La Salle River Watershed

State of the Watershed Report

May 2007

This Report Prepared by:

La Salle Redboine Conservation District Staff

With Technical Information Provided by:

Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration
Building Up – Wendy Bulloch
City of Winnipeg – Naturalists Services Branch
Fisheries and Oceans Canada
Manitoba Agriculture, Food and Rural Initiatives
Manitoba Conservation – Environmental Programs Branch
Manitoba Conservation – Geomatics Branch
Manitoba Conservation – Wildlife and Ecosystem Protection Branch
Manitoba Habitat Heritage Corporation
Manitoba Intergovernmental Affairs and Trade – Community Planning Services
Manitoba Science, Technology, Energy and Mines
Manitoba Transportation and Government Services
Manitoba Water Services Board
Manitoba Water Stewardship – Fisheries Branch
Manitoba Water Stewardship – Groundwater Management
Manitoba Water Stewardship – Office of Drinking Water
Manitoba Water Stewardship – Regional Water Operations
Manitoba Water Stewardship – Surface Water Management
Manitoba Water Stewardship – Water Licensing
Manitoba Water Stewardship – Water Quality Management
North – South Consultants
Red River Basin Commission

La Salle River State of the Watershed Report 2007
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BIODIVERSITY

WATERSHED DEVELOPMENT

Section 1 – Executive Summary

Acknowledgements:

This document was prepared as a planning tool for use in the development of the La Salle River Integrated Watershed Management Plan. Documents have been pooled together from multiple sources in order to provide a holistic view of the condition of the La Salle River Watershed as of 2007. This represents the first time that information about the La Salle River has been gathered together and presented to the public to raise awareness about watershed issues.

The La Salle Redboine Conservation District would like to acknowledge the efforts and support of Mr. Barry Oswald, Manager, Water Planning Branch of Manitoba Water Stewardship in assisting in the preparation of this document and assistance in developing the La Salle River Watershed Management Plan. Special thanks is also extended to all the civil servants from various Federal and Provincial departments and Non-governmental Agencies who supported the planning process by collecting and presenting watershed information to the Water Planning Advisory Team.

The Watershed Plan:

Flooding, declining water quality, soil erosion, loss of wildlife habitat, stream bank erosion, wetland drainage, lack of drought protection and increasing water demand. These are all common concerns for many watersheds in southern Manitoba.

The La Salle River is no different. A recently completed Provincial water quality study identifies that nutrient loading to the La Salle River, which many experts consider the greatest threat to water quality, has nearly doubled in the past 30 years. Spring and summer flooding of farm land and private property have increased in frequency and cost of damages.

As populations increase, so are demands for access to potable water. Development and intense use of areas near watercourses contribute to water contamination and reduce the stability of sensitive river banks. Uncontrolled drainage of fields and wetlands can increase runoff intensity and reduce base flows of streams in dryer months.

These things all occur in the La Salle River Watershed but to what extent? How concerned should we be? What can we do about it? The issues identified above are not singular unrelated problems. They cannot be fixed in isolation. They are symptoms of a larger concern and must be treated as a system. That system is the watershed!

Watersheds are defined as areas of land that captures precipitation (i.e. rain, snow melt) and funnels it to a river, lake or stream. It is a community where people, business, agriculture, government, institutions, plants, and animals are interconnected by the common water resource. The community influences the watershed and the watershed influences the community. A watershed is a complex system and to protect its health everyone who has a stake in the watershed may have to make trade offs, compromises and maybe even some sacrifices to keep it healthy.

A healthy watershed requires a community supported plan to protect this complex resource for current and future watershed residents. A watershed plan is a document prepared by the watershed community that describes the actions needed over time to achieve a sustainable healthy watershed. The La Salle River Watershed Management Plan is simply an organized way of looking at big picture issues and setting long and short term priorities for improving the La Salle River Watershed.

This plan will be holistic and will provide a venue where all watershed residents, local municipalities and government agencies can openly discuss watershed concerns and work together to develop long term solutions.

There are increasing pressures on the watershed due to a growing economy. A watershed plan ensures the resources in the watershed are managed in a sustainable fashion. The plan is a roadmap for the community to help plan and practice good common sense programs, and help define what is important to the community.

The watershed plan for the La Salle River will help set local priorities between need-to-do's and nice-to-do's and helps communicate to the public where the work will be done. It also demonstrates to senior governments that local people are in charge of managing their own resources. The plan also sets a way to measure future progress on meeting resource goals and objectives.

The plan will help groups like the La Salle Redboine Conservation District set programming agendas and direct limited funds to watershed priorities. Information provided by the watershed management plan should be used by area planning districts in their development plans to avoid potential conflicts with existing or future development in the watershed.

The La Salle River watershed encompasses 2,400km2 of the central plains region of Manitoba. It is home to a large number of small communities including 5 rural municipalities and portions of the City of Winnipeg. The watershed is also represented by 5 planning districts, a wide variety of producer groups, Hutterite Colonies, community associations, business associations and the La Salle Redboine Conservation District.

Under the recently enable Water Protection Act, the La Salle Redboine Conservation District has been established as the Water Planning Authority (WPA) for the La Salle River Watershed. This means that the Conservation District has been assigned the responsibility of preparing and implementing a watershed plan for the La Salle River.

The plan will be completed within a two year time frame and ready to be implemented in early 2008. A full scale review of the progress of the plan will also be completed in 2013 to identify successes, failures and to introduce refinements to ensure the plan is up to date with the needs of the watershed.

Section 1 – Executive Summary

Deliverables from the Watershed Planning Process:

State of the Watershed Report - This document will pull information from several sources to quantify the current state of the La Salle River Watershed. The information contained in the report will be extensively used to evaluate the requirements of the final watershed plan.

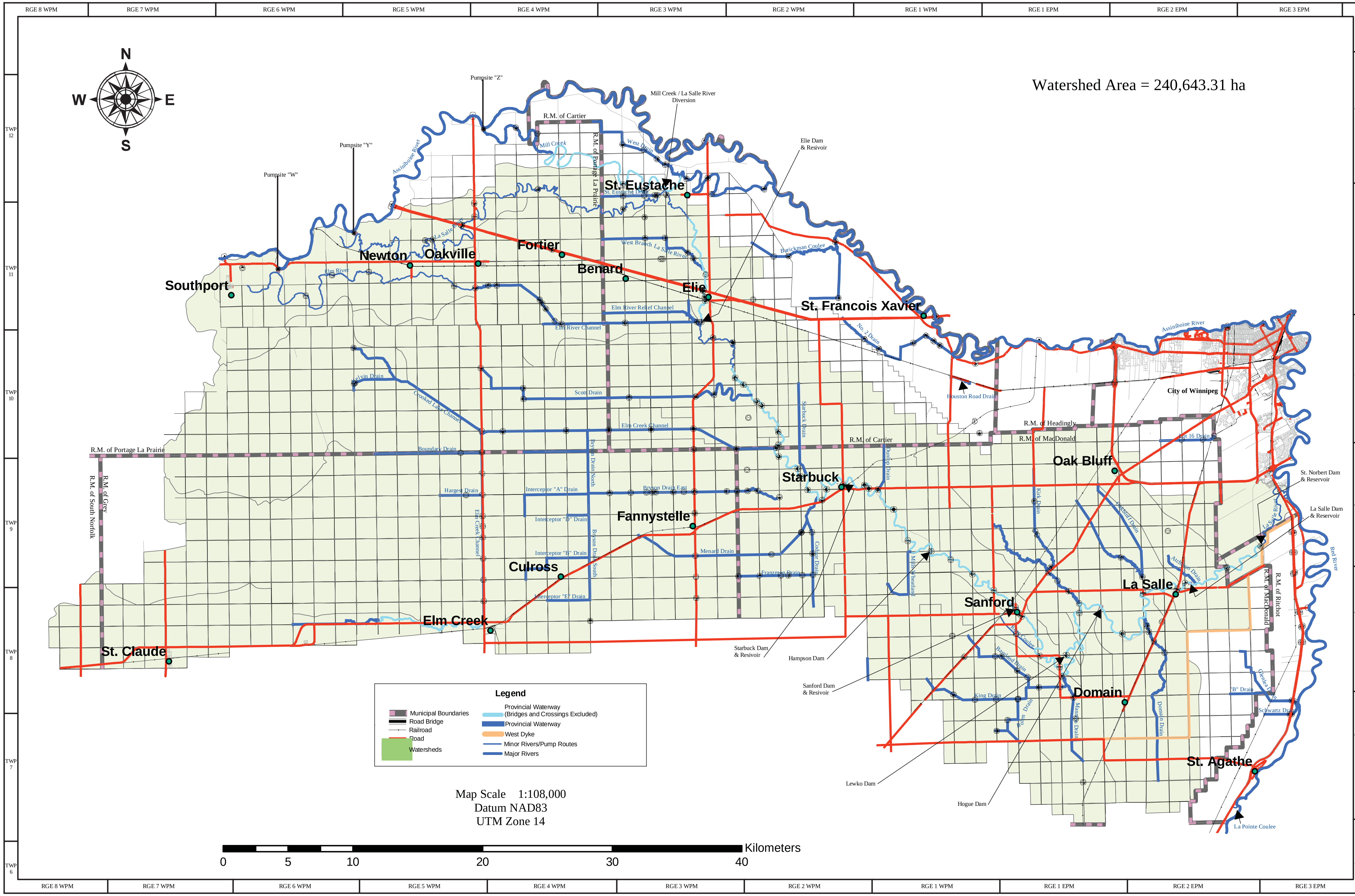
Watershed Report Card - This simplistic report will be widely distributed throughout the watershed and will contain provincial indicators for the health of the watershed. These report cards will be completed periodically in the future and will be useful in presenting and evaluating the success and shortcomings of the watershed plan.

Source Water Protection Plan - This plan will be prepared for drinking water sources in the watershed. Using available information this plan will identify, assess and mitigate threats to domestic drinking water supplies.

Public Awareness - A heightened public awareness about the health issues and potential solutions to concerns of the La Salle River Watershed is probably the single most important deliverable from the entire process.

Integrated Watershed Management Plan – A community support road map to addressing issues of environmental concern within the watershed. This 10 year plan will be implemented and monitored for success on the landscape.

La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

Section 3 – The Watershed Plan

Section 3.1 - The Planning Process, Key Players and Terms

The Process:

In 2002, the La Salle Redboine Conservation District was formed in the South Central region of Manitoba to address soil and water management issues in the La Salle River watershed. The need for a strategic watershed management plan quickly became evident as a prerequisite to success of limited funding for conservation programming on the landscape.

With numerous resident organizations and separate planning bodies in the watershed, it is imperative for proper watershed function that a uniform holistic plan be adopted to manage resources and development in the La Salle River watershed.

In January 2005, the Province of Manitoba passed the Water Protection Act[1]. This Act outlines various mechanisms to address concerns and protect water resources in the Province of Manitoba. One avenue for this to occur was through watershed management planning. The Water Protection Act set out specific guidelines to follow when developing integrated watershed management plans. As part of this process a Water Planning Authority (WPA) is assigned the responsibility for preparing and implementing an integrated watershed management plan for a specific watershed.

Pursuant to the spirit of the Water Protection Act, the La Salle Redboine Conservation District spearheaded the formation of the La Salle River Watershed Planning Authority to oversee the creation and implementation of an integrated watershed management plan (IWMP) for the La Salle River Watershed.

To be declared a Water Planning Authority for a watershed an organization must first sign a memorandum of understanding with the Province of Manitoba and develop a terms of reference to guide the planning process. To help offset the cost of developing a watershed plan, a grant of $25,000 dollars is provided to each Water Planning Authority. Once these steps are satisfied the actual watershed planning process begins.

The planning cycle involves a two year process for the La Salle River Watershed Plan as outlined below:

Month/Year	Deliverable/Task
Mar/06 to Oct/06	Get organized, form planning committee or Water Planning Advisory Team (WPAT) with community members, associations and government agencies
Oct/06 to April/07	Review and compile state of the watershed report with WPA and WPAT

[1] A copy of The Water Protection Act can be found on-line at: http://web2.gov.mb.ca/laws/statutes/2005/c02605e.php

Mar/07	Consult the community about their concerns for the watershed
May/07	Present state of the watershed report to community
May/07 to Dec/07	Assemble draft plan with input from all watershed stakeholders process guided by WPA and WPAT members
Jan/08 to Feb/08	Present draft plan to community for feedback
Feb/08	Assemble final plan with revisions from community feedback
Mar/08	Distribute final plan to community and forward final plan to Province of Manitoba for approval
Apr/08	Implement recommended actions from plan and monitoring of progress
April 2018	Full Evaluation of Watershed Plan

Watershed planning is a perpetual cycle where a road map to watershed protection and improvement is outlined in consultation with as many stakeholders as possible (technical and non technical advice). This road map is then followed and monitored for its success on the landscape. Every ten years the watershed plan is to be re-evaluated and fine tuned to meet the needs of the watershed and local community.

The Players:

The Water Planning Authority (WPA):

The Water Planning Authority for the La Salle River Watershed is the La Salle Redboine Conservation District[2]. The WPA ensures that all provisions for preparing the IWMP, contents of the IWMP, consultation and public meetings, and plan review, revision and approval process are completed in accordance with the Water Protection Act. This group must also consider Provincial water and land best management practices, policies, legislation and actively engage members of the public in developing the watershed plan.

The Water Planning Advisory Team (WPAT):

This is a group comprised of key watershed resident associations and technical support staff. The mandate of this group is to: 1) help the WPA collect key information throughout the process, 2) design appropriate public consultation methods, 3) voice

[2] More information about the La Salle Redboine Conservation District can be found on-line at: www.lasalleredboine.com

opinions about La Salle River Watershed management issues and 4) help engage participation from area residents.

The technical support staff is comprised of members of the provincial and federal public service that have key science based information about aspects of the watershed that is important to the planning process. These individuals are responsible to provide comment on all available watershed technical information about their respective fields to the WPAT. Information provided to the planning group would focus on, 1) identification of areas or criteria of concern within the watershed (e.g. soil erosion risk, or development within floodplains etc.), 2) the extent of current impacts, a historical review of impacts and potential of future impacts based on data available and 3) recommendations to the WPAT based on future information needed about the watershed and the adoption of best management practices to address concerns within the watershed.

A complete listing of members of the WPA and WPAT is provided in *Table 1*.

The Terms of Reference for the Watershed Plan:

The purpose of developing the La Salle River Watershed Integrated Watershed Management Plan is:

- To establish the current state of the watershed in order to identify issues and target areas for remediation work and conservation programming;
- To establish surface water management policies, including retention and drainage requirements;
- To identify water quality standards for the watershed to be able to begin setting watershed goals;
- To identify source protection zones to assist in protecting water, aquatic ecosystems or drinking water sources;
- To empower the local WPA to protect their own water, aquatic ecosystems and drinking water sources;
- To address, identify or establish:
  - Water quality standards, objectives and guidelines;
  - Water quality management zones and regulations;
  - Studies required relating to water, land use, demographics, the environment, etc.;
  - Encourage public input;
  - Water management principles;
  - Provincial land use policies, development plans, and zoning by-laws;
  - Ways for a planning district or rural municipality to adopt the plan
  - Implementation, monitoring and evaluation strategies
  - Required watershed maps
  - Plan review date
  - Any other relevant information.
- To plan for drinking water source and aquatic ecosystem protection on a watershed boundary; and

- To develop a cooperative funding effort between local watershed and provincial interests.

The purpose is not to:

- Commit the La Salle Redboine Conservation District nor any Planning District to programming outside of their respective mandates
- Infringe on confidentiality nor target watershed residents

The Water Protection Act outlines key considerations and contents of a watershed management plan. As such, the IWMP will address the following issues.

Section 15 of the Act states that a WPA must consider the following:

1. water quality standards, objectives and guidelines that apply to the watershed;
2. whether a water quality zone is included within any part of the watershed, and if so, any regulations made under section 4 respecting the zone;
3. studies that the authority considers relevant relating to water, land use, demographics, the capacity of the environment to accommodate development, and any other matter related to present or future physical, social or economic factors;
4. comments received through public consultation or public meetings held under section 17;
5. prescribed water management principles;
6. relevant provincial land use policies, development plans, and zoning by-laws;
7. any other information that the authority considers relevant.

Section 16 of the Act states that a water management plan:

1. Must deal with the protection, conservation or restoration of water, aquatic ecosystems and drinking water sources in the watershed:
2. Must contain objectives, policies and recommendations regarding some or all of the following:
    a) protection, conservation and restoration of water, aquatic ecosystems and drinking water sources,
    b) the prevention, control and abatement of water pollution, including wastewater and other point-source discharges, and non-point sources of pollution,
    c) land drainage and flood control, including the maintenance of land drainage and flood control infrastructure,
    d) activities in water quality management zones, riparian areas, flood areas, flood plains and reservoir areas,
    e) water demand management, water use practices and priorities, the conservation of water supplies, and the reduction of water use and consumption during drought and other periods of water shortage,
    f) the supply, distribution, storage and retention of water,

g) emergency preparedness to address spills, accidents and other emergencies that may affect water, aquatic ecosystems or a drinking water source

3. Must specify linkages between water management and land use planning so as to facilitate the adoption, in a development plan or other planning instrument, of some or all of the provisions of the watershed plan.

4. Must identify ways in which the plan can be implemented, monitored and evaluated.

The desired outcome of the integrated watershed management planning process (IWMP):

The IWMP will provide the watershed residents with a water management plan, a source water protection plan, a business plan for delivering the watershed plan, and a monitoring plan for long term success. Once implemented, these components combined will provide the first barrier in a multi-barrier approach to aquatic ecosystem and drinking water source protection.

Water Planning Advisory Team - Membership List

Community Associations and Local Groups

Assiniboine Community College
Bon Homme Colony
Brant Wood Colony
Central Manitoba Resource Management (MRM)
Central Plains / White Plains Regional Development
Club Snow - Portage la Prairie
Community of Elm Creek
Community of Fannystelle
Community of Haywood
Community of La Salle
Community of Oakville
Community of Sanford
Community of Springstien
Community of St. Claude
Community of St. Eustache
Community of St. Norbert
Community of Starbuck
Cross Country Snow Drifters - RM of Macdonald
Dairy Farmers of Manitoba
Domain Recreation Club
Elm River Colony
Grand Colony
Homewood Colony
Huron Colony
Iberville Colony
International Erosion Control Association - NPC
James Valley Colony
Keystone Agricultural Producers
La Salle District Chamber of Commerce
Manitoba Canola Growers Association
Manitoba Cattle Producers Assocation
Manitoba Pork Council
Manitoba Pulse Growers Association
Manitoba Zero Tillage Research Association
Milltown Colony
Nature Conservancy of Canada
Organic Producers Association
Portage Economic & Community Development
Portage la Prairie School Division
Portage Planning District
Prairie Fruit Growers Association
Prairie Rose School Division
Prairie Spirit School Division
Rivers West
RM of Cartier
RM of Grey
RM of MacDonald
RM of Portage
RM of Ritchot
Rosedale Colony
Sanford Collegiate
Snoflies - Carman & Area
St. Claude Game & Fish
Starlite Colony
Sunnyside Colony
Vegetable Growers Association of Manitoba
Vermillion Colony
Waldhiem Colony
White Plains Crop Improvement Association
White Plains Recreation District
Winnipeg Naturalist Services Branch

Science & Technical Support Agencies

Agriculture and Agri-Food Canada
Conservation Data Centre
Delta Marsh Field Station
Ducks Unlimited Canada
Environment Canada
Fisheries and Oceans Canada
Manitoba Agriculture, Food and Rural Initiatives
Manitoba Agriculture, Food and Rural Initiatives - Agro Woodlot
Manitoba Conservation
Manitoba Conservation - Remote Sensing Technologist
Manitoba Conservation - Water Development & Control Assessment Officer
Manitoba Habitat Heritage Corporation
Manitoba Intergovernmental Affairs and Trade
Manitoba Transportation and Government Services
Manitoba Water Stewardship
Manitoba Water Stewardship - Fisheries
Manitoba Water Stewardship - Groundwater
Manitoba Water Stewardship - Hydrology
Manitoba Water Stewardship - Licensing
Manitoba Water Stewardship - Licensing Allocation
Manitoba Water Stewardship - Licensing Allocation
Manitoba Water Stewardship - Manitoba Water Services Board
Manitoba Water Stewardship - Office of Drinking Water
Manitoba Water Stewardship - Surface Water Quality
Science, Technology, Energy & Mines - Aggregate Geologist
Science, Technology, Energy & Mines - GIS Technologist
Science, Technology, Energy & Mines - Quaternary Geologist

Section 3.2 – The Water Planning Authority

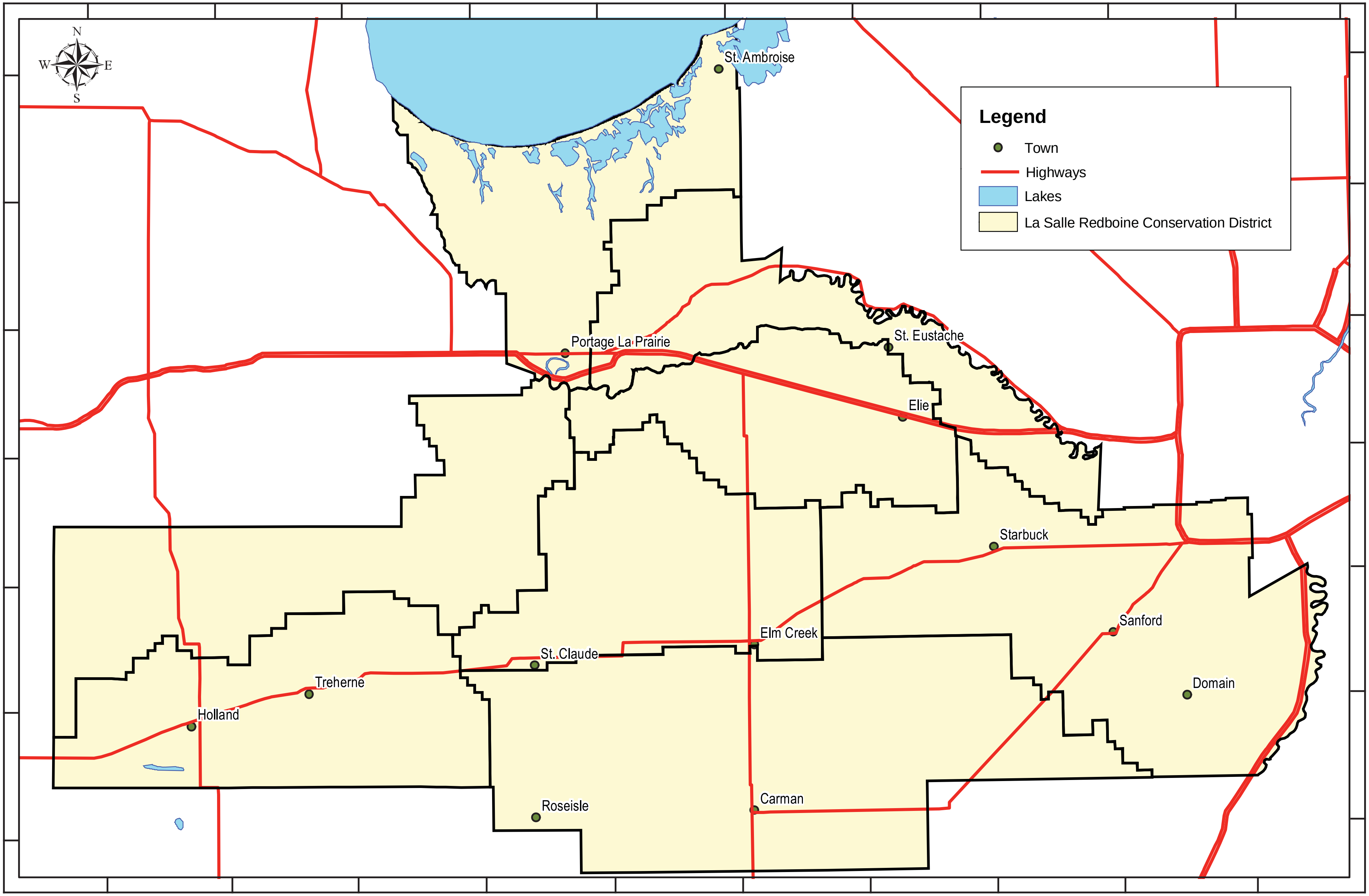
La Salle Redboine Conservation District[1]

The La Salle Redboine Conservation District is a grass roots, not-for-profit conservation organization responsible for watershed planning, enhancement and education initiatives for 7,000 sq km of south central Manitoba's watersheds. The organization consists of a partnership of 12 municipalities, watershed residents and Manitoba Water Stewardship. Our mandate is to protect and develop our watershed's natural resources in a sustainable manner for the greater benefit of present and future generations. We have operated since 2002 and as of 2006 have completed over 185 watershed restoration projects with over 600 landowners.

Our member municipalities include: RM of Cartier, RM of Macdonald, RM of Ritchot, RM of Portage, RM of Grey, RM of Dufferin, RM of South Norfolk, RM of Victoria, City of Portage la Prairie, Town of Carman, Town of Treherne, and Village of St. Claude. We are governed by 48 members of the board of directors consisting of half municipal councilors and half dedicated watershed residents. Our head office is located in Holland, MB and is staffed by 3 full time employees.

[1] More information about the La Salle Redboine Conservation District can be found on-line at: www.lasalleredboine.com

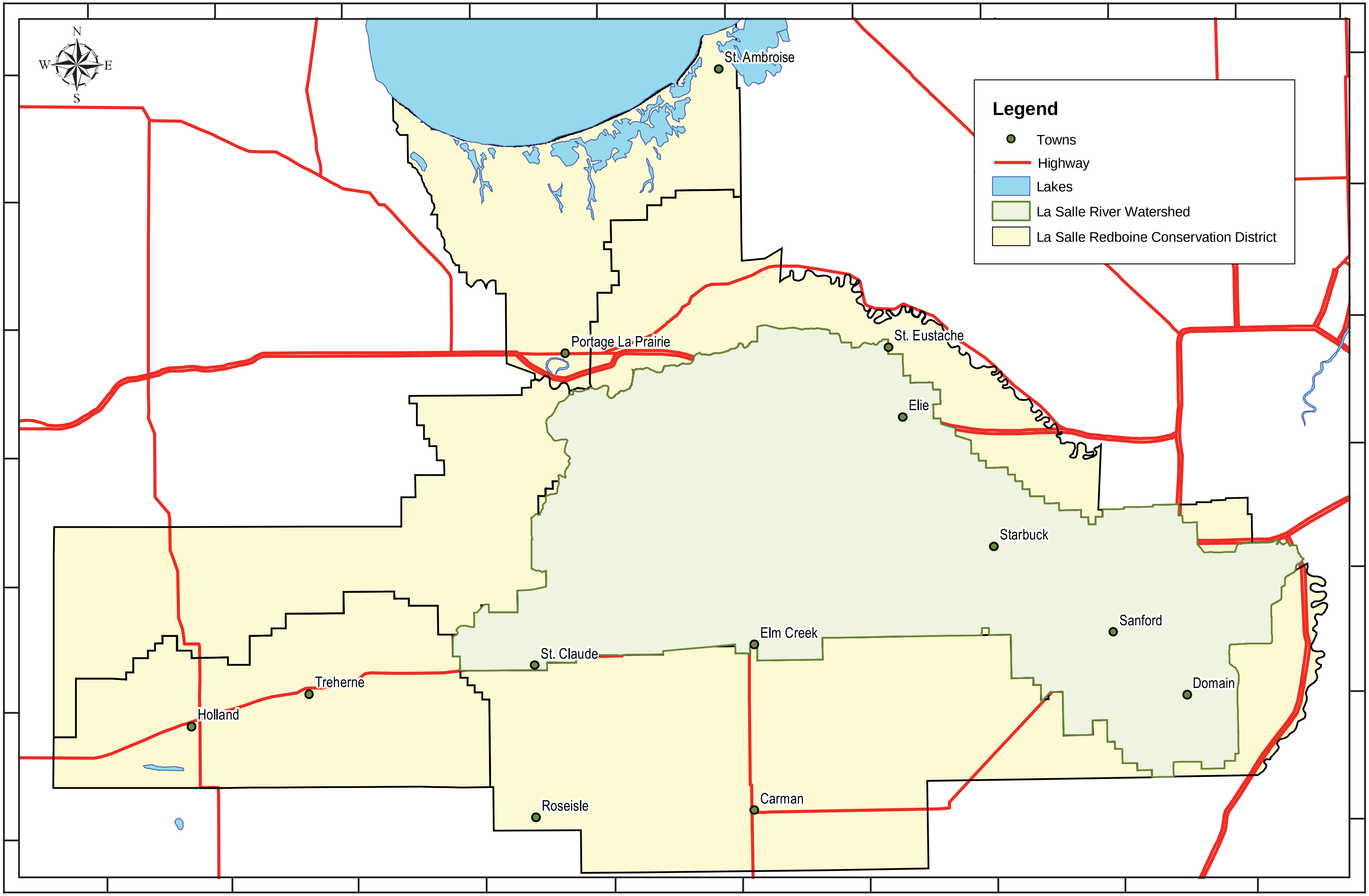
La Salle Redboine Conservation District



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

La Salle River Watershed
within the La Salle Redboine Conservation Distirict



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Section 4.0 – Earth Resources

Section 4.1 - Geological Resources of the La Salle River Watershed (Source: Manitoba Science, Technology, Energy and Mines)

Surficial Geology:

The surficial sediments in the watershed are primarily glaciolacustrine sand and clay; alluvial sediments occur near Portage La Prairie. The units are shown on the surficial geology map and the depth to bedrock map which accompany this report.

Approximately two thirds of the watershed is underlain by clay deposited in glacial Lake Agassiz. Clay thicknesses range from up to 50 m of clay in the Portage La Prairie area (Ringrose, unpublished) to < 5 m at the eastern edge of the watershed. The clay deposits consist of a lower, dark grey clay and a thinner upper unit of lighter coloured, calcareous silty clay. The clay plain has a gentle ridge ans swale surface particularly in the eastern portion. The ridges are 1-3 m high, with 1- 3 km spacing and are oriented southeast. The western part of the watershed is underlain by medium to fine sand that forms the distal edge of the Assiniboine delta. This sand has been blown into dunes in the area of the Portage sandhills. A Lake Agassiz beach ridge runs along the eastern edge of the delta sediments. In the watershed, this ridge consists primarily 3 m of fine sand over clay. There is a very small glaciofluvial gravel deposit on the northeastern edge of the watershed. Sediments of an alluvial fan that extends to Lake Manitoba occur in the north central part of the area.

Late Glacial History:

The general sequence of events during the Late Wisconsinan glaciation of Manitoba has been outlined by several authors and the following is a compilation of their work. Manitoba was glaciated by ice from two centres of outflow; the Labradorean and Keewatin ice domes. During the Late Wisconsinan, in southern Manitoba, ice first advanced from the northeast to an undetermined western limit. Retreat of this ice was followed by an advance of the Red River Lobe flowing southeastwards down the Manitoba Lowlands, eventually reaching Iowa. Along the western edge of the province, ice advanced from the Keewatin sector. During deglaciation this ice stagnated on the uplands while the ice in the Lowlands remained active. A series of readvances characterize the overall retreat of the Red River ice from southern Manitoba. Since natural drainage is to the north, meltwater ponded against the retreating ice front, forming glacial lakes. Glacial Lake Agassiz was the largest of these, covering parts of Ontario, Manitoba and Saskatchewan during its existence. The lake has a four part history: the high water Lockhart phase during which the lake drained south to the Mississippi River and the Gulf of Mexico, the low water Moorehead phase during which the lake drained through eastern outlets to the Atlantic Ocean, the high water Emerson phase when drainage was again south to the Gulf of Mexico and the Morris phase when the lake finally disappeared from the continent.

Within the watershed area, the Red River lobe deposited a calcareous silty till, often in southeast oriented ridges (flutes). These are particularly common in the eastern part of

the area; the clay ridges in that area are a result of clay deposits reflecting the underlying fluted till surface. As the ice retreated, the Lockhart phase of Lake Agassiz began and the deep water dark clays were deposited in the basin. The Keewatin ice to the west had retreated, leaving stagnating ice on the uplands. The Assiniboine River formed as a spillway draining glacial lakes formed from meltwater from the retreating ice front and the stagnating ice. The Assiniboine delta was deposited where the spillway entered Lake Agassiz. The fine sand and silts of the distal edge of the delta overlies clay in the LaSalle River watershed. The delta had completely formed by the end of the Lockhart phase about 11 000 yrs. B. P.. Outlets opening in Ontario allowed the lake to drain to the low water Moorehead level. An ice advance closed these outlets, starting the Emerson phase as water levels rose again. The calcareous silty clays were deposited at this time. The beach ridge was deposited during the Morris phase as the lake drained from the area.
As the lake retreated the Assiniboine river entrenched itself across the newly exposed delta sediments. When it reached the change in slope at the edge of the delta, the river began to deposit the Portge La Prairie alluvial fan. The fan was built by a series of channels. Initially the river entered Lake Manitoba through what is now the Willowbend channel. The river changed course several times as the fan built up and local slope changed. The current LaSalle river occupies an Assiniboine river paleochannel that was active approximately 2 890 yrs B.P. (Rannie et al, 1989).

Mineral Rights:

There is no simple answer as to who owns the mineral rights on a parcel of land. It depends on what is on the title. There are some broad general rules but each time the land changes hands, the seller could have retained certain rights or split titles. Often there are the words "excepting out" followed by a list of minerals, meaning the seller has retained ownership of those minerals, however occasionally the title states "valuable stone". In some instances, that has been considered to mean sand and gravel. In other cases, quarter or half interests of the mineral rights have been retained or split among heirs. So the only certain way to tell who owns what rights is to go to the appropriate Land Titles office and examine the wording on the title.

Having said that, the following is the case for most titles. There are usually three parts to the title of any piece of land: the surface rights, the sand and gravel rights and the mineral underrights. Whether these rights are crown or private depends on when the land was homesteaded (or first title issued):

- Prior to Jan 11, 1890 everything went to the purchaser except gold & silver with some exceptions. For example, the lands given to the Hudson Bay Co. when they deeded their charter lands to Canada.
- Between 1890 & July 15, 1930 mineral underrights were retained by the Canadian government. Sand & gravel was not included in this. During this time, sand & gravel ran with the surface title unless specifically excepted out on the new title when the land was resold.
- Subsequent to July 15, 1930 Manitoba became the Crown. Only the surface rights went to the purchaser and the sand & gravel and mineral underrights were retained by the Crown.

Section 4.0 – Earth Resources

Unless the land reverts to the Crown during a tax sale, the private rights on the original title are conveyed to the new owner - unless the seller "excepts out" things they want to retain rights to.

Crown-owned mineral rights, excluding oil and gas, are administered by the Mines Branch of the Department of Science, Technology, Energy and Mines. Petroleum Branch regulates oil and gas production in the province. Under the Mines Branch, minerals are divided into quarry minerals and other minerals, primarily metals. Quarry Minerals Regulation (Manitoba Regulation 65/92) lists the minerals which are considered "quarry minerals". Crown quarry minerals are extracted either under a quarry lease, which gives the holder exclusive rights to the commodity listed on the lease, or by casual quarry permit. The permit is for a designated area and many contractors can remove material from the deposit. Minerals other than those designated as "quarry" are regulated under the Mineral Disposition and Mineral Lease Regulation (Manitoba Regulation 64/92). Initially an exploration company will take out a mineral claim, often several claims as a block covering a large area. If a viable deposit is discovered, the claim will be converted into a mineral lease before mining takes place.

Regulation of Aggregate Resources:

Aggregate extraction is regulated through the Quarry Minerals Regulation (Manitoba Regulation 65/92) under the Manitoba Mines and Minerals Act, through policies under the Planning Act and through municipal development plans and their zoning by-laws. Policy #9 under the Planning Act is designed to protect high quality mineral resources from conflicting land uses until the resource has been extracted. Most development plans include maps showing high quality aggregate deposits. Zoning by-laws identify where extraction is allowed or excluded; the by-laws may set strict land use controls on mining.

The Quarry Minerals Regulation sets standards for such things as safety slopes, setbacks from adjacent property lines and waterways, noise levels and location of petroleum storage, etc. it also provides for the "Pit and Quarry Rehabilitation" program. Under this program, landowners can apply to have depleted or abandoned gravel pits and quarries rehabilitated to a standard that is "safe, environmentally stable and compatible with adjoining lands".

Mineral Resources in the LaSalle River Watershed:

There has been very little economic use made of the mineral resources in the area. The Mines Branch has only two records of aggregate extraction. Gravel was removed from the glaciofluvial deposit in 1994 and ~40 000 tonnes of sand was extracted from the deltaic sands in 1996. Silty clay from the eastern part of the delta area has been used in brick manufacturing in the past. However, none of the extraction sites were within the LaSalle watershed.

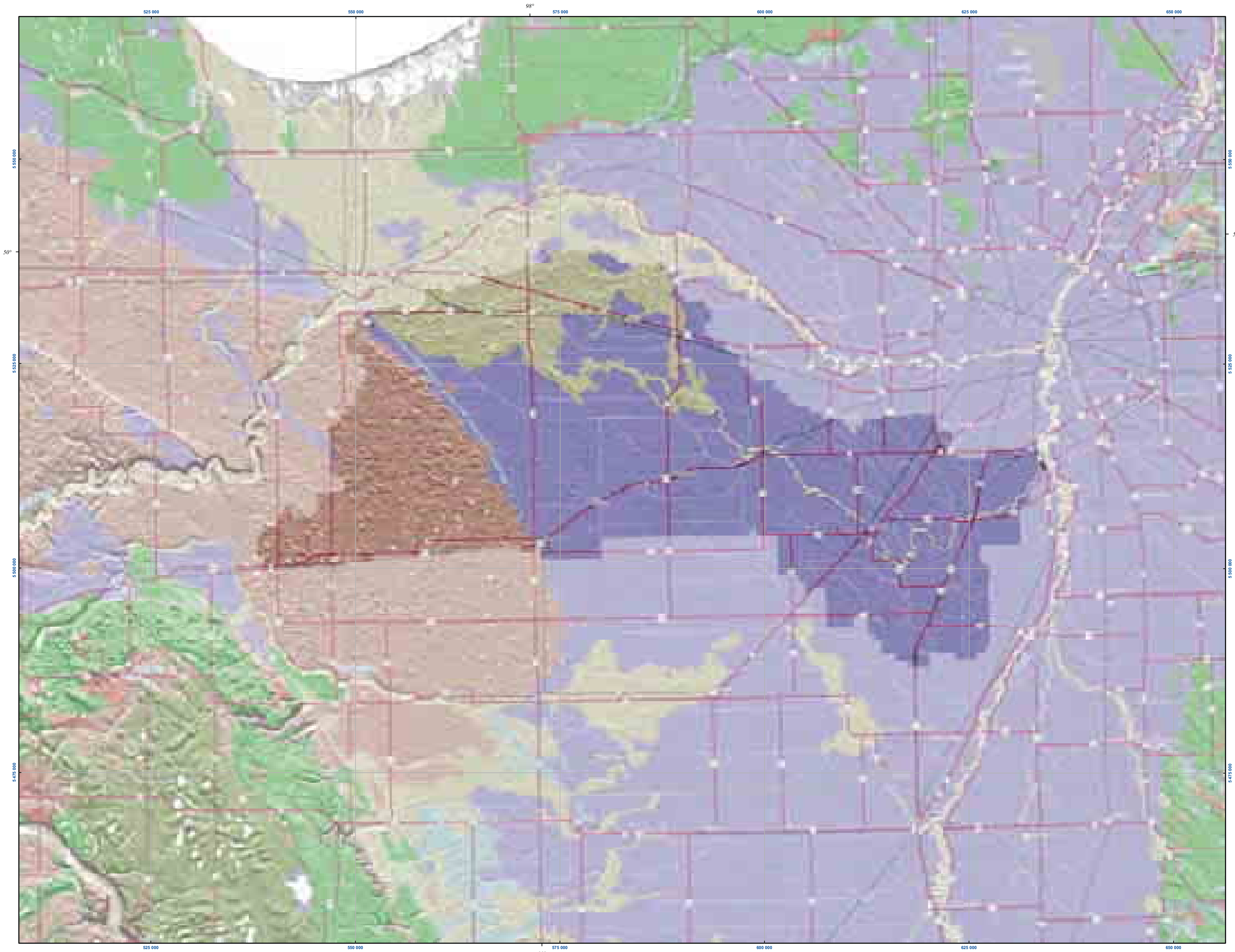
Section 4.0 – Earth Resources

Suggested References:

Rannie, W.F., Thorleifson, L.H. and Teller, J.T. 1989: Holocene evolution of the Assiniboine River paleochannels and Portage La Prairie alluvial fan; *in* Canadian Journal of Earth Sciences, Vol. 26, No 9, p. 1834-1831.

Teller, J.T., Thorleifson, L.H., Matile, G. and Brisbin, W.C. 1996: Sedimentology, geomorphology and history of the central Lake Agassiz basin (Field trip B2); Geological Association of Canada – Mineralogical Association of Canada Joint Annual Meeting, 1996, 101 p.

SECTION 4.1.2



Scale 1:250 000

0 10 20 30

Kilometres

North American Datum 1983
Universal Transverse Mercator Projection, Zone 14
Shuttle Radar Topography Mission elevation data provided by NASA (2003)
100X vertical exaggeration

LEGEND

Quaternary

O	ORGANIC DEPOSITS: peat, muck; 1–5 m thick; very low relief wetland deposits; commonly in low-lying areas; accumulated in fen, bog, swamp, and marsh settings; in permafrost areas commonly includes permafrost features such as patterned ground and peat palsas.
Lm	SHORELINE SEDIMENTS: sand and gravel; 1–2 m thick; beaches; formed by waves at the margins of modern lakes
C	COLLUVIUM: landslide debris, eroded slopes, mass flow deposits associated with steep slopes
E	EOLIAN: sand and minor silt; dunes, blowouts and undulating plains; generally overlies deltaic sediments, coarse lacustrine sediments, or glaciofluvial deposits
A	ALLUVIAL SEDIMENTS: sand and gravel, sand, silt, clay, organic detritus; 1–20 m thick; channel and overbank sediments; reworked by existing rivers and deposited primarily as bars
Ms	MARGINAL GLACIOMARINE SEDIMENTS: littoral sand and gravel; 1–10 m thick; beach ridges, spits, bars; formed by waves at the margin of the glacial Tyrell Sea and present-day Hudson Bay
M	OFFSHORE GLACIOMARINE SEDIMENTS: clay, silt, minor sand; 1–20 m thick; very low relief massive and laminated deposits which are commonly overlain by peat; deposited from suspension in the offshore, deep water of the glacial Tyrell Sea and present-day Hudson Bay
Ls	MARGINAL GLACIOLACUSTRINE SEDIMENTS: sand and gravel; 1–20 m thick; beach ridges, spits, bars, littoral sand and gravel; formed by waves at the margin of glacial lakes Agassiz, Souris and Hind, and other small proglacial lakes in the extreme northwestern portion of the province
Lc	OFFSHORE GLACIOLACUSTRINE SEDIMENTS: clay, silt, minor sand; 1–20 m thick; low relief massive and laminated deposits; deposited from suspension in offshore, deep water of glacial Lakes, primarily Lake Agassiz; commonly scoured and homogenized by icebergs
Gs	DISTAL GLACIOFLUVIAL SEDIMENTS: fine sand, minor gravel, thin silt and clay interbeds; 1–75 m thick; subaqueous outwash fans; deposited in glacial Lake Agassiz by meltwater turbidity currents; commonly reshaped by wave erosion and reworked by wind
G	PROXIMAL GLACIOFLUVIAL SEDIMENTS: sand and gravel; 1–20 m thick; complex deposits, belts with single or multiple esker ridges and kames, as well as thin, low-relief deposits; deposited in contact with glacial ice by meltwater

TILL: diamicton; unsorted glacial debris; 1–75 m thick; generally low-relief, commonly streamlined deposits; in Lake Agassiz basin areas, the till can be wave-washed, covered discontinuously by a thin veneer of glaciolacustrine sediments and scoured by icebergs; thicker sequences, primarily above the Manitoba Escarpment and in the Hudson Bay Lowland, consist of multiple units of varying texture and provenance

Tm	clay diamict; calcareous, primarily composed of Mesozoic shale from above the Manitoba Escarpment
Tc	silt diamicton; calcareous, largely composed of Paleozoic rocks from the Hudson Bay Lowland and the Interlake region of southern Manitoba
Tp	sand diamicton; non-calcareous, often bouldery, predominantly composed of Precambrian crystalline rocks

Pre-Quaternary

ROCK: > 75% bedrock outcrop; generally subglacially eroded and unweathered; in areas of permafrost includes frost shattered, angular, monolithic boulder fields (Felsenmeer)

Rm	Mesozoic terrane; shale-dominated rocks above the Manitoba Escarpment, exposed in the base of spillways and along the Manitoba Escarpment in association with colluvium
Rc	Paleozoic terrane; carbonate-dominated rocks in areas west of Lake Winnipeg, exposed typically as glacially striated, low-relief surfaces, and along large river valleys in the Hudson Bay Lowland
Rp	Precambrian terrane; intrusive, metasedimentary, and metavolcanic rocks having a glacially scoured irregular surface with high local relief

Uncoloured legend blocks indicate units that do not appear on this map.
Letter symbols on legend blocks (not shown on map face) are used to identify units in the map legend database included on the Manitoba SGCMS DVD.
To aid the reader, a shadow effect has been added to exaggerate the topographic relief based on data from the Shuttle Radar Topography Mission Digital Elevation Model.[1]

[1] United States Geological Survey 2002: Shuttle radar topography mission, digital elevation model, Manitoba; United States Geological Survey, URL <ftp://edcsgs9.cr.usgs.gov/pub/data/srtm/>, portions of files N48W88W.hgt.zip through N60W102.hgt.zip, 1.5 Mb (variable), 90 m cell, zipped hgt format [Mar 2003].

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Modified from:
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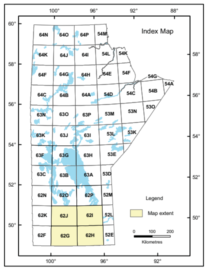
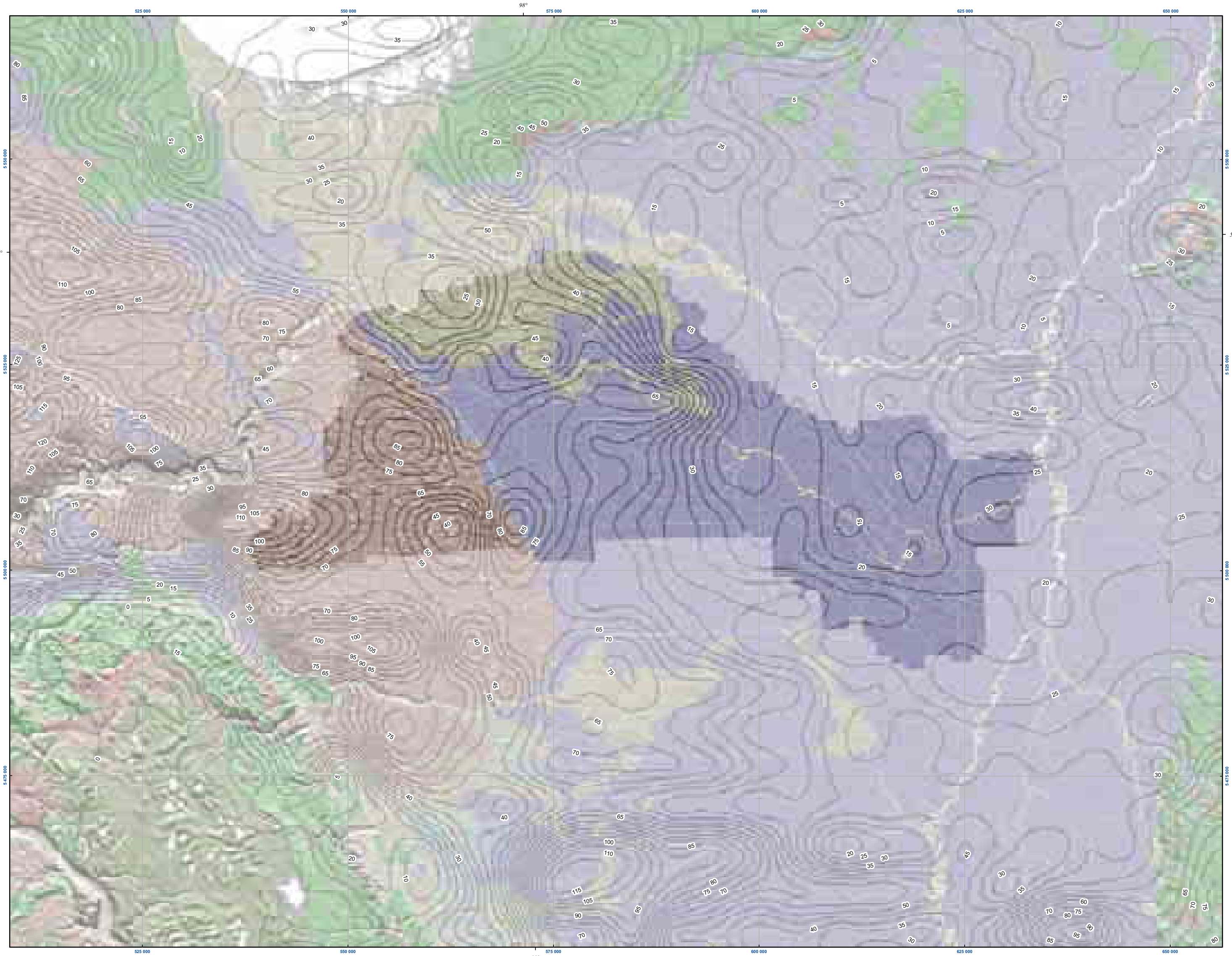
INTEGRATED WATERSHED MANAGEMENT PLAN

Surficial geology of the La Salle River watershed
Portions of: NTS 62G, 62H, 62I, 62J Manitoba



Manitoba

SECTION 4.1.3



Scale 1:250 000

0 10 20 30

Kilometres

North American Datum 1983
Universal Transverse Mercator Projection, Zone 14
Shuttle Radar Topography Mission elevation data provided by NASA (2003)
100X vertical exaggeration
Contours based on spline grid with 500 metre cell

LEGEND

Quaternary

O ORGANIC DEPOSITS: peat, muck; 1–5 m thick; very low relief wetland deposits; commonly in low-lying areas; accumulated in fen, bog, swamp, and marsh settings; in permafrost areas commonly includes permafrost features such as patterned ground and peat palsas.

Lm SHORELINE SEDIMENTS: sand and gravel; 1–2 m thick; beaches; formed by waves at the margins of modern lakes

C COLLUVIUM: landslide debris, eroded slopes, mass flow deposits associated with steep slopes

E EOLIAN: sand and minor silt; dunes, blowouts and undulating plains; generally overlies deltaic sediments, coarse lacustrine sediments, or glaciofluvial deposits

A ALLUVIAL SEDIMENTS: sand and gravel, sand, silt, clay, organic detritus; 1–20 m thick; channel and overbank sediments; reworked by existing rivers and deposited primarily as bars

Ms MARGINAL GLACIOMARINE SEDIMENTS: littoral sand and gravel; 1–10 m thick; beach ridges, spits, bars; formed by waves at the margin of the glacial Tyrell Sea and present-day Hudson Bay

M OFFSHORE GLACIOMARINE SEDIMENTS: clay, silt, minor sand; 1–20 m thick; very low relief massive and laminated deposits which are commonly overlain by peat; deposited from suspension in the offshore, deep water of the glacial Tyrell Sea and present-day Hudson Bay

Ls MARGINAL GLACIOLACUSTRINE SEDIMENTS: sand and gravel; 1–20 m thick; beach ridges, spits, bars, littoral sand and gravel; formed by waves at the margin of glacial lakes Agassiz, Souris and Hind, and other small proglacial lakes in the extreme northwestern portion of the province

Lc OFFSHORE GLACIOLACUSTRINE SEDIMENTS: clay, silt, minor sand; 1–20 m thick; low relief massive and laminated deposits; deposited from suspension in offshore, deep water of glacial Lakes, primarily Lake Agassiz; commonly scoured and homogenized by icebergs

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Tc silt diamicton; calcareous, largely composed of Paleozoic rocks from the Hudson Bay Lowland and the Interlake region of southern Manitoba

Tp sand diamicton; non-calcareous, often bouldery, predominantly composed of Precambrian crystalline rocks

Pre-Quaternary

ROCK: > 75% bedrock outcrop; generally subglacially eroded and unweathered; in areas of permafrost includes frost shattered, angular, monolithic boulder fields (Felsenmeer)

Rm Mesozoic terrane; shale-dominated rocks above the Manitoba Escarpment, exposed in the base of spillways and along the Manitoba Escarpment in association with colluvium

Rc Paleozoic terrane; carbonate-dominated rocks in areas west of Lake Winnipeg, exposed typically as glacially striated, low-relief surfaces, and along large river valleys in the Hudson Bay Lowland

Rp Precambrian terrane; intrusive, metasedimentary, and metavolcanic rocks having a glacially scoured irregular surface with high local relief

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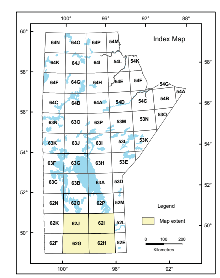
INTEGRATED WATERSHED MANAGEMENT PLAN

Depth to bedrock in the La Salle River watershed
Portions of: NTS 62G, 62H, 62I, 62J Manitoba



Manitoba

Section 4.2 - Soil Resources in the La Salle River Watershed (Source: Manitoba Agriculture Food and Rural Initiatives)

Soil Resources in the La Salle River Watershed - Supporting Text Descriptions:

A series of soil and landscape maps were presented at the February 23, 2007 meeting of the Watershed Planning Authority Team (WPAT) in partnership with Jason Vanrobaeys of PFRA. Following is a brief description and interpretation of the seven watershed maps presented:

Note: map scale

Approximately the western 2/3 of the watershed (RMs of Grey and Portage la Prairie, along with small portions of Cartier and Macdonald) have been mapped at a “detailed” scale of 1:20 000 (i.e. approximately 32 inspection sites per section of land were used to map the soils of the area). The remaining eastern 1/3 of the watershed (largely the majority of Cartier and Macdonald municipalities) has been mapped at a “general” or reconnaissance level of 1:126 720 (i.e. approximately 1-6 inspection sites per section of land).

Detailed soil survey maps identify more of the variation in soil types across smaller landscapes. As a result, detailed soil survey maps are much more accurate and reliable for making decisions at the farm-level. Reconnaissance or general soil surveys give only a broad picture of the dominant soil types and distribution of soils that occur over relatively large areas. The landscape may actually include farily significant areas of different soils that are not identified on the map. As such, reconnaissance soil surveys are best suited to making general comparisons of soil capabilities and limitations on a regional or national scale.

1. Surface Texture:

Soil texture is the relative proportion of sand, silt and clay. The texture of a soil cannot be altered. In agriculture, soil texture is determined by measuring the size and distribution of particles less than 2 mm in diameter. Sandy soils are referred to as “light” soils because they are easily tilled; clay soils are referred to as “heavy” soils because of their difficult workability.

The map reports on surface texture of soils in the watershed because some soils have a change in texture from the surface layer to the texture found at depth.

In this watershed, about 74% of the area has a **clay** surface texture, with lighter soils (sands and coarse loamy soils) making up about 18% of the watershed, concentrated in the western areas.

Sandy soils (such as Almasippi sands) are more prone to leaching losses of soluble nutrients such as nitrogen fertilizers because water moves quickly through them (at about 2 inches per hour). By contrast, clay soils (such as Red River clays) have extremely slow infiltration rates (less than 0.04 inches per hour), which makes them more prone to water ponding and losses of soluble nutrients via runoff.

2. Internal Drainage:

Soil drainage refers to the speed and extent of water removal from the soil by runoff (surface drainage) and downward flow through the soil profile (internal drainage). It also refers to the frequency and duration when the soil is not saturated. The drainage classes reported in the watershed map are as follows:

- Rapid – water is removed rapidly in relation to supply – very coarse textured soils in higher landscape positions have rapid internal drainage (about 1% of this watershed).
- Well – water is removed readily in relation to supply, such that there is development of a subsoil horizon which typifies well drained soils (about 5% of this watershed).
- Imperfect – water is removed somewhat slowly in relation to supply to keep the soil wet for a significant part of the growing season, either due to shallow water tables in sandy soils or slow infiltration rates in clay soils (about **61%** of this watershed).
- Poor – water is removed so slowly that the soil remains wet or the water table is near the surface for a large part of the time. These are usually the lower-lying areas where surface drainage improvements have not been made (about 2% of the watershed).
- Poor (Improved) – areas that were originally poorly drained but surface drainage improvements have resulted in soils behaving as if they have imperfect internal drainage characteristics, even though soil properties may still be indicative of poorly-drained conditions. These are usually clay soils in lower-lying areas where surface drainage enhancements have been made (about 28% of the watershed).
- Very Poor – soils that are so poorly drained that peat material has built up and saturated conditions are prevalent. Very poorly drained soils are organic (peat) soils with no drainage improvements made (about 1% of the watershed).

3. Agriculture Capability or Canada Land Inventory (CLI) rating:

Agriculture capability is a seven-class rating of mineral soils based on the severity of limitations for dryland farming. This system does not rate the soil's productivity, but rather its capability to sustain agricultural crops based on limitations due to soil properties, topography and climate.

Class 1 soils have no limitations, whereas class 7 soils have such severe limitations that they are not suitable for agricultural purposes. The general gradation of agriculture capability classes is as follows:

- Class 1, 2 and 3 soils are capable of sustained production of common field crops, and are thus considered as "prime agricultural lands".
- Class 4 soils are marginal for sustained arable agriculture and should be in permanent forage production.
- Class 5 soils are suitable only for improved permanent pasture.
- Class 6 soils are suitable only for native pasture use.
- Class 7 soils are incapable of use for arable agriculture or permanent pasture (i.e. it is nearly impossible to drive on class 7 soils, let alone try to farm them).

Agriculture capability subclasses identify the soil properties or landscape conditions that may limit use, such as: adverse climate (C); dense subsoils (D); erosion damage (E); inundation or flooding by streams or lakes (I); lack of soil moisture (M); salinity (N); stones (P); shallow depth to bedrock (R); topography or slopes (T); excess water other than from flooding (W); or two or more minor limitations in combination (X).

In the La Salle River Watershed, nearly 50% of the soils are **Class 2** in terms of their agriculture capability, followed by 36% of the soils as **Class 3**. Although not depicted on the map, most of the clay soils found in the eastern 2/3 of the watershed have an excess water (W) limitation due to the slow infiltration of water (i.e. 2W or 3W). The sandy soils in the western 1/3 of the watershed have a lack of soil moisture (M) limitation and, in some cases, a combination of M and W limitations due to their sandy textures and shallow water tables, respectively. These soils are referred to as "wet sands" and usually have an agriculture capability rating of 3MW or 4MW.

4. Irrigation Suitability:

Irrigation suitability is a general suitability rating for irrigated crop production. This classification system considers soil and landscape characteristics such as texture, drainage, depth to water table, salinity, geological uniformity, topography and stoniness and ranks them in terms of their sustained quality due to long term management under irrigation. It does not consider factors such as water application, water availability, water quality or the economics of this type of land use. Irrigation suitability classes are excellent, good, fair and poor.

Almost 73% of the watershed is rated as having **poor** irrigation suitability because the heavy clay soils present higher risks of problems occurring if irrigation is practiced on them, such as increased risk of excess water ponding, runoff of nutrients, and development of salinity. About 16% of the watershed has good irrigation suitability, concentrated in the sandy areas and especially where internal drainage improvements could easily be made.

5. Soil Salinity:

Soil salinity is a limitation where plant growth is reduced due to the presence of soluble salts in soil which holds water more tightly than the ability of plants to extract water from the soil. As a result, many plants will exhibit symptoms of droughtiness, but the soil is often relatively moist.

For soil salinity to occur, there must be the presence of soluble salts in the subsoil, groundwater or in both, and the presence of wet conditions, either as a shallow water table or frequently saturated conditions that can result in soluble salts moving into the root zone of the soil through the upward movement of water.

Approximately 84% of the watershed is considered **non-saline**, due to a lack of salts present in the bedrock and subsoil, or due to the absence of a shallow water table or shallow bedrock with salts present. What little salinity does occur is only weakly saline, significantly affecting only the most sensitive crops, such as pulse crops and vegetables, and these areas are mostly confined to locations adjacent to watercourses and drainage ditches. Individual aerial photos, soil testing and producer experience would give more detail of the salinity status of specific fields in the watershed.

6. Water Erosion Risk:

Water erosion is the detachment, movement and depletion of soil from the land surface by precipitation leaving the landscape as runoff. Soil erosion by water is often accelerated on agricultural lands by leaving insufficient cover on soils prone to runoff at crucial times (i.e. just prior to or just after spring seeding). A general rule of thumb is to maintain at least 35% cover on soils at all times.

In general, soil erosion by water is more of a concern on clays and loam soils than sands, because the slower infiltration rates on the heavier-textured soils leaves them more prone to runoff and subsequent erosion. Slope length and steepness are other important factors: doubling the length of the slope increases soil losses by 1.5 times; doubling the incline of the slope increases soil losses by 2.5 times.

Approximately 96% of the watershed is at either a **negligible or low** risk of soil erosion by water, even under bare soil conditions. This is largely the result of very flat topography and the presence of sandy soils in the western 1/3 of the watershed. Coupled with management practices that leave enough cover on the soil, the risk of water erosion goes down even further. The greatest risk of water erosion occurs during rapid spring snowmelts and along ditches and watercourses with greater slopes. Of greater concern than soil erosion by water may be the transport of soluble nutrients during times of runoff in the watershed, but this should be discussed in more detail elsewhere.

7. Wind Erosion Risk:

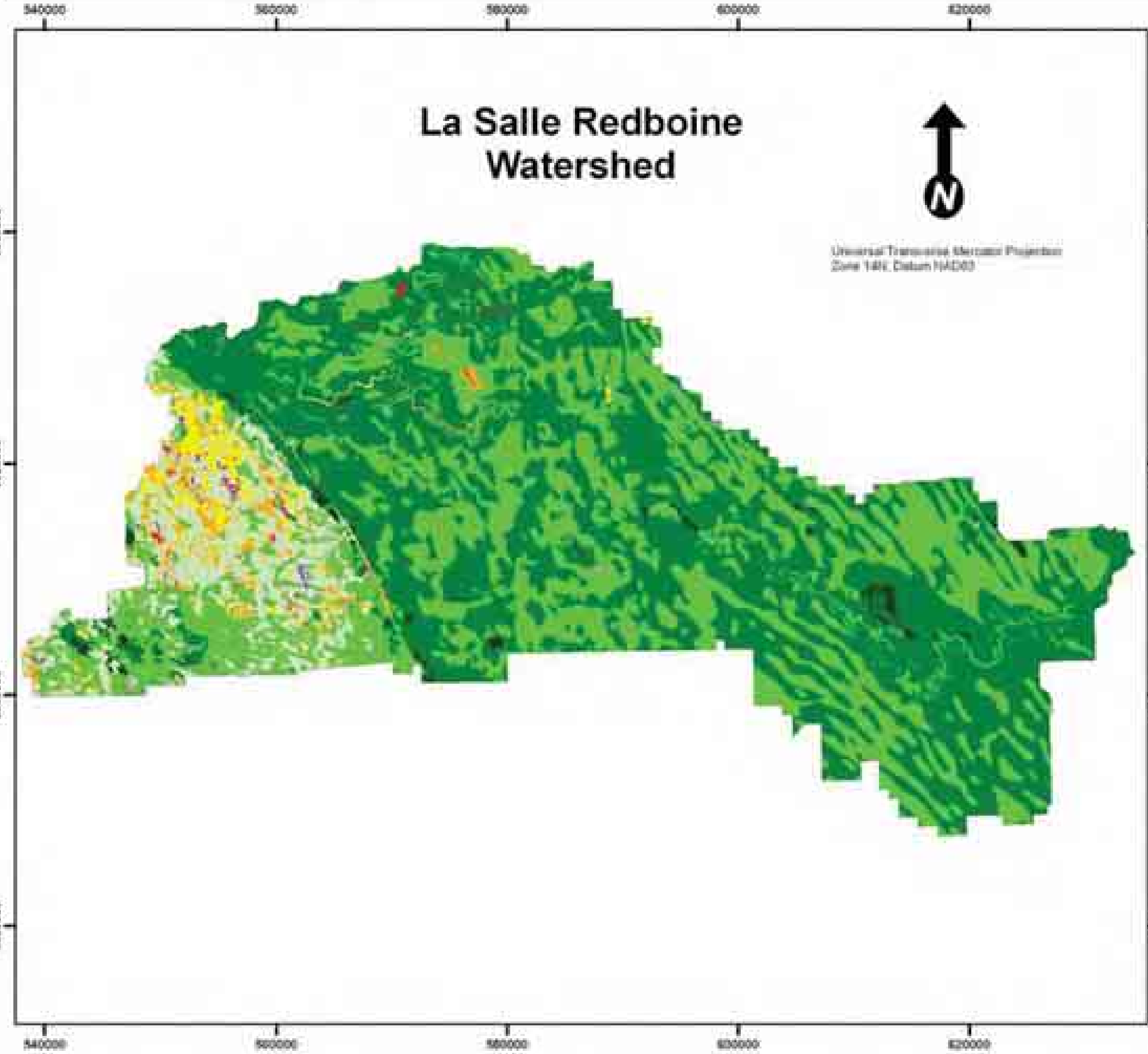
Wind erosion is the detachment, movement and depletion of soil from the land surface by wind. Soil erosion by wind is often accelerated on agricultural lands by excessive tillage and by leaving insufficient cover on soils prone to wind erosion (i.e. just prior to or just after spring seeding). A general rule of thumb is to maintain at least 35% cover on soils at all times.

