 land cover. A review of recent federal and provincial policies and programs was conducted to assess their impact on agricultural land use and management.

Results reveal the Westlake IWMP study area as a diverse agricultural landscape. Slight differences are evident from the northern part of the watershed compared to the southern areas with respect to soils types, land use, cropping practices, crop types, and livestock types and sizes of livestock operation. From 2001 to 2006, there were fewer but larger farms located in the study area, with a trend towards more modest, sustainable agriculture production. Livestock production is important throughout the watershed, while crop production tends to be dominating in the north and eastern portion. The watershed has an increasing reliance on commercial fertilizers and pesticides, with a larger proportion of cropland being treated to crop inputs. Compared to five years ago, there has been an overall increase in annual cropland, forages, and treed/forested areas (suggesting encroachment) and decreases noted in wetlands, and grasslands. The majority of farms employ conventional tillage practices, however, over the last five years, there has been an increase in the amount of farms practicing no-till and conservation tillage practices.

Analysis of land cover over a 13-year period corresponds with the Census data, particularly the conversion of wetlands and the increases in annual cropland. Analysis of soils under annual

cropland showed trends of increases to the amount of annual cropland on soils that are class 4 or lower. Areas were identified and mapped within the watershed where the combination of annual cropping and landscape risk factors such as wind erosion, agricultural capability, drainage, and slope indicate special management of these lands may be warranted. An examination of land cover data was undertaken to identify changes in land cover with respect to grasslands, wetlands, and annual cropland, and how they relate to the issues of flooding and natural areas. Due to data limitations, all geographic analyses using land cover and soils data require further verification for accuracy assessment.

The interest and willingness of producers in the watershed in addressing environmental issues was demonstrated by their participation under two key environmental programs in the Agricultural Policy Framework (APF); the Environmental Farm Plan (EFP) Program and the Canada-Manitoba Farm Stewardship Program (CMFSP). There were average levels of uptake in both programs, as 106 Beneficial Management Practice (BMP) projects were completed with financial and technical assistance through the CMFSP. Over 51% were non-point source livestock related BMP projects and 20% were non-point source crop related BMPs.

Recommendations from the analysis to address drinking water quality and source water protection include considerations for marginal land management options. These include adoption of BMPs where annual cropland is located on soils with agricultural capability of Class 4 or lower, protection and management of environmentally sensitive lands, and private source water assessments. With respect to flooding and drainage, recommendations include water supply assessment and surface water management assessment study conducted on the entire watershed to understand where gains could be made for flood protection. In addition, the promotion of point specific BMPs (riparian buffer design, riffle structures/ headwater storage options, erosion control structures) and landscape type BMPs (sustainable woodlot management options and sustainable rotational grazing) need to be considered on a targeted watershed perspective. An examination of the role of agro-forestry to reduce flood frequency could be carried out to explore options for maintaining particular lands that provide environmental benefits by reducing impacts of drainage and flooding. Recommendations for surface water quality include sustainable land management, water erosion mitigation practices such as grassed waterways, buffer establishment, and land conversion to forages, as well as promoting BMPs that will reduce nutrient transport to waterbodies. Analysis of the erosion issue revealed the focus should be on wind erosion and that recommendations included use of cover crops and residue management to annual cropland areas. Potential indicators were also identified for each recommendation presented to allow the IWMP process to evaluate progress related to addressing issues in the future.

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C. Preface

In 2009, the Alonsa Conservation District (ACD) was designated as the Watershed Planning Authority to develop a comprehensive integrated watershed plan (IWMP) for the Westlake Study Area. A Project Management Team (PMT) was formed to guide the watershed planning process. A formal request was made on behalf of the PMT and Manitoba Water Stewardship to Agriculture and Agri-Food Canada - Agri Environment Services Branch (AESB) and Manitoba Agriculture Food and Rural Initiatives (MAFRI) to provide input into the IWMP process. Agriculture is a shared responsibility between the federal and provincial governments. As such, AESB and MAFRI are partnering to provide professional and technical guidance to the IWMP process on agricultural issues and agri–environmental priorities.

This report focuses on information related to agricultural activities and land resources in the watershed. It is important to note that in addition to agriculture, there are other industries, sectors, and users of the watershed's resources that also have an impact on the watershed. As there are scale and accuracy limitations associated with the data, it should be noted that the information contained within this report does not replace the need for site-specific analysis; rather, it serves as a guide for general planning purposes in the Westlake Study Area. More information on the data used in this document can be found within the Appendices section of the report.

D. Introduction

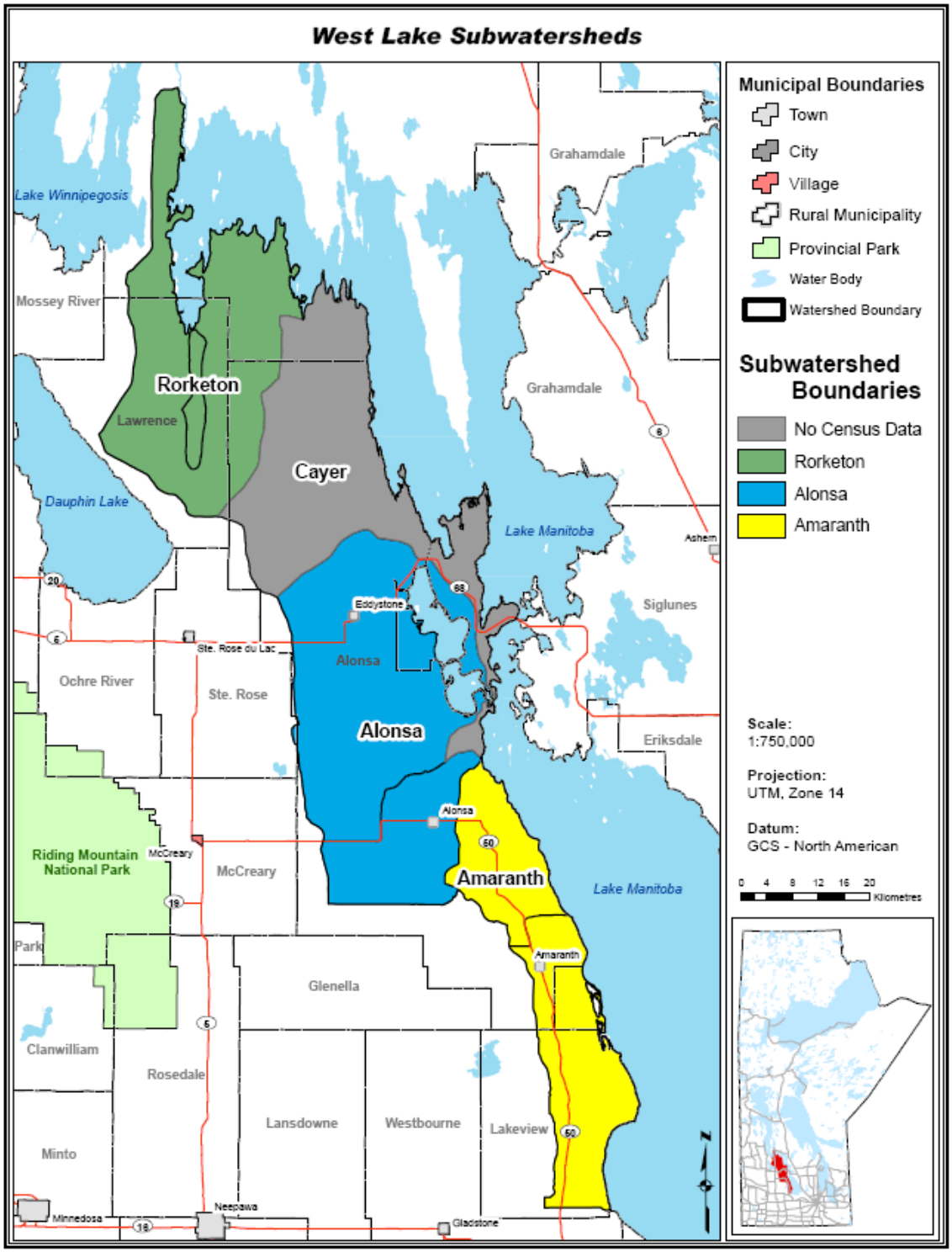
The Westlake Integrated Watershed Management Plan (IWMP) Area is defined by Manitoba Water Stewardship as a number of watersheds that make up the western shoreline of Lake Manitoba (***Figure 1***). The Westlake IWMP study area is approximately 407, 000 ha in size and along the area east of Lake Dauphin along a western shoreline of Lake Manitoba and Lake Winnipegosis. Some of the communities located within the study area include Toutes Aides, Eddystone, Alonsa, Amaranth, and Langruth. O-Chi-Chak-Ko-Sipi, Ebb and Flow, and Sandy Bay First Nations are all located within this IWMP study area.

Objective

Understanding the current state and trends in agricultural land use and practices along with landscape characteristics is essential for developing an integrated watershed management plan. Agricultural land use and associated land cover can influence watershed processes and impact issues like water quality and hydrological flow within the watershed. Knowledge of these factors contributes to developing sustainable land use strategies that will lead to a healthier and more ecologically functioning landscape. To better understand agricultural changes and impacts within the watershed, AESB and MAFRI partnered to analyze agricultural aspects, focusing on the major issues identified in the 2009 public consultations in support of the IWMP. Specifically, the document will examine the following in order to help guide watershed management:

- **"Near-Current" Agricultural Land Use and Management using the latest available Census of Agriculture data and satellite imagery.**
- **Five-year change in agricultural land use and management using 2001 and 2006 Census of Agriculture data and a time series of satellite imagery.**
- **Land cover data in combination with landscape risk factors pertaining to the soil and water resource.**
- **The impact of recent federal and provincial initiatives, policies and regulations impacting agricultural land management and land use planning activities in the watershed**.

Figure 1: Westlake Watershed Study Area and Subwatershed Groupings (used for the Census of Agriculture analysis)



E. Agricultural Land Use and Management

i. Current Agricultural Land Use of the Westlake IWMP Study Area

a) Agricultural Profile

Agricultural profiling refers to the characterization of agricultural production in a specified area or a region. The ability to use Census of Agriculture information collected from producers can provide a snapshot in time of the agricultural footprint on the landscape. This information can be portrayed either on a municipal or geographical boundary (like a watershed) and can provide value to understanding the influence and trends of the industry in the area.

Census of Agriculture data at a subwatershed scale has been obtained from Statistics Canada for the 2006 Census year. Further details on the method used to interpolate Statistics Canada's Census of Agriculture from a geographic boundary to a subwatershed boundary are provided in ***Appendix A***. For reporting purposes, numbers have been rounded to the nearest 5 for farm numbers, 10 for livestock and smaller area data, and 100 for poultry, financial data and for larger areas.

Due to some variances in the boundaries between the Manitoba subwatershed layer and the subwatershed boundaries for the Census data, only 75% of the IWMP study area can be accurately represented in the agricultural profile. Agricultural activities were analyzed for the Rorketon, Alonsa and Amaranth subwatersheds (***Figure 1***). The Rorketon Subwatershed refers to the northern part of the IWMP study area and drains north into Lake Manitoba. The Alonsa Subwatershed refers to the area draining into the Garrioch Creek, Lonely Lake and Ebb and Flow Lake. The Amaranth Subwatershed is the southern portion of the study area and drains directly into Lake Manitoba from the communities of Lakehead to Sliver Ridge (see ***Figure 1***). The Cayer River Subwatershed, which cannot be profiled, due to insufficient census data, is the area around the communities of Cayer and Reykjavik, and drains into the Crane River and Lake Manitoba. ***Table 1*** lists these subwatersheds with their respective sizes and proportion of the IWMP study area.

Table 1: Subwatershed Areas

Subwatershed name	Area (hectares)	Percent of Westlake IWMP study area
Rorketon	98,308	24%
Alonsa	130,897	32%
Amaranth	74,576	18%
Cayer*	192,507	25%
Westlake IWMP	407,288	

* Part of the Westlake IWMP area does not have sufficient Census of Agriculture data available due to the suppression of data to protect confidentiality.

Land Use and Land Management

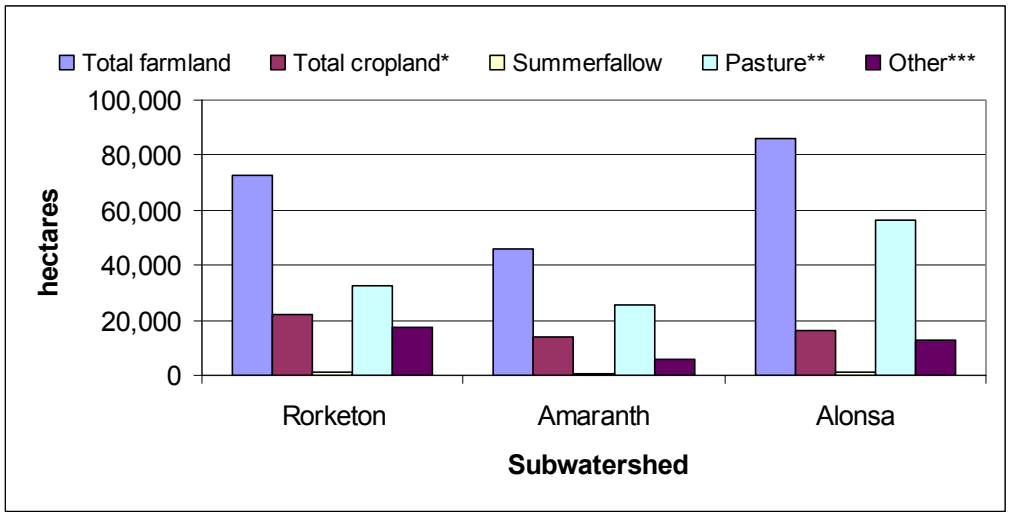
Rorketon Subwatershed:
In 2006, the Rorketon Subwatershed reported approximately 95 farms with 75% of the subwatershed area being used for farming. According to the 2006 Census of Agriculture data, over 15% of the farmland in the Rorketon Subwatershed was dedicated to annual crop production and 60% to pasture, alfalfa, hay and fodder crops. Cereals made up almost 29% of the cultivated land while almost 15% was seeded to oilseeds (mainly canola but some flax). Half of the cultivated land was in forages. Land management practices included over 55% of the cultivated land prepared with conservation or zero tillage, while the remaining area was prepared with conventional tillage practices. Beef production was the main livestock in the area, with almost 75 farm operations reporting over 8,100 beef cows, an average of over 210 cows per farm. Total cattle and calves in the area added up to almost 16,000 animals. Fifteen farms reported a total of 190 horses and ponies. Less than 5 farms reported poultry.

Amaranth Subwatershed:
In 2006, the Amaranth Subwatershed reported approximately 58 farms with 62% of the subwatershed area being used for farming. Twenty percent of the farmland in the Amaranth Subwatershed was dedicated to annual crop production, and almost 70% to pasture, alfalfa, and hay and fodder crops. Cereals made up 35% of the cultivated area, oilseeds (mainly canola) almost 15%, and forages 40%. Land management practices included almost 55% of the cultivated land prepared with conventional tillage practices, and the remaining area with conservation tillage or zero tillage practices. Beef production is the main livestock in the subwatershed, with 40 farm operations reporting almost 3,600 beef cows, an average of almost 90 cows per farm. Total cattle and calves reported in the area added up to almost 8,980 animals. Less than 15 farms reported a total of 125 horses and ponies. Less than 5 farms reported poultry.

Alonsa Subwatershed:
The Alonsa Subwatershed reported almost 105 farms with an area equivalent to over 65% of the subwatershed area being use for farming. In 2006, over 5% of the farmland in the Alonsa Subwatershed was dedicated to annual crop production, and almost 80% to pasture, alfalfa, hay and fodder crops. Cereals made up slightly more than 20% of the cultivated area, oilseeds (mainly canola) less than 5%, and forages 65%. Land management practices included almost 65% of the cultivated land prepared with conventional tillage practices, and the remaining area with conservation tillage or zero tillage practices. Beef production is the main livestock in the subwatershed, with over 80 farm operations reporting almost 8,000 beef cows, an average of 100 cows per farm. Total cattle and calves reported in the area added up to almost 19,060 animals. Over 25 farms reported a total of 250 horses and ponies. Less than 5 farms reported poultry or pigs.

When comparing the three subwatersheds, although Alonsa reported the largest area of the farmland, Rorketon reported the most cropland. Pasture land makes up more than half of the farmland in both Amaranth and Alonsa (***Figure 2***).

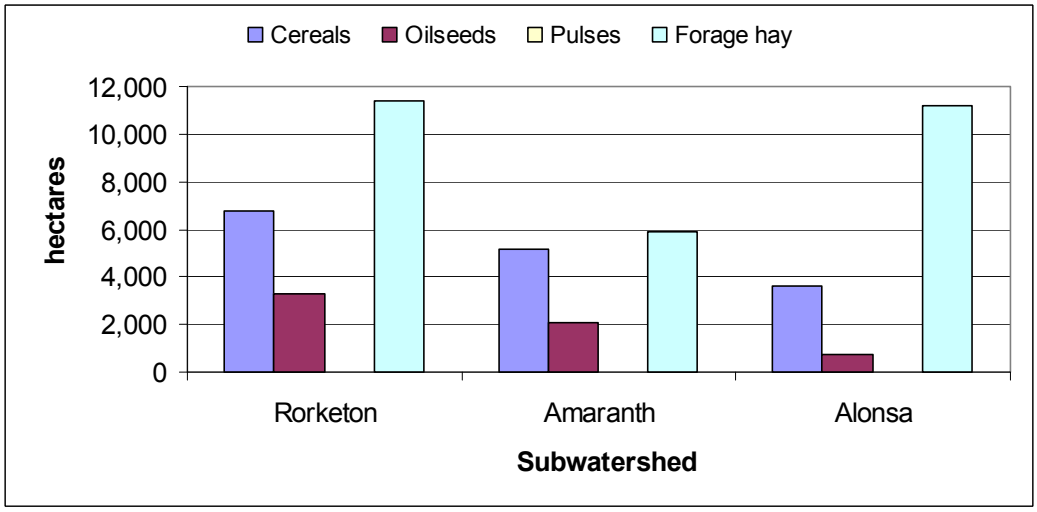
Figure 2: Distribution of Agricultural Land Use (2006 Census of Agriculture)



* Total cropland includes all field crops, vegetables, fruit and nuts and sod
** Pasture includes tame pasture and natural areas used for pasture
*** Other category includes all other land uses including farmyard, woodlots, Christmas trees, wetlands, etc.

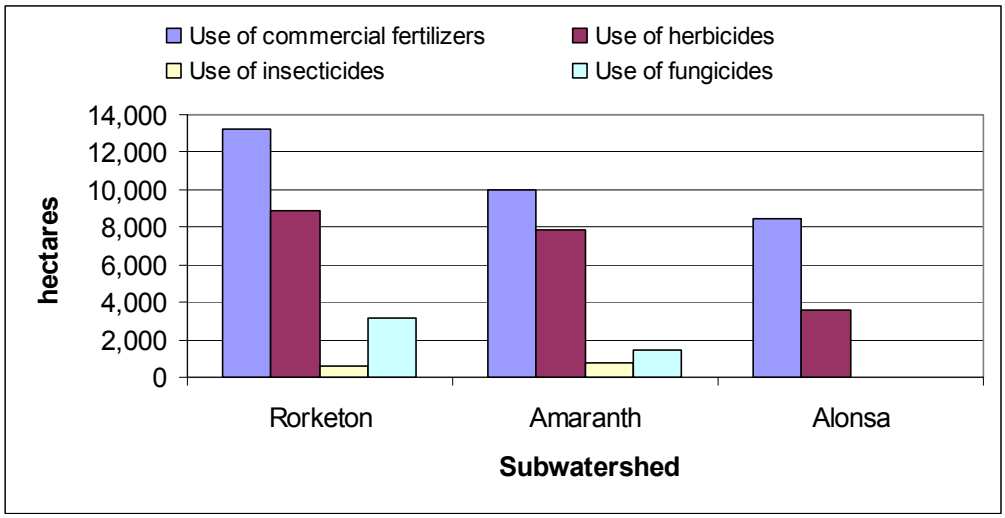
With respect to crops grown in 2006, over half of the cropland was dedicated to forage for hay production in the Rorketon and Alonsa Subwatersheds. Cereals and oilseeds (mainly canola) were grown in all three subwatershed, but in the Amaranth Subwatershed, they made up almost half of the total cropland while in the Alonsa Subwatershed, they were only grown on a quarter of the cropland (***Figure 3***).

Figure 3: Distribution of the main crop types grown in the Westlake Watershed (2006 Census of Agriculture)



As for crop inputs, cropland in Alonsa received, on average, less inputs than crops in the other subwatershed (***Figure 4***). Some fungicides and insecticides were applied in Rorketon and Amaranth.

Figure 4: Area treated to crop inputs in the 2005 crop year (2006 Census of Agriculture)



Conventional tillage tends to be the dominant tillage practice in Alonsa with fields prepared for seeding using tillage practices which incorporate most of the crop residue into the soil (***Figure 5***). In the Rorketon and Amaranth subwatersheds, conservation and zero tillage practices are more predominantly used.

Figure 5: Tillage practices in the Westlake Watershed (2006 Census of Agriculture)

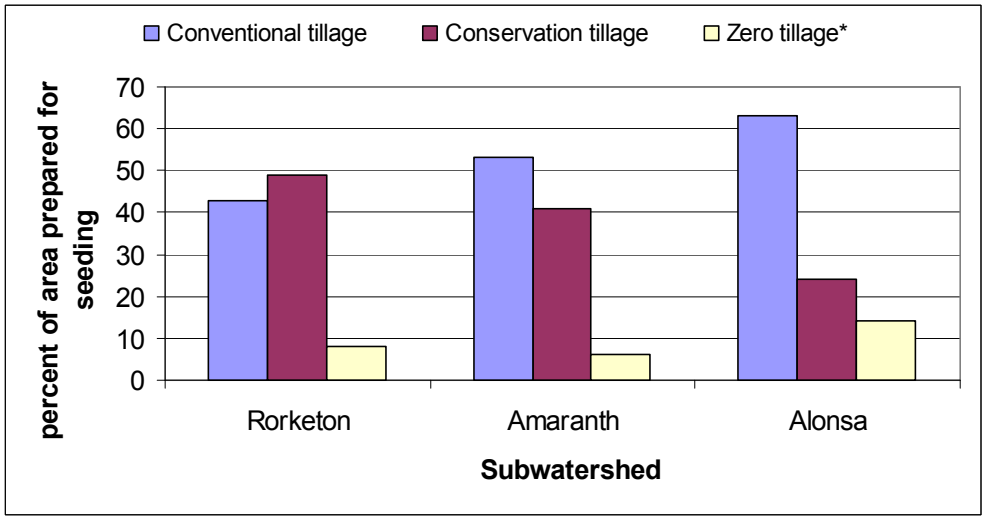
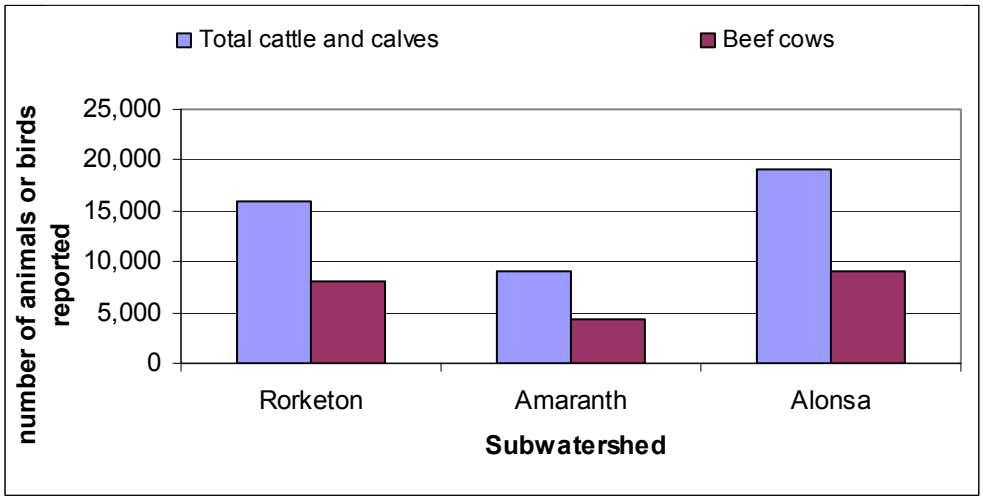


Figure 6 summarizes the livestock numbers in the Westlake Watershed. Livestock production is important in the watershed, with beef being the main livestock product raised in the watershed. For all three subwatersheds, beef cows made up approximately half of the total cattle and calves number, indicating that cow/calf operations dominate. The Alonsa Subwatershed reported the highest number of cattle and calves, while the Amarant Subwatershed is an area that is more diversified. Pigs and poultry are present, though numbers have been suppressed due to the small number of farms reporting.

Figure 6: Total livestock numbers in the Westlake Watershed (2006 Census of Agriculture)



Total Animal Units (AU) produced in the watershed (based on annual nitrogen production) has been estimated using Manitoba's AU coefficients and by making several assumptions (refer to ***Appendix B***). As represented in ***Table 2***, cattle and calves, consisting mainly of beef cattle, contributed the majority of animal units produced in each of the subwatersheds (over 95% in all subwatersheds). Since beef production consists of mainly cow/calf operations, manure nitrogen and phosphorous will be deposited on pastureland directly by the animals during the grazing season, and possibly accumulated in more concentrated areas during the winter season.

Table 2: Estimated annual animal units produced in the subwatersheds of Westlake* (according to the number of livestock reported on Census day, 2006)

Livestock Type	Animal Units (AU)			Total Animal Units
	Rorketon	Amaranth	Alonsa	
Total Cattle and Calves	10,349	5,773	11,808	27,929
Total Pigs	0	0	0	0
Total Poultry	0	0	0	0
Total Horses and Ponies	190	125	249	565
Other livestock - sheep, goats, bison, elk)	0	0	0	0
TOTAL AU*	10,539	5,898	12,057	28,494

* some livestock numbers have been suppressed to preserve confidentiality of the Census data and are not included in the calculations of total animal units.

Intensity of the livestock production can be determined by the average size of flocks and herds. In all subwatersheds, the average number of total cattle and calves and beef cows per farm is similar; with average of 110 beef cows per farm.