In general, soil erosion by wind is more of a concern on sands than on clays and loams, because sands tend to dry out quickly and what soils clods may form tend to break down easily into single-grained particles, which are highly prone to wind erosion.

About 65% of the watershed is rated as **moderate** risk for wind erosion, mostly corresponding to the areas with a clay surface texture. Almost 27% of the watershed is either at high or severe risk of wind erosion under bare soil conditions. The sandy surface texture is what makes these soils prone to wind erosion, but under management practices that promote adequate soil cover, such as forages and pasture, the risk of wind erosion is low. Extra care should be taken if some of these sandy soils are planted to low residue annual crops, such as field beans and potatoes. In these cases, cover crops should be included and the crop rotation should include high residue crops preceding and following low residue crops.

Reference Materials:

For more information about soils, landscapes and the issues presented and discussed, please refer to MAFRI's ***Soil Management Guide***, located on the MAFRI website at: http://www.gov.mb.ca/agriculture/soilwater/index.html. The reader is also encouraged to visit the Agri-Maps website at http://maf112gis1:90/website/index.html or to view the appropriate hard-copy soil survey reports, many of which are available at your local MAFRI office.



Agriculture Capability	Area (Acres)	% of Watershed
Water	558.9920	0.0900
Unclassified	667.4070	0.1100
Class 1	7372.6960	1.2400
Class 2	295665.6480	49.7300
Class 3	213693.1510	35.9400
Class 4	48072.7350	8.0900
Class 5	11183.9800	1.8800
Class 6	14487.9590	2.4400
Class 7	773.3020	0.1300
Organic	2104.0630	0.3500

Legend

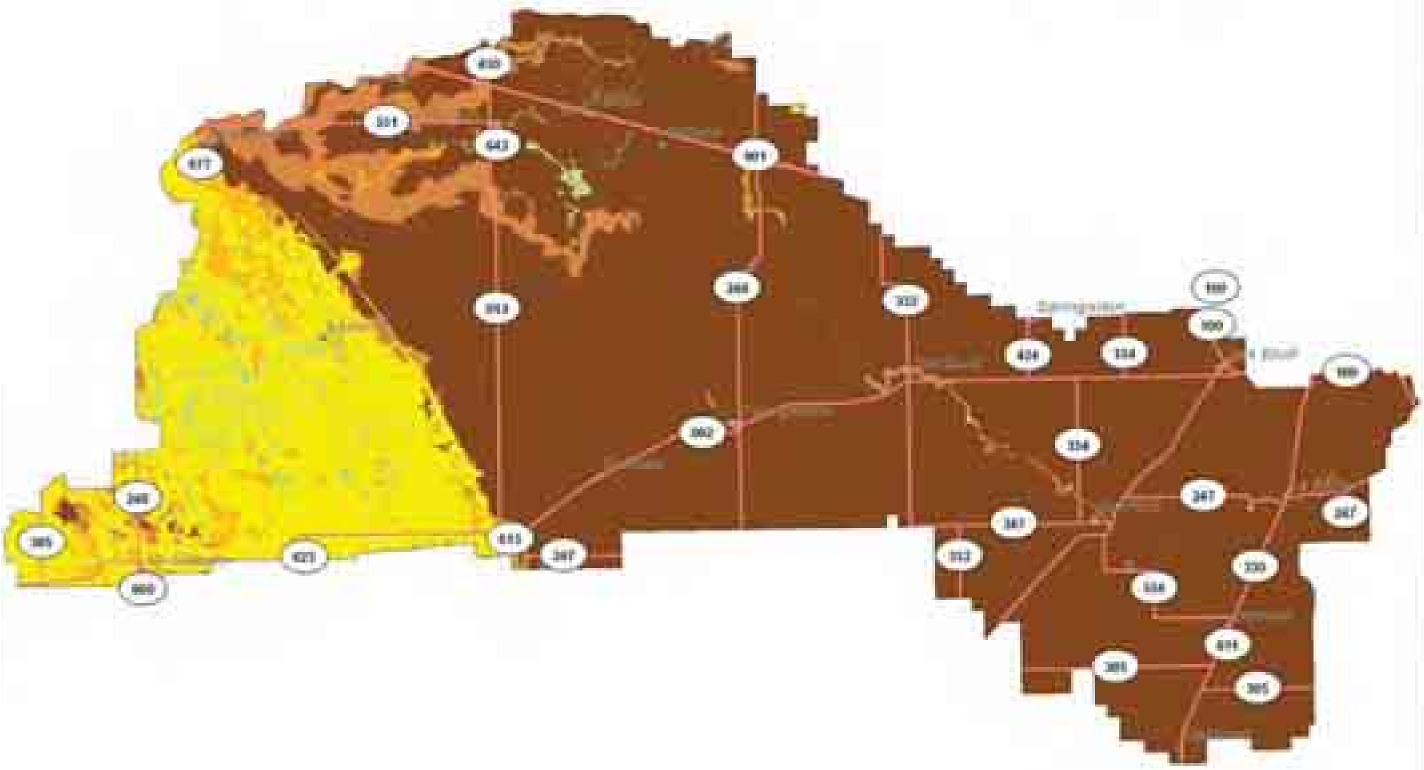
Agriculture Capability

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified
- Water

Manitoba

La Salle Redboine Watershed

Universal Transverse Mercator Projection
Zone 14N, Datum NAD83



Surface Texture	Area (Acres)	Area (Hectares)	% of Watershed
Water	558.9920	226.2170	0.0940
Unclassified	667.4070	270.0911	0.1122
Clayey	439486.0370	177854.4177	73.9154
Loamy	32306.4650	13074.0161	5.4336
Coarse Loamy	27075.9750	10957.3032	4.5538
Sands	84119.9950	34042.2937	14.1478
Organic	10365.0620	4194.6090	1.7433

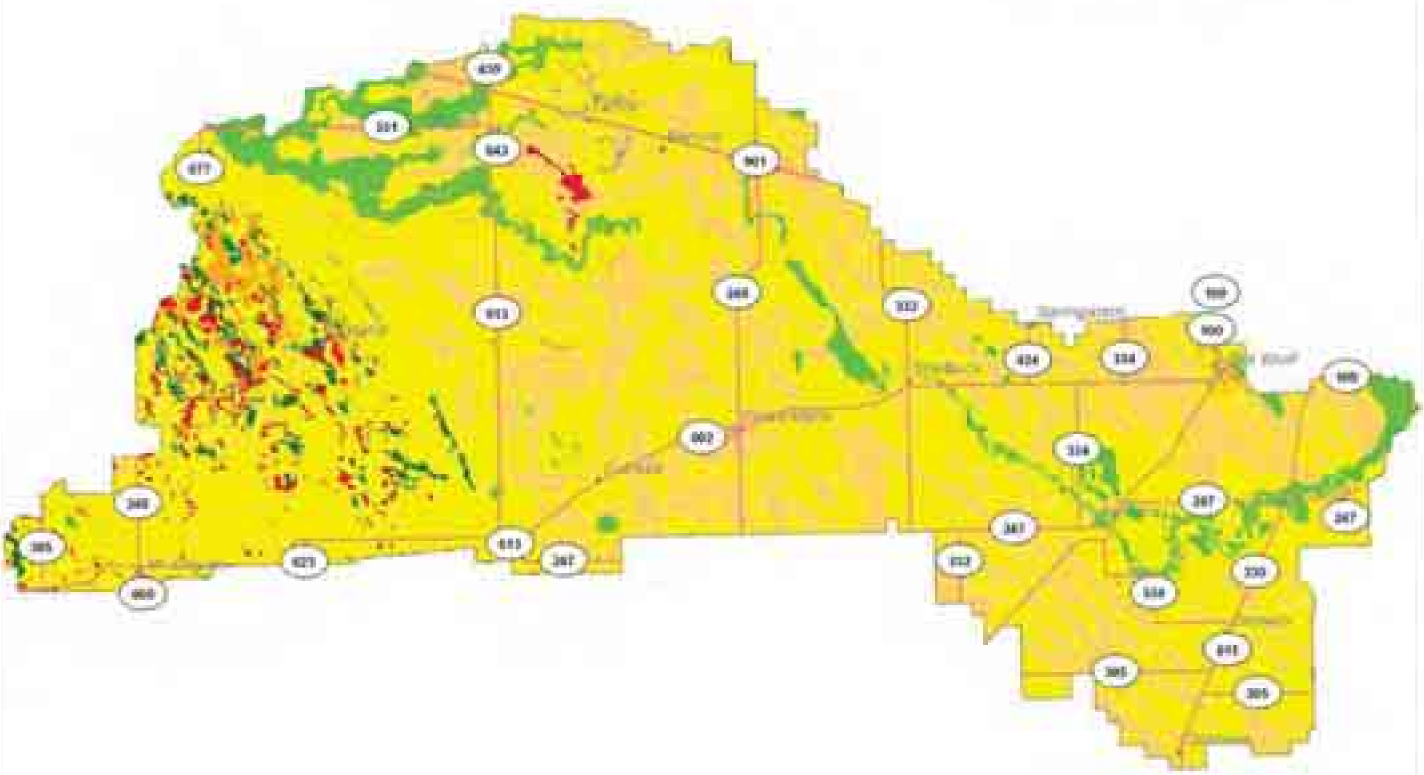
Legend

Surface Texture

- Water
- Unclassified
- Clayey
- Loamy
- Coarse Loamy
- Sands
- Organic

Manitoba

La Salle Redboine Watershed



Universal Transverse Mercator Projection
Zone 14N, Datum NAD83

Soil Drainage	Area (Acres)	Area (Hectares)	% of Watershed
Water	558.9920	226.2170	0.0940
Marsh	618.0000	250.0968	0.1039
Unclassified	667.4070	270.0911	0.1122
Rapid	7789.3220	3152.2397	1.3101
Well	32332.8490	13084.6934	5.4379
Imperfect	363599.2060	147143.9810	61.1523
Poor (Improved)	166934.9150	67556.4400	28.0761
Poor	13255.2980	5364.2508	2.2294
Very Poor	8823.9440	3570.9381	1.4841

Legend

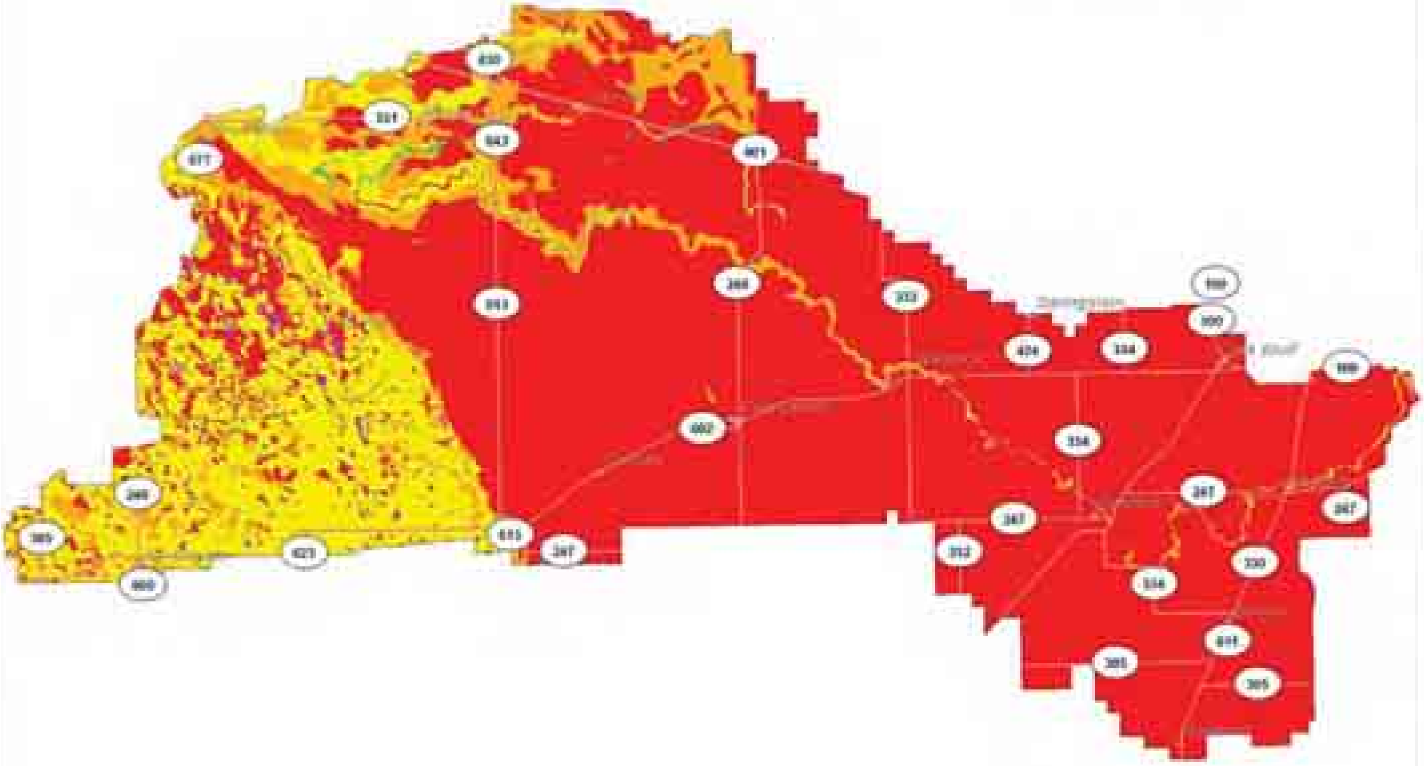
Soil Drainage

- Water
- Marsh
- Unclassified
- Rapid
- Well
- Imperfect
- Poor (Improved)
- Poor
- Very Poor

Manitoba

La Salle Redboine Watershed

Universal Transverse Mercator Projection
Zone 14N, Datum NAD83



Irrigation Suitability	Area (Acres)	Area (Hectares)	% of Watershed
Water	558.9920	226.2170	0.0940
Unclassified	667.4070	270.0911	0.1122
Excellent	709.0810	286.9561	0.1193
Good	97315.0390	39382.1604	16.3670
Fair	61845.5250	25028.0986	10.4015
Poor	431379.8260	174573.9371	72.5520
Organic	2104.0630	851.4876	0.3539

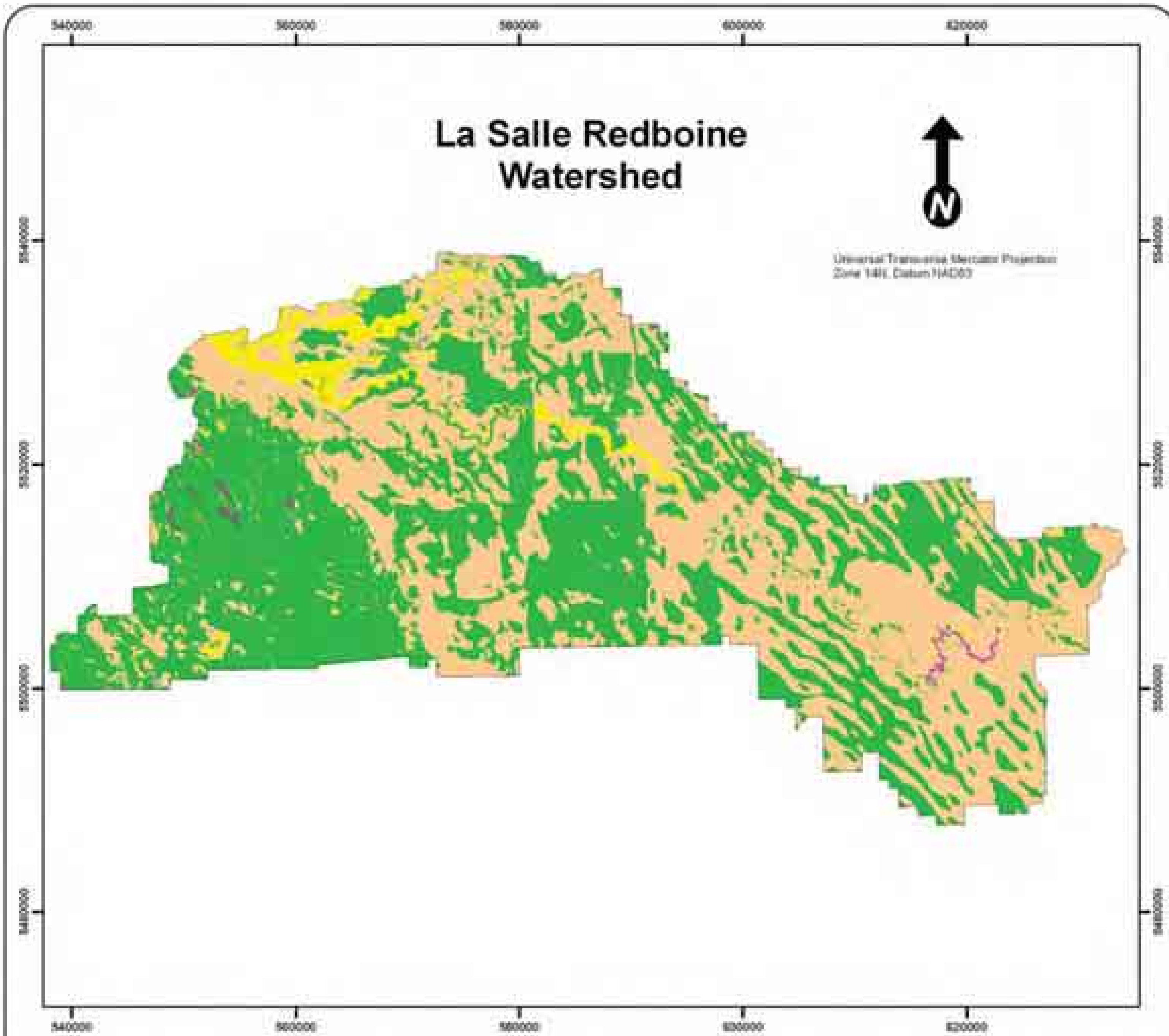
Legend

Irrigation Suitability

- Water
- Unclassified
- Excellent
- Good
- Fair
- Poor
- Organic

Manitoba

La Salle Redboine Watershed



Water Erosion Risk (Bare Soil)	Area (Acres)	% of Watershed
Water	558.9920	0.0900
Unclassified	667.4070	0.1100
Negligible	289229.7270	48.6400
Low	280071.7630	47.1000
Moderate	21344.2160	3.5900
High	1219.4970	0.2100
Severe	1488.3310	0.2500

Legend

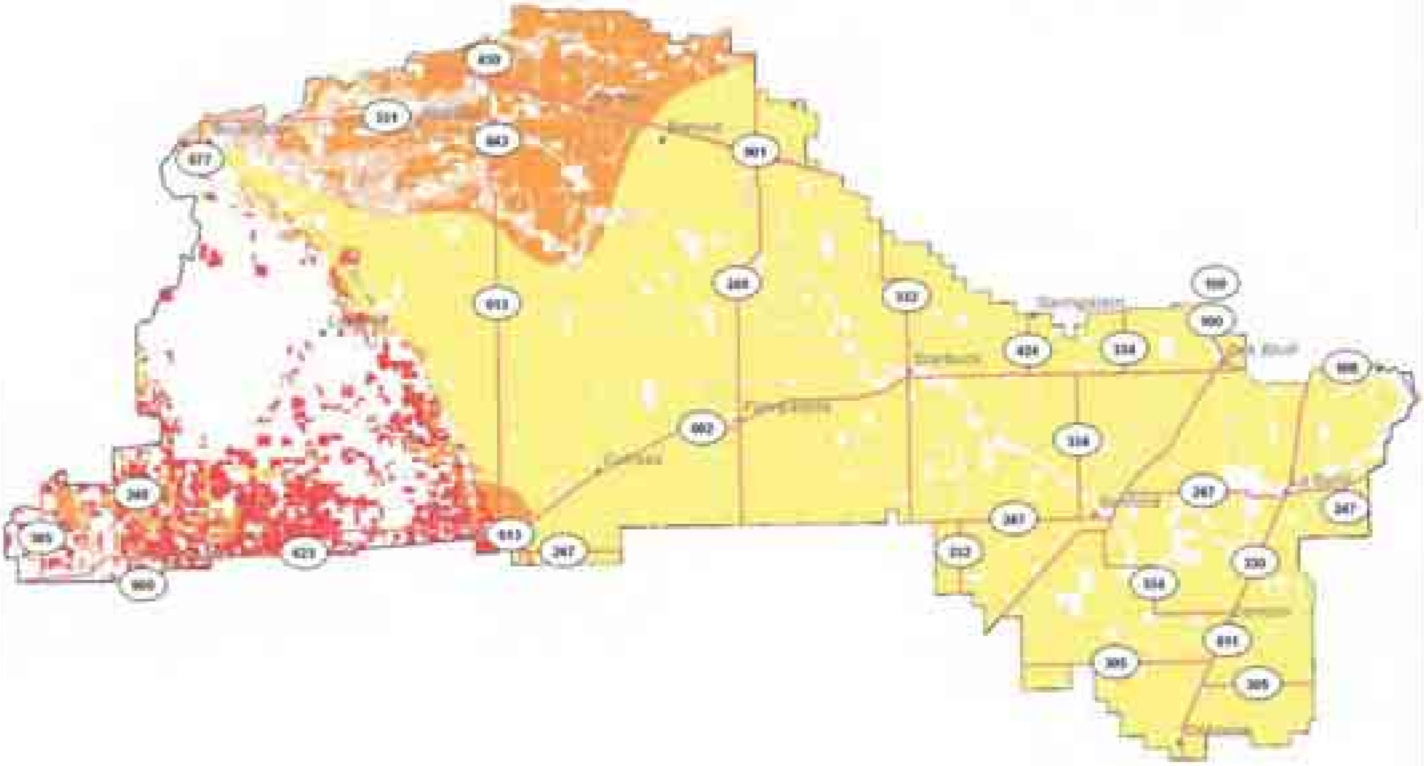
Water Erosion Risk (Bare Soil)

- Negligible
- Low
- Moderate
- High
- Severe
- Unclassified
- Water

Manitoba

La Salle Redboine Watershed

Universal Transverse Mercator Projection
Zone 14N, Datum NAD83



Cropland with Risk of Wind Erosion (Bare Soil)	Area (Acres)	Area (Hectares)	% of Watershed
Low Risk	22816.3840	9233.5008	3.7731
Moderate Risk	341591.3650	138237.6872	56.4882
High Risk	56157.0130	22726.0300	9.2866
Severe Risk	28921.5050	11704.1658	4.7827

Legend

Cropland with Risk of Wind Erosion (Bare Soil)

- Low Risk
- Moderate Risk
- High Risk
- Severe Risk

Manitoba

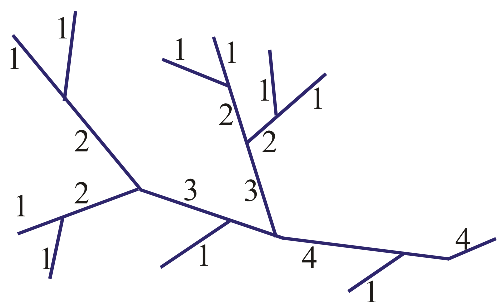
Section 5.0 Water Resources

Section 5.1 Waterways of the La Salle River Watershed (Source: La Salle Redboine Conservation District)

The channel of the La Salle River was carved in centuries past by the erratic flows of the Assiniboine River. In its wake the Assiniboine left a large defined channel with wide gentle meanders and fertile soils. The watershed is also characterized by a number of natural creek tributaries and artificial man made drains.

To better understand waterway development within a watershed, several classification systems have been developed. These classification systems allow cross watershed comparison of streams and an improved understanding of stream size (magnitude). A commonly used classification in Manitoba is the Strahler System. Waterways in the headwaters are assigned an order of magnitude of 1. When two order 1 streams merge they become an order 2. When two order 2 streams merge they become a 3rd order stream; and so on (Environmental Hydrology, 2004 in Manitoba Soil Management Guide, 2006). There are 1,885 km of classified waterways in the La Salle River Watershed.

Example of stream classification using the Strahler System:



This table contains a summary of classified waterways in the La Salle River Watershed[1] by order of magnitude according to the Strahler Classification System:

Order of Magnitude	Total Length in Watershed
1	655 km or 409 miles
2	685 km or 428 miles
3	324 km or 203 miles
4	115 km or 72 miles
5	106 km or 66 miles

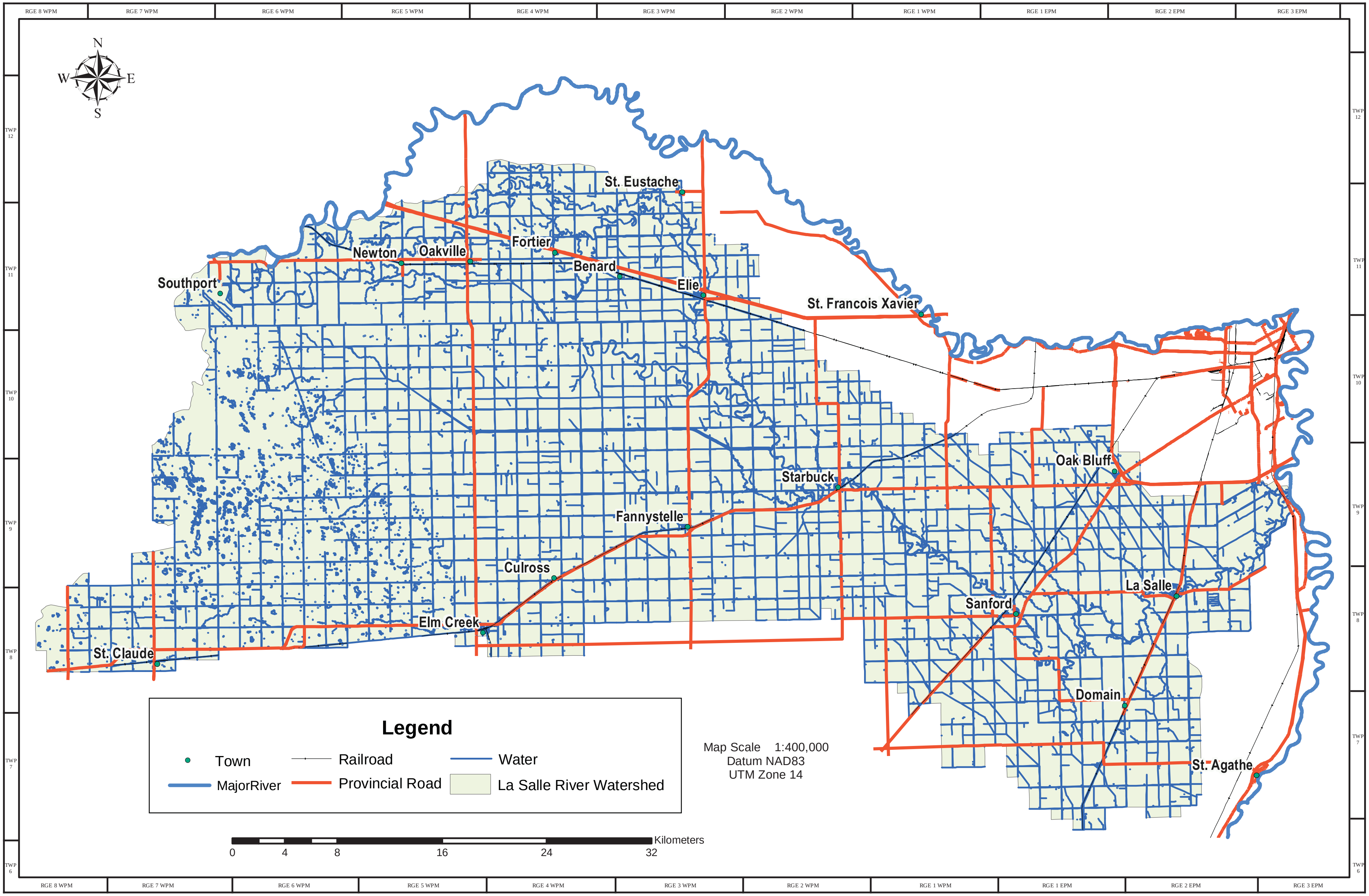
Order of magnitude at various points in the watershed:

- Elie Dam @ Elie - Order 5
- Elm Creek Channel @ Outlet to La Salle - Order 5
- Elm Creek @ Elm Creek Town Site - Order 3
- La Salle River @ Mouth to Red River - Order 5

[1] For more information about order of magnitude refer to *Sections 5.1.1 – 5.1.6* of State of the Watershed Report.

SECTION 5.1.1

Surface Water Network within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

SECTION 5.1.2


UPPER LA SALLE RIVER 21 SQ. MI. =56 Km2
MILL CREEK 54 SQ. MI. =140 km2
REVISION NO. | DATE OF REVISION | REVISION | INITIAL
1 | JUNE / 66 | Drainage Area Revised, Drains Changed and Added.
2 | MAY/67 | Drains Changed, Deleted and Added
3 | SEPT. / 71 | Drainage Area Revised, Drains Changed.
4 | JULY / 72 | Drains Changed and Added.
5 | 79 10 10 | Drains Changed, Added, and Deleted.
6 | 80 12 10 | Drains Changed and Added.
7 | 83 04 28 | Boundary Changed
8 | 83 06 13 | Boundary and Drains Added.
9 | 86 11 17 | Boundary and Drains Added
10 | AUG/01 | Map Title Revised
RGE. 7W.
RGE. 6W.
RGE. 5W.
RGE. 4W.
RGE. 3W.
RGE. 2W.
RGE. 1W.
TWP. 12
TWP. 11
TWP. 10
PUMPSITE "Z"
PUMPSITE "Y"
PUMPSITE "W"
MILL CREEK LA SALLE DIVERSION
R.M. OF PORTAGE LA PRAIRIE
R.M. OF GREY
R.M. OF CARTIER
R.M. OF MACDONALD
PORTAGE
CARTIER
LEGEND
WATER COURSE
1st ORDER DRAINS
2nd ORDER DRAINS
3rd ORDER DRAINS
4th ORDER DRAINS
5th ORDER DRAINS
6th ORDER DRAINS
7th ORDER DRAINS
LIMITS OF DRAINAGE AREA
CITY, TOWN AND MUNICIPAL BOUNDARIES
PROVINCIAL TRUNK HIGHWAYS
PROVINCIAL ROADS
ADJACENT WATERSHED
SCALE IN MILES
SCALE IN KILOMETRES
24
PROVINCE OF MANITOBA
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT
WATER RESOURCES BRANCH
R. CRAIG
CROSS REFERENCES
REVISIONS
APPROVED AS TO
PLAN OF
UPPER LA SALLE RIVER AREA
SHOWING
DESIGNATIONS OF DRAINS
AS SHOWN
77 01 15
1 OF 1
12-5-1335

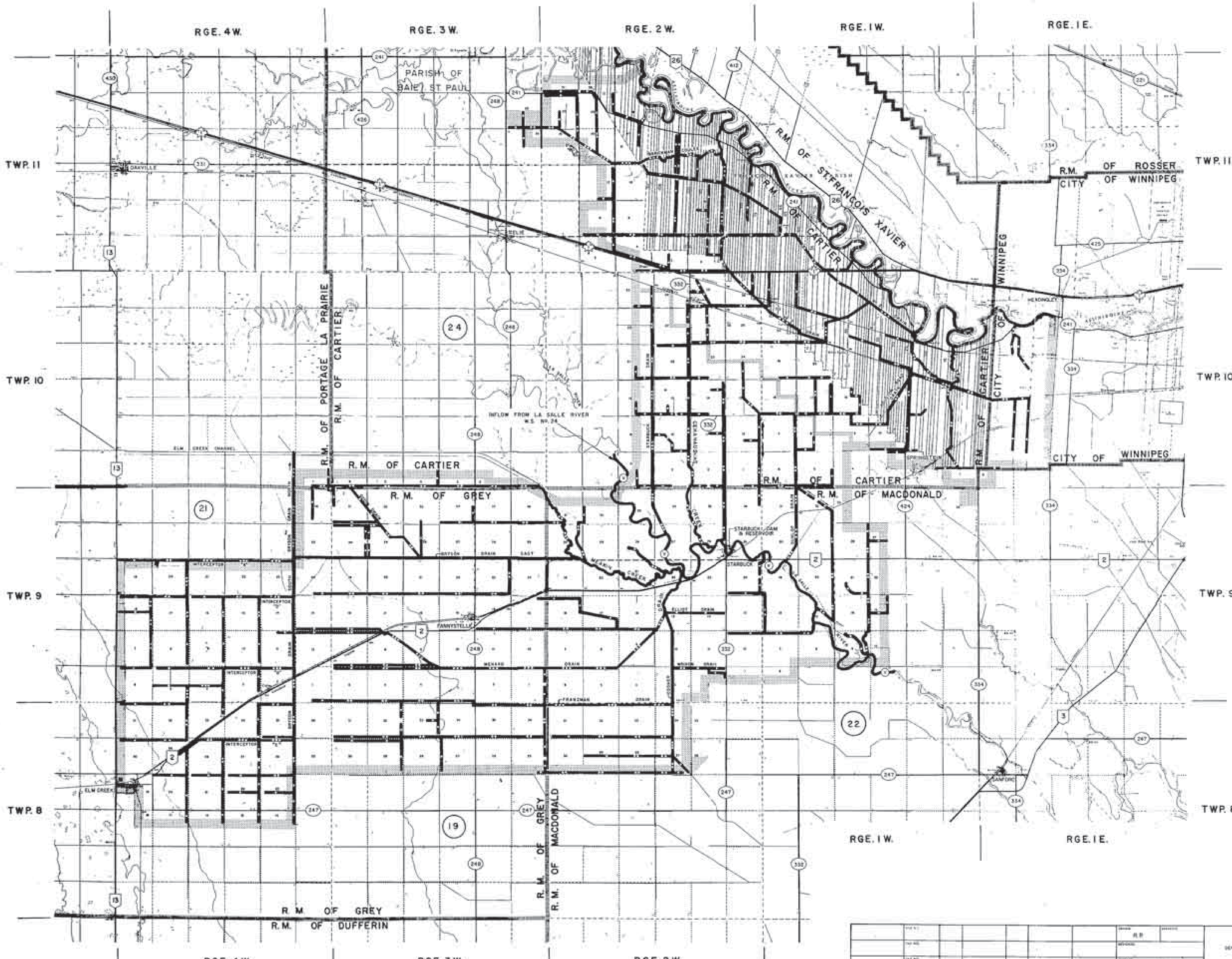
SECTION 5.1.3

REVISION NO.	DATE OF REVISION	REVISION	INITIAL
1.	June/67	Drains Deleted, Added and Changed	
2.	June/68	Drains Added	
3.	April/75	Drain Added	
4.	June/79	Drainage Area Deleted	
5.	83 04 26	Boundary and Drains Changed	
6.	86 11 21	Boundary Changed & Drains Added	

SECTION 5.1.4

REVISION NO.	DATE OF REVISION	REVISION	INITIAL
1	June/66	Drains Changed.	
2	June/67	Drains Changed, Deleted and Added.	
3	Sept/71	Drainage Area Revised, Drains Changed	
4	June/79	Drainage Area Added and Deleted.	
5	MAY/83	[illegible]	[illegible]
6	NOV/90	[illegible] Changed	

245.65 SQ. MI.
636.23 Km^2



LEGEND

WATER COURSE
1st ORDER DRAINS
2nd ORDER DRAINS
3rd ORDER DRAINS
4th ORDER DRAINS
5th ORDER DRAINS
6th ORDER DRAINS
7th ORDER DRAINS

ADJACENT WATERSHED
LIMITS OF DRAINAGE AREA
CITY, TOWN AND MUNICIPAL BOUNDARIES
PROVINCIAL TRUNK HIGHWAY
PROVINCIAL ROADS
TRANS CANADA HIGHWAY

SCALE IN MILES
SCALE IN KILOMETRES

23

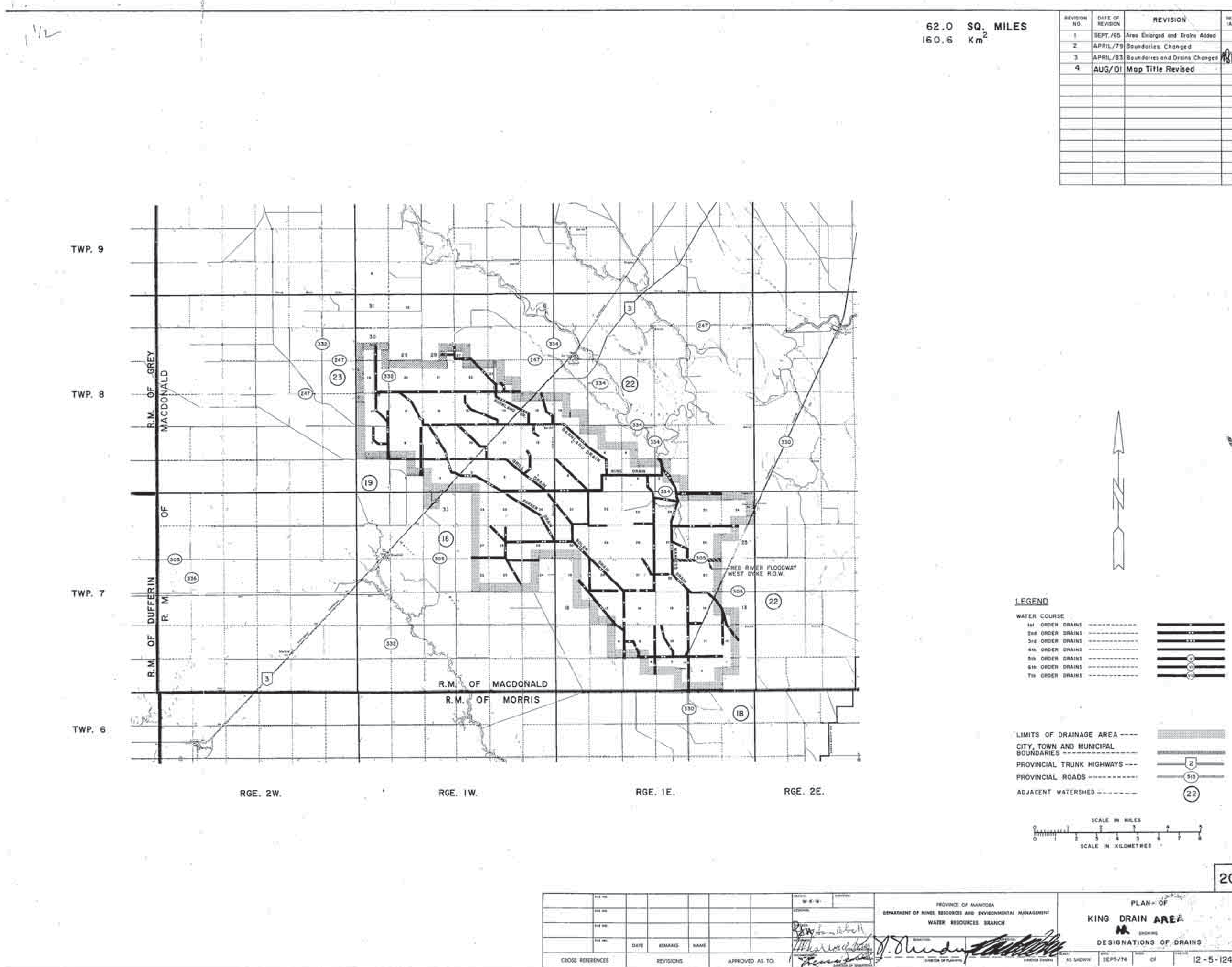
PROVINCE OF MANITOBA
DEPARTMENT OF MINES, NATURAL RESOURCES AND ENVIRONMENT
WATER RESOURCES DIVISION

PLAN OF
CENTRAL LA SALLE RIVER AREA
SHOWING
DESIGNATIONS OF DRAINS

CROSS REFERENCES | REVISIONS | APPROVED AS TO

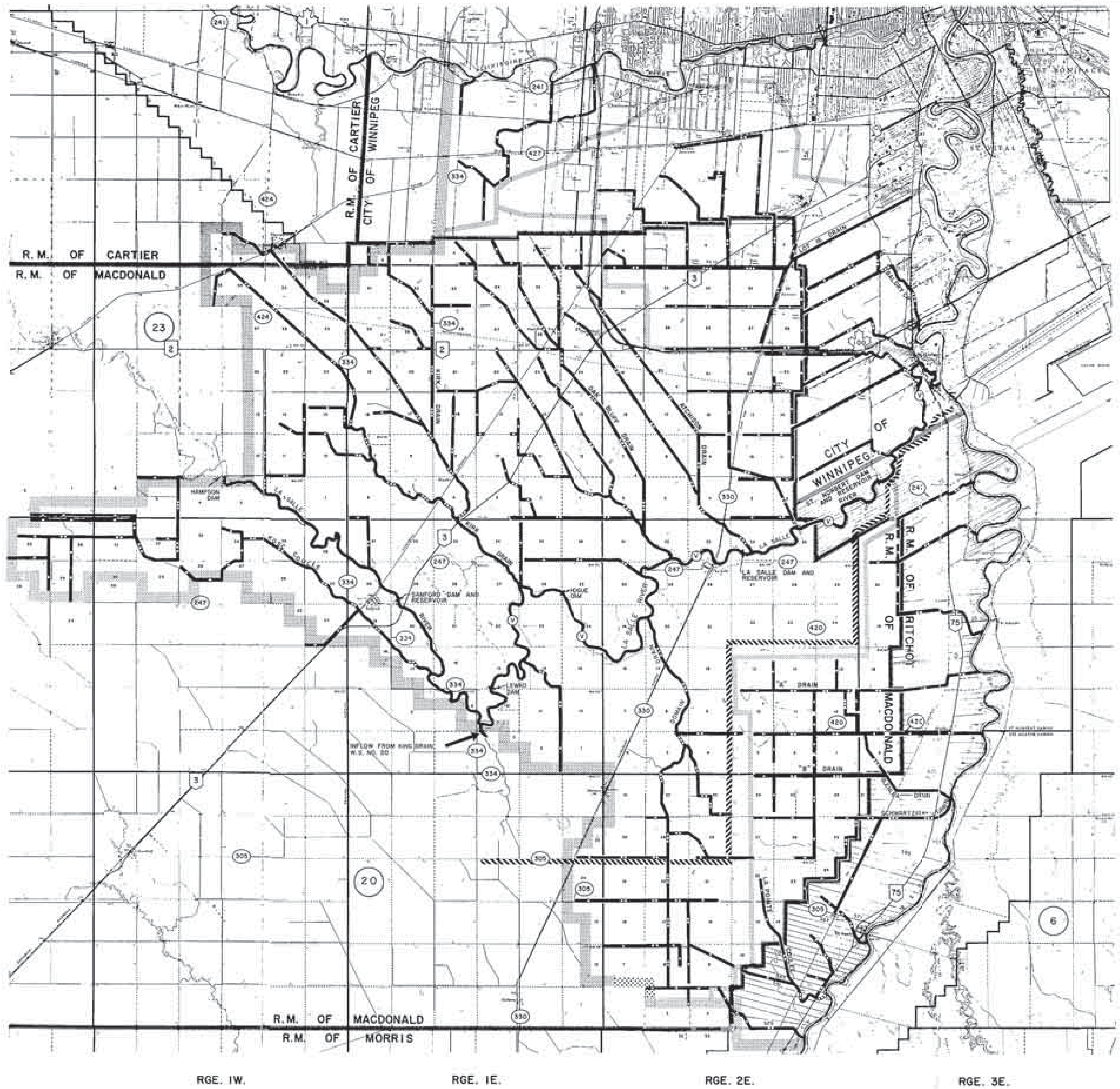
79 06 01 | 1 of 1 | 12-5-1336

SECTION 5.1.5



62.0 SQ. MILES
160.6 Km²
REVISION NO.	DATE OF REVISION	REVISION
1	SEPT./65	Area Enlarged and Drains Added
2	APRIL/79	Boundaries Changed
3	APRIL/83	Boundaries and Drains Changed
4	AUG/01	Map Title Revised
TWP. 9
TWP. 8
TWP. 7
TWP. 6
R.M. OF GREY
R.M. OF MACDONALD
R.M. OF DUFFERIN
R.M. OF MACDONALD
R.M. OF MORRIS
RED RIVER FLOODWAY WEST DYKE R.O.W.
RGE. 2W.
RGE. 1W.
RGE. 1E.
RGE. 2E.
LEGEND
WATER COURSE
1st ORDER DRAINS
2nd ORDER DRAINS
3rd ORDER DRAINS
4th ORDER DRAINS
5th ORDER DRAINS
6th ORDER DRAINS
7th ORDER DRAINS
LIMITS OF DRAINAGE AREA
CITY, TOWN AND MUNICIPAL BOUNDARIES
PROVINCIAL TRUNK HIGHWAYS
PROVINCIAL ROADS
ADJACENT WATERSHED
SCALE IN MILES
SCALE IN KILOMETRES
20
PROVINCE OF MANITOBA
DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT
WATER RESOURCES BRANCH
PLAN OF
KING DRAIN AREA
DESIGNATIONS OF DRAINS
CROSS REFERENCES
REVISIONS
APPROVED AS TO:
SEPT./74
12-5-1243

SECTION 5.1.6



296.1 SQ. MILES
766.9 Km^2

REVISION NO.	DATE OF REVISION	REVISION	INIT-IAL
1	June /66	Drain Deleted and Added	
2	May /67	Drains Changed and Added	
3	Sept /71	Drains Changed and Added	
4	Dec /71	Drains Changed and Added	
5	Apr /79	Boundaries Changed	
6	Apr /83	Boundaries & Drains Changed	
7	91 03 20	Boundary and Drain Changed	

LEGEND

WATER COURSE
1st ORDER DRAINS
2nd ORDER DRAINS
3rd ORDER DRAINS
4th ORDER DRAINS
5th ORDER DRAINS
6th ORDER DRAINS
7th ORDER DRAINS

ADJACENT WATERSHED
LIMITS OF DRAINAGE AREA
CITY, TOWN AND MUNICIPAL BOUNDARIES
PROVINCIAL TRUNK HIGHWAYS
PROVINCIAL ROADS
RED RIVER FLOODWAY WEST DYKE R.O.W.

SCALE IN MILES
SCALE IN KILOMETERS

22

PROVINCE OF MANITOBA
DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT
WATER RESOURCES BRANCH

PLAN OF
LOWER LA SALLE RIVER
AND ADJACENT AREA
SHOWING
DESIGNATIONS OF DRAINS

AS SHOWN | 77 02 28 | 1 OF 1 | 12-5-1337

CROSS REFERENCES | REVISIONS | APPROVED AS TO:

Section 5.0 – Water Resources

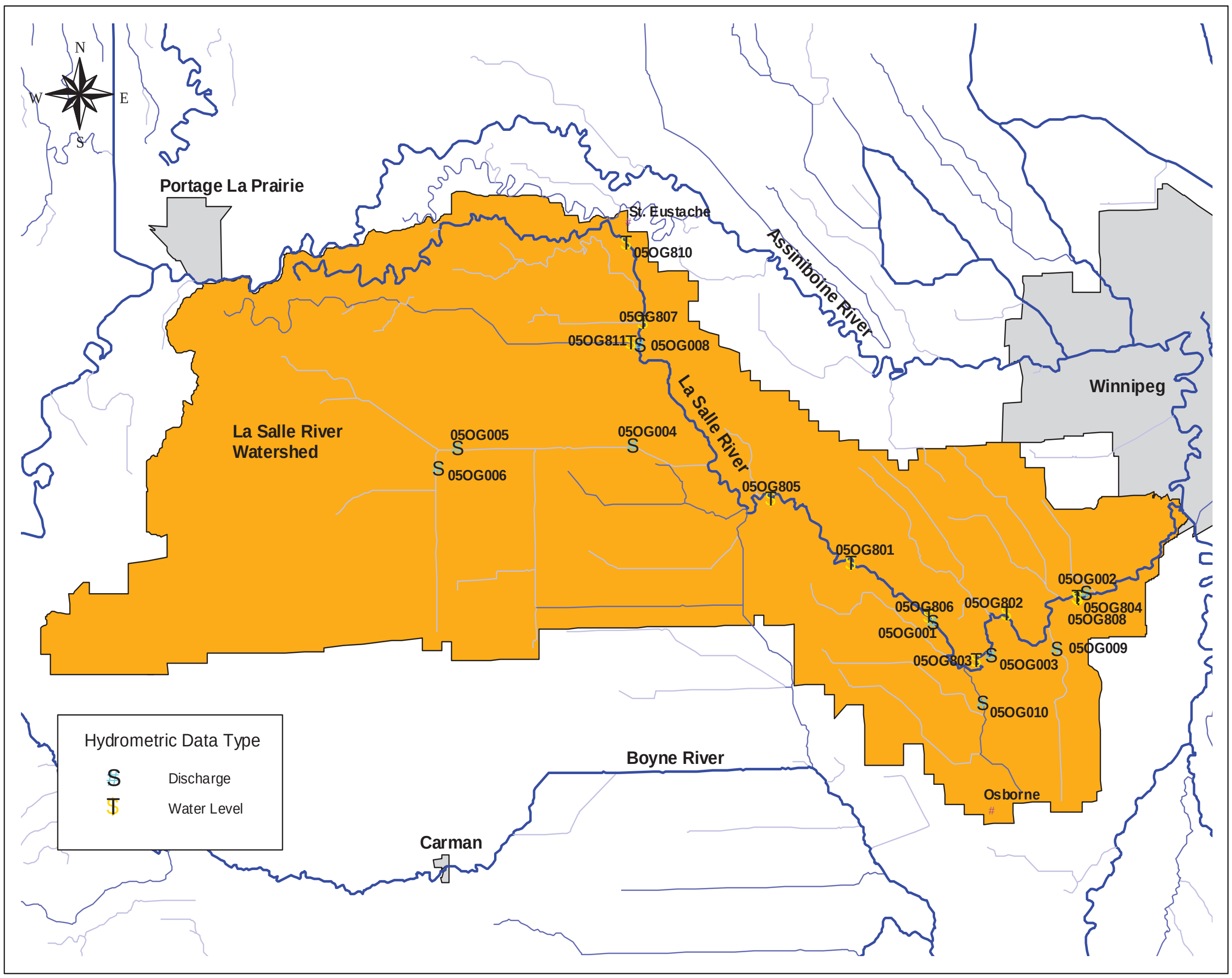
Section 5.2 – Surface Water Hydrology Report (source: Manitoba Water Stewardship)

Disclaimer: The hydrologic conditions presented in this report are estimates to indicate the health of the watersheds as of 2006. They should not be used for licensing or design purposes. The trends are based on historical records and are subject to change as more hydrological information becomes available. Factors such as climate change or land use changes could impact the values in the future. Utilization of this information on a specific case by case basis requires detailed analysis by trained professionals and is intended for demonstration purposes only.

Planning Area Boundary:

The La Salle River planning area extends from Portage La Prairie east to the City of Winnipeg and from the Community of Osborne north to the Community of St. Eustache. The La Salle River planning area is shown on Figure 1.

Figure 1: La Salle River Planning Area and Location of Hydrometric Gauging Stations



The planning area in this case is a watershed, but is made up of a number of sub-watersheds including the Elm Creek Channel, Domain Drain and others. By definition, a watershed is the land area that contributes surface water runoff to a common point. It is separated from adjacent watersheds by a land ridge or divide. Watersheds can vary in size, from a few acres to thousands of square kilometers. A larger watershed can contain many smaller sub-watersheds which are defined in the same manner as a watershed. On a larger scale, a basin is defined as a collection of watersheds that feed into a common main tributary or large body of water (e.g. the Red River Basin). A sub-basin is a division of a basin and will be made up of multiple watersheds.

Watershed and basin boundaries form a prime ecological unit for:

- information and knowledge management and analysis, and
- water and land use planning and management.

Watershed and basin boundaries are defined through the application of the best available science and modified with documented and verifiable local input. Agriculture and Agri-Food Canada through the efforts of the Prairie Farm Rehabilitation Administration (AAFC-PFRA) and Manitoba Water Stewardship have delineated a system of watershed and basin boundaries for Manitoba. These boundaries have been designed to extend to the mouths of some rivers and streams and along large bodies of water. The La Salle River planning area boundaries were established using this system of watersheds.

Climate:

The La Salle River planning area is considered to be within the Lake Manitoba ecoregion which is part of the Prairie ecozone. The region is considered to be one of the warmest and most humid regions in the Canadian Prairies. The mean annual temperature is approximately 2.5°C. The mean summer temperature is 16.5°C and the mean winter temperature is -13.0°C[1]. The mean annual precipitation is approximately 560mm[2]. Approximately 434mm, or 78%, of this precipitation falls as rain, the rest falls as snow. Approximately 7.9% of the average annual precipitation results in streamflow. The potential mean annual gross evaporation increases in a northeasterly direction from 790mm in Portage La Prairie to 834mm in Winnipeg[3].

Water Courses:

The La Salle River planning area has one main watercourse; the La Salle River. Additional watercourses include the Elm River, Elm Creek Channel, Scott Coulee, Meakin Creek, King Drain, Domain Drain, Manness Drain and many others that act as tributaries and empty into the La Salle River.

The La Salle River watershed has a gross drainage area of approximately 2406.4km^2 at the point where it enters the Red River and drains in an easterly direction from its headwaters east of Portage La Prairie, Manitoba to its outlet at the Red River, south of St. Norbert, Manitoba. The watershed is shown in orange on Figure 1. The topography in this region is flat to rolling.

Hydrometric Data:

The collection of hydrometric data is critical to the understanding of the availability, variability and distribution of water resources and provides the basis for responsible decision making on the management of this resource. Historic hydrometric data provides the basis for understanding the potential extent and limitation of the resource. Water level and stream flow data collected under the Canada-Manitoba Hydrometric Agreement, which is part of a National Hydrometric Program, supports activities such as policy development, operation of water control works, flow forecasting, water rights licensing, water management investigations and hydrologic studies, ecosystem protection and scientific studies. Environment Canada, the Province of Manitoba and Manitoba Hydro operate 143 discharge and 133 water-level gauging stations under this Agreement.

Streamflow and water level data has been collected at 19 hydrometric gauging stations within the La Salle River planning area for varying time periods since the 1950s, with some sporadic data dating back to 1915. The locations of the 19 stations are shown on Figure 1. Table 1 provides information relating to the type of data collected, the years of operation and the operating periods for each station.

Streamflow (Discharge) Data:

Historic streamflow data is available on the La Salle River, Elm Creek Channel, Manness Drain and Domain Drain. Of the 9 discharge stations listed in Table 1, only 3 are still operational.

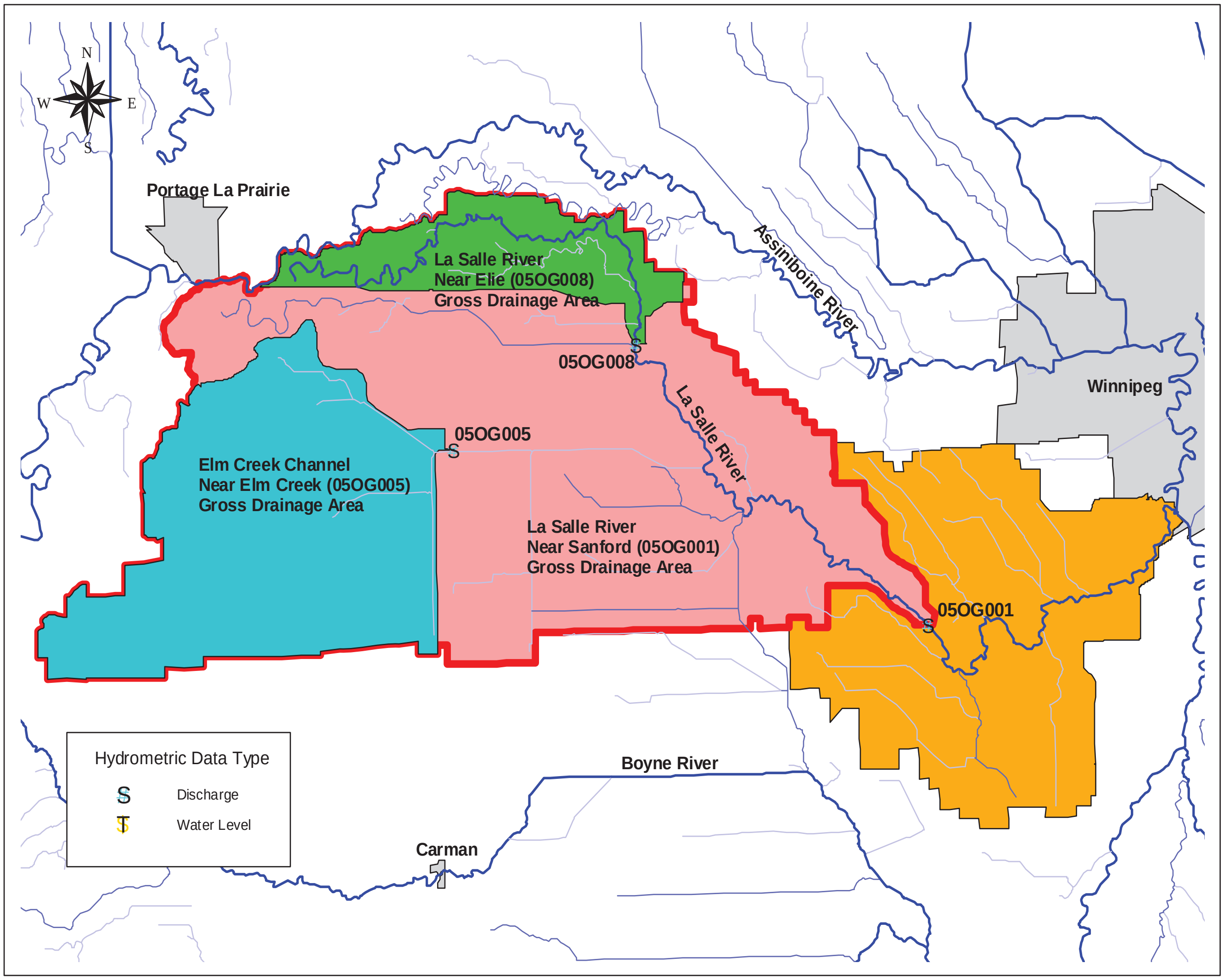
The first of these three gauges is La Salle River near Sanford (05OG001). This stations gross drainage area is equal to 1802.5km^2 and is shown on Figure 2. The gauging station operated sporadically during the years 1915 to 1934, but was then discontinued until 1956. The gauge was operational for a short time period from April 1956 to September 1958 and then annually during the entire year from 1966 to 1994. In 1995, the operating period of the gauge was reduced to the March to October period. This reduced operating period remained in affect until 2002 when the gauge was once again operated annually during the entire year. Gauging station 05OG003, located downstream of 05OG001, was operated during the years 1958 to 1966 when station 05OG001 was not.

The second operational gauge is Elm Creek Channel near Elm Creek (05OG005). This stations gross drainage area is equal to 589.0km^2 and is shown on Figure 2. The gauging station operated annually during the March to October period from 1960 to 1971. In 1972, the operating period of the gauge was reduced to the March to June period. This reduced operating period remains in affect at the present time.

The third operational gauge is La Salle River near Elie (05OG008). This stations gross drainage area is equal to 189.4km^2 and is shown on Figure 2. The gauging station operated annually during the March to October period from 1979 to 1996. In 1997, the gauge was discontinued. The gauge was reinstated in 2002 and operates during the March to May period at the present time.

Section 5.0 – Water Resources

Figure 2: Gross Drainage Areas for Discharge Stations 05OG001, 05OG005 & 05OG008.



Water Level Data:

Historic water level data is available on the La Salle River, Elm River, Elm Creek Channel, Manness Drain and Domain Drain. Of the 10 water level stations listed in Table 1, only 6 are still operational. The 6 stations 05OG801, 05OG804, 05OG805, 05OG806, 05OG807, 05OG808 all began operation in 1978 and operate annually during the spring-thaw to freeze-up conditions.

Realtime water level data for La Salle River near Sanford (05OG001), La Salle River near Elie (05OG008), and Elm Creek Channel near Elm Creek (05OG005) is available from Environment Canada's website: http://scitech.pyr.ec.gc.ca/waterweb/formNav.asp.

Table 1: La Salle River Planning Area Hydrometric Gauging Station Data

Station Number	Station Name	Years of Operation	Period of Operation	Type of Data	Gross/Effective Drainage Area (km^2)
05OG001	La Salle River near Sanford	1915 to 1934	Sporadic	Discharge	1802.5 / 1610.5
		1956 to 1958	Apr. '56 to Sep. '58		
		1966 to 1994	All Year		
		1995 to 2001	March to October		
		2002 to Present	All Year		
05OG002	La Salle River at La Salle	1935 to 1936	April to August	Discharge	2301.8 / 2109.8
05OG003	La Salle River near Sanford	1958 to 1966	All Year	Discharge	2016 / 1823.9
05OG004	Elm Creek Channel near Fannystelle	1960 to 1977	March to October	Discharge	646.7 / 454.7
05OG005	Elm Creek Channel near Elm Creek	1960 to 1971	March to October	Discharge	589 / 397.0
		1972 to Present	March to June		
05OG006	Elm Creek Channel No. 3 near Elm Creek	1960 to 1974	March to October	Discharge	384.6 / 295.2
		1975 to 1994	March to June		
05OG008	La Salle River near Elie	1979 to 1996	March to October	Discharge	189.4 / 189.4
		2002 to Present	March to May		
05OG009	Domain Drain near Domain	1981 to 1987	March to October	Discharge	76.6 / 76.6
05OG010	Manness Drain near Sanford	1981 to 1987	March to October	Discharge	50.6 / 50.6
05OG801	La Salle River above Hampson Dam	1978 to Present	Spring Thaw to Freeze-up	Water Level	1768.7 / 1576.6
05OG802	La Salle River above Hogue Dam	1978 to 2002	Spring Thaw to Freeze-up	Water Level	2118.8 / 1926.7
05OG803	La Salle River above Lewko Dam	1978 to 1996	April to October	Water Level	2008.9 / 1816.8
05OG804	La Salle River above St. Norbert Dam	1978 to Present	Spring Thaw to Freeze-up	Water Level	2356.4 / 2164.3
05OG805	La Salle River above Starbuck Dam (P.R. 332)	1978 to Present	Spring Thaw to Freeze-up	Water Level	1657.6 / 1465.5
05OG806	La Salle River above Sanford Dam	1978 to Present	Spring Thaw to Freeze-up	Water Level	1801.3 / 1609.3
05OG807	La Salle River at Elie	1978 to Present	Spring Thaw to Freeze-up	Water Level	186.9 / 186.9
05OG808	La Salle River above La Salle Dam (P.R. 330)	1978 to Present	Spring Thaw to Freeze-up	Water Level	2301.8 / 2109.8
05OG810	La Salle River near St. Eustache	1986	June to October	Water Level	88.7 / 88.7
05OG811	Elm River near Elie	1986	June to September	Water Level	159.6 / 159.6

Streamflow Characteristics:

Section 5.0 – Water Resources

La Salle River:

The daily discharge data for the gauging station on the La Salle River was statistically analyzed to determine runoff characteristics of the La Salle River planning area. The results of the analysis are presented as follows:

The streamflow data for La Salle River near Sanford (05OG001) is representative of streams in the La Salle River planning area. The gross drainage area of station 05OG001 is equal to 1802.5km^2. The station has an effective to gross drainage area ratio equal to 0.89. The gross drainage area boundary is defined as the area at a specific location, enclosed by its drainage divide, which might be expected to entirely contribute runoff to that specific location under extremely wet conditions. The effective drainage area is that portion of a drainage area which might be expected to entirely contribute runoff to the main stem during a median (1:2 year event) runoff year under natural conditions. This area excludes marsh and slough areas and other natural storage areas which would prevent runoff from reaching the main stem in a year of average runoff. The effective to gross drainage area ratio is an indication of how well an area is drained. A perfectly drained area has a ratio of one.

The mean monthly discharge data for the La Salle River is shown in Table 2. Based on available data, the average runoff during the period 1956 to 2005 is equal to 79,980dam^3 or an equivalent depth of 44mm over the gross drainage area for station 05OG001. The annual runoff depths for the La Salle River from 1956 to 2005 are shown on Figure 3. They range from a minimum of 3mm in 1981 to a maximum of 162mm in 2005. This figure also illustrates the variability in runoff from year to year, as well as the years above and below average runoff.

Figure 3: Equivalent Annual Runoff Depths for the La Salle River (05OG001)

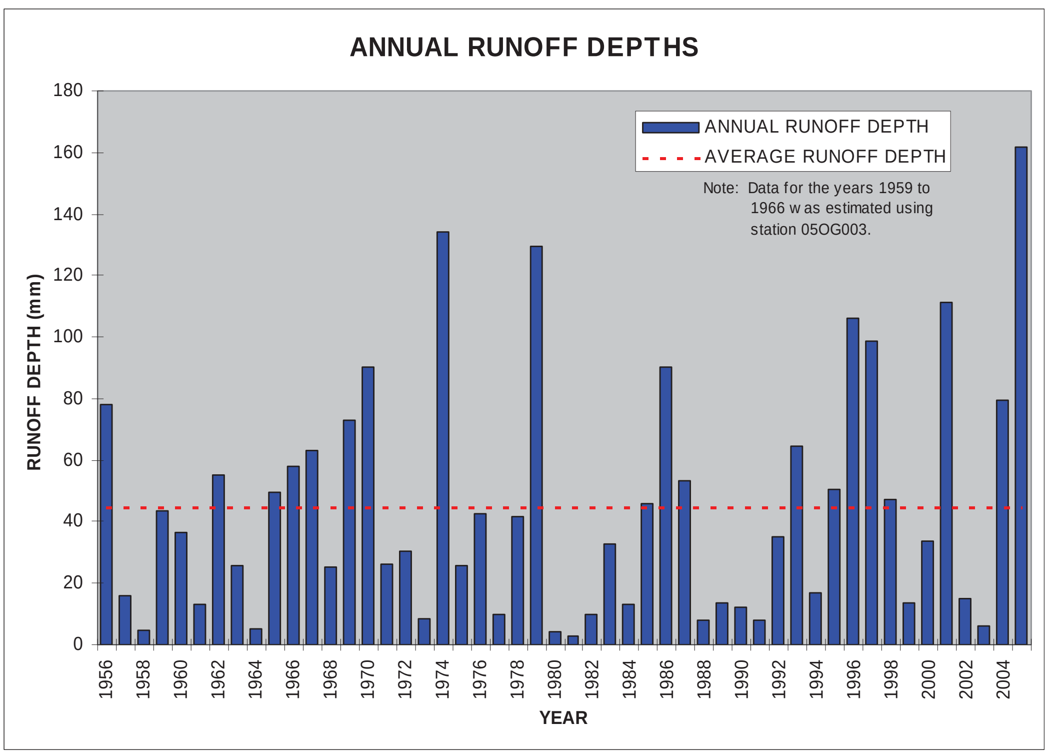


Table 2: La Salle River near Sanford (05OG001)

	Mean Monthly Discharge (m^3/s)												Annual Volume
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**dam^3**
1915	-	-	-	-	-	-	-	-	-	-	-	-	-
1916	-	-	-	-	-	-	-	-	-	-	-	-	-
1920	-	-	-	-	-	-	-	-	-	-	-	-	-
1922	-	-	-	2.84	1.39	0.17	0.34	0.39	0.27	-	-	-	-
1923	-	-	-	-	20.40	1.35	1.26	0.26	-	-	-	-	-
1924	-	-	-	-	3.22	0.09	0.05	0.02	0.00	-	-	-	-
1925	-	-	3.76	19.70	0.58	2.55	1.19	0.12	0.07	-	-	-	-
1926	-	-	-	-	-	-	-	-	-	-	-	-	-
1927	-	-	-	-	18.10	3.32	1.85	0.36	0.21	-	-	-	-
1928	-	-	-	3.41	0.24	2.85	3.79	0.29	0.07	-	-	-	-
1929	-	-	-	-	0.10	0.18	0.28	0.22	0.26	-	-	-	-
1930	-	-	-	7.93	1.39	0.07	-	-	-	-	-	-	-
1932	-	-	-	-	-	-	-	-	-	-	-	-	-
1933	-	-	-	-	-	-	-	-	-	-	-	-	-
1934	-	-	-	13.00	0.80	-	-	-	-	-	-	-	-
1956	-	-	-	25.40	24.50	0.36	0.43	0.17	1.17	0.72	0.62	0.03	140,660
1957	0.05	0.03	2.50	6.75	0.43	0.37	0.24	0.10	0.29	0.09	0.02	0.00	28,470
1958	0.00	0.00	0.67	0.83	0.12	0.07	1.50	0.04	0.00	0.00	0.00	0.00	8,560
1959	0.00	0.00	0.01	13.05	1.99	0.20	0.00	0.15	0.03	11.44	2.70	0.05	78,010
1960	0.03	0.03	0.04	22.98	1.70	0.30	0.10	0.02	0.02	0.00	0.00	0.00	65,510
1961	0.00	0.00	1.02	7.13	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23,950
1962	0.00	0.00	0.00	11.62	3.81	3.85	0.47	15.38	2.36	0.04	0.01	0.00	99,030
1963	0.00	0.00	1.84	6.45	1.32	8.06	0.14	0.00	0.00	0.00	0.00	0.00	46,460
1964	0.00	0.00	0.00	2.68	0.12	0.54	0.03	0.00	0.05	0.00	0.00	0.00	8,870
1965	0.00	0.00	0.00	31.83	2.09	0.51	0.00	0.00	0.05	0.00	0.00	0.00	89,560
1966	0.00	0.00	0.01	27.00	8.62	0.00	2.50	0.26	1.67	0.00	0.00	0.00	104,830
1967	0.00	0.00	0.00	39.90	3.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	113,690
1968	0.00	0.00	0.88	1.74	0.18	0.06	0.77	10.50	2.91	0.18	0.06	0.00	45,860
1969	0.00	0.00	0.00	28.40	5.65	3.30	10.70	1.87	0.16	0.19	0.00	0.00	131,870
1970	0.00	0.00	0.00	35.50	25.90	0.47	0.03	0.00	0.00	0.00	0.00	0.00	162,700
1971	0.00	0.00	0.00	17.20	1.00	0.09	0.04	0.00	0.00	0.00	0.00	0.00	47,590
1972	0.00	0.00	0.04	20.30	0.65	0.02	0.01	0.00	0.00	0.00	0.00	0.00	54,540
1973	0.00	0.00	3.36	0.64	0.20	1.17	0.13	0.19	0.00	0.00	0.00	0.00	15,050
1974	0.00	0.00	0.00	49.00	41.40	1.41	0.00	0.00	0.00	0.00	0.00	0.00	241,550
1975	0.00	0.00	0.00	13.50	3.95	0.19	0.18	0.00	0.00	0.00	0.00	0.00	46,560
1976	0.00	0.00	0.00	27.90	0.22	1.07	0.04	0.03	0.01	0.03	0.25	0.16	77,000
1977	0.03	0.02	0.02	1.03	0.17	0.05	1.79	0.01	3.33	0.32	0.01	0.01	17,760
1978	0.01	0.01	0.05	20.90	7.07	0.35	0.12	0.02	0.22	0.05	0.01	0.01	75,320
1979	0.01	0.01	0.02	37.60	48.60	1.64	0.45	0.11	0.00	0.00	0.00	0.00	233,460
1980	0.00	0.00	0.00	2.64	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	7,420
1981	0.00	0.01	1.16	0.52	0.16	0.02	0.01	0.00	0.00	0.00	0.00	0.00	4,980
1982	0.00	0.00	0.35	6.32	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	17,490
1983	0.00	0.00	0.48	20.50	0.01	1.55	0.05	0.00	0.00	0.00	0.00	0.00	58,600
1984	0.00	0.00	0.07	1.26	0.28	7.05	0.16	0.00	0.00	0.10	0.04	0.14	23,630
1985	0.07	0.04	7.55	11.10	0.33	0.02	0.09	8.93	0.71	0.74	0.97	0.74	82,640
1986	0.17	0.05	8.63	25.90	20.90	0.28	4.90	0.26	0.16	0.22	0.14	0.09	162,970

1987	0.09	0.06	0.06	33.20	0.29	0.32	0.19	1.37	0.29	0.36	0.27	0.38	95,770
1988	0.21	0.24	0.33	2.96	0.14	0.02	0.03	0.01	0.37	0.58	0.39	0.27	14,420
1989	0.14	0.07	0.03	6.87	0.25	0.79	0.44	0.11	0.15	0.20	0.21	0.12	24,410
1990	0.14	0.07	0.18	5.74	0.52	0.95	0.24	0.05	0.09	0.19	0.21	0.19	22,270
1991	0.11	0.07	0.13	2.60	1.48	0.08	0.23	0.07	0.04	0.25	0.24	0.24	14,560
1992	0.20	0.13	1.55	20.30	0.71	0.15	0.27	0.15	0.26	0.21	0.15	0.09	62,880
1993	0.15	0.09	0.48	17.30	0.94	0.67	7.38	15.20	1.18	0.31	0.23	0.23	116,570
1994	0.15	0.10	2.74	2.57	0.39	0.28	0.26	0.17	0.13	4.02	0.35	0.25	30,230
1995	-	-	14.30	16.50	0.93	0.31	0.34	0.86	1.03	0.24	-	-	90,900
1996	-	-	0.99	35.18	32.60	1.44	0.84	0.63	0.61	0.40	-	-	191,460
1997	-	-	0.03	30.47	34.20	0.42	1.31	0.26	0.35	0.32	-	-	177,710
1998	-	-	10.96	18.40	0.51	0.90	1.23	0.17	0.14	0.13	-	-	85,200
1999	-	-	1.14	4.18	1.75	0.66	0.68	0.23	0.35	0.26	-	-	24,340
2000	-	-	1.64	0.35	0.29	3.38	14.70	0.41	1.28	0.67	-	-	60,400
2001	-	-	0.35	55.30	9.88	0.95	5.90	3.28	0.33	0.30	0.19	0.13	200,310
2002	0.14	0.15	0.13	2.90	0.38	5.93	0.23	0.24	0.08	0.09	0.11	0.07	27,130
2003	0.09	0.07	0.63	1.52	0.44	0.57	0.35	0.24	0.20	0.11	0.10	0.10	11,050
2004	0.11	0.09	1.79	34.40	5.30	8.39	0.48	0.89	1.31	1.11	0.91	0.20	143,350
2005	0.19	0.15	0.26	34.00	4.68	12.40	54.40	2.51	0.62	0.53	0.42	0.21	291,470
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	4980
Maximum	0	0	14	55	49	12	54	15	3	11	3	1	291470
Mean	0	0	1	16	6	1	2	1	0	0	0	0	79,980

Note: Mean monthly discharges were calculated using the entire period of record.
Mean annual volume was calculated using the years 1956 - 2005.
Data for the years 1959 to 1966 was estimated using station 05OG003.

The bar graph on Figure 4 illustrates the distribution of annual runoff for the La Salle River in the March to October months. It can be seen that the majority of runoff, 54%, occurs in April as a result of snowmelt and early spring rains when the watershed is still saturated. The maximum daily discharge of each year, as well as the date it occurred, was reviewed. It revealed that in 41 of the 50 years (1956-2005), the annual peak flow occurred during the spring runoff; in 7 out of the 50 years, the peak flow occurred during the summer months of June to August; and in 2 of the 50 years, the peak flow occurred during the fall months of September to October.

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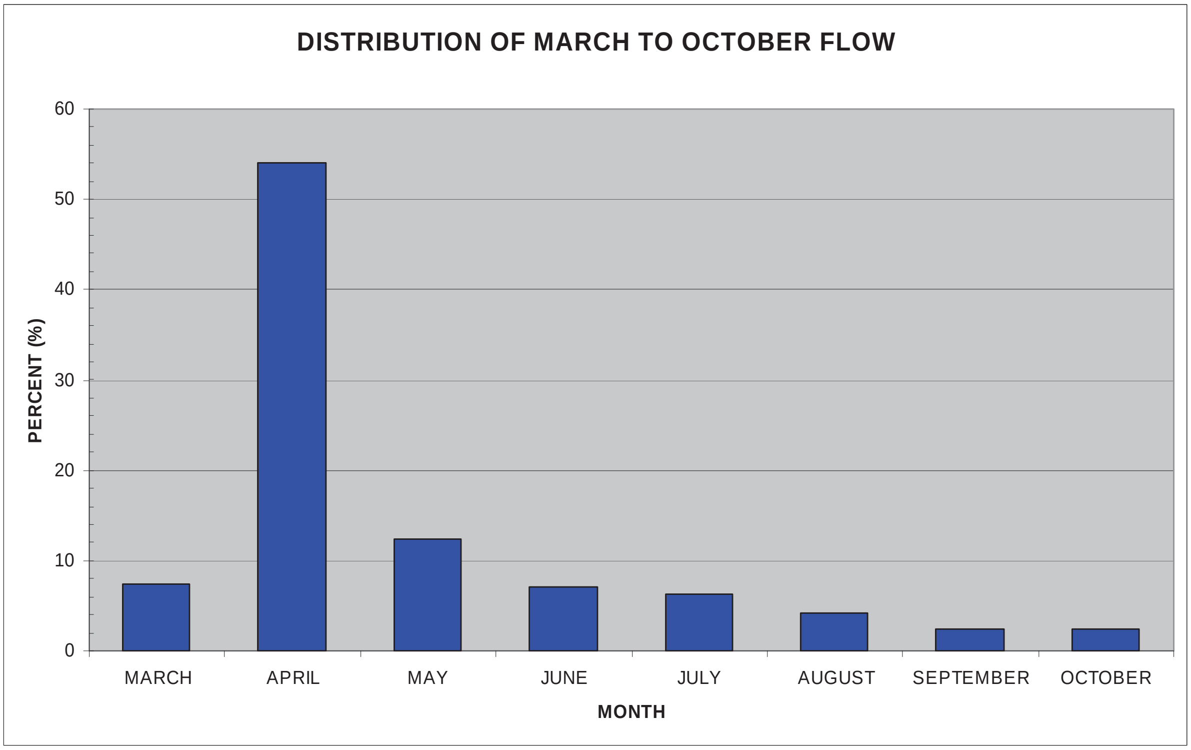
Figure 4: Distribution of Annual Runoff for the La Salle River (05OG001)



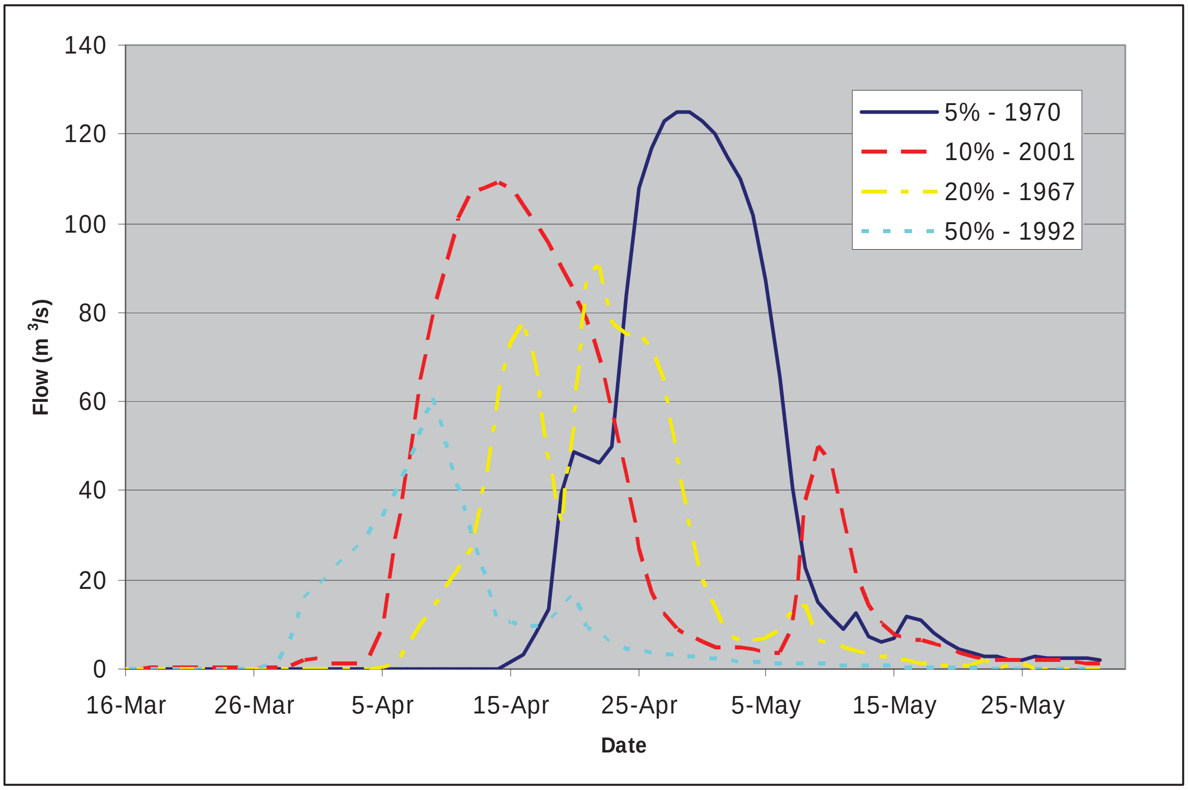
The results of a statistical analysis of the La Salle River data are shown in Table 3. The expected annual peak discharge, runoff volume and corresponding unit depth for selected frequencies are given.

Table 3: Frequency of Flood Flows for the La Salle River (05OG001)

Flood Frequency	Annual Peak Discharge (m^3/s)	Annual Runoff Volume (dam^3)	Unit Runoff (dam^3 / km^2)
1%	154.0	422,400	234.3
2%	141.8	344,400	191.1
5%	123.8	249,400	138.4
10%	108.3	184,100	102.1
50%	61.2	55,350	30.7
80%	38.3	22,380	12.4
90%	29.1	13,420	7.4

La Salle River recorded flow hydrographs for years representative of the 5%, 10%, 20% and 50% floods are plotted on Figure 5. The spring runoff hydrographs show some variability concerning the date the peak discharge occurs. In general, the peak occurs between April 1 and April 30 with some occurrences in late March.

Figure 5: La Salle River near Sanford (05OG001) - Spring Runoff Hydrographs



Summary:

In summary, analysis of the available streamflow data in the La Salle River indicates the following:

- Streamflow varies considerably over the months and years.
- Annual streamflow usually peaks in April during the spring runoff period.
- On average, 70 to 75% of the annual runoff volume occurs in the period from the beginning of March to the end of May.
- The La Salle River experienced periods of zero flow and as a result is classified as an intermittent stream. The remaining watercourses in the planning area are also classified as intermittent.
- On the major watercourses, spring flooding is more significant than flooding from summer precipitation events. It is the smaller drainage areas (less than 30 km^2) that are sensitive to rainfall events. Localized flooding can occur in the smaller poorly drained areas from excessive rainfall events.

Water Allocation:

The issuance of a Water Rights License requires the determination of the availability of water for human use allocation and the determination of instream flow needs (an estimate of a threshold flow above which a user may pump water from a stream). The allocation procedure depends on whether the stream is considered to be perennial or intermittent.

Intermittent:

The total spring volume (March to May) of water available for allocation on intermittent streams is based on the eight out of ten-year (80%) risk level. This would apply to smaller tributary streams.

On intermittent streams, one half of the spring volume of water is available for human use in eight out of ten years. The other half is allocated for maintainance of stream "health" or to maintain the ecological integrity of the stream system, referred to as an Instream Flow Need (IFN). The IFN is a specified minimum instantaneous flow that determines when a user may pump from the stream. Only when the flow in the stream is greater than the IFN can pumping occur. The IFN is computed based on daily stream flow records to ensure that at the 80% spring volume, one half of the total flow goes to protecting the stream's environmental needs with the other half being allocable.

Perennial:

The Tessman Method has been adopted in Manitoba for determination of the IFN on perennial streams. This method establishes a range of instream flow recommendations for each month based on the following criteria:

1. For months where the average recorded flow for the period of record is less than 40% of the overall mean annual flow, the minimum instream flow is equal to that average monthly flow.
2. If the mean monthly flow is between 40% and 100% of the overall mean annual flow then the minimum instream flow is equal to 40% of the mean annual flow.
3. For months where the mean monthly flow is greater than the mean annual flow, then the minimum instream flow is equal to 40% of that month's overall mean flow.

Under the 80% risk level, the volume of water available for human use allocation is the 80th percentile value from a duration curve of available volumes after the IFN requirements have been satisfied.

The La Salle River is considered to be an intermittent stream. Therefore, the intermittent method described above was used in determining an allocable volume of water and the instream flow need. Using the La Salle River near Sanford (05OG001) as the index station, a volume of water was estimated at the mouth of the river (where it empties into the Red River) using a drainage area ratio. The allocable volume of water for the La Salle River watershed is equal to 5685dam^3. The instream flow need is equal to 3.42m^3/s. Again, these values were estimated based on data from the La Salle River near Sanford (05OG001) station and adjusted based simply on a drainage area ratio.

The allocable volume of water and instream flow need values are estimates only for the La Salle River at the mouth to indicate the health of the watershed as of 2006. They should not be used for design or licensing purposes. These values should be reviewed as additional hydrologic data becomes available. The determination of the availability of water for allocation and instream flow needs for other locations in the La Salle River planning area require site specific analysis. Many variables, including hydrologic conditions, selection of index station and the corresponding period of record, watershed characteristics including landuse, soils and topography, location of the site, and other

factors are considered in the analysis and can be very complex, especially in an ungauged watershed, or certain portions of a large gauged watershed.

Water Supply :

Assiniboine-La Salle River Diversions:

The Assiniboine-La Salle Diversion was constructed in 1984 to ensure a dependable water supply for the communities of Starbuck, Sanford and La Salle, as well as for domestic, stockwatering and irrigation use along the La Salle River. The project consists of three pumping stations on the Assiniboine River downstream of Portage la Prairie. The location of the three pumping stations is shown on Figure 5.

Site Y Pump station, located in section 30-11-5W, diverts water into the upper reaches of the La Salle River. The total pumping capacity of Site Y is $0.71m^3/s$, but the pumping rate is variable depending on the amount of precipitation received in the area and downstream water demands. Operation guidelines call for pumping to commence at a maximum rate of $0.71m^3/s$ from May 1 to October 31 and a maximum flow of $0.28m^3/s$ from November 1 to April 30, each year.

Site W Pump station, located in section 16-11-6W diverts water in the upper reaches of the Elm River, a tributary of the La Salle River. The total pumping capacity rate of Site W equals $0.42m^3/s$. Operation guidelines call for pumping to commence from May 1 to October 31 each year to maintain flow in the Elm River Channel near Elie. The pumping rates are variable; depending on the amount of rainfall received in the area and downstream water demands. Unlike Site Y, there is no pumping during the winter months, for the period of November 1 to April 30, on the Elm River.

The Assiniboine-Mill Creek Diversion is located in section 19-12-4W. The total pumping capacity of Site Z is $0.28m^3/s$ but the pumping rate is variable depending on the amount of precipitation received in the area and downstream water demands. Operation guidelines call for pumping to occur from May 1 to October 31. Operation of the pump station is used to augment flows on the La Salle River during periods of peak use and/or low flows on Mill Creek. Similar to Site W, there is no pumping during the winter months, for the period November 1 to April 30.

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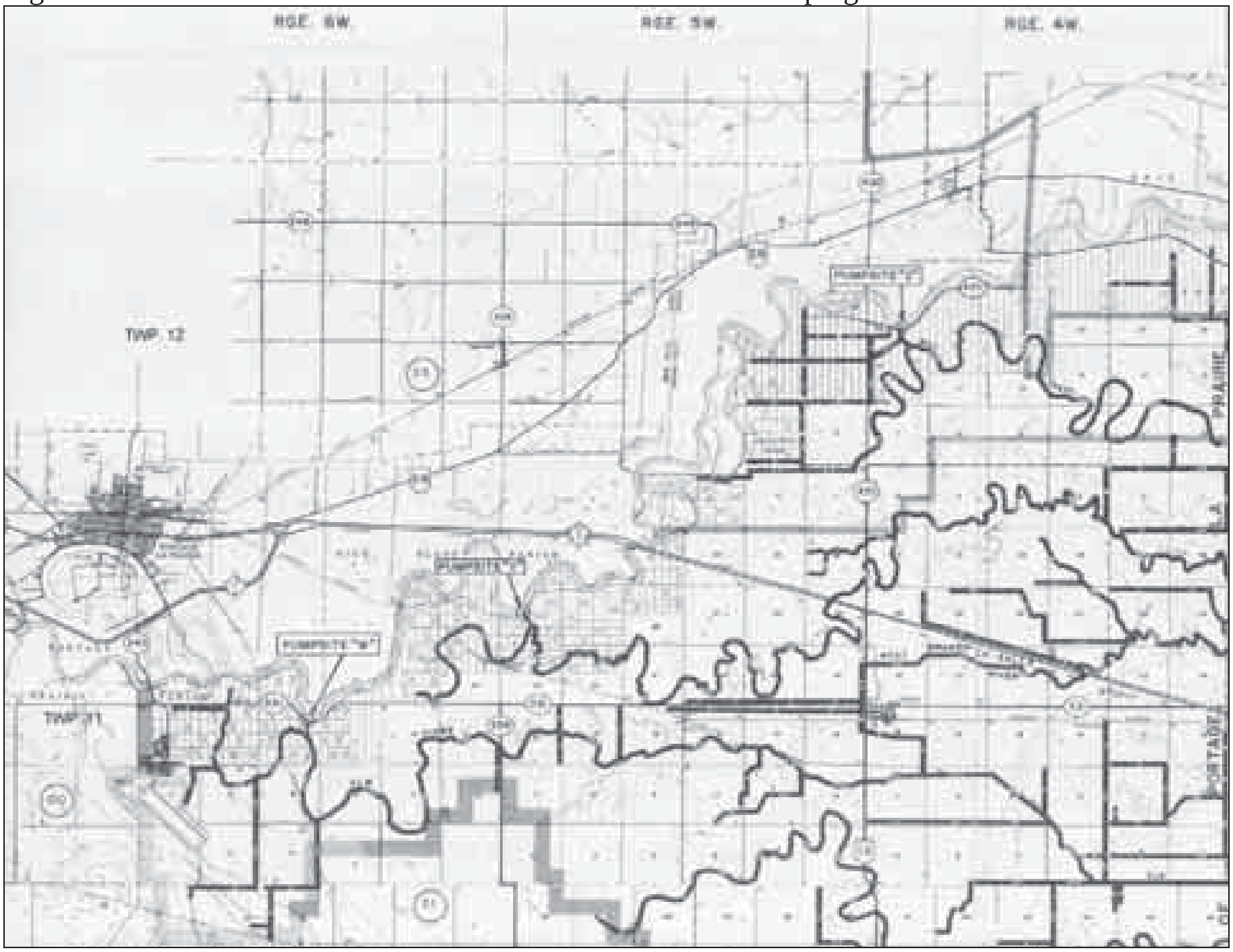
Figure 5: Location of Assiniboine-La Salle River Diversion Pumping Stations



Dams:

Flows in the La Salle River are normally very low and a series of small dams have been built to provide storage and to increase low water levels for both domestic and agricultural use.

A total of 8 structures were built on the La Salle River between the communities of Elie and St. Norbert between the years 1941 and 1962. Details including the location, year of construction, full supply level (FSL) and associated storage, and the type of structure are shown in Table 4.

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Table 4: Provincial Dam Inventory within the La Salle River Planning Area

Dam and/or Reservoir	Location	Year of Construction	Constructed By	Purpose	Full Supply Level (FSL) (m)	Total Storage @ FSL (dam^3)	Description
Elie	SE 2-11-3W	1962	P.F.R.A.	Stockwater and Water Conservation	239.499	126	Stoplog Structure
Hampson	NW 3-9-1W	1955	P.F.R.A.	Stockwater and Water Conservation	233.172	444	Fixed Crest Rock Overflow Structure
Hogue	SE 26-8-1E	1953	P.F.R.A.	Stockwater and Water Conservation	229.362	222	Fixed Crest Rock Overflow Structure
La Salle	SW 34-8-2E	1961	P.F.R.A.	Stockwater and Water Conservation	227.990	469	Fixed Crest Rock Overflow Structure
Lewko	SW 15-8-1E	1955	P.F.R.A.	Stockwater and Water Conservation	230.734	296	Fixed Crest Rock Overflow Structure
Sanford	SW 29-8-1E	1941	P.F.R.A.	Stockwater and Water Conservation	232.867	345	Stoplog Structure
Starbuck	SW 25-9-2W	1961	P.F.R.A.	Stockwater and Water Conservation	235.610	691	Fixed Crest Structure
St. Norbert	River Lot 64 St. Norbert Parish	1941	P.F.R.A.	Stockwater and Recreation	226.201	148	Stoplog Structure

Canada-Manitoba Flood Risk Mapping Program:

Flooding is a serious concern to many residents of Manitoba. Although the public is probably more aware of flooding in the Red River Valley, flooding also occurs along numerous other rivers, streams and lakes. In attempt to reduce flood damages, Canada and Manitoba signed a General Agreement Respecting Flood Damage Reduction on December 20, 1976. One aspect of the Agreement provided for the formal delineation and mapping of a communities' flood risk area which are areas inundated by a "design flood". The "design flood" for the flood risk mapping program was the greater of the 100-year flood or the largest recorded flood for that area. In other words, the maps show areas that have a 1% chance (or a lesser chance) of being flooded in any given year.

Flood risk areas for seventeen communities within Manitoba have been designated and mapped. The flood risk area mapping was completed during the 1980s and was based on available hydrologic data at that time. Studies were undertaken to determine the flood risk area and floodway of the La Salle River at the communities of Elie, Sanford, La Salle and Starbuck, including the adjoining areas in the Rural Municipality of Macdonald.

Floodways and Floodway Fringes:

The flood risk areas were divided into two zones for most of the mapped communities: the floodway and the floodway fringe. The term "floodway", is a general term that refers to the portion of the flood risk area where the water is the deepest and most destructive. "Floodway", in this case, does not refer to a man-made structure. The floodway is the area into which the flow could be confined, while causing only a moderate rise in water levels upstream, and where the water is one metre or more deep. Floodway areas were designated to indicate where new development should not be permitted. The remaining portion of the flood risk area is called the floodway fringe. In this outer zone, floodwaters tend to move more slowly, and are shallower. The floodway fringe could be completely filled in or developed without causing any problems upstream. Each of the two zones is treated differently regarding development restrictions.

Development in Flood Prone Areas:

Damages and hardships resulting from flooding have resulted in large costs to the public. Controlling the use of areas prone to flooding is one effective way of reducing these damages, as are certain structural works such as dikes or diversions. Under the terms of the General Agreement, Canada and Manitoba agreed to discourage any new development from occurring in any designated floodway area. Within a floodway area, the two governments agreed not to finance or engage in any further projects. Under this Agreement, they agreed to withhold flood assistance payments for flood damages to any structures constructed within a floodway area, after its official designation. At the same time, they agreed to encourage suitable land use, such as recreational and agricultural uses, and appropriate zoning aimed at restricting development in those areas. With respect to the floodway fringe area, it was agreed that restrictions concerning financial assistance or concerning development were not to be applied to undertakings that were adequately flood proofed. If the new development did not meet proper flood proofing requirements, financial support from government sources would not be available and assistance payments would not be made in the future.

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Conversion Units:

Temperature: °C = 5/9 (°F – 32)

Length: 1 mm = 0.039370 inches

Area: 1 km^2 = 0.38610 mi^2

Volume: 1 dam^3 = 0.8107 acre-ft

Flow: 1 m^3/s = 35.315 ft^3/s

Resources:

[1] Environment Canada, Canadian Climate Normals or Averages 1971-2000.
[2] Agriculture and Agri-Food Canada, Mean Annual Precipitation in the Canadian Prairies for the Standard 30-Year Period 1971-2000.
[3] Agriculture and Agri-Food Canada, Mean Annual Gross Evaporation in the Canadian Prairies for the Standard 30-Year Period 1971-2000.

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Section 5.3 - Surface Water Quality of the La Salle River (Source: Manitoba Water Stewardship)

The La Salle River Watershed from a Water Quality Perspective.

A number of reports/studies have been conducted over the last 25 years examining the surface water quality within the La Salle River watershed. These can be summarized as follows:

- A CONDUCTIVITY STUDY ON THE LA SALLE RIVER, 1980-81. Williamson D. A. Winnipeg: Department of Environment. 1982
- A PRELIMINARY INVESTIGATIONINTO THE PRESENCE OF AGRICULTURAL PESTICIDES IN THE LA SALLE AND ASSINIBOINE RIVERS, MANITOBA, CANADA. Williamson, D. A. Winnipeg, Manitoba Environment. 1984
- CONTAMINATION BY PESTICIDES OF THE LA SALLE AND ASSINIBOINE RIVERS, MANITOBA, CANADA Therrien-Richards, S and D. A. Williamson. Ottawa, Environment Canada and Manitoba Environment and Workplace Safety and Health. 1987.
- AN ASSESSMENT OF PESTICIDE RESIDUES IN SURFACE WATERS OF MANITOBA, CANADA. Curry R. S. and D. A. Williamson. Winnipeg, Manitoba Environment. 1995.
- A POST-HOC ASSESSMENT OF THE ASSINIBOINE-LA SALLE RIVER DIVERSION PROJECT. Lowman, Lisa. Winnipeg. Man. University of Manitoba. 2001
- LONG – TERM TRENDS IN TOTAL NITROGEN AND TOTAL PHOSPHORUS CONCENTRATIONS IN MANITOBA STREAMS. Jones G and N. Armstrong Winnipeg, Manitoba Conservation. 2001.
- A PRELIMINARY ESTIMATE OF TOTAL NITROGEN AND TOTAL PHOSPHORUS LOADING TO STREAMS IN MANITOBA, CANADA. Bourne A., N. Armstrong, and G. Jones. Winnipeg, Manitoba Conservation. 2002.

The Water Quality Management Section maintains a province-wide monitoring program that provides information on long term trends in surface water quality. There is currently one long-term monitoring station within the La Salle River watershed as well as other monitoring stations established for short term projects (Table 1).

Table 1: Water quality monitoring stations within the watershed area.

EMS Station Number	**Location for La Salle River Stations**	**Period**	**Frequency**

Long Term Water Quality Stations			
MB05OCS026	Upstream of Hwy 75 Bridge	Apr-Nov 1973-77 July-Oct 1988 Jan-Oct-1989-94 Jan-Oct 1995 Jan-Oct 1996 Jan-Oct 1997 Jan-Oct 1998 Apr-Sept 1999	3-4 samples/yr 2 samples/yr 4 samples/yr 12 samples/yr 17 samples/yr 8 samples/yr 11 samples/yr 3 samples/yr
MB05OGS039	Downstream of LaBarriere Dam	Aug-Dec 1984 Jan-June 1985 Jan-Oct 2000-05	6 samples/yr 7 samples/yr 4 samples/yr

The long term monitoring station (MB05OCS026) is located close to the La Salle River outlet to the Red River in Saint Norbert (Figure 1). This site was located as far as possible downstream to capture the cumulative upstream inputs affecting water quality within the watershed. The location was moved slightly upstream to the LaBarriere Dam (MB05OGS039) in 2000 because of backwater impacts at the original site during high flows on the Red River. Water samples are collected and analysed for a wide range of variables at the long-term monitoring station and the water quality status is summarized with the Water Quality Index.

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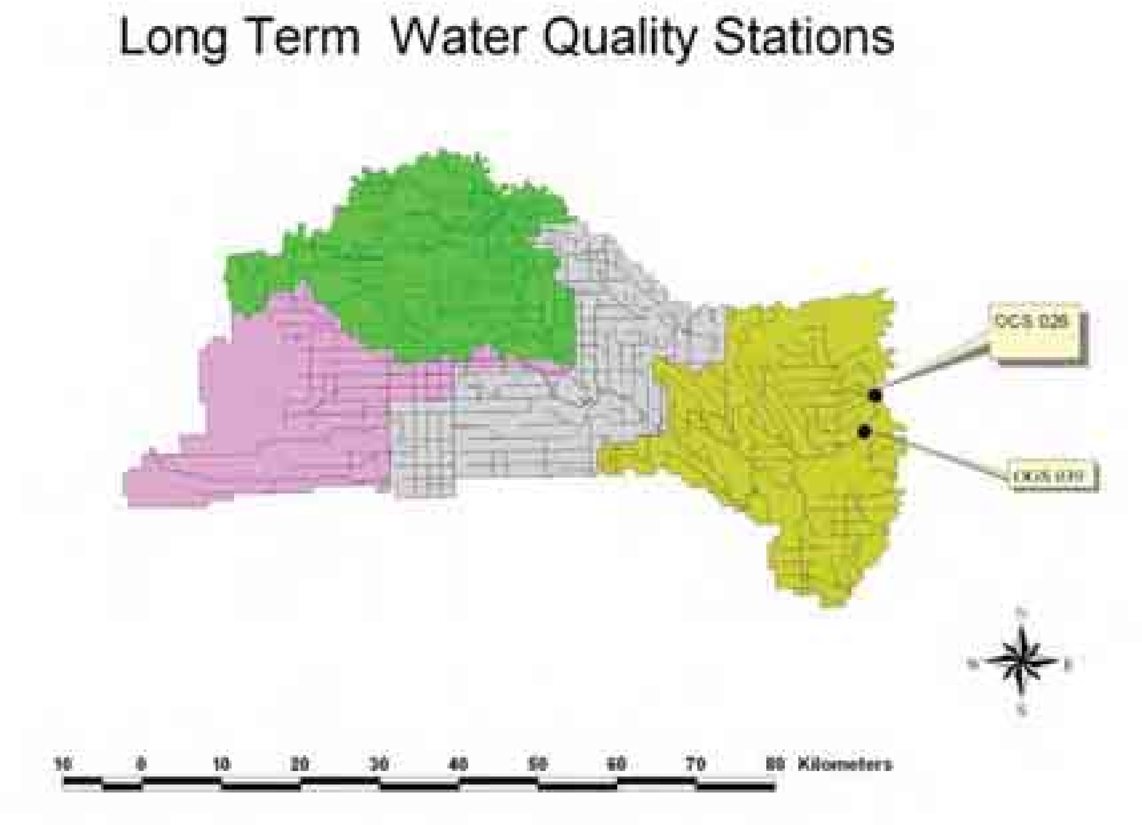
Figure 1: Location of long term monitoring stations in the La Salle River Watershed.-



The Canadian Council of Ministers of the Environment (CCME) Water Quality Index is used to summarize large amounts of water quality data into simple terms (e.g., good) for reporting in a consistent manner. Twenty-five variables are included in the Water Quality Index (Table 2) and are compared with water quality objectives and guidelines contained in the Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson 2002 and Table 2).

Table 2. Water quality variables and objectives or guidelines (Williamson 2000, Williamson 1988) used to calculate Water Quality Index (CCME 2000).

Variables	Units	Objective Value	Objective Use
Fecal Coliform MF	**Bacteria/100mL**	**200**	**Recreation**
Ph	**Ph Units**	**6.5-9.0**	**Aquatic Life**
Specific Conductivity	**uS/cm**	**1000**	**Greenhouse Irrigation**
Total Suspended Solids	**mg/L**	**25 (mid range)**	**Aquatic Life**

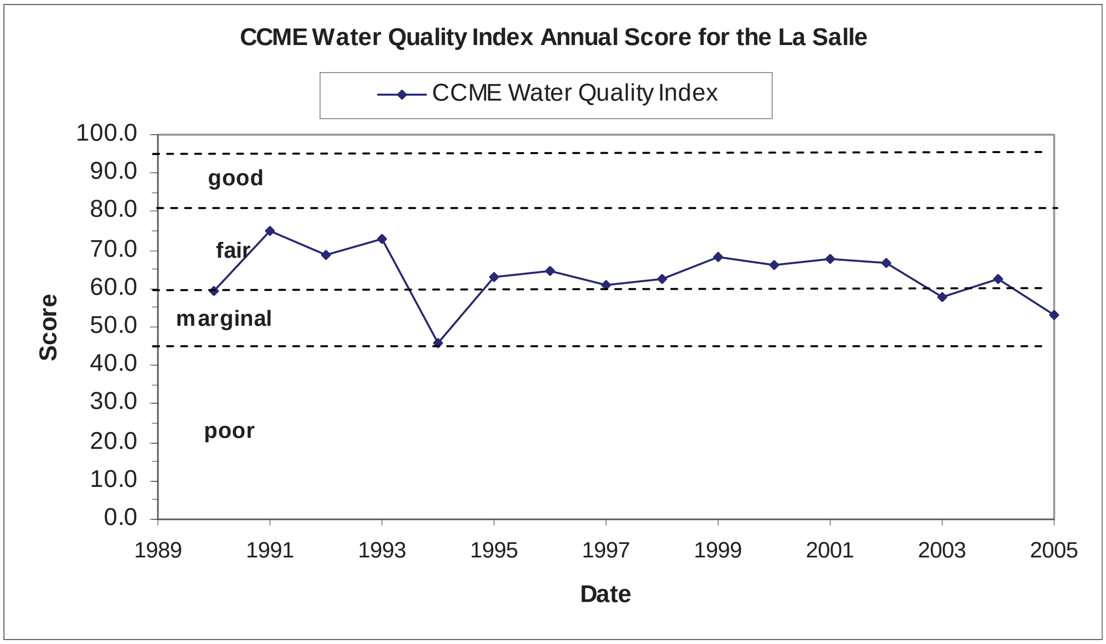
Dissolved Oxygen	**mg/L**	**5 (mid range)**	**Aquatic Life**
Total or Extractable Cadmium*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total or Extractable Copper*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total Arsenic	**mg/L**	**0.025**	**Drinking Water, Health**
Total or Extractable Lead*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Dissolved Aluminum	**mg/L**	**0.1 for pH >6.5**	**Aquatic Life**
Total or Extractable Nickel*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total or Extractable Zinc*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total or Extractable Manganese	**mg/L**	**0.05**	**Drinking Water, Aesthetic**
Total or Extractable Iron	**mg/L**	**0.3**	**Drinking Water, Aesthetic**
Total Ammonia as N	**mg/L**	**Calculation based pH**	**Aquatic Life**
Soluble or Dissolved Nitrate-Nitrite	**mg/L**	**10**	**Drinking Water, Health**
Total Phosphorus	**mg/L**	**0.05 in Rivers or 0.025 in Lakes**	**Nuisance Plant Growth**
Dicamba	**ug/L**	**0.006 ug/L where irrigation is a use of the waterbody, otherwise 10 ug/L for the protection of Aquatic Life within the waterbody**	**Irrigation**
Bromoxynil	**ug/L**	**0.33**	**Irrigation**
Simazine	**ug/L**	**0.5**	**Irrigation**
2,4 D	**ug/L**	**4**	**Aquatic Life**
Lindane	**ug/L**	**0.08**	**Aquatic Life**
Atrazine	**ug/L**	**1.8**	**Aquatic Life**
MCPA	**ug/L**	**0.025 ug/L where irrigation is a use of the waterbody, otherwise 2.6 ug/L for the protection of Aquatic Life within the waterbody**	**Irrigation**
Trifluralin	**ug/L**	**0.2**	**Aquatic Life**

The Water Quality Index combines three different aspects of water quality: the 'scope,' which is the percentage of water quality variables with observations exceeding guidelines; the 'frequency,' which is the percentage of total observations exceeding guidelines; and the 'amplitude,' which is the amount by which observations exceed the guidelines. The basic premise of the Water Quality Index is that water quality is excellent when all guidelines or objectives set to protect water uses are met virtually all the time. When guidelines or objectives are not met, water quality becomes progressively poorer. Thus, the Index logically and mathematically incorporates information on water quality based on comparisons to guidelines or objectives to protect important water uses. The Water Quality Index ranges from 0 to 100 and is used to rank water quality in categories ranging from poor to excellent.

- Excellent (95-100) - Water quality never or very rarely exceeds guidelines
- Good (80-94) - Water quality rarely exceeds water quality guidelines
- Fair (60-79) - Water quality sometimes exceeds guidelines and possibly by a large margin
- Marginal (45-59) - Water quality often exceeds guidelines and/or by a considerable margin
- Poor (0-44) - Water quality usually exceeds guidelines and/or by a large margin

An annual water quality index was calculated for the La Salle Rive from 1990 to 2005 based on water quality data from the long term station. In instances where more than one objective or guideline is available for a specific variable, the most restrictive has been used in the Index. As an example, for the herbicide Dicamba, the guideline for irrigation (.006 mg/L) is much lower than the guideline for the protection of aquatic life (10 mg/L) and would be used in the Index. Results shown in Figure 2 indicate that over the 16 year time frame, water quality is generally fair with some years with marginal water quality.

Figure 2: CCME Water Quality Index for the La Salle River.



Concentrations of Dicamba and MCPA (Figures 3 and 4) generally exceed the guidelines when detected and greatly influence the index. Both Dicamba and MCPA are herbicides commonly used to control broadleaf weeds on agricultural land or road and utility right of ways. Dicamba can enter surface waters through spills, aerial drift, improper disposal methods, and direct overspray of water bodies during application. Dicamba is very soluble in water and run-off from adjacent cropland is another pathway into the aquatic environment. Dicamba was detected in 36 % of samples taken (139) while MCPA was only detected in 16 % of samples taken (94). MCPA and Dicamba are often marketed together as multi mixed product but can also be distributed separately.

Figure 3: Historical Dicamba Concentrations Detected in the La Salle Watershed from 1984 – 2006.

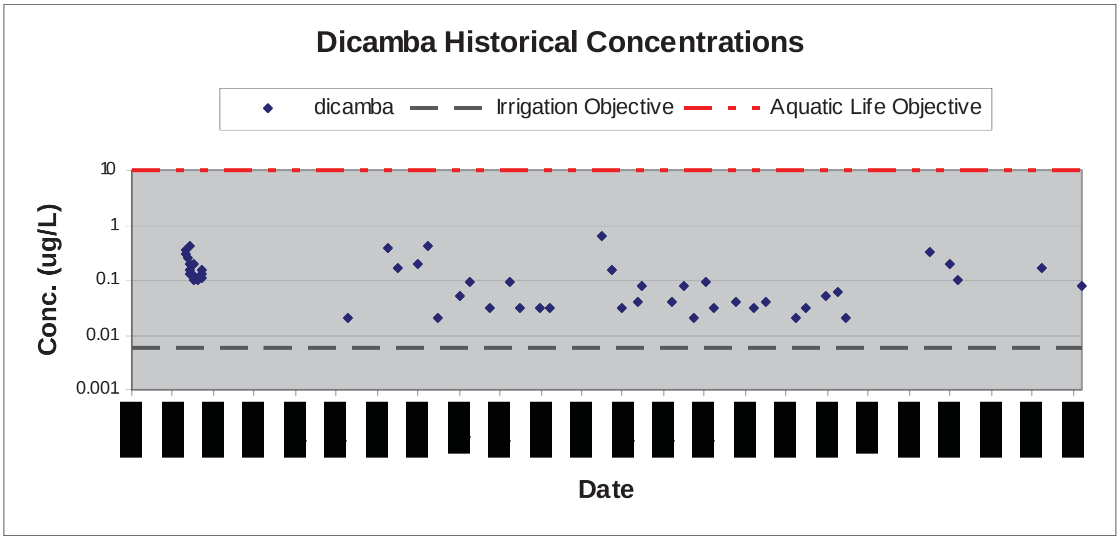


Figure 4: Historical MCPA Concentrations Detected in the La Salle Watershed from 1984 – 2006.

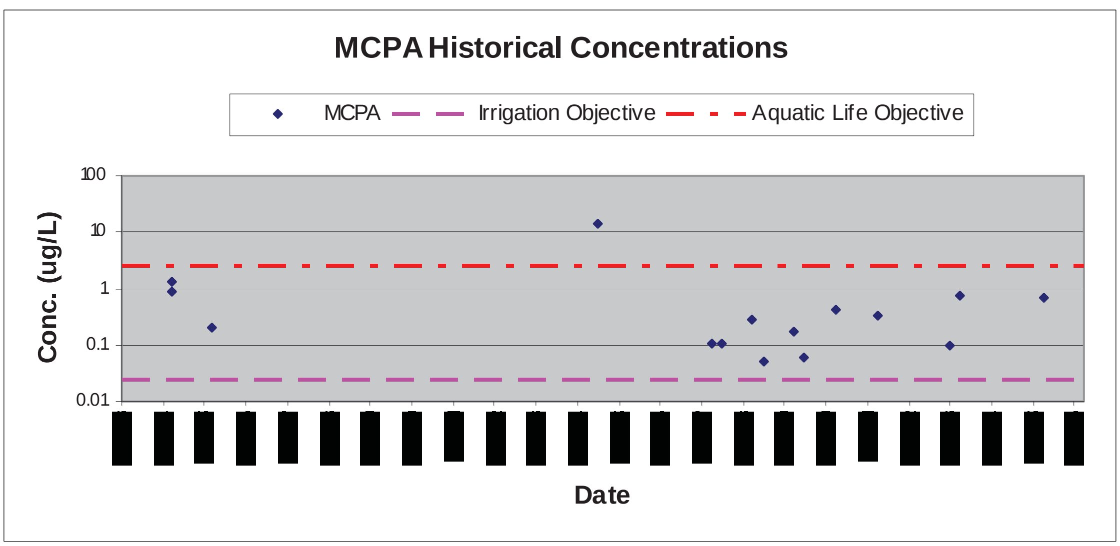
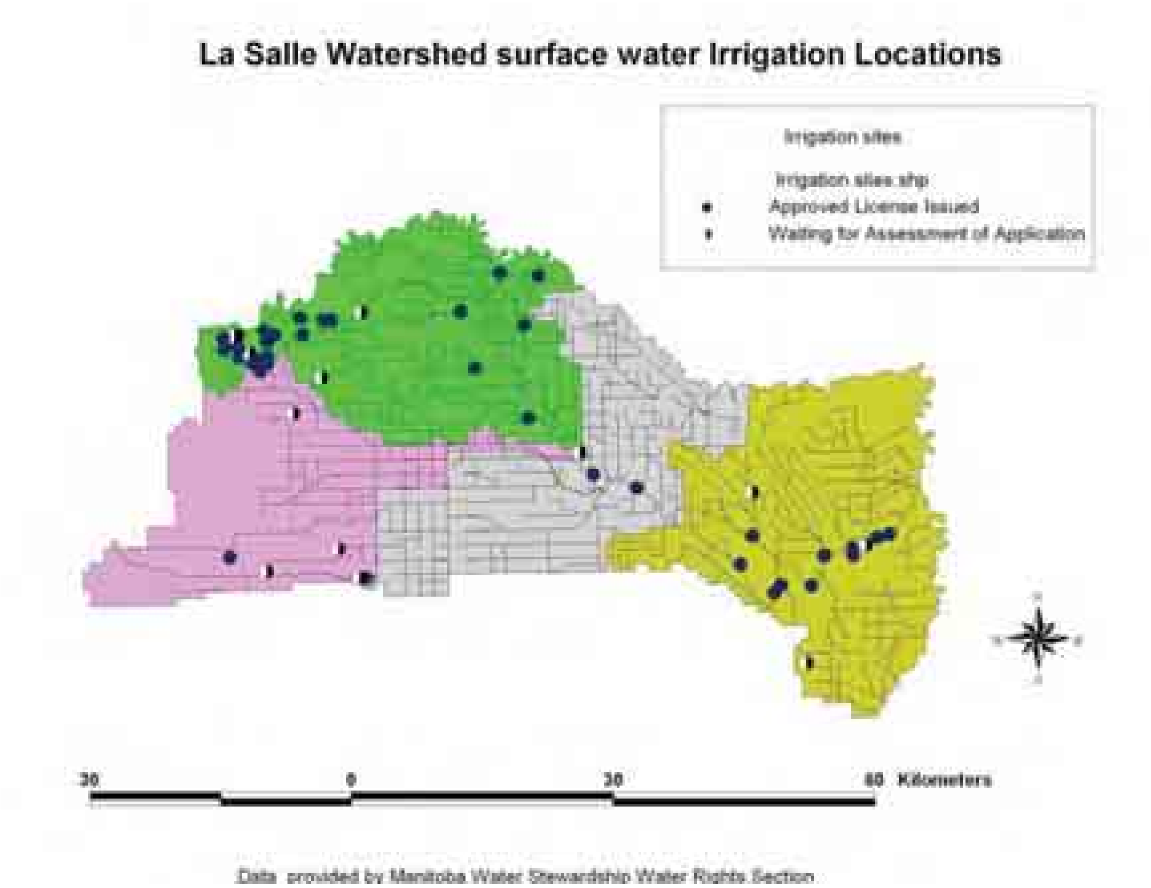


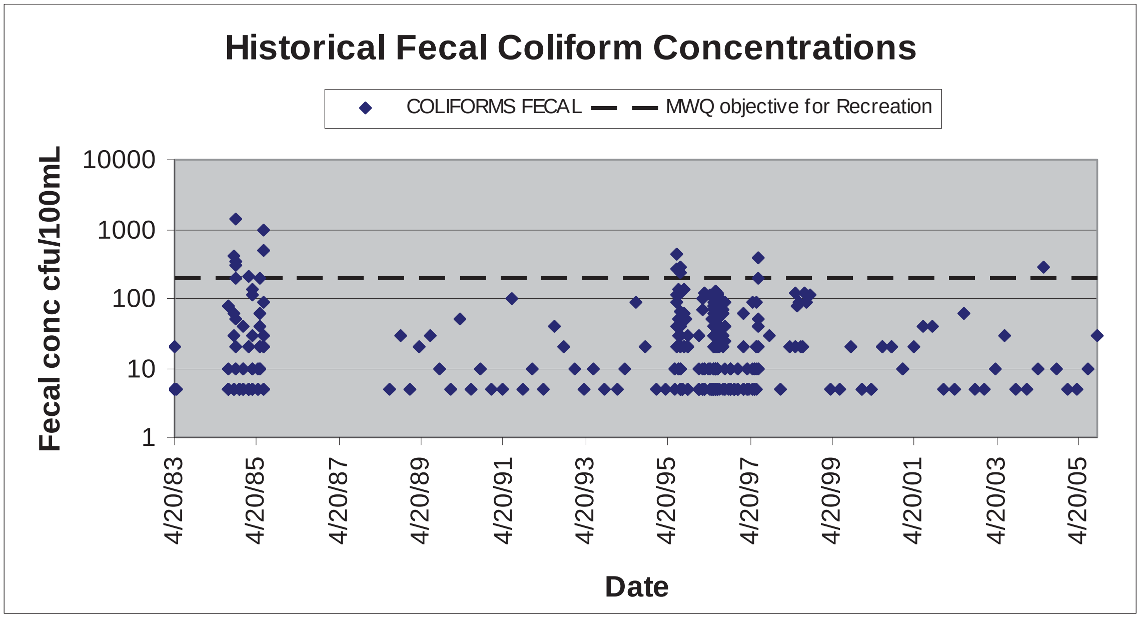
Figure 5: Locations of Surface Water Irrigation Licensed sites within the La Salle River Watershed



Licenses for irrigation are concentrated in the upper western corner of the watershed as well as in the lower reaches of the watershed where some of the higher water demand users are located such as the golf courses and water treatment plant (Figure 5). The upper reaches of the Elm Creek Channel are also starting to be developed based on pending applications. To improve water quality as indicated by the Water Quality Index, consideration should be given to best management practices that could reduce the transport of Dicamba and MCPA to surface water while still maintaining their beneficial use in controlling broadleaf weeds within the watershed.

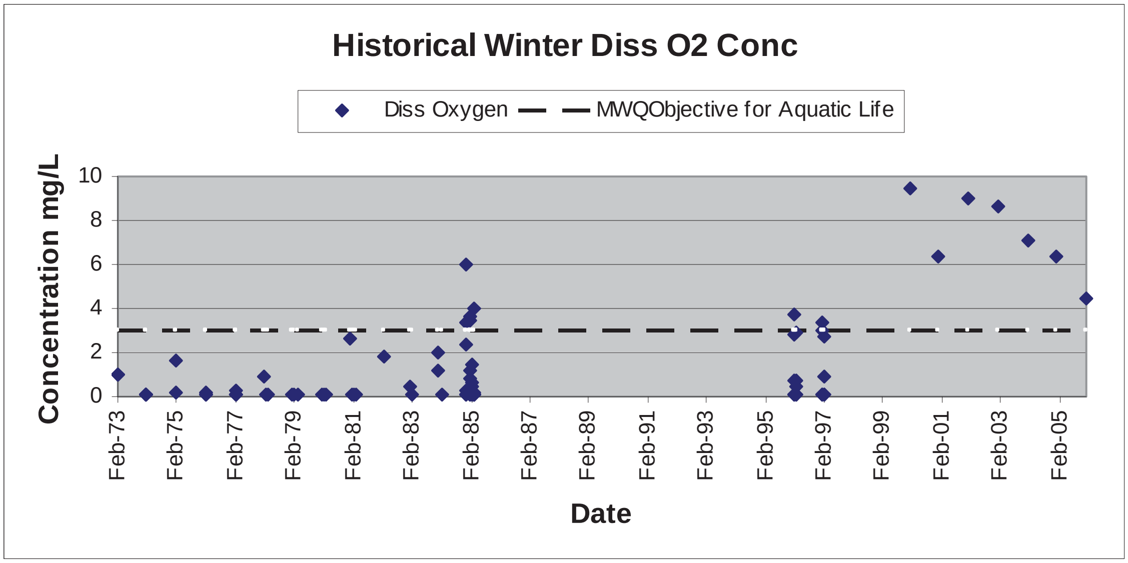
Fecal coliform bacteria are found in the intestinal tracts of birds and mammals and are used as indicators of other waterborne illness and viruses. Fecal coliforms are often introduced into the waterway as feces from humans, livestock or wildlife. The Manitoba Water Quality Guideline for fecal coliforms for the protection of recreational uses is 200 colony forming units per 100mL. Relatively few exceedences of the fecal coliform guideline were observed on the La Salle River between 1983 to 2005 (Figure 6).

Figure 6: Historical Fecal Coliform Concentrations within the La Salle River Watershed



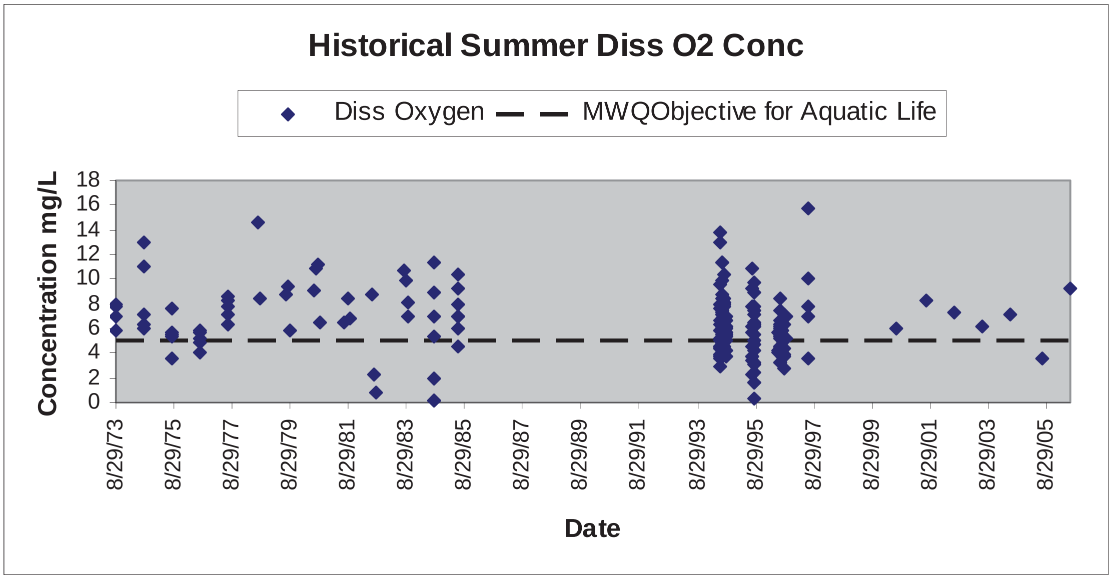
Adequate instream dissolved oxygen concentrations are essential to the overall health of the aquatic community. Oxygen is introduced into water systems via atmospheric exchange and plant photosynthesis. Oxygen is moderately soluble in water and its solubility is effected by temperature, elevation, salinity and mixing. Oxygen can be lost from water systems via bacterial decomposition of organic material and via plant and animal respiration. When oxygen consumption exceeds production then oxygen depletion (anaerobic conditions) can occur thereby impacting aquatic life. Oxygen concentrations can be depleted during winter when ice cover limits atmospheric exchange and reduces photosynthesis capability within the stream leading to greater consumption than production. In the La Salle River, oxygen consumption during the winter greatly exceeds production and anaerobic conditions can occur (Figure 7). Dissolved oxygen concentrations are generally higher in the 2000's but this may reflect the change in location and mixing that is occurring at the dam at LaBarriere Park.

Figure 7: Historic Winter Dissolved Oxygen Concentration within the La Salle River Watershed



Warmer water temperatures during the summer months generally increase biological activity and overall productivity. Warmer temperatures also enhance bacteria activity and consumption of oxygen. Solubility of oxygen also decreases with warmer temperatures. Therefore, stream oxygen concentrations may also drop below water quality objectives in summer. While summer dissolved oxygen concentrations throughout the La Salle River are generally above the Manitoba Surface Water Quality Objective for the protection of aquatic life, oxygen depletion occurs occasionally (Figure 8).

Figure 8: Historic Summer Dissolved Oxygen Concentration within the La Salle River Watershed



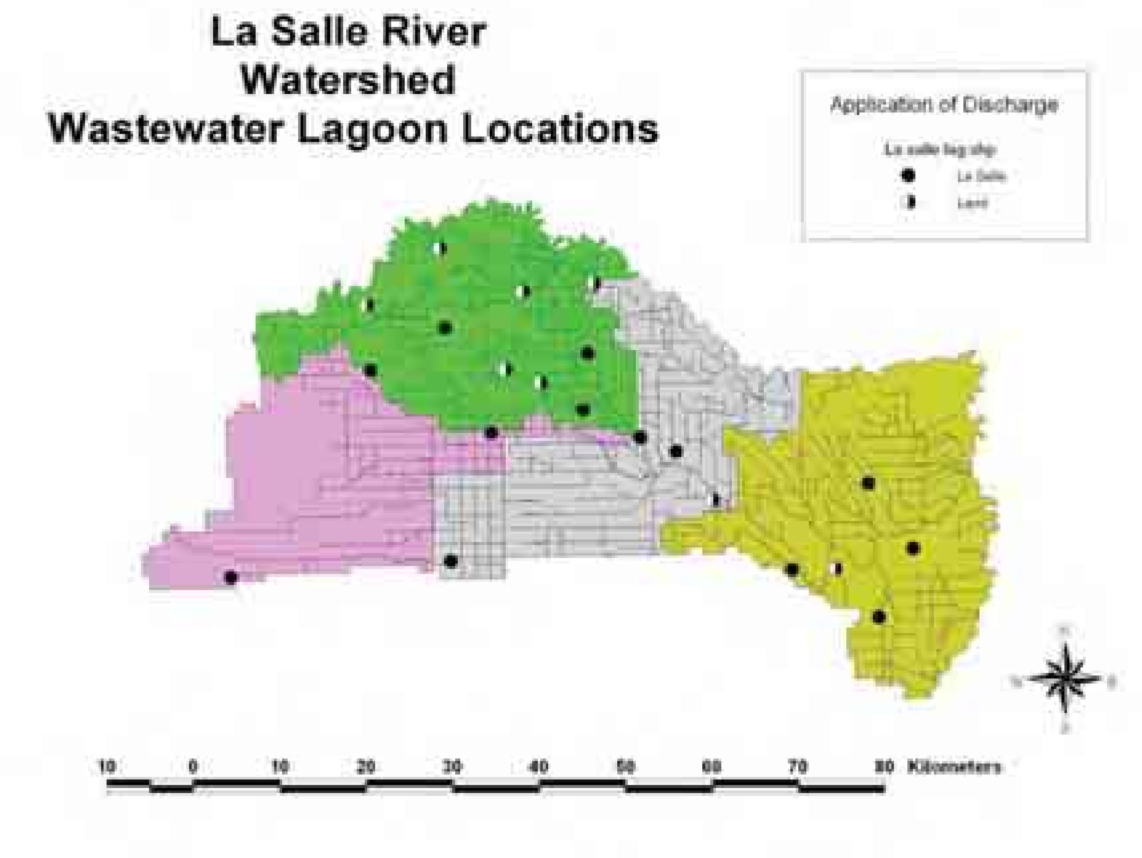
Nutrients play an important role in the stream ecosystem and are essential to overall biological productivity. However, excessive levels of phosphorus and nitrogen fuel the production of algae and aquatic plants. Extensive algal blooms can cause changes to aquatic life habitat, reduce essential levels of oxygen, interfere with drinking water treatment facilities, and cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins. Limiting and managing nutrient inputs in the La Salle River may assist in mitigating conditions associated with eutrophication such as dissolved oxygen depletion.

Nutrients as measured by total phosphorous and total nitrogen have been increasing in the La Salle River since the early 1970's. Jones and Armstrong (2001) demonstrated that total phosphorous concentrations have increased by over 194 % while total nitrogen concentrations have increased by 146 % over the time period from 1973 to 2000. This corresponds to an approximate increase in phosphorus and nitrogen loads of 29 tonnes and 118 tonnes, respectively. For comparison, studies have shown that since the early 1970s, phosphorus loading has increased by about 10 per cent to Lake Winnipeg and nitrogen loading has increased by about 13 per cent. Increased nutrient concentrations have resulted in the deterioration of water quality and development of more frequent and more widely distributed algal blooms in Lake Winnipeg.

Manitobans, including those in the La Salle River watershed, contribute about 47 % of the phosphorus and 49 % of the nitrogen to Lake Winnipeg (Bourne *et al.* 2002, updated in 2006). About 15 % of the phosphorus and 5 % of the nitrogen entering Lake Winnipeg is contributed by agricultural activities within Manitoba. In contrast, about 9 % of the phosphorus and 5 % of the nitrogen entering Lake Winnipeg from Manitoba is contributed by wastewater treatment facilities such as lagoons and sewage treatments plants.