Farm Financial Characteristics

Rorketon Subwatershed:
In 2006, the Rorketon Subwatershed reported approximately 95 farms with 75% of the subwatershed area being used for farming. Generally, the average farm size was approximately 775 ha/farm (1,910 acres/farm) with an average capital investment of $840 per hectare of farmland (or almost $651,000/farm). Livestock-related expenses per hectare of farmland were over $15/ha and crop-related expenses were over $100/ha. Per farm, net cash income was estimated to be almost $7,750 and the sales to expense ratio was reported to be 1.08 (farm operations received $1.08 gross revenue for every $1 of agricultural expense). Local knowledge indicates that the significantly lower net income in this watershed is representative of true living conditions in this area and may also be attributed to off-farm jobs and could be the effects of BSE.

Amaranth Subwatershed:
In 2006, the Amaranth Subwatershed reported approximately 58 farms with 62% of the subwatershed area being used for farming. Generally, the average farm size was approximately 790 ha/farm (1,955 acres/farm) with an average capital investment of $930 per hectare of farmland (or almost $737,000/farm). Livestock-related expenses per hectare of farmland were almost $20/ha and crop-related expenses were almost $110/ha. Per farm, net cash income was estimated to be almost $18,000 and the sales to expense ratio was reported to be 1.17 (farm operations received $1.17 gross revenue for every $1 of agricultural expense).

Alonsa Subwatershed:
The Alonsa Subwatershed reported almost 105 farms with an area equivalent to over 65% of the subwatershed area being use for farming. Generally, the average farm size was around 835 ha/farm (2,060 acres/farm) and farms had an average capital investment of almost $655 per hectare (or over $545,500 per farm). Average livestock-related expenses per hectare of farmland almost $30/ ha farmland, while crop-related expenses were almost $70/ha. Net cash income was estimated to be almost $13,850 per farm and the sales to expense ratio was reported to be 1.17.

Farms in all three subwatersheds are similar in size, though they tend to be slightly larger in the Alonsa Subwatershed (***Figure 7***). A look at the farm financial activity shows that farms in Amaranth tended to have higher sales and expenses, as well as estimated profit per farm (***Figure 8***).

Figure 7: Total number of farms and average farm size in the Westlake Watershed (2006 Census of Agriculture)

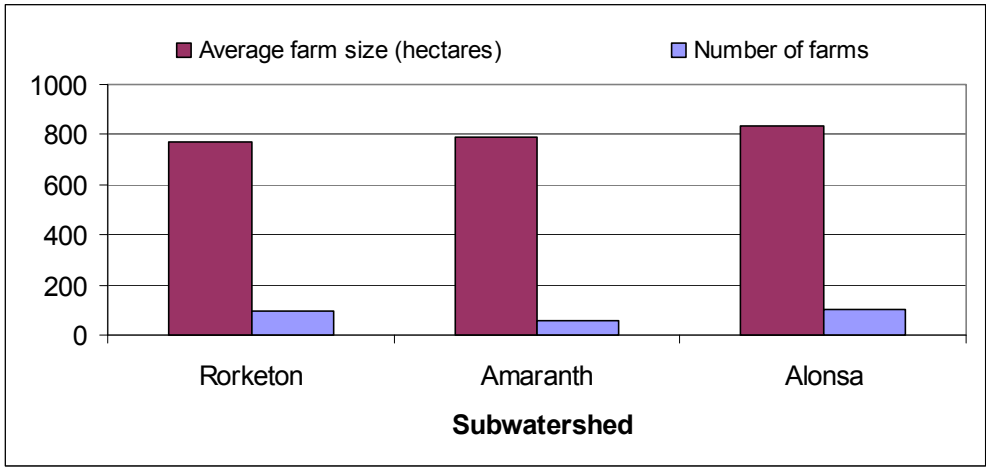
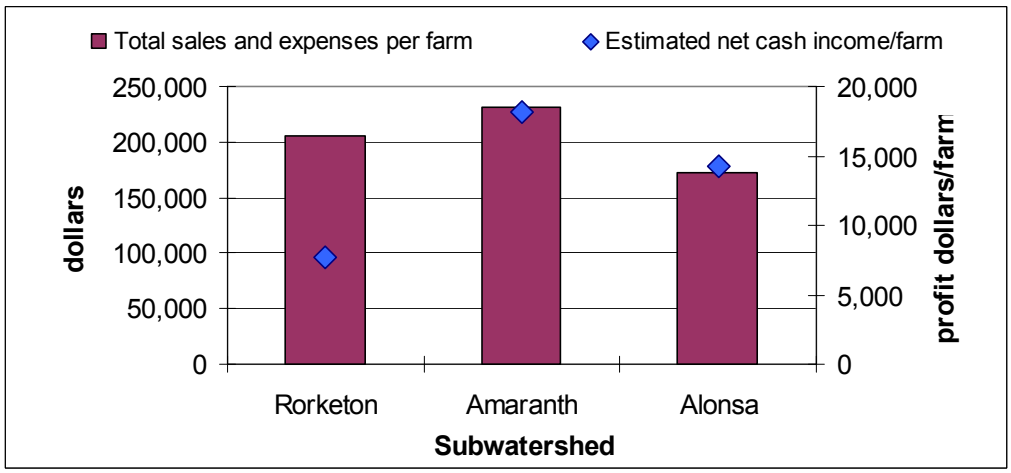
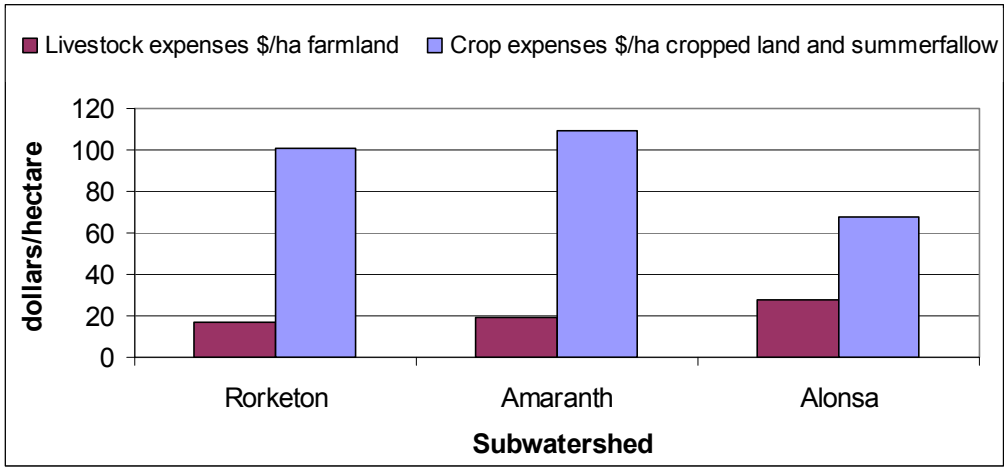


Figure 8: Summary of farm financial activity for the 2005 calendar year (2006 Census of Agriculture)



Livestock and crop-related expenses reported for the 2005 crop year have been determined on a per hectare basis. ***Figure 9*** shows that on average, farm operations in Alonsa had the highest livestock-related expenses per hectare of farmland. With respect to crop-related expenses, producers in Alonsa also reported the lowest expenses per hectare of cropped land and summerfallow. A closer look at the crop input costs shows that while farms in Rorketon spent more per hectare on fertilizer, farms in Alonsa had the highest costs of pesticides per hectare of applied chemical (***Table 3***).

Figure 9: Average livestock and crop-related expenses per hectare for the 2005 calendar year (2006 Census of Agriculture)



* Livestock-related expenses include total feed, supplements, and hay purchases, livestock and poultry purchases, veterinary services, drugs, semen, breeding feeds, etc
** Crop-related expenses include purchases of fertilizer, lime, herbicides, insecticides, fungicides, and seed and plant (excluding materials purchased for resale)

Table 3: Average dollars per hectare spent on fertilizer and pesticides in the 2005 calendar year (2006 Census of Agriculture)

Subwatershed name	Dollars spent on fertilizer per hectare applied	Dollars spent on pesticides per hectare applied
Rorketon	$91	$57
Amaranth	$86	$46
Alonsa	$82	$66

2006 Agriculture Profile Summary

- **Approximately two thirds of the land in the watershed is owned and managed by farm operations.**
- **Agriculture activities tend to be very similar throughout the watershed with some differences seen between the three subwatersheds.**
- **Beef is the main livestock production in the watershed. In all three subwatersheds, land use for beef production dominates (pastures and seeded forage for hay) but in the Alonsa Subwatershed, it makes up a greater portion of the farmland than in the other two subwatersheds (80%). With respect to beef herds, on average, farms report very similar number of cattle and calves. Farms in Alonsa also spend more on livestock-related expenses per hectare of farmland.**
- **Crop production is important in the watershed with annual crops making up a greater portion of the cropland in Amaranth where fertilizer and herbicides used on approximately 70% and 55% of the cropped land respectively. In Rorketon, these inputs are used on a smaller percentage of the cropped land. In Alonsa, about half of the cropland was fertilized with commercial fertilizer, and less than a quarter had herbicide applications.**
- **In Rorketon, conservation and zero tillage practices are reported on almost 55% of the annually cropped lands. In Alonsa and Amaranth, conventional tillage practices are predominately used.**
- **On average, farms in Amaranth have the highest total income and expenses, as well as the highest average net cash income per farm when compared to farms in the other two subwatersheds.**

b) 2006 Land Cover Summary

Land cover data was derived from 30 metre resolution LANDSAT Thematic Mapper satellite imagery taken on August 22, 2006. The land cover data provides information on the spatial extent of general types of land cover within a given area at that point in time. Further details on the land cover data, and the constraints associated with this data are provided in ***Appendix C***.

- **Annual Cropland accounts for approximately 10% of the land use in the Westlake watershed.**
- **In 2006, over half (62,667 ha) of the land was classified as trees, water, or wetlands (*Table 4, Figures 10* and *11*).**
- **Grassland/pasture areas cover another 30% (or 35,767 ha) of the watershed and are mainly located in the central portions of the watershed.**
- **Annual Cropland accounts for 9% of the watershed (approximately 33,500 ha).**
- **Forage land, usually representing alfalfa stands, makes up 5% of the watershed.**
- **Wetlands occupy a relatively small portion of the watershed (approximately 8%) with the majority found in the headwater - western portion of the watershed.**
- **Approximately 3% of the watershed is classified as water.**
- **Trees are the predominant land cover in the watershed covering 43% of the area (or 49,383 ha.)**

Table 4: 2006 Land Cover by Subwatershed (hectares)[1]

	Annual Cropland	Trees	Water	Grassland/ Pasture	Wetlands[2]	Forage	Urban	Total[3]
Rorketon	7,739	33,538	2,238	23,360	9,954	5,751	1,216	83,796
Cayer	788	48,084	1,740	18,481	22,218	2,101	876	94,288
Alonsa	4,050	66,448	12,305	41,286	14,678	3,655	1,510	133,548
Amaranth	20,948	18,436	482	21,347	5,573	4,977	1,814	73,577
Total	**33,511**	**165,213**	**16,747**	**103,377**	**52,277**	**16,461**	**5,,355**	**395,593**

1. Area totals are approximate due to the nature of the image analysis procedure
2. Due to seasonal changes in wetland size, date of imagery will affect area.
3. Extent of Land Cover image does not encompass entire IWMP study area.

Figure 10: Land Cover of the Westlake Watershed in 2006

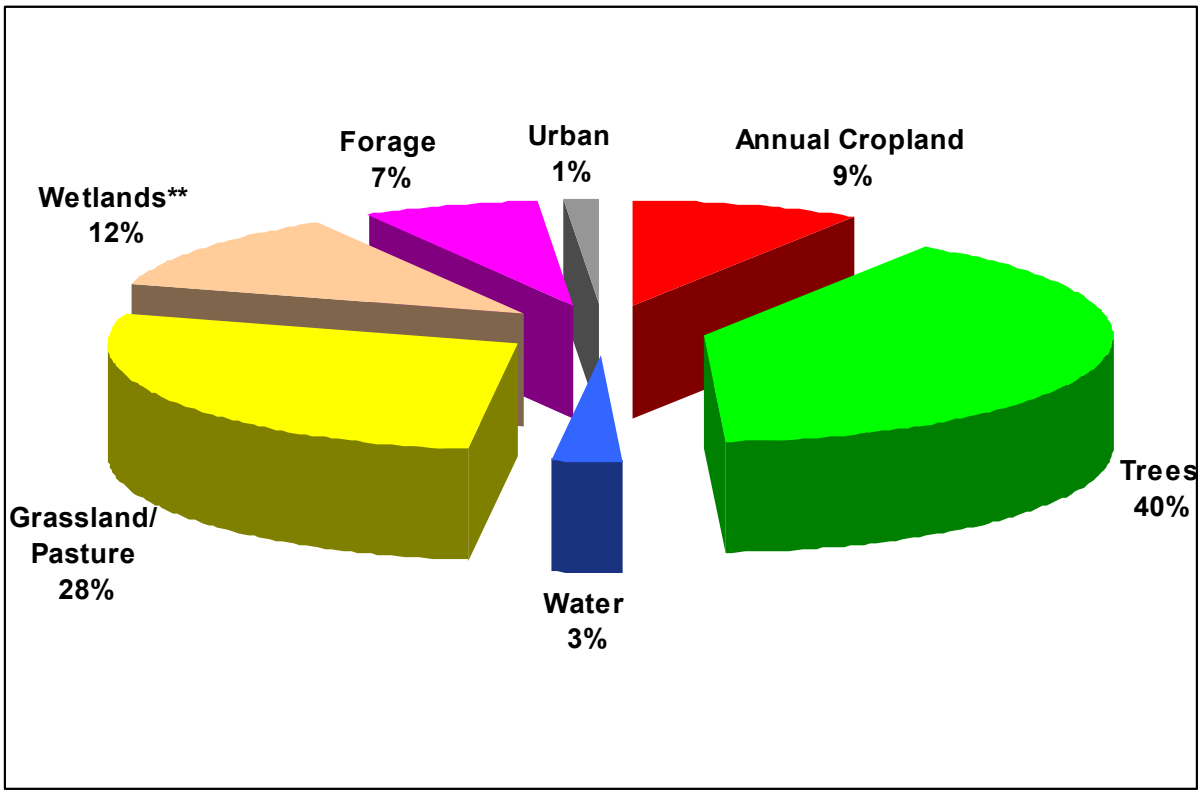
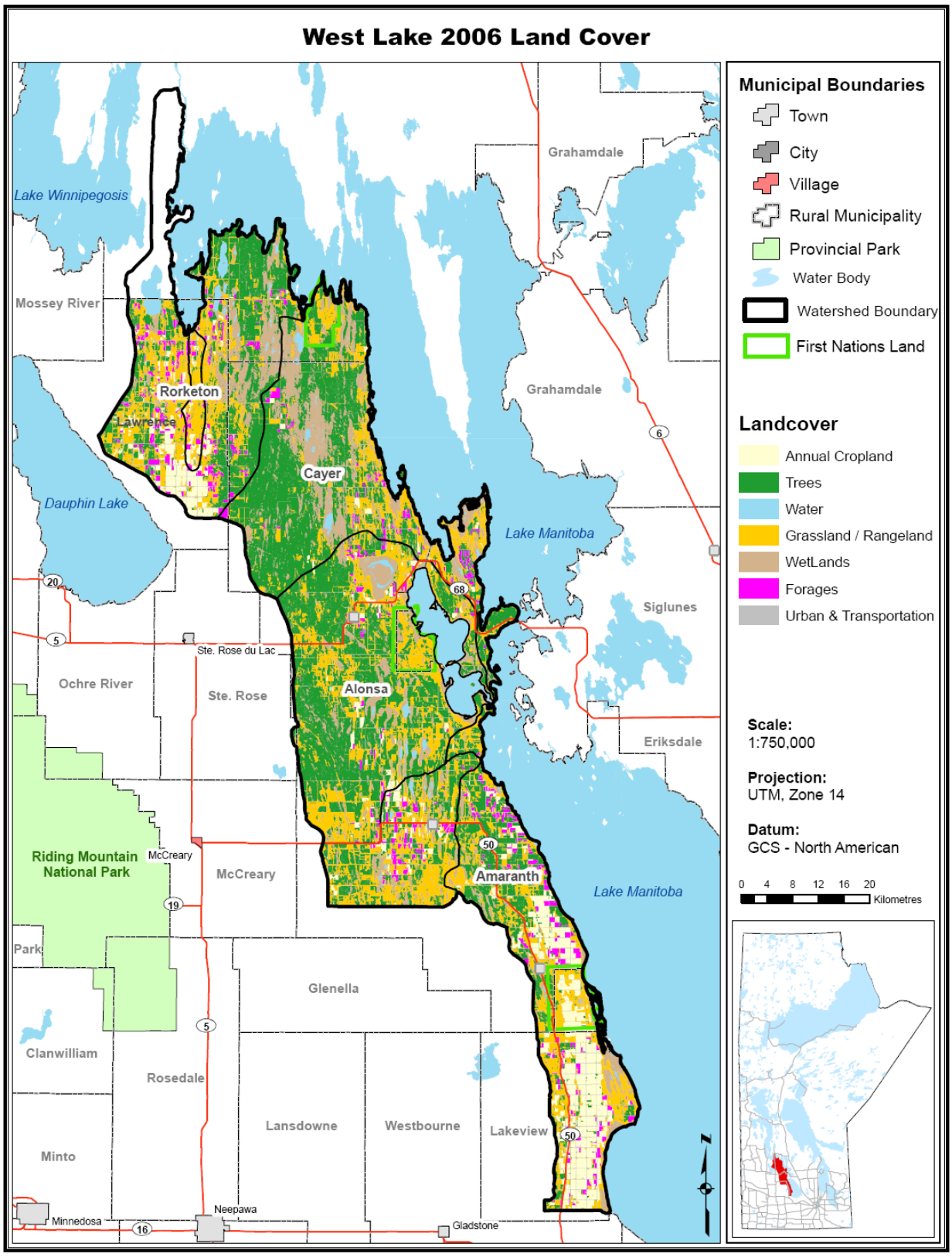


Figure 11: 2006 Land Cover in the Westlake Watershed*



*Land cover was derived from satellite imagery captured September 9, 2006.

ii. Agricultural Land Use Trends

Agricultural land use is dynamic and there are many factors influencing changes over time. The factors vary from economic drivers like commodity prices, land values, input costs, and government programs to social influences like changing demographics and increasing environmental awareness. Changes in land use can have an environmental and economic impact on the health of a watershed. By assessing anticipated changes, land use trends can be useful for guiding the development of future activities and initiatives that encourage sustainable resource management in the watershed.

a) Changes in Agricultural Production (2001 to 2006 Census Data)

Census of Agriculture data from 2001, acquired from Statistics Canada, has been extrapolated to the same subwatershed boundaries as the 2006 data, which can illustrate changes in agricultural production. This data has been analyzed to better understand the contributions agriculture is making in the Westlake IWMP study area and its three subwatersheds. For more detailed data from 2001 and 2006 Census of Agriculture, refer to ***Appendix I*** and ***J***.

There are many factors that influence decisions made on individual farms. In order to understand if changes are the result of adaptation in farming systems and/or practices, or due to weather, market and other influences, it is important to also be aware of local conditions. As such, it is recommended that findings from this report be further verified by land use and industry specialists and individuals with significant local watershed knowledge.

For this analysis, 2001 Census of Agriculture data is not available for the Rorketon subwatershed. Therefore, the five year change analysis has only been carried out for the Alonsa and Amaranth subwatersheds.

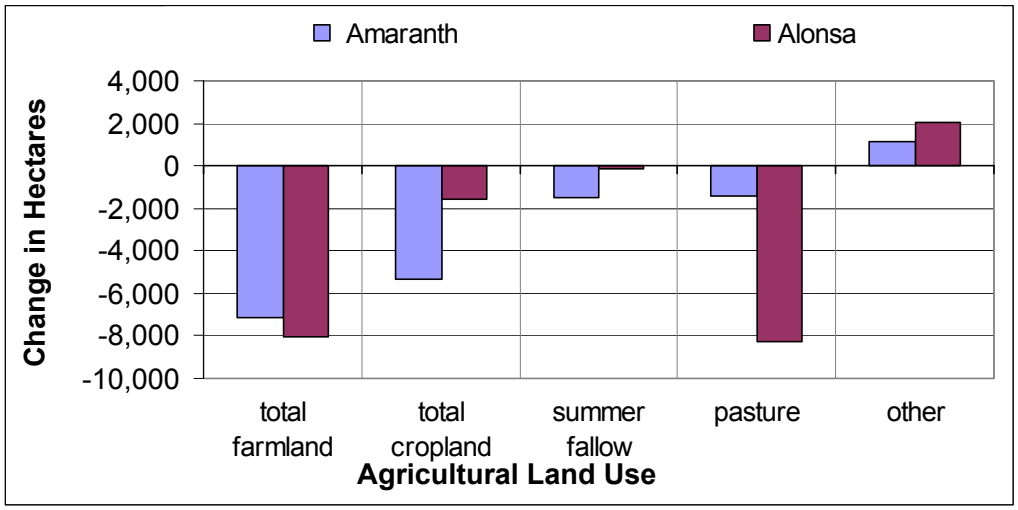
Five-Year Change in Land Use

According to the analysis of the Census of Agriculture from 2001 to 2006, there was a reduction in the number of farms reporting in the watershed. At the same time, a corresponding increase in average farm size in both subwatersheds occurred (***Table 5***). Amaranth experienced a 45% decrease in the number of farms, with the remaining farms increasing in size by 57%. In Alonsa, the changes were not as significant. In both subwatersheds, there was a large overall decrease in total farmland reported (***Figure 12***). The amount of pasture land decreased in Alonsa while the amount of cropland was reduced in Amaranth. The large decrease in pasture reported in Alonsa is most likely due to a decrease in area leased from governments **(Table 6)**. In both subwatersheds, there was a general decrease in the use of summerfallow.

Table 5: Change in number of farms reporting, and average farm size from 2001 to 2006.

Subwatershed	Number of Farms			Average Farm size (ha/farm)		
	2001 Census	2006 Census	5-Year Change	2001 Census	2006 Census	5-Year Change
Amaranth	105	58	-47	506	791	+287
Alonsa	123	103	-20	765	836	+71

Figure 12: Change in agricultural land use types from 2001 to 2006 according to Census of Agriculture data.



* Total cropland includes all field crops, vegetables, fruit and nuts and sod
** Pasture includes tame pasture and natural areas used for pasture
*** Other category includes all other land uses including farmyard, woodlots, Christmas trees, wetlands, etc.

Table 6: Summary of Change in Land Tenure

2006 Census	Total Area of Land (ha): operated by farmers	owned	leased from government	rented, leased or crop-shared from others
Amaranth	46,023	23,066	16,750	6,207
Alonsa	86,091	30,609	48,818	6,664
2001 Census				
Amaranth	53,132	31,186	17,069	4,877
Alonsa	94,114	29,228	59,369	5,527
5-Year Change				
Amaranth	-7,109	-8,121	-319	1,330
Alonsa	-8,024	1,381	-10,551	1,137

Changes to Annual Cropping Practices

Figure 13 outlines the changes in annual cropping practices between 2001 and 2006. Specifically the following trends were noted:

In the Amaranth Subwatershed:

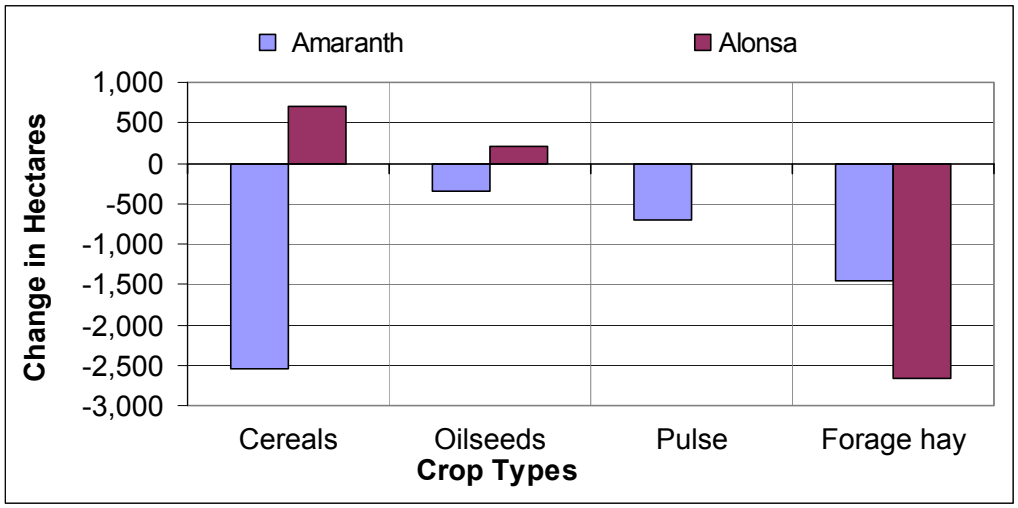
- There was an overall decrease in cropland. All crop types experienced decreases, with a major decrease in cereals (~2,500 ha) and forages (~1,500 ha)

In the Alonsa Subwatershed:

- There was slight increase in cereals and oilseeds, but a large decrease in forage hay (~2,500 ha),

These changes are likely in direct response to market trends, as producers aim at maximizing profits.

Figure 13: Change in area of crop types from 2001 to 2006 according to Census of Agriculture data.



Changes in tillage practices that occurred in the five year interval differed between the two subwatersheds. In Amaranth, there was a decrease in the use of conventional tillage (incorporating most crop residue in the soil), while in Alonsa, it increased. In Amaranth, the use of conservation tillage (retaining most crop residue on the surface) increased. In Alonsa, the data for conservation and zero tillage usage was suppressed. (***Table 7***).

Table 7: Comparison of distribution of tillage practices between 2001 and 2006

Subwatershed	Percent of area prepared for seeding using:					
	Tillage incorporating most crop residue into the soil		Tillage retaining most crop residue on the surface		No-till or zero-till seeding	
	2001	2006	2001	2006	2001	2006
Amaranth	62%	53%	22%	41%	8%	6%
Alonsa	52%	63%	*	24%	*	14%

* data has been suppressed by Statistics Canada

Change in Annual Cropping Inputs

Notable changes in crop inputs are summarized below for the two subwatersheds (***Figure 14*** and ***Tables 8*** and ***9***).

In the Amaranth Subwatershed, from 2001 to 2006:

- There was a corresponding decrease in the use of fertilizers and pesticides due to the overall decrease in cropland

- There was a slight increase in the proportion of cropland with fertilizer applications, and a slight decrease in the proportion of herbicide applications
- Farmers reported an increase in fertilizer costs of almost $10 per hectare. Pesticide costs per hectare increased slightly

In Alonsa Subwatershed, from 2001 to 2006:

- There was an increase in fields with fertilizer application and a slight increase in areas with herbicide treatment
- Farmers reported an increase in fertilizer costs of almost $35 per hectare while pesticide costs per hectare increased by around $25.