As part of Lake Winnipeg Action Plan, the Province of Manitoba is committed to reducing nutrient loading to Lake Winnipeg to those levels that existed prior to the 1970s. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Reductions in nutrient loads across the Lake Winnipeg watershed will benefit not only Lake Winnipeg but also improve water quality in the many rivers and streams that are part of the watershed including the La Salle River. In particular, issues related to excessive plant growth and reduced dissolved oxygen concentrations in the La Salle River can be mitigated by reducing nutrient loads to surface waters.

Figure 9: Location of all wastewater lagoons within the La Salle Watershed.



One of the sources of nutrients to the La Salle River is wastewater treatment lagoon discharge. There are a total of 25 lagoons in the La Salle River watershed of which 8 discharge via land application (Figure 9). The remaining 17 lagoons discharge directly or indirectly via the drainage network to the La Salle River. Calculations indicate that contributions from these discharges contribute 7.3 % of the total phosphorus and 12.3 % of the total nitrogen load to the La Salle River. Remaining sources of nutrients to the La Salle River include runoff associated with fertilizer and manure application, septic fields, enhanced drainage and reduced riparian vegetation, erosion, and instream processes. These many activities each contribute a relatively small proportion of the overall nutrient load to the La Salle River. However, the sum of these many small nutrient loads impacts the La Salle River and downstream waterways such as Lake Winnipeg. It is evident that reducing nutrients across the La Salle River watershed is a challenge that will require the participation and co-operation of all residents and will involve:

- Implementing controls on nutrients in municipal and industrial wastewater treatment facilities and considering the cumulative impact of multiple lagoon discharges along the La Salle River.
- Developing scientifically-based measures to control the application of inorganic fertilizers, animal manure, and municipal sludge to agricultural lands.

- Reducing nutrient contributions from individual homeowners.

Individual residents can help by taking the following steps:

- Maintain a natural, riparian buffer along waterways. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
- Value and maintain wetlands. Similar to riparian buffers along waterways, wetlands slow erosion and help reduce nutrient inputs to lakes, rivers, and streams. Wetlands also provide flood protection by trapping and slowly releasing excess water while providing valuable habitat for animals and plants.
- Don't use fertilizer close to waterways. Heavy rains or over-watering your lawn can wash nutrients off the land and into the water.
- Use phosphate-free soaps and detergents. Phosphates have been prohibited from laundry detergents but many common household cleaners including dishwasher detergent, soaps, and other cleaning supplies still contain large amounts of phosphorus. Look for phosphate-free products when you are shopping.
- Ensure that your septic system is operating properly and is serviced on a regular basis. It's important that your septic system is pumped out regularly and that your disposal field is checked on a regular basis to ensure that it is not leaking or showing signs of saturation.

One of the short term studies undertaken on the La Salle River examined ammonia concentrations in wastewater lagoon discharges. In 1996, several lagoon discharges were sampled and monitoring occurred upstream and downstream of the wastewater discharge into the La Salle River. Organic matter in a lagoon breaks down naturally to ammonia and then in the presence of sufficient oxygen to nitrite/nitrate as part of the treatment process. Ammonia, while an essential and readily used nutrient for plant growth, can in its un-ionized state be toxic to aquatic life. The toxicity of ammonia in surface waters is related to the total amount of ammonia present, and in particular the ratio of un-ionized to total ammonia. This ratio is affected by the pH and to a lesser extent the temperature of the water. Results of the study indicated that for all of the lagoon discharges monitored in 1996, there were no exceedences of the Manitoba Water Quality Objectives for ammonia for the protection of aquatic life.

Drainage

Although it is recognized that drainage in Manitoba is necessary to support sustainable agriculture, it is also recognized that drainage works can impact water quality and fish habitat. Types of drainage include the placement of new culverts or larger culverts to move more water, the construction of a new drainage channels to drain low lying areas, the draining of potholes or sloughs to increase land availability for cultivation and the installation of tile drainage. Artificial drainage can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide load to receiving drains, creeks and rivers. All types of drainage should be constructed so that there is no net increase in nutrients (nitrogen and phosphorus) to waterways. To ensure that drainage maintenance, construction, and re-construction occurs in an environmentally friendly manner, the following best available technologies, and best management practices aimed at reducing impacts to water quality and fish habitat are recommended.

- Surface drainage should be constructed as shallow depressions and minimal removal of vegetation and soil should be observed during their construction.
- Based on Canada Land Inventory Soil Capability Classification for Agriculture (1965) Class 6 and 7 soils should not be drained.
- When sloughs or potholes are drained then an additional holding pond or wetland should be constructed as a collection point for the water prior to entering the municipal drain, creek or river. This will help filter nutrients from runoff from the land as well as compensate for the loss of wetlands that support wildlife.
- Erosion control methodologies according to the guidelines outlined in *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* should be used where the surface drain intersects with another water body.
- A strip of vegetation of at least 1 metre should be maintained along the surface drainage channel as a buffer. This will reduce erosion of the channel and aid in nutrient removal.
- When necessary the proponent must revegetate exposed areas along the bank of the surface drainage channel.
- Discharge from tile drainage should enter a holding pond or wetland prior to discharging into a drain, creek or river.
- Nutrient application needs to be established for most efficient uptake by the crop and should occur just prior to seeding. Fall application of manure or fertilizer should not be permitted on drained land.

Summary

- Water quality is an important issue within the watershed. The water quality index is an excellent method of evaluating water quality and assessing changes/improvements over time.
- Nutrient enrichment or eutrophication is one of the most important water quality issues in Manitoba. It is evident that reducing nutrients across the La Salle River watershed is a challenge that will require the participation and co-operation of all residents and will involve many actions.
- To improve water quality, consideration should be given to best management practices that could reduce the transport of Dicamba and MCPA to surface water while still maintaining their beneficial use in controlling broadleaf weeds within the watershed.
- Best management practices for reducing nutrient contributions and managing drainage in an environmentally friendly manner should also be implemented on a watershed basis.

SECTION 5.4

La Salle River
Integrated Watershed Management Plan:
State of the Watershed Report
Groundwater Resources

Graham Phipps
Groundwater Management Section
March 2007

Manitoba Water Stewardship

Summary

Much of the La Salle River watershed has no potable groundwater supplies and the potable groundwater resources present are not uniformly distributed. Bedrock aquifers are saline to varying degrees and are not considered potable sources of water. The chance of developing potable water supplies only exists within limited areas of sand and gravel deposits within the overburden.

The salinity in the bedrock groundwater within the watershed decreases from approximately 10,000 mg/L in the southwest to 5,000 mg/L total dissolved solids towards the northeast. Outside of the watershed, towards the north and east, fresh water replaces the saline water. Water supplies, especially within the carbonate aquifer are generally good; groundwater from the carbonate aquifer may be useful for heating / cooling exchange systems or potentially other industrial uses.

Overburden aquifers consist of glacio-fluvial sand (Almasippi sand), paleo-channel and alluvial sand (aquifers of limited extent associated with stream and river deposited sediment), glacial outwash sand and gravel, and confined sand and gravel aquifers within or underlying glacial till. The Almasippi sand is fairly extensive west of a line from Elm Creek to Southport, however its thickness is variable and it is generally low yielding. Paleo-channel and alluvial aquifers are associated with pre-historic drainage and modern drainage systems and are very limited in size and extent. These are located primarily in the Oakville area and near modern rivers and streams. The only example of glacial outwash in the watershed is the Elie aquifer located northeast of the town of Elie. Confined sand and gravel aquifers are intersected in drill holes scattered throughout the watershed, but primarily in a bedrock depressional ‘trough’ which roughly lies in a line between Elm Creek and Southport. Confined sand and gravel aquifers within the glacial till are frequently located at depths below 20 metres.

Groundwater from overburden aquifers vary considerably in quality. Most wells completed in the overburden will yield hard to very hard water. Few groundwaters have hardness less than 200 mg/L $CaCO_3$, whereas most groundwater has hardness greater than 400 mg/L $CaCO_3$. Total dissolved solids ranges from 300 to 1,400 mg/L in shallow aquifers and up to approximately 5,000 mg/L in confined sand and gravel aquifers. The water quality decreases in confined sand and gravel aquifers that are located closer to the bedrock.

The Groundwater Management Section of Water Stewardship currently operates 18 monitoring wells, primarily to measure water levels, and one rain gauge within the watershed. Earliest monitoring began in 1960’s in the carbonate aquifer, primarily in response to the construction of the floodway. Town supply exploration and monitoring programs were carried out in the 1960’s (Elie) 1970’s (Oakville, Elm Creek) and monitoring in the Almasippi sand was added in the 1990’s.

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Introduction

Groundwater, like most natural resources, is the responsibility of the provinces. The transfer of responsibility for water from the federal government to the provinces began with *The Natural Resource Transfer Agreement* in 1930. Although groundwater was not specified, it was assumed to be included. In the same year Manitoba passed the *Water Rights Act* which was consequently amended it in 1959 to include groundwater. The 1959 *Water Resources Administration Act* was established to create a comprehensive water management agency. Shortly after, *The Ground Water and Water Well Act* (1963) passed and was meant to address drilling practices and groundwater data collection. Groundwater is regulated under a number of provincial acts including *The Environment Act, The Water Protection Act, The Health Act, The Drinking Water Safety Act, The Water Resources Conservation Act, The Planning Act, The Water Rights Act, The Ground Water and Water Well Act* and subsequent Regulations.

Early regional studies of groundwater and aquifers were carried out by the federal government. These consisted of door to door well surveys, township summaries of water supply and quality, regional maps of surficial geology, well locations and producing zones. Formal studies of groundwater were initiated by the province in the early 1960's and by the mid 60's the Groundwater Management Section began operating a monitoring well network.

The Groundwater Management Section (GMS) of Water Stewardship advises on groundwater management issues including allocation of groundwater and groundwater protection. The GMS operates a monitoring well network, from which data on groundwater conditions such as water levels and water quality is collected, stored and compiled. Studies meant to address specific aquifer or groundwater concerns have been carried out by the section as have regional groundwater resource mapping. Systematic hydrogeologic mapping was conducted from the 1960's through the 1980's consisting of regional stratigraphic drilling, pump testing, well data and quality compilations resulting in 11 regional groundwater availability map series on a scale of 1:250,000 completed by 1989. The Section has also prepared reports on hydrogeology and groundwater resources at various scales including towns, drainage basins, municipalities, planning districts and watersheds over the years.

The Ground Water and Water Well Act and Well Drilling Regulation require that water well drillers be licensed by the province and that the driller supply the province with a report of all wells drilled. The report should contain information on date and ownership, the well location, a description of the material drilled, and information on well construction and pump testing if completed. This information is stored within a database in the Groundwater Management Section.

A glossary of select terms is provided in Appendix A at the back of this report.

Groundwater Backgrounder

Groundwater is water that fills the pores and fractures in the ground. At some point as water recharges the soil and moves down through the profile all of the pore space will be saturated. The surface where this occurs is called the water table. Not only must sediment or rock be saturated to recover groundwater, it must also be permeable enough to allow the water to move at a reasonable rate. Because these properties are largely controlled by the material the water is moving through the geology of the formations are important in understanding water movement. Additionally the natural water quality which the water acquires depends on the materials it flows through.

Aquifers and Aquitards

A geologic formation from which economically significant quantities of water flows to a spring or can be pumped for domestic, municipal, agricultural or other uses is called an aquifer. From glacial times on (the Quaternary period of geologic time), aquifers are primarily formed within sand or gravel deposits. Within pre-glacial or bedrock formations, aquifers are formed from sandstone, hard fractured shale/siltstone or permeable limestone. Aquifers can be separated vertically by less permeable layers; layers that do not readily allow water flow or act as barriers to flow. These confining layers are called aquitards and are principally formed from glacial till or clay deposits in Quaternary sediments or by unfractured or soft shale, massive or unfractured limestone, or gypsum in bedrock layers.

During recharge rain moves vertically through the soil and shallow geologic horizons until it reaches the water table. The water table can be determined within a shallow dug or drilled hole by allowing the water level to come to a static or resting position. In permeable material the water table forms the top of an unconfined aquifer. In an unconfined aquifer the water table and consequently the amount of water in storage, moves up and down over the seasons or longer climatic periods in response to recharge or discharge from the aquifer.

If an aquifer is situated between aquitards and the water level in a well rises above the base of the upper confining unit the aquifer is called a confined aquifer. In a confined aquifer all of the pore space is filled with water and any addition or reduction of water in storage results in a change of water pressure in the aquifer. When the pressure in the aquifer is above the local ground surface, drilling into this formation will result is a flowing artesian well. Confined aquifers are recharged either at a location at higher elevation where the aquifer is no longer confined or it is recharged very slowly through the layers that confine it.

Groundwater discharge can be dispersed over large areas or focused, such as in springs and commonly discharge areas are topographically controlled. Springs form where the water table intersects the ground surface commonly in depressions or hillsides, including river banks. If a higher permeability layer overlies a lower permeability layer on a hillside or river bank the vertical flow of groundwater may be impeded by a low permeability layer causing the water to move laterally to discharge as a spring. Some springs are formed from flowing artesian aquifers where water moves up along fractures or are man-made resulting from unsealed boreholes or blow-outs at the bottom of excavations. Groundwater may also discharge over larger areas resulting in perennially wet areas, bogs or swamps.

Groundwater Flow

Groundwater moves from higher elevation to lower elevation or from higher pressure to lower pressure. The height of the water table or the pressure in an aquifer is called the hydraulic head. The difference in hydraulic head in an aquifer between two locations is used to determine the hydraulic gradient. The groundwater flow direction is from the higher to lower hydraulic pressure along the maximum slope of the hydraulic gradient. Typically, under ambient conditions, groundwater moves quite slowly. In unconfined aquifers the water table loosely mimics the surface elevation and in areas of low topographic relief the typical hydraulic gradient is in the range of one metre of water head decline per kilometer distance. The ability for a geologic material to move water is called hydraulic conductivity. The amount of groundwater that moves through a geologic material will depend upon both the hydraulic gradient, the hydraulic conductivity and the thickness of the aquifer.

Aquifer Studies and Groundwater Data

Early studies of the aquifers of southern Manitoba included work completed by the Geological Survey of Canada for regional resource mapping (Selwyn, 1890; Johnston, 1934; Charron, 1961) and to identify the salt water-freshwater boundary in bedrock (Charron, 1962). Groundwater resource compilations for portions of the watershed were completed by Charron (1961) for the Fannystelle area (Tps. 1 to 6, Rges. 1 to 5, W1). During this latter study 1710 homes were visited and water sources inventoried.

The province compiled the groundwater resources on a 1:250,000 map scale for the Brandon (62G) map sheet (Sie and Little, 1976) and the Winnipeg (62H) map sheet (Little, 1980). The LaSalle River watershed lies within these two Groundwater Availability Study areas. Additional provincial studies that include portions of the watershed include the Groundwater Resources (Synopsis) in the Portage La Prairie R.M. (1982), Groundwater Resources in the MacDonald – Ritchot Planning District (A Synopsis) (1984) and Aquifer Enhancement Investigations 1980-1986.

The provincial Groundwater Availability Studies include a set of diagrams showing the map sheet location, drift thickness, bedrock topography, surface deposits, a number of cross-sections and a table of selected well water chemistry. The Groundwater Availability series have formed the main regional scale compilation of groundwater data to date. The groundwater synopses consist of a brief description of groundwater resources and include maps.

Groundwater Data and Monitoring

The Groundwater Management Section of Water Stewardship maintains a database of well logs for the province. Based on the current data there are 1139 well and test hole records in the La Salle River Watershed (Figure 1). Almost half (523) of the logs are from test wells. Of the total number of logs, 166 record the end of hole in bedrock with the remaining holes were finished in overburden. Of the drillers logs more than 500 wells were reportedly completed in sand and gravel or silt and approximately 100 wells were completed in bedrock.

The Groundwater Management Section drilling and monitoring well installations began in 1963 and currently 18 active monitoring stations and one rain gauge are operated within the watershed (Figure 2). The province has an additional 38 wells within 10 km of the watershed boundary. Provincial monitoring wells have been installed in response to obtaining groundwater information on a regional basis and to monitor specific projects (i.e. construction of the floodway or identification of town water supplies) resulting in variable periods of record as wells are established and others are inactivated in response to groundwater information needs. Town supply exploration and monitoring programs were carried out in the 1960’s (Elie) 1970’s (Oakville, Elm Creek) and monitoring in the Almasippi sand was added in the 1990’s. In total the Groundwater Management Section has drilled or monitored a total of 150 sites, of which 115 were test holes and 35 have some amount of monitoring information.

The province also stores groundwater chemistry information from provincial monitoring wells, private wells sampled during various groundwater projects and results that are supplied to the province from drillers or other sources. The chemistry from the provincial monitoring wells is available to the public.

Bedrock Aquifers

Bedrock aquifers are present beneath the entire watershed. In succession overlying the pre-Cambrian basement are the sandstone aquifer within the Winnipeg Formation, limestone and dolostone aquifers of the Red River (subcrops only on the extreme eastern portion of the watershed), Stony Mountain, Stonewall, and Interlake (Ordovician and Silurian age). Above these lie Devonian through Jurassic age carbonates which contain interbedded shale and gypsum on the western side of the watershed. The Swan River Sandstone aquifer of Cretaceous age is only present on the extreme western portion of the watershed. None of the bedrock aquifers are considered potable water supplies and therefore few wells have been drilled into these aquifers.

Within the carbonate aquifers that underlie the watershed primary porosity will be quite low and generally not well interconnected and groundwater flow is primarily through bedding planes and secondary features that developed after the rock was deposited. These features include joints, fractures and solution channels which enhance permeability. Because of these features well yields can be quite variable depending on the permeable features and density of the features intersected within each drill hole. Well yields that have been reported in driller's logs vary from less than 0.1 L/s to greater than 18 L/s, with an average of 2.5 L/s.

Saline and brackish water is found within the bedrock aquifers of this area. The salinity is associated with long flow systems and increases towards the southwest, the origin of the saline water. The transition between salt and 'fresh' water occurs relatively abruptly, roughly at the location of the Red River on the east and a slightly more gradual transition to fresh-water north of the Assiniboine River.

This transition results from fresh (meteoric) water recharge in the Interlake area, southeast of Winnipeg, on the aquifers most easterly extent and in local areas where glacial outwash sand and gravel are hydraulically connected to the underlying carbonate aquifer. In areas where thick clay layers overly aquifers such as throughout much of the Red River Valley there is not expected to be any measurable local recharge to bedrock aquifers.

The total dissolved solids (TDS) of the carbonate aquifer groundwater ranges between 5,000 and 10,000 mg/L. The dissolved constituents are primarily composed of sodium (Na) and chloride (Cl) with lesser amounts of calcium (Ca) and sulphate (SO_4). Calcium and magnesium although not dominating the chemistry are of high enough concentration to make the water very hard. Dissolved iron (Fe) and fluoride (F) can also be high.

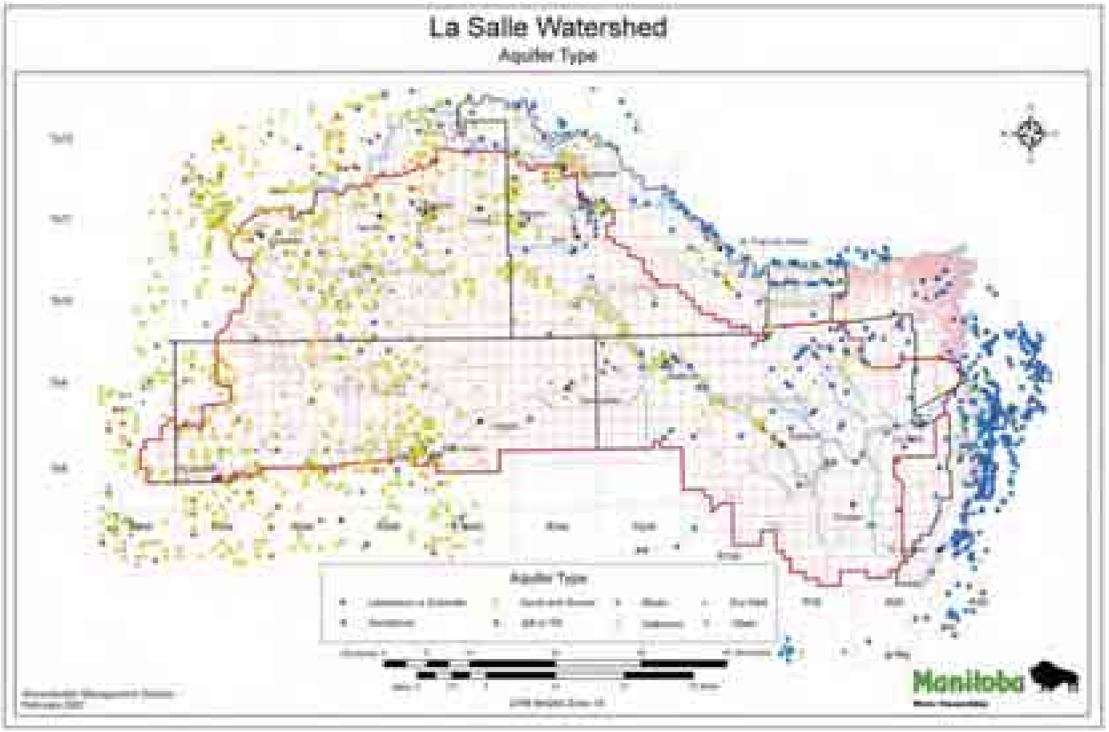

Figure 1. Location of well logs within the Provincial well database coded by aquifer material that the well is completed. Wells are displayed in the centre of the quarter-section in which they are drilled unless more accurate information is available. Multiple wells may be stacked at any one location.

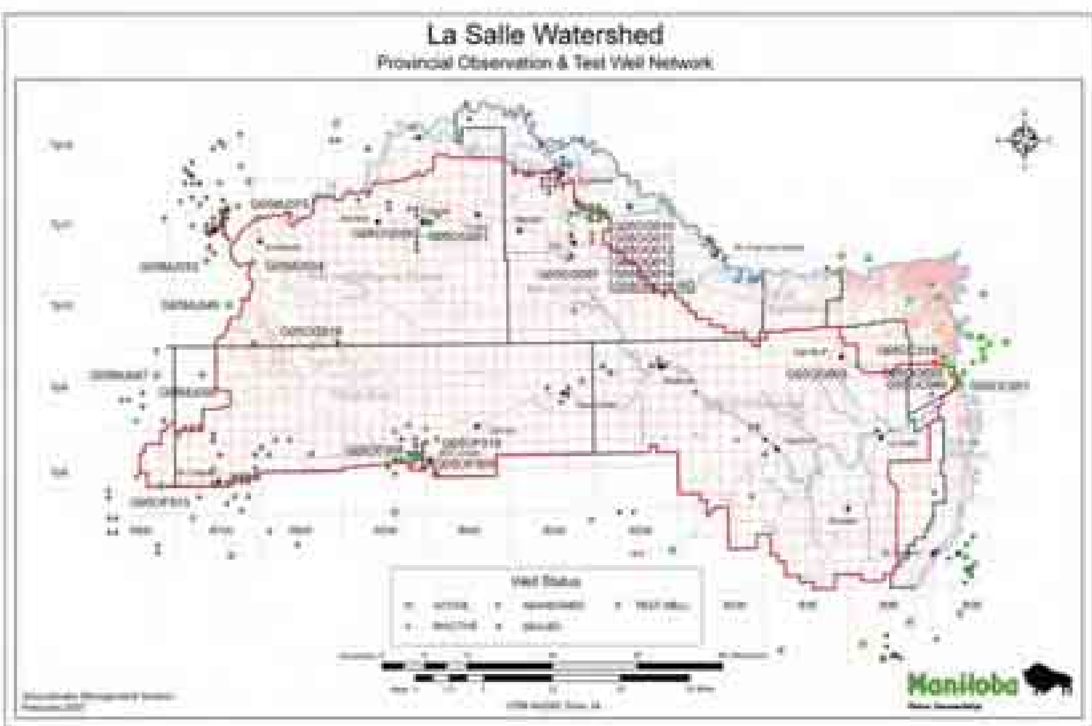

Figure 2. Location of Groundwater Management drilling activity including status with active observation wells labeled. Active stations are currently collecting data; inactive stations have collected observations during some period in the past; sealed wells are wells that have recently been sealed with an available well sealing log; method of abandonment is not available for abandoned holes but common practices at the time of abandonment most likely would have been used.

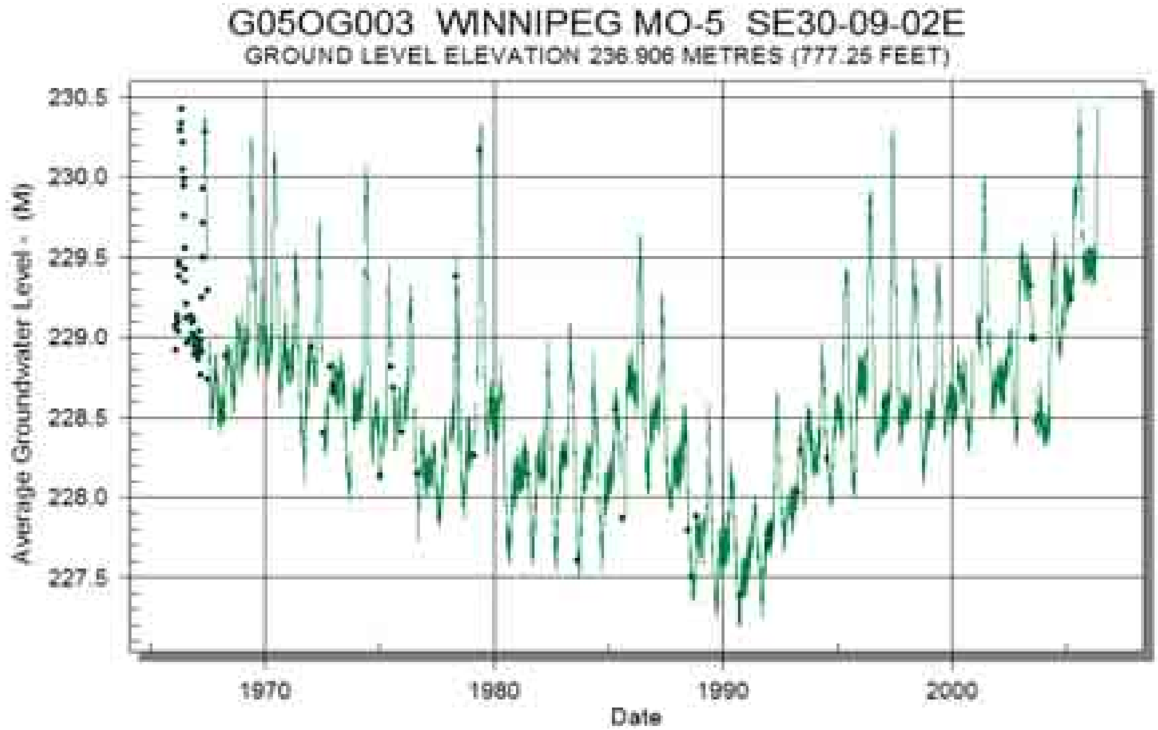

Figure 3 Groundwater elevations are monitored continuously such as at station G05OG003, which started monitoring in 1966 and has the longest continuous record in the watershed. This well is 44.5 meters deep and is completed as an open hole within the carbonate rock. See Figure 2 for location.

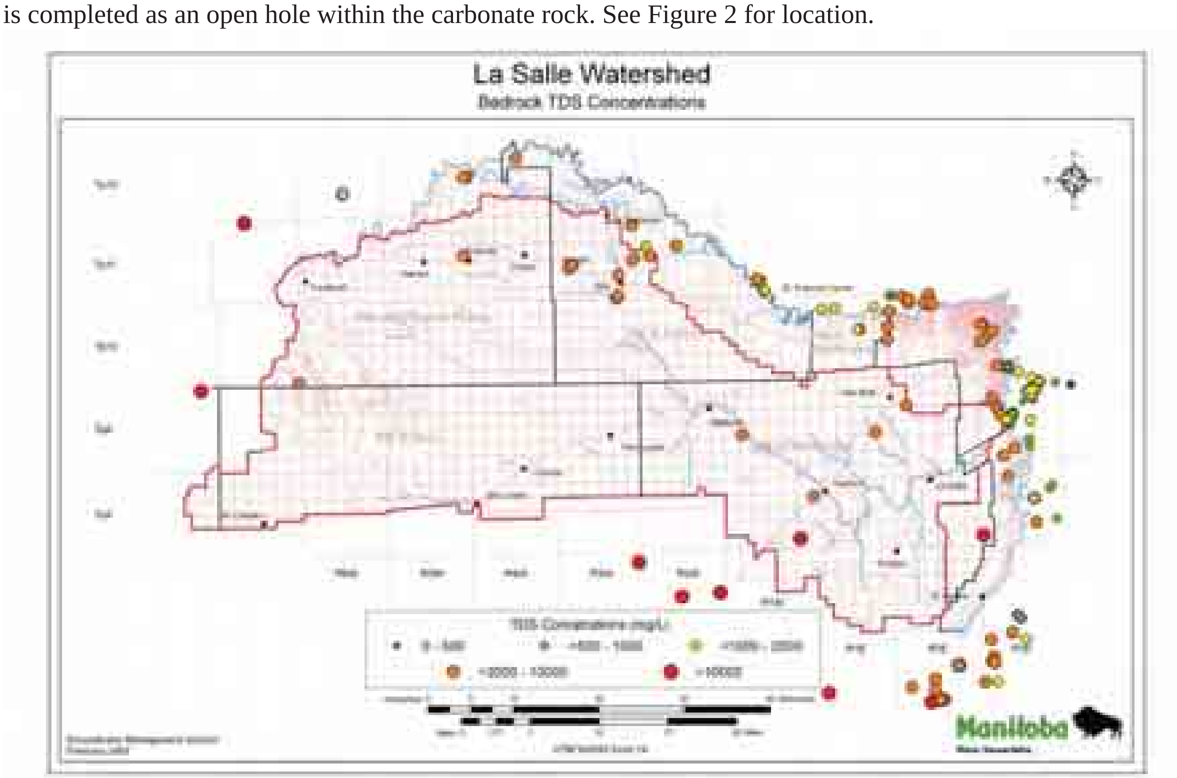

Figure 4. Display of total dissolved solids (TDS) in groundwater from bedrock wells within and including a 10 Km buffer around the watershed. Few samples are available from within the watershed. The fresher water is evident east of the Red River on this diagram. Lower TDS north of Elie results from recharge to the carbonate through the outwash gravel deposits of the Elie pit.

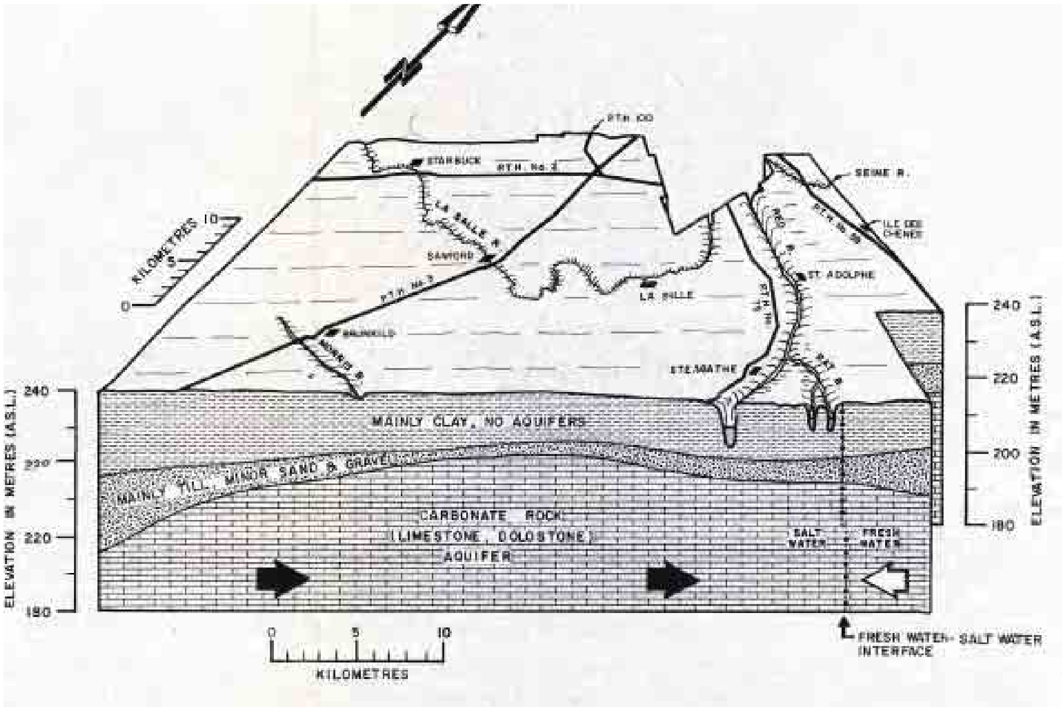

Figure 5. . Block Diagram showing an east-west geologic profile south of Brunkild (from Rutulis, 1984). Direction of saline water flow is designated by the black arrow and fresh water from the east by the white arrow. The depth to bedrock increases from the high point in the centre of the diagram towards the west.

Quaternary Aquifers

Within glacial and recent sediments aquifers are formed as sand and gravel within or at the base of glacial till, glacial outwash or alluvial sand deposited from modern or ancestral rivers or within a distal deltaic environment. Each of these aquifer types was deposited within a different geologic setting, each resulting in differences in characteristics such as aquifer extent, depth to water-bearing layers (Figure 6) and aquifer thickness (Figure 7); all of which have an influence on water availability, quantity and quality.

Glacio-Fluvial Sand Aquifers

Aquifers within the Almasippi sand are located on the western portion of the watershed (Figure 1) below the escarpment and above the glacial Lake Agassiz Burnside beach strandline. The Burnside strandline is located on the western side of Elm Creek and extends towards Southport. Along its reach the strandline largely separates the lacustrine clay to the east from the surficial fine Almasippi sand to the west. The Almasippi sands are shallow (Figure 6) and are variable in thickness ranging from a few metres up to eight or more metres (Figure 7). The texture consists of fine to medium grained sand with silty and or clayey stratification. The sand rests directly upon laminated lacustrine clay and silt.

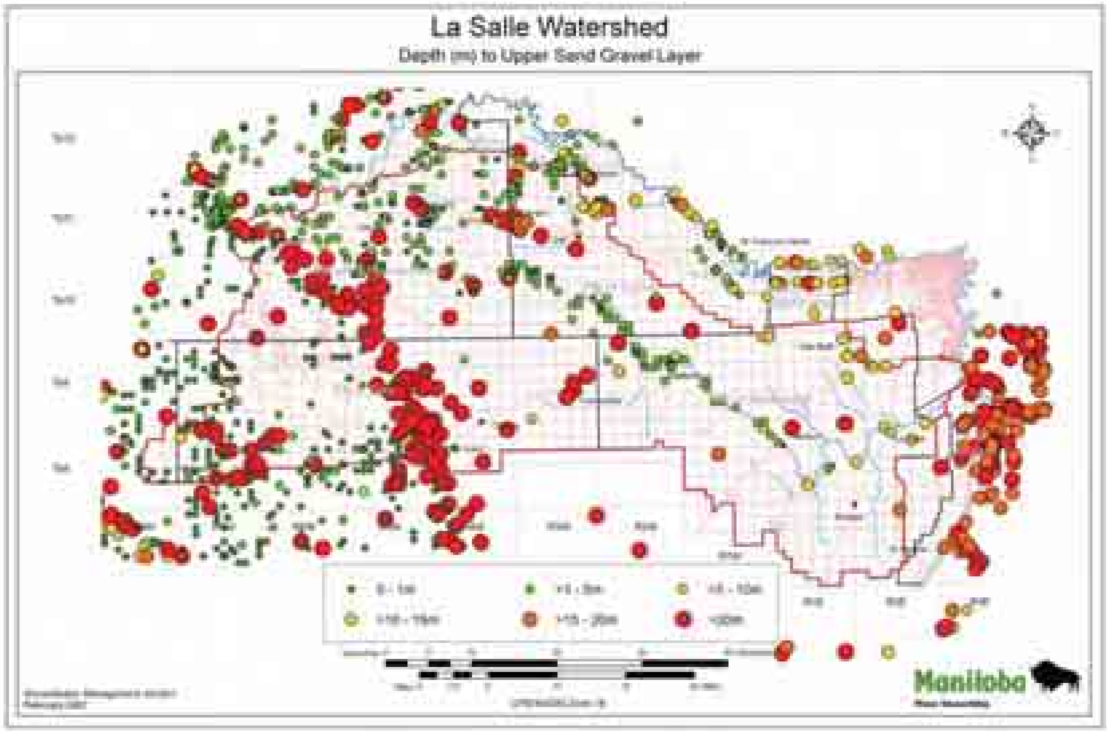

Figure 6. Diagram showing depth (m) to uppermost sand or gravel layer reported from all well logs. Almasippi sands, west of line joining Elm Creek with Southport, are at or near the ground surface. In the Oakville area sand is commonly within a couple of metres below ground, as it is in alluvial aquifers adjacent to the La Salle River. Deeper sand and gravel is encountered along the border between the Almasippi sand and lacustrine lake clay to the east. A few deeper sand/gravel layers are also scattered throughout the watershed and occur in areas of the Almasippi where shallow sand was not encountered.

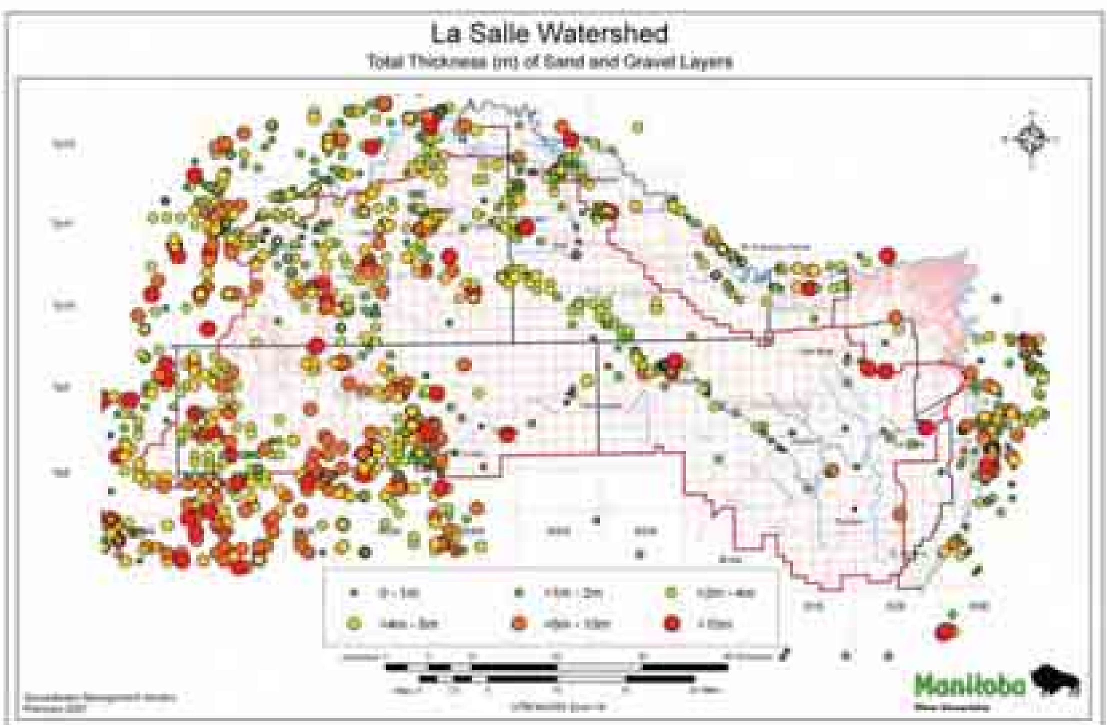

Figure 7. Diagram showing the total thickness of sand and gravel layers reported in any well log. Most aquifers adjacent to rivers (i.e. La Salle) or in paleo channels in the Oakville area are quite thin. Deep sand and gravel (compare to previous figure) are also commonly thin. In the Almasippi sand area the total thickness of sand and gravel is quite variable.

The groundwater within the Almasippi sand is exploited by both drilled and wide diameter bored / dug wells. Low yielding bored wells are commonly deepened below the water producing zone to provide additional storage in areas with low water supplies. Water levels vary throughout the year and can be near surface immediately after spring recharge and recede over the growing season and winter. Recharge of the unconfined aquifer is solely from local precipitation. Snow melt will contribute the largest proportion of recharge, however, rain events greater than the available water holding capacity of the soil will also result in recharge events. A typical hydrograph of groundwater levels is shown in Figure 8.

The regional groundwater flow direction in the Almasippi sand aquifer is predominantly from the west towards the east. The water levels will reflect the overall ground elevation on a regional scale. Minor topography changes and variability sediment such as increase in silt or clay content will affect the local flow direction. The regional gradient is in the range of approximately one to two metres per kilometer and transport rates are expected to be quite slow, in the order of a few metres per year. The regional water level in sand and gravel aquifers is illustrated in Figure 9.

Well yields are variable, but generally water supplies sufficient for domestic and livestock needs are obtained. Charron (1964) reports that, contrary to belief, few wells in this aquifer reportedly went dry during the 1930's drought. Test drilling may be beneficial to determine optimum well location because of the variability in sand thickness and uniformity.

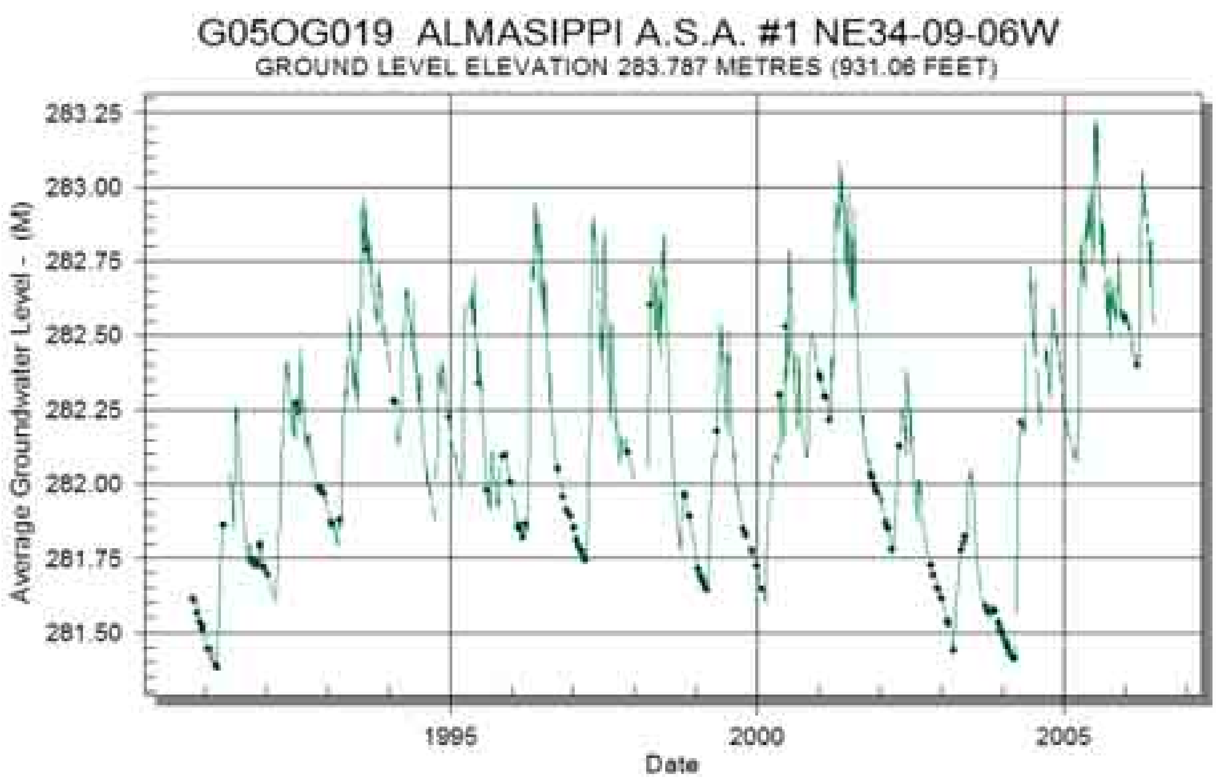

Figure 8. Hydrograph for site G05MJ019 monitoring water levels in the Almasippi sand shows water level spikes in response to spring recharge and recession through the fall and winter. The groundwater elevation is within a metre of the ground surface 283.79 metres above sea level after spring recharge in more than half the years of the monitoring record. See Figure 2 for location of well.

Based on well survey information, it is not uncommon for more than one well to be used to supply a farmstead. In this type of setting wells 'going dry' may be more indicative of the aquifer inability to transport groundwater quickly or extent of the contributing sand than overall groundwater quantity.

Natural water quality is quite good with total dissolved solids in the 300 to 700 mg/L range. The water is relatively hard, 150 to 600 mg/L as $CaCO_3$, with most solutes comprised of calcium (Ca), magnesium (Mg), and bicarbonate (HCO_3). Chloride (Cl), sodium (Na) and sulfate (SO_4) are naturally quite low; generally less than 10, 15 and 30 mg/L, respectively. Because the sand commonly extends to the ground surface or has only a relatively thin cover of silt or finer material within the soil zone the risk of groundwater contamination is relatively high. There are few lab results with comprehensive analyses of drinking water quality parameters. Within the Groundwater Management Section database there are less than half a dozen coliform bacteria results and only a few more nitrate analyses. Although none of the nitrate analysis within the database are greater than the drinking water health-based guideline of 10 mg/L-N; there is measurable nitrate and coliform indicating the vulnerability of this type of aquifer and the wells commonly used to access the water within it. Well siting, maintenance and activities near the well area are important factors in obtaining and sustaining healthy water supplies.

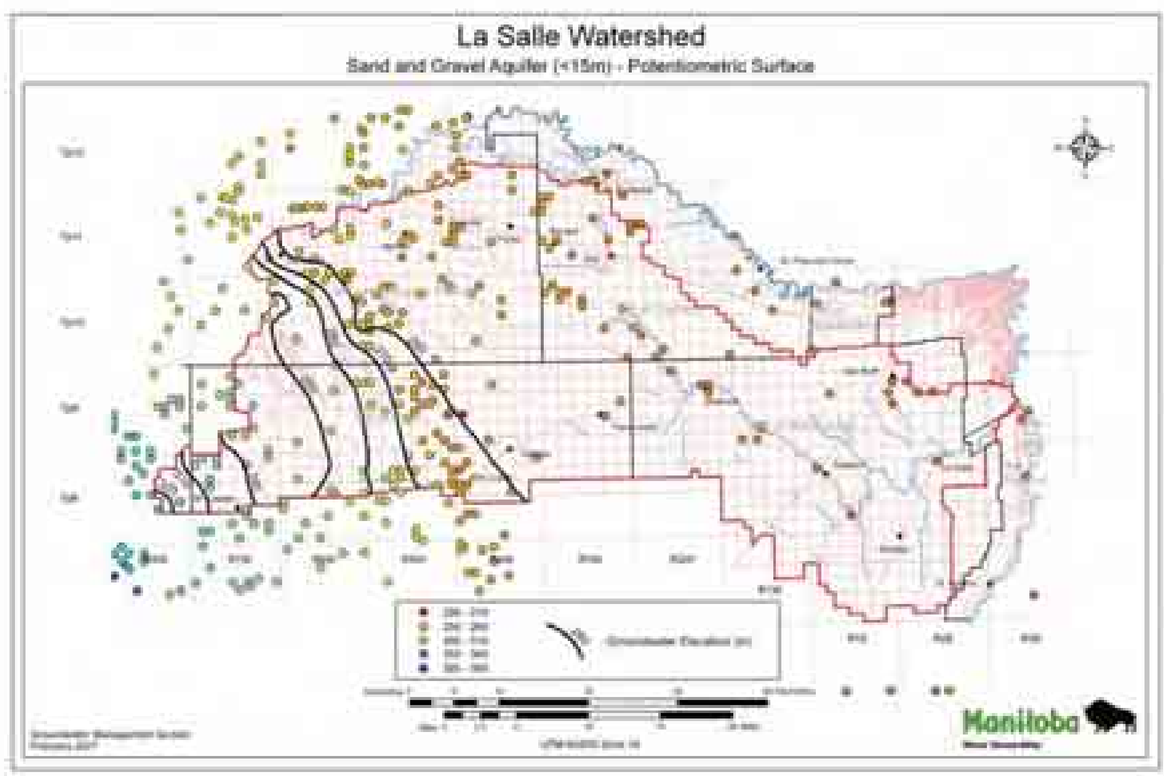

Figure 9. Contour diagram of water level elevations using information from the shallow wells completed in the Almasippi sand area. Contour intervals are 10 meters and show regional groundwater flow from the west to east-northeast.

Paleo-Channel and alluvial aquifers

Alluvial aquifers are found near modern streams and rivers, such as the La Salle and within the flood plain of the ancestral Assiniboine River. These aquifers were formed from sand and silt deposited on the banks and within the channel and because of the modes of deposition individual aquifers have a very limited aerial extent.

Paleo-channel aquifers were formed during the Holocene (post-glacial) by streams on the clay plain distributing the flow from the Assiniboine River as it came down the eastern edge of the escarpment. Channel aquifers are recognized visually as narrow slightly depressed meandering features on the ground surface. The channel widths range from less than 100 to several hundred metres and individual lengths can be traced for kilometers. The channels are in-filled with sand, silt and clay material and aquifers are discontinuous along the length of any one channel. These depressed areas collect run-off from the surrounding clay plain and may seasonally form intermittent water courses. Channel aquifers are present in the upper La Salle sub district, especially in the Oakville area. All of these aquifers are located near the surface and may have a meter or two of clay or silty-clay at the surface overlaying the sand.

In the Oakville area the channel aquifer had an influence on the settlement and placement of the homestead. Most farmyards in this area are located on a portion of a channel aquifer. The town of Oakville is built over a paleo-channel aquifer and previously exploited this water source for the town supply with wells located in the channel immediately south of town. The loading station south-west of town is also completed into the same channel.

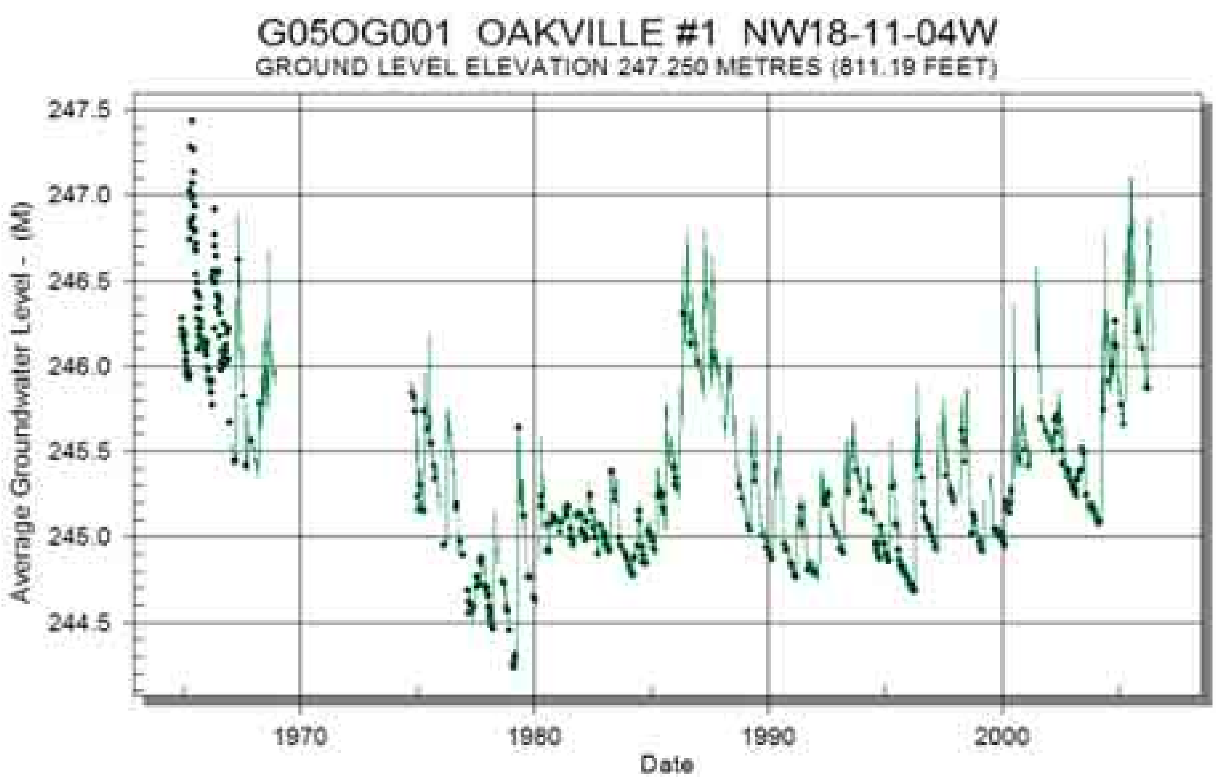

Figure 10. Hydrograph of groundwater elevations for a channel aquifer in the Oakville area is shown. The base of the aquifer this monitoring is installed is 240.85metres. See Figure 2 for location of site

Groundwater flow is dictated by the geometry of each aquifer and is restricted to within the channel outline. Channel aquifers are recharged directly from runoff within the channel depression and from surrounding land and respond quickly to recharge events.

Alluvial aquifers are stratified sediments deposited within the inner bank of stream meanders. As a stream meander length increases a greater amount of sediment is deposited on the inner portion of the meander bend. As the meander grows the extent of sand and silt deposition grows leading to the tendency of having larger water supplies and greater sand thickness within larger meanders.

Lithology of these aquifers typically consists of sand and silts. These may be separated vertically or cut-off horizontally from other permeable layers by clay. Commonly sand deposits are covered by finer textured sediments. In the upper La Salle sub-district there are few alluvial aquifers formed along the southward flowing portion of the La Salle River near Elie. The number of wells (Figure 1) increases as the river turns southeast following the ancestral Assiniboine River channel.

Wide diameter bored and dug wells are more commonly used in these aquifers than drilled wells. The advantage of wide diameter wells is they provide a reservoir in low yielding sediments. Well yields will be highly variable and because of the lack of continuity of aquifers a larger proportion of dry wells are expected during groundwater exploration.

Water quality in the alluvial aquifers ranges from good to fair. Total dissolved solids range from approximately 300 to 1400 mg/L with most solutes consisting of calcium, magnesium and bicarbonate. Hardness as $CaCO_3$ ranges from less than 100 mg/L to more than 1000 mg/L. Natural water chemistry consist of chloride ranging from less than 10 to 100 mg/L, sulphate ranging from less than 10 to greater than 500 mg/L and sodium concentrations from less than 10 to more than 100 mg/L. Alluvial aquifers located within the meanders of modern rivers may hydraulically connect the well to the steam. If this is the case water supplies may be more certain, however water quality may be a greater concern because of the influence of surface water.

Glacial Outwash Sand and Gravel aquifers

Glacial outwash deposits result from direct melting of glaciers which deposit stratified sediment forming elongate sand and gravel deposits. The Elie pit located approximately four kilometers northeast of Elie is the only example of this type of aquifer within the watershed. Even though the surface exposure of this aquifer is quite small, less than a quarter section, locally it was an important water source providing the supply to the town of Elie and surrounding users. The aquifer had been exploited as a potable water source prior to the initial investigations which started in 1964 to delineate the aquifer and determine if it could meet the requirements of the town of Elie. The town supply well was completed in 1968.

The aquifer itself consists of stratified sand, gravel, silt, and clay deposit overlaying a thin till layer or at the southern portion of the aquifer lying directly on carbonate bedrock. The depth to bedrock varies from approximately 16 to 25 metres below ground.

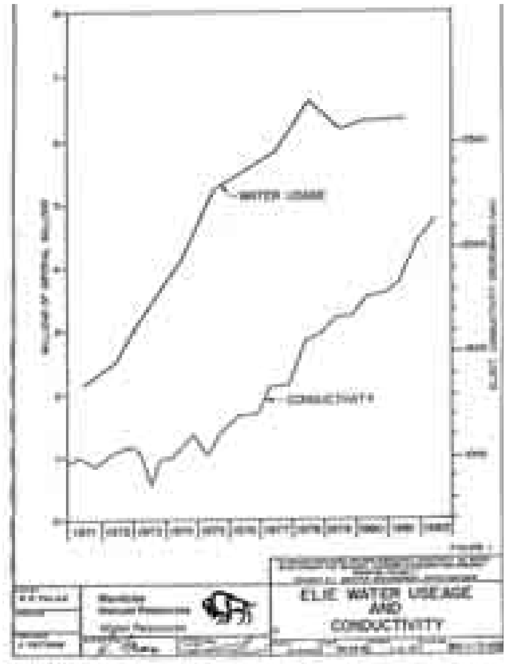

Figure 11. Graph of water usage and groundwater conductivity from the Elie town well. An increase in electrical conductivity indicates a greater salt load and influx of deeper saline water into the aquifer with pumping. Diagram from Petsnik, 1986.

Water quality in the Elie aquifer is generally quite good. Total dissolved solids ranges from 200 mg/L to approximately 500 mg/L from the sand and gravel as compared to approximately 3,000 mg/L in the underlying carbonate aquifer. The TDS of the upper portion of the carbonate aquifer immediately below the Elie aquifer is better quality than surrounding bedrock water because of the local recharge of meteoric water through the outwash sand and gravel. During the 1970’s water quality as determined by water electrical conductivity, a measurement of salinity deteriorated in conjunction with increasing water usage. Increased pumping in excess of natural recharge from the sand and gravel was associated with an upwelling and mixing with more saline water from the bedrock (Figure 11).

Recharge to this aquifer is directly from precipitation to the open workings of the gravel pit and also through the soil cover overlying the sand and gravel where the gravel is not exposed. During the early to mid 1980’s the Elie aquifer was studied because it was the only potable groundwater source in this area and to determine if enhanced artificial recharge could offset the water quality deterioration. The artificial recharge enhancement project (Petsnik, 1986) was planned to divert water from the La Salle River through surface drains to recharge the aquifer where it is exposed within the gravel pit. Because the water quality from the La Salle could not be assured to meet drinking water quality the feasibility study was abandoned.

Confined Sand and Gravel Aquifers

Confined sand and gravel aquifers are found as layers, or lenses within or underlying the glacial till. A scattering of test holes and wells have reported confined sand and gravel aquifers spread throughout the watershed however water quality is quite poor in most of these aquifers and is only acceptable quality for potable or livestock water needs in a narrow band running between the towns of Elm Creek and Southport.

The depth to sand and gravel aquifers is typically greater than 20 metres and aquifer thicknesses have been reported to range from less than one to 10 or more metres. Where the aquifers are separated from the surface or shallower sand and gravel aquifers the amount of recharge will be limited and even though the well yields can be large, ranging from less than 0.1 to greater than 10 L/s, the average being approximately 1.5 L/s, significant drawdown in production wells is expected. The specific capacity, a measure of the productivity of the well, ranges from less than one to more than 100 m^3 of water per day per metre drawdown in the well. Non-pumping water levels are in the range of six to 15 metres below ground.

Water quality is also highly variable ranging from relatively satisfactory to not being recommended as a potable source because of excessive hardness and total dissolved solids. Measured TDS is in the range of 500 to 5000 mg/L and hardness expressed as CaCO3 ranges from 300 to almost 2,000 mg/L. Chloride and sodium each range from 100 to 1000 mg/L and sulphate ranges from less than 100 to 2,000 mg/L. Most chemistry results are above the aesthetic objectives for drinking water for these major constituents.

Water Supply

East of a line from Elm Creek to Southport potable groundwater is limited to channel and alluvial deposits of limited extent. West of this line groundwater is generally easily accessed but well yields will generally be relatively low but sufficient in most areas for farm supplies. Charron (1964) reported that in spite of many potable wells being constructed into shallow sand aquifers that these aquifers were quite resistant to drought and with few exceptions continued to supply water during the drought of 1930’s. Water is available in some areas from deeper confined aquifers. These have primarily been discovered along the Elm Creek to Southport line at depths below 20 metres and scattered throughout the area east of this line at somewhat shallower depths. The confined aquifers east of this line are not sought after for potable supplies because of poor quality.

Groundwater Use

Driller logs specify the intended water use for new production wells. Well use can be recorded as single or multiple uses. Within the La Salle watershed the following water uses are recorded: 317 domestic, 67 livestock, 183 combined domestic and livestock, 31 municipal, 9 industrial, 2 combined air conditioning / heating and domestic 5 air conditioning / heating, and 3 wells completed for other use. Domestic and combined domestic and livestock use is the most frequent well use.

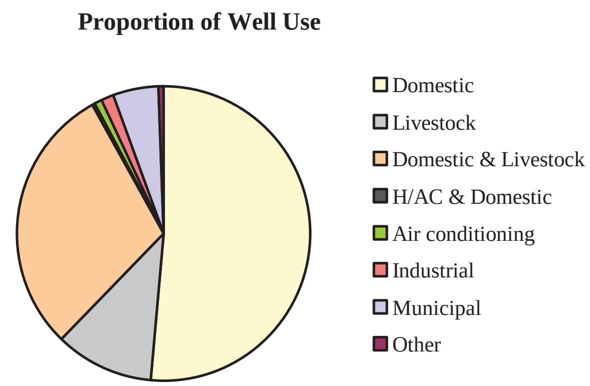

Figure 12. Proportion of well use within the watershed: the largest number of wells are used as domestic supplies, the second most common use is combined domestic and livestock.

Private Well Water Quality

There is little information with the Groundwater Management Section for routine water quality from domestic wells within the water shed. Water quality surveys were conducted by the Geological Survey of Canada during their regional well survey in the early 1960’s and domestic wells were sampled as part of the Rural Groundwater Quality Initiative by the province in 1999-2000.

Where information is available for nitrate, well completion and lithology, the evidence shows that the depth to the uppermost sand and gravel and the depth below ground of the well screen or perforations are important factors on nitrate concentrations in the well water. Where the depth to the uppermost sand in a well it is greater than about three metres and the depth to the perforations is at least 6 metres there is a reduced risk of measuring nitrate above the drinking water guideline value of 10 mg/L of nitrate as Nitrogen. However nitrate can still be detected in wells that are deeper, even wells more than 40 metres deep have had measurable nitrate.

Total coliform bacteria are commonly detected in private well water. The presence of coliform bacteria is an indicator that the factors may exist where there are pathways for well water to be contaminated with water from the ground surface or from near surface. Well owners that have had positive coliform results need to assess their well for security and maintenance. Fact sheets are available from the province to help in sampling and interpreting the results of tests.

Water quality deteriorates with the proximity of sand and gravel aquifers to the bedrock. Most shallow aquifers have better natural water quality whereas deeper aquifers have higher TDS, however shallower wells are more prone to contamination.

Availability of Data and Information Gaps

Well log and groundwater information is stored by the Groundwater Management Section. Results from past well surveys indicate that only about half of the wells in service are recorded and the accuracy of the location of the majority of wells is to the quarter section on which it is drilled. Wells are often located in areas of convenience, in the same general areas as potential contamination sources and neglected, abandoned or unused wells can act as a direct conduit from the surface to aquifers. Abandoned, unsealed wells located these areas should be sealed to lessen the potential spread of contaminants to an aquifer. The knowledge of accurate well location is an important step in identifying sites for future well sealing. The province does not have access to well surveys conducted by other organizations; additional information on wells and locations would be beneficial in managing the provinces groundwater resources.

Groundwater forms the baseflow to streams. When run off from the land surface ceases the water sustaining the flow the streams comes from groundwater. There is little knowledge of the contribution of groundwater to streams. It is expected that within the clay plain shallow water contribution to streams and rivers would largely be restricted to alluvial sediments near the rivers (release from bank storage). Streams and drains originate on the eastern limit of the Almasippi sand and the Burnside beach; the contribution of groundwater to these surface water features is not quantified.

Issues, Concerns and Recommendations

- There are limited potable groundwater resources within the watershed. Much of the groundwater is present in aquifers that potentially are vulnerable to water quality degradation.
- Thin aquifers and aquifers of limited extent will be more prone to droughts.
- High use groundwater withdrawals require assessment on an individual project basis.
- Groundwater level monitoring by the province will continue as required.
- In cooperation with CD a well inventory should be completed along with general field chemistry assessment – include: well inventory, GPS coordinates, construction with rudimentary water quality, and comprehensive chemistry on select wells.
- Groundwater Management Section is committed to completing new set of groundwater map compilation based on the watershed scale. These will be produced in a digital format

Vulnerable Groundwater Areas / Well-head Protection

Previous well surveys by Manitoba and other provinces show that well location, construction and maintenance are important factors in man-made water quality problems. Because much of the potable water in the watershed is accessed by shallow wide diameter wells water quality problems can be expected to occur. The watershed authority should encourage owners of private wells to self-assess or have their well assessed for physical conditions that may affect water quality. Water testing should be encouraged for all drinking water sources on a regular basis.

Community or municipal wells require well specific assessment to determine the vulnerability in the development of well head protection policies. As a minimum the individual characteristics of each well, aquifer and geology should be considered to assess vulnerability.

References

Betcher, B., Grove, G., and C. Pupp., 1995. Groundwater in Manitoba: Hydrogeology, Quality Concerns, Management. National Hydrology Research Institute report CS-93017. 47pp.

Charron J.E., 1961. Groundwater Resources of Fannystelle Area, Manitoba (Tps. 1 to 6, Rges. 1 to 5, W. Prin. Mer.) Geological Survey of Canada Bulletin 98

Charron, J.E., 1962. Fresh-Water and Salt-Water Boundary in the Groundwater of South-Central Manitoba. Geological Survey of Canada Department of Mines and Technical Surveys, Ottawa. Paper 62-11

Johnson, W.A., 1934. Surface Deposits and Ground-water Supply of Winnipeg Map-area, Manitoba. Canada Department of Mines, Bureau of Economic Geology, Geological Survey, Ottawa. Memoir 174

Little, J., 1980. Groundwater Availability Series Brandon Area (62-H), Province of Manitoba

Petsnik, J., 1986. Aquifer Enhancement Investigations, 1980 – 1986. Manitoba Natural Resources. 26 pp. figures.

Rutulis, M., 1984. Groundwater Resources in the MacDonald – Ritchot Planning District (A Synopsis). Hydrogeology Section Hydrotechnical Services.

Sei, D., and J. Little, 1976. Groundwater Availability Series Winnipeg Area (62-G), Province of Manitoba

Sewyn, 1890, referenced within W.O Karvinen and M. L. McAllister, 1994. Rising to the Surface: Emerging Groundwater Policy Trends in Canada. Queen’s University 143 pp.

Appendix A

Definition of Terms

Definitions

Alluvial	Sediment deposited by running water.
Aquifer	A porous and permeable geologic formation that is saturated and capable of producing useful quantities of water to wells or springs.
Aquifer, confined	An aquifer that is overlain by a layer of material with considerably lower permeability. The water within the aquifer is under pressure so that it rises above the top of the aquifer material in a well drilled into the aquifer; synonym: artesian.
Aquifer, unconfined	An aquifer where the water table forms the upper boundary.
Aquitard	A saturated low permeability unit that does not yield water readily.
Hardness	A property of water that reduces the effectiveness of soap. It is primarily caused by calcium and magnesium ions; expressed in ppm (parts per million) CaCO3, or as gpg (grains per gallon U.S.) where one gpg equals 17.1 ppm.
Hydraulic conductivity	The rate that water moves through water is able to move through a permeable material.
Hydraulic gradient	The change in hydraulic head over a given distance in a direction which produces the maximum rate of decrease of hydraulic head.
Hydraulic head	The total water pressure, generally expressed as elevation.
Lacustrine sediment	Sediment deposited within lakes.
mg/L	milligrams per litre; a common unit of measure for solutes in most groundwater, it is equivalent to a part-per-million.
Outwash	Stratified sand and gravel washed out from a glacier by meltwater streams and deposited in front of an active glacier.
Overburden	Unconsolidated material overlying bedrock. In Manitoba overburden is derived during glaciation or more recent time.
Permeability	The property or capacity of a porous rock, sediment or soil to transmit water, it is a measure of ease that water will flow.
Quaternary	The period of geologic time most noted for glaciation beginning between 2 and 3 million years ago and extending to the present.

Specific capacity	It is an expression of the productivity of a well obtained by dividing the rate of discharge of a well per unit of drawdown during pumping.
Total Dissolved Solid	(TDS) a measure of the concentration of dissolved minerals in water expressed in mg/L or ppm.
Water table	The surface where all the pore space is filled with water and can be observed by measuring the water level in shallow wells installed into the zone of saturation.
Well yield	The volume of water discharged from a well, frequently determined during short-term pump tests immediately after drilling the well.

Section 5.0 – Water Resources

Section 5.3 - Surface Water Quality of the La Salle River (Source: Manitoba Water Stewardship)

The La Salle River Watershed from a Water Quality Perspective.

A number of reports/studies have been conducted over the last 25 years examining the surface water quality within the La Salle River watershed. These can be summarized as follows:

- A CONDUCTIVITY STUDY ON THE LA SALLE RIVER, 1980-81. Williamson D. A. Winnipeg: Department of Environment. 1982
- A PRELIMINARY INVESTIGATIONINTO THE PRESENCE OF AGRICULTURAL PESTICIDES IN THE LA SALLE AND ASSINIBOINE RIVERS, MANITOBA, CANADA. Williamson, D. A. Winnipeg, Manitoba Environment. 1984
- CONTAMINATION BY PESTICIDES OF THE LA SALLE AND ASSINIBOINE RIVERS, MANITOBA, CANADA Therrien-Richards, S and D. A. Williamson. Ottawa, Environment Canada and Manitoba Environment and Workplace Safety and Health. 1987.
- AN ASSESSMENT OF PESTICIDE RESIDUES IN SURFACE WATERS OF MANITOBA, CANADA. Curry R. S. and D. A. Williamson. Winnipeg, Manitoba Environment. 1995.
- A POST-HOC ASSESSMENT OF THE ASSINIBOINE-LA SALLE RIVER DIVERSION PROJECT. Lowman, Lisa. Winnipeg. Man. University of Manitoba. 2001
- LONG – TERM TRENDS IN TOTAL NITROGEN AND TOTAL PHOSPHORUS CONCENTRATIONS IN MANITOBA STREAMS. Jones G and N. Armstrong Winnipeg, Manitoba Conservation. 2001.
- A PRELIMINARY ESTIMATE OF TOTAL NITROGEN AND TOTAL PHOSPHORUS LOADING TO STREAMS IN MANITOBA, CANADA. Bourne A., N. Armstrong, and G. Jones. Winnipeg, Manitoba Conservation. 2002.

The Water Quality Management Section maintains a province-wide monitoring program that provides information on long term trends in surface water quality. There is currently one long-term monitoring station within the La Salle River watershed as well as other monitoring stations established for short term projects (Table 1).

Table 1: Water quality monitoring stations within the watershed area.

EMS Station Number	Location for La Salle River Stations	Period	Frequency

Long Term Water Quality Stations			
MB05OCS026	Upstream of Hwy 75 Bridge	Apr-Nov 1973-77 July-Oct 1988 Jan-Oct-1989-94 Jan-Oct 1995 Jan-Oct 1996 Jan-Oct 1997 Jan-Oct 1998 Apr-Sept 1999	3-4 samples/yr 2 samples/yr 4 samples/yr 12 samples/yr 17 samples/yr 8 samples/yr 11 samples/yr 3 samples/yr
MB05OGS039	Downstream of LaBarriere Dam	Aug-Dec 1984 Jan-June 1985 Jan-Oct 2000-05	6 samples/yr 7 samples/yr 4 samples/yr

The long term monitoring station (MB05OCS026) is located close to the La Salle River outlet to the Red River in Saint Norbert (Figure 1). This site was located as far as possible downstream to capture the cumulative upstream inputs affecting water quality within the watershed. The location was moved slightly upstream to the LaBarriere Dam (MB05OGS039) in 2000 because of backwater impacts at the original site during high flows on the Red River. Water samples are collected and analysed for a wide range of variables at the long-term monitoring station and the water quality status is summarized with the Water Quality Index.

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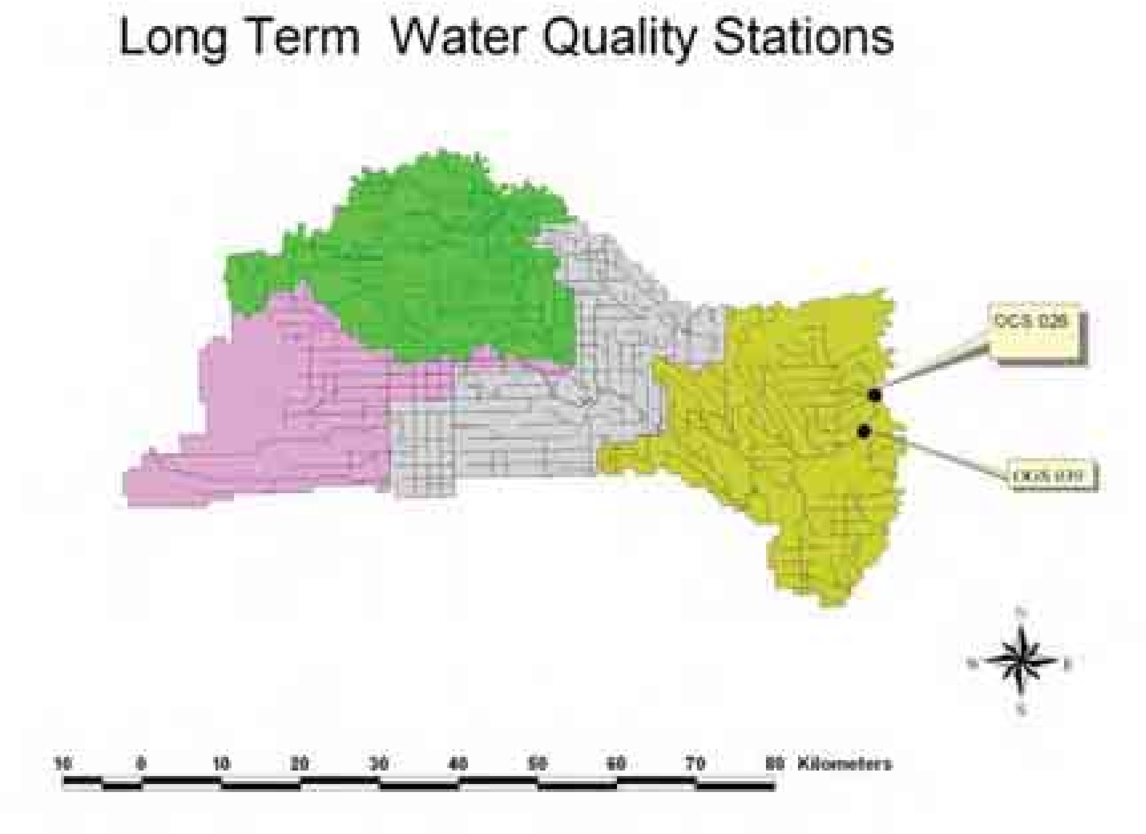
Figure 1: Location of long term monitoring stations in the La Salle River Watershed.-



The Canadian Council of Ministers of the Environment (CCME) Water Quality Index is used to summarize large amounts of water quality data into simple terms (e.g., good) for reporting in a consistent manner. Twenty-five variables are included in the Water Quality Index (Table 2) and are compared with water quality objectives and guidelines contained in the Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson 2002 and Table 2).

Table 2. Water quality variables and objectives or guidelines (Williamson 2000, Williamson 1988) used to calculate Water Quality Index (CCME 2000).

Variables	Units	Objective Value	Objective Use
Fecal Coliform MF	**Bacteria/100mL**	**200**	**Recreation**
Ph	**Ph Units**	**6.5-9.0**	**Aquatic Life**
Specific Conductivity	**uS/cm**	**1000**	**Greenhouse Irrigation**
Total Suspended Solids	**mg/L**	**25 (mid range)**	**Aquatic Life**

Dissolved Oxygen	**mg/L**	**5 (mid range)**	**Aquatic Life**
Total or Extractable Cadmium*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total or Extractable Copper*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total Arsenic	**mg/L**	**0.025**	**Drinking Water, Health**
Total or Extractable Lead*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Dissolved Aluminum	**mg/L**	**0.1 for pH >6.5**	**Aquatic Life**
Total or Extractable Nickel*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total or Extractable Zinc*	**mg/L**	**Calculation based on Hardness (7Q10)**	**Aquatic Life**
Total or Extractable Manganese	**mg/L**	**0.05**	**Drinking Water, Aesthetic**
Total or Extractable Iron	**mg/L**	**0.3**	**Drinking Water, Aesthetic**
Total Ammonia as N	**mg/L**	**Calculation based pH**	**Aquatic Life**
Soluble or Dissolved Nitrate-Nitrite	**mg/L**	**10**	**Drinking Water, Health**
Total Phosphorus	**mg/L**	**0.05 in Rivers or 0.025 in Lakes**	**Nuisance Plant Growth**
Dicamba	**ug/L**	**0.006 ug/L where irrigation is a use of the waterbody, otherwise 10 ug/L for the protection of Aquatic Life within the waterbody**	**Irrigation**
Bromoxynil	**ug/L**	**0.33**	**Irrigation**
Simazine	**ug/L**	**0.5**	**Irrigation**
2,4 D	**ug/L**	**4**	**Aquatic Life**
Lindane	**ug/L**	**0.08**	**Aquatic Life**
Atrazine	**ug/L**	**1.8**	**Aquatic Life**
MCPA	**ug/L**	**0.025 ug/L where irrigation is a use of the waterbody, otherwise 2.6 ug/L for the protection of Aquatic Life within the waterbody**	**Irrigation**
Trifluralin	**ug/L**	**0.2**	**Aquatic Life**

The Water Quality Index combines three different aspects of water quality: the 'scope,' which is the percentage of water quality variables with observations exceeding guidelines; the 'frequency,' which is the percentage of total observations exceeding guidelines; and the 'amplitude,' which is the amount by which observations exceed the guidelines. The basic premise of the Water Quality Index is that water quality is excellent when all guidelines or objectives set to protect water uses are met virtually all the time. When guidelines or objectives are not met, water quality becomes progressively poorer. Thus, the Index logically and mathematically incorporates information on water quality based on comparisons to guidelines or objectives to protect important water uses. The Water Quality Index ranges from 0 to 100 and is used to rank water quality in categories ranging from poor to excellent.

- Excellent (95-100) - Water quality never or very rarely exceeds guidelines
- Good (80-94) - Water quality rarely exceeds water quality guidelines
- Fair (60-79) - Water quality sometimes exceeds guidelines and possibly by a large margin
- Marginal (45-59) - Water quality often exceeds guidelines and/or by a considerable margin
- Poor (0-44) - Water quality usually exceeds guidelines and/or by a large margin

An annual water quality index was calculated for the La Salle Rive from 1990 to 2005 based on water quality data from the long term station. In instances where more than one objective or guideline is available for a specific variable, the most restrictive has been used in the Index. As an example, for the herbicide Dicamba, the guideline for irrigation (.006 mg/L) is much lower than the guideline for the protection of aquatic life (10 mg/L) and would be used in the Index. Results shown in Figure 2 indicate that over the 16 year time frame, water quality is generally fair with some years with marginal water quality.

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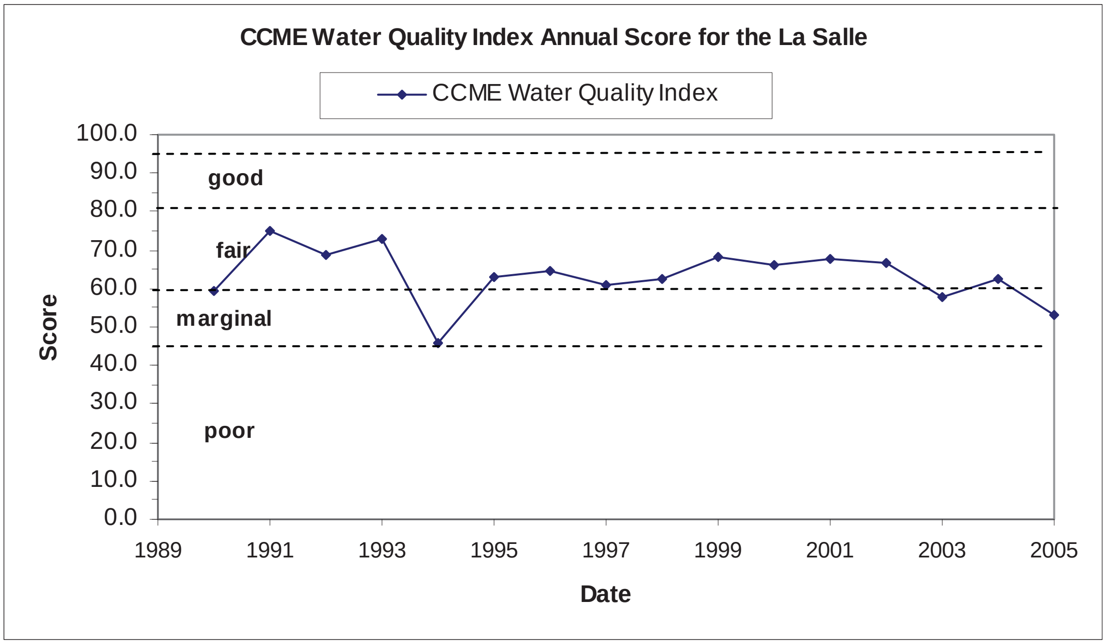
Figure 2: CCME Water Quality Index for the La Salle River.



Concentrations of Dicamba and MCPA (Figures 3 and 4) generally exceed the guidelines when detected and greatly influence the index. Both Dicamba and MCPA are herbicides commonly used to control broadleaf weeds on agricultural land or road and utility right of ways. Dicamba can enter surface waters through spills, aerial drift, improper disposal methods, and direct overspray of water bodies during application. Dicamba is very soluble in water and run-off from adjacent cropland is another pathway into the aquatic environment. Dicamba was detected in 36 % of samples taken (139) while MCPA was only detected in 16 % of samples taken (94). MCPA and Dicamba are often marketed together as multi mixed product but can also be distributed separately.

Figure 3: Historical Dicamba Concentrations Detected in the La Salle Watershed from 1984 – 2006.

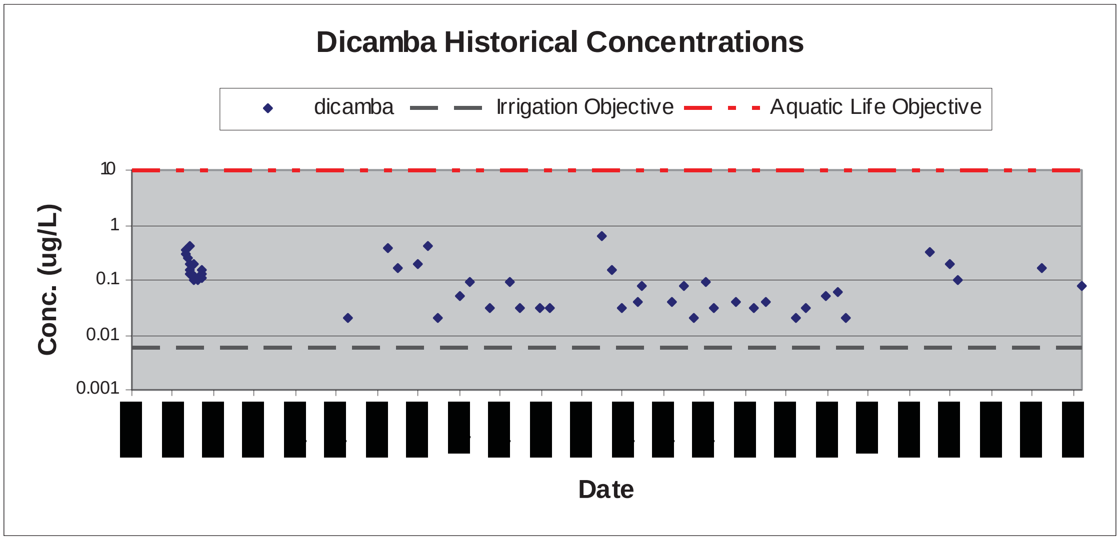


Figure 4: Historical MCPA Concentrations Detected in the La Salle Watershed from 1984 – 2006.

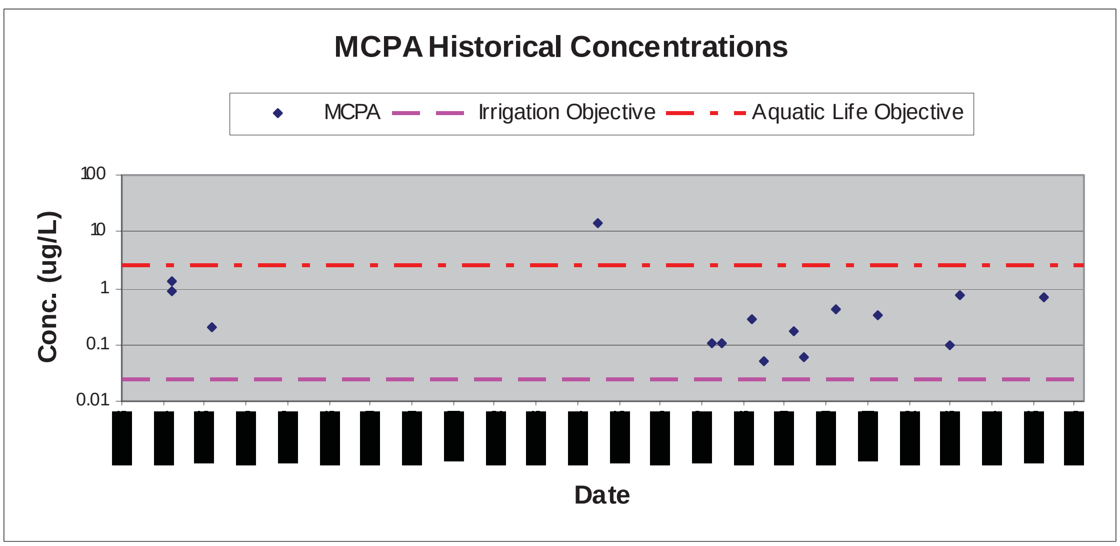
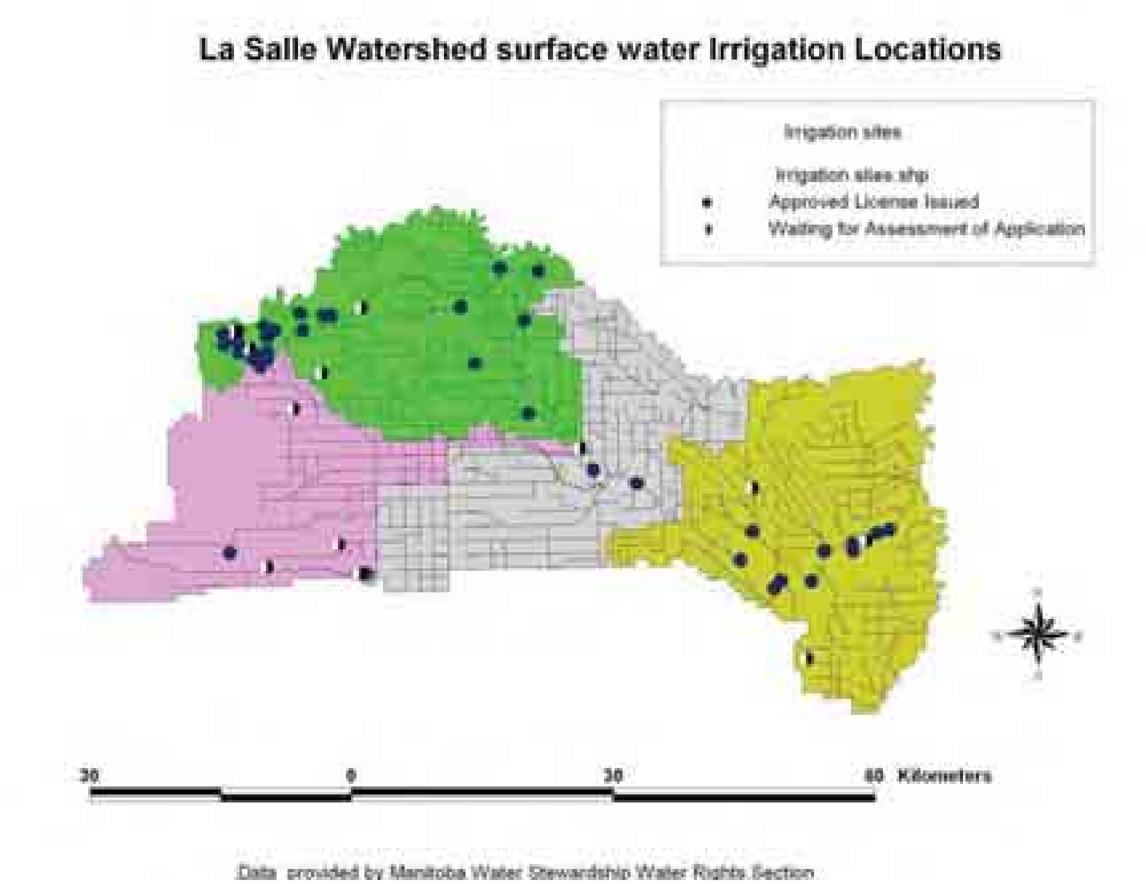


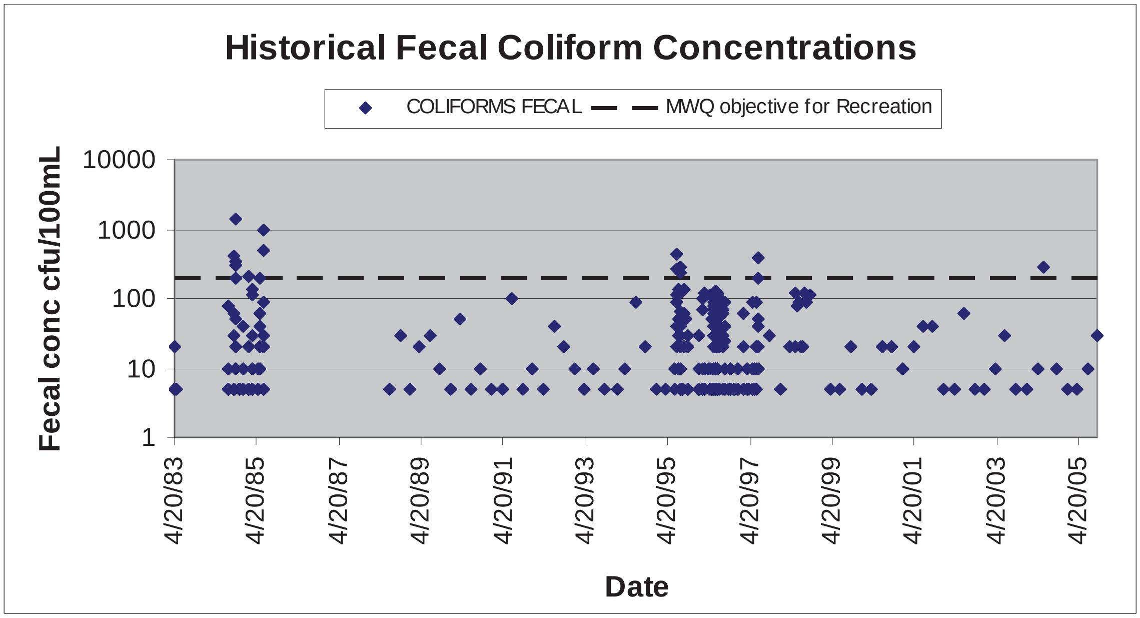
Figure 5: Locations of Surface Water Irrigation Licensed sites within the La Salle River Watershed



Licenses for irrigation are concentrated in the upper western corner of the watershed as well as in the lower reaches of the watershed where some of the higher water demand users are located such as the golf courses and water treatment plant (Figure 5). The upper reaches of the Elm Creek Channel are also starting to be developed based on pending applications. To improve water quality as indicated by the Water Quality Index, consideration should be given to best management practices that could reduce the transport of Dicamba and MCPA to surface water while still maintaining their beneficial use in controlling broadleaf weeds within the watershed.

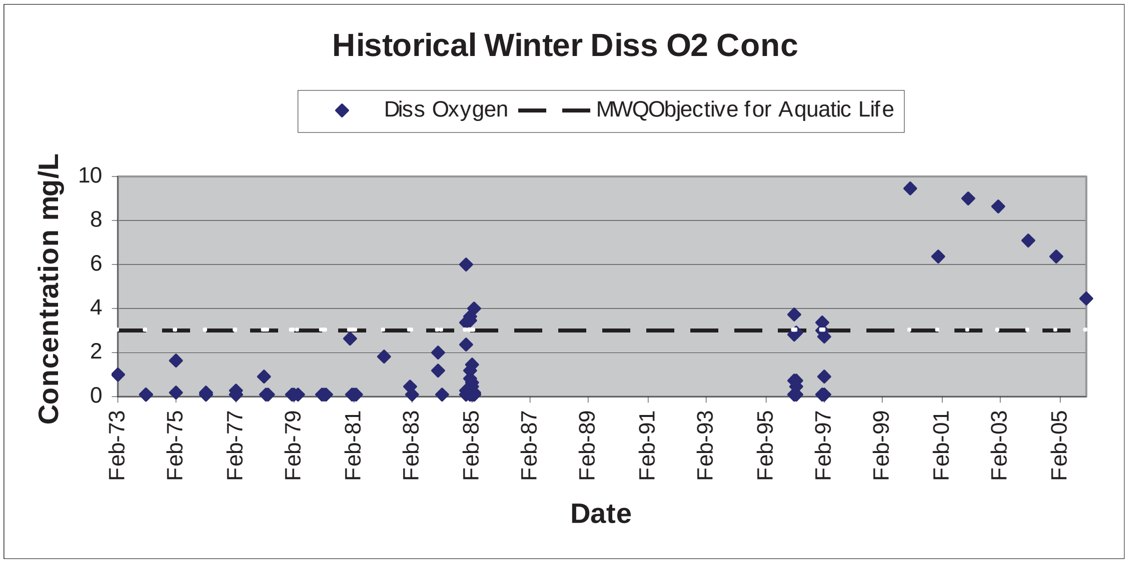
Fecal coliform bacteria are found in the intestinal tracts of birds and mammals and are used as indicators of other waterborne illness and viruses. Fecal coliforms are often introduced into the waterway as feces from humans, livestock or wildlife. The Manitoba Water Quality Guideline for fecal coliforms for the protection of recreational uses is 200 colony forming units per 100mL. Relatively few exceedences of the fecal coliform guideline were observed on the La Salle River between 1983 to 2005 (Figure 6).

Figure 6: Historical Fecal Coliform Concentrations within the La Salle River Watershed



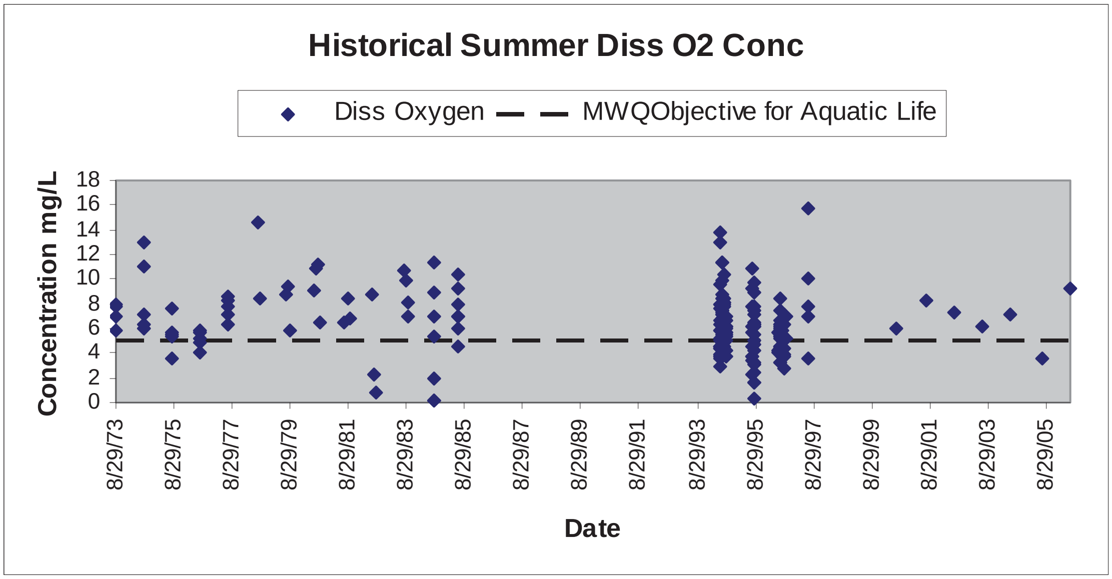
Adequate instream dissolved oxygen concentrations are essential to the overall health of the aquatic community. Oxygen is introduced into water systems via atmospheric exchange and plant photosynthesis. Oxygen is moderately soluble in water and its solubility is effected by temperature, elevation, salinity and mixing. Oxygen can be lost from water systems via bacterial decomposition of organic material and via plant and animal respiration. When oxygen consumption exceeds production then oxygen depletion (anaerobic conditions) can occur thereby impacting aquatic life. Oxygen concentrations can be depleted during winter when ice cover limits atmospheric exchange and reduces photosynthesis capability within the stream leading to greater consumption than production. In the La Salle River, oxygen consumption during the winter greatly exceeds production and anaerobic conditions can occur (Figure 7). Dissolved oxygen concentrations are generally higher in the 2000's but this may reflect the change in location and mixing that is occurring at the dam at LaBarriere Park.

Figure 7: Historic Winter Dissolved Oxygen Concentration within the La Salle River Watershed



Warmer water temperatures during the summer months generally increase biological activity and overall productivity. Warmer temperatures also enhance bacteria activity and consumption of oxygen. Solubility of oxygen also decreases with warmer temperatures. Therefore, stream oxygen concentrations may also drop below water quality objectives in summer. While summer dissolved oxygen concentrations throughout the La Salle River are generally above the Manitoba Surface Water Quality Objective for the protection of aquatic life, oxygen depletion occurs occasionally (Figure 8).

Figure 8: Historic Summer Dissolved Oxygen Concentration within the La Salle River Watershed



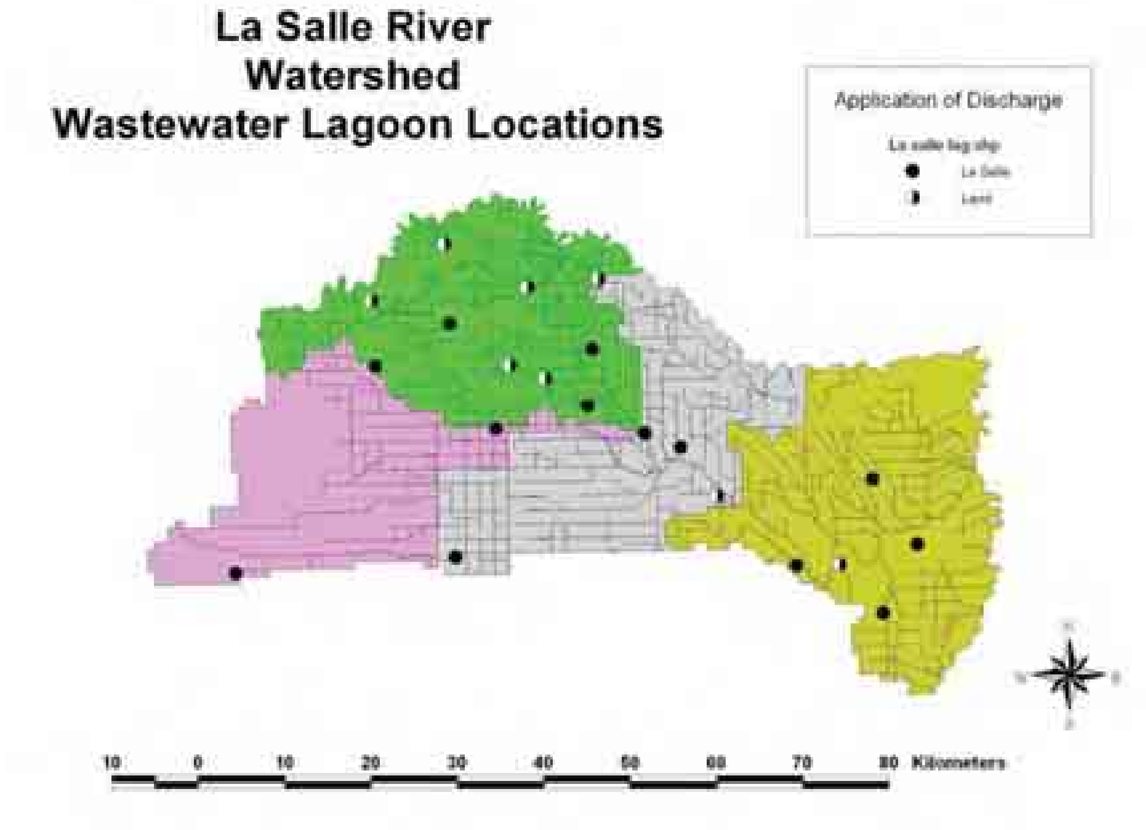
Nutrients play an important role in the stream ecosystem and are essential to overall biological productivity. However, excessive levels of phosphorus and nitrogen fuel the production of algae and aquatic plants. Extensive algal blooms can cause changes to aquatic life habitat, reduce essential levels of oxygen, interfere with drinking water treatment facilities, and cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins. Limiting and managing nutrient inputs in the La Salle River may assist in mitigating conditions associated with eutrophication such as dissolved oxygen depletion.

Nutrients as measured by total phosphorous and total nitrogen have been increasing in the La Salle River since the early 1970's. Jones and Armstrong (2001) demonstrated that total phosphorous concentrations have increased by over 194 % while total nitrogen concentrations have increased by 146 % over the time period from 1973 to 2000. This corresponds to an approximate increase in phosphorus and nitrogen loads of 29 tonnes and 118 tonnes, respectively. For comparison, studies have shown that since the early 1970s, phosphorus loading has increased by about 10 per cent to Lake Winnipeg and nitrogen loading has increased by about 13 per cent. Increased nutrient concentrations have resulted in the deterioration of water quality and development of more frequent and more widely distributed algal blooms in Lake Winnipeg.

Manitobans, including those in the La Salle River watershed, contribute about 47 % of the phosphorus and 49 % of the nitrogen to Lake Winnipeg (Bourne *et al.* 2002, updated in 2006). About 15 % of the phosphorus and 5 % of the nitrogen entering Lake Winnipeg is contributed by agricultural activities within Manitoba. In contrast, about 9 % of the phosphorus and 5 % of the nitrogen entering Lake Winnipeg from Manitoba is contributed by wastewater treatment facilities such as lagoons and sewage treatments plants.

As part of Lake Winnipeg Action Plan, the Province of Manitoba is committed to reducing nutrient loading to Lake Winnipeg to those levels that existed prior to the 1970s. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Reductions in nutrient loads across the Lake Winnipeg watershed will benefit not only Lake Winnipeg but also improve water quality in the many rivers and streams that are part of the watershed including the La Salle River. In particular, issues related to excessive plant growth and reduced dissolved oxygen concentrations in the La Salle River can be mitigated by reducing nutrient loads to surface waters.

Figure 9: Location of all wastewater lagoons within the La Salle Watershed.



One of the sources of nutrients to the La Salle River is wastewater treatment lagoon discharge. There are a total of 25 lagoons in the La Salle River watershed of which 8 discharge via land application (Figure 9). The remaining 17 lagoons discharge directly or indirectly via the drainage network to the La Salle River. Calculations indicate that contributions from these discharges contribute 7.3 % of the total phosphorus and 12.3 % of the total nitrogen load to the La Salle River. Remaining sources of nutrients to the La Salle River include runoff associated with fertilizer and manure application, septic fields, enhanced drainage and reduced riparian vegetation, erosion, and instream processes. These many activities each contribute a relatively small proportion of the overall nutrient load to the La Salle River. However, the sum of these many small nutrient loads impacts the La Salle River and downstream waterways such as Lake Winnipeg. It is evident that reducing nutrients across the La Salle River watershed is a challenge that will require the participation and co-operation of all residents and will involve:

- Implementing controls on nutrients in municipal and industrial wastewater treatment facilities and considering the cumulative impact of multiple lagoon discharges along the La Salle River.
- Developing scientifically-based measures to control the application of inorganic fertilizers, animal manure, and municipal sludge to agricultural lands.

- Reducing nutrient contributions from individual homeowners.

Individual residents can help by taking the following steps:

- Maintain a natural, riparian buffer along waterways. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
- Value and maintain wetlands. Similar to riparian buffers along waterways, wetlands slow erosion and help reduce nutrient inputs to lakes, rivers, and streams. Wetlands also provide flood protection by trapping and slowly releasing excess water while providing valuable habitat for animals and plants.
- Don't use fertilizer close to waterways. Heavy rains or over-watering your lawn can wash nutrients off the land and into the water.
- Use phosphate-free soaps and detergents. Phosphates have been prohibited from laundry detergents but many common household cleaners including dishwasher detergent, soaps, and other cleaning supplies still contain large amounts of phosphorus. Look for phosphate-free products when you are shopping.
- Ensure that your septic system is operating properly and is serviced on a regular basis. It's important that your septic system is pumped out regularly and that your disposal field is checked on a regular basis to ensure that it is not leaking or showing signs of saturation.

One of the short term studies undertaken on the La Salle River examined ammonia concentrations in wastewater lagoon discharges. In 1996, several lagoon discharges were sampled and monitoring occurred upstream and downstream of the wastewater discharge into the La Salle River. Organic matter in a lagoon breaks down naturally to ammonia and then in the presence of sufficient oxygen to nitrite/nitrate as part of the treatment process. Ammonia, while an essential and readily used nutrient for plant growth, can in its un-ionized state be toxic to aquatic life. The toxicity of ammonia in surface waters is related to the total amount of ammonia present, and in particular the ratio of un-ionized to total ammonia. This ratio is affected by the pH and to a lesser extent the temperature of the water. Results of the study indicated that for all of the lagoon discharges monitored in 1996, there were no exceedences of the Manitoba Water Quality Objectives for ammonia for the protection of aquatic life.

Drainage

Although it is recognized that drainage in Manitoba is necessary to support sustainable agriculture, it is also recognized that drainage works can impact water quality and fish habitat. Types of drainage include the placement of new culverts or larger culverts to move more water, the construction of a new drainage channels to drain low lying areas, the draining of potholes or sloughs to increase land availability for cultivation and the installation of tile drainage. Artificial drainage can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide load to receiving drains, creeks and rivers. All types of drainage should be constructed so that there is no net increase in nutrients (nitrogen and phosphorus) to waterways. To ensure that drainage maintenance, construction, and re-construction occurs in an environmentally friendly manner, the following best available technologies, and best management practices aimed at reducing impacts to water quality and fish habitat are recommended.

- Surface drainage should be constructed as shallow depressions and minimal removal of vegetation and soil should be observed during their construction.
- Based on Canada Land Inventory Soil Capability Classification for Agriculture (1965) Class 6 and 7 soils should not be drained.
- When sloughs or potholes are drained then an additional holding pond or wetland should be constructed as a collection point for the water prior to entering the municipal drain, creek or river. This will help filter nutrients from runoff from the land as well as compensate for the loss of wetlands that support wildlife.
- Erosion control methodologies according to the guidelines outlined in *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* should be used where the surface drain intersects with another water body.
- A strip of vegetation of at least 1 metre should be maintained along the surface drainage channel as a buffer. This will reduce erosion of the channel and aid in nutrient removal.
- When necessary the proponent must revegetate exposed areas along the bank of the surface drainage channel.
- Discharge from tile drainage should enter a holding pond or wetland prior to discharging into a drain, creek or river.
- Nutrient application needs to be established for most efficient uptake by the crop and should occur just prior to seeding. Fall application of manure or fertilizer should not be permitted on drained land.

Summary

- Water quality is an important issue within the watershed. The water quality index is an excellent method of evaluating water quality and assessing changes/improvements over time.
- Nutrient enrichment or eutrophication is one of the most important water quality issues in Manitoba. It is evident that reducing nutrients across the La Salle River watershed is a challenge that will require the participation and co-operation of all residents and will involve many actions.
- To improve water quality, consideration should be given to best management practices that could reduce the transport of Dicamba and MCPA to surface water while still maintaining their beneficial use in controlling broadleaf weeds within the watershed.
- Best management practices for reducing nutrient contributions and managing drainage in an environmentally friendly manner should also be implemented on a watershed basis.

SECTION 5.4

La Salle River
Integrated Watershed Management Plan:
State of the Watershed Report
Groundwater Resources

Graham Phipps
Groundwater Management Section
March 2007

Manitoba Water Stewardship

Summary

Much of the La Salle River watershed has no potable groundwater supplies and the potable groundwater resources present are not uniformly distributed. Bedrock aquifers are saline to varying degrees and are not considered potable sources of water. The chance of developing potable water supplies only exists within limited areas of sand and gravel deposits within the overburden.

The salinity in the bedrock groundwater within the watershed decreases from approximately 10,000 mg/L in the southwest to 5,000 mg/L total dissolved solids towards the northeast. Outside of the watershed, towards the north and east, fresh water replaces the saline water. Water supplies, especially within the carbonate aquifer are generally good; groundwater from the carbonate aquifer may be useful for heating / cooling exchange systems or potentially other industrial uses.

Overburden aquifers consist of glacio-fluvial sand (Almasippi sand), paleo-channel and alluvial sand (aquifers of limited extent associated with stream and river deposited sediment), glacial outwash sand and gravel, and confined sand and gravel aquifers within or underlying glacial till. The Almasippi sand is fairly extensive west of a line from Elm Creek to Southport, however its thickness is variable and it is generally low yielding. Paleo-channel and alluvial aquifers are associated with pre-historic drainage and modern drainage systems and are very limited in size and extent. These are located primarily in the Oakville area and near modern rivers and streams. The only example of glacial outwash in the watershed is the Elie aquifer located northeast of the town of Elie. Confined sand and gravel aquifers are intersected in drill holes scattered throughout the watershed, but primarily in a bedrock depressional ‘trough’ which roughly lies in a line between Elm Creek and Southport. Confined sand and gravel aquifers within the glacial till are frequently located at depths below 20 metres.

Groundwater from overburden aquifers vary considerably in quality. Most wells completed in the overburden will yield hard to very hard water. Few groundwaters have hardness less than 200 mg/L $CaCO_3$, whereas most groundwater has hardness greater than 400 mg/L $CaCO_3$. Total dissolved solids ranges from 300 to 1,400 mg/L in shallow aquifers and up to approximately 5,000 mg/L in confined sand and gravel aquifers. The water quality decreases in confined sand and gravel aquifers that are located closer to the bedrock.

The Groundwater Management Section of Water Stewardship currently operates 18 monitoring wells, primarily to measure water levels, and one rain gauge within the watershed. Earliest monitoring began in 1960’s in the carbonate aquifer, primarily in response to the construction of the floodway. Town supply exploration and monitoring programs were carried out in the 1960’s (Elie) 1970’s (Oakville, Elm Creek) and monitoring in the Almasippi sand was added in the 1990’s.

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Introduction

Groundwater, like most natural resources, is the responsibility of the provinces. The transfer of responsibility for water from the federal government to the provinces began with *The Natural Resource Transfer Agreement* in 1930. Although groundwater was not specified, it was assumed to be included. In the same year Manitoba passed the *Water Rights Act* which was consequently amended it in 1959 to include groundwater. The 1959 *Water Resources Administration Act* was established to create a comprehensive water management agency. Shortly after, *The Ground Water and Water Well Act* (1963) passed and was meant to address drilling practices and groundwater data collection. Groundwater is regulated under a number of provincial acts including *The Environment Act, The Water Protection Act, The Health Act, The Drinking Water Safety Act, The Water Resources Conservation Act, The Planning Act, The Water Rights Act, The Ground Water and Water Well Act* and subsequent Regulations.

Early regional studies of groundwater and aquifers were carried out by the federal government. These consisted of door to door well surveys, township summaries of water supply and quality, regional maps of surficial geology, well locations and producing zones. Formal studies of groundwater were initiated by the province in the early 1960's and by the mid 60's the Groundwater Management Section began operating a monitoring well network.

The Groundwater Management Section (GMS) of Water Stewardship advises on groundwater management issues including allocation of groundwater and groundwater protection. The GMS operates a monitoring well network, from which data on groundwater conditions such as water levels and water quality is collected, stored and compiled. Studies meant to address specific aquifer or groundwater concerns have been carried out by the section as have regional groundwater resource mapping. Systematic hydrogeologic mapping was conducted from the 1960's through the 1980's consisting of regional stratigraphic drilling, pump testing, well data and quality compilations resulting in 11 regional groundwater availability map series on a scale of 1:250,000 completed by 1989. The Section has also prepared reports on hydrogeology and groundwater resources at various scales including towns, drainage basins, municipalities, planning districts and watersheds over the years.

The Ground Water and Water Well Act and Well Drilling Regulation require that water well drillers be licensed by the province and that the driller supply the province with a report of all wells drilled. The report should contain information on date and ownership, the well location, a description of the material drilled, and information on well construction and pump testing if completed. This information is stored within a database in the Groundwater Management Section.

A glossary of select terms is provided in Appendix A at the back of this report.

Groundwater Backgrounder

Groundwater is water that fills the pores and fractures in the ground. At some point as water recharges the soil and moves down through the profile all of the pore space will be saturated. The surface where this occurs is called the water table. Not only must sediment or rock be saturated to recover groundwater, it must also be permeable enough to allow the water to move at a reasonable rate. Because these properties are largely controlled by the material the water is moving through the geology of the formations are important in understanding water movement. Additionally the natural water quality which the water acquires depends on the materials it flows through.

Aquifers and Aquitards

A geologic formation from which economically significant quantities of water flows to a spring or can be pumped for domestic, municipal, agricultural or other uses is called an aquifer. From glacial times on (the Quaternary period of geologic time), aquifers are primarily formed within sand or gravel deposits. Within pre-glacial or bedrock formations, aquifers are formed from sandstone, hard fractured shale/siltstone or permeable limestone. Aquifers can be separated vertically by less permeable layers; layers that do not readily allow water flow or act as barriers to flow. These confining layers are called aquitards and are principally formed from glacial till or clay deposits in Quaternary sediments or by unfractured or soft shale, massive or unfractured limestone, or gypsum in bedrock layers.

During recharge rain moves vertically through the soil and shallow geologic horizons until it reaches the water table. The water table can be determined within a shallow dug or drilled hole by allowing the water level to come to a static or resting position. In permeable material the water table forms the top of an unconfined aquifer. In an unconfined aquifer the water table and consequently the amount of water in storage, moves up and down over the seasons or longer climatic periods in response to recharge or discharge from the aquifer.

If an aquifer is situated between aquitards and the water level in a well rises above the base of the upper confining unit the aquifer is called a confined aquifer. In a confined aquifer all of the pore space is filled with water and any addition or reduction of water in storage results in a change of water pressure in the aquifer. When the pressure in the aquifer is above the local ground surface, drilling into this formation will result is a flowing artesian well. Confined aquifers are recharged either at a location at higher elevation where the aquifer is no longer confined or it is recharged very slowly through the layers that confine it.

Groundwater discharge can be dispersed over large areas or focused, such as in springs and commonly discharge areas are topographically controlled. Springs form where the water table intersects the ground surface commonly in depressions or hillsides, including river banks. If a higher permeability layer overlies a lower permeability layer on a hillside or river bank the vertical flow of groundwater may be impeded by a low permeability layer causing the water to move laterally to discharge as a spring. Some springs are formed from flowing artesian aquifers where water moves up along fractures or are man-made resulting from unsealed boreholes or blow-outs at the bottom of excavations. Groundwater may also discharge over larger areas resulting in perennially wet areas, bogs or swamps.

Groundwater Flow

Groundwater moves from higher elevation to lower elevation or from higher pressure to lower pressure. The height of the water table or the pressure in an aquifer is called the hydraulic head. The difference in hydraulic head in an aquifer between two locations is used to determine the hydraulic gradient. The groundwater flow direction is from the higher to lower hydraulic pressure along the maximum slope of the hydraulic gradient. Typically, under ambient conditions, groundwater moves quite slowly. In unconfined aquifers the water table loosely mimics the surface elevation and in areas of low topographic relief the typical hydraulic gradient is in the range of one metre of water head decline per kilometer distance. The ability for a geologic material to move water is called hydraulic conductivity. The amount of groundwater that moves through a geologic material will depend upon both the hydraulic gradient, the hydraulic conductivity and the thickness of the aquifer.

Aquifer Studies and Groundwater Data

Early studies of the aquifers of southern Manitoba included work completed by the Geological Survey of Canada for regional resource mapping (Selwyn, 1890; Johnston, 1934; Charron, 1961) and to identify the salt water-freshwater boundary in bedrock (Charron, 1962). Groundwater resource compilations for portions of the watershed were completed by Charron (1961) for the Fannystelle area (Tps. 1 to 6, Rges. 1 to 5, W1). During this latter study 1710 homes were visited and water sources inventoried.

The province compiled the groundwater resources on a 1:250,000 map scale for the Brandon (62G) map sheet (Sie and Little, 1976) and the Winnipeg (62H) map sheet (Little, 1980). The LaSalle River watershed lies within these two Groundwater Availability Study areas. Additional provincial studies that include portions of the watershed include the Groundwater Resources (Synopsis) in the Portage La Prairie R.M. (1982), Groundwater Resources in the MacDonald – Ritchot Planning District (A Synopsis) (1984) and Aquifer Enhancement Investigations 1980-1986.

The provincial Groundwater Availability Studies include a set of diagrams showing the map sheet location, drift thickness, bedrock topography, surface deposits, a number of cross-sections and a table of selected well water chemistry. The Groundwater Availability series have formed the main regional scale compilation of groundwater data to date. The groundwater synopses consist of a brief description of groundwater resources and include maps.

Groundwater Data and Monitoring

The Groundwater Management Section of Water Stewardship maintains a database of well logs for the province. Based on the current data there are 1139 well and test hole records in the La Salle River Watershed (Figure 1). Almost half (523) of the logs are from test wells. Of the total number of logs, 166 record the end of hole in bedrock with the remaining holes were finished in overburden. Of the drillers logs more than 500 wells were reportedly completed in sand and gravel or silt and approximately 100 wells were completed in bedrock.

The Groundwater Management Section drilling and monitoring well installations began in 1963 and currently 18 active monitoring stations and one rain gauge are operated within the watershed (Figure 2). The province has an additional 38 wells within 10 km of the watershed boundary. Provincial monitoring wells have been installed in response to obtaining groundwater information on a regional basis and to monitor specific projects (i.e. construction of the floodway or identification of town water supplies) resulting in variable periods of record as wells are established and others are inactivated in response to groundwater information needs. Town supply exploration and monitoring programs were carried out in the 1960’s (Elie) 1970’s (Oakville, Elm Creek) and monitoring in the Almasippi sand was added in the 1990’s. In total the Groundwater Management Section has drilled or monitored a total of 150 sites, of which 115 were test holes and 35 have some amount of monitoring information.

The province also stores groundwater chemistry information from provincial monitoring wells, private wells sampled during various groundwater projects and results that are supplied to the province from drillers or other sources. The chemistry from the provincial monitoring wells is available to the public.

Bedrock Aquifers

Bedrock aquifers are present beneath the entire watershed. In succession overlying the pre-Cambrian basement are the sandstone aquifer within the Winnipeg Formation, limestone and dolostone aquifers of the Red River (subcrops only on the extreme eastern portion of the watershed), Stony Mountain, Stonewall, and Interlake (Ordovician and Silurian age). Above these lie Devonian through Jurassic age carbonates which contain interbedded shale and gypsum on the western side of the watershed. The Swan River Sandstone aquifer of Cretaceous age is only present on the extreme western portion of the watershed. None of the bedrock aquifers are considered potable water supplies and therefore few wells have been drilled into these aquifers.

Within the carbonate aquifers that underlie the watershed primary porosity will be quite low and generally not well interconnected and groundwater flow is primarily through bedding planes and secondary features that developed after the rock was deposited. These features include joints, fractures and solution channels which enhance permeability. Because of these features well yields can be quite variable depending on the permeable features and density of the features intersected within each drill hole. Well yields that have been reported in driller's logs vary from less than 0.1 L/s to greater than 18 L/s, with an average of 2.5 L/s.

Saline and brackish water is found within the bedrock aquifers of this area. The salinity is associated with long flow systems and increases towards the southwest, the origin of the saline water. The transition between salt and 'fresh' water occurs relatively abruptly, roughly at the location of the Red River on the east and a slightly more gradual transition to fresh-water north of the Assiniboine River.

This transition results from fresh (meteoric) water recharge in the Interlake area, southeast of Winnipeg, on the aquifers most easterly extent and in local areas where glacial outwash sand and gravel are hydraulically connected to the underlying carbonate aquifer. In areas where thick clay layers overly aquifers such as throughout much of the Red River Valley there is not expected to be any measurable local recharge to bedrock aquifers.

The total dissolved solids (TDS) of the carbonate aquifer groundwater ranges between 5,000 and 10,000 mg/L. The dissolved constituents are primarily composed of sodium (Na) and chloride (Cl) with lesser amounts of calcium (Ca) and sulphate (SO_4). Calcium and magnesium although not dominating the chemistry are of high enough concentration to make the water very hard. Dissolved iron (Fe) and fluoride (F) can also be high.

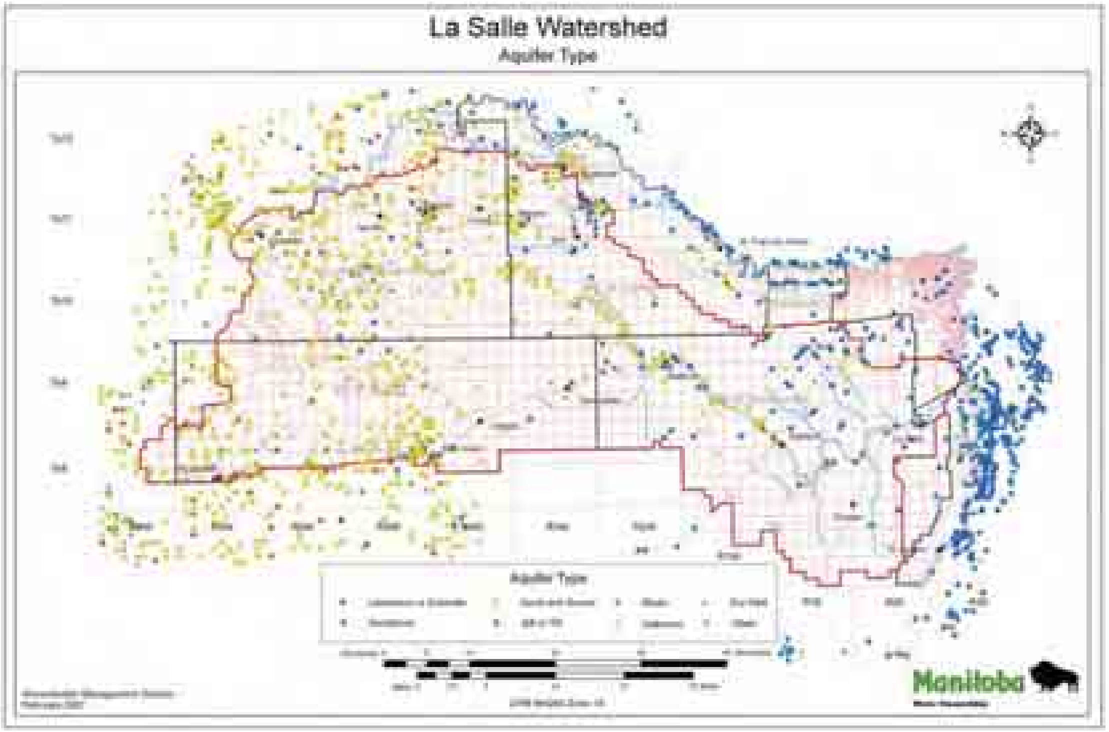


Figure 1. Location of well logs within the Provincial well database coded by aquifer material that the well is completed. Wells are displayed in the centre of the quarter-section in which they are drilled unless more accurate information is available. Multiple wells may be stacked at any one location.

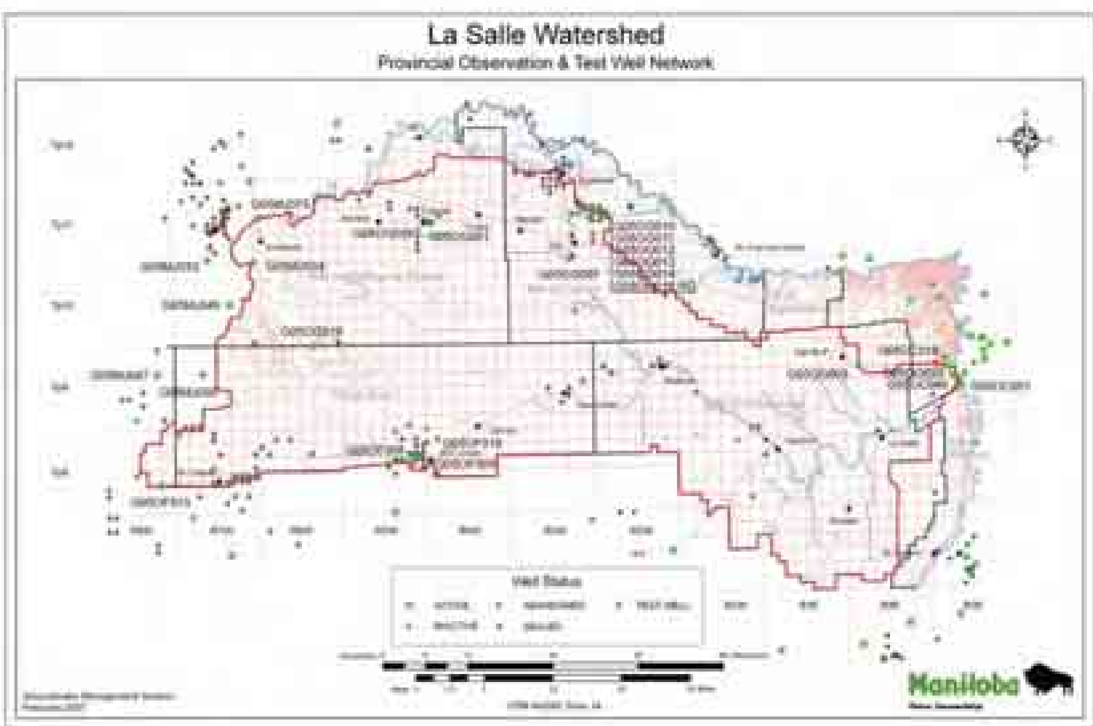


Figure 2. Location of Groundwater Management drilling activity including status with active observation wells labeled. Active stations are currently collecting data; inactive stations have collected observations during some period in the past; sealed wells are wells that have recently been sealed with an available well sealing log; method of abandonment is not available for abandoned holes but common practices at the time of abandonment most likely would have been used.

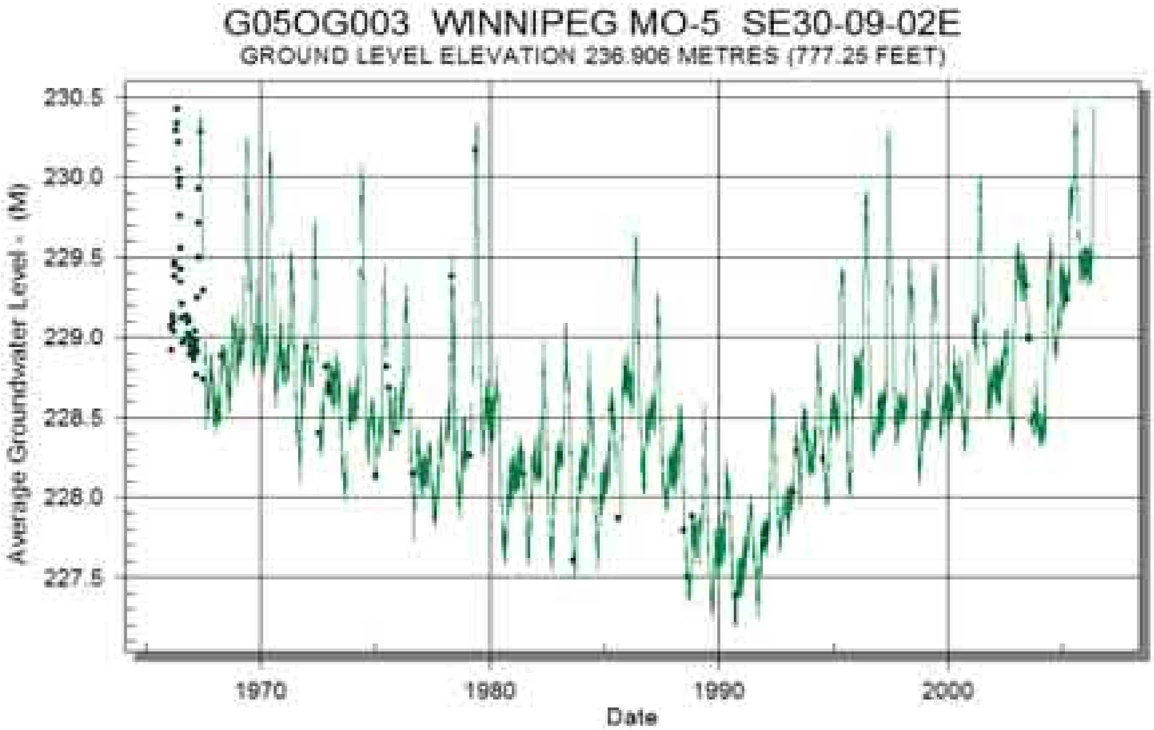


Figure 3 Groundwater elevations are monitored continuously such as at station G05OG003, which started monitoring in 1966 and has the longest continuous record in the watershed. This well is 44.5 meters deep and is completed as an open hole within the carbonate rock. See Figure 2 for location.