Figure 14: Change in crop inputs from 2000 to 2005 according to Census of Agriculture data.

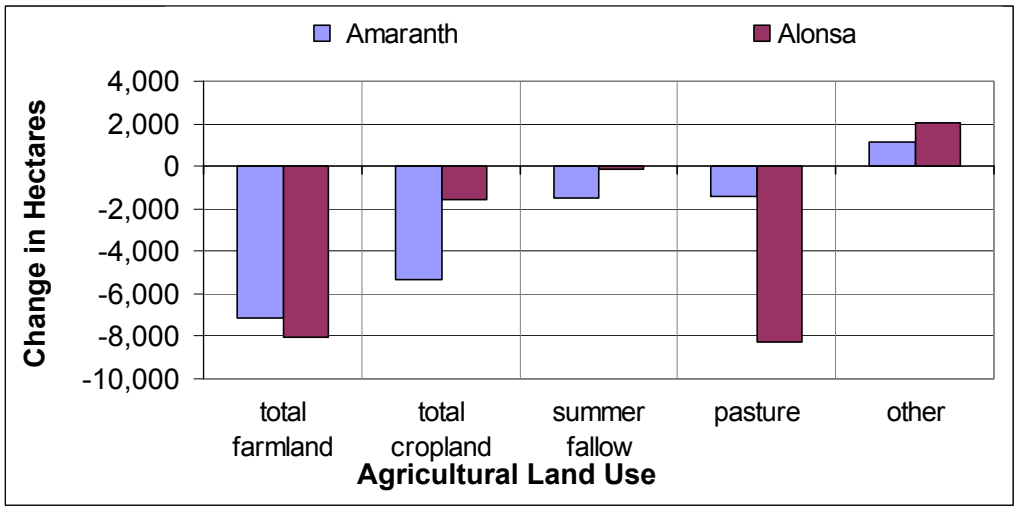


Table 8: Percent of cropland with fertilizer or herbicide applications in 2000 and 2005 (Census of Agriculture)

Subwatershed	Percent of cropland with Fertilizer Application		Percent of cropland with Herbicide Application	
	2000	2005	2000	2005
Amaranth	68%	71%	61%	56%
Alonsa	43%	52%	19%	22%

* Cropland includes all field crops (including alfalfa and other seeded forages), vegetables, fruit and nuts and sod

Table 9: Comparison of average cost of fertilizer or pesticide inputs in 2000 and 2005 (as reported in the 2001 and 2006 Census of Agriculture)

Subwatershed	Average cost of fertilizer input ($/ha)		Average cost of pesticide input ($/ha)	
	2000	2005	2000	2005
Amaranth	$77	$86	$43	$46
Alonsa	$48	$82	$41	$66

Relative Change in the Livestock and Poultry Sector
Overall, there was a slight decrease in the number of farms reporting cattle (see ***Figures 15*** and ***16*** and ***Table 9)*** during the period between 2001 and 2006.

Cattle Industry
In the Amaranth Subwatershed, there was:

- A large decrease in total cattle reported, but only a small decrease in beef cows
- The number of farms reporting beef cattle decreased by half
- An increase in average herd size, with an increase of an average of 50 beef cows per farm

In the Alonsa Subwatershed, there was:

- A slight decrease in total cattle but an increase in number of total beef cows
- A decrease of almost 20 farms reporting cattle, and 15 fewer farms with beef cows
- A moderate increase in average herd size with an average increase of 20 beef cows per farm.

Local knowledge suggests significant decreases in livestock numbers in both subwatersheds can be attributed to the pressures of BSE on younger producers (who could not survive and move on to regular-paying employment) and the senior rancher (who had the tendency to fold).

Hog Industry
There are few farms reporting hogs in the Westlake IWMP and the animal numbers have been suppressed to protect confidentiality.

From 2001 to 2006 in the Amaranth Subwatershed, there was:

- No change in the number of farms reporting pigs (see ***Table 10***)

From 2001 to 2006 in the Alonsa Subwatershed, there was:

- A decrease in the number of farms reporting pigs.

Poultry Industry
There are a small number of farms reporting poultry in the Westlake IWMP and the data on the number of birds has been suppressed to protect confidentiality.

In the Amaranth Subwatershed, there was:

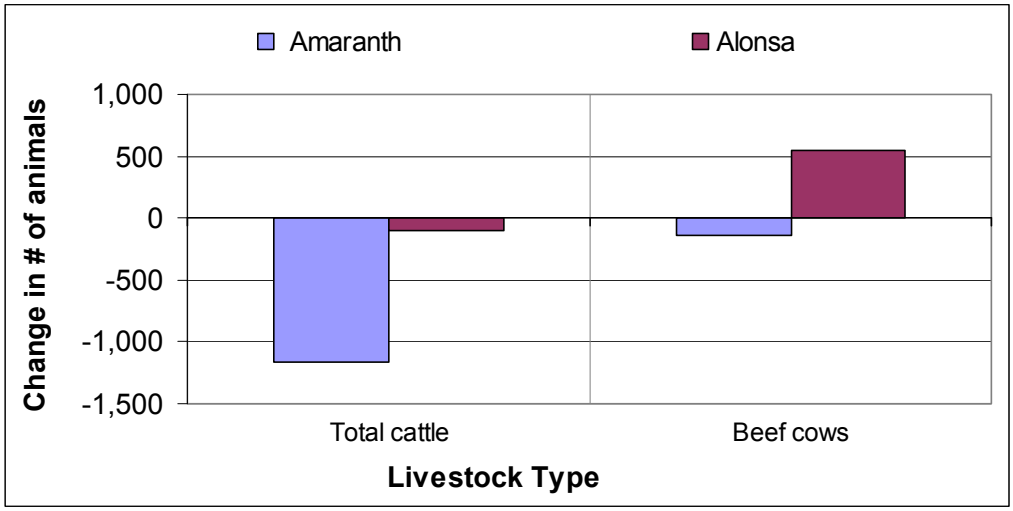
- A reduction of farms reporting poultry, (see ***Table 10***)

In the Alonsa Subwatershed, there was:

- A reduction of farms reporting poultry

Again, changes from one commodity to another are largely market driven. The general trend toward fewer but larger farms is most likely due to economic factors.

Figure 15: Change in number of livestock from 2001 to 2006, (Census of Agriculture data).

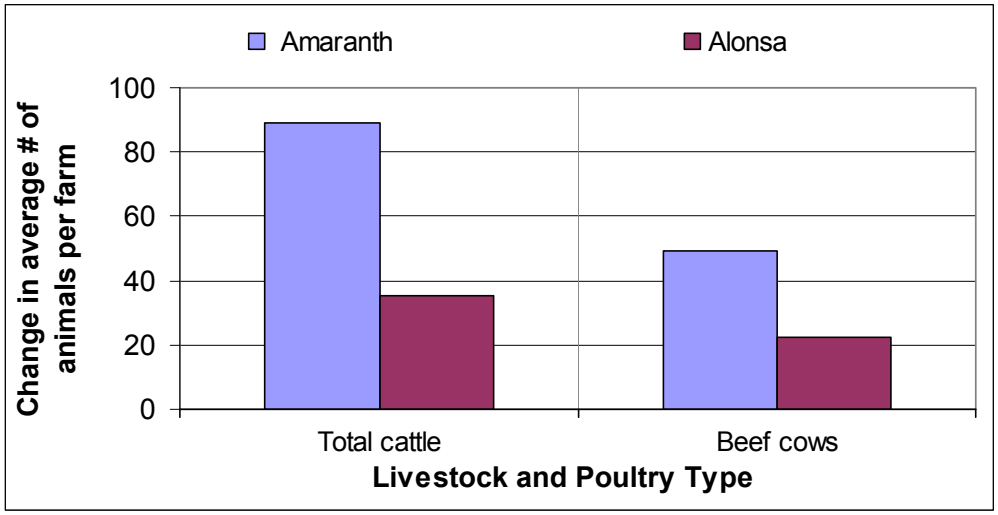


* data suppression occurs for total poultry and total pig numbers in the Alonsa and Amaranth Subwatersheds for 2006, therefore, changes cannot be analyzed

Table 10: Five-year change in number of farms reporting livestock and poultry from 2001 to 2006, (Census of Agriculture data)

Subwatershed/Census year		Number of Farms reporting:					
		Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Amaranth	2001	79	75	1	1	1	7
	2006	41	40	0	1	0	3
	5-year change	**-38**	**-35**	**-1**	**0**	**-1**	**-4**
Alonsa	2001	104	97	1	4	2	5
	2006	86	82	0	2	1	3
	5-year change	**-17**	**-15**	**-1**	**-2**	**-1**	**-2**

Figure 16: Change in average number of livestock per farm from 2001 to 2006, according to Census of Agriculture data.



* data suppression occurs for total poultry and total pig numbers in the Alonsa and Amaranth Subwatersheds for 2006, therefore, changes cannot be analyzed

Summary of Changes in Agricultural from 2001 to 2006:

Over the five year period, there was/were:

- **Fewer but larger farms. Amaranth experienced the greatest change with almost 45% less farms in 2006 and increasing farms sizes for the remaining farms**
- **A large decrease in farmland (over 7,000 ha). In Amaranth, there was a reduction in cropland, in Alonsa, there was a decrease in pasture (due to a reduction in leased government lands).**
- **A decrease in conventional tillage practices in Rorketon from 2001 to 2006, while in Alonsa, there was an increase.**
- **A slight increase in the proportion of cropland receiving fertilizers.**
- **A slight increase in the proportion of cropland receiving herbicide applications in Alonsa, and a slight decrease in Amaranth.**
- **A large decrease in cattle numbers, as well as farms reporting cattle in Amaranth. Herd sizes increased on the remaining farms, including an increase of approximately 50 beef cows per farm**

b) Land Cover – 1993, 2002, 2006

Land cover maps used in this analysis were developed from 30 metre resolution LANDSAT Thematic Mapper satellite imagery. These data sets are point in time and allow users to see the spatial extent of general types of land cover within a given area over time. Further details on the information used for the land cover analysis and the constraints associated with this data are provided in ***Appendix C***. The 1993 land cover was derived from satellite imagery captured on May 14, 1993, and the 2002 land cover is from imagery taken on May 31st, 2002, while the 2006 land cover was captured on September 9th, 2006.

Summary of Land Cover Change

An analysis of land cover data from 1993, 2002 and 2006 satellite imagery supports the trends seen in the census data, with modest declines in cropland since the 1990s, and increases in grassland and forages over the same period (***Table 11***, ***Figure 17***).

Although there are some inherent limitations in analyzing land cover data to determine changes in land use, some changes can be noted:

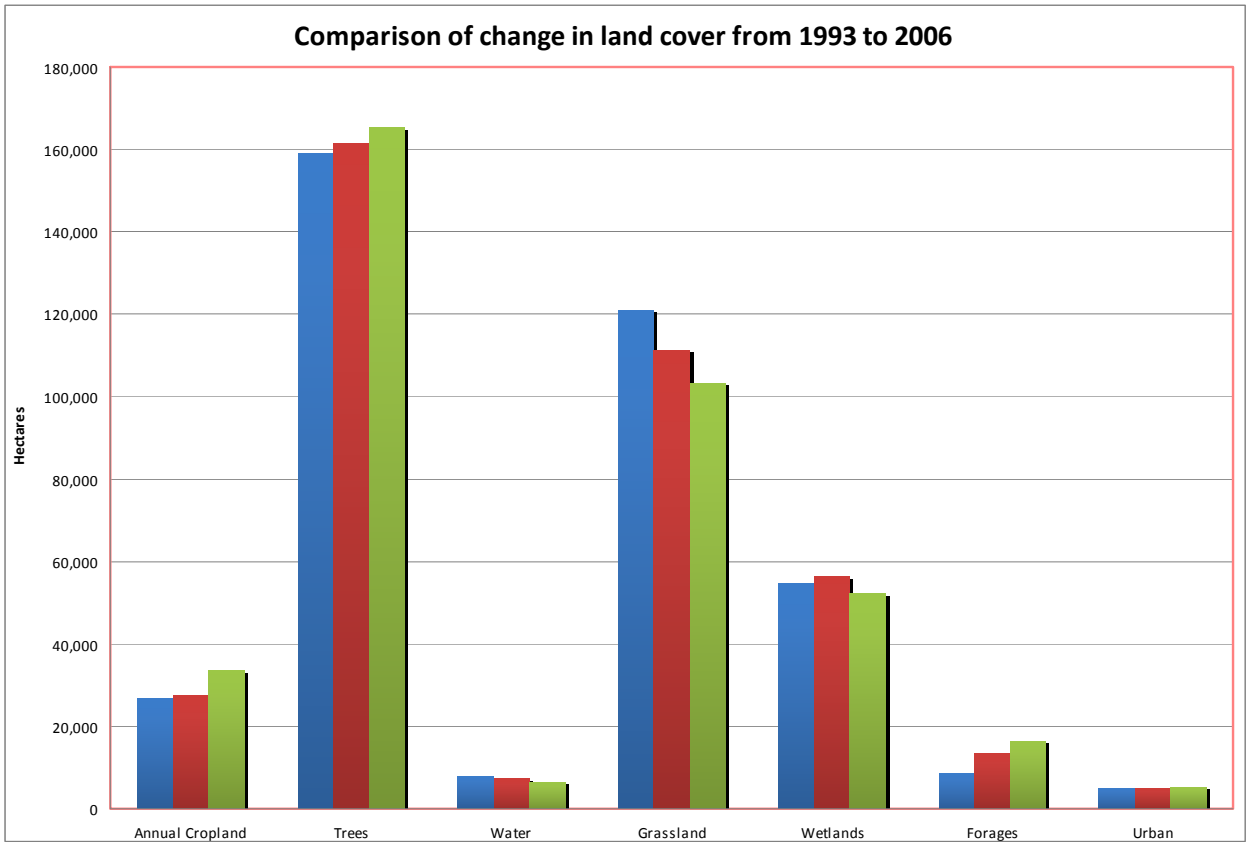
- **The largest change in land cover was noted in the grasslands, where there was a decrease of approximately 17,000 hectare (from 121,000 to 104,000 ha.). These changes have been linked to increases in tree cover, forages, and annual cropland (all showing an approximate 2% increase within their individual class).**
- **Decreases noted in the grasslands would primarily be attributed to forest encroachment and forage rejuvenation based on local knowledge. The changes are mostly noted along the south and southwest portion of the watershed, with a majority of those areas affected by forest encroachment.**
- **According to local information, forages did increases in the watershed. Some of the forage increases may be attributed to the local conservation district forage assistance program.**
- **Local knowledge suggests that the changes noted to grassland may be the result of increased activity in these areas for increased forage production. Due to the BSE outbreak in 2001, both tame and native stands were harvested to support increased herd sizes. The 2006 year was also a drier fall, and many native stands were harvested, possibly resembling the appearance of newer forage stands.**
- **Forest encroachment suggests a shift in biodiversity in the area. Local knowledge suggests that some of the forest encroachment may be related to landholdings becoming idle as a result of some producers approaching retirement and having smaller herd numbers. It may also be linked to Louisiana Pacific no longer harvesting softwood on Crown Lands in the watershed due to higher costs to softwood production.**
- **Changes in annual cropland showed an increase of almost 2% (or approximately 7,100 hectares). Local knowledge suggest that this may be due to possible land clearings to support increase forage/pasture, the growing corn for silage, or adoption of winter site management practices (winter grazing) and cast the appearance of annual cropland.**
- **Total precipitation levels and total rainfall levels recorded for the watershed noted higher amounts than the 30 year average for two of the three year land cover intervals identified (see *Appendix N*).**

Table 11: Change in land cover from 1993 to 2002 to 2006[1]

Land Cover	1993 Area (ha)	2002 Area (ha)	2006 Area (ha)	Change from 1993 to 2002 (ha)	Change from 2002 to 2006 (ha)
Annual Cropland	26,578	27,664	33,511	1,086	5,847
Trees	159,248	161,935	165,213	2,145	3,820
Water	18,403	17,730	16,747	-673	-983
Grassland	120,883	111,416	103,377	-9,467	-8,039
Wetlands	54,603	56,386	52,277	1,783	-4,109
Forages	8,372	13,477	16,461	5,105	2,984
Urban	5,087	5,131	5,355	44	223
Totals[(2)]	**393,175**	**393,197**	**392,940**		

1. Area totals are approximate due to the nature of the image analysis procedure
2. Extent of Land Cover image does not encompass entire IWMP study area.

Figure 17: Comparison of change in land cover from 1993 to 2006*



* Area totals are approximate due to the nature of the image analysis procedure
** Due to seasonal changes in wetland size, date of imagery will affect area
***Area North of RM of Lawrence was not included in data analysis

iii. Other Agricultural Land Use Trends/Impacts

Agricultural land use is constantly changing due to factors such as weather, markets, crop rotation or changes in agricultural production systems (livestock versus crop production). In this section, a more detailed examination of the land cover classes from 1993 is compared to the 2006 imagery in order to assess how much one classification has changed over a time period. It can also identify where changes in land use are occurring, thereby giving some indication of influences of land management or land use change. It should be noted that data classification limitations and the acquisition dates of the satellite images can introduce discrepancies into these values. As noted in the earlier section, precipitation levels noted for the landcover dates may also influence land cover classifications. Further field investigations would be required to verify these findings.

Changes in Annual Cropland Area

Changes in land use can reflect changes in land management practices, and possible impacts on environmentally sensitive areas. Annual cropland changes tend to be due to crop rotations, market and economic drivers, as well as, environmental factors. Analyzing changes in annual cropland can be useful to help explain changes in environmental factors like water quality, both surface and ground, and flooding. ***Figure 19*** identifies where changes in annual cropland have taken place from 1993 to 2006.

In the Westlake IWMP:

- **The area of annual cropland more than doubled from 1993 to 2006** (***Table 10***).
- **Analysis indicates that annual cropland was most often converted from grassland – approximately, 8,800 ha. of grassland in 1993 converted to cropland in 2006 (*Figure 18*).**
- **Approximately 1,900 ha. experienced a reciprocal conversion of cropland in 1993 to grassland in 2006, resulting in a small net increase of annual cropland in the very north west and southeast portions of the watershed (*Figure 19*).**
- **Most of the remaining land that was converted to annual cropland in 2006 came largely from wetlands and treed areas that were present in 1993 (*Table 10*).**
- **With seeded forages, there was more cropland being converted to forage than the reverse, resulting in a net conversion of almost 3,000 ha of cropland to forage by 2006.**

Figure 18: Total change in area of annual cropland, in relation to other land cover types, in the Westlake IWMP study area (from 1993 to 2006)

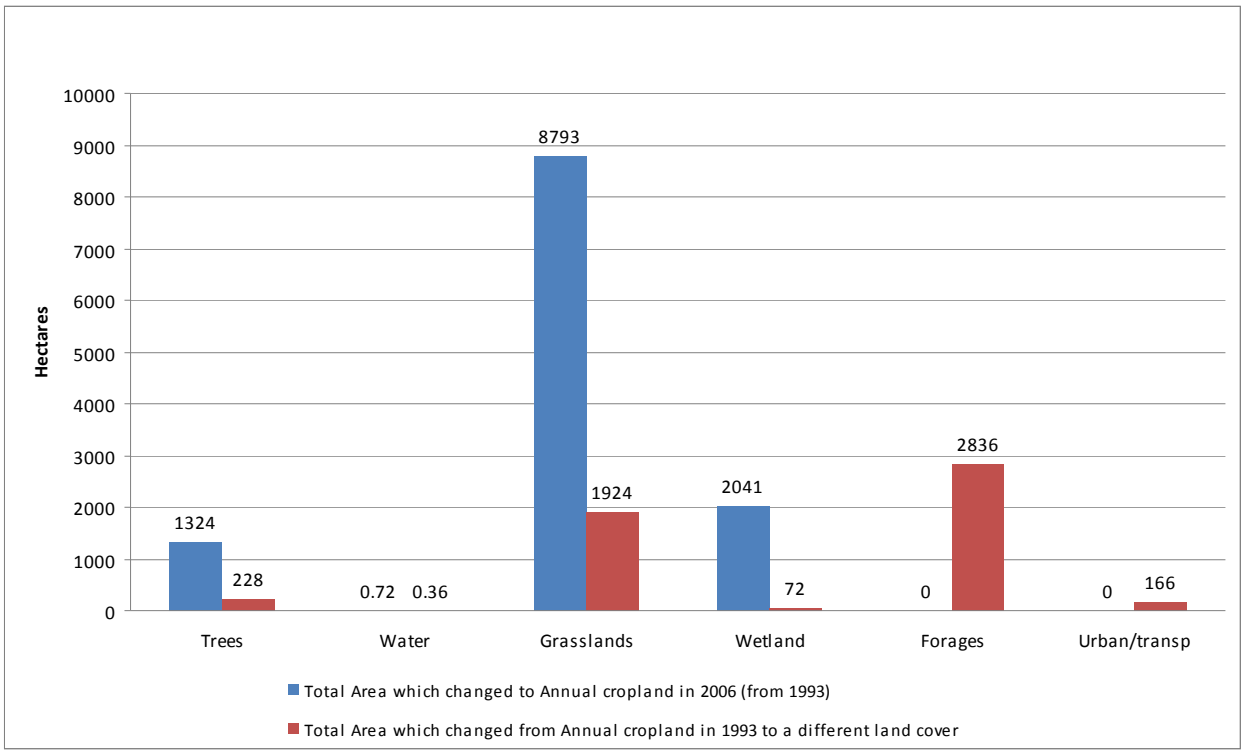
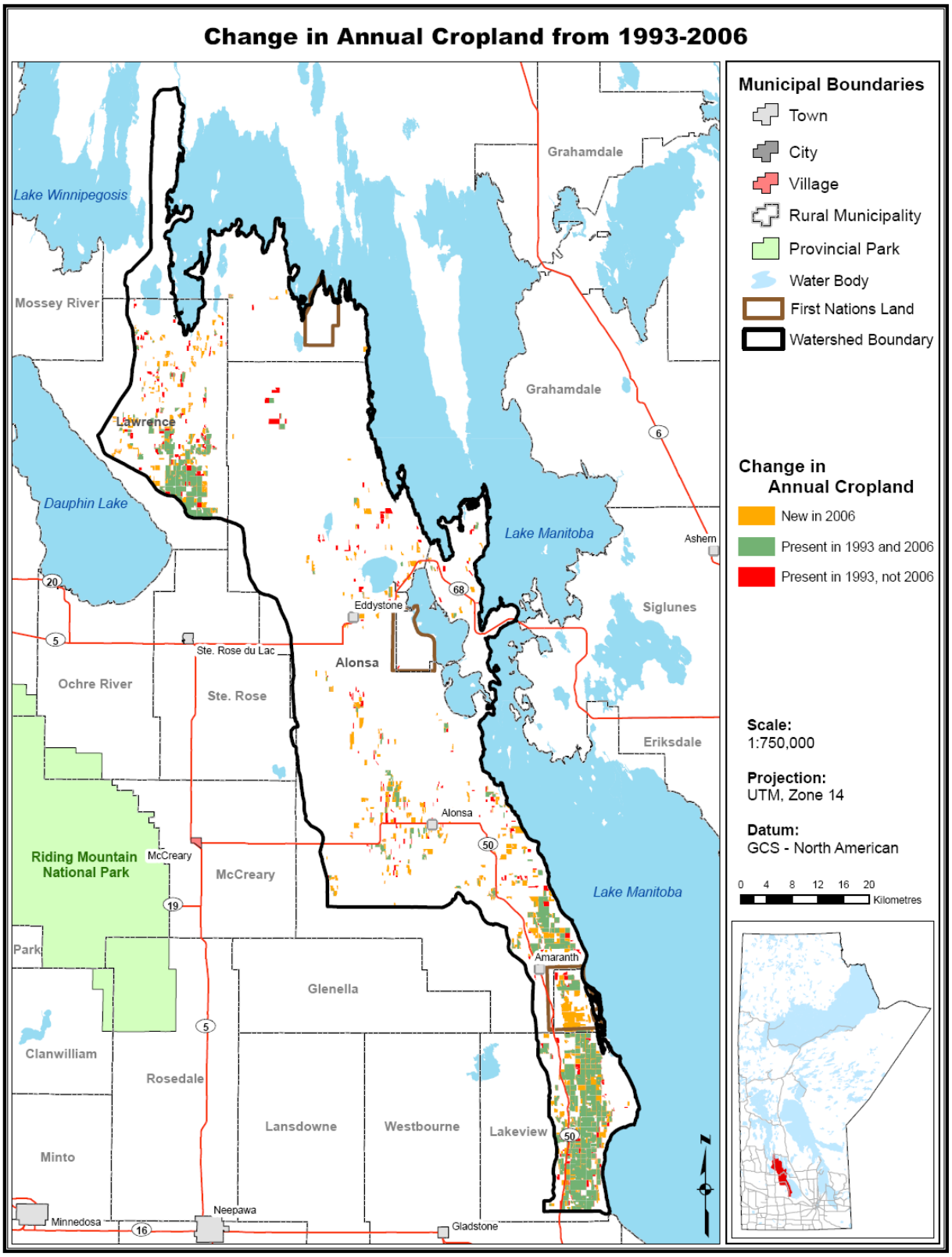


Figure 19: Analysis of Annual Cropland changes between the 1993 and 2006 Land Cover data*



* Land cover is derived from satellite imagery taken May 14, 1993 and September 9, 2006

Changes in Grassland Area

Analyzing changes in grassland land cover can be useful to understand water quality risks associated to water quality and can be beneficial for reducing runoff and flood mitigation. ***Figure 21*** summarizes the amount of land which changed to or from grassland from 1993 to 2006.

While conversion to grasslands may be due to market and economic pressures, producers may also choose to convert land to decrease environmental risks. For example, the increased conversion of grasslands to annual cropland on soils prone to erosion could impact water quality, as well as, increase flooding downstream due to potential increased runoff. As a result, this could also lead to increased contaminants in water if appropriate management practices are not applied.

In the Westlake Study area:

- **There was an overall decrease of almost 17,000 ha of grassland from 1993 to 2006 (*Table 5*).**
- **The decrease of grassland in 1993 was primarily a change to trees (approximately 22,000 ha.), suggesting tree encroachment into natural grasslands and pastures is occurring (*Figure 20* and *Figure 21*).**
- **The conversion of grassland to trees was 36% larger than what was noted for the reciprocal conversion (Approximately 16300 ha of trees to grasslands in 2006.).**
- **Another significant change noted was from grassland in 1993 to annual cropland (approximately 8,000 ha.) in 2006. Local Knowledge indicates that the area in general is not conducive to annual cropping, and the change may be more a result of pasture or forage rejuvenation, or a move to winter site management. Greencover funding was also in place at the time, thus this incentive would have resulted in an increase to tame forage.**
- **The movement of grassed lands to trees is most likely a result of brush encroachment.**
- **Most of the changes from 1993 grasslands were noted in the very southeast portions of the watershed.**

Figure 20: Total change in area of grassland compared to other land cover types in the Westlake IWMP study area (from 1993 to 2006)

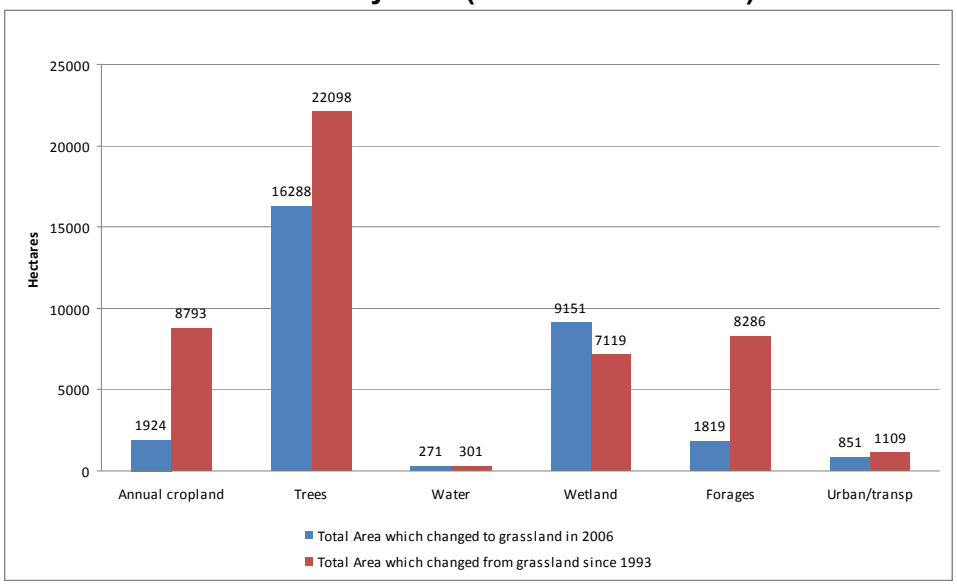
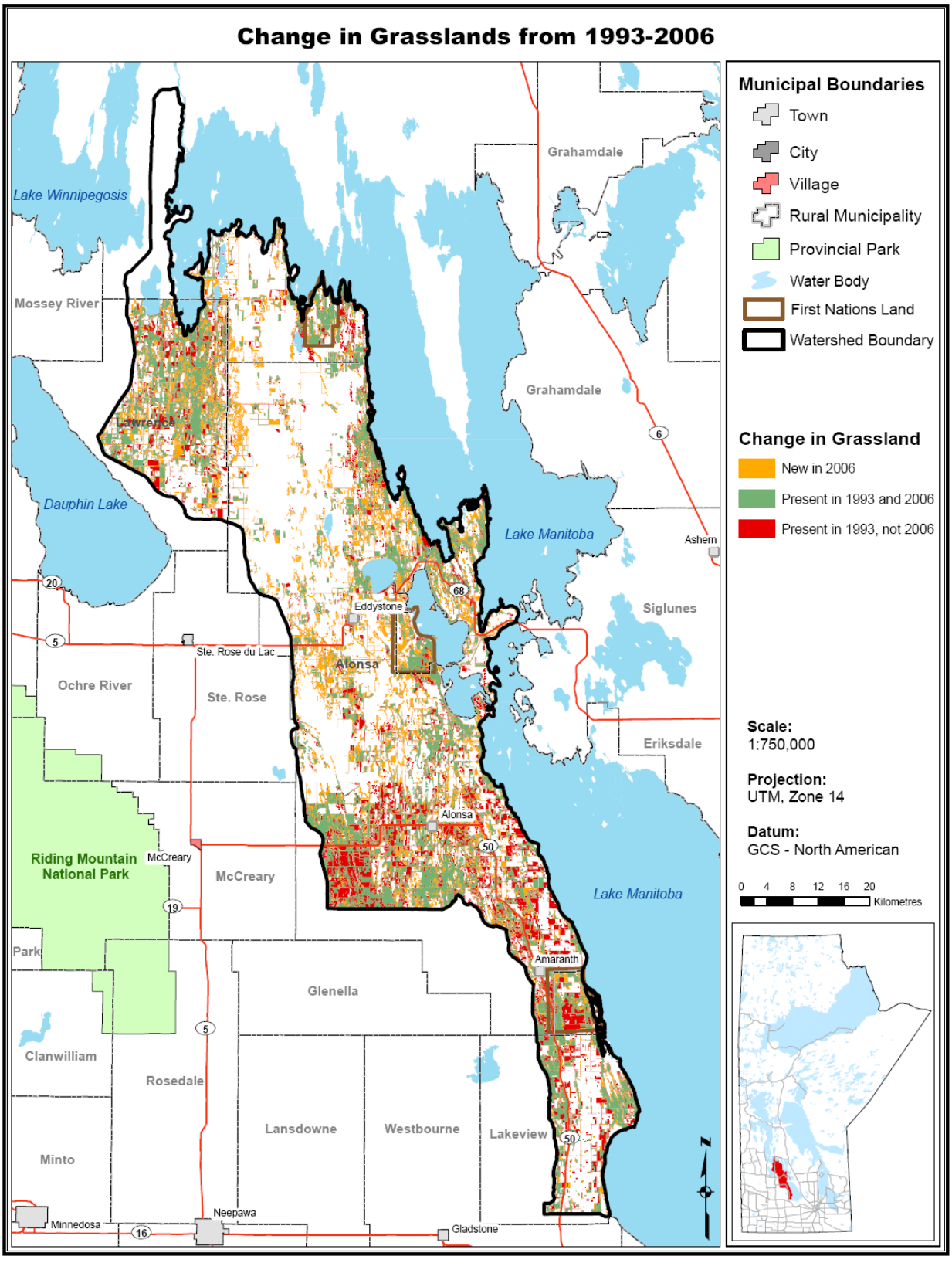


Figure 21: Analysis of Grasslands changes between the 1993 and 2006 Land Cover data*



* Land cover is derived from satellite imagery taken May 14, 1993 and September 9, 2006

Changes in Forested Areas

Assessing the Forested Areas classification change can provide information on the impacts of flooding, water supply and quality, as well as biodiversity. ***Figure 23*** summarizes the areas which experienced changes to and from forested cover from 1993 to 2006**.**

In the Westlake watershed:

- **There was an overall increase of approximately 6,400 ha. of forested areas in 2006 when compared to 1993 (*Table 10*).**
- **A majority of the forested areas has been converted from grassland in 1993 (approximately 22,000 ha.), mainly the result of encroachment.**
- **At the same time, approximately 16,000 ha. of forested lands in 1993 were converted to other land cover. However, the net amount was still more grassland that was converted to forestry encroachment (*see Figure 22*).**
- **Most of the areas converted to forest noted for 2006 are dispersed throughout the watershed, with larger amounts found in the very south portions of the watershed.**
- **One possible consideration for some of the changes noted could be the result of annual precipitation levels in the area, which showed above normal rainfall for the 2005 year (see *Appendix N)*.**

Figure 22: Total Change Forested Lands compared to Other Land Cover Types, in the Westlake IWMP study area (from 1993 to 2006)

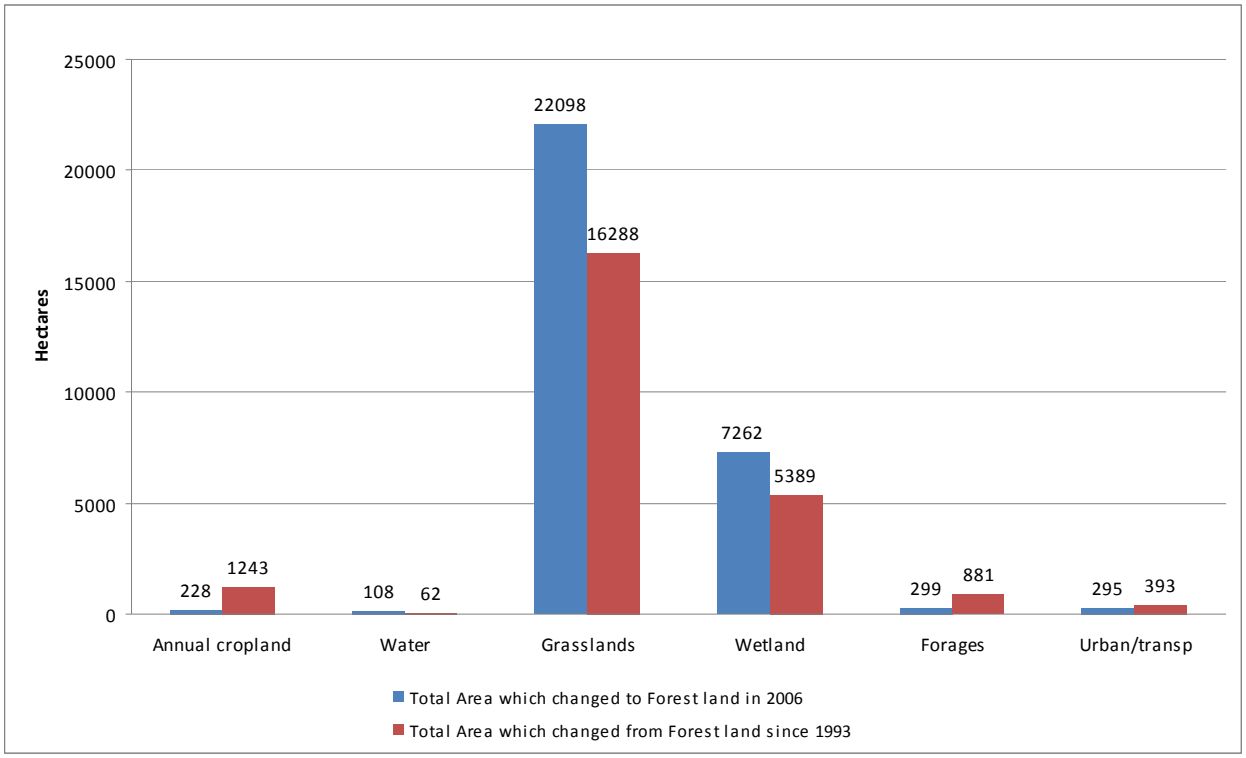
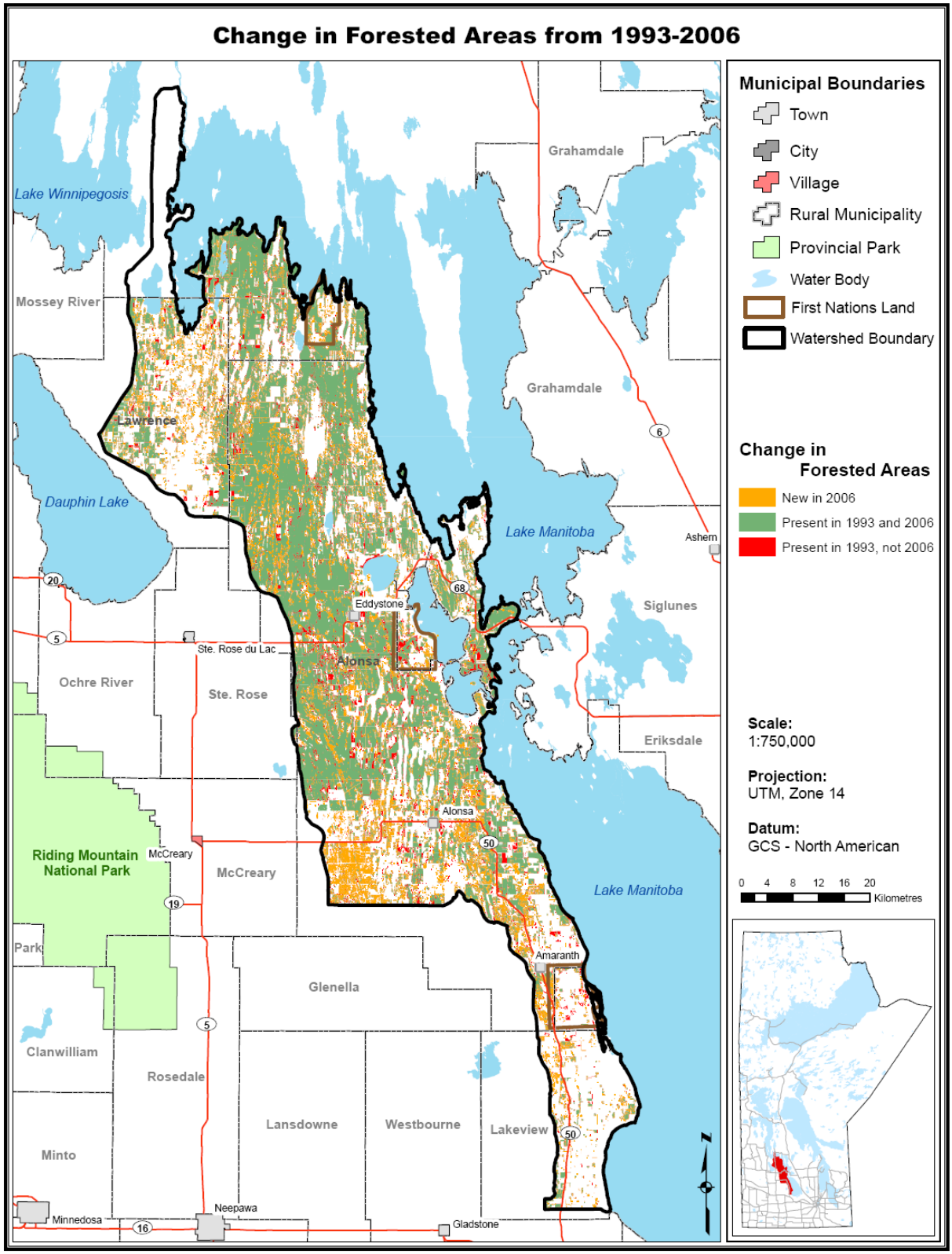


Figure 23: Analysis of Forested Areas change between the 1993 and 2006 Land Cover data*



* Land cover is derived from satellite imagery taken May 14, 1993 and September 9, 2006

F. Agricultural Land Use and Management Considerations

This section involves the analysis of a combination of factors including land use and the characteristics of the local landscape in order to determine where consideration should be given to how the land is used or managed, including the potential for adoption of Beneficial Management Practices (BMPs). Land cover data represents an indicator of how the land is being used, while relevant landscape characteristics and risk factors are contained within the soils dataset. Further information about land cover data can be found in ***Appendix C***, while more information about the soils data can be found in ***Appendix D***.

i. Agricultural Capability Analysis

The Canada Land Inventory System (CLI) was used to classify land based on agricultural capability. The CLI is a comprehensive survey of land capability and land use aimed at providing a basis for making land-use planning decisions. Under the CLI, lands are classified according to physical capability for agricultural use (PFRA, 2005).

Agriculture capability can best be described as the ability of the land to support the appropriate type of crops and agriculture management practices. soil types, topography, stoniness, soil moisture deficiency, low fertility, and other potential limitations all influence how the land is being used and what practices should be applied. Classes ranging from 1 to 7 have been established, with 1 being the highest rated land class with no limitations to annual crop production and 7 being the lowest rated land for agriculture (not suitable for agriculture). Further information about CLI and specific characteristics and limitations associated with the various land classes is provided in ***Appendix E***.

Analytical Methods
Analysis of the land classes using CLI helps to understand the extent of agricultural activity over marginal lands. The analysis included determining how much annual crop production takes place on marginal lands, to what extend marginal lands are protected by perennial forage cover, and what changes in management practices have taken place between 1993 and 2006.

The analysis concludes the following:

- **A relatively small portion of the watershed is considered productive Class 2 and 3 lands (11% or approximately 34,000 ha.).**
- **89% (308,000 ha.) of the soils in the watershed are Class 4 and lower.**
- **Over 4% of the watershed (14,576 ha.) consists of organic soils.**
- **The class 4 or lower soils are associated with an elongated beach ridge running parallel to the lakeshore in the southern portion of the watershed (*see Figure 24*).**

<u>2006 Cropland on Class 4 and poorer soils</u>

Within the Westlake Watershed study area:
- **The majority of the annual cropland is located on marginal agricultural land, classified as Class 4 and poorer (58%, 16,300 ha.).**
- **The majority of the annual cropland on Class 4 and lower soils are located in the northwest and southeastern portions of the watershed** (**see *Figure 24***).
- **In 2006, there were no organic lands identified used for annual cropland. In 1993, 3% of the annual cropland was located on organic soils** (**see *Table 12***).
- **The amount of marginal land being annually cropped has increased since 1993.**

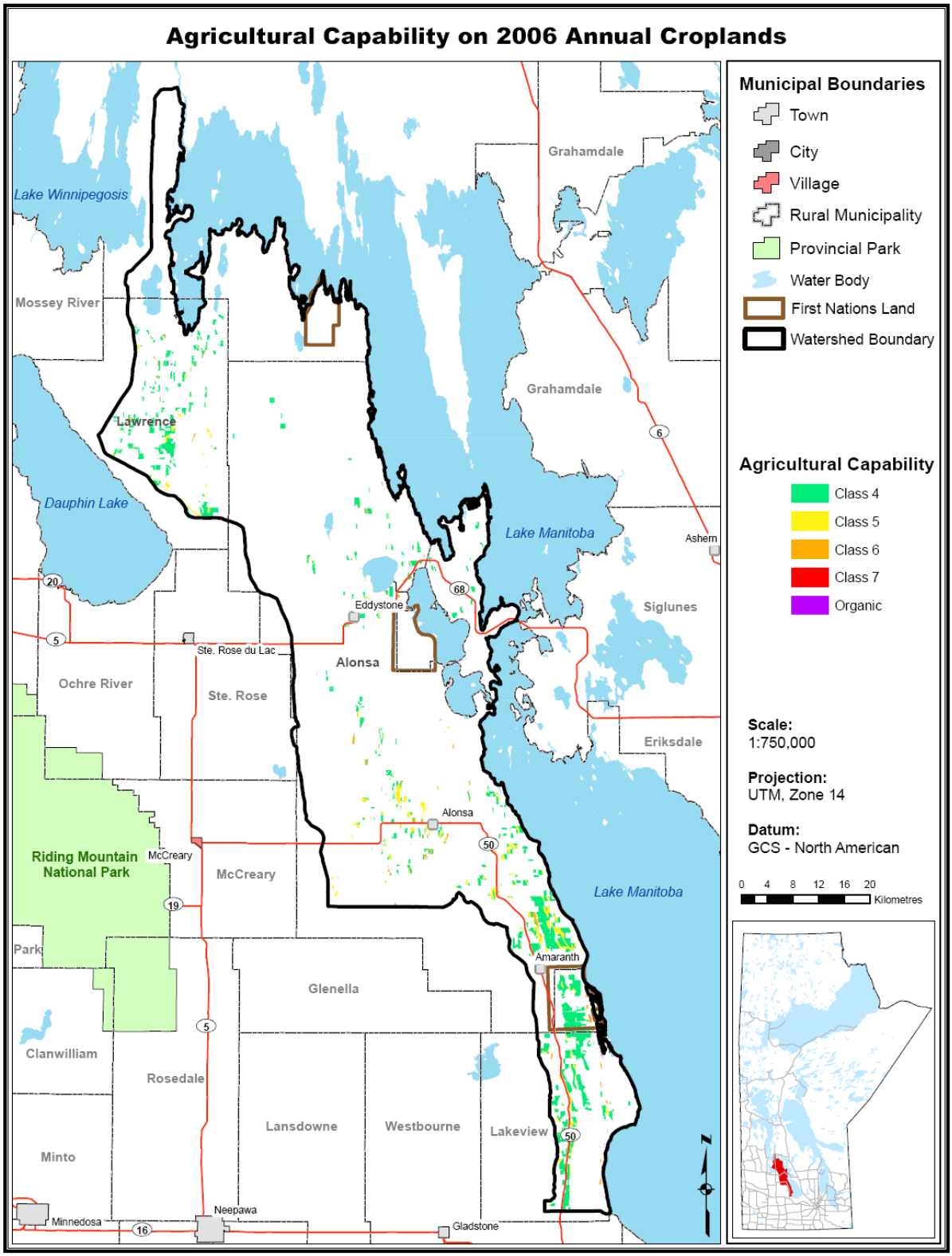
- **Increases were reflected on all Classes, with a majority of the increases noted on Class 2.**
- **The increase in annual crop production may be linked to livestock operations incorporating silage or annual forages in their feeding strategies or winter grazing/winter site management.**

Table 12: Agricultural Capability in the Westlake Watershed Study Area

Class[1]	Total Area in IWMP (ha)	2006 Annual Cropland (ha)[2]	Distribution of Annual Cropland (%)	1993 Annual Cropland (ha)[3]	1993 to 2006 Change in Annual Cropland Area (ha)[4]
Class 1	0	0	0	0	0
Class 2	24,728	12,712	38	11,912	800
Class 3	8,805	1,310	4	876	434
Class 4	197,283	15,662	47	11,273	4,388
Class 5	51,532	3,054	9	2,143	911
Class 6	42,357	643	2	316	327
Class 7	2,278	0	0	0	0
Organic	14,576	20	0	17	3
Unclassified	18	0	0	0	0
Water	4,982	0	0	0	0
TOTAL[(5)]	346,560	33,401	100	26,538	6,863

1. Agricultural Capability is based on the CLI Rating of the dominant soil series for each soil polygon
2. Annual Cropland taken from the 2006 Land Cover (from Landsat Imagery captured on September 9, 2006)
3. Annual Cropland taken from the 1993 Land Cover (from Landsat Imagery captured on May 14, 1993)
4. Figures are derived from the total area of annual cropland in 2006 minus total annual cropland in 1993 in each Class
5. Extent of Soils data is limited in size and does not encompass entire IWMP study area

Figure 24: Areas annually cropped in 2006 on soils with an agricultural capability of Class 4, 5, 6 or 7 in the Westlake Watershed IWMP study area[1]



1. Agricultural capability is based on the CLI Rating of the dominant soil series for each soil polygon

ii. Wind Erosion Risk Analysis

Wind erosion risk information in Manitoba has been developed from the provincial soil survey data and the Soil Landscapes of Canada (SLC Ver 1.0 - see ***Appendix G***). The Wind Erosion Risk model used for the Agriculture Canada Wind Erosion Risk Maps (1989) incorporates soil moisture, surface roughness and aggregate size, and drag velocity by wind. Erosion risk classes were assigned based on the weighted average soil loss for each map polygon. The five classes of soil erosion risk (ranging from negligible to severe) are based on a bare, unprotected soil condition and do not consider land use and crop management factors. Cropping and residue management practices can significantly reduce erosion risk depending on crop rotation, soil type, and landscape features. Basing soil erosion risk on a bare soil scenario helps to identify areas dominated by sensitive, erosive soils which may otherwise be masked if a land use or surface vegetation cover factor was considered (Eilers et. al. 1989).

In the Westlake Watershed:

- **Approximately 10% is considered to be soils with a moderate, high, or severe wind erosion risk** (***see Table 13***). **This is situated in the eastern portion of the watershed (northwest of Alonsa and small pockets east of Lake Dauphin in the Rural Municipality of Lawerence. Affected areas generally correspond to those areas with coarse textured soils.**
- **The majority of the watershed, or almost 87%, is considered to have a negligible to low risk of wind erosion. As such, wind erosion is not considered to be a major issue in the watershed. It is recommended that the small amount of land at risk to wind erosion should be protected through land management practices such as perennial cover**
- **Based on the 2006 land cover data, approximately 11% of the annual cropland was located on soils with moderate, high, to severe risk for wind erosion** (***see Table 13***). **This is an increase of approximately 1,486 ha from what was identified for 1993 on these types of soils. This increase may also be associated to the amount of available hectares for annual cropland in 2006, approximately 6,900 ha. more than 1993.**

Table 13: Wind Erosion Risk on Annual Cropland in the Westlake Watershed Study Area from 2006 Land Cover [1]

Wind Erosion[1]	Total Area in IWMP (ha)	2006 Annual Cropland (ha)[2]	Distribution of Annual Cropland (%)	1993 Annual Cropland (ha)[3]	1993 to 2006 Change in Annual Cropland Area (ha)4
Negligible	40,711	8,188	24	7,432	756
Low	210,145	21,069	63	16,239	4,830
Moderate	12,950	2,297	7	1,803	494
High	21,410	1,231	4	732	498
Severe	192	0	0	0	0
Organic Soil	52,424	613	2	331	282
Water	18,210	20	0	0	20
Unclassified	50,979	94	0	41	52
TOTAL[(5)]	**407,022**	**33,511**	**100**	**26,578**	**6,933**

1. Wind Erosion Risk is based on the weighted wind erosion rating for each soil polygon and assumes bare soil.
2. Annual Cropland taken from the 2006 Land Cover (from Landsat Imagery captured on September 9, 2006)
3. Annual Cropland taken from the 1993 Land Cover (from Landsat Imagery captured on May 14, 1993)

4. Figures are derived from the total area of annual cropland in 2006 minus total annual cropland in 1993 in each Risk Class
5. Extent of Soils data is limited in size and does not encompass entire IWMP study area

iii. Water Erosion Risk Analysis

The overland flow of water can, under certain circumstances, carry particles of soil with it. Rain splash erosion, sheet erosion, rill erosion and gully erosion are all caused by water. Where this occurs, there is the potential to carry large quantities of sediment and contaminants to nearby waterways and waterbodies throughout the watershed. This section examines where in the watershed that there may be a greater potential for this to happen. The analytical component of this section focuses on annual cropland from land cover data (see ***Appendix C***) in conjunction with water erosion risk (see ***Appendix F***) and the proximity of these areas to water courses.

Water Erosion Risk

The risk of water erosion was estimated using the Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith (1965). The USLE predicted soil loss (tonnes/hectare/year) was calculated for each soil component in the soil map polygon. Water erosion risk factors used in the calculation include mean annual rainfall, slope length, slope gradient, vegetation cover, management practices, and soil erodability (Eilers et. al. 2002). Erosion risk classes were assigned based on the weighted average soil loss for each map polygon. The five classes of soil erosion risk (ranging from negligible to severe) are based on bare and unprotected soil conditions. Cropping and residue management practices can significantly reduce this risk depending on crop rotation, soil type, and landscape features. Basing the soil erosion risk on a bare soil scenario helps to identify areas dominated by sensitive, erosive soils which may otherwise be masked if a land use or surface vegetation cover factor was considered (Eilers et. al. 2002).