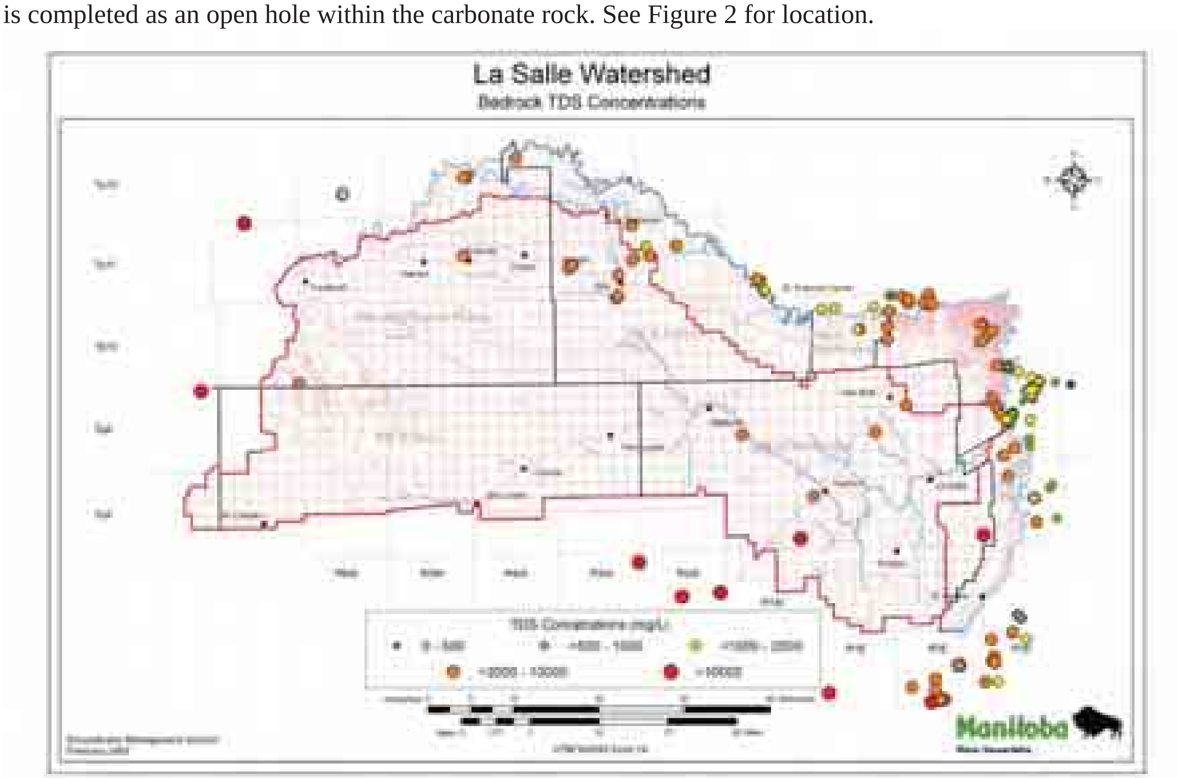


Figure 4. Display of total dissolved solids (TDS) in groundwater from bedrock wells within and including a 10 Km buffer around the watershed. Few samples are available from within the watershed. The fresher water is evident east of the Red River on this diagram. Lower TDS north of Elie results from recharge to the carbonate through the outwash gravel deposits of the Elie pit.

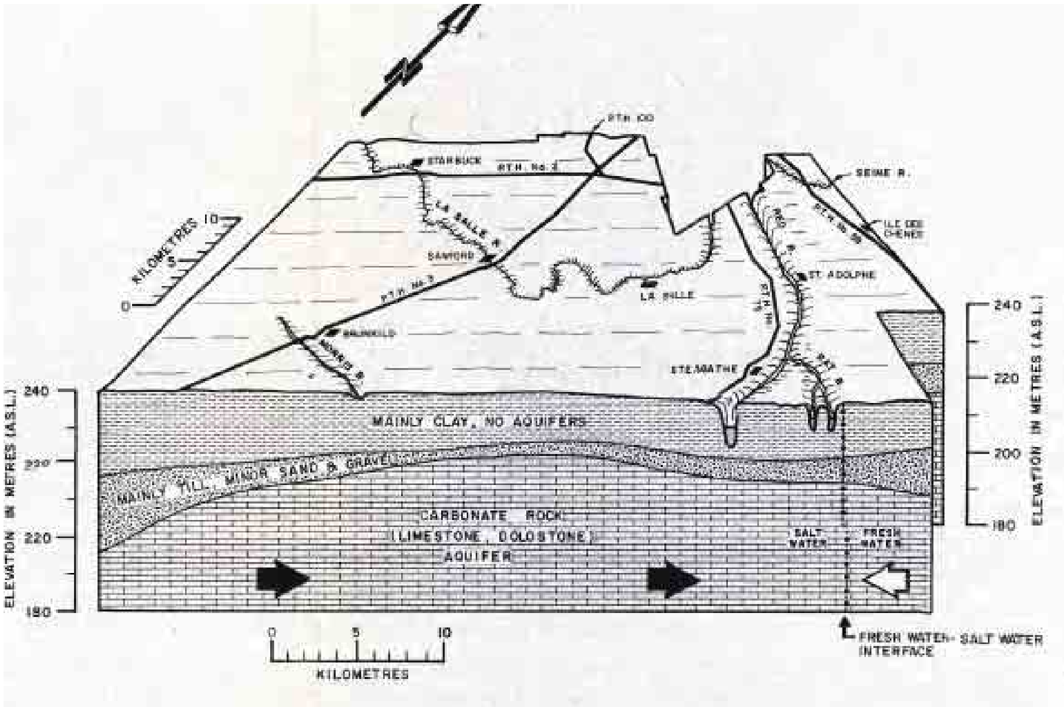


Figure 5. . Block Diagram showing an east-west geologic profile south of Brunkild (from Rutulis, 1984). Direction of saline water flow is designated by the black arrow and fresh water from the east by the white arrow. The depth to bedrock increases from the high point in the centre of the diagram towards the west.

Quaternary Aquifers

Within glacial and recent sediments aquifers are formed as sand and gravel within or at the base of glacial till, glacial outwash or alluvial sand deposited from modern or ancestral rivers or within a distal deltaic environment. Each of these aquifer types was deposited within a different geologic setting, each resulting in differences in characteristics such as aquifer extent, depth to water-bearing layers (Figure 6) and aquifer thickness (Figure 7); all of which have an influence on water availability, quantity and quality.

Glacio-Fluvial Sand Aquifers

Aquifers within the Almasippi sand are located on the western portion of the watershed (Figure 1) below the escarpment and above the glacial Lake Agassiz Burnside beach strandline. The Burnside strandline is located on the western side of Elm Creek and extends towards Southport. Along its reach the strandline largely separates the lacustrine clay to the east from the surficial fine Almasippi sand to the west. The Almasippi sands are shallow (Figure 6) and are variable in thickness ranging from a few metres up to eight or more metres (Figure 7). The texture consists of fine to medium grained sand with silty and or clayey stratification. The sand rests directly upon laminated lacustrine clay and silt.

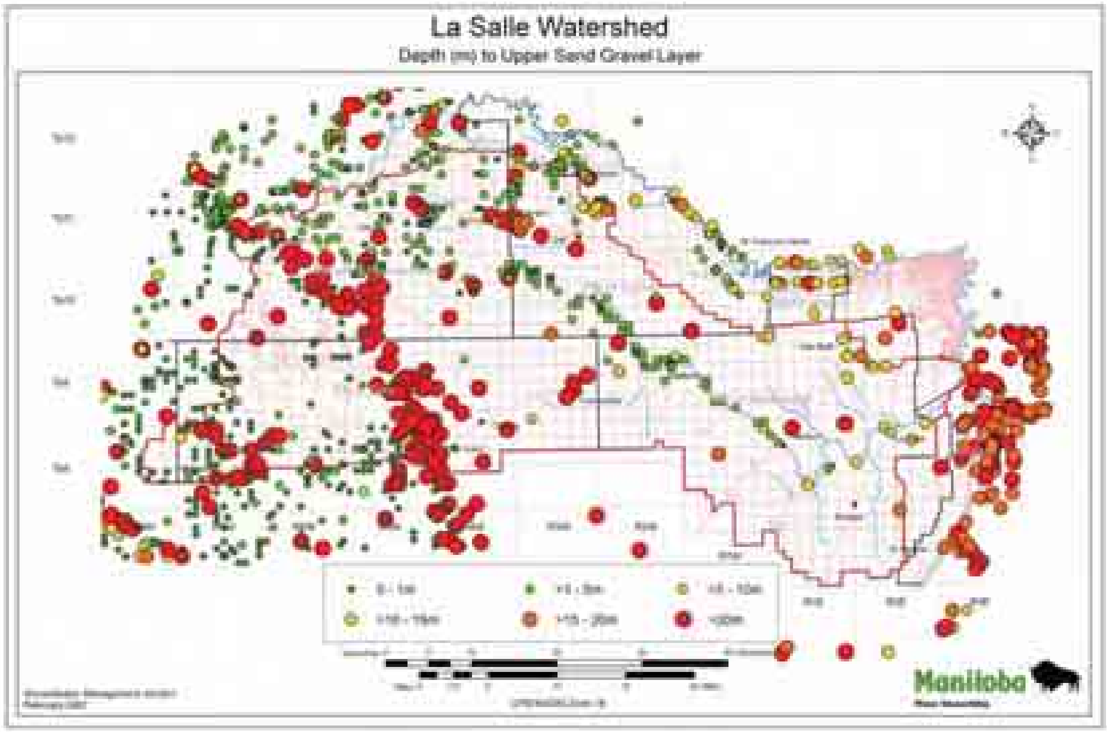


Figure 6. Diagram showing depth (m) to uppermost sand or gravel layer reported from all well logs. Almasippi sands, west of line joining Elm Creek with Southport, are at or near the ground surface. In the Oakville area sand is commonly within a couple of metres below ground, as it is in alluvial aquifers adjacent to the La Salle River. Deeper sand and gravel is encountered along the border between the Almasippi sand and lacustrine lake clay to the east. A few deeper sand/gravel layers are also scattered throughout the watershed and occur in areas of the Almasippi where shallow sand was not encountered.

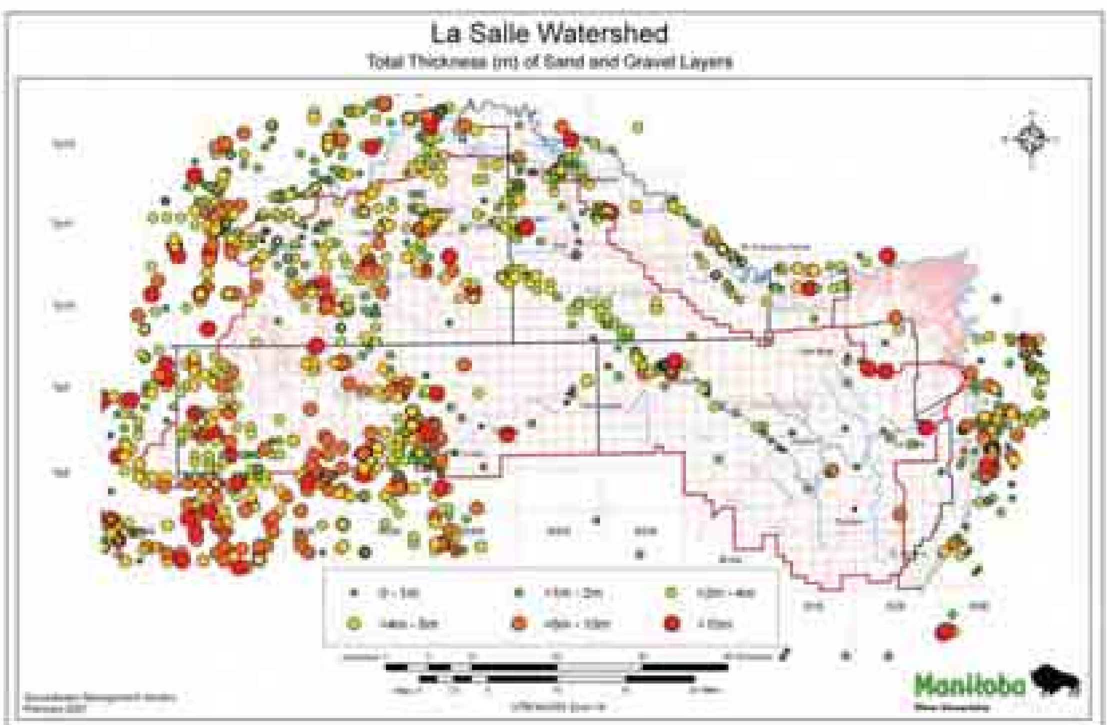


Figure 7. Diagram showing the total thickness of sand and gravel layers reported in any well log. Most aquifers adjacent to rivers (i.e. La Salle) or in paleo channels in the Oakville area are quite thin. Deep sand and gravel (compare to previous figure) are also commonly thin. In the Almasippi sand area the total thickness of sand and gravel is quite variable.

The groundwater within the Almasippi sand is exploited by both drilled and wide diameter bored / dug wells. Low yielding bored wells are commonly deepened below the water producing zone to provide additional storage in areas with low water supplies. Water levels vary throughout the year and can be near surface immediately after spring recharge and recede over the growing season and winter. Recharge of the unconfined aquifer is solely from local precipitation. Snow melt will contribute the largest proportion of recharge, however, rain events greater than the available water holding capacity of the soil will also result in recharge events. A typical hydrograph of groundwater levels is shown in Figure 8.

The regional groundwater flow direction in the Almasippi sand aquifer is predominantly from the west towards the east. The water levels will reflect the overall ground elevation on a regional scale. Minor topography changes and variability sediment such as increase in silt or clay content will affect the local flow direction. The regional gradient is in the range of approximately one to two metres per kilometer and transport rates are expected to be quite slow, in the order of a few metres per year. The regional water level in sand and gravel aquifers is illustrated in Figure 9.

Well yields are variable, but generally water supplies sufficient for domestic and livestock needs are obtained. Charron (1964) reports that, contrary to belief, few wells in this aquifer reportedly went dry during the 1930’s drought. Test drilling may be beneficial to determine optimum well location because of the variability in sand thickness and uniformity.

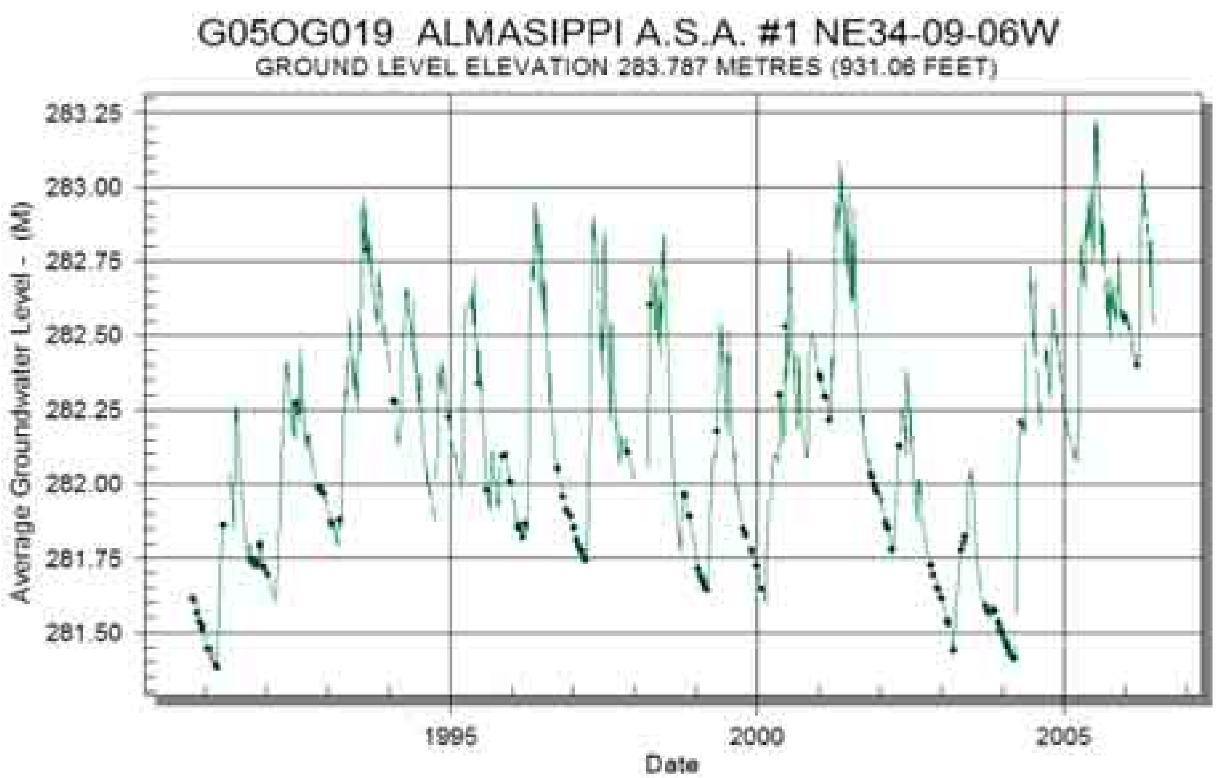


Figure 8. Hydrograph for site G05MJ019 monitoring water levels in the Almasippi sand shows water level spikes in response to spring recharge and recession through the fall and winter. The groundwater elevation is within a metre of the ground surface 283.79 metres above sea level after spring recharge in more than half the years of the monitoring record. See Figure 2 for location of well.

Based on well survey information, it is not uncommon for more than one well to be used to supply a farmstead. In this type of setting wells ‘going dry’ may be more indicative of the aquifer inability to transport groundwater quickly or extent of the contributing sand than overall groundwater quantity.

Natural water quality is quite good with total dissolved solids in the 300 to 700 mg/L range. The water is relatively hard, 150 to 600 mg/L as $CaCO_3$, with most solutes comprised of calcium (Ca), magnesium (Mg), and bicarbonate (HCO_3). Chloride (Cl), sodium (Na) and sulfate (SO_4) are naturally quite low; generally less than 10, 15 and 30 mg/L, respectively. Because the sand commonly extends to the ground surface or has only a relatively thin cover of silt or finer material within the soil zone the risk of groundwater contamination is relatively high. There are few lab results with comprehensive analyses of drinking water quality parameters. Within the Groundwater Management Section database there are less than half a dozen coliform bacteria results and only a few more nitrate analyses. Although none of the nitrate analysis within the database are greater than the drinking water health-based guideline of 10 mg/L-N; there is measurable nitrate and coliform indicating the vulnerability of this type of aquifer and the wells commonly used to access the water within it. Well siting, maintenance and activities near the well area are important factors in obtaining and sustaining healthy water supplies.

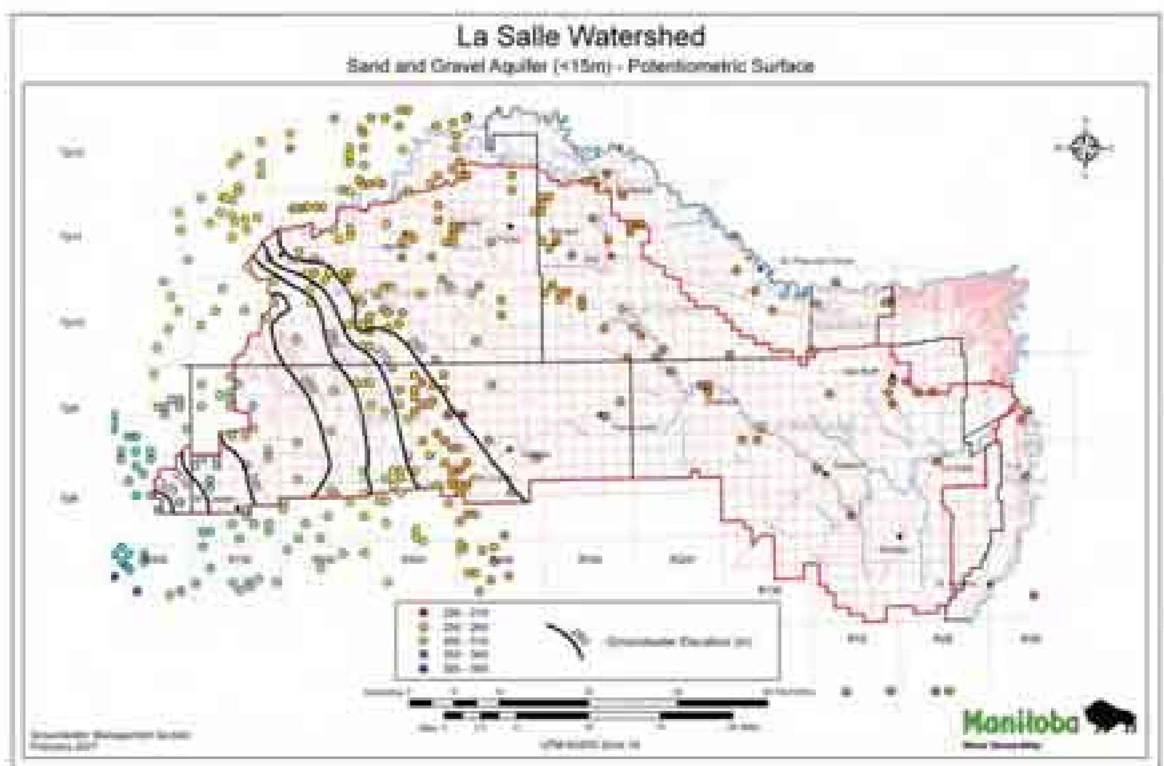


Figure 9. Contour diagram of water level elevations using information from the shallow wells completed in the Almasippi sand area. Contour intervals are 10 meters and show regional groundwater flow from the west to east-northeast.

Paleo-Channel and alluvial aquifers

Alluvial aquifers are found near modern streams and rivers, such as the La Salle and within the flood plain of the ancestral Assiniboine River. These aquifers were formed from sand and silt deposited on the banks and within the channel and because of the modes of deposition individual aquifers have a very limited aerial extent.

Paleo-channel aquifers were formed during the Holocene (post-glacial) by streams on the clay plain distributing the flow from the Assiniboine River as it came down the eastern edge of the escarpment. Channel aquifers are recognized visually as narrow slightly depressed meandering features on the ground surface. The channel widths range from less than 100 to several hundred metres and individual lengths can be traced for kilometers. The channels are in-filled with sand, silt and clay material and aquifers are discontinuous along the length of any one channel. These depressed areas collect run-off from the surrounding clay plain and may seasonally form intermittent water courses. Channel aquifers are present in the upper La Salle sub district, especially in the Oakville area. All of these aquifers are located near the surface and may have a meter or two of clay or silty-clay at the surface overlaying the sand.

In the Oakville area the channel aquifer had an influence on the settlement and placement of the homestead. Most farmyards in this area are located on a portion of a channel aquifer. The town of Oakville is built over a paleo-channel aquifer and previously exploited this water source for the town supply with wells located in the channel immediately south of town. The loading station south-west of town is also completed into the same channel.

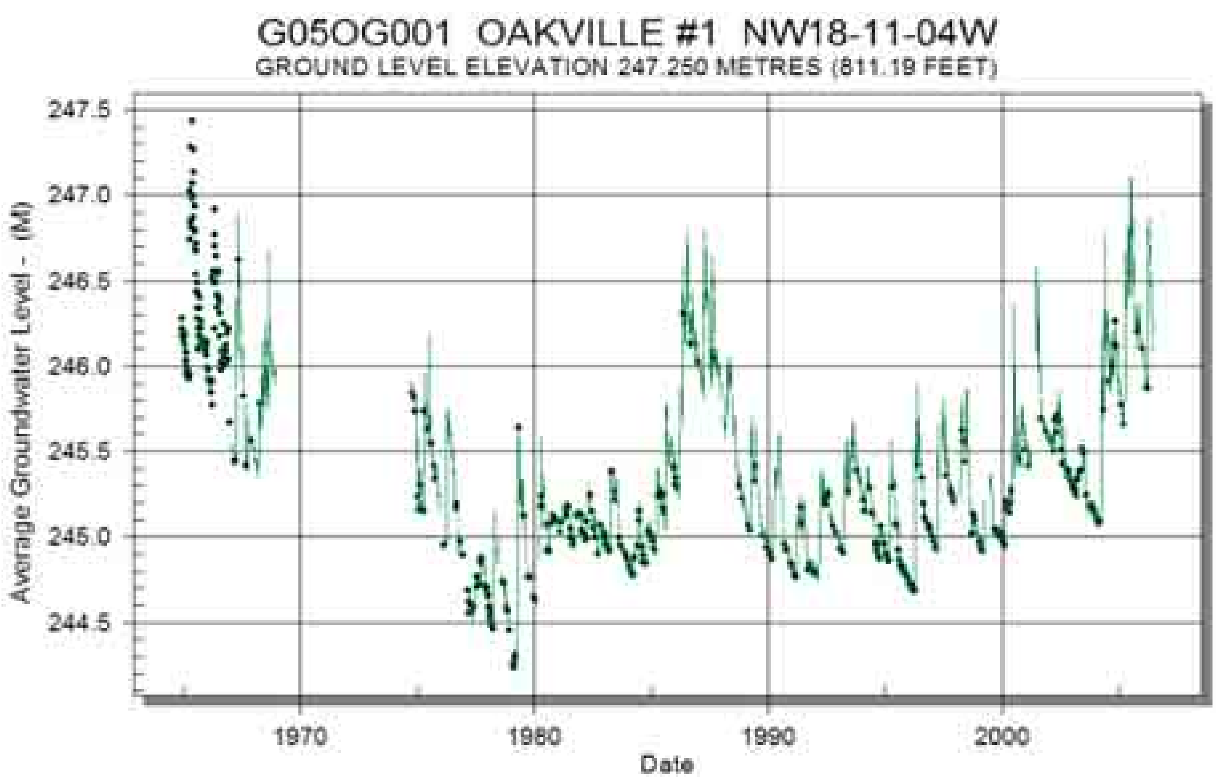


Figure 10. Hydrograph of groundwater elevations for a channel aquifer in the Oakville area is shown. The base of the aquifer this monitoring is installed is 240.85metres. See Figure 2 for location of site

Groundwater flow is dictated by the geometry of each aquifer and is restricted to within the channel outline. Channel aquifers are recharged directly from runoff within the channel depression and from surrounding land and respond quickly to recharge events.

Alluvial aquifers are stratified sediments deposited within the inner bank of stream meanders. As a stream meander length increases a greater amount of sediment is deposited on the inner portion of the meander bend. As the meander grows the extent of sand and silt deposition grows leading to the tendency of having larger water supplies and greater sand thickness within larger meanders.

Lithology of these aquifers typically consists of sand and silts. These may be separated vertically or cut-off horizontally from other permeable layers by clay. Commonly sand deposits are covered by finer textured sediments. In the upper La Salle sub-district there are few alluvial aquifers formed along the southward flowing portion of the La Salle River near Elie. The number of wells (Figure 1) increases as the river turns southeast following the ancestral Assiniboine River channel.

Wide diameter bored and dug wells are more commonly used in these aquifers than drilled wells. The advantage of wide diameter wells is they provide a reservoir in low yielding sediments. Well yields will be highly variable and because of the lack of continuity of aquifers a larger proportion of dry wells are expected during groundwater exploration.

Water quality in the alluvial aquifers ranges from good to fair. Total dissolved solids range from approximately 300 to 1400 mg/L with most solutes consisting of calcium, magnesium and bicarbonate. Hardness as $CaCO3$ ranges from less than 100 mg/L to more than 1000 mg/L. Natural water chemistry consist of chloride ranging from less than 10 to 100 mg/L, sulphate ranging from less than 10 to greater than 500 mg/L and sodium concentrations from less than 10 to more than 100 mg/L. Alluvial aquifers located within the meanders of modern rivers may hydraulically connect the well to the steam. If this is the case water supplies may be more certain, however water quality may be a greater concern because of the influence of surface water.

Glacial Outwash Sand and Gravel aquifers

Glacial outwash deposits result from direct melting of glaciers which deposit stratified sediment forming elongate sand and gravel deposits. The Elie pit located approximately four kilometers northeast of Elie is the only example of this type of aquifer within the watershed. Even though the surface exposure of this aquifer is quite small, less than a quarter section, locally it was an important water source providing the supply to the town of Elie and surrounding users. The aquifer had been exploited as a potable water source prior to the initial investigations which started in 1964 to delineate the aquifer and determine if it could meet the requirements of the town of Elie. The town supply well was completed in 1968.

The aquifer itself consists of stratified sand, gravel, silt, and clay deposit overlaying a thin till layer or at the southern portion of the aquifer lying directly on carbonate bedrock. The depth to bedrock varies from approximately 16 to 25 metres below ground.

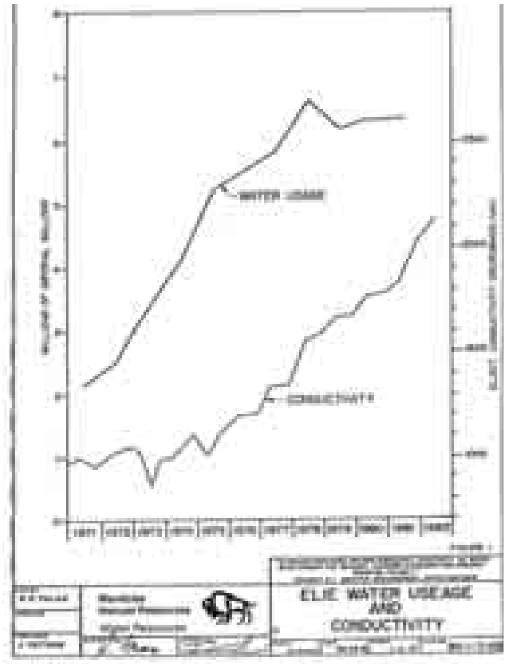


Figure 11. Graph of water usage and groundwater conductivity from the Elie town well. An increase in electrical conductivity indicates a greater salt load and influx of deeper saline water into the aquifer with pumping. Diagram from Petsnik, 1986.

Water quality in the Elie aquifer is generally quite good. Total dissolved solids ranges from 200 mg/L to approximately 500 mg/L from the sand and gravel as compared to approximately 3,000 mg/L in the underlying carbonate aquifer. The TDS of the upper portion of the carbonate aquifer immediately below the Elie aquifer is better quality than surrounding bedrock water because of the local recharge of meteoric water through the outwash sand and gravel. During the 1970's water quality as determined by water electrical conductivity, a measurement of salinity deteriorated in conjunction with increasing water usage. Increased pumping in excess of natural recharge from the sand and gravel was associated with an upwelling and mixing with more saline water from the bedrock (Figure 11).

Recharge to this aquifer is directly from precipitation to the open workings of the gravel pit and also through the soil cover overlying the sand and gravel where the gravel is not exposed. During the early to mid 1980's the Elie aquifer was studied because it was the only potable groundwater source in this area and to determine if enhanced artificial recharge could offset the water quality deterioration. The artificial recharge enhancement project (Petsnik, 1986) was planned to divert water from the La Salle River through surface drains to recharge the aquifer where it is exposed within the gravel pit. Because the water quality from the La Salle could not be assured to meet drinking water quality the feasibility study was abandoned.

Confined Sand and Gravel Aquifers

Confined sand and gravel aquifers are found as layers, or lenses within or underlying the glacial till. A scattering of test holes and wells have reported confined sand and gravel aquifers spread throughout the watershed however water quality is quite poor in most of these aquifers and is only acceptable quality for potable or livestock water needs in a narrow band running between the towns of Elm Creek and Southport.

The depth to sand and gravel aquifers is typically greater than 20 metres and aquifer thicknesses have been reported to range from less than one to 10 or more metres. Where the aquifers are separated from the surface or shallower sand and gravel aquifers the amount of recharge will be limited and even though the well yields can be large, ranging from less than 0.1 to greater than 10 L/s, the average being approximately 1.5 L/s, significant drawdown in production wells is expected. The specific capacity, a measure of the productivity of the well, ranges from less than one to more than 100 m^3 of water per day per metre drawdown in the well. Non-pumping water levels are in the range of six to 15 metres below ground.

Water quality is also highly variable ranging from relatively satisfactory to not being recommended as a potable source because of excessive hardness and total dissolved solids. Measured TDS is in the range of 500 to 5000 mg/L and hardness expressed as CaCO3 ranges from 300 to almost 2,000 mg/L. Chloride and sodium each range from 100 to 1000 mg/L and sulphate ranges from less than 100 to 2,000 mg/L. Most chemistry results are above the aesthetic objectives for drinking water for these major constituents.

Water Supply

East of a line from Elm Creek to Southport potable groundwater is limited to channel and alluvial deposits of limited extent. West of this line groundwater is generally easily accessed but well yields will generally be relatively low but sufficient in most areas for farm supplies. Charron (1964) reported that in spite of many potable wells being constructed into shallow sand aquifers that these aquifers were quite resistant to drought and with few exceptions continued to supply water during the drought of 1930’s. Water is available in some areas from deeper confined aquifers. These have primarily been discovered along the Elm Creek to Southport line at depths below 20 metres and scattered throughout the area east of this line at somewhat shallower depths. The confined aquifers east of this line are not sought after for potable supplies because of poor quality.

Groundwater Use

Driller logs specify the intended water use for new production wells. Well use can be recorded as single or multiple uses. Within the La Salle watershed the following water uses are recorded: 317 domestic, 67 livestock, 183 combined domestic and livestock, 31 municipal, 9 industrial, 2 combined air conditioning / heating and domestic 5 air conditioning / heating, and 3 wells completed for other use. Domestic and combined domestic and livestock use is the most frequent well use.

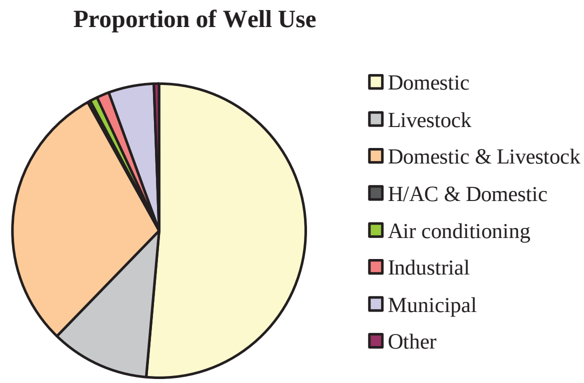


Figure 12. Proportion of well use within the watershed: the largest number of wells are used as domestic supplies, the second most common use is combined domestic and livestock.

Private Well Water Quality

There is little information with the Groundwater Management Section for routine water quality from domestic wells within the water shed. Water quality surveys were conducted by the Geological Survey of Canada during their regional well survey in the early 1960's and domestic wells were sampled as part of the Rural Groundwater Quality Initiative by the province in 1999-2000.

Where information is available for nitrate, well completion and lithology, the evidence shows that the depth to the uppermost sand and gravel and the depth below ground of the well screen or perforations are important factors on nitrate concentrations in the well water. Where the depth to the uppermost sand in a well it is greater than about three metres and the depth to the perforations is at least 6 metres there is a reduced risk of measuring nitrate above the drinking water guideline value of 10 mg/L of nitrate as Nitrogen. However nitrate can still be detected in wells that are deeper, even wells more than 40 metres deep have had measurable nitrate.

Total coliform bacteria are commonly detected in private well water. The presence of coliform bacteria is an indicator that the factors may exist where there are pathways for well water to be contaminated with water from the ground surface or from near surface. Well owners that have had positive coliform results need to assess their well for security and maintenance. Fact sheets are available from the province to help in sampling and interpreting the results of tests.

Water quality deteriorates with the proximity of sand and gravel aquifers to the bedrock. Most shallow aquifers have better natural water quality whereas deeper aquifers have higher TDS, however shallower wells are more prone to contamination.

Availability of Data and Information Gaps

Well log and groundwater information is stored by the Groundwater Management Section. Results from past well surveys indicate that only about half of the wells in service are recorded and the accuracy of the location of the majority of wells is to the quarter section on which it is drilled. Wells are often located in areas of convenience, in the same general areas as potential contamination sources and neglected, abandoned or unused wells can act as a direct conduit from the surface to aquifers. Abandoned, unsealed wells located these areas should be sealed to lessen the potential spread of contaminants to an aquifer. The knowledge of accurate well location is an important step in identifying sites for future well sealing. The province does not have access to well surveys conducted by other organizations; additional information on wells and locations would be beneficial in managing the provinces groundwater resources.

Groundwater forms the baseflow to streams. When run off from the land surface ceases the water sustaining the flow the streams comes from groundwater. There is little knowledge of the contribution of groundwater to streams. It is expected that within the clay plain shallow water contribution to streams and rivers would largely be restricted to alluvial sediments near the rivers (release from bank storage). Streams and drains originate on the eastern limit of the Almasippi sand and the Burnside beach; the contribution of groundwater to these surface water features is not quantified.

Issues, Concerns and Recommendations

- There are limited potable groundwater resources within the watershed. Much of the groundwater is present in aquifers that potentially are vulnerable to water quality degradation.
- Thin aquifers and aquifers of limited extent will be more prone to droughts.
- High use groundwater withdrawals require assessment on an individual project basis.
- Groundwater level monitoring by the province will continue as required.
- In cooperation with CD a well inventory should be completed along with general field chemistry assessment – include: well inventory, GPS coordinates, construction with rudimentary water quality, and comprehensive chemistry on select wells.
- Groundwater Management Section is committed to completing new set of groundwater map compilation based on the watershed scale. These will be produced in a digital format

Vulnerable Groundwater Areas / Well-head Protection

Previous well surveys by Manitoba and other provinces show that well location, construction and maintenance are important factors in man-made water quality problems. Because much of the potable water in the watershed is accessed by shallow wide diameter wells water quality problems can be expected to occur. The watershed authority should encourage owners of private wells to self-assess or have their well assessed for physical conditions that may affect water quality. Water testing should be encouraged for all drinking water sources on a regular basis.

Community or municipal wells require well specific assessment to determine the vulnerability in the development of well head protection policies. As a minimum the individual characteristics of each well, aquifer and geology should be considered to assess vulnerability.

References

Betcher, B., Grove, G., and C. Pupp., 1995. Groundwater in Manitoba: Hydrogeology, Quality Concerns, Management. National Hydrology Research Institute report CS-93017. 47pp.

Charron J.E., 1961. Groundwater Resources of Fannystelle Area, Manitoba (Tps. 1 to 6, Rges. 1 to 5, W. Prin. Mer.) Geological Survey of Canada Bulletin 98

Charron, J.E., 1962. Fresh-Water and Salt-Water Boundary in the Groundwater of South-Central Manitoba. Geological Survey of Canada Department of Mines and Technical Surveys, Ottawa. Paper 62-11

Johnson, W.A., 1934. Surface Deposits and Ground-water Supply of Winnipeg Map-area, Manitoba. Canada Department of Mines, Bureau of Economic Geology, Geological Survey, Ottawa. Memoir 174

Little, J., 1980. Groundwater Availability Series Brandon Area (62-H), Province of Manitoba

Petsnik, J., 1986. Aquifer Enhancement Investigations, 1980 – 1986. Manitoba Natural Resources. 26 pp. figures.

Rutulis, M., 1984. Groundwater Resources in the MacDonald – Ritchot Planning District (A Synopsis). Hydrogeology Section Hydrotechnical Services.

Sei, D., and J. Little, 1976. Groundwater Availability Series Winnipeg Area (62-G), Province of Manitoba

Sewyn, 1890, referenced within W.O Karvinen and M. L. McAllister, 1994. Rising to the Surface: Emerging Groundwater Policy Trends in Canada. Queen’s University 143 pp.

Appendix A

Definition of Terms

Definitions

Alluvial	Sediment deposited by running water.
Aquifer	A porous and permeable geologic formation that is saturated and capable of producing useful quantities of water to wells or springs.
Aquifer, confined	An aquifer that is overlain by a layer of material with considerably lower permeability. The water within the aquifer is under pressure so that it rises above the top of the aquifer material in a well drilled into the aquifer; synonym: artesian.
Aquifer, unconfined	An aquifer where the water table forms the upper boundary.
Aquitard	A saturated low permeability unit that does not yield water readily.
Hardness	A property of water that reduces the effectiveness of soap. It is primarily caused by calcium and magnesium ions; expressed in ppm (parts per million) $CaCO_3$, or as gpg (grains per gallon U.S.) where one gpg equals 17.1 ppm.
Hydraulic conductivity	The rate that water moves through water is able to move through a permeable material.
Hydraulic gradient	The change in hydraulic head over a given distance in a direction which produces the maximum rate of decrease of hydraulic head.
Hydraulic head	The total water pressure, generally expressed as elevation.
Lacustrine sediment	Sediment deposited within lakes.
mg/L	milligrams per litre; a common unit of measure for solutes in most groundwater, it is equivalent to a part-per-million.
Outwash	Stratified sand and gravel washed out from a glacier by meltwater streams and deposited in front of an active glacier.
Overburden	Unconsolidated material overlying bedrock. In Manitoba overburden is derived during glaciation or more recent time.
Permeability	The property or capacity of a porous rock, sediment or soil to transmit water, it is a measure of ease that water will flow.
Quaternary	The period of geologic time most noted for glaciation beginning between 2 and 3 million years ago and extending to the present.

Specific capacity It is an expression of the productivity of a well obtained by dividing the rate of discharge of a well per unit of drawdown during pumping.

Total Dissolved Solid (TDS) a measure of the concentration of dissolved minerals in water expressed in mg/L or ppm.

Water table The surface where all the pore space is filled with water and can be observed by measuring the water level in shallow wells installed into the zone of saturation.

Well yield The volume of water discharged from a well, frequently determined during short-term pump tests immediately after drilling the well.

Section 6.0 – Biodiversity

Section 6.1 – Wildlife Resources of the La Salle River Watershed (Source: Manitoba Conservation)

The La Salle River Watershed's main land use is the production of agricultural crops. Over 80% of the area is categorized as agricultural. Although agricultural crops provide some habitat for wildlife the key habitat areas are along riparian corridors, forested and grassland areas, which would total less than 10% of the watershed. One Provincial Wildlife Management Area (WMA), the Portage Sandhills WMA, is located in the watershed. This 1,600 ha WMA provides habitat for deer and grouse and consists of sand dunes, aspen-oak forest and mixed grass-prairie. Sand dune ecosystems are extremely fragile and this one is protected from vehicle use. The watershed supports a significant population of white-tailed deer, and a variety of fur bearing animals and neo-tropical birds.

The key element, from a wildlife standpoint, will be the preservation and enhancement of what little habitat remains. By definition wildlife habitat is the environment where animals, plants and other organisms survive and where they receive their life requisites, namely food, water and cover. It is anticipated that the watershed management plan will adopt a no net loss philosophy for these key areas. In addition to habitat, the plan should address the species of concern from the biotics database.

Manitoba Conservation staff from the Interlake Region have relatively little species specific information to provide as baseline data for the plan. Very limited survey information has been collected over the years, except for white-tailed deer survey information in Game Hunting Area (GHA) 33. The last deer survey was flown in January1998 with a total GHA population estimate of 4,210 (±30%). In 1991 a more area specific survey was flown in GHA 33, with 221 deer observed in the La Salle river corridor.

Wildlife staff will contribute to the Integrated management plan through specific wildlife concerns and will review specific requests on an as needed basis.

Section 6.0 - Biodiversity

Section 6.2 - Protected Areas within the La Salle River Watershed (Source: Protected Area's Initiative)

Protected Areas Properties within the La Salle River Watershed 2007

Watershed	Protected Area	Area (ha)	Ecological Reserve	National Park	Private Lands	Provincial Park	Wildlife Management Area	Grand Total
La Salle River	Portage Sandhills Wildlife Management Area	Protected Area (ha) within Watershed					1,591.28	
		Total Area (ha) of Protected Area					4,773.83	
	St. Norbert Provincial Park	Protected Area (ha) within Watershed				3.86		
		Total Area (ha) of Protected Area				6.62		
	Trappist Monastery Provincial Park	Protected Area (ha) within Watershed				2.02		
		Total Area (ha) of Protected Area				2.02		
Total Protected Areas (ha) within La Salle River Watershed						5.88	1,591.28	1,597.16

SECTION 6.2.1

MANITOBA'S Protected Areas INITIATIVE

Manitoba's Protected Areas Initiative is a government program dedicated to building a network of protected areas that contains the tremendous biodiversity found in Manitoba's varied landscapes. The goal of the Protected Areas Initiative is to permanently protect a representative sample of each of the province's 18 natural regions and sub-regions (areas that are differentiated from one another by their geographic, climatic and vegetative features).

Manitoba's commitment to establish a network of protected areas began in 1990, when the province became the first jurisdiction in Canada to commit to the World Wildlife Fund Canada's Endangered Spaces Campaign. In doing so, Manitoba became a partner and a leader in an international effort to protect the environment.

Protected areas prohibit, through legal means, logging, mining, hydroelectric development, oil and gas development, and other activities that significantly and adversely affect habitat. Activities such as intensive agriculture, urban or major recreational developments are avoided when establishing protected areas. Protected areas respect Aboriginal and treaty rights and agreements such as the Manitoba Treaty Land Entitlement Framework Agreement. Protected areas remain open for activities such as hunting, trapping and fishing.

Since the start of the Protected Areas Initiative the area of protected lands has increased from 350,000 hectares to just over 5.4 million hectares in 2006. Approximately 8.4% of Manitoba's lands are protected. Manitoba's network of protected areas is made up of a number of different land designations including national parks, provincial parks and park reserves, ecological reserves, wildlife management areas, provincial forests, and private lands owned by conservation agencies.

Maintaining protected areas provides many ecological and social benefits. In addition to allowing the land to maintain its natural cycles and processes, protected areas conserve biological diversity including natural gene pools. Protected areas can serve as scientific benchmarks when measuring environmental change over time and can serve as a model for the growth and succession of an ecosystem. Protected areas may also preserve land where

Aboriginal people can maintain their traditional ecological knowledge and continue traditional activities such as trapping, hunting and fishing.

Representation is the underlying principle in designing our network of protected areas. It is a measure of the degree to which an individual protected area, or the network of protected areas, portrays the biodiversity of Manitoba. Enduring features analysis is used to determine where new protected areas should be established. Enduring features are combinations of soils and surficial geology that are used to represent the biodiversity within each natural region. Enduring features analysis allows for the identification of Areas of Special Interest (ASI) and aids in prioritizing which areas are most critical for protection. ASIs are study areas selected so that they represent all of the enduring features found within the natural region that are still needed to complete representation. They are not protected in any formal manner.

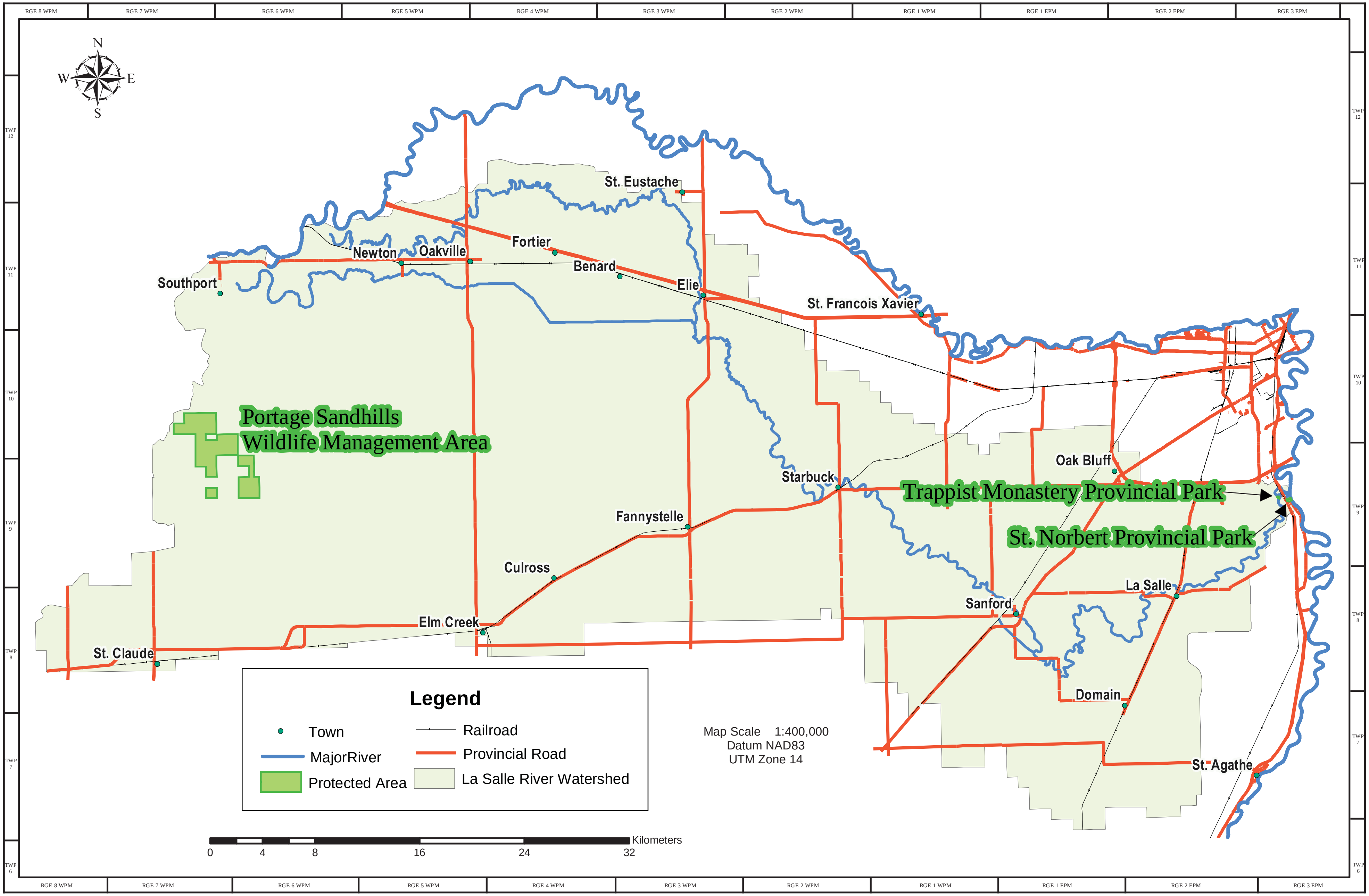
Protected areas proposals are reviewed through the Protected Areas Initiative's consultation process with the First Nations and Aboriginal communities, forestry and minerals sectors, and other key stakeholders. These consultations are an integral aspect of the program because they form a foundation of general agreement upon which a protected area can be granted permanent protection.

All Manitobans are encouraged to get involved and help complete Manitoba's network of protected areas. Contact us if you are aware of areas that have significant or unusual natural features, wildlife, birds or vegetation or contact the Manitoba Habitat Heritage Corporation if you own land you wish to protect.

For more information on the Protected Areas Initiative please visit our website www.ManitobaProtectedAreas.com or contact us:

Protected Areas Initiative
Box 53, 200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3
Phone: (204) 945-4040
Toll free: 1-800-282-8069 ext. 4040
Email: pai@gov.mb.ca

Protected Areas within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Section 6.0 - Biodiversity

Section 6.3 - Rare Species and Species at Risk within the La Salle River Watershed

(Source: Manitoba Conservation Data Center)

The Manitoba Conservation Data Centre (CDC) is a storehouse of information on Manitoba's biodiversity – its plant and animal species, as well as its natural plant communities. Housed within the Wildlife and Ecosystem Protection Branch of Manitoba Conservation, the CDC is Manitoba's authoritative source of information on rare species, including Species at Risk. The information has many uses, including conservation and development planning, and is made available to government agencies, the private sector, and the public.

The Manitoba CDC is a member of NatureServe, a network of over 80 similar organizations throughout Canada, the United States and Latin America. NatureServe and its member programs use a scientifically and empirically defined methodology and rigorous standards common to all CDC's throughout the network. The CDC exchanges its biodiversity data annually with NatureServe, thereby gaining access to the expertise of a team of biodiversity scientists from throughout the western hemisphere.

The CDC has developed lists of plant and animal species and plant communities, also known as elements of biodiversity, found in Manitoba. It assigns each of these elements a conservation status rank, based on how rare the species or community is in Manitoba, and then collects detailed information on where the provincially rare elements have been found. These locations, known as element occurrences, are mapped using specialized geographic information system (GIS) and database software known as Biotics.

The following information on species occurring within the LaSalle River Watershed is based on existing data known to the Manitoba CDC at the time of the request. These data are dependent on the research and observations of CDC staff and others who have shared their data, and reflects our current state of knowledge. An absence of a data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present; in many areas, comprehensive surveys have never been completed. Therefore, this information should be regarded neither as a final statement on the occurrence of any species of concern, nor as a substitute for on-site surveys for species as part of environmental assessments. Also, because the Manitoba CDC's Biotics database is continually updated and because information requests are evaluated by type of action, any given response is only appropriate for its respective request.

The Manitoba CDC should be contacted for an update on this natural heritage information if more than six months passes before it is utilized.

Section 6.0 - Biodiversity

Conservation Status Ranks for Species found within the LaSalle River Watershed:

SCIENTIFIC NAME (COMMON NAME)	Number of occurrences[1]	Manitoba Status Rank[2]
Plants[3]		
Cyperus erythrorhizos (Red-root Flatsedge)	1	Very Rare (S1)
Euphorbia geyeri (Prostrate Spurge)	1	Very Rare (S1)
Amorpha fruticosa (False Indigo)	1	Very Rare (S1S2)
Lygodesmia rostrata (Annual Skeletonweed)	2	Very Rare (S1S2)
Arisaema triphyllum ssp. triphyllum (Jack-in-the-pulpit)	1	Rare (S2)
Carex cristatella (Crested Sedge)	2	Rare (S2)
Circaea lutetiana ssp. canadensis (Large Enchanter's-nightshade)	1	Rare (S2)
Cyperus houghtonii (Houghton's Umbrella-sedge)	1	Rare (S2)
Cyperus schweinitzii (Schweinitz's Flatsedge)	1	Rare (S2)
Dalea villosa var. villosa (Silky Prairie-clover)	4	Rare (S2)
Heteranthera dubia (Water Star-grass)	1	Rare (S2)
Orobanche ludoviciana (Louisiana Broom-rape)	2	Rare (S2)
Panicum linearifolium (White-haired Panic-grass)	1	Rare (S2)
Carex emoryi (Emory's Sedge)	1	Rare (S2?)
Boltonia asteroides var. recognita (White Boltonia)	3	Rare (S2S3)
Lotus purshianus (Prairie Trefoil)	1	Rare (S2S3)
Hudsonia tomentosa (False Heather)	1	Uncommon (S3)
Phryma leptostachya (Lopseed)	1	Uncommon (S3)
Stipa viridula (Green Needle Grass)	1	Uncommon (S3)
Verbena bracteata (Bracted Vervain)	1	Uncommon (S3)
Viola conspersa (Dog Violet)	1	Uncommon (S3?)
Carex tribuloides (Prickly Sedge)	1	SNA
Sisyrinchium campestre (White-eyed Grass)	2	SU
Animals[4]		
Athene cunicularia (Burrowing Owl)	1	Very Rare (S1B)
Macrhybopsis storeriana (Silver Chub)	5	Uncommon (S3)
Ichthyomyzon castaneus (Chestnut Lamprey)	1	Uncommon (S3S4)
Strix varia (Barred Owl)	2	Uncommon (S3S4)
Plant Community		
Salix exigua shrubland (Sandbar Willow Shrubland)	1	Uncommon (S3S4)

1: The number of times a specific example of a plant, animal or vegetative community occurs at a specific geographic location within the LaSalle River Watershed.
2: Please refer to Conservation Status Rank Definitions
3: Vascular and Non-Vascular plants
4: Vertebrate and Invertebrate animals

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Conservation Status Rank Definitions:

The following definitions, stated in general terms, are used by the Manitoba Conservation Data Centre.

S1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

S2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

S3 Uncommon throughout its range or in the province (21 to 100 occurrences).

S4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

S5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially eradicable under present conditions.

SU Possibly in peril, but status uncertain; more information needed.

SH Historically known; may be rediscovered.

S#S# Numeric range rank**:** A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact status of the species (e.g., S1S2).

S#B Breeding: Basic rank refers to the breeding population of the element in the province.

S#N Non-breeding: Basic rank refers to the non-breeding population of the element in the province.

SNR A species not ranked. A rank has not yet assigned or the species has not been evaluated.

SNA A conservation status rank is not applicable to the element.

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General Information for the Watershed Plan:

Description/history of organizations activities/mandate in the La Salle River Watershed:

The Manitoba Conservation Data Centre (MBCDC) is a storehouse of information on Manitoba's biodiversity – its plant and animal species, as well as its natural plant communities. The MBCDC functions under the umbrella of NatureServe and NatureServe Canada, a network of 75 similar centres throughout Canada, the United States and Latin America. This network, along with a central team of scientists, maintains science-based information about the biodiversity of the western hemisphere.

Description of the data collected and why it is collected i:.

The MBCDC has developed lists of plant and animal species and plant communities, also known as elements of biodiversity, found in Manitoba. MBCDC assigns each of these elements a conservation status rank, based on how rare the species or community is in Manitoba, then collects detailed information on where the provincially rare elements have been found. These locations, known as element occurrences, are mapped in a geographic information system (GIS) and entered into Biotics a species and plant community database. The MBCDC uses a scientifically and empirically defined methodology and rigorous standards common to all CDC's throughout the network. The information has many uses, including conservation and development planning, and is made available to government, the private sector, and the public.

Description of information gaps that exist and recommendation of follow up reports or studies that could be conducted:

These data are dependent on the research and observations of our scientists and reflects our current state of knowledge. An absence of data does not confirm the absence of any rare or endangered species. Many areas of the province have never been thoroughly surveyed, however, and the absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. The information should, therefore, not be regarded as a final statement on the occurrence of any species of concern nor should it substitute for on-site surveys for species or environmental assessments.

Recommendations on best management practices, risk management or watershed management policies that will assist in alleviating concern and appropriate locations for each practice within the Sub Watersheds:

Comments on threats to some specific aquatic species which occur in the LaSalle River watershed;

Chestnut Lamprey (*Ichthyomyzon castaneus*) - Subject to Blockage/alteration of tributary.

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Silver Chub (*Macrhybopsis storeriana*) - Main core population in Red River susceptible to habitat destruction. All populations are susceptible to human activities.

The information provided in this report is based on existing data known to the Manitoba CDC of the Wildlife and Ecosystem Protection Branch at the time of the request. Because our Biotics database is continually updated and because information requests are evaluated by type of action, any given response is only appropriate for its respective request.

Please contact the Manitoba CDC for an update on this natural heritage information if more than six months passes before it is utilised.

Third party requests for products wholly or partially derived from the Biotics database must be approved by the Manitoba CDC before information is released. Once approved, the primary user will identify the Manitoba CDC as data contributors on any map or publication using data from our database, as the Manitoba Conservation Data Centre; Wildlife and Ecosystem Protection Branch, Manitoba Conservation.

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Section 6.4 - Fisheries Resources of the La Salle River Watershed (Source: Manitoba Water Stewardship)

Background:

Fishery resources are being impacted to various degrees by human activities and natural occurrences in all agro-Manitoba watersheds and the La Salle River watershed is no exception. The watershed itself is fairly void of major fish barring waterways with the exception of the La Salle River in particular the reach of the La Salle River from the Red River to the first dam located at La Barriere Park. Other waterways such as the Morris River, Elm and Meakin Creek as well as a number of drains (12) that have been investigated recently by the Department of Fisheries and Oceans (during the spring freshet) indicated the presence of a few fish species that can tolerate relatively poor aquatic habitat conditions.

Historical fishery/stream inventory data in combination with recent stream and drain inventory assessments provide a snapshot of the state of the fisheries in this watershed. In particular, the 2006 La Salle River Watershed Assessment Survey report, which was funded by the Fisheries Enhancement Initiative and coordinated by the La Salle Redboine Conservation District, provided some current information on a number of parameters affecting the health of the watershed and provides some possible mitigation solutions.

Existing Fishery Resources Conditions:

The La Salle River is the main fish barring water course found in the watershed. The majority of other waterways in this watershed are constructed drains with the exception of the Morris River and Elm and Meakin creeks. The La Salle River, being a tributary of the Red River, has the potential for numerous Red River fish species to inhabit the river in particularly lower reaches near the mouth of the river. Past fishery investigations documented in the Fisheries Inventory and Habitat Classification System (FIHCS) as well as the recent 2005 La Salle River Watershed Assessment Survey have identified 33 species in the La Salle River (bigmouth buffalo, black bullhead, black crappie, black nose dace, brown bullhead, blue gill, brook stickleback, burbot, channel cat, common shiner, creek chub, carp, central mudminnow, emerald shiner, fathead minnow, freshwater drum, northern pike, goldeye, johnny darter, quillback sucker, river darter, river shiner, rock bass, sauger, spotfin shiner, tadpole madtom, shorthead redhorse sucker, silver chub, silver redhorse sucker, walleye, white bass, white sucker, yellow perch.). It should be noted that the majority of the above species were caught in lower reaches of the river near the Red River. The bigmouth buffalo and the silver chub which are present in the river are presently listed as special concern under the federal Species at Risk Act.

During high spring freshet years, fish runs from the Red River are able to pass over a number of dams along the river (for a short period of time) and access upper reaches of the system. During low or normal spring flow years fish passage over the dams is restricted.

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Actual fish utilization of the La Salle River during the summer months in mid and upper reaches of the river appears to be limited to mostly fish species that can survive in poor habitat conditions (bullheads, sticklebacks,suckers, fathead minnows, central mudminnows, carp). The aquatic habitat in these reaches of the river are impacted by water withdrawals, excessive nutrient loading into the river, and the series of low head dams. Results from winter oxygen monitoring conducted by Fisheries Branch in 1992 along the mid and upper reaches of the river (behind the eight dams along the system) showed evidence of anoxic conditions at all sites that would result in fish kills.
In contrast, fish species diversification is much greater in lower reaches of the river in proximity to the Red River.

Recent fishery inventories implemented in the spring on other waterways and drains in the watershed (Elm Creek, Morris River, Meakin Creek, King, Barnland, Boundary, Coder, Domain, Franzman, Kelvin, Kirk, Manness, Oak Bluff, 11-A drains and Scott Coulee) indicate the presence of a few tolerant fish species (brook stickleback, fathead minnow, central mudminnow, bullheads, sucker, carp). The vast majority of these waterways would be unsuitable for fish species beyond the summer months due to lack of water to sustain fish presence.

Issues/areas of concern:

As presented in the 2006 La Salle River Watershed Assessment Survey report, the La Salle River Watershed illustrates an area that is highly impacted by anthropogenic influences. The aquatic and fishery health of the La Salle River is being greatly impacted by excessive nutrient loading from agricultural, municipal, and residential sources. Furthermore, degraded riparian buffer zones along the river and associated drainage network reduces the buffering of nutrient and sediment loading into the river from upslope sources. Reduced flow in the river due to water withdrawals for domestic and irrigation purposes also greatly reduces the quality of aquatic habitat for fish species. Several fish migration blockages have been identified along the river and historical information indicates low oxygen levels and subsequent winter kill conditions occur within mid and upper reaches of the river. Similarly, other waterways in the watershed are impacted and are generally only suitable for some fish species during the spring freshet period.

Data Gaps/Future Considerations:

Further winter oxygen readings should be done along the La Salle River at sites sampled in 1992 to determine the current extent of winter kill conditions. This work should be done in mid February.

Management Recommendations:

Follow the recommendations of the 2006 La Salle River Watershed Assessment Survey Report. As far as fishery concerns in the La Salle River, it would be essential to address water quality and quantity issues along the river prior to addressing fish passage issues.

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Water quality and quantity problems would have to be improved along the river system in order to sustain fish presence in through out the year.

Summary of La Salle River Watershed Assessment Survey – With Emphasis on La Salle River, Elm River, Elm Creek, Channel, and the King Drain – 2005. (N/S)

La Salle River:

Physical and Hydrological Information:

- Low gradient stream running primarily through agricultural land.
- Variable water depths, greater than 1 meter at center channel.
- Commencing in the 1940's series of 8 provincially owned dams were constructed along the La Salle River by PFRA. Three of these dams (located at St. Norbert, Elie, and Sanford are considered stop-log dams. – remaining are fixed crest.
- This succession of dams has changed the riverine habitat of the La Salle River to a series of impoundments which have filled with sediment and blocked fish movement.
- Low head dams, flow augmentation and irrigation play a significant part in the flow regime of the La Salle River. To provide adequate flow for domestic consumption, livestock watering and irrigation, flows of the La Salle River are augmented (0.70 m3/sec) with water drawn from the Assiniboine River (pumping station).
- There are three active pumping sites on the La Salle River (run late April/May to end of October)
- Significant irrigation withdrawals also significant water withdrawals for domestic consumption from RM of MacDonald plant located in Stanford --- servicing Sanford, Starbuck, Oakbluff, La Salle, and Brunkild.

Water Quality:

- Water from La Salle is used for a number of purposes including recreation, municipal water supply, livestock watering, and irrigation.
- Lots of water quality data available including current -- indicates a system that is stressed primarily due to point/non point anthropogenic inputs (cultivation, livestock operations, wastewater lagoon discharge, recreational sites, urban storm water drains, landscape and soils). Water quality results suggest that anthropogenic loading to the La Salle River has increased substantially over the last 25 years. In 2001, the La Salle River accounted for 1.5% of TN and 1.3% of TP in the Red River. – a eutrophic system.
- As a result heavy weed growth and duck weed growth along the river--- poor water quality.
- From study data – water quality parameters measures – dissolved oxygen met or exceeded the MB guidelines, for the protection of cool-water aquatic live in the open water season. Oxygen may decline at nights due to the amount of vegetation.

Also a problem in winter were oxygen levels of 0.4 to 202 ppm have been recorded.

Fish Species Presence:

- As a tributary of the Red River, there is a potential for numerous Red River species to inhabit the La Salle . Most species are found in the lower reach up to the dam at Laberiere Park (blockage to fish passage except for extreme high spring flow years).
- FIHCS lists 13 fish species 3 species are special concern – listed by COSEWIC – bigmouth buffalo, silver chub, chestnut lamprey.
- Actual fish utilization of the La Salle River is restricted due to habitat suitability, water quantity and a series of low head dams that restrict movement up from the Red River. Studies on the lower reaches of the La Salle in close proximity to the Red River showed use by numerous species. See table 8. and Table 9. for NS spring and summer catches for La Salle River, King Drain, and Elm Creek
- For this study – 118 fish were caught in the La Salle River in the spring (spring spawners) pike, sucker species, carp, bullheads found through out La Salle. Five fish captured in King Drain (pike, sucker), – no fish in Elm Creek Drain. Summer catches --- 148 fish captured in La Salle River watershed --- majority were carp (66), brook stickleback (28) fathead minnow (n=25) and 1 central mudminnow. YOY carp were captured in King Drain (18).