In the Westlake Watershed:

- **Approximately 4% of the study area (15,200 ha.) has a moderate or high risk to water erosion.**
- **There was no severe water erosion risk areas identified in the watershed.**
- **Analysis of 2006 land cover shows that approximately 31%, (10,200 ha.) of the annual cropland hectares was located on soils with a moderate or high water erosion risk.**
- **There was virtually no change in the amount of annual cropland that was located on soils with a moderate or high water erosion risk from 1993 (36% or over 9,500 ha., see *Table 14, Figure 26*).**

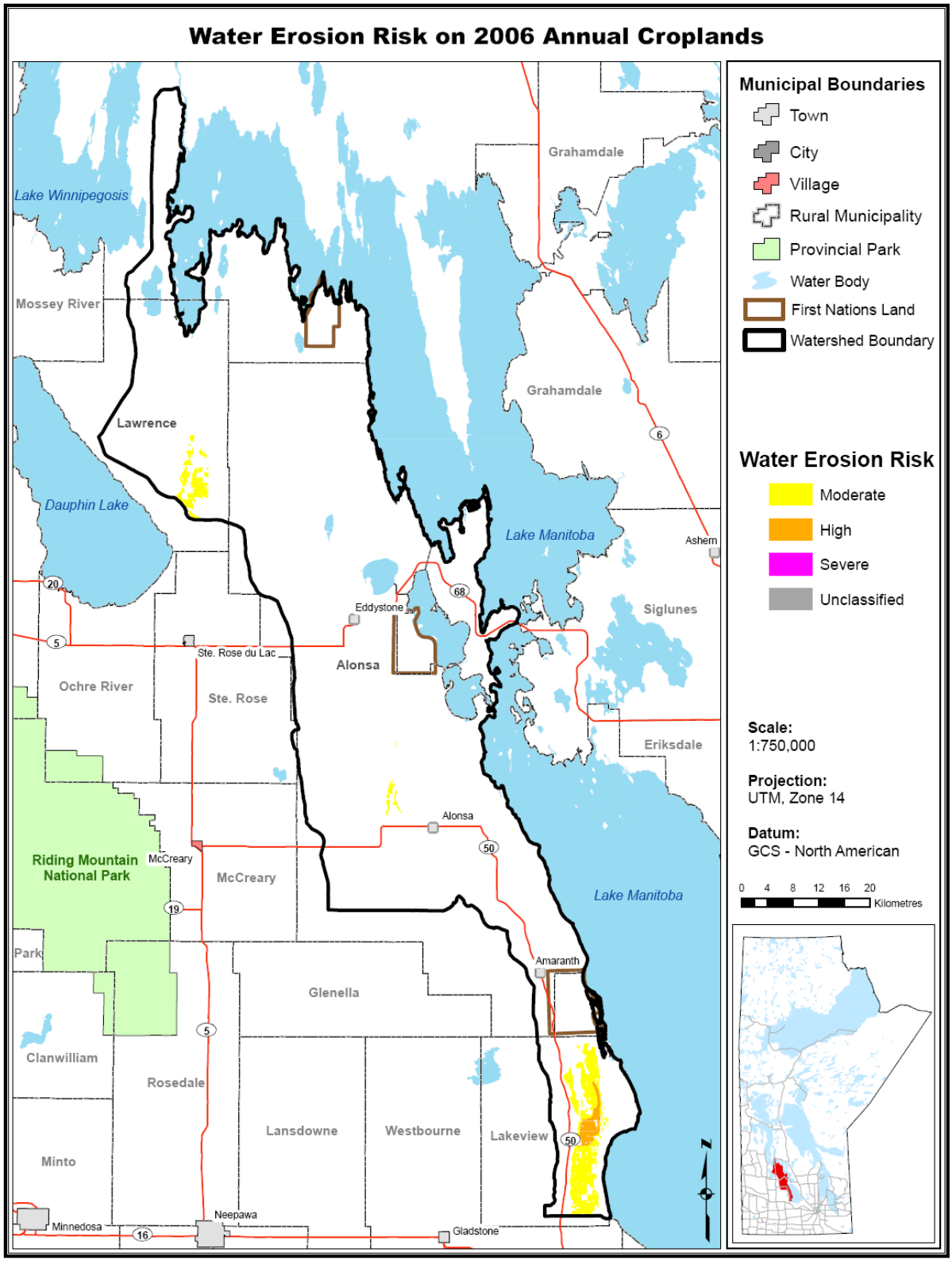
Most of the soils with high or the severe risk of water erosion are located in the northwest and very southeast portions of the study area (*see Figure 25).*

Table 14: Water Erosion Risk on Annual Cropland in the Westlake Watershed Study Area from 2006 Land Cover

Water Erosion[1]	Total Area in IWMP (ha)	2006 Annual Cropland (ha)[2]	Distribution of Annual Cropland (%)	1993 Annual Cropland (ha)[3]	1993 to 2006 Change in Annual Cropland Area (ha)[4]
Negligible	267,446	17,276	52	12,066	5,210
Low	58,,918	5.949	18	4,930	1,109
Moderate	13,678	88,56	27	8,331	524
High	1,517	1,319	4	1,209	110
Severe	0	0	0	0	0
Water	4,982	0	0	0	0
Unclassified	18	0	0	0	0
TOTAL[(5)]	**346,560**	**33,401**	**100**	**26,537**	**6,864**

1. Water Erosion Risk is based on the weighted average USLE predicted soil loss within each soil polygon, assuming bare unprotected soil.
2. Annual Cropland taken from the 2006 Land Cover (from Landsat Imagery captured on September 9, 2006)
3. Annual Cropland taken from the 1993 Land Cover (from Landsat Imagery captured on May 14, 1993)
4. Figures are derived from the total area of annual cropland in 2006 minus total annual cropland in 1993 in each Risk Class
5. Extent of Soils data is limited in size and does not encompass entire IWMP study area

Figure 25: Risk of Water Erosion on 2006 Annual Cropland in the Westlake Watershed[1]



1. Water Erosion Risk is based on bare soil and does not take into account vegetative cover or management practices

iv. Soil Drainage Analysis

Soil drainage reflects the actual moisture content in excess of field capacity and the length of the saturation period within the plant root zone. Excess water content in the soil limits the free movement of oxygen and decreases the efficiency of nutrient uptake. Delays in spring tillage and planting are more likely to occur in depressional or imperfectly to poorly drained areas of individual fields. Surface drainage improvements and tile drainage are management practices that can potentially be used to manage excess moisture conditions in soils but should only be used if deemed appropriate for a site specific situation and only where regulations requirements can be met. Agriculture and Agri-Food Canada (AAFC) has classified soils for their drainage capacity using a five class system (see ***Appendix H***).

Improved drainage indicates areas where networks of surface drains can accelerate surface runoff that reduce the duration of surface ponding and provide greater flexibility to crop management. While these drains effectively move water off fields and decrease the amount of standing water in agricultural fields, other adverse effects need to be considered. The drains facilitate water moving off fields more quickly than under natural run off conditions resulting in river channels being filled to high water levels during heavy precipitation events. High water levels could lead to a flood or near-flood stage, thereby increasing the risk for water erosion or property damage. Also, man-made drainage systems tend not to have riparian buffers associated with them, unlike natural and undisturbed watercourses. With decreased or non-existing riparian buffers, there is an increased risk of nutrient and sediment loading into watercourses, a critical water quality issue associated with Lake Winnipeg. Riparian areas and perennial vegetation on adjacent lands are able to trap and store sediment and nutrients from field runoff during the growing season, reducing the risk of contaminating surface water.

- **Analysis of the soil drainage shows that the majority, or approximately 59% (203,100 ha.) of the study area, can be considered very poorly to imperfectly drained.**
- **Approximately 63% (20,900 ha.) of the 2006 annual cropland (see *Table 15)* is considered to very poorly to imperfectly drained land.**
- **Most of the imperfectly drained soils are located in the eastern and central portions of the watershed.**
- **There is a small portion located on the eastern shores of the very bottom of the watershed.**

Soil Drainage of Annual Cropland

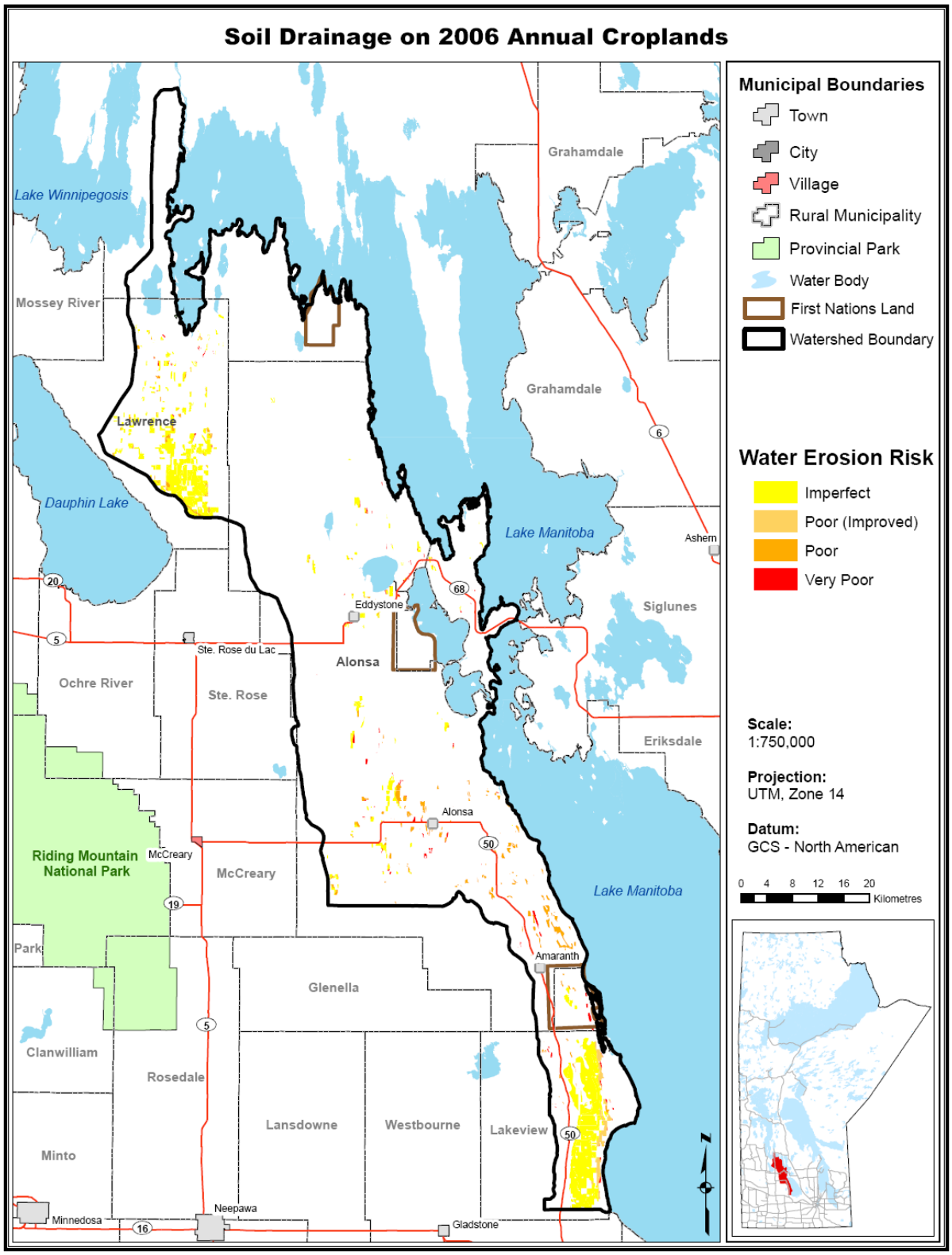
- **Most of the annual cropland in 2006 was located on very poor to imperfectly drained soils in the very northwest and southeastern portions of the watershed (refer to *Figure 26*).**
- **The percentage of annual cropland on very poor to imperfectly drained has remained the same from 1993 to 2006 despite the increase in annual cropland hectares for 2006 (an increase of approximately 6,900 ha. *See Table 15*).**

Table 15: Soil Drainage Classes in the Westlake Watershed

Drainage Class[1]	Total Area in IWMP (ha)	2006 Annual Cropland (ha)[2]	Distribution of Annual Cropland (%)	1993 Annual Cropland (ha)[3]	1993 to 2006 Change in Annual Cropland Area (ha)[4]
Rapid	2,465	2	0	0	2
Well	134,016	12,537	38	8,879	3,658
Imperfect	102,303	16,896	51	14,926	1,969
Poor (Improved)	1,081	974	3	782	192
Poor	42,897	2,329	7	1,616	713
Very Poor	56,863	663	2	333	330
Unclassified	19	0	0	0	0
Water	4,982	0	0	0	0
TOTAL[(5)]	**344,625**	**33,401**	**100**	**26,537**	**6,864**

1. Drainage Class is based on the CLI Rating of the dominant soil series for each soil polygon
2. Annual Cropland taken from 2006 Land Cover (from Landsat Imagery captured on September 9, 2006)
3. Annual Cropland taken from the 1993 Land Cover (from Landsat Imagery captured on May 14, 1993)
4. Figures are derived from the total area of Annual cropland in 2006 minus total Annual cropland in 1993 in each class
5. Extent of Soils data is limited in size and does not encompass entire IWMP study area

Figure 26 - Soil Drainage with Respect to 2006 Annual Cropping in the Westlake Watershed Study Area[1]



1. Soil drainage class is based on the dominant soil series for each soil polygon

v. Soil Slope Analysis

Slope can serve as an indicator to how fast water is going to flow off the land after a significant spring runoff or rainfall event. Steep sloped landscapes tend to have a higher risk for water erosion and for potential damage to infrastructure due to the increased velocity of runoff. Flat landscapes are generally more at risk to flooding and damage to crops and forages from excessive moisture.

Classification field summarizing slope steepness is based on the dominant slope gradient of map polygon. Further detail would require site visits and ground truthing on individual fields for greater understanding of agricultural impacts.

The Westlake Study Area shows that:

- **The watershed is relatively flat and prone to damage from overland flooding.**
- **Over 60% of the watershed is defined as having 0-2% slope (level to nearly level landscapes) with the remainder of the watershed at 2-5% slope (very gently sloping landscapes).**
- **Analysis of the soils and the 2006 Land cover data indicates that all of the forage and annual cropland are located on soils with slopes of 0-5% (see *Table 16*).**
- **A majority of annual cropland (62%) and forages (50%) are situated on flat landscapes (0-2% slope).**
- **Most of these lands were located in the very northwest and southeast portions of the watershed (see *Figure 27*).**

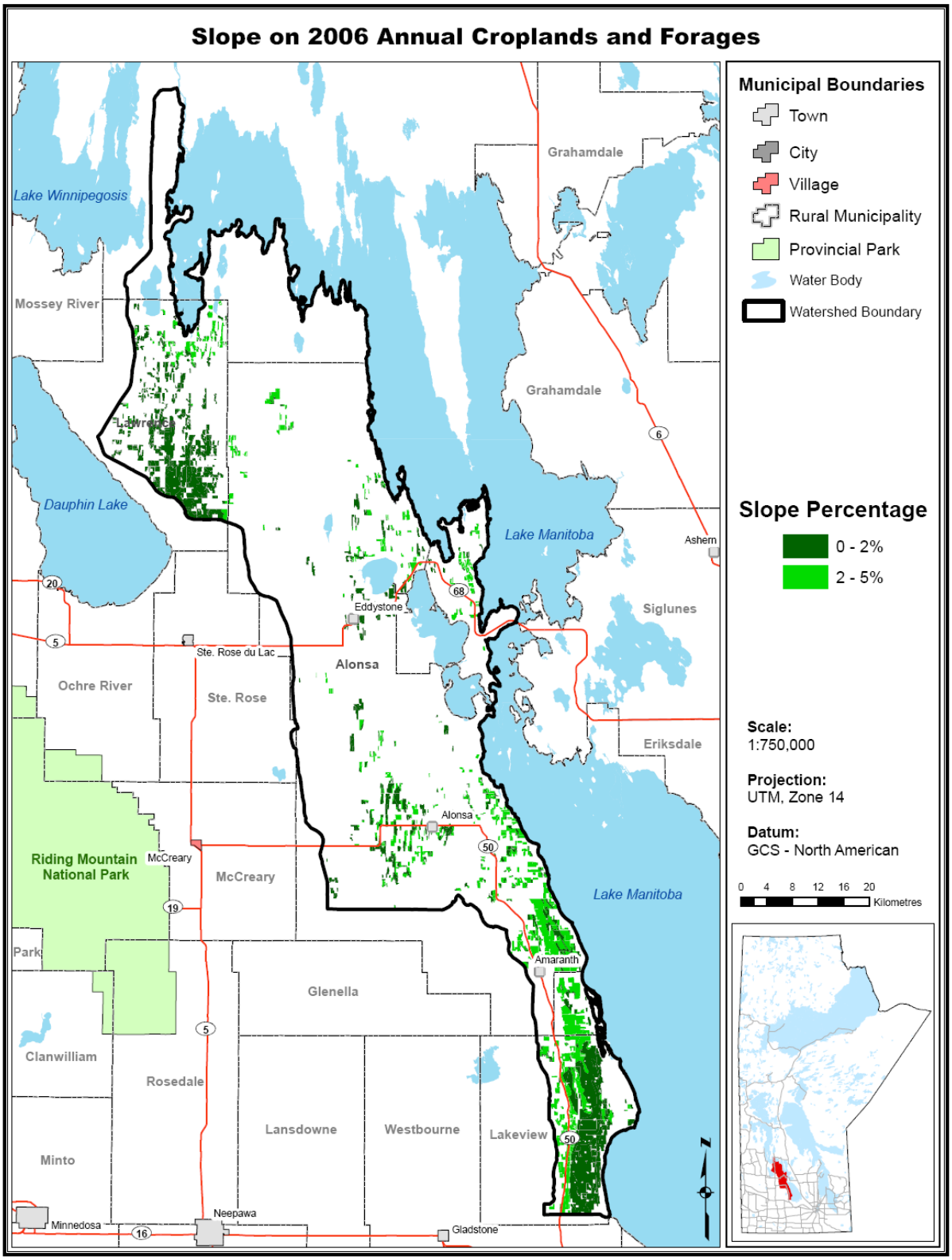
Table 16: 2006 Annual Cropland and Forages Land Cover Breakdown on Specific Slopes in the Westlake Study Area.

Soil/Topography Slope	Annual Cropland Ha. (1)	Percentage of Total Crop	Forages Ha. (2)	Percentage of Total Forage
0 - 2%	20,863	62	8,257	50
2 - 5%	12,538	38	7,757	47
Total	**33,401**		**16,014**	

(1) Total Annual Cropland from 2006 Landcover Data = 33,511 ha
(2) Total Forage from 2006 Landcover Data = 16,461 ha

Figure 27 – Slope with Respect to 2006 Annual Cropland and Forages in the Westlake Watershed Study Area[1]

1. Soil drainage class is based on the dominant soil series for each soil polygon



G. Recent Federal and Provincial Policies and Programs Affecting Agricultural Land Use and Management

i. Crown Land Management in the Westlake Watershed

The majority of crown lands in the Westlake Watershed are located in the Rural Municipality of Alonsa (see ***Table 17***). Crown Land statistics are captured on a municipal boundary basis. As such, the statistics shown below are based on the total amount of crown land within the municipalities including areas beyond the watershed. Although the information is not available on a watershed basis, it does provide a general indication of the use and management of crown lands within the Westlake portion of the watershed.

The information presented in ***Table 17*** and ***Table 18*** is derived from two different datasets which results in minor discrepancies for the total amount of hectares of crown land within these two municipalities.

Table 17: Crown Lands by Rural Municipality in the Westlake Watershed Study Area

Rural Municipality	Total Area (ha.)	Percentage
Alonsa	132,394	91
Lawerence	9,546	6
Lakeview	4,053	3
TOTAL	**145,994**	**100**

- **Approximately 146,000 ha are available for agricultural use through the Agricultural Crown Land leasing and permitting program (See *Appendix M*).**
- **20,735 ha of land is managed by AESB's Community Pasture Program (see *Figure 29*).**

Table 18: Hectares by MAFRI Crown Land Use Coding

Crown Land Use	Total Area (ha.)	Percentage
Agricultural Use (Lease)	103,482	72
Agricultural Use (Yearly Permits)	9,296	6
Community Pastures (Managed by AESB)	20,735	14
No Agricultural Use (Wildlife, Recreational)	12,386	8
Uncoded (No Agricultural Use)	123	0
TOTAL	**146,022**	**100**

Crown land is subject to specific land use and management based on government acts, regulations and policies. MAFRI is involved in the planning and regulatory management of approximately 648,500 Crown land leased hectares in Manitoba. More information regarding Crown Land Policy, Management, and regulation can be found in ***Appendix K***. This land base, which is primarily utilized for forage production and rangeland, provides the annual feed requirements for approximately 10 % of the provincial beef herd according to local authorities. Given that crown land accounts for approximately 43% of the land base in the watershed, one could assume that continued agricultural use on these crown lands is extremely important in sustaining annual feed requirements for the cow calf herd in the Westlake Watershed.

Of the 91% of the crown land located in the Rural Municipality of Alonsa, approximately 112,800 ha were utilized in 2009 for some form of agricultural production (long term forage lease or short term hay permit - see ***Figure 28***). (MAFRI, Land Use Planning Knowledge Centre).

ii. Management Considerations on Crown Lands

a) Land Capability Classification

***Table* 19** illustrates the agricultural land use capability of crown land in the Westlake Watershed. Approximately 70% of the total crown lands within the watershed are either Class 4 or Class 5 (see ***Figure* 29, *Table 19*)**. These viable lower class lands are suitable for supporting the existing cow calf enterprises within the watershed and should be maintained in agricultural production through the crown land leasing system.

Table 19: Agricultural Capability of Crown lands in the Westlake Watershed Study Area *

Agricultural Capability	Total Area (ha.)	Percentage of Crown Land Area
Class 1-3	8,532	5,1
Class 4-5	117,368	69.5
Class 6-7	28,897	17.5
Organic	11,967	7.1
Unclassified	2,056	1.2
Water	0	0
TOTAL	**168,821**	**100**

* Table does not include other categories and reflects a smaller area of Crown lands in the watershed.

Figure 28 - Crown Land Characterization Coding in the Westlake Watershed Area

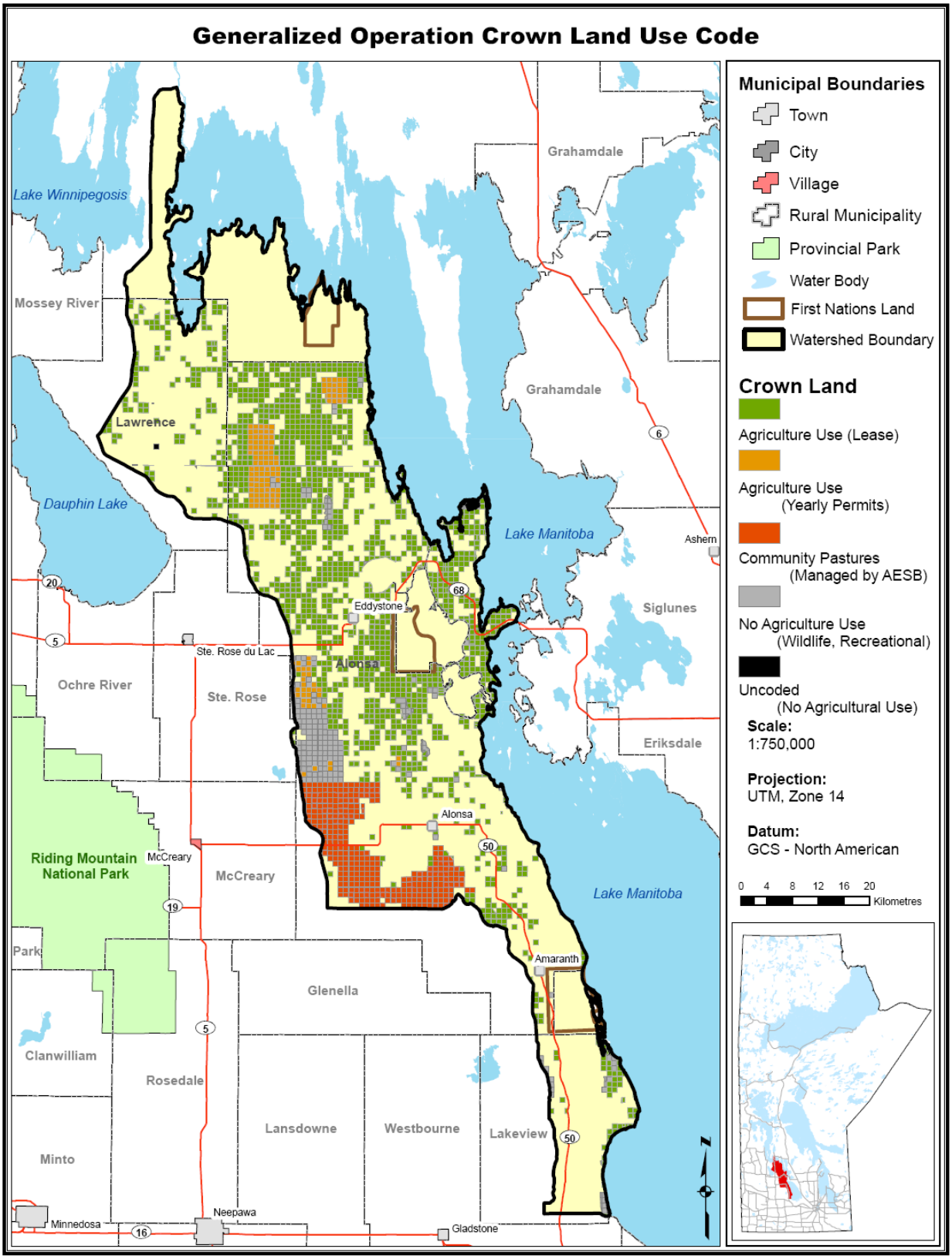
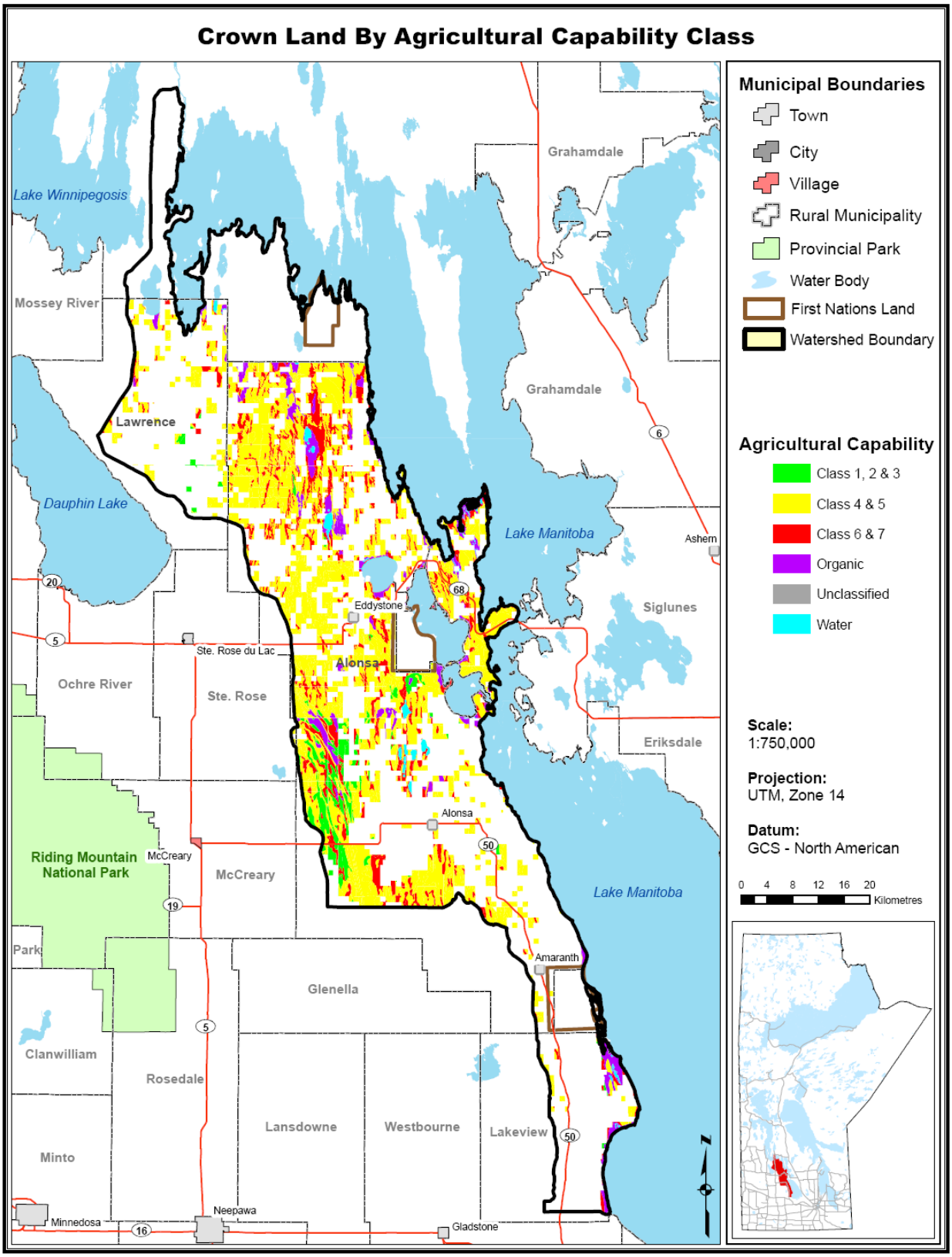


Figure 29: Agricultural Capability of Crown Lands in the Westlake Watershed



b) Wooded Species Encroachment on Crown Lands

As noted in Section E iii, there was an overall decrease of almost 12,000 ha of grassland between 1993 and 2006. This trend also occurs on crown lands with the watershed (see ***Table 20***).

Between 1993 and 2006, the largest increase took place on lands available for agriculture use (lease), while the lowest increase has taken place on lands identified for agriculture use (yearly permits).

It would seem to indicate that lands with wildlife or recreational use have reached equilibrium in terms of wooded species encroachment, while lands available for long term agricultural use have the second lowest rate of increase. This would seem to indicate that a woody species regeneration has been slowed on these lands somewhat maintaining productivity.

Wooded species encroachment is a function of management (e.g. grazing), weather (rainfall), drainage, by reduced cattle numbers, and by financial pressures in the industry. In general terms, the primary woody species encroaching on grassland tend to be poplar and willow.

A number of key factors have played a role in the reduction of productivity on both crown and private lands within the Westlake Watershed including reduced grazing pressure and lower cattle numbers, as well as excessive moisture and poor drainage.

Table 20: Change in Grassland to Trees on Crown Lands (1993-2006)

Generalized Operation Land Use Code	Total Area (ha)	Total Area which changed from grassland in 1993 to trees in 2006	% Change	% Change/Yr
Agricultural Use (Lease)	103,482	6,303	6	0.5
Agricultural Use (Yearly Permits)	9,296	759	1	.1
Community Pastures (Managed by AESB)	20,735	4,247	21	1.6
No Agriculture Use (Wildlife, Recreational)	12,386	922	1	.1
Uncoded (No Agricultural Use)	123	0	-	-
Total	**146,022**	**12,230**	**12**	**.92**

It should be noted that the factors identified above have played a key role in reducing the overall productivity on crown lands within the watershed. Extension activities focusing on range management and your farmer entrance into the cow calf sector would help to address this loss of productivity.

Changes to private and crown land productivity may also be linked to the age demographic. Manitoba Agriculture, Food and Rural Initiatives completed area scans across agro-Manitoba in 2007. Scans within the Westlake Watershed area revealed the median age of the population in the area to be approximately 50 years of age, more than 10 years older than the provincial median which was 36.8 years of age.

This would indicate an overall older generation of producers in this area, which could indicate a tendency toward more traditional farming practices. This, in combination with the modest net farm income earned in this area (approximately 13,000 per annum in the year 2000 {Stats Canada Census of Agriculture}) and higher unemployment rate may indicate an aversion to invest in more conservation-minded methods, or even maintaining existing fields. This may be evidenced in the change of grasslands and pasture to trees in this area.

ii. Recent Federal-Provincial Programs

Environmental Farm Planning and Canada-Manitoba Farm Stewardship Program - On-Farm Beneficial Management Practices Adoption

In 2003, the Agricultural Policy Framework (APF) was launched as a new national approach to support agricultural activities associated with Business Risk Management, food safety and quality, science and innovation, environment, and skill development. In support of priorities related to soil, air, water and biodiversity, various environmental initiatives were introduced across Canada including Environmental Farm Planning and the National Farm Stewardship Program. Environmental Farm Planning (EFP) is awareness and planning tool used to enhance producers' understanding of potential on-farm environmental risks and to develop action plans for how these risks can be addressed. Many producers in Manitoba, including those in the watershed, have participated in the EFP process to gain an improved understanding of the potential environmental risks associated with agriculture, as well as, those on their own farms. The EFP process also allowed producers to develop an action plan that outlines how potential risks on their farms can be addressed through the adoption of beneficial management practices (BMPs). Financial and technical support has been offered to producers wishing to adopt BMPs through the Canada Manitoba Farm Stewardship Program (CMFSP) between 2003 and 2009. This program offered 30 different BMPs to producers that had completed an EFP. (For a list and description of the BMPs see ***Appendix L***).

Participation in the Environmental Farm Plan Program is aggregated by municipalities in the study area (***Appendix M***). The information portrays the number of participants in the Environmental Farm Planning process based on where EFP workshops were held. Therefore it should be noted that participants may reside in the surrounding area and not necessarily in location of the workshop. Environmental Farm Planning Workshops were well attended, with a high degree of producers completing the process to receive a Statement of Completion for eligibility to BMP funding through the CMFSP. These numbers within the study area were at the Manitoba average as well, indicating that producers in the Westlake watershed are proactive in nature and environmental issues are high on their priorities.

In the Westlake Watershed study area there were a total of 106 BMP projects that were completed by producers (***Table 21***). All of these BMPs contribute to reducing risks to water quality. Of the 106 completed, 54 of the projects were categorized as Non-Point Source – Livestock Related BMPs.

The top three BMPs adopted by producers in the study area through the CMFSP were Winter Site Management, Improved Cropping Systems, and Enhancing Wildlife Habitat and Biodiversity.

The adoption of BMPs by producers is not limited to those funded through the CMFSP. Other agencies like Conservation Districts, Ducks Unlimited Canada, and Manitoba Habitat Heritage Corporation also support the adoption of various BMPs. In 2009, Manitoba Food and Rural

Initiatives (MAFRI) have initiated to offer BMP support through the Growing Forward Initiative. Further information about the current Growing Forward Program in support of Environmental Farm Planning and BMPs can be found on the MAFRI website at: http://www.gov.mb.ca/agriculture//soilwater/farmplan/index.html

As indicated in the public consultation process for the IWMP, there have been many producers who have adopted BMPs on their own initiative, so it is difficult to determine precise adoption levels. However, considering the number of farms in the watershed, the CMFSP program data does suggest that producers in the watershed are progressive in terms of BMP adoption and that future conservation programs that may stem from IWMP implementation are likely to have considerable levels of participation in this region.

Table 21: BMP Adoption through the Canada-Manitoba Farm Stewardship Program 2003-2008[8]

BMP Categories	Westlake IWMP
Point Source - Livestock Manure Related[1]	9
Point Source - Other (Petroleum, Nutrients from Feed, Pesticides, etc.)[2]	8
Non Point Source - Livestock Related[3]	54
Non Point Source - Crop Related[4]	19
Non Point Source - Crop Related (Pesticides)[5]	<5
Soil Erosion - Soils at Risk[6]	<5
Biodiversity[7]	11
Total	**106**

1. These include BMPs 1, 2, 4, 5, 6
2. These include BMPs 8, 9, 17
3. These include BMPs 3, 7, 10, 26, 30
4. These include BMPs 14, 18, 24, 29
5. These include BMPs 16, 20, 25
6. These include BMPs 11, 12, 13, 15, 19, 27
7. These include BMPs 21, 22, 23, 28
8. Refer to Appendix L for BMP descriptions

H. Agricultural Land Use and Management Recommendations*

Watershed Issue	Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Surface Water Quantity	**Influences on Water Management** – Parts of the watershed are vulnerable to flooding due to excess moisture and/or increased drainage. The following trends have been noted in the watershed and influence this issue: • **Farm Size**- Fewer but larger farms. Amaranth experienced the greatest change with almost 45% less farms in 2006 and increasing farms sizes for the remaining farms A large decrease in farmland (over 7,000 ha). In Amaranth, this came mainly from cropland, in Alonsa, from pasture. • The average size of farms, in terms of area per farm, has increased steadily from about 506 ha to about 791ha in the Alonsa area, an increase of approximately 56%. • **Annual Cropping** – Trends noted include: (a) Annual Cropland accounts for 9 % of the watershed (approximately 33,511 ha).Annual cropland has increased by almost 3% (or approximately 7,100 hectares) between 2002 and 2006 **(Table 11, Page 31).** This may be attributed to land clearing for other agricultural land management practices like Winter Site Management or Silage development**.** (b) Analysis indicates that annual cropland was most often changed from grassland land cover – approximately, 8,800 ha. of grassland in 1993 converted to cropland in 2006 **(Figure 18, page 33)**. Most of the remaining land that was changed to annual cropland in 2006 came largely from wetlands and treed areas that were present in 1993 (**Table 11, Page 31**). (c) **Marginal Land-** The 2006 land cover data indicates that over 53% of annual cropland is located on land rated as Class 4 or poorer **(Table 12, Page 40)**. (d) **Tillage Practices** - In Rorketon, conservation and zero tillage practices are reported over 55% of the fields prepared for seeding for 2006. In Alonsa, conventional tillage practices are reported on 65% of fields being prepared for seeding **(Figure 5, Page 15).** From 2001 to 2006 , conventional tillage dominates in the Alonsa and Amaranth subwatersheds (**Table 7, Page 25).** • **Soil Drainage**- Approximately 58% of the study area can be considered very poor to imperfectly drained. These types of lands make up 63% of the 2006 annual cropland. Most of the imperfectly drained soils are found in the very south-eastern portion of the watershed (**Figure *27,* Page 49**). • **Slope**- Over 60% of the watershed is defined as having 0-2% slope (level to nearly level landscapes) with the remainder of the watershed at 2-5% slope (very gently sloping landscapes). A majority of annual cropland (62%) and forages (50%) are situated on flat landscapes (0-2% slope) **(Figure 28, Page 53)**. • **Class 4 and Poorer Agricultural Lands** - Within the Westlake Watershed, approximately 89% of the land is classified as Class 4 and poorer. The 2006 land cover data indicates that over 53% of annual cropland is located on land rated as Class 4 or poorer**(Table 12, Page 40)**. There has also been a steady increase in forages **(Figure 17, Page 31).** • **Tree Land Cover** - Changes in land cover between 1993 and 2006 show an increase of 6,400 ha in forested areas, primarily in the southern portions of the watershed. a majority of the forested areas land cover came at the expense of what was previously noted as grassland land cover in 1993 (approximately 22,000 hectares) **(Table 11, Page 31, Figure 20, Page 35).** • **Grassland** - Approximately 5,000 ha. was changed from grassland in 1994 to annual cropland in 2006 **(Figure 21, Page 36).** • **Forages** - Forage land cover had increase by approximately 5,100 ha. from 1993 to 2006 **(Table 11, Page 31).** • **Wetlands** – Trends noted include: (a) Wetlands make up 13% of the watershed **(Table 11, Page 31).** (b) The area covered by wetlands decreased by approximately 1,582 hectares from 1993-2006**(Table 11, Page 31)**. • **Precipitation Levels**- All weather stations located in the watershed had recorded Total Annual Precipitation and Total Annual Rainfall corresponding to years of land cover imagery: (a) 50% of the observed periods for total annual precipitation and total annual rainfall levels were above the 30 year averages. The above normal readings were noted for the 2000/2001and 2005/2006 year records. (b) A majority of the Total Annual Precipitation comes in the form of Rainfall (approximately 75%)(**see Appendix N, Page 88)**. • **BMP Adoption -** Of the 106 completed practices, 17 of the projects were categorized as Point Source BMPs. **(Table 21, Page 57).** • **Timing of Land cover Imagery** -Timing of Imagery and classification definitions may affect the number (i.e. a decrease or increase) of wetlands identified and should be verified with site specific analysis (ground truthing)	Examine the needs for a surface **water assessment and management study** for the entire watershed. **Site Specific BMP Implementation for Water Management** - Promote and provide technical assistance for water management BMPs (e.g. riparian buffers, riffle structures, headwater storage options, and erosion control in key priority areas of the watershed. **Watershed Approach to Water Management BMP Implementation** - Promote and provide technical assistance for water management BMPs using whole watershed approach with consideration of upstream opportunities and downstream effects (e.g. perennial forage establishment, sustainable woodlot management, sustainable rotational grazing, riparian area management). Examine other **Land Management Opportunities** that provide value to landowners and contribute environmental benefits (e.g. wetlands or riparian buffers). **Education -** Encourage environmental educational initiatives that demonstrate the benefits of implementing BMPS (as above) to support better surface water management.	Areas in the watershed that are: • Imperfectly drained soils and annual cropland • wetland areas for backflood irrigation • identified to maintain a sustainable percentage of natural wetland areas on class 4 or higher lands that assist with wetland retention purposes Entire Watershed	Proportion of watershed where: • wetlands have changed (e.g. increase in sizes and/or numbers), • the change of annual cropland hectares on imperfectly drained soils • wetland, tree, grassland/pasture and forage land cover classes have increased • BMPs have been implemented to manage flooding and/or restore wetlands Changes in surface water flows as identified through stream flow measurements Number of educational initiatives presented

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators; need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

Watershed Issue	Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Drinking Water Quality	**Changing use and management of environmentally sensitive lands**, such as natural forests and wetlands that provide ecological benefits like clean water. The following influences refer to this issue: • **Tree Land Cover**- Treed areas dominated the watershed in the 2006 Land Cover (43%) **(Table 4, Page 20).** • **Agricultural influence on source water areas in watershed**- Activities on land may lead to the possibility of increased movement into the subsurface and impacting the groundwater supply. Specific influences may include: • **Annual Cropping** – Trends noted include: (a) Annual Cropland accounts for 9% of the watershed (approximately 33,511 ha).Annual cropland has increased by almost 3% (or approximately 7,100 hectares) between 2002 and 2006 **(Table11, Page 31).** This may be attributed to land clearing for other agricultural land management practices like Winter Site Management or Silage development**.** (b) Analysis indicates that annual cropland was most often changed from grassland land cover – approximately, 8,800 ha. of grassland in 1993 converted to cropland in 2006 **(Figure 18, page 33)**. Most of the remaining land that was changed to annual cropland in 2006 came largely from wetlands and treed areas that were present in 1993 (**Table 11, Page 31**). (c) **Marginal Land-** The 2006 land cover data indicates that over 53% of annual cropland is located on land rated as Class 4 or lower **(Table 12, Page 40)**. (d) **Tillage Practices** - In Rorketon subwatershed, conservation and zero tillage practices are reported on almost 60% of the fields prepared for seeding, with conventional tillage dominating. In Alonsa, conventional tillage practices increased **(Figure 5, Page 15; Table 7, Page 25).** • **Grasslands -** There was an overall decrease of almost 17,000 ha of grassland in 2006, from 1993 **(Table 11, Page 31).** • **Perennial Forages –** There has been a steady decrease in the amount of forages and pasture in the watershed since 2001 reported by farmers in Census of Agriculture **(Figure 13, Page 25).** Decreases noted may be attributed to flooding due to above normal rainfall being recorded in 1993 and 2005 in portions of the watershed **(Appendix N, Page 88).** • **Nutrient transport from agricultural land** due to fertilizers and manure application may lead to impacts on drinking water source. The following trends (or influences) may affect this issue: (a) **Oilseeds, Spring Wheat** –Overall decrease in watershed with a slight increase in oilseed and spring wheat production in the southeast portion of the watershed, may be leading to increased levels of nutrient application on cropland **(Figure 13, Page 25).** (b) **Crop Inputs -** Overall decrease of crop inputs in watershed from 2000 to 2005, with slight increase noted in the southeastern portion of the watershed (**Figure, 14, Page 26**). • **Livestock Numbers –** Decreases noted in cattle numbers for the Alonsa and Amaranth subwatershed areas, as well as farms reporting cattle. In spite of this, herd sizes increased on the remaining farms, including an increase to beef cows per farm. Average herd size per farm increased as well **(Page 29)**. • **Beef Production** - Total Cattle and Calves make up approximately 44,000 head in the watershed with average herd size being between 210-220 cows/farm. Beef Cows make up approximately 21,000 head in the watershed, with average herd size being 110 beef cows per farm. (**Figure, 6, Page 16**). • **BMP Adoption -** Of the 106 completed, 17 of the projects were categorized as Point Source BMPs. **(Table 21, Page 57).**	**Conduct Assessment of where vulnerabilities are with respect to groundwater (i.e. groundwater risk areas like recharge areas, high water table areas and contamination sources in or near these areas)** **Nutrient Losses from Agricultural Lands** –- Promote BMPs aimed at reducing nutrient transport to waterbodies (e.g. nutrient management plans, soil testing, manure testing, riparian area management and buffer strips) specify within point and non point **Education -** Encourage environmental educational initiatives that demonstrate the importance of wellhead and watershed protection to support better drinking water quality.	Groundwater risk areas, specifically those that are recharge areas, high water table areas and contamination sources in or near wellheads). Areas near source water or waterways and are: • In annual crop production and receive fertilizer or manure application Entire Watershed	With respect to drinking source watersheds, specifically: • Percent change of landcover to Perrenial cover, • Percent change of wetland areas, • # of BMPs implemented in riparian areas. Change in area of watershed that: • # of farmers implementing BMPs to reduce nutrient losses from cropland (e.g. nutrient management plans, buffer strips, soil and manure testing), • are forested or wetland areas, • have grazing BMPs implemented for the riparian areas. Changes that reflect positive source water quality testing results Number of educational initiatives presented

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators; need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

Watershed Issue	Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Surface Water Quality	**Agricultural influence on source water areas in watershed**- Activities on land may lead to the possibility of increased nutrient movement into the waterways. Specific influences may include: • **Annual Cropping** – Trends noted include: (a) Annual Cropland accounts for 9 % of the watershed (approximately 33,511 ha).Annual cropland has increased by almost 3% (or approximately 7,100 hectares) between 2002 and 2006 **(Table11, Page 31).** This may be attributed to land clearing for other agricultural land management practices like Winter Site Management or Silage development**.** (b) Analysis indicates that annual cropland was most often changed from grassland land cover – approximately, 8,800 ha. of grassland in 1993 converted to cropland in 2006 **(Figure 18, page 33)**. Most of the remaining land that was changed to annual cropland in 2006 came largely from wetlands and treed areas that were present in 1993 (**Table 11, Page 31**). (c) **Marginal Land-** The 2006 land cover data indicates that over 53% of annual cropland is located on land rated as Class 4 or poorer **(Table 12, Page 40)**. (d) **Tillage Practices** - In Rorketon, conservation and zero tillage practices are reported over 55% of the fields prepared for seeding for 2006. In Alonsa, conventional tillage practices are reported on 65% of fields being prepared for seeding **(Figure 5, Page 15).** From 2001 to 2006 , conventional tillage dominates in the Alonsa and Amaranth subwatersheds (**Table 7, Page 25).** • **Crown Lands** - In the Westlake Watershed study area, there are approximately 146,000 hectares of Crown Lands, representing 37% of the total watershed **(Table 17, Page 51).** • **Herd Numbers –**Total Cattle and Calves make up approximately 44,000 head in the watershed with average herd size being between 210-220 cows/farm. Beef Cows make up approximately 21,000 head in the watershed, with average herd size being 110 beef cows per farm (**Figure, 6, Page 16**). • **Commercial Fertilizer**- Crop production is important in both subwatersheds. In Alonsa, annual crops tend to make up a greater portion of the cropland, and fertilizer and herbicides are used on around 70% and 55% of the cropped land respectively. In Rorketon, these inputs are used on a smaller percentage of the cropped land. In Amaranth, about half of the cropland was fertilized with commercial fertilizer, and less than a quarter had herbicide applications **(Figure 9/Table 3, Page 19).** • **Herbicide Use**- In Alonsa from 2001 to 2006, there was a decrease in the use of fertilizers and pesticides, partially due to the overall decrease in cropland. In Amaranth, there was a slight increase in the proportion of cropland with fertilizer applications, and a slight decrease in the proportion of herbicide applications **(Figure 14, Page 26).** • **Grasslands –** There was an overall decrease of almost 12,000 ha of grassland in 2006, from 1993 **(Table 9, Page 26).** • **Perennial Forages –** There has been a steady decrease in the amount of forages and pasture in the watershed since 2001 reported by farmers in Census of Agriculture **(Figure 13, Page 25).** Decreases noted may be attributed to flooding due to above normal rainfall being recorded in 1993 and 2005 in portions of the watershed **(Appendix N, Page 89).** • **Precipitation Levels**- All weather stations located in the watershed had recorded Total Annual Precipitation and Total Annual Rainfall corresponding to years of land cover imagery: (a) 50% of the observed periods for total annual precipitation and total annual rainfall levels were above the 30 year averages. The above normal readings were noted for the 2000/2001and 2005/2006 year records. (b) A majority of the Total Annual Precipitation comes in the form of Rainfall (approximately 75%)(**see Appendix N, Page 88**). • **BMP Adoption -** Of the 106 completed, 54 of the projects were categorized as Non Point Source – Livestock Related BMPs. **(Table 21, Page 57).** • **Soil Drainage**- Approximately 52% of the study area can be considered very poor to imperfectly drained. These types of lands make up 63% of the 2006 annual cropland. Most of the imperfectly drained soils are found in the very south-eastern portion of the watershed (**Table 15-Page 47, Figure 26-Page 48**). • **Water Erosion Risk**-Soils and land cover data suggest <1% of the watershed has areas with a high water erosion risk, and only some with moderate water erosion risk. **(Table 14-Page44, Figure 25- Page 45)**. • **Wind Erosion Risk** - Approximately 9% of the Westlake Watershed is considered to have moderate, high or severe wind erosion risk, primarily in the eastern portion of the watershed. 11% of the annual cropland was located on soils with these wind erosion risks **(Table 12, Page 42).**	**Riparian Area Assessment –** Conduct a Riparian Area Assessment of select tributaries in the Westlake Watershed to determine where mitigation measures would be most effective. **Nutrient Losses from Agricultural Lands** –- i) Promote the adoption of BMPs that assist in the reduction of nutrient of surface water bodies. These include the adoption of riparian buffers, a management regime for healthy buffers, increase the size of buffers near specific streams, and nutrient management planning. ii) Promote the adoption of BMPs aimed at reducing nutrient transport to waterbodies (e.g. nutrient management plans, soil testing, and manure testing, feedlot relocation, winter site management, and farmyard runoff control). **Education – i)** Encourage environmental educational initiatives that demonstrate the benefits of implementing BMPS (as above) to support better surface water quality. **ii)** Explore options to utilize Community Pasture/Crown Lands for demonstration projects or extension activities for BMPs related to priority IWMP issues (surface water management, water quality, and/or wildlife habitat). These options would further the goals of the IWMP and also align with the mandate of the Community Pasture Program.	Specific tributaries in the Westlake Watershed Annual cropland located on soils with agricultural capabilities of Class 4 and poorer, as well as, organic soils. Established Feedlot sites that are within the riparian area of sensitive streams. Agro-Woodlot stands that are primarily mature in age and are located near water source areas. Entire Watershed Areas in the watershed that are: • Community Pasture and other perennial cover (forest, grassland or pasture) or wetlands near class 4 or poorer land	The number of kilometers of riparian area that is unhealthy or needing improvement Change in area of watershed that : • have implemented BMPs to reduce nutrient losses from cropland (e.g. nutrient management plans, buffer strips, soil and manure testing, feedlot runoff,) • are forested or wetland areas • have grazing BMPs implemented for the riparian areas Changes that reflect positive source water quality testing results Number of workshops presented or amount of extension material received Successful two way extension activities between the watershed stakeholders and Community Pasture

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators; need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