Benthic Invertebrates:

- Macro- invertebrates collected by Collin Hughes from 1995 to 1997 indicated the biological condition of the La Salle River was moderately impaired. However in 1998 collections indicated moderately to severely impaired. Samples taken by North South showed similar results.

Aquatic Habitat Conditions (La Salle Watershed):

- 36% highly impacted, 35% moderately impacted, 25 % severely impacted, minimally impacted 3%

La Salle River Aquatic Habitat Conditions:

- Highly impacted – 44%, moderately impacted – 43%, severely impacted -10%, minimally impacted areas – 4%.

Elm River Aquatic Habitat Conditions:

- Severely impacted – 38%, highly impacted - 35%, moderately impacted – 24%, and minimally impacted areas – 4%.

Domain, Elm Creek, King, and Maness drains – Habitat Conditions:

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- Nearly the entire habitat rated was severely impacted.

Note: Drains in the areas are impacting aquatic habitat and water quality.

Potential Barriers in the watershed:

- A total of 75 potential barriers to fish movement were identified through out the La Salle Watershed (fig 16 appendixes 6 of the report). Sixty-one percent of these (46) were considered to be anthropogenic in origin (ford crossings, culverts, low head dams.), while remaining 39% were associated with natural occurring debris.

Potential Rehabilitation Sites – 119 sites identified in the report

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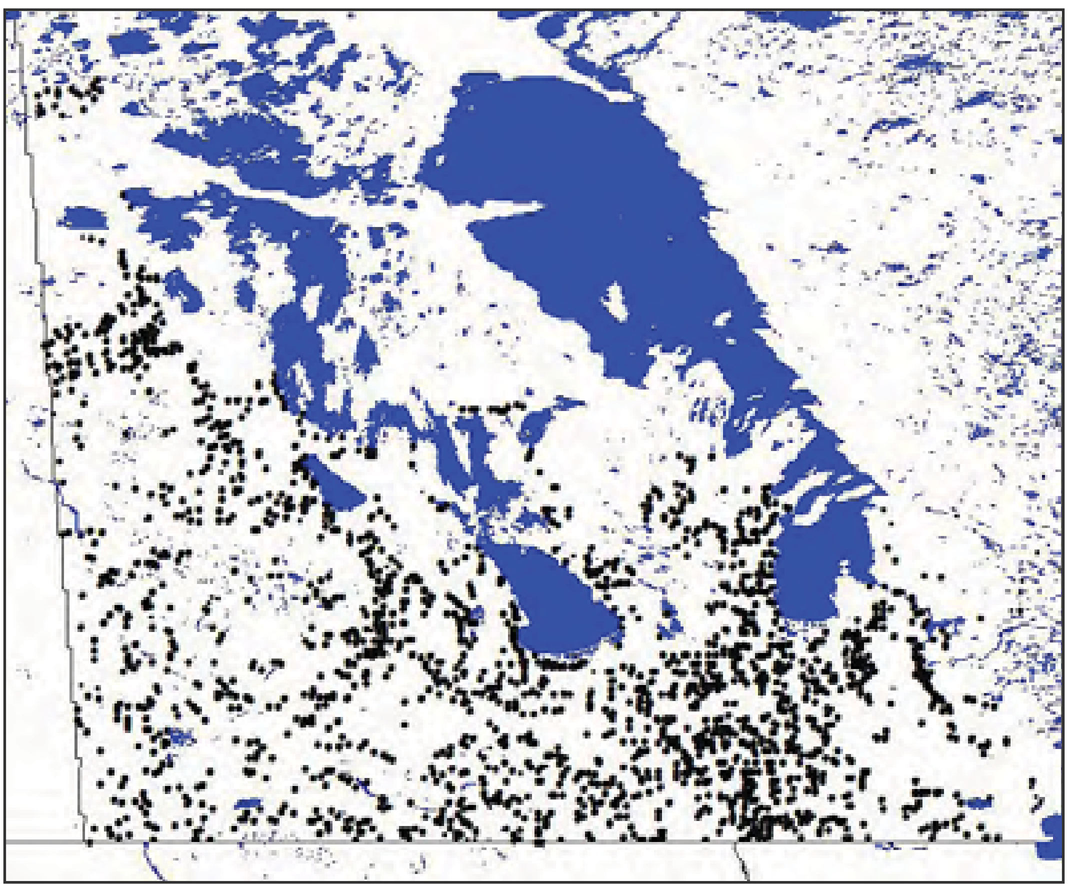
Section 6.5 – Fish Habitat Inventory for Agricultural Manitoba with Comments on the La Salle River Watershed (Source: Fisheries and Oceans Canada)

In the spring of 2002, the Department of Fisheries and Oceans Canada initiated a fish habitat inventory of streams and drains in agricultural areas of Manitoba. The final season of the inventory was completed in the summer of 2006. The data collection was focussed on smaller river systems, headwater tributaries, channelized streams and constructed drains.

The purpose of the fish habitat inventory was to gather information from areas where little or no sampling had been carried out to date. The inventory utilized sampling protocols adapted from the U.S. Environmental Protection Agency *Rapid Bioassessment Protocols for use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition* (Barbour et al. 1999).

The results of the fish habitat inventory are being used to classify the fish habitat based on habitat complexity (diversity), the fish community utilizing the stream reach, and flow duration. The results of the fish habitat inventory and habitat classification will be published in the fall/winter of 2006.

Figure 1: Map showing the location of the 2,371 reaches surveyed between 2002 and 2006 throughout agro-Manitoba.



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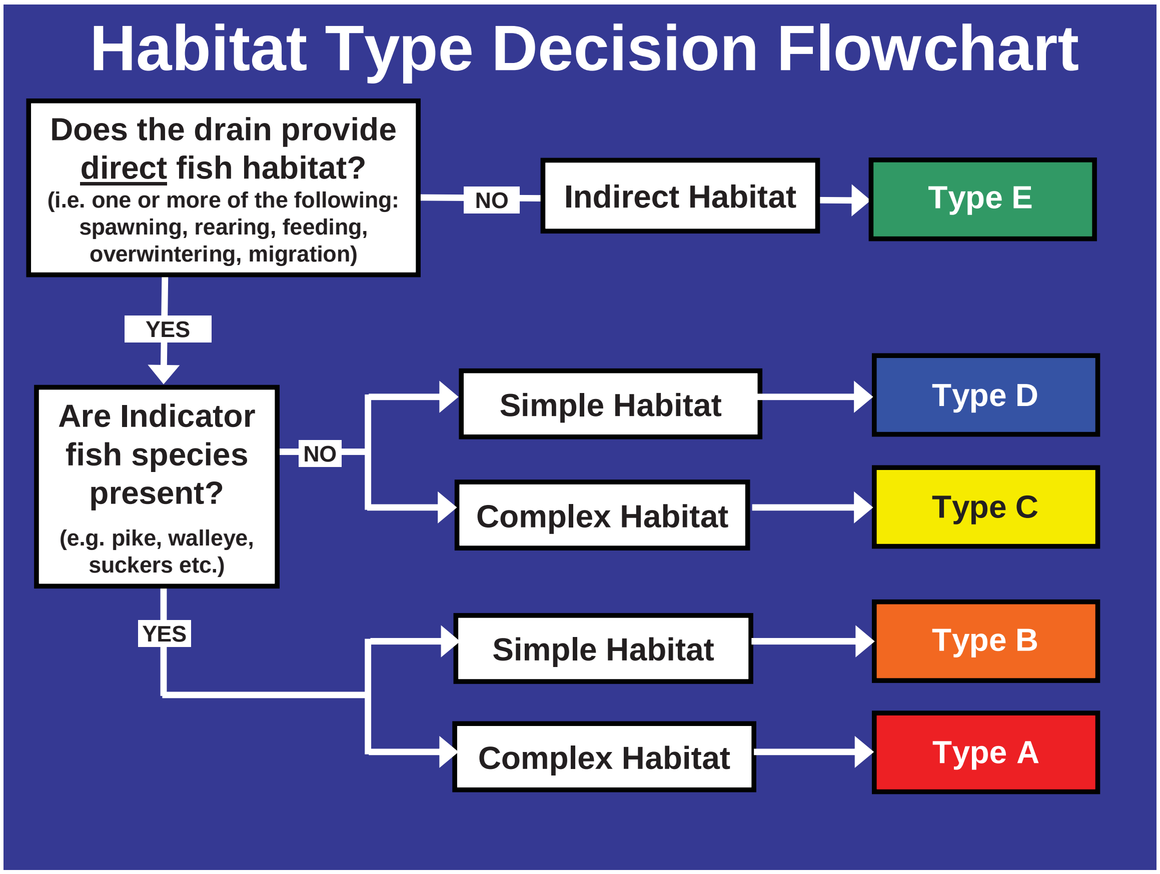
The results of the fish habitat inventory will be used to classify the stream/drain network using the following decision schematic.

Figure 2: Fish habitat type decision schematic.



Indirect Habitat typically has insufficient flow duration for fish to complete one or more of their life processes (spawning, rearing, feeding, over wintering or migration). These ephemeral channels do provide water and nutrients to downstream areas, and works occurring in or near Indirect Fish Habitat can impact Direct Fish Habitat through the transport and deposit of sediment and other deleterious substances.

Indicator Species include those fish with sport or commercial fishery value, and includes species at risk.

Simple Habitat is typically linear, has a trapezoidal channel cross-section, grassed banks or dikes, and a soft bottom, or a single substrate type.

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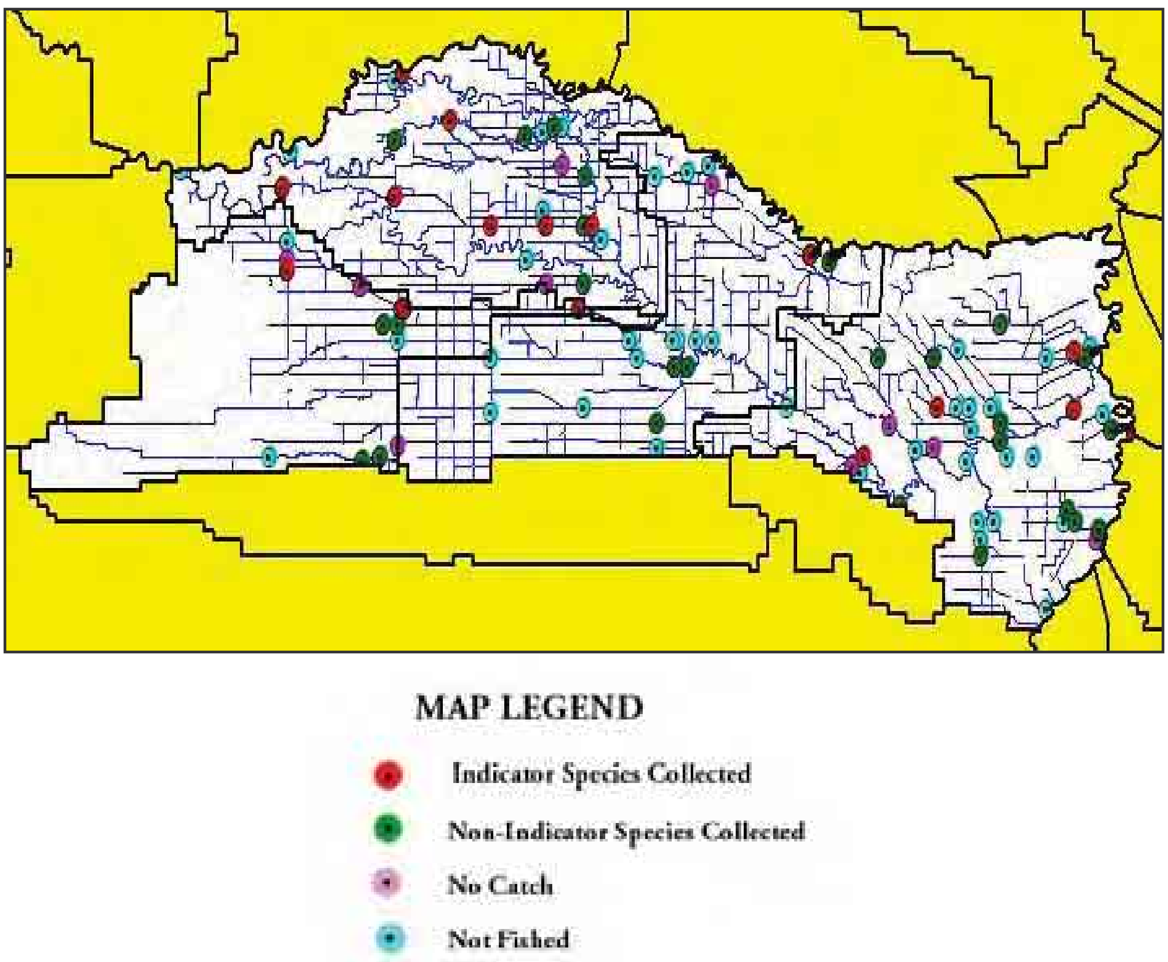
Reach Surveys Carried Out in the La Salle River Watershed:

Reach surveys were carried out at 92 locations in the La Salle River watershed. A full reach survey included the measurement of basic water quality parameters, sampling the fish and benthic invertebrate community, assessing and rating 14 habitat parameters, documenting reach conditions in a series of photographs and a field sketch to document sampling locations, channel dimensions, riparian conditions, adjacent land use practices and other features of interest.

If a reach was dry, or unsafe to wade due to high water, data collection was limited to documenting the site conditions to help determine habitat complexity.

Figure 3: Map showing the location and status of surveyed reaches in the La Salle River watershed.



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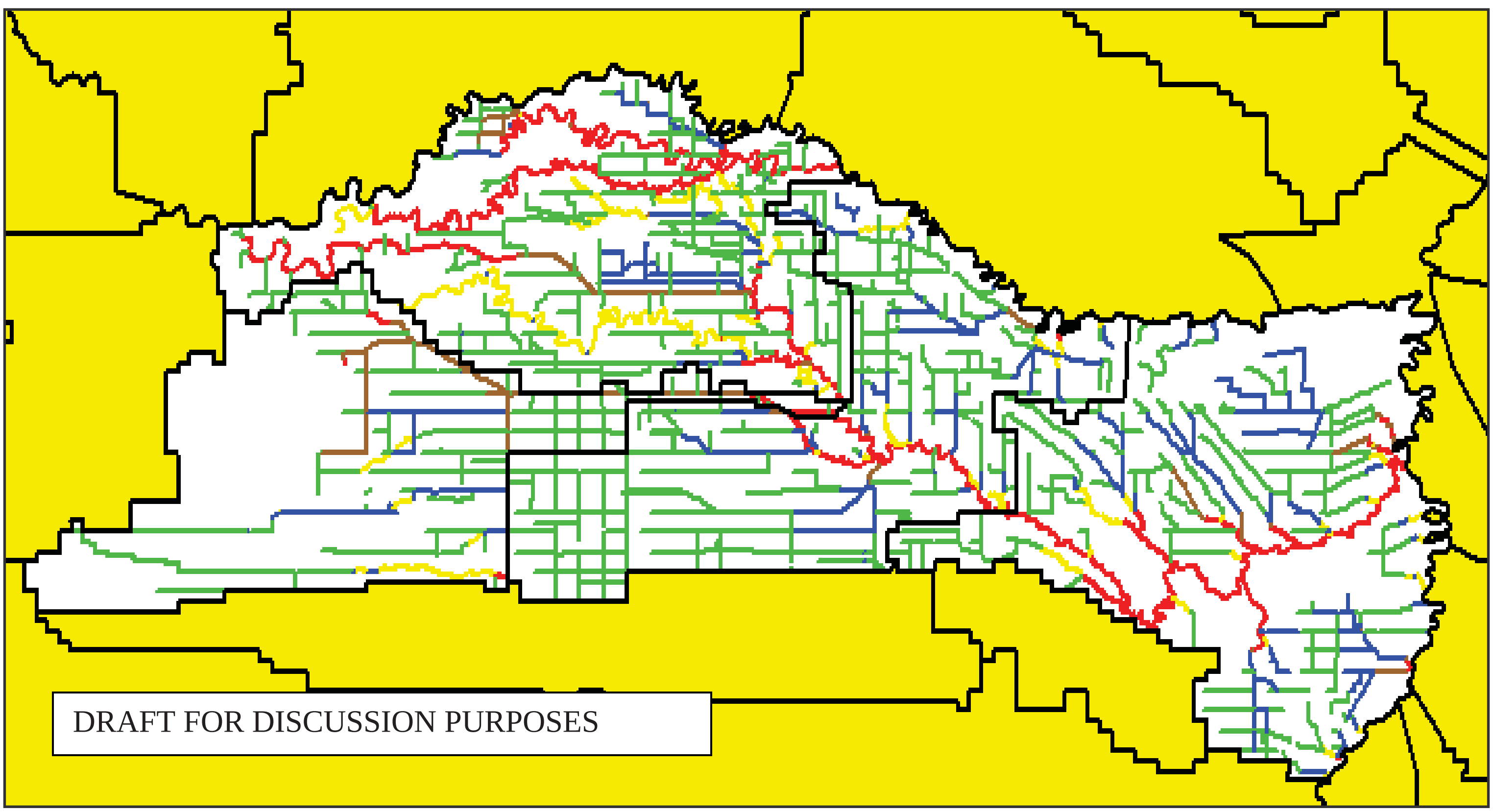
Fish Habitat Classification Mapping:

The map base for the fish habitat classification exercise will utilize a combination of the Indexed Drains Layer (Designation of Drains Map line data available from the Manitoba Lands Initiative website), and line and polygon data that is presently being developed (National Hydrological Network, set for rollout in 2009).

Version 1.0 of the fish habitat classification maps is now being prepared and will be reviewed by the Manitoba/Canada Agricultural Drainage Committee in September. The fish habitat maps will be released for public use as soon as the Committee review is completed. A DRAFT version of the La Salle River watershed fish habitat classification map is provided for review purposes only. The results of the fish habitat inventory and habitat classification maps are still in preparation and are subject to change.

Figure 4: Draft Fish Habitat Classification Map for the La Salle River watershed.



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Section 6.6 - Riparian Area Assessment for the LaSalle River (Source: Manitoba Habitat Heritage Corporation)

Compiled and submitted by:
Marilena Kowalchuk
Riparian Program Coordinator, Manitoba Habitat Heritage Corporation
200-1555 St. James Street, Winnipeg, MB R2V 0S6
Phone: (204) 784-4358
Email: mkowalchuk@mhhc.mb.ca
&
Tim Sopuck
Manager of Operations
MHHC
204-784-4357
tsopuck@mhhc.mb.ca

Outline

1. Definition
2. Benefits to watershed health
3. state of riparian health
4. recommended steps
5. programs and resources

What are riparian areas?
Riparian areas are the bands of land adjacent to water bodies such as runs, creeks, rivers, wetlands and lakes. They are transitional zones between the aquatic and terrestrial ecosystems. Abundant moisture is a key factor that defines riparian areas, as are the processes that create fertile soil conditions. These areas support some of the most diverse and productive ecosystems on the prairies.

Benefits of riparian areas to water quality and watershed health
It must be recognized that riparian areas function most effectively within a landscape that is well managed overall and that the benefits will be enhanced cumulatively at the watershed scale. Although riparian areas only occupy a small percentage of the land area within the watershed, they represent an extremely important component of the overall landscape. Their ecological functions are summarized below:

Trapping sediment: The vegetation in riparian areas collects sediment that are transported through runoff from adjacent lands. Reducing the amount of sediment reaching the water improves water quality. The accumulated sediment in turn enhances riparian soils.

Filtering water: Nutrients, pathogens and other contaminants are transported over the landscape attached to sediment, so by trapping sediment, riparian areas are also helping to prevent these elements from entering the waterway. The vegetation growth and other processes help to break down, remove and recycle these components within the ecosystem.

Maintaining banks and shorelines: The vegetation and extensive root systems in healthy riparian areas trap sediment and slow the flow of water, thereby reducing erosion. In flowing systems, water naturally erodes bank materials on the outside bend of streams and deposits sediment on the inside bend. The riparian area helps to balance and normalize these processes.

Reducing impacts of flooding: Riparian areas act like safety valves, storing excess water during flood events and reducing the intensity of flooding downstream.

Recharging local groundwater reserves: The productive riparian vegetation increases water infiltration during runoff and flooding, and their deep roots draw up moisture. The spongy soils in these areas store water and keep it nearer to the surface. The higher water tables help moderate water levels and stream flow, increasing local water availability.

Enhancing biodiversity and habitat: Riparian zones support lush, diverse plant communities and are often the only significant natural areas in agricultural landscapes. A high proportion of prairie species rely on riparian areas for at least part of their lifecycle. They also act as corridors that link these vital habitats, which is important for species dispersal and migration. Healthy riparian areas also benefit the adjacent aquatic habitat as overhanging trees and vegetation provides shade that moderates water temperature. Reducing sediment from runoff also contributes to aquatic health.

What does a healthy riparian area look like?

Riparian areas will differ depending on factors like type of water body, soils and topography, but a number of features will be consistent relating to health and function:

- Riparian soil surface is covered by vegetation growth, with little to no bare soil exposed
- Healthy and diverse plant communities that include herbaceous species (especially sedges and grasses), shrubs and trees (where appropriate). Shrubs and trees are actively regenerating with all age categories represented; individuals are healthy (no excessive browsing or disease) and decadent or dead wood is not present in large amounts.
- Invasive species and other weeds are at a minimum
- Structural alteration of the bank or shore is minimal
- Rutting, pugging and hummocking of riparian soils is minimal
- The bank is being held together by deep binding root mass (for flowing water systems)
- Excess water can escape the banks and access the floodplain (for flowing water systems)

Riparian area management

Activities that disturb or alter the natural plant communities within riparian zones and/or the structural integrity of the banks or shores may have an impact on the ability of the riparian area to provide ecosystem services. Whether the land is used for agriculture, timber harvest, recreation, or residential development, information and technical assistance is available to ensure that these practices are conducted in ways that sustain riparian health. Financial assistance may be available for some users/activities. Resources are listed at the end of this document.

Status of riparian area health in the LaSalle River Watershed.
On-the-ground, systematic assessments of riparian area health have not been undertaken in this watershed. The analysis presented here is based on an analysis of 2000 landcover data provided by PFRA (Table 1, below).

This data set is derived from Landsat satellite imagery and assigns the predominant land cover to a pixel that represents a 30m x 30m area. This analysis may identify areas with reduced riparian function from the predominant land use identified. However, since a number of essential riparian components occur within a few metres of the bank or shore, this very coarse resolution does not provide an accurate measurement of riparian condition. It also does not provide information on land uses such as grazing.

Table 1. Summary of percent land use/land cover within 50 metres of watercourses in the La Salle River watershed.

Land Use	Percent
Annual Crops	75%
Permanent Cover	2%
Native Cover	6%
Roads and Trails	16%
Other	1%

It is difficult to make specific statements from such a coarse analysis, but it is sufficient to reinforce what is generally known about the watershed. Given that annual cropping is the predominant land use within the 50 meter riparian buffer, riparian area health has been significantly impacted in this watershed. From the intensity of cultivation, it can also be concluded that land use impacts on riparian areas are greater than the average expected for Agro Manitoba. While the analysis was not stratified, given the intensity of annual cropping in the mid and downstream portions of the watershed, impairment of riparian zones in those areas would be disproportionately greater.

Manitoba has not undertaken systematic, on-the-ground inventories of riparian habitat in its agricultural regions but such work is ongoing in Alberta and is starting in Saskatchewan. Agricultural landscapes in those jurisdictions have an estimated 80% of their riparian areas classified as “unhealthy” or “impaired”. This aggregate result likely reflects the state of riparian area health in Agro Manitoba. Given the intensity of land use and drainage infrastructure in this watershed relative to other areas of the province, it is reasonable to conclude that a very high proportion of riparian areas in this watershed are not providing a full suite of ecological services.

Riparian health is most accurately evaluated by conducting an onsite assessment so a more accurate report of riparian area health within the watershed will require a more in depth analysis, including a ground survey component. An investment of time and financial resources is required to plan and conduct the inventory, but a science-based evaluation and report of riparian area health can help to identify and priorize higher risk areas and target programs as well as establish a benchmark against from which to measure change and progress.

Recommended goal

Ideally watershed managers and stakeholders would strive to achieve the state where for all riparian zones and/or buffers within the watershed are in a healthy, fully-functioning condition. Given the intensity of land use and drainage infrastructure, especially in the central and eastern portions, such a target would present massive challenges. A more plausible objective would be maintenance/enhancement of existing native riparian areas and establishment of permanent cover along existing waterways, to the extent possible, to minimize soil erosion and provide additional watershed benefits.

Recommended steps

Assessment

a) Perform an analysis of existing data sets and information (Landsat, soil maps, etc.) related to riparian landscapes within the watershed to construct a preliminary framework for improving riparian health based on areas with the highest risk for riparian degradation. Riparian sites that are cropped annually and fall within a highly erodible soil category should be given highest priority, followed by riparian areas that do not have a tree or shrub component and that fall within a highly erodible soil category, and so on.

b) Conduct a more comprehensive assessment and inventory of riparian area health:

- to have a science-based evaluation and report of riparian area health
- to further and more accurately identify and prioritize higher risk areas and target programs
- to establish a benchmark against which to measure change and progress

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Education
Encourage all owners/managers of riparian lands to achieve a better understanding of the role of riparian areas in the watershed, how these areas function, and how to assess and manage them appropriately. Ensure that this knowledge is current and accessible.

Stewardship
A number of programs are currently in place to support landowners in their choice to adopt sustainable riparian management practices. When possible, facilitate riparian stewardship through educational and financial incentive programs.

Resources:

Technical and/or financial assistance

Conservation District
LSRBCD technical and financial assistance can adjusted and applied to promote riparian area enhancement. The CD can also provide advice and contact information regarding other programs available to landowners in the watershed.

Canada-Manitoba Farm Stewardship Program
This program encourages Manitoba agricultural producers to evaluate their operations, develop environmental action plans and adopt beneficial management practices (BMPs) that will further contribute to a cleaner and healthier environment and enhance agricultural sustainability. The Environmental Farm Plan (EFP) initiative is a component of the Agricultural Policy Framework (APF) agreement, a federal-provincial-territorial agreement on agricultural and agri-food policy. Farm Stewardship Association of Manitoba (FSAM) helps deliver the EFP program in Manitoba.

Producers must complete an EFP or partake in an EAEP to be eligible for financial assistance to adopt practices in various BMPs.

Riparian BMPs include:
10 - Riparian Area Management
11 - Erosion Control Structures (Riparian)
30 - Riparian Health Assessment

A number of other BMPs may also improve riparian health:
7 - Wintering Site Management
26 - Grazing Management Planning
21 - Enhancing Wildlife Habitat and Biodiversity
28 - Biodiversity Enhancement Planning

For the most current information and more details on program delivery and EFP workshops, contact FSAM 1-866-872-8521 or your local MAFRI or PFRA office.

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Grazing Clubs
A grazing club is a community of rotational graziers who work together to improve the management of their pastures. Activities include meetings and pasture tours to explore and discuss pasture management techniques and local issues. Manitoba Grazing Clubs are supported by Ducks Unlimited Canada, the Manitoba Forage Council and Manitoba Agriculture, Food and Rural Initiatives and others. Call your local MAFRI office for Grazing Club contact information.
Manitoba Forage Council website: http://forage.lldt.net/grazingclubs/default.aspx
Manitoba Grazing Clubs website: http://www.grazingclubs.ca/

Manitoba Agro Woodlot Program
The Manitoba Agro Woodlot Program provides technical assistance to landowners regarding sustainable woodlot management. Contact the regional office in St. Pierre Jolys (433-3078) for more information. Manitoba Agro Woodlot Program Website: http://www.gov.mb.ca/agriculture/woodlot/index.html

PFRA Shelterbelt Tree Program
The Shelterbelt Tree Program provides technical assistance and distributes seedlings for planting shelterbelts or for conservation and land reclamation projects, including riparian plantings. Farmers and producers, federal and provincial government departments, municipal governments (villages, towns, cities), charitable organizations, and Band Councils or individuals for planting trees on Indian Reserves are eligible. For more information, call (306) 695-2284 or visit http://www.agr.gc.ca/pfra/shelterbelt_e.htm.

Fisheries and Oceans Canada (DFO) – Stewardship-in-Action Initiative
This program is intended to provide financial support to help regional, watershed, and local community groups grow their capacity to be effective advocates of fish habitat. The program helps groups to identify their interests, their capacities, and come to their own conclusions about how best to meet their stewardship objectives. This initiative was launched in 2003. A call for proposals is put out with proposals due early in the year. Contact DFO (204) 983-5000 for more information.

Fisheries Enhancement Initiative
The Manitoba Fisheries Enhancement Initiative funds projects that protect or improve fish stocks or enhance the areas where fish live. Project examples include restoring damaged streambanks using vegetation, rock or fencing and off stream water development. Organizations such as fish and game associations, community groups, local government agencies, school and youth groups and business organizations may apply. Contact the nearest Manitoba Fisheries office for more information.

Section 6.0 - Biodiversity

Tax Credit Programs

Riparian Tax Credit
The Riparian Tax Credit is an innovative program initiated by the Manitoba Department of Finance. It is designed to encourage farm operators to upgrade their management of lakeshores and river and stream banks and it recognizes those who have already done so. For more information, call 1-800-782-0771 or visit the website: http://www.gov.mb.ca/finance/tao/riparian.html.

Education and extension programs

Managing the Water's Edge
200-1555 St. James Street
Winnipeg, MB R3H 1B5
Phone: (204) 784-4350
Email: mhhc@mhhc.mb.ca

Managing the Water's Edge provides workshops, presentations and written materials that help landowners to understand and assess riparian areas so they can make informed management decisions.

It is a multi-agency extension initiative that draws support and expertise from: Manitoba Agriculture Food and Rural Initiatives; Manitoba Cattle Producers Association; Manitoba Habitat Heritage Corporation; Agriculture and Agri-Food Canada; Ducks Unlimited Canada; Fisheries and Oceans Canada; Manitoba Conservation Districts; Manitoba Water Stewardship; and Manitoba Conservation.

Living by Water Project
Manitoba/Saskatchewan region
c/o Nature Saskatchewan
206-1860 Lorne Street
Regina, SK S4P 2L7
Phone: (306) 780-9273
Email: info@naturesask.ca
http://www.livingbywater.ca/

The Living by Water Project is a national initiative to encourage and support individual shoreline residents across the country to work towards healthier human and wildlife habitat along the shorelines of Canada.

Websites

Manitoba Riparian Health Council
http://www.riparianhealth.ca/

Section 6.0 - Biodiversity

This website provides information on the various federal, provincial and non-government agencies and their programs that have an interest in riparian health in Manitoba. Other riparian related information and management tools are also available at this website.

Printed materials
The following documents are available through Managing the Water's Edge:

Riparian Grazing Strategies Fact Sheet Series. Managing the Water's Edge. 2006.
1. What are Riparian Areas?
2. Riparian Grazing Plans
3. Stocking Rate and Carrying Capacity
4. Improving Bank Stability
5. Improving Water Quality
6. Improving Riparian Biodiversity

These fact sheets are intended audience includes livestock producers with a riparian component in their pastures and anyone with an interest in riparian areas and their management.

Grazing Strategies for Riparian Areas in Manitoba. 2006. Manitoba Riparian Health Council. Winnipeg, Manitoba.

This manual is intended as a technical resource for extension and decision-support staff that, through their work activities, have an impact on agricultural production practices. A copy is available at Conservation District offices.

Managing the Water's Edge – Riparian Health Assessment for Streams and Small Rivers. Version 1, 2004. Winnipeg, Manitoba.

This workbook/field guide offers a simple way to assess the health of riparian areas based on key features. It is strongly encouraged that in order to use this guide most effectively, there should be some preparatory training such as attending a Managing the Water's Edge workshop. This workbook is designed for streams and small rivers in Manitoba. A workbook designed for lakes, sloughs and wetlands is available from the Cows & Fish program in Alberta (http://www.cowsandfish.org/) with plans to develop a Manitoba version in the future.

A number of other excellent fact sheets and booklets that have been produced by the Cows and Fish program in Alberta and are available directly through their website (http://www.cowsandfish.org/) or through Managing the Water's Edge.

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Section 7.0 – Watershed Development

Section 7.1 – The Watershed Community[1]

Introduction:

The Community Planning Service Portage la Prairie regional office was asked to provide data to the LaSalle Watershed Planning Authority for use in a background study related to the development of an integrated watershed plan. This document describes data provided to the LaSalle Watershed Planning Authority by the Portage la Prairie regional office.

Spatial Context:

The Government of Manitoba, Intergovernmental Affairs, Community Planning Services regional office in Portage la Prairie provides planning related services to 21 municipalities (See Figure 1).

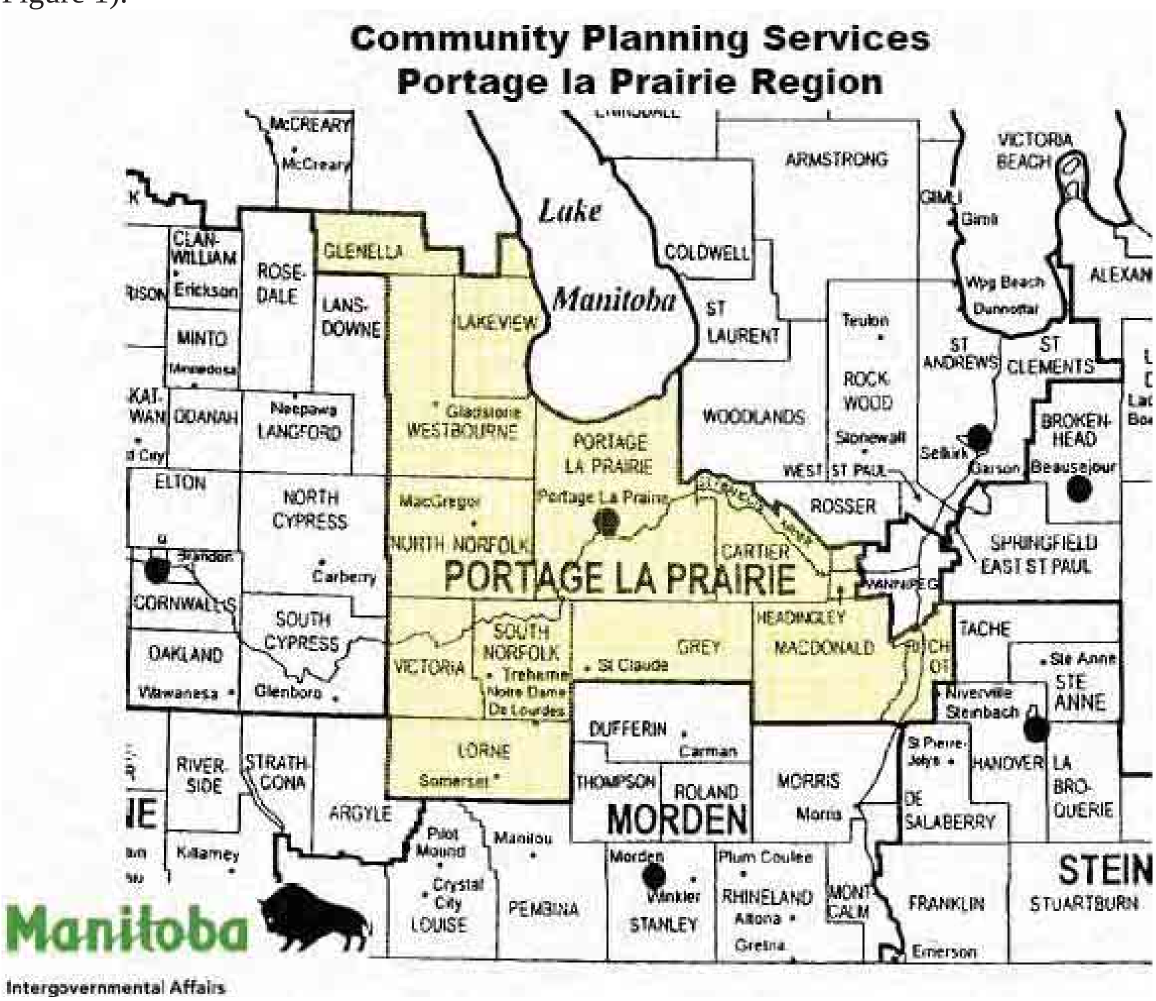


Figure 1 -Portage la Prairie Regional Office

[1] Statistical demographic information can be found in Section 7.1.2

Section 7.0 – Watershed Development

The boundaries of the three sub-districts of the La Salle Redboine Conservation District fall almost entirely within municipalities serviced by the Portage la Prairie regional office (See Figure 2).

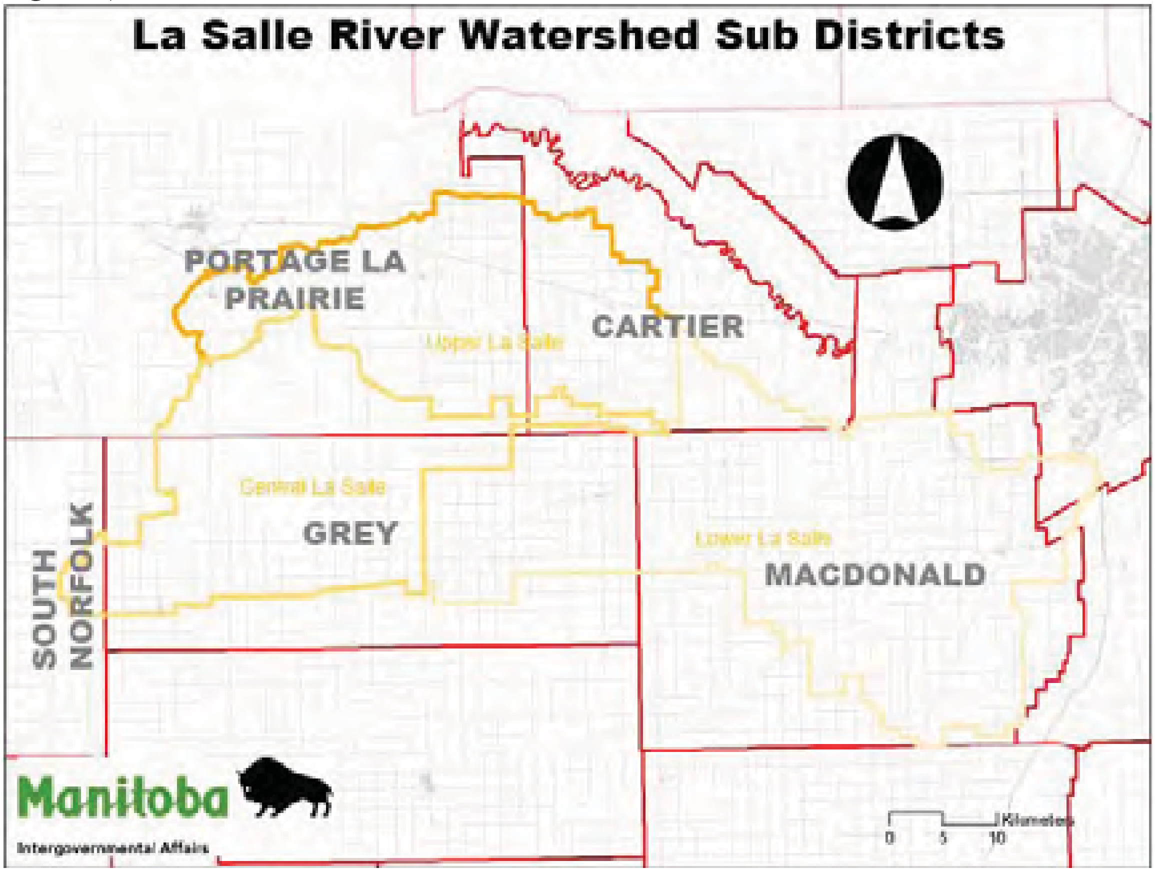


Figure 2 - LSRBCD Location

Section 7.0 – Watershed Development

Statistics Canada Data:

Demographic data related to each watershed sub-district has been provided to the Water Planning Authority in two formats: HTM and Microsoft Excel. These files contain Statistics Canada Census data queried for each watershed sub-district using the PCensus product. Population trend analysis generated by PCensus was also included in the delivery package (LSRBCD_Demographics.HTM & LSRBDCD_Demographics.XLS).

Care should be taken when using PCensus data for analysis purposes as the accuracy of such data is not available. The method by which the PCensus product aggregates population counts into choropleth boundaries has not been verified. In addition, the method used to project 2001 population counts to 2006 and beyond is also not available and therefore, the reliability of such data is not known (See Figure 3)

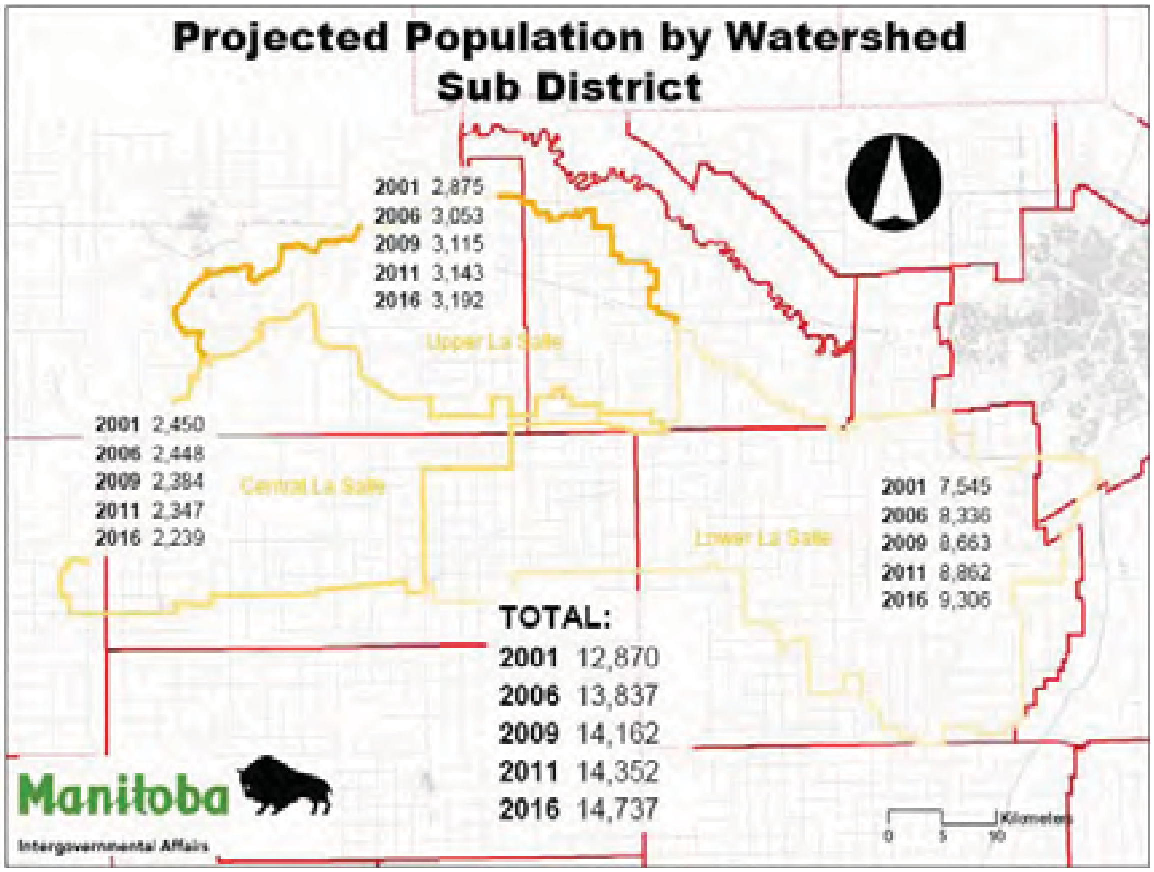


Figure 3 - Population Projections by Sub-District

It should be noted that dwelling counts generated from the PCensus product will differ from dwelling counts derived from the DwellingUnits shapefile provided with the delivery package. The method used by PCensus to generate dwelling count projections to 2006 and beyond is not available, and caution should be exercised when using this data for analysis purposes.

Section 7.0 – Watershed Development

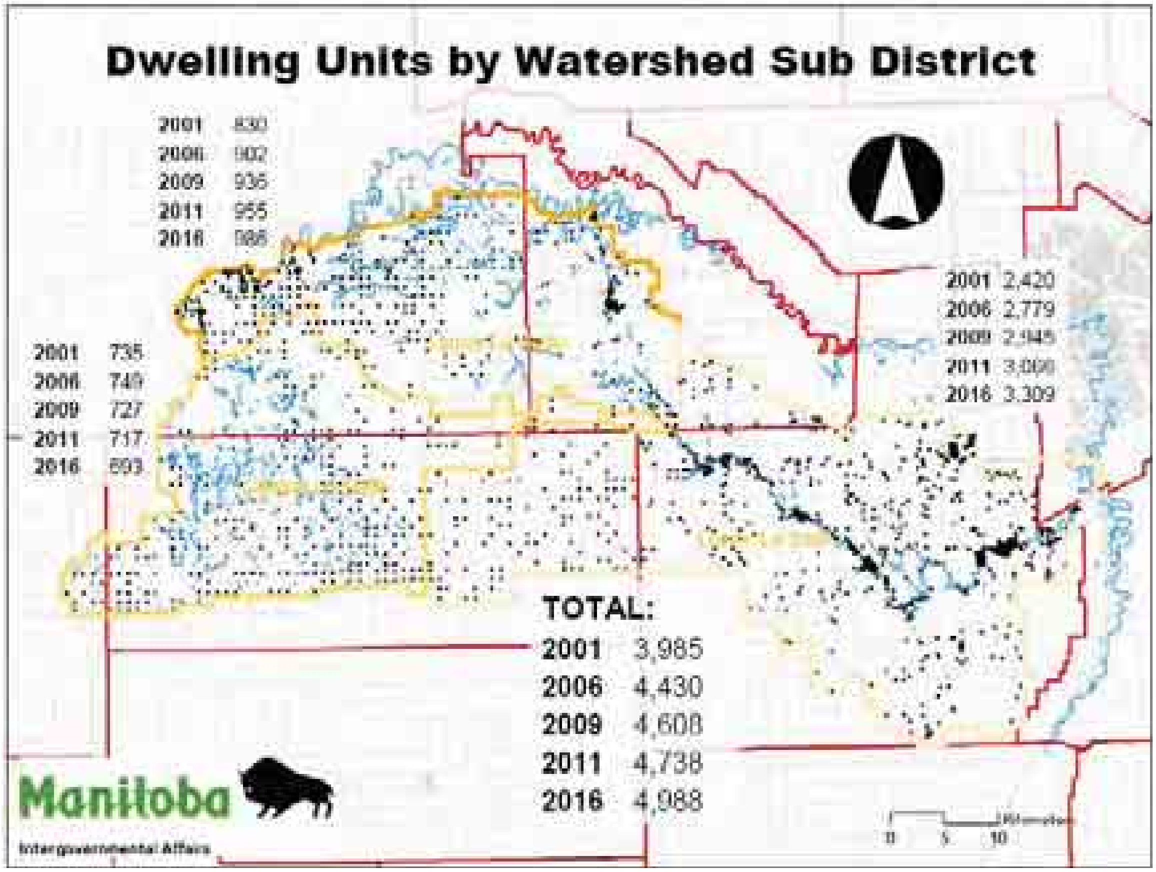


Figure 4 – Dwelling Units from PCensus

Section 7.0 – Watershed Development

By-Laws:

Development Plan:

The purpose of a Development Plan is to provide policies and regulations based upon community goals and objectives for the conservation and use of community resources and the orderly and economic development of the Planning District.

The Community Planning Services Portage la Prairie regional office does not currently have any development plan maps available in a format suitable for GIS. Maps in PDF or hardcopy may be made available upon request.

Zoning:

The purpose of a Zoning By-law is to ensure general conformance with the objectives and policies of the Development Plan and regulate the use of land.

The Community Planning Services Portage la Prairie regional office does not currently have any zoning maps available in a format suitable for GIS. Maps in PDF or hardcopy may be made available upon request.

Section 7.0 – Watershed Development

Livestock Operations:

The general location of known livestock operation structures within the boundaries of the LSRBCD has been provided in shapefile format (farmstructures.shp). This data has been derived from a database maintained by Government of Manitoba Assessment Services. Each point represents the centroid location of each section containing a structure related to a farming operation. While this data is not accurate enough to perform detailed site specific analysis, it is provided in sufficient accuracy to support watershed-wide analysis.

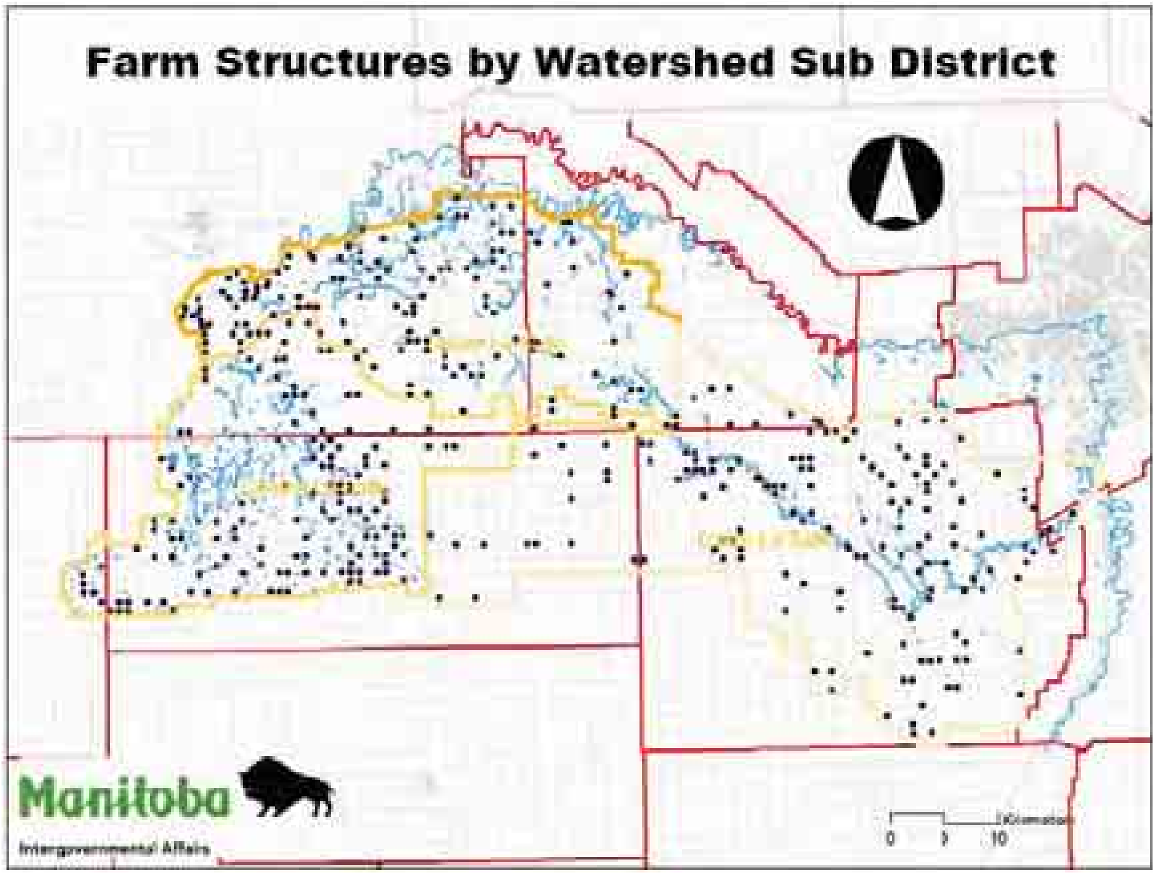


Figure 5 - Farm Structures

Section 7.0 – Watershed Development

Dwelling Units:

The general location of known dwellings within the boundaries of the LSRBCD has been provided in Shapefile format (dwellingunits.shp). This data has been derived from a database maintained by Government of Manitoba Assessment Services. Each point represents the centroid location of each section containing a dwelling unit. While this data is not accurate enough to perform detailed site specific analysis, it is provided in sufficient accuracy to support watershed-wide analysis.

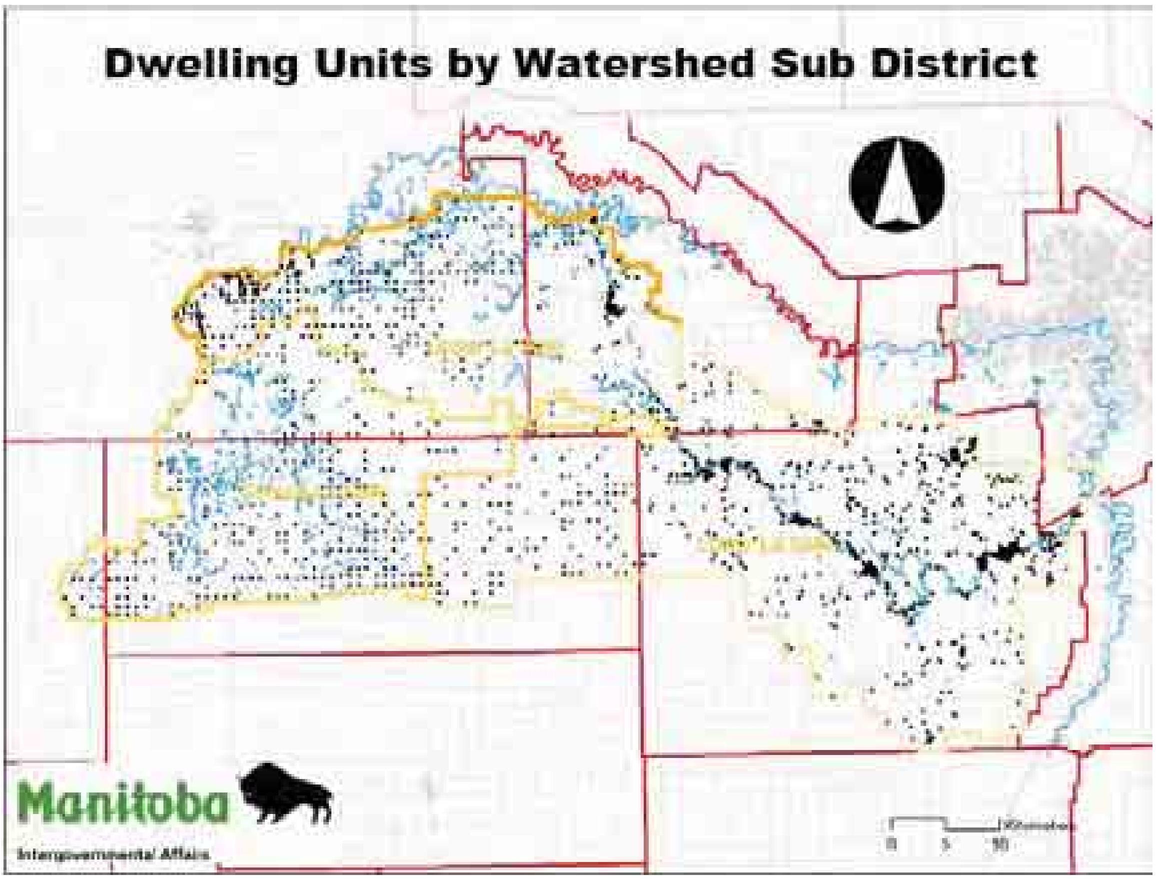
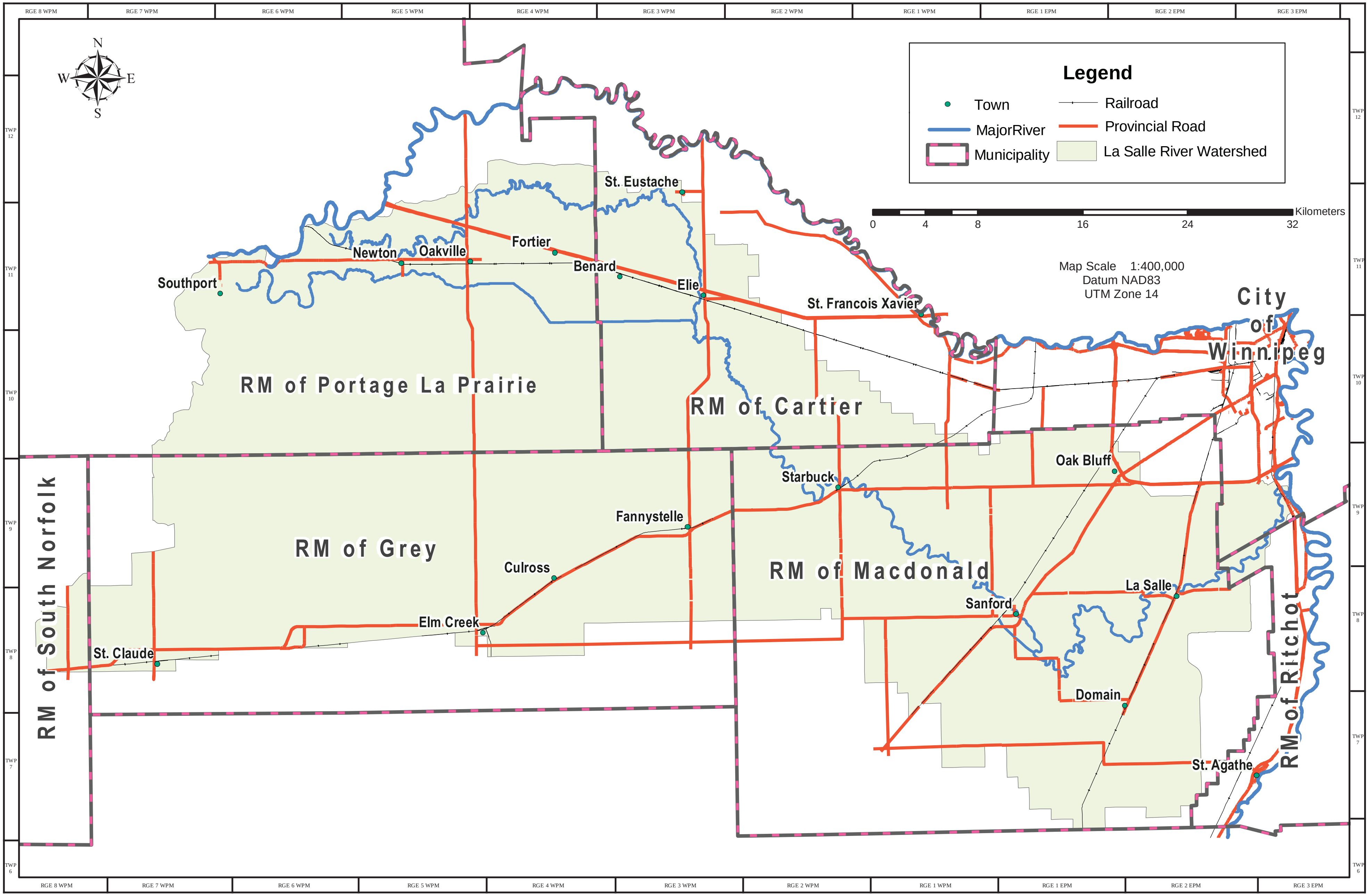


Figure 6 - Dwelling Units from Assessment Database

Municipalities within the La Salle River Watershed

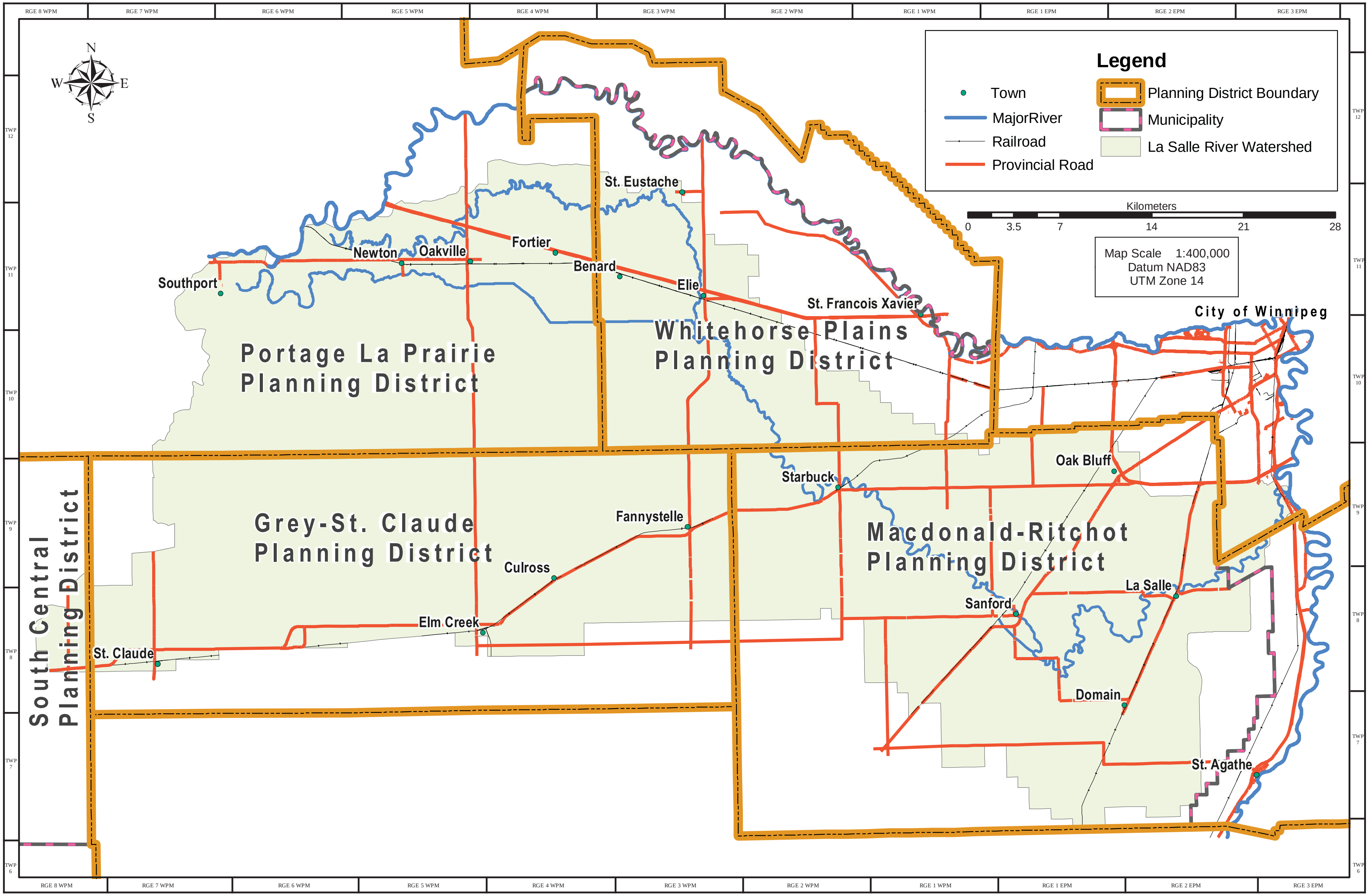


Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

SECTION 7.1.4

Planning Districts within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Section 7.0 – Watershed Development

Section 7.2.1 – Roadways of the La Salle River Watershed

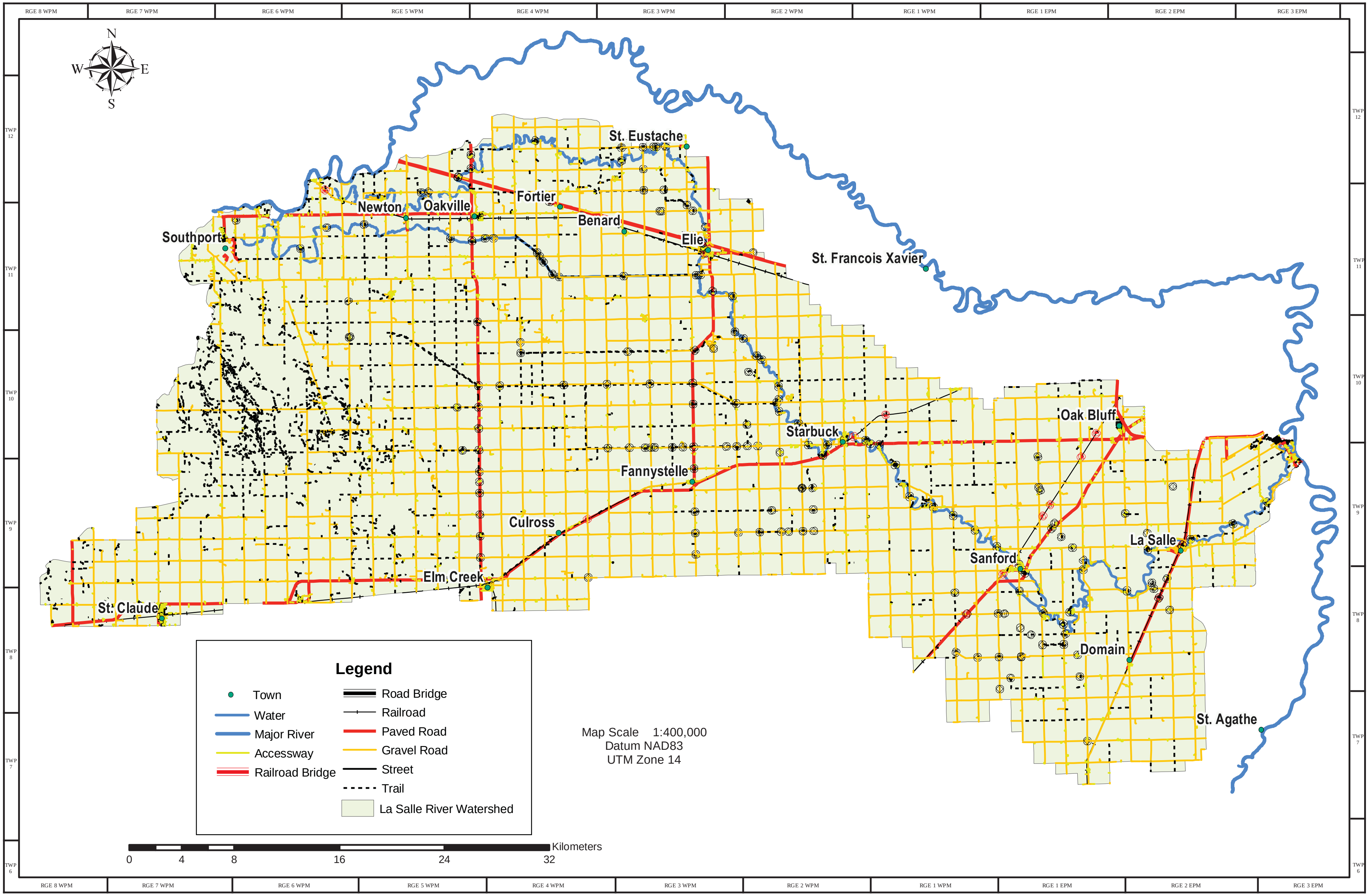
This section provides a summary of the road network of the La Salle River Watershed based on information from the Manitoba Land Initiative[1]. Besides improving access to areas of the watershed, road development can also impact watershed hydrology, wildlife and habitat. Road density (km of road/km2) is a good indicator of the degree of road development within a specific area.