Watershed Issue	Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Soil Salinity/loss/ Erosion	The following influences or trends may affect this issue: • **Annual Cropping** – Trends noted include: (a) Annual Cropland accounts for 9 % of the watershed (approximately 33,511 ha).Annual cropland has increased by almost 3% (or approximately 7,100 hectares) between 2002 and 2006 **(Table11, Page 31).** This may be attributed to land clearing for other agricultural land management practices like Winter Site Management or Silage development**.** (b) Analysis indicates that annual cropland was most often changed from grassland land cover – approximately, 8,800 ha. of grassland in 1993 converted to cropland in 2006 **(Figure 18, page 33)**. Most of the remaining land that was changed to annual cropland in 2006 came largely from wetlands and treed areas that were present in 1993 (**Table 11, Page 31**). (c) **Marginal Land-** The 2006 land cover data indicates that over 53% of annual cropland is located on land rated as Class 4 or lower **(Table 12, Page 40)**. (d) **Tillage Practices** - In Rorketon, conservation and zero tillage practices are reported over 55% of the fields prepared for seeding for 2006. In Alonsa, conventional tillage practices are reported on 65% of fields being prepared for seeding **(Figure 5, Page 15).** From 2001 to 2006, conventional tillage dominates in the Alonsa and Amaranth subwatersheds (**Table 7, Page 25).** • **Water Erosion Risk**-Soils and land cover data suggest <1% of the watershed has areas with a high water erosion risk, and only some with moderate water erosion risk. **(Table 14, Figure 25, Page 44).** • **Wind Erosion Risk** - Approximately 9% of the Westlake Watershed is considered to have moderate, high or severe wind erosion risk, primarily in the eastern portion of the watershed. 11% of the annual cropland was located on soils with these wind erosion risks **(Table 13, Page 42).** • **Slope**-Over 60% of the watershed is defined as having 0-2% slope (level to nearly level landscapes) with the remainder of the watershed at 2-5% slope (very gently sloping landscapes). A majority of annual cropland (62%) and forages (50%) are situated on flat landscapes (0-2% slope) **(Figure 27, Page 50)**. • **Perennial Cover** -There has been a steady decrease in the amount of perennial cover in the watershed (e.g. improved pasture and alfalfa) since 2001 **(Figure 18, Page 26)** Decreases noted may be attributed to flooding due to above normal rainfall being recorded in 1993 and 2005 in portions of the watershed **(Appendix N, Page 89).** • **Tree Land Cover** - Changes in land cover between 1993 and 2006 show an increase of 6,400 ha in forested areas, primarily in the southern portions of the watershed. A majority of the forested areas land cover came at the expense of what was previously noted as grassland land cover in 1993 (approximately 22,000 hectares) **(Table 9, Page 28, Figure 22, Page 37).** • **Farm Size-** The average size of farms, in terms of area per farm, has increased steadily from about 506 ha to about 791ha in the Alonsa area, an increase of approximately 56%. The amount of land farmed in the watershed has shown a large decrease in farmland (over 7,000 ha). In Alonsa, this came from cropland, in Amaranth, from pasture slightly in the watershed. **(Figure 12, Page 24).** • **BMP Adoption -** Of the 106 completed, less than 5 of the projects were categorized as Soil Erosion - Soils at Risk Erosion Protection BMPs. **(Table 20, Page 57).** • **Age of Producers-** The median age of the population in the area to be approximately 50 years of age, more than 10 years older than the provincial median which was 36.8 years of age. **(Section Eib, Page 20)** • **Precipitation Levels**- All weather stations located in the watershed had recorded Total Annual Precipitation and Total Annual Rainfall corresponding to years of land cover imagery: (a) Levels for total annual precipitation and total annual rainfall were above the 30 year averages to more than 50% of the observed dates. The above normal readings were noted for the 2000/2001and 2005/2006 year records. (b) A majority of the Total Annual Precipitation comes in the form of Rainfall (approximately 75%)(**see Appendix N, Page 88)**. • Due to data limitations, further attention to these areas such as site assessments would be required if action (BMP implementation) is indeed warranted.	**(Analysis found little risk to that water/wind erosion or soil salinity at the watershed scale. Any concerns identified by local stakeholders are most likely related to site specific issues and any recommendations for addressing such issues should be considered on a case by case basis.)** **Water Erosion Mitigation** - Promote BMPs in areas with potential risk for water erosion (e.g. riparian buffer, and perennial cover establishment for the lower class of lands in severe or highly erosive areas). **Wind Erosion Mitigation** - Promote BMPs, such as the use of cover crops and residue management techniques, and shelterbelt establishment in the few areas where wind erosion is an issue	Areas in the watershed that are: • in close proximity to waterways and in annual crop production and high risk of water erosion • Annual cropped lands of class 4 and poorer	Proportion of the watershed: • where annual cropland hectares within 50 m of a water course have been converted to annual cover • have been water erosion mitigation BMPs (e.g. cover crops, buffer strips, etc.) implemented • where BMPs have been adopted in critical areas or targeted areas; water quality results or report card larger waterways

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators; need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

I. References:

Agriculture and Agri-Food Canada. 2003-2008. *BMP Fact Sheets*, Canada-Manitoba Farm Stewardship Program

Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration, *Historical Perspective of Precipitation on the Prairies*. Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration, Regina, Saskatchewan. www.agr.gc.ca/pfra/drought/drhistprecip_e.htm

Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration, Prairies East Region. 2004. *Summary of Resources and Land Use Issues Related to Riparian Areas in the Westlake Watershed Study Area*. Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration, Winnipeg.

Coote, Eilers & Langman. 1989. *Agriculture Canada Wind Erosion Risk Maps*

Eilers, R.G., G.W. Lelyk, P. Cyer, and W.R. Fraser. *Status of Agricultural Soil Resources of Manitoba; Summary of Applications and Interpretations of RMSID, (Rural Municipality Soil Information Data Base).*

Environment Canada, *Canadian Climate Normals or Averages 1971-2000*, http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html

Manitoba Agriculture Food and Rural Initiatives. *North Parkland Go Team Area Scan December 2006*. 2006. Manitoba Agriculture Food and Rural Initiatives, Carman, Manitoba

Manitoba Agriculture Food and Rural Initiatives. *Central Plains Go Team Area Scan December 2006*. 2006. Manitoba Agriculture Food and Rural Initiatives, Carman, Manitoba

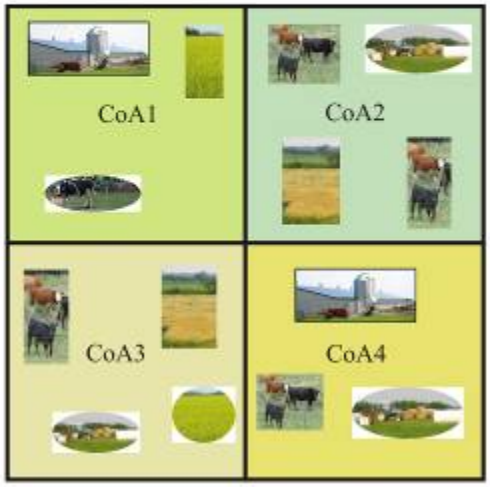
Manitoba Conservation. 2001, 2006. *Land Use/Land Cover Descriptions*. Geomatics and Remote Sensing Branch

J. Appendices

Appendix A: Diagram for Interpolating Census of Agriculture Data (Area Weighting Method)

Basic concept of interpolating Census of Agriculture (CoA) using the area weighting method*

Census of Agriculture (CoA) from Statistics Canada's geographic boundaries



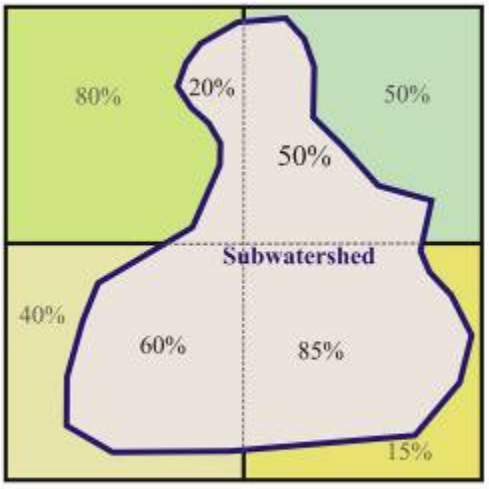
CoA is the sum of all survey forms of farms with farm headquarters located in the specific boundary

For Example - Total cattle and calves

CoA1 = 540 total cattle
CoA2 = 300 total cattle
CoA3 = 125 total cattle
CoA4 = 1200 total cattle

CoA from Statistics Canada's geographic boundary

CoA interpolated to subwatershed boundary



Interpolated CoA for Subwatershed =
(CoA1: 540 cattle x 20%) +
(CoA2: 300 cattle x 50%) +
(CoA3: 125 cattle x 60%) +
(CoA4: 1200 cattle x 85%) = 1353.6 total cattle and calves**

** due to the methodology of interpolating data, final census numbers are estimates.

*This is a simplified explanation of the methodology used to interpolated Census of Agricultural data from Statistic Canada's geographic boundaries into other specified boundaries such as watersheds. There are other factors not explained here that are taken into account during the process.

Appendix B: Animal Unit Calculations

Summary of Animal Unit coefficients used in Manitoba as compared to those used for calculations in this report[1]. Assumptions are given in the following Table:

Livestock	Animal Units produced by one animal (MAFRI)	Animal Unit coefficient used in report
Dairy		
Milking Cows (including associated livestock)	2.000	2.000
Beef		
Beef Cows, incl. associated livestock	1.250	1.250
Backgrounder	0.500	\
Summer pasture	0.625	} 0.631
Feedlot	0.769	/
Hogs		
Sows, farrow-to-finish	1.250	--
Sows, farrow-to-weanling	0.313	0.313
Sows, farrow-to-nursery	0.250	--
Weanlings	0.033	--
Grower/finishers	0.143	0.143
Boars (artificial insemination operations)	0.200	0.200
Chickens		
Broilers	0.0050	0.0050
Roasters	0.0100	--
Layers	0.0083	0.0083
Pullets	0.0033	0.0033
Turkeys		
Broilers	0.010	\
Heavy Toms	0.020	} 0.014
Heavy Hens	0.010	/
Horses (PMU)		
Mares, including associated livestock	1.333	1.00
Sheep		
Ewes, including associated livestock	0.200	0.200
Feeder Lambs	0.063	--
Goats	0.143	0.143
Bison		
Cow	1.00	\
Bull	1.00	} 0.8875
Calf	0.25	/
Elk		
Cow	0.53	\
Bull	0.77	} 0.520
Calf	0.05	/

1. An Animal Unit is defined as the number of livestock required to excrete 73 kg (160 lbs) of nitrogen in a 12-month period (as defined in the Farm Practices Guidelines for Poultry Producers in Manitoba

Summary of assumptions made in calculating Animal Units1 from 2001 Agricultural Census Data

Livestock	**Manitoba Animal Unit Category**	**Census Category**	**Assumptions Used for Animal Unit Calculations with census data**
Dairy	Milking cows (including associated livestock)	Dairy cows	Assumed categories are equal.
Beef	Beef cows	Beef cows	Assumed number of beef cows reported in 2001 Census equal cow/calf pairs
	Backgrounder Summer pasture Feedlot cattle	Heifers and steers for slaughter or feeding 1 yr and older (combined categories)	Assumed steers and heifers reported in these census categories are split into the three categories (communication with MAFRI). Animal unit coefficient determined using this ratio.
Pigs	Sows, farrow–to-weanling	Sows	Assumed there are no farrow-to-finish operations and no weanling operations in Manitoba – only farrow-to-weanling and grower/finisher operations.
	Grower/finishers	Grower and finisher pigs	
	Boars (artificial insemination operations)	Boars	Assumed all boars reported in the 2001Census are from artificial inseminations.
Chickens	Broilers	Broilers and roasters	Assumed all birds reported in the census category are broilers (communication with MAFRI).
	Layers	Laying hens (19 weeks and older)	Assumed categories are equal.
	Pullets	Pullets (under 19 weeks)	Assumed categories are equal.
	Broiler breeding hens	Laying hens in hatcheries	Assumed all laying hens in hatchery supply flocks reported in Manitoba are broiler breeder hens.
Turkeys	Broiler, Heavy Toms, Heavy Hens	Turkeys	Assumed “turkeys” represents 20% boilers, 40% heavy toms, 40% heavy hens (communication with MAFRI). Animal unit coefficient is determined using this ratio.
Sheep	Ewes, including associated livestock	Ewes	Assumed ewe/lamb pairs (communication with MAFRI).
	Feeder lambs	Lambs	Assumed no feeder lambs in province since numbers are very small and cannot be determined from census data (communication with MAFRI).
Horses	Horses	Total horses and ponies	Assumed each animal produces 1 Animal Unit – PMU farms not identified in Census (communication with MAFRI).
Bison	Bison	Bison	Assumed adults represent 85% and calves represent 15% of bison population in Manitoba (communication with MAFRI). Animal unit coefficient is determined using this ratio.
Elk	Elk	Elk	Number of calves and sex of animals not identified in Census – assumed 45% cows, 35% bulls and 20% calves (communication with MAFRI). Animal unit coefficient is determined using this ratio.
Goats	Goats	Goats	Number of kids and sex of animals not identified in Census – assumed 7 goats make up one Animal Unit, irregardless of age and sex.

1. One Animal Unit is defined as the number of livestock required to excrete 73 kg (160 lbs) of nitrogen in a 12-month period (as defined in the Farm Practices Guidelines for Poultry Producers in Manitoba)

Appendix C: Land Cover Time Frame, Classifications, and Constraints

For the IWMP study area, imagery was available for the years of 1993, 2000, and most recently, 2006. Imagery was classified by the Manitoba Conservation - Manitoba Remote Sensing Centre into 16 unique land cover classes. To simplify the analysis, the 16 classes were aggregated into 7 basic land cover classes: annual cropland, forages, grasslands/pasture, trees, wetlands, water, and urban/transportation.

The 1993 land cover used satellite imagery that was captured on May 14, 1993. Imagery for the 2002 land cover data was taken May 31, 2002. The 2006 land cover data utilized satellite imagery that was captured on September 9, 2006.

Data Constraints

It should be noted that the use of land cover data has limitations from a couple of perspectives. Weather patterns in years leading up to the imagery will impact the cover analysis and may be short term as opposed to a long term trend. Further, past image classifications were undertaken for specific purposes with standardization occurring between 2000-2001 and 2005-2006 as detailed below:

- Classification effort - the 1993 image classification concentrated specifically on annual cropland to aid in delivery of the Western Grains Transportation Payment Program. Greater attention was paid to all classification categories on the 2002 image classification.
- The classification of forages and forages/grasslands - As the land cover classifications could be difficult to interpret given the age of the forage stand and the reflectance of the satellite imagery for classification.
- With respect to the increased level of forages, some of the forage conversion trends may be explained through the adoption of Permanent Cover Program offered by Agriculture Canada in the early 1990s. A program summary for the Westlake Watershed study area could provide more insight toward understanding the forage trends and if they were indeed related to the Permanent Cover Program, however, the data could not be made available in time for this report. There is some indication from local contacts that the program uptake by producers was low for this watershed, however, without an actual program summary, it cannot be quantified. This information will be available for future reports or for this watershed at a later date.

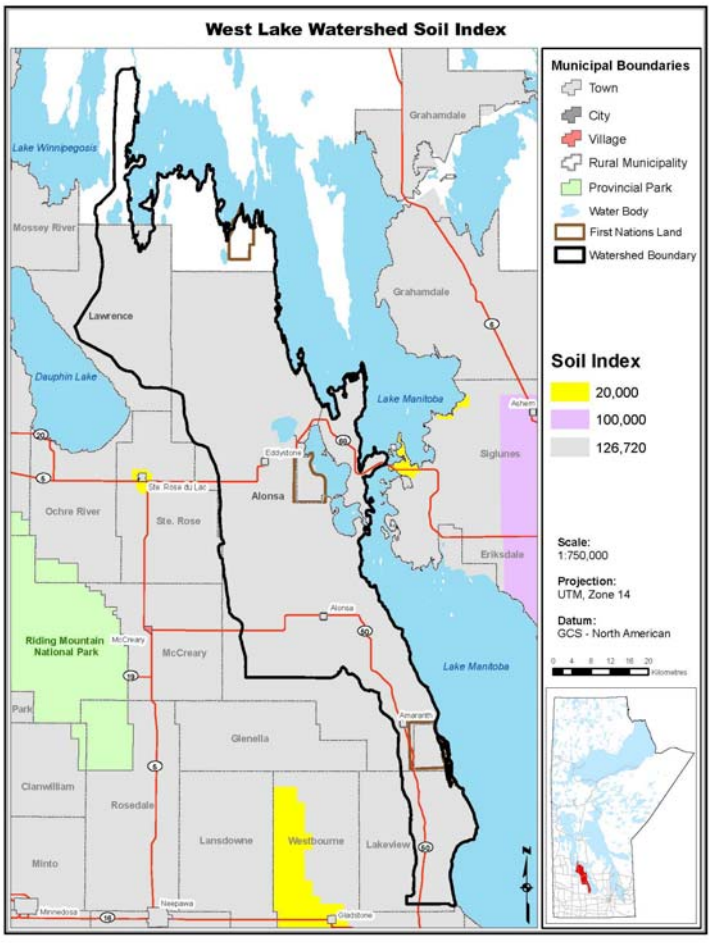
Classification Scheme: Land Cover Mapping of Manitoba	
1. Annual crop land:	Land that is normally cultivated on an annual basis.
2. Forage:	Perennial forages, generally alfalfa or clover with blends of tame grasses.
3. Grassland:	Areas of native or tame grasses, may contain scattered stands of trees
4. Trees:	Lands that are primarily in tree cover
5. Wetlands:	Areas that are wet, often with sedges, cattails, and rushes
6. Water	Open water – lakes, rivers, streams, ponds, and lagoons
7. Urban and Transportation:	Towns, roads, railways, quarries

Appendix D: Soil Information and Background

Soils data within the watershed can be used to provide information on various soil characteristics as well as interpretative ratings such as agriculture capability, water and wind erosion risk. Used in conjunction with the land cover data from 1993-2006, observations about temporal land use trends can be made and used to explain any changes in land management practices.

Soils data within Manitoba have been mapped at different scales of accuracy. In the Westlake study area, soils were surveyed at more reconnaissance scale of 1:100,000 (grey area) (see figure below).

Reconnaissance soils data is more suitable for broader landscape based analysis and regional planning purposes. This information is not suitable for the development of municipal development plans/zoning by-laws, agronomic assessment for irrigation and other site specific land use activities. Analysis of this nature requires more detailed soils information for assessments and management considerations. Soil information provided in this report is based on the characteristics of the dominant soil series within the various soils polygons.



Appendix E: Canada Land Inventory System Land Classes

Agricultural Capability for Manitoba

Agriculture capability is a 7 class rating of mineral soils based on the severity of limitations for dryland farming. This system does not rate the productivity of the soil, but rather its capability to sustain agricultural crops based on limitations due to soil properties and landscape features and climate. This system is usually applied on a soil polygon basis and the individual soil series are assessed and maps portray the condition represented by the dominant soil in the polygon. Class 1 soils have no limitations, whereas Class 7 soils have such severe limitations that they are not suitable for agricultural purposes. In general, it takes about 2 acres (0.8 hectares) of Class 4 land to equal production from 1 acre (0.4 hectares) of prime (Class 1) land. (From *Land: The Threatened Resource*).

Class 1: Soils in this class have no important limitations for crop use. The soils have level to nearly level topography; they are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in good tilth and fertility; soils are moderately high to high in productivity for a wide range of cereal and special crops (field crops).

Class 2: Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderate to high in productivity for a fairly wide range of field crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3: Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. Under good management, these soils are fair to moderate in productivity for a fairly wide range of field crops.

Class 4: Soils in this class have significant limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few field crops, the yield for a range of crops may be low or the risk of crop failure is high. These soils are low to moderate in productivity for a narrow range of field crops but may have higher productivity for a specially adapted crop or perennial forage.

Class 5: Soils in this class have severe limitations that restrict their capability to producing perennial forage crops and improvement practices are feasible. These soils have such serious soil, climatic or other limitations that they are not capable of use for sustained production of annual

field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage plants.

Class 6: Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery or because the soils are not responsive to improvement practices.

Class 7: Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. Bodies of water too small to delineate on the map are included in this class. These soils may or may not have a high capability for forestry, wildlife and recreation.

Agriculture capability subclasses identify the soil properties or landscape conditions that may limit use. A capital letter immediately following the class number identifies the limitation (eg. 2W, 3N, etc.).

Subclasses:
C - adverse climate (outside the boundaries of agro-Manitoba)
D - undesirable soil structure and/or low permeability
E - erosion damage
I - inundation (flooding) by streams and lakes
M - moisture (droughtiness) or low water holding capacity
N - salinity
P - stoniness
R - consolidated bedrock
T - topography (slopes)
W - excess water other than flooding (inadequate soil drainage or high water table)
X - two or more minor limitations

Appendix F: Water Erosion Risk

Water erosion information is available as part of the provincial soil survey data that has been compiled from reconnaissance (1:126,720 scale) and detailed (1:40,000 & 1:20,000 scale) soil survey reports. The Universal Soil Loss Equation (USLE) that was developed by Wischmeier and Smith (1965) was used to provide information on water erosion as part of the provincial soils data. The USLE provides a quantitative estimate on the amount of soil that is displaced due to water erosion (either tonne/ha or ton/ac) on an annual basis due to soil, climatic, landscape and management factors that influence the rate of erosion. The USLE can be written as:

A = RKLSCP

Where:

A = Predicted water erosion rate
R = Erosivity of rainfall and snowmelt factor
K = Soil erodibility factor
L = Slope length factor
S = Slope steepness factor
C = Crop cover and management factor (set at 1.0 - assuming bare, unprotected soil)
P = Conservation practice factor (set at 1.0 - assuming no conservation practices)

Due to limitations that are inherent in the model, the lack of the inclusion of conservation management practices and crop cover factors, the numbers that are generated from the USLE should not be used as a value for actual soil loss due to water erosion. However, the USLE is useful in comparing water erosion risk between soils based on their soil/landscape properties and climatic conditions. To accomplish this, the computed USLE values have been compiled into the following 5 group risk classes:

N = Negligible	< 2.7 ton/ac/yr (< 6 tonne/ha)
L = Low	2.7 – 4.9 ton/ac/yr (6 – 11 tonne/ha)
M = Moderate	4.9 – 9.8 ton/ac/yr (11 – 22 tonne/ha)
H = High	9.8 – 14.7 ton/ac/yr (22 – 33 tonne/ha)
S = Severe	> 14.7 ton/ac/yr (> 33 tonne/ha)

By using the risk class groupings, soils can be compared on the basis of their soil physical properties, landscape and climate for resource analysis and targeting of soil conservation programming.

Appendix G: Wind Erosion Risk

Wind erosion information in Manitoba has been developed from the provincial soil survey data and the Soil Landscapes of Canada (SLC Ver 1.0). A geographic information system (GIS) was used to combine both spatial datasets, creating a derived product upon which wind erosion was calculated.

The wind erosion model that is used for the Agriculture Canada Wind Erosion Risk Maps (1989) was applied to the derived dataset. The model was developed from the works of Chepil (1945, 1956) and Chepil and Woodruff (1963) and derives an index value *E* for wind erosion risk (Coote, Eilers & Langman, 1989). The model is stated as:

$$E = kC(V_*^2 - \gamma W^2)^{1.5}$$

Where:

E = maximum instantaneous soil movement by wind (dimensionless)
k = surface roughness and aggregation factor (dimensionless)
C = factor representing soil; resistance to movement by wind (dimensionless)
V_* = drag velocity of wind at soil surface ($cm \cdot s^{-1}$)
γ = soil moisture shear resistance (dimensionless), a value of 5000 was used
W = available moisture of the surface soil ($m^3 water \cdot m^{-3} soil$)

For the analysis, the V_* and *W* values were used from the Soil Landscapes of Canada series. These values are listed for each polygon in the Wind Erosion Risk publication. A listing of *k* and *C* values are also listed in the report and are based on soil surface texture. The values were entered into the database based on soil surface texture types taken from the provincial soil survey data.

Following entering of values for *K*, *C*, *W* and calculating values for V_*, the dimensionless wind erosion index values (*E)* were calculated for each polygon. These values were rated as per the rating system in the Wind Erosion Risk publication.

Class	**E Value**
Negligible	< 100
Low	101 - 250
Moderate	251 - 400
High	401 - 700
Severe	> 700

The ratings are for bare soil and do not consider land use and crop management factors. *E* values were calculated only for those soils within the seamless soil layer that had a mineral soil surface texture rating. Polygons that were rated as being organic soils, bare rock and water in either the seamless soil data or the SLC data did not have *E* values calculated.

For those polygons that have secondary and/or tertiary soils listed within the map unit, a weighted calculation was done based on the percent of occurrence. If organic soils existed in any combination (primary, secondary, tertiary) with mineral soils, weightings were based on mineral soils only.

Appendix H: Soil Drainage Classes

Soil Drainage Class	Description
Very Poor	Water is removed from the soil so slowly that the water table remains at or on the soil surface for the greater part of the time the soil is not frozen. Excess water is present in the soil throughout most of the year
Poor	Water is removed so slowly in relation to supply that the soil remains wet for a large part of the time the soil is not frozen. Excess water is available within the soil for a large part of the time.
Imperfect	Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly down the profile if precipitation is the major source
Well	Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying materials or laterally as subsurface flow
Rapid	Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep slopes during heavy rainfall.
Source: *System of Soil Classification of Canada – Canada-Manitoba Soil Survey Reports*	

Drainage classification is based on the dominant soil series within each individual soil polygon

Appendix I: 2006 Census of Agriculture data

Table 1: Agricultural Land Use types reported in the 2006 Census of Agriculture (hectares)

Subwatershed	Total Farmland	Total Cropland**	Summerfallow	Pasture***	Other*
Rorketon	72,731	21,838	952	32,339	17,603
Amaranth	46,023	14,067	815	25,347	5,794
Alonsa	86,091	16,079	1,074	56,197	12,740

*Other category includes all other land uses including farmyard, woodlots, Christmas trees, wetlands, etc.
** Total cropland includes all field crops, forages, vegetables, fruit and nuts and sod
*** Pasture includes tame pasture and natural areas used for pasture.