Summary of Roadways in the La Salle River Watershed:

Watershed	Area(km2)	total road length(km)	Road Density(km/km2)
Upper La Salle Map: 5.1.2	610.2	621.8	1.01
Elm Creek Channel Map: 5.1.3	653.9	791.9	1.21
Lower La Salle Map: 5.1.4 5.1.5 5.1.6	1142.3	1446.8	1.27

[1] More information about the Manitoba Land Initiative can be found at: https://web2.gov.mb.ca/mli/

Road Network within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Section 7.0 – Watershed Development

Section 7.2.3 - Comments from Transportation and Government Services

The following information is being provided to the La Salle Redboine Conservation District for the development of a Watershed Management Plan.

Description of TGS mandate in the La Salle River Watershed:

- Our Department has been mandated by the Provincial Government to establish and manage Manitoba's highways

- Our responsibilities include drainage structures and ditches along provincial highways

- Our Department occasionally undertakes drainage improvements along our highways but when the project addresses a drainage problem associated with the highway itself. If the project eliminates a threat to the highway or addresses a drainage problem that compromises the integrity of the highway, we will address the problem subject to availability of funding. If the project addresses local drainage issues of adjacent lands only, we offer to co-operate by providing permission, subject to various conditions, should the local drainage authority (the RM) wish to proceed with the project at their expense.

Description of the data we have collected:

- Our Department maintains an inventory for all of our highways. The inventory includes the location of highways, traffic volumes, pavement structures, and right-of-way width

- Our Department also maintains a bridge inventory for all of our structures including bridges and large diameter culverts. The bridge inventory includes data on structure location, structure type, year of construction, design flows and structure size

Trends identified in the watershed:

- The public is developing higher expectations regarding the level of service provided for drainage. Requests for drainage work have increased and private landowners are now starting to undertake drainage improvements on public land

- Ditches along our roads and the municipal roads have been deepened to improve drainage however these improvements have lead to numerous slope failures along the roadways

Section 7.0 – Watershed Development

Areas of concern or risks to the watershed:

- Drainage and drainage improvements are a significant area of concern for our Department. The majority of our public complaints are related to drainage issues

- Spills of hazardous materials along our highways are an identified risk to the watershed. Our Department has procedures in place to deal with these accidents when they occur along our highways

Information gaps and follow-up reports:

- Our Department would appreciate detailed drainage maps for the watershed and design flows for the culverts and bridges in the watershed. The availability of design flows and detailed maps would hopefully reduce the amount of ad-hoc drainage in the watershed and would make incremental improvements to the watershed easier to implement for the various jurisdictions

- Maps showing navigable waterways and fish bearing streams would also be useful

- We would also appreciate clarification of the responsibilities, related to drainage, of the various jurisdictions within the watershed

Recommendations regarding policy:

- Our Department would like to see the development of standards for drainage improvements to address side slope failures, steep side slopes (a roadside hazard for motorists) and erosion control

Information for watershed planning:

- Our Department has placed a substantial amount of information on the Manitoba Land Initiative website (http://web2.gov.mb.ca/mli/). The information includes highway location and highway number

- Our Department also has information on bridge sites within the watershed. We are trying to export the data from our database to provide the information to you in an electronic form. If we are successful, I will forward the information to you at a later date

Section 7.0 – Watershed Development

Section 7.3.1 - Provincial Drainage Infrastructure and Management (source: Manitoba Water Stewardship - Regional Operations)

Regional Operations History:

Drainage, designed to remove excess rainfall from cropland during the growing season, is based on the productive capability of the soil and on technical, economic, and environmental factors. Drainage, and the lack of resources dedicated to the maintenance and reconstruction of existing works, has long been an issue throughout agricultural areas. Land drainage is a partnership between landowners, municipalities, Conservation Districts and the Province. Direct provincial responsibility lies with Manitoba Water Stewardship (Conservation) for the Provincial Waterway system and with Transportation and Government Services for the drains and ditches paralleling Provincial Trunk Highways and Provincial Roads.

Basic agricultural land drainage works in the province were completed in the early 1900’s, under the jurisdictions of various municipally-based entities known as Drainage Districts. In the 1930's and 1940's provisions were made for the maintenance of the drains through the establishment of Drainage Maintenance Districts, again established on municipal boundaries. In 1965 Manitoba took a proactive approach to resolving inter-municipal drainage issues by being the first of all surrounding jurisdictions to take on the responsibility for Provincial Waterways (the major drains) based on a watershed systems approach. In general, Municipalities became responsible for those components of the tributary system which outlet into the Provincial Waterways.

During the 1960’s and the period between the late 1970’s and the mid 1980’s, a number of cost sharing programs between federal, provincial and municipal jurisdictions resulted in significant temporary boosts to drainage system reconstruction and development. The dryer cycle in regional weather of the late 1980’s, resulted in drainage issues becoming less prominent. A commensurate loss of federal support saw provincial technical and financial resources dedicated to drainage significantly reduced.

In 1989 the provincial government held a series of public consultations which resulted in the publication of *Manitoba’s Water Policies*. Drainage was raised as a significant issue. Drainage priorities delineated were as follows: maintenance of the existing system -first priority, reconstruction -second priority, and new construction -third priority. The policies further stated that drainage should be undertaken on a watershed basis in order to encompass issues related to water retention, control and timing of runoff.

During the 1990’s, a wetter than normal cycle predominated, revealing the effects of the deteriorated drainage infrastructure across the province, i.e. attendant crop and other flooding related damages. The increased profile of drainage issues also highlighted regulatory shortcomings. The Province responded by transferring staff to regional postings so that drainage regulation could be administered at the local level. Enforcement of *The Water Rights Act* was actively pursued for the first time. The result of these changes was quicker action on enforcement and a shorter turn around time on licensing. There was also a significant increase in drainage license applications.

Section 7.0 – Watershed Development

In 1997/98, a public review panel on land drainage clearly heard that the Province should maintain ultimate jurisdiction and authority over drainage and drainage licensing. The main recommendations were to fund capital projects, maintain and improve drainage works, further improve drainage licensing administration and enforcement of the act. Two reviews of *The Water Rights Act* were conducted and although drainage was only one portion of the act, the majority of the comments received were on drainage issues. As a result of legal challenges, amendments were made to *The Water Rights Act* to clarify provincial jurisdiction over drainage.

Since 1965, when the province took responsibility for provincial waterways, the program budgets for land drainage have been inconsistent, with an overall trend to decreasing the effective funding aimed at maintenance. This has occurred despite the fact that many higher value crops are more sensitive to excess water and require higher drainage standards, and that construction, design, and maintenance costs have increased.

Current Status:

More recently, excessive spring and summer rainfall in 1999, 2000, 2002, and 2004 has again resulted in significant crop losses and property damage. Drainage issues have been on the agenda at Association of Manitoba Municipalities (AMM) and Keystone Agricultural Producers (KAP) meetings for the last several years. Many municipalities continue to petition the Province to increase funding to achieve appropriate levels of maintenance and reconstruction on the Provincial Waterway system. Manitoba Water Stewardship (Conservation) has committed to developing long term funding plans for drainage and to sharing these with interested municipal Councils. To date however, no comprehensive plans have been approved for distribution and discussion.

The continuing decline in technical staffing for design services, inadequate construction and maintenance funding, and a coincident thrust to address drainage problems through regulatory means, i.e. the prohibition of drainage as opposed to development of cooperative solutions to drainage problems, has produced a significant increase in litigation against the Province, both in terms of challenges to legislation and claims for damages as a result of the failure to maintain Provincial Waterways. Solutions to drainage issues have also been hindered by increased environmental scrutiny wherein a lack of clear guidelines and policy have frustrated local governments, individual producers and others who have taken matters into their own hands.

Required drainage system capacity has been increasing due to greater planting levels in specialty crops, improved on-farm infrastructure and urban development into agricultural areas. A general increase in farm size and landowners' abilities to alter runoff has also aggravated the situation.

Planning of land drainage projects generally requires multi-year scheduling for surveys, design, environmental approvals, land acquisition and construction of the works. As part of a proactive approach, Manitoba Water Stewardship (Conservation) has been preparing 5-year Capital and Minor Infrastructure plans, which include the required drainage infrastructure improvements. For the last two years, Capital expenditure plans based on annual allotments of $2.5 million,

$4.5 million and unrestricted funding have been submitted for Treasury Board consideration. The plans necessarily include non-drainage-related infrastructure (i.e. flood control works, etc.) as highest priority, but include drainage project priorities as determined within the regions. For 2000/2001 to 2002/2003, the land drainage related component of the Capital infrastructure program has been limited to about $2.5 million. Maintenance has been relatively constant over the years at a present value of $3.1 – 3.7 million per annum. Maintenance and construction of drainage transportation crossings currently involves up to 50 percent of the provincial drainage budgets.

Currently, there are no discussions between the province and the federal government regarding cost sharing agreements specific to drainage infrastructure in the province. It is expected that through the input of interest groups, and cooperation from Conservation Districts and rural municipalities, processes will continue to evolve which will ensure watershed-based projects integrate all resources.

MANITOBA WATER STEWARDSHIP (CONSERVATION)
(and predecessor designations)
DRAINAGE EXPENDITURES
ON THE PROVINCIAL WATERWAY SYSTEM
CAPITAL & MAINTENANCE

Fiscal Year	**($ M's) ~ Present Value, 2002**
67/68	8.5
68/69	9.3
69/70	7.1
70/71	7.0
71/72	7.2
72/73	6.5
73/74	6.5
74/75	6.1
75/76	6.1
76/77	7.9
78/79	12.0
79/80	6.3
80/81	7.1
81/82	9.7
82/83	8.2
83/84	8.3
84/85	8.5
85/86	11.5
86/87	8.4
87/88	7.4
88/89	8.8
89/90	7.3
90/91	6.8

91/92	6.7
92/93	6.4
93/94	6.0
94/95	5.9
95/96	6.1
96/97	6.4
97/98	6.1
98/99	6.0
99/00	7.3
00/01	5.2
01/02	4.9
02/03	5.2
03/04	6.1
04/05	6.3

Notes:

- These figures also include the maintenance of water supply and, but exclude flood control works.
- Around 1990/91 the Administration of the day implemented the elimination of field and design services which removed $3.6 million from drainage services. These costs would be in addition to that shown above.
- The portion of the maintenance budget going to projects other than drainage maintenance has been increasing in the last 10 years.
- The portion of the capital budget going to crossing replacement is increasing.
- These expenditures include regional operation expenses and departmental salary costs related to waterway maintenance activities.

Drainage Discussion Paper

Brief History of Water Stewardship Regional Infrastructure and Operations:

The Department of Water Stewardship's Regional Infrastructure and Operations Department has existed in some form or another since the late 1950's. The provincial department was formed to undertake all forms of water resource development for the benefit of Manitoba. The scope of this work included the engineering, construction, design and administration services required for the constructions of dams, drainage ditches, flood control infrastructure, reservoirs, drinking and waste water systems as well as many other water related services required by rural Manitobans. At its peak Regional Operations had over 400 employees doing water resources work throughout the province. The current department has undergone several administrative changes and has been reduced to approximately 25% of its original size. The current focus of the department is to improve existing drainage and flood control infrastructure through reconstruction projects as well as the continued maintenance of existing infrastructure.

Existing Drainage System:

Section 7.0 – Watershed Development

The current drainage system servicing Manitoba has evolved significantly over the past 60 years. The original landscape consisted of swamps, natural streams and rivers which served as the primary drainage system for Manitoba. As population increased, so did the rural land base, and agricultural land use exploded. During this time of expansion the Red River valley was pockmarked with swamps and wetlands, and had very limited drainage. The soils in this area were determined to be some of the best agricultural suited soils in the world, and efforts were undertaken to maximize the productivity of this land. The increase in agricultural productivity and its importance to the Manitoba economy dictated that a comprehensive drainage network strategy had to be developed to maximize the potential of agricultural land production. In the late 50' and early 60's the province took on the role of water management and began a huge undertaking in developing one of the most comprehensive, intense and well developed drainage systems in Canada. The drainage design criteria and methodology developed by the Province has been adopted as an industry standard by private design consultants, the United States Army Core of Engineers and is used as a teaching tool in Universities and colleges across Canada.

In developing a Provincial network of drains the natural watersheds of Manitoba had to be established, and a classification system of existing drains on the landscape had to be developed. Provincial Surveyors and Engineers were sent out physically note all natural and man made waterways and drains on the landscape. The survey information was used to establish watershed boundaries and document drainage systems existing on the landscape. All of this information was combined to develop Provincial Designation of Drain Maps. Drains are classified in terms of **order**. Drains range in size from 1rst order to 7^{th} order – the higher the number being the largest size of drain. Examples of first to third order drains include small swales, depressions or man made ditches in which water runs only in spring or after heavy rains – this may include ditches along municipal roads. Third Order to 7^{th} order streams are typically larger in size, many have been man made including municipal and highway road drains, and have significant measurable flows of surface water runoff during spring and after heavy rains. Fifth order and higher streams typically have year round flows, and are physically large waterways such as the Assiniboine, Souris and Red Rivers.

Jurisdiction Over Waterways:

All property in, and all rights to the use, diversion or control of all water in the province in vested in the Crown in right of Manitoba. All drainage works (other than those owned by the Province) in the province are subject to the jurisdiction of the Water Rights Act.

Rural Municipalities are local drainage authorities, responsible for the construction and maintenance of municipal drainage infrastructure. This typically includes smaller natural waterways as well as municipal road ditches. All municipal drainage works are subject to regulation under the Water Rights Act which is administered by the Province of Manitoba.

In some areas, Conservation Districts have authority over the waterways contained within their district. These are specific districts that have special agreements in place with the Province to maintain and operate these waterways. The Conservation Districts drainage activity is still regulated by the province under the jurisdiction of the Water Rights Act.

The Province is an important owner/operator of Provincial waterways. These waterways were designed and constructed by the province and are currently maintained and operated by Regional

Operations. These drains are formally designated as being under Provincial jurisdiction through Orders-in-Council. There are approximately 2700 miles (4500 km's) of Provincial Waterways in Manitoba incorporating 600 bridges and 1500 major multiple culvert crossings. Existing provincial waterway infrastructure has a current replacement value of $1 billion dollars.

Drain Design Process:

Once the Province recognized the agricultural capability of the Red River Valley and areas of the Interlake and northern Manitoba a strategy was developed to help maximize the potential of farm land. Drainage of these areas was identified as the major component needed to ensure the land base would become and remain suitable for profitable agricultural production. Water Stewardship, with help from other government departments such as Agriculture developed a drain design formula that would ensure the size and type of drains constructed would reflect the type and value of the land the drain was servicing. All drain surveying, drafting, design, administration and construction supervision was done in house. Drains were designed using complex engineering techniques and formulas developed by Water Stewardship. Due to the different land types throughout the province, different standards were developed for construction to ensure that the "best" land received the highest standard of drainage. Four standards were developed, each designed to remove a predetermined size rainfall event within a given timeframe. Specialty crops (beans, potatoes) had rainfall removed with a few hours, cereal crops (canola, wheat) within 36 hours, forage crops (hay land) within 4 days, pioneer land within 10 days. These standards were developed with input from agricultural experts at the time, and based on the crop types and land use in the 60's and 70's. The timeline criteria were combined with other design elements which help to dictate drain size and type. The main criteria used to asses and design a potential drain are soil type, existing topography (slope of land) and a cost benefit formula using the potential crop value to "tweak" a drain design to maximize crop potential. Soil type is a key design element. The soil characteristics determine how much runoff is coming from the landscape (eg. Clay soils have less water infiltrating downward than do sandy soils) so if one soil type is predominant it will affect the runoff rate and therefore drain capacity. Soil type combines with slope of the land determines if the speed of water in the drain needs to be controlled. Through a series of comprehensive tests allowable drain slopes and in channel velocities were established and incorporated into all drain designs. Added to these specific engineering criteria is a cost benefit value which reflects the value of the land and crop type that the potential drain will service. Drains were designed specifically for the area they service. This same design process is used currently by Regional Operations when undertaking drain reconstruction projects.

Current Operation of Drainage System:

The existing drainage infrastructure on the landscape was designed and constructed to service an agricultural land base and practices established in the late 60's and early 70's. As technology and agricultural research has advanced, so has the capability of the agricultural land base to handle increasingly specialized crops. Land previously classified as marginal or non-productive has now become some of the most profitable and expensive land in agro-Manitoba. An example of this in the sandy soils in south central Manitoba. In the late 60's this land was determined to be non-profitable and was deemed inadequate for cereal crop production, it was seen as not being important (by local government and producers) to service via a complex drainage network. Today this land is ideally suited for specialty potato production, and is classified as the most valuable agricultural land in Manitoba with sale prices being in excess of $3500 per acre. This example is specific to this land type, but different scales of this increase in land value and productivity is common throughout agro Manitoba. Simply put the drainage standard that the Provincial network of drains was designed and constructed to does not exist anymore. Land once considered marginal is no longer so, and the opening up of previously undeveloped land has increased the area draining into Provincial Infrastructure substantially. Previously marginal land is now some of the most valuable land in the province – but at the time of original construction the servicing of this land by a drainage network was not considered, or any existing drain was designed to service the land value of the day.

Prioritizing of Work –Maintenance and Reconstruction:

Reconstruction of Existing Infrastructure:

The increase in land values and changing land use practices have made most of our provincial drainage network obsolete. Our drains are now simply not large enough to service the current land base adequately, and redesign and reconstruction of these waterways is required. The redesign and reconstruction of waterways is undertaken and administered by Water Stewardship. Individual farmers, farm lobby groups as well as municipalities lobby Water Stewardship to improve our existing infrastructure to reflect current land values. This lobbying is not limited to one particular area, but is spread out across the province. Due to the system wide degradation of our drainage system Water Stewardship has to prioritize its work to address areas of highest concern. In order to prioritize, Water Stewardship incorporates current land values, existing infrastructure condition and public demand to determine which waterways require immediate improvement. In order to ensure priorities are acted upon, and that the worst problems are being addressed 5-year plans are developed to address infrastructure priorities. An annual budget of approximately 1.9million dollars is provided to undertake reconstruction projects throughout the province. For simple reference, the average cost of reconstruction of a provincial drain is $200 - 250 000 dollars per mile. A number of other factors can drive this cost up considerably. The demands for improvements far outweigh our current ability to deliver. A map showing the last 5 years of reconstruction projects has been provided.

Maintenance:

Water Stewardship is continually undergoing maintenance on its waterways. This activity includes bridge reconstruction, culvert replacement, vegetation removal and other related activities. Our maintenance activities are mainly fixing broken or damaged infrastructure, and responding to complaints by municipalities or landowners being serviced by our infrastructure. Annual maintenance budget for the entire province is $ 2.0 million dollars out of which all departmental maintenance employees are paid Bridges and crossing receive their own budget of $ 1.3 million annually, but the cost to replace one bridge crossing a provincial waterway can be $350 000 dollars. With 600 bridge crossings and 1500 culvert crossings repair and replacement activities are limited.

Provincial Drainage Infrastructure within the La Salle Redboine Conservation District:

Section 7.0 – Watershed Development

The agricultural land base within the LRCD is substantial and is serviced by approx 470 miles of provincial waterways constructed with 102 bridges and 83 culverts. These waterways are supplemented by a municipal drainage network which is subject to licensing under the Water Rights Act. Drainage Licensing will be discussed separately further into this report.

Portage Diversion:

The LRCD contains one of the Province's most important pieces of flood protection infrastructure – the Portage Diversion.

The Portage Diversion is similar in nature to the floodway in terms of design and principle. The Portage Diversion structure is located approximately 1 mile southwest of Portage La Prairie on the Assiniboine River. There are two separate structures. They are described as follows:

1. **The Assiniboine River Control Structure (Spillway**) **–** this structure is imbedded in the river and consists of two hydraulic gates that rest on the bed of the Assiniboine River which can be raised and lowered to manipulate the amount of flow in the Assiniboine River that flows to Winnipeg. It is not typically recognized that the control of water levels on the Assiniboine River is critical to controlling floodwater elevations within the City of Winnipeg
2. **Portage Diversion Inlet Structure and Channel –** when the gates of the river control structure are raised, to flows in the Assiniboine River are diverted down the Portage Diversion channel through the Inlet structure. The inlet structure has gates which are also manipulated to control water levels down the diversion channel into Lake Manitoba.

This flood protection infrastructure is used to control water levels on the Assiniboine River – and is integral in the protection of Winnipeg from flood waters.

Water Rights (Drainage) Licensing:

Water Stewardship's Regional Operations is responsible for administering and enforcing the Water Rights Act. The Water Rights Act is used to govern drainage and water diversion or control activities on the landscape. Typically proponents of drainage related projects apply to Water Stewardship for approval of their projects. Water Stewardship staff inspect the proposed project and either approve the project as applied for, approve with conditions and changes, reject the proposal. The role of the province in regulation is to ensure that any proposed project does not have a negative impact on upstream or downstream water users without the confines of jurisdictional boundaries.

As a whole the geographical area of the LRCD has one of the lowest rates of drainage licensing in the province. Licenses are usually applied for by municipalities, with a smattering of individual landowners applying as well. A breakdown (approx.) of licenses applied for by municipality in the past 5 years is as follows:

- R.M. of Victoria – 5 application by municipality, 4 applications by individuals
- R.M. of South Norfolk – 10 applications by municipality, 6 applications by individuals

Section 7.0 – Watershed Development

- R.M. of Dufferin – 35 - 40 applications by municipality, 15 - 18 applications by individuals
- R.M. of Grey – 11-13 application by municipality, 5-7 applications by individuals
- R.M. of Portage La Prairie – 3 -5 applications by municipality, 10 – 14 applications by individuals
- R.M. of MacDonald – 3-5 applications by municipality, 4 applications by individuals
- R.M. of Cartier – 2-3 applications by municipality, 0 applications by individuals
- R.M. of Ritchot – 5-6 applications by municipality, 2 applications by individuals

This averages out to 26 total applications for the LRCD per year – average of 4 per municipality (including municipalities). If we remove the R.M. of Dufferin which is by far the most consistent municipality for applying for Water Rights Licenses the average per year drops to 14 total applications per year, or 3 per municipality (including individuals).

The number of applications and licenses are not reflective of the amount of drainage occurring on the landscape. It is recognized that some municipalities have bigger drainage budgets than others, and those with smaller budgets do not undertake much drainage work, and that is reflected in the number of applications. As well many municipalities are not undertaking new drainage works, and are simply maintaining an existing system. However, there are municipalities and individuals within the LRCD that are undertaking extensive, unlicensed drainage works. This does not necessarily mean that all unlicensed work is detrimental to the landscape, but some of the work is harmful and leads to the biggest issue facing drainage licensing – enforcement under the Water Rights Act.

Enforcement of Water Rights Act:

Historically enforcement under the Water Rights Act has been sporadic and largely ineffective partially due to process, but largely due to weakness in the Act and reluctance to prosecute.

Historically if a person or company performed illegal drainage works a drainage officer would investigate, and if a violation of the Water Rights Act had occurred a letter notifying the landowner or proponent of the work would be sent informing them of their violation. The letter would outline the actions required to mitigate the problem, be it closing in the works, modifying them to some degree, or altering the project entirely. The offender would then have a certain amount of time to comply with the letter. In some cases compliance was undertaken quickly, often as a result of the offender not being aware a licence was required etc. In some cases offenders undertook the remedial work reluctantly due to misinformation (meaning they were told no approval was required by an alternate party).

In most other cases the offender does not comply with the letter from Water Stewardship, and harsher measures are required. The next step in this process is the issuing of a Ministerial Order – which is an order signed by the Minister of Water Stewardship ordering the offending party to modify the illegal drainage works to the conditions outlined in the Order in a required amount of time. If the offender does not comply, the province can order a third party to undertake the required work, and all costs incurred are the responsibility of the offender to pay.

Section 7.0 – Watershed Development

Previously under the Water Rights Act and offender could appeal this order to the Municipal Board, and any appeal stayed the order – meaning that until the matter was heard before the board the illegal works could remain open until found illegal. This has lead to further non-compliance, and ultimately litigation against the province for non-enforcement. The result is essentially a beauracratic nightmare which leaves the initial issue ultimately unresolved.

Enforcement under the Water Rights Act has been brought up repeatedly as a main issue of concern by entities such as AMM and the Conservation District Program. Recently a review of the Water Rights Act has been undertaken by Water Stewardship and Provincial Cabinet, resulting in the formation and passing of the Water Right Amendment Act. This Act is intended to give more enforcement powers to Water Stewardship staff and effectively deal with drainage offenses as they occur. The new legislation will give officers the ability to issue on the spot fines, enforcement notices, and in extreme cases allow for equipment seizure all with the legislative ability to legally support these actions. These changes have been welcomed by most municipalities and Conservation Districts. The changes in legislation require the appropriate training of Water Stewardship staff be undertaken. It is likely that enforcement ability will be available until the spring of 2007.

In conclusion the Role of Water Stewardship's Regional Operations within the LaSalle Redboine Conservation district is varied and quite complex. Historically the province has undertaken a large amount of work with the CD's geographical area, as this is one of the predominant agricultural areas in the Province. Being primarily agricultural this area is also ripe with drainage complaints arising form individual and municipal activities. Water Stewardship Regional Operations is a strong proponent of the IWMP as it will help address longstanding water issues throughout the CD. As well it will be a useful tool in the long and short term planning regarding potential drainage projects and their long term feasibility.

Drainage Standards

Purpose of Artificial Drainage

- The primary purpose of artificial agricultural drainage is to reduce to tolerable levels the damage to agricultural crops, caused by excess rainfall during the growing season. Excess rainfall is that portion of the rainfall that is in excess of what the agricultural plants can use for growth. This excess rainfall, if it remains on the crop field, will first damage, then destroy, the agricultural crop, by severely reducing the amount of free-air oxygen that is absorbed by the roots of the crop plants. Artificial agricultural drainage provides for the draining away of the excess rainfall which ponds on the crop fields.

- Artificial drainage has secondary agricultural benefits which occur when the water table is lowered by some desirable amount. They include:

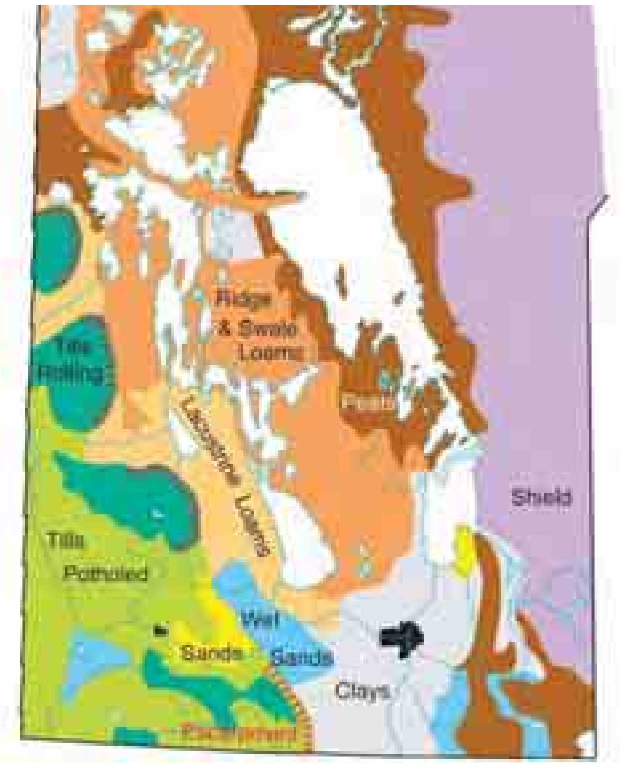
  - increasing the depth of the root zone, making more of the soil nutrients available to the plant and producing a more drought-resistant plant
  - enabling better growth of beneficial soil bacteria
  - increasing the soil temperature

- The artificial drainage network also provides some degree of flood protection to residences and to the road network throughout Manitoba. Both in the summer and in the spring, the drainage network carries away rainfall and/or snowmelt runoff that would otherwise flood residences and overtop municipal or provincial roads. Even when not overtopped, many roads would deteriorate significantly if summertime or springtime floodwaters remained against the road slopes for long periods of time.

Where Artificial Drainage is Needed in Manitoba

There are three regions in Manitoba that require drainage, as shown on Figure 1:

1. The "Clays" area of the Red River Valley, the "Ridge and Swale Loams" area of the Interlake, and the "Lacustrine Loams" area west of Lake Manitoba.



2. The wet sands areas west of Portage la Prairie, in the southeast, and southwest of Brandon.

3. The peat areas of the Interlake and the southeast.

Figure 1

In the clay and loam areas, artificial drainage is needed because the natural drainage is poor, that is, summer-time rainwater ponds for long periods of time.

Poor natural drainage occurs for two principle reasons:

- The land is so flat that rainfall runoff occurs very slowly naturally, or
- There are no natural streams capable of removing rainfall water in a timely manner.

In these areas, soils are poorly or imperfectly drained. These areas are shown as yellow and orange on the MAFRI "Internal soil drainage map" (Figure 2). The clays, and to a lesser extent the loams, retain soil moisture even after surface water drains away; this makes the need for drainage in these soils especially necessary for agricultural crop growth.

Artificial drainage benefits around 5.5 million acres of agricultural land. Approximately 2.5 million acres could sustain no cropland production without drainage.

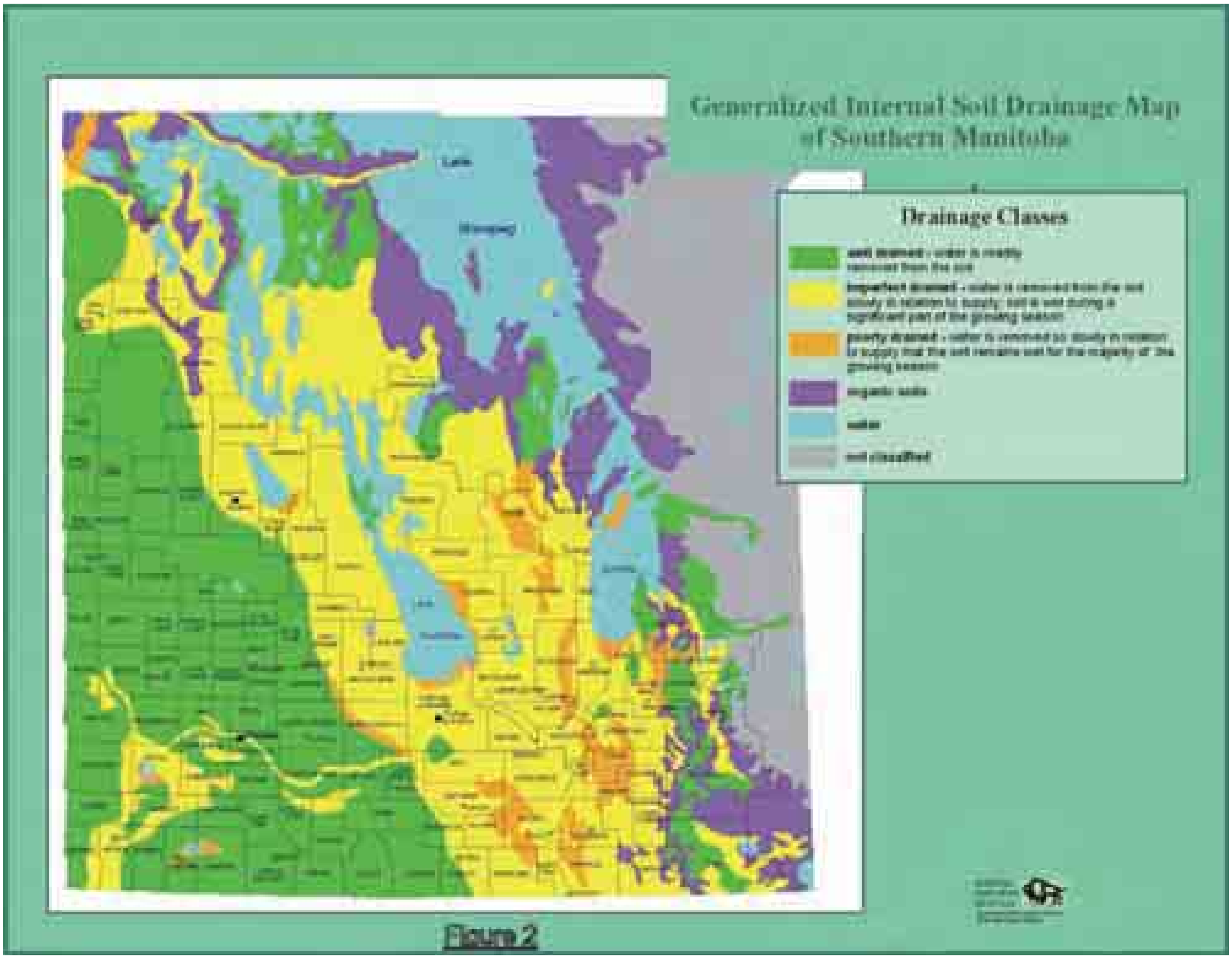


Figure 2

Figure 3

"Clays" area of Red River Valley

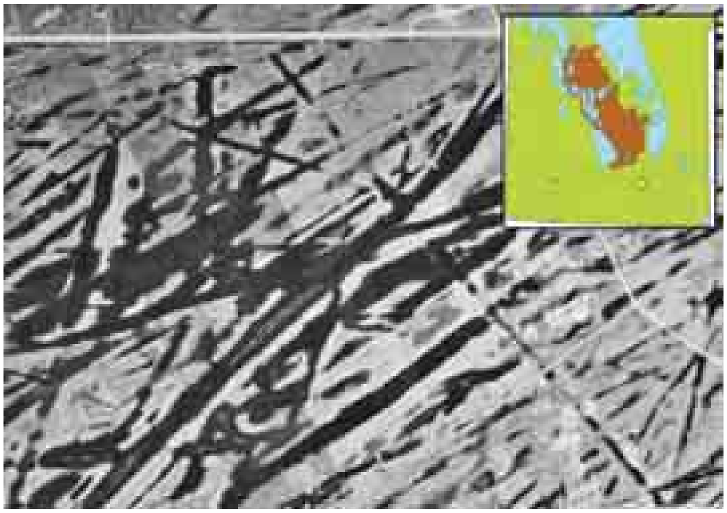


Figure 4

"Ridge and Swale Loams" area of the Interlake

Figure 5

- In the wet sands areas, water tables are often quite high. This can negatively affect agricultural crop production, as high water tables drown out the plants' lower root zone. Water table management is required for crop production.
- The wet sands area is shown on the map in Figure 1. The problem of high water tables is illustrated in Figure 5.

Figure 6

- In the peat land areas, water table control is also required for agricultural production purposes. If the water table is too high, drowning of plants and/or their root zones occurs. If the water table is too low, the peat soils dry out, resulting in oxidation of the soils, subsidence and risk of fire.

- The peat land areas are shown on the map in Figure 1. A typical peat area is shown in the photograph in Figure 6.

Where Artificial Drainage is Not Usually Needed

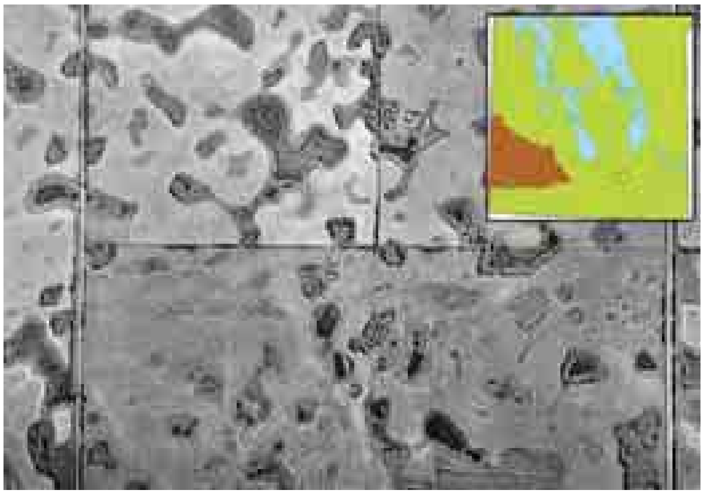


Figure 7

- Artificial drainage is not usually needed in the potholed, rolling, and escarpment areas of western Manitoba. These areas are shown in Figure 1.

- The pothole region of western Manitoba is illustrated in the aerial photograph in Figure 7.

Figure 8

- An example of a poorly-conceived drain in an escarpment area is shown in the photograph in Figure 8.

Artificial Drainage Networks in Manitoba

Artificial drainage networks typically consist of these components:

1. On-farm drains, swales and draws that convey excess rainfall from the interior of the farm field to the edge of the field

2. Small to medium-sized drains that start at the edge of farm fields and get larger in size as the smallest drains join together.

    - These drains are usually under the jurisdiction of the Rural Municipal governments, except where conservation districts exist which have jurisdiction over the drainage network. These small to medium-sized drains are called first-, second- and third-order waterways. Examples are shown in Figures 9, 10 and 11, respectively.

Figure 9

Figure 10

Figure 11

3. The main, large drains which the small and medium-sized drains exit into.

    - These drains are usually under the jurisdiction of the Province, and the larger ones typically exit into rivers or lakes. Again, where conservation districts exist that have jurisdiction over the drainage network, these drains are under the districts' jurisdiction. These larger drains are mostly fourth-, fifth- and sixth-order waterways. Two examples are shown in Figures 12 and 13. In many of the larger drains (like the one in Figure 13) there are significant berms besides the main channel, dikes at the berms outside edge, and then an outside drain to collect and direct local runoff to culverts thru the dikes.

Figure 12

Figure 13

An example of a network of small and medium-sized municipal drains and the larger Provincial drains is shown on Figure 14. This network is in an area east of Portage la Prairie.

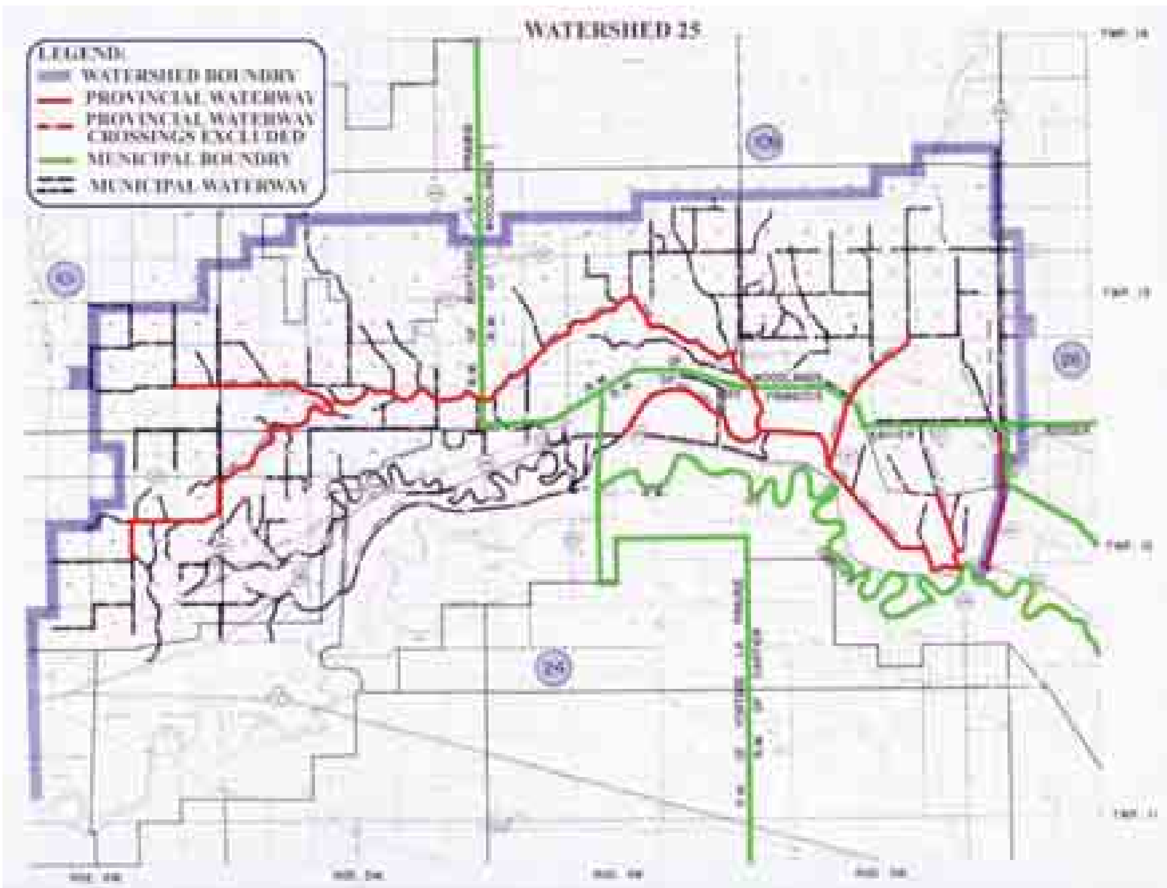


Figure 14

Provincial Drains

There are approximately 2,700 miles (4,500 km) of Provincial drains (called Provincial waterways) in Manitoba - Figure 15.

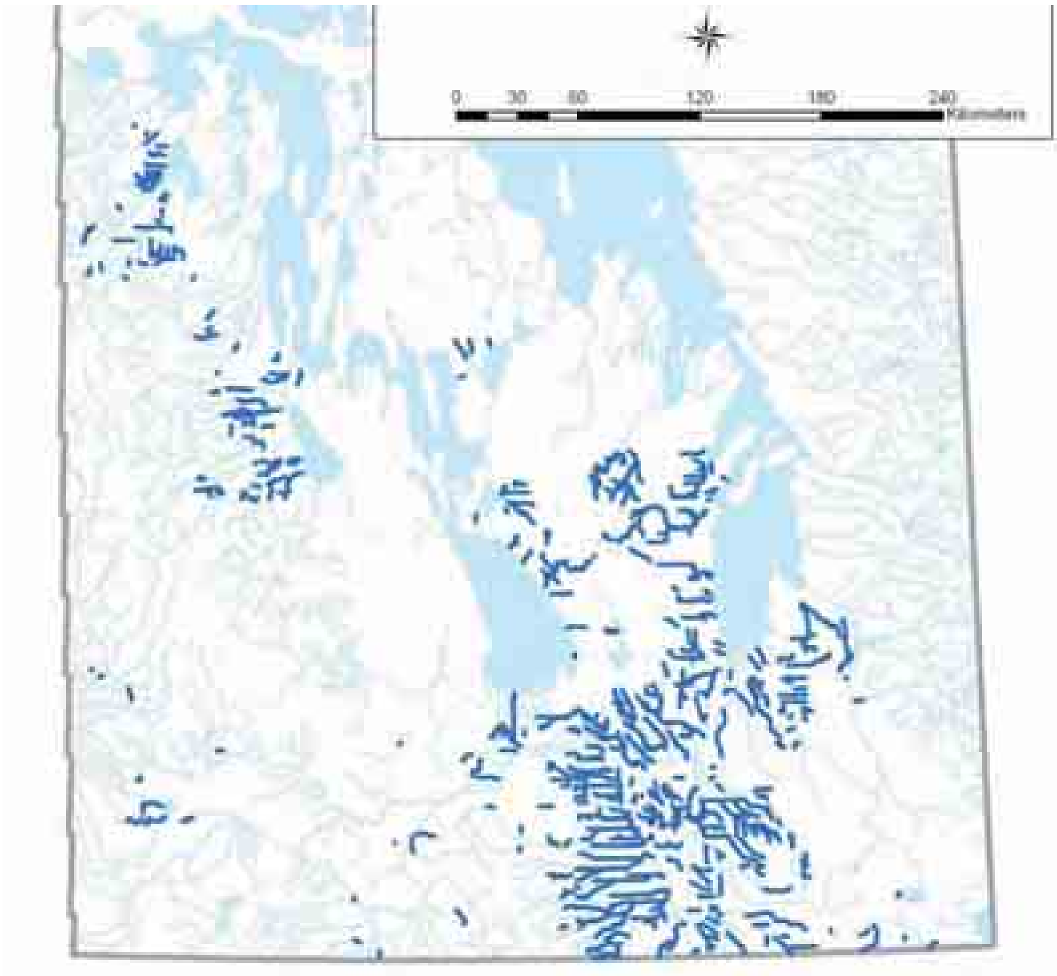


Figure 15

These drains are formally designated as being under Provincial jurisdiction, through Orders-in-Council. They are formally called Provincial Waterways.

There are around 600 bridge crossings on the Provincial drains. As well, there are around 1,500 major culvert crossings.

The Provincial drains have a replacement value of approximately $1 billion.

In 2005, the Provincial Government allocated $1.9 million for the upgrading of nine Provincial drains. As well, $2.0 million was allocated to maintenance of the Provincial drains; an additional $1.3 million was allocated to repair bridge and culvert crossings on these drains.

Drainage Design Standard

- The standard used to determine the size of drains in any particular area is related to the soil capability. That is, areas consisting of soils which are capable of producing high-value specialty crops such as sunflowers and peas would have a high standard of drainage. On the other hand, areas consisting of soils which are capable of producing only forage crops or native hay crops would have a low standard of drainage.

- Four distinct drainage standards have been developed. These are based on soil capability.
  - i. Special, high-value crops: excess rainfall to be removed from cropland within a few hours.
  - ii. Cereal crops: excess rainfall removed from cropland within 36 hours.
  - iii. Forage crops: excess rainfall removed from cropland within four days.
  - iv. 'Pioneer': excess rainfall removed from cropland within 10 days.

  The map in Figure 16, which was produced in the late 1980's, generally illustrates where the above standards are applied across Manitoba. Today, almost 20 years later, the "special crops" area, and the "grain-major crops" area in the Interlake are both notably larger.

  It should be noted that the above standards are not applicable to peat (organic) soils or to wet sands. This is because, on those soils, water table management is required rather than surface drainage works.

- The sizing of drains in any specific area is based on an economic benefit-cost technique. In this technique, the benefits and costs of drainage works are evaluated to arrive at an optimum drain sizing. This technique is based on an extended research study undertaken in the early 1970's. Currently, benefit-cost analyses are not undertaken for each particular drainage network being improved; instead, the results of a series of such analyses conducted in the 1980's and early 1990's are interpolated and extrapolated, based on the area characteristics.

- One of the principle characteristics that is implicitly incorporated into the economic benefit-cost technique is topography. In areas with mildly steep topography, excess rainfall drains off the land more easily, naturally. As well, once in the drainage network, flow velocities are somewhat higher, thus requiring smaller drains to carry the rainfall runoff. On the other hand, in areas with flatter topography, flow velocities are lower, and thus larger drains are required. Thus, all other things being equal, larger drains are required in areas of flatter topography as compared to areas with steeper topography.

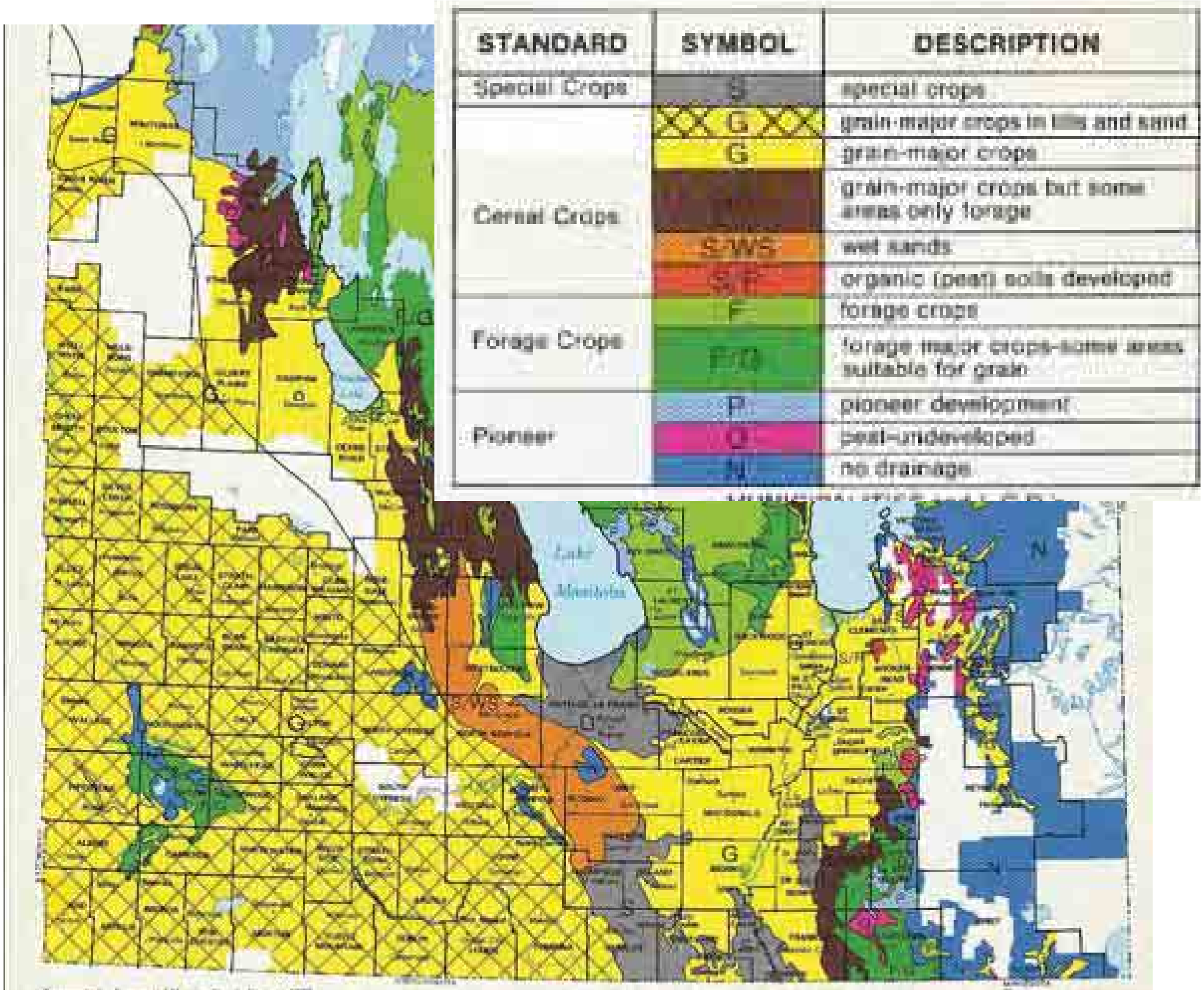


Figure 16

- Another characteristic that influences drain sizing is soil type. Soils of different porosity can have similar capabilities for crop production, therefore would have the same drainage standard. For example, dense clay and a relatively pervious loam may both have the same capability for producing a high-value crop like soy beans. However, the dense clay would require a larger, higher-capacity drainage system, as the natural internal drainage characteristics would be quite poor. The relatively pervious loam, on the other hand, has much better natural internal drainage characteristics, so would require a smaller, lower-capacity drainage system. Thus, to provide for the same level of protection from the damaging effects of excess summer rainfalls on the clay and loam soils, the clay area would require a larger, higher-capacity drainage system.

- In summary, the drainage standard is set based on the capability of the soil, with the drain sizing being further affected by key characteristics like topography and like the internal drainage properties of the soils.

- It should be noted that many Provincial drains are not currently sized to the appropriate standard. That is, many drains are under-sized, and do not have the hydraulic capacity to adequately drain the cropland area that is serviced by that drain. Consequently, too often crop losses following heavy summer rainfalls are at unacceptably high levels.

- Many Provincial drains that are adequately sized are not regularly maintained. The excessive vegetation in the drains reduces the effective hydraulic capacity of these drains, with the result that their effective capacity is below the required standard. This leads to significant crop losses following heavy summer rainfalls.

Historical Drainage Design Standards

- Prior to the adoption of the economic benefit-cost method of determining drain sizing, two empirical formulae were used. These formulae were developed in other jurisdictions.

- One formula is called the "M" curve. It was applied in areas which experience relatively high rates of runoff, such as in areas with steep topographies and impervious soils. It was also applied in areas with higher-value specialty crops, which require better drainage.

- The second formula is called the "S" curve. It was applied in areas which experience relatively low rates of runoff, such as in areas with flat slopes and pervious soils, and in areas with crops that do not require a high standard of drainage.

Environmental Criteria Currently Included in Drain Upgrades

- Drain flow velocities are to be below 2.5 feet/second, or 0.76 m/sec. This criterion is implemented to prevent erosion in the drainage channel. This criterion is usually met by appropriately designing the earthen channel. If these criteria cannot be met in this way, erosion control structures are incorporated into the channel. These structures have the effect of reducing the longitudinal slope of the water surface in the drain channel, which results in a reduced flow velocity.

- Drain side slopes are to be 1 vertical to 3 horizontal, or flatter. This is meant to reduce the chance of slumping of the drain channel's sides. Slumping results in the deposition of earth in the channel bottom. This criterion also allows for the mechanical mowing of the channel's sides.

- Features required by the Department of Fisheries and Oceans are incorporated into the drain upgrade. These features can include things like larger culvert crossings, rock rip rap placed at various locations within the channel (especially downstream of culverts), and channel modifications to enhance fish habitat.

- Upgrading drains from downstream to upstream, to ensure that downstream reaches can accommodate any increased flows due to upstream improvements.

- It should be noted that some existing drains do not meet some of the above-listed criteria because of drain degradation over time, and then inadequate funding to restore the drains back to the proper physical condition.

Agriculture in the Red River Valley and Manitoba

Below are a few points, for additional perspective, regarding the role of agriculture in Manitoba's economy, and drainage overall.

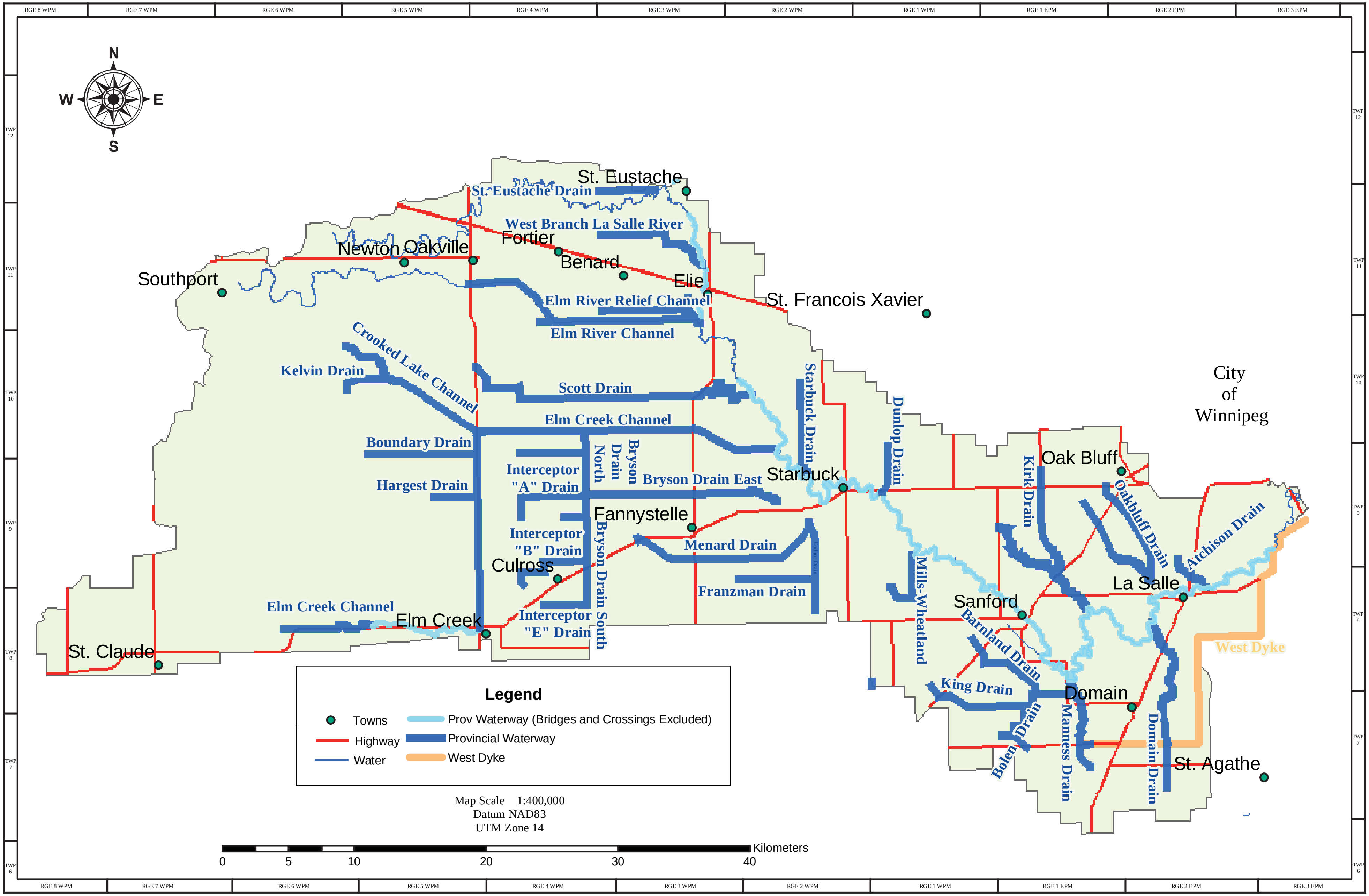
- About one-eighth of Manitoba's economy is directly or indirectly dependent on agriculture. About one job in eleven is the result of agricultural production.

- In 2004, cash receipts from crops in all of Manitoba totaled $1.9 billion.

- In the Red River Valley there are approximately 0.53 million hectares (1.3 million acres) that require artificial land drainage to be agriculturally productive. In Manitoba, artificial drainage benefits around 2.2 million hectares (5.5 million acres) of agricultural land. Of that total, approximately 1 million hectares (2.5 million acres) could sustain no cropland production without drainage. In Manitoba as a whole, there are approximately 4.7 million hectares (11.6 million acres) of cropland.

SECTION 7.3.4

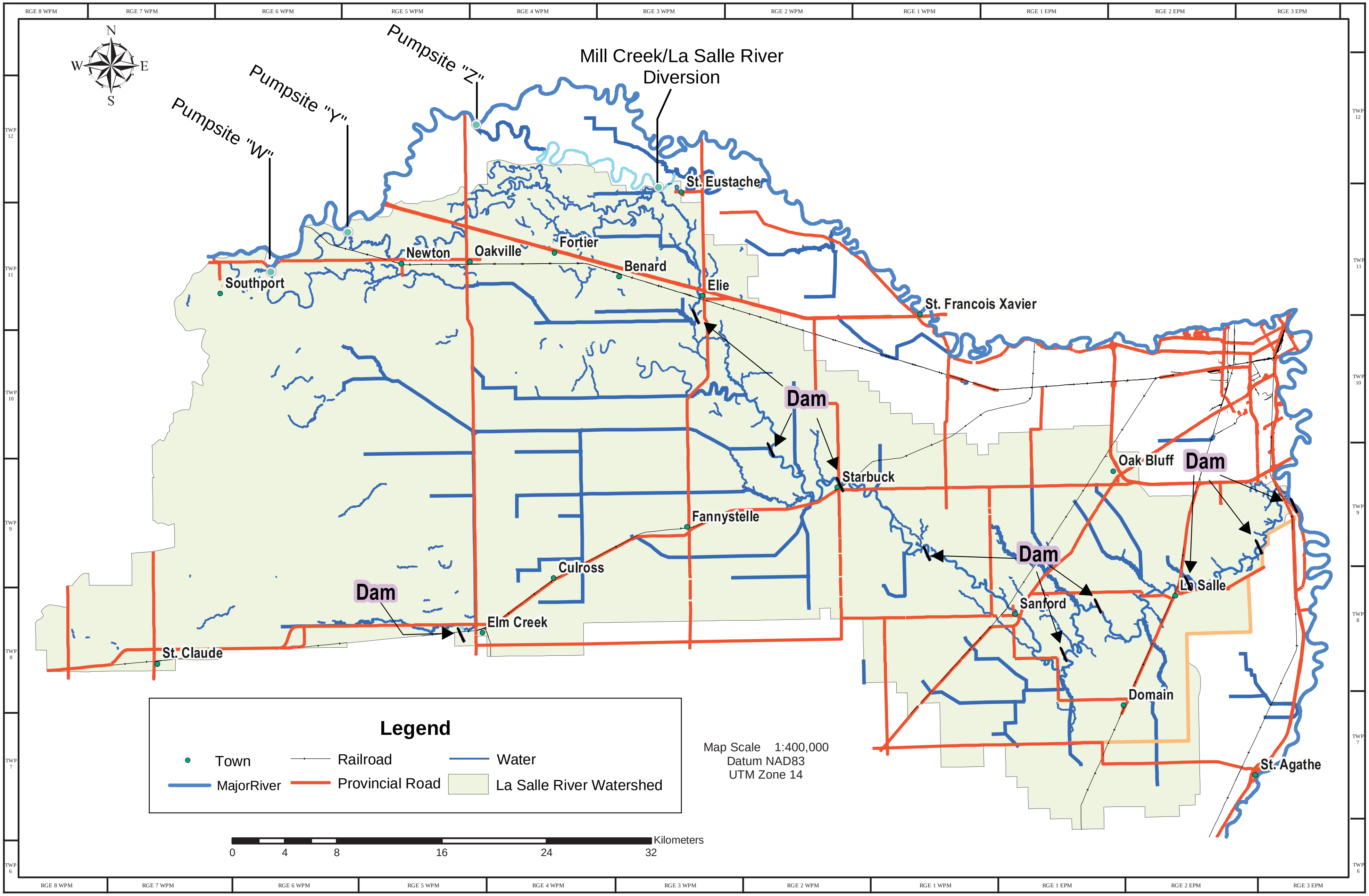
Provincial Drain Infrastructure within La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Water Control Structures within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Section 7.0 – Watershed Development

Section 7.4.1 – Water Use Allocations of the La Salle River Watershed

The Water Licensing Branch is the regulatory body that is responsible for issuing authorizations (e.g. permits, licenses, etc.) under *The Water Rights Act* for the use of water for municipal, agricultural, industrial, irrigation, or other purposes. Water used for domestic purposes does not require a license. A more detailed description of the Water Licensing Branch's mandate and contact information are available on the Manitoba Water Stewardships website.

The intent of water rights licensing is to protect the interests of domestic users, licensees, the general public and the environment with respect to the use or diversion of water or the construction and operation of water control works under license. Licenses are issued on "first in time – first in right" principle", established by the date the application is submitted. The general and specific conditions that are included on all licenses reflect, in part, the information received from the technical and management studies that have been carried out for the project and/or water body. For surface water projects, this determination is based on an analysis of stream flow data, riparian needs, the water use requirements of senior licensed water users, domestic water use needs, and instream flow requirements. For groundwater projects, this determination is based on an assessment of hydrogeological information including; geological information on aquifers, aquifer sustainable yield estimates and water allocation budgets, where available, as well the water use requirements of senior licensed users and domestic water use needs.

There are presently sixty-nine surface water projects on file with the Water Licensing Branch in the La Salle River watershed of which sixty-two of these projects are for irrigation purposes. These irrigation projects represent 70% of all of the water allocated under licence in the La Salle River watershed. There are also three surface water agricultural (livestock) projects and three surface water sourced municipal distribution systems in the La Salle watershed; two Hutterite Colonies and the Rural Municipality of MacDonald rural pipeline which is allocated 817.8 dam^3 per year. There are presently eighteen groundwater projects on file with the Water Licensing Branch in the La Salle River watershed of which eight are for agricultural purposes, five are for irrigation purposes, four are for municipal purposes and one license is allocated for hydrostatic testing purposes. The groundwater municipal distribution