Table 2: Distribution of crop types as reported in the 2006 Census of Agriculture (hectares)

Subwatershed	Total Cropland*	Cereals	Oilseeds	Pulse	Forage for hay	Forage for seed	Other**
Rorketon	21,838	6,799	3,308	0	11,395	0	336
Amaranth	14,067	5,186	2,074	0	5,904	0	903
Alonsa	16,079	3,592	748	0	11,206	71	461

x – data has been suppressed by Statistics Canada to preserve confidentiality of the data
* Total Cropland includes all field crops, forages, vegetables, fruits and nuts, and sod
** Other category includes other special field crops, fruits and nuts, sod, vegetables, and all suppressed hectares in the listed categories

Table 3: Total area treated with crop inputs for the 2005 cropping year, as reported in the 2006 Census of Agriculture (hectares)

Subwatershed	Use of commercial Fertilizers	Use of Herbicides	Use of Insecticides	Use of Fungicides
Rorketon	13,220	8,916	563	3,201
Amaranth	10,023	7,891	726	1,419
Alonsa	8,438	3,583	0	0

Table 4: Total dollars spent on crop inputs for the 2005 cropping year, as reported in the 2006 Census of Agriculture

Subwatershed	Total crop expenses	Total fertilizer and lime	Total herbicides, insecticides & fungicides	Total seed
Rorketon	$2,310,168	$1,208,014	$727,820	$374,334
Amaranth	$1,621,594	$866,243	$460,178	$295,172
Alonsa	$1,160,252	$688,375	$237,578	$234,299

Table 5: Tillage practices on areas prepared for seeding as reporting as a percentage of total cultivated land, as reported in the 2006 Census of Agriculture

Subwatershed	Tillage incorporating most crop residue into the soil	Tillage retaining most crop residue on the surface	No-till or zero-till seeding
Rorketon	43%	49%	8%
Amaranth	53%	41%	6%
Alonsa	63%	24%	14%

Table 6: Total number of livestock and poultry on Census Day in 2006, as reported in the 2006 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Rorketon	15,985	8,138	0	0	0	x
Amaranth	8,978	4,410	0	x	0	x
Alonsa	19,058	8,978	0	x	x	x

x – data has been suppressed by Statistics Canada to preserve confidentiality

Table 7: Total number farms reporting livestock and poultry on Census Day in 2006, as reported in the 2006 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Rorketon	76	74	0	0	0	2
Amaranth	41	40	0	1	0	3
Alonsa	86	82	0	2	1	3

Table 8: Average number of livestock animals or poultry birds per farm on Census Day in 2006, as reported in the 2006 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Rorketon	211	110	0	0	0	x
Amaranth	218	110	0	x	0	x
Alonsa	220	110	0	x	x	x

x – data has been suppressed by Statistics Canada to preserve confidentiality

Table 9: Summary of farm financial characteristics in 2005, as reported in the 2006 Census of Agriculture

Subwatershed	Number of Farms	Average farm size (ha)	Average Capital investment ($/farm)	Average livestock-related expenses ($/ha farmland)*	Average crop-related expenses ($/ha cropland and summerfallow)*	Estimated profit ($/farm)*
Rorketon	94	773	651,060	17	101	7,730
Amaranth	58	791	736,754	19	115	18,193
Alonsa	103	836	545,521	28	68	14,212

* Calculations are based on the expenses for the 2005 calendar year, as reported in the 2006 Census of Agriculture

Appendix J: 2001 Census of Agriculture data

Table 1: Agricultural Land Use types reported in the 2001 Census of Agriculture (hectares)

Subwatershed	Total Farmland	Total Cropland**	Summerfallow	Pasture***	Other*
Amaranth	53,132	19,380	2,304	26,763	4,686
Alonsa	94,114	17,645	1,239	64,498	10,733

*Other category includes all other land uses including farmyard, woodlots, Christmas trees, wetlands, etc.
** Total cropland includes all field crops, forages, vegetables, fruit and nuts and sod
*** Pasture includes tame pasture and natural areas used for pasture.

Table 2: Distribution of crop types as reported in the 2001 Census of Agriculture (hectares)

Subwatershed	Total Cropland*	Cereals	Oilseeds	Pulse	Forage for hay	Forage for seed	Other**
Amaranth	19,380	7,722	2,429	695	7,361	0	1,174
Alonsa	17,645	2,886	535	0	13,880	0	345

x – data has been suppressed by Statistics Canada to preserve confidentiality of the data
* Total Cropland includes all field crops, forages, vegetables, fruits and nuts, and sod
** Other category includes other special field crops, fruits and nuts, sod, vegetables, and all suppressed hectares in the listed categories

Table 3: Total area treated with crop inputs for the 2000 cropping year, as reported in the 2001 Census of Agriculture (hectares)

Subwatershed	Use of commercial Fertilizers	Use of Herbicides	Use of Insecticides	Use of Fungicides
Amaranth	13,265	11,889	1,956	2,822
Alonsa	7,522	3,341	0	0

Table 4: Total dollars spent on crop inputs for the 2000 cropping year, as reported in the 2001 Census of Agriculture

Subwatershed	Total crop expenses	Total fertilizer and lime	Total herbicides, insecticides & fungicides	Total seed
Amaranth	$2,141,984	$1,021,008	$720,971	$400,005
Alonsa	$591,509	$362,266	$137,997	$91,246

Table 5: Tillage practices on areas prepared for seeding as reporting as a percentage of total cultivated land, as reported in the 2001 Census of Agriculture

Subwatershed	Tillage incorporating most crop residue into the soil	Tillage retaining most crop residue on the surface	No-till or zero-till seeding
Amaranth	62%	22%	8%
Alonsa	52%	x	x

x – data has been suppressed by Statistics Canada to preserve confidentiality

Table 6: Total number of livestock and poultry on Census Day in 2001, as reported in the 2001 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Amaranth	10,143	4,554	x	x	x	810
Alonsa	19,154	8,432	x	x	x	x

x – data has been suppressed by Statistics Canada to preserve confidentiality

Table 7: Total number farms reporting livestock and poultry on Census Day in 2001, as reported in the 2001 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Amaranth	79	75	1	1	1	7
Alonsa	104	97	1	4	2	5

Table 8: Average number of livestock animals or poultry birds per farm on Census Day in 2001, as reported in the 2001 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Amaranth	128	61	x	x	x	123
Alonsa	185	87	x	x	x	x

x – data has been suppressed by Statistics Canada to preserve confidentiality

Table 9: Summary of farm financial characteristics for the 2000, as reported in the 2001 Census of Agriculture

Subwatershed	Number of Farms	Average farm size (ha)	Average Capital investment ($/farm)	Average livestock-related expenses ($/ha farmland)*	Average crop-related expenses ($/ha cropland and summerfallow)*	Estimated profit ($/farm)*
Amaranth	105	506	470,529	28	99	169,650
Alonsa	123	765	510,329	28	31	140,261

* Calculations are based on the expenses for the 2000 calendar year, as reported in the 2001 Census of Agriculture

Appendix K: Private and Crown Land Planning in the Westlake Watershed

Overview

The Provincial Land Use Policies (PLUPs) outline Agriculture's interests of both private and crown land that is used for agriculture by maintaining this land as viable agricultural land, minimizing subdivision, and protecting farms from encroachment by other uses which may be incompatible with normal farming operations.

Policy #1 of the Provincial Land Use Policies Regulation guides General Development while Policy #2 guides Agriculture. The objectives of policy #2 are to maintain a viable base of agricultural lands for present and future food and fibre production and agricultural diversification, and to protect agricultural operations.

Provincial Land Use Policies

These policies guide local and provincial authorities in preparing Development Plans and in making land use decisions. The PLUPS cover nine broad policy areas, of which Agriculture is one component; each policy area is given equal precedence. The other areas, besides agriculture, are General Development, Renewable Resources, Water and Shoreline, Recreational Resources, Natural Features and Heritage Resources, Flooding and Erosion, Provincial Highways, and Mineral Resources. The various government departments have an interest in "their" policies and are involved in establishing them.

Development Plans

The Provincial Land Use Policies are applied at the local level through the Development Plan which is initiated by a municipality or planning district (group of municipalities). The Development Plan is the agreement between the local and provincial governments on matters concerning land use and future development and it should be generally consistent with the PLUPs.
This is where the policies governing the protection of prime agricultural land and agricultural operations are set out. The Plan sets out land use objectives and patterns or characteristics of development for an area. Through the Development Plan, lands are designated for certain uses such as agriculture, agriculture restricted, residential, industrial or commercial. Once adopted, all proposed development and land use changes must be evaluated under the policies of the development plan.

Zoning By-Laws

Regulating the Use of the Land: Following the approval of a development plan, a municipality must enact a zoning by-law that is consistent with their development plan. A municipal zoning by-law contains the rules and regulations that control development as it occurs. A zoning by-law further divides a municipality into various zones such as rural residential, highway-commercial and general agricultural. For example, an area that is designated as Agricultural in a development plan may be further zoned as Agricultural General and Agricultural Restricted, with both zones having separate criteria for agricultural development. The zoning by-law sets out requirements and criteria under which development may occur, including property site size, dimensions, separation distances and other siting criteria. It also specifies permitted and conditional uses within each zone.

Planning -General

Integrated watershed planning is a community based focused planning process around issues which effective water management. This planning needs to support the existing community framework for economic development and land use planning. In most cases, this means,

integration of the IWMP into the existing Development Plan. The Development Plan is the local legal framework under *The Planning Act.*

All of the municipalities (with exception of Alonsa) included in the Westlake IWMP area have Development Plans which govern land use decisions including the protection and use of agricultural lands. The Rural Municipality of Alonsa is developing their first ever development plan. Development of rural lands for non-agricultural use can impact watershed health, and may result in enhanced drainage above agricultural requirements. Because of this, the ability of the landscape to provide ecological goods and services such as the retention and filtering of water is impacted with development. Within a Development Plan, protecting agricultural land from non agricultural use may also mean protecting wetlands and tree cover, especially if the farmland is maintained for grazing purposes. For these reasons, having agricultural lands protected in a Development Plan will have benefits for the five issues (surface water quality, ground water quality, source water protection, soils and land use and habitat & wildlife) identified in the public consultations.

There are 2 planning districts within the Westlake IWMP area:
• Lakeshore Planning District
• Big Grass Planning District

The following sections describe the framework for land use planning from a legal perspective, set out by the Provincial Government.

Crown Land Management and Planning in the Westlake Creek Watershed.

Overview

In ***1930***, responsibility for ***Crown Lands*** was transferred to the provincial government of ***Manitoba.*** Virtually all of Northern ***Manitoba***, beyond the Department of Aboriginal and Northern Affairs boundary, is what they called “unorganized territory" and is also ***Crown land*****.**
Today, Manitoba’s Crown Lands are used for varying purposes, including agriculture, mining, and cottages. Other areas are set aside for research, environmental protection, public recreation, and resource management. Approximately 95% of the province's forests sit within provincial Crown land.

Operations

The planning and classification of Crown land in agro-Manitoba is the ultimate responsibility of the Crown Lands Assistant Deputy Minister’s Committee (CLADMC), previously known as the Crown Land Classification Committee (CLCC). The CLCC was created in 1975 by the Premier of Manitoba for the specific purpose of Crown land use planning and resolution of land and resource use conflicts between departments of government. It is an interdepartmental committee with representation from Manitoba Agriculture, Food and Rural Initiatives (MAFRI), Conservation, Water Stewardship, Aboriginal and Northern Affairs, Science Technology Energy & Mines (STEM) and Intergovernmental Affairs (IAF). The committee reports to cabinet.
The CLCC determined that to achieve its objectives, there was a need for on-the-ground planning and resource management expertise. This was obtained by creating local Block Planning Committees (BPC’s), comprised of regional specialists from those departments on CLADMC. Eight BPCs were created in 1976. The BPC’s meet every two months or as needed to discuss issues related to crown lands in their respective regions. Minutes are then forwarded to CLADMC for final approval.

Multi-Use Concept
The Provincial Crown Land Planning Process is strongly guided by the concept of multiple resource use whereby Crown Lands may be used by both competing and complementary users. Complementary use of Crown land requires special consideration be given to management in order to ensure that one resource use does not compromise the other. One such example is timber harvesting/livestock grazing, where a project initiated by MAFRI (Garland Project) is showing that proper management (of livestock grazing and forestry practices) can result in long term benefits to both resource users. The science and research from this project will be very beneficial in resolving a longstanding land use issue, and ultimately make more land available for complementary use. The information from this project will also assist private landowners in terms of managing their resources (e.g.; in instances where the land management objective is to enhance both forestry potential and livestock grazing).

Management and Administration
Management and administration of Crown land is shared by Manitoba Conservation, Manitoba Agriculture, Food and Rural Initiatives (MAFRI), Aboriginal and Northern Affairs and Manitoba Infrastructure and Transportation (MIT). The Crown Lands and Property Agency of MIT is responsible for the administration of Crown land, issues leases and permits upon the direction of MAFRI with regard to Crown lands classified for agricultural uses and issues leases and permits for all other Crown lands as directed by Manitoba Conservation. Manitoba Aboriginal and Northern Affairs maintain authority equivalent to that of local government for Crown land dispositions in the Northern Affairs area.

Manitoba Agricultural Crown Lands
Agricultural Crown Lands in Manitoba are managed and regulated by the Agriculture Crown Lands section of the Land Use Branch of Manitoba Agriculture, Food and Rural Initiatives. MAFRI issues agricultural leases and permits on those lands which are designated as primarily agricultural as well as multi-use lands which may be used for agricultural purposes on a secondary or interim use-basis, subject to specific conditions and covenants required by other resource users. The section also advertises available agricultural Crown lands for lease and ensures equitable allocation.

Appendix L: Beneficial Management Practices offered under the Canada Manitoba Farm Stewardship Program 2003-2008

NFSP System Development
BMP Category Code/Practice Code Assignment

NOTE 1: The units of measurement are: distance = kilometers (km), area = acres, volume = cubic meters (m3)

NOTE 2: Funding is expressed as thousands of $ = K (eg. $4K = $4,000)

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
01	Improved Manure Storage and Handling	0101	increased storage to meet winter spreading restrictions (including satellite storage)	volume (m^3)	30%	$30K
		0102	improved features to prevent risks of water contamination (leaks, spills)	N/A		
		0103	slurry storage covers to reduce odours and GHG emissions	N/A		
		0104	containment systems for solid manure (includes covers)	N/A		
		0105	assessment and monitoring of existing manure storage infrastructure	N/A		
		0106	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)	N/A		
02	Manure Treatment	0201	dewatering systems, nutrient recovery systems	N/A	30%	$30K
		0202	composting of manure			
		0203	anaerobic biodigestors			
		0204	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
03	Manure Land Application	0301	specialized/modification to equipment for improved manure application	N/A	30%	$10K
04	In Barn Improvements	0401	more efficient livestock watering devices and cleanout systems to reduce water use and decrease manure volumes	N/A	30%	$20K
		0402	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
05	Farmyard Runoff Control	0501	upstream diversion around farmyards ;downstream protection (eg. catch basins, retention ponds, constructed wetlands)	N/A	50%	$20K
		0502	construction of impermeable base and roof for minimizing runoff from livestock pen areas and confinement areas (feed bunks, water infrastructure, walls and electrical costs are not eligible)			
		0503	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
06	Relocation of Livestock Confinement and Horticultural Facilities	0601	relocation of livestock facilities such as corrals, paddocks and wintering sites away from riparian areas	N/A	50%	$30K
		0602	relocation of horticultural facilities such as greenhouses and container nurseries from riparian areas			
		0603	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
07	Wintering Site Management	0701	shelterbelt establishment	# kms	50%	$15K
		0702	portable shelters and windbreaks	# kms		
		0703	alternative watering systems (ie: solar, wind or grid power)	N/A		
		0704	field access improvements: alleyway/access lane upgrades	# kms		
		0705	fence modifications	# kms		
08	Product and Waste Management	0801	improved on-farm storage and handling of agricultural products (eg. fertilizer, silage, petroleum products, and pesticides)	N/A	30%	$15K
		0802	improved on-farm storage, handling, and disposal of agricultural waste (eg. livestock mortalities, fruit and vegetable cull piles, wood waste)			
		0803	composting of agricultural waste (eg. Livestock mortalities fruit, vegetable, wood, straw residue)			
		0804	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
09	Water Well	0901	sealing & capping old water wells	N/A	50%	$6K

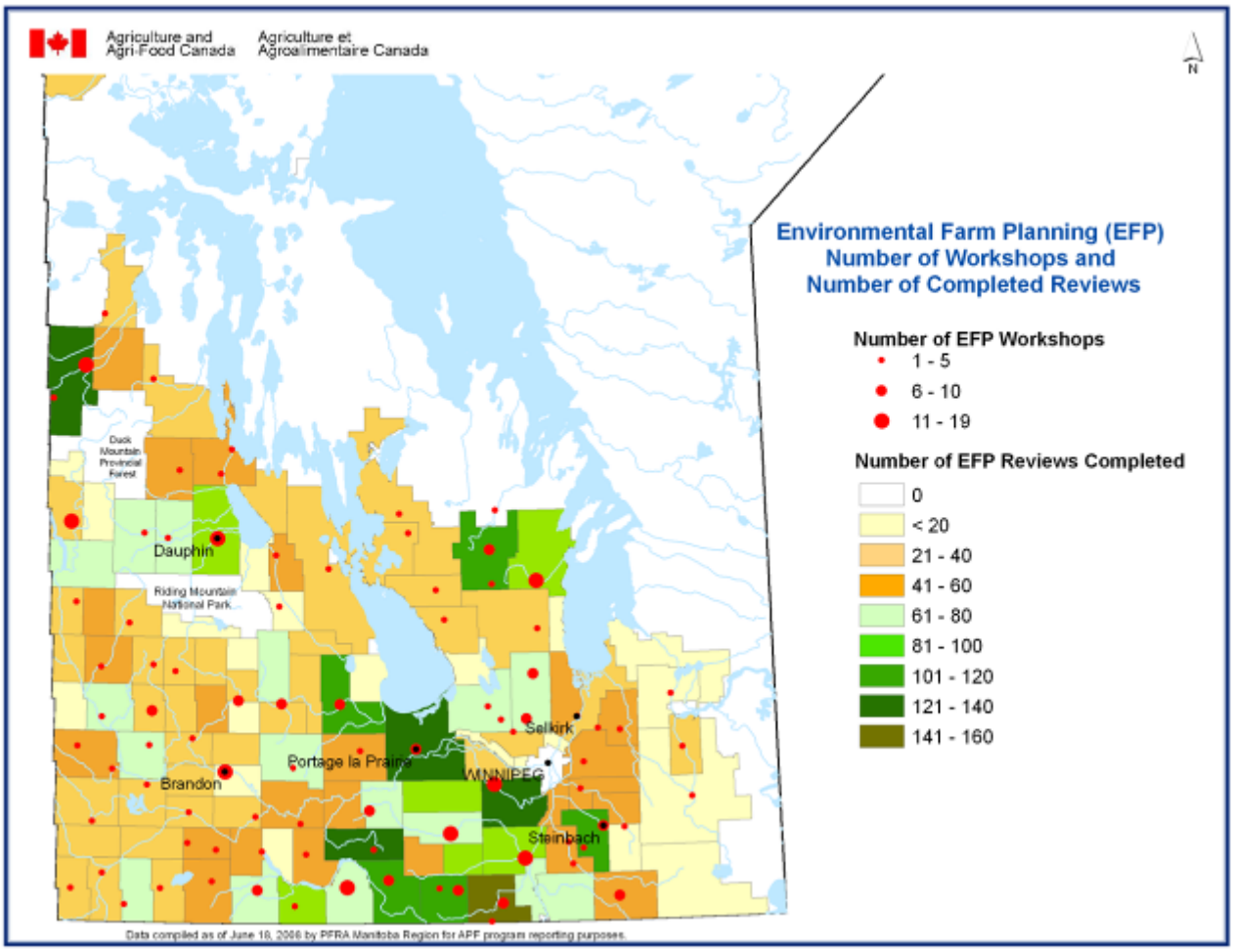
BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
	Management	0902	protecting existing water wells from surface contamination			
10	Riparian Area Management (GREENCOVER)	1001	alternative watering systems (ie: solar, wind or grid power)to manage livestock:	N/A	50%	$20K
		1002	buffer establishment and planting of forages (planting and establishment costs for trees and shrubs for the year of planting and one year after the planting year, or the termination of the NFSP funding, whichever comes first)	# acres		
		1003	fencing to manage grazing and improve riparian condition/function	# kms		
10	Riparian Area Management (GREENCOVER)	1004	native rangeland restoration or establishment: native species of forages, shrubs, and trees	# acres		
		1005	grazing management in surrounding uplands: alternative watering systems (ie: solar, wind or grid power) and cross fencing	# kms offence		
		1006	improved stream crossings	N/A		
11	Erosion Control Structures(Riparian) (GREENCOVER)	1101	constructed works in riparian areas: contour terraces, gully stabilization, bank stabilization, erosion control matting, silt fencing, drop inlet and enhanced infiltration systems, in-channel control, retention ponds and erosion control dams	N/A	50%	$20K
		1102	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
12	Erosion Control Structures(Non Riparian)	1201	constructed works in non riparian areas: contour terraces, gully stabilization, bank stabilization, erosion control matting, silt fencing, drop inlet systems and enhanced infiltration systems, in-channel control, retention ponds and erosion control dams, mechanical wind screens	N/A	50%	$20K
		1202	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
13	Land Management for Soils at Risk	1301	forage or annual barrier establishment for soils at risk (eg. stripcropping, grassed waterways, perennial forages on severely erodible or saline soils)	# acres	50%	$5K
		1302	straw mulching	# acres		
		1303	grazing management in critical erosion areas not associated with riparian zones: alternative watering systems (ie: solar, wind or grid power), crossfencing	# kms offence		

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
14	Improved Cropping Systems	1401	equipment modification on pre-seeding implements for restricted zone tillage for row crops, seeding and post seeding implements for low disturbance placement of seed and fertilizer	N/A	30%	$15K
		1402	chaff collectors and chaff spreaders installed on combines			
		1403	precision farming applications: GPS information collection, GPS guidance (ie: autosteer, lightbars, software) , manual and variable rate controllers for variable fertilizer application			
15	Cover Crops	1501	establishment of non-economic cover crop	# acres	30%	$5K
		1502	equipment modification for inter row seeding of cover crops (eg. relay crops)	N/A		
16	Improved Pest Management	1601	equipment modification for improved application	N/A	30%	$5K
		1602	information collection and monitoring			
		1603	biological control agents			
		1604	cultural control practices			
		1605	mobile water tanks			
17	Nutrient Recovery from Waste Water	1701	recycling of waste water streams from milkhouses, fruit and vegetable washing facilities, and greenhouses in order to recover nutrients	N/A	30%	$20K
		1702	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
18	Irrigation Management	1801	irrigation equipment modification/improvement to increase water or nutrient use efficiency	N/A	30%	$10K
		1802	equipment to prevent backflow of altered irrigation water into water sources			
		1803	improved infiltration galleries and irrigation intake systems			
19	Shelterbelt Establishment (GREENCOVER)	1901	establishment of shelterbelts for farmyard, live stock facilities, dugout snowtrap, wildlife habitat enhancement, field (planting and establishment costs for trees and shrubs for the year of planting and one year after the planting year, or the termination of the NFSP funding, whichever comes first)	# kms	50%	$10K

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
		1902	tree materials required for shelterbelt establishment	N/A		
20	Invasive Alien Plant Species Control	2001	integrated approaches (cultural, mechanical, and biological) for control of invasive plant species (eg. leafy spurge, purple loosestrife, scentless chamomile)	N/A	50%	$5K
21	Enhancing Wildlife Habitat and Biodiversity	2101	buffer strips: native vegetation	# acres	50%	$10K
		2102	alternative watering systems (ie: solar, wind or grid power)	N/A		
		2103	improved grazing systems: crossfencing	# kms		
		2104	wildlife shelterbelt establishment	# kms		
21	Enhancing Wildlife Habitat and Biodiversity	2105	improved stream crossings	N/A		
		2106	hayland management to enhance wildlife survival	N/A		
		2107	wetland restoration	acres		
22	Species at Risk	2201	alternative watering systems (ie: solar, wind or grid power)	N/A	50%	$10K
		2202	improved grazing systems: crossfencing	# kms		
		2203	plant species establishment	# acres		
		2204	infrastructure development and relocation	N/A		
23	Preventing Wildlife Damage	2301	forage buffer strips	# acres	30%	$10K
		2302	fencing or netting to protect stored feed, concentrated livestock, high value crops, drip irrigation systems, and other ag. activities	# km offence		
		2303	scaring and repellant systems and devices	N/A		
24	Nutrient Management Planning	2401	consultative services to develop nutrient management plans, planning and decision support tools	# acres	50%	$4K
25	Integrated Pest Management	2501	consultative services to develop integrated pest management plans, planning and decision support tools	# acres	50%	$2K

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
	Planning					
26	Grazing Management Planning (GREENCOVER)	2601	consultative services to develop range and grazing management plans, planning and decision support tools	# acres	50%	$2K
27	Soil Erosion and Salinity Control Planning	2701	consultative services to develop soil erosion and salinity control plans, planning and decision support tools	# acres	50%	$2K
28	Biodiversity Enhancement Planning	2801	consultative services to plan habitat enhancement, wetland restoration, stewardship for species at risk and/or wildlife damage prevention within agricultural land base; planning and decision support tools	# acres	50%	$2K
29	Irrigation Management Planning	2901	consultative services for planning improved water use efficiency and reduced environmental risk of existing irrigation systems, planning and decision support tools	# acres	50%	$2K
30	Riparian Health Assessment (GREENCOVER)	3001	consultative services for assessing riparian health, planning and decision support tools	# acres	50%	$2K

Appendix M: Environmental Farm Plan Workshops and EFP Statement of Completions in Manitoba



Appendix N: Annual Precipitation for weather stations located in the Westlake IWMP for selected years.*

Weather Station	Total Annual Precipitation (mm)						
	1992	**1993**	**1999**	**2000**	**2005**	**2006**	**30-year average (1971 - 2000)**
Alonsa	528.4	489	640.6	652.7	606.6	616.1	566.5
Langruth	455.6	462.5	563.4	700.6	-	-	546.7
Ste. Rose[(1)]	M	506.2	564.8E	567.6	M	293.3E	501.1
Vogar[(1)]	428	M	M	599.8	549.1	435.3	515.2

Weather Station	Total Annual Rainfall (mm)						
	1992	**1993**	**1999**	**2000**	**2005**	**2006**	**30-year average (1971 - 2000)**
Alonsa	369.8	415.5	563.0	477.6	408.0	434.1	424.9
Langruth	342.3	424.6	467.8	542.1	-	-	411
Ste. Rose[(1)]	M	440.2E	513.E	408.1	M	435.4E	387.8
Vogar[(1)]	319.8	466.9	M	457.2	411.3	307.7	393.4

*Annual precipitation and rainfall data was obtained from the Environment Canada website at:
http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html

(1) Data was gathered from a community located outside the IWMP study area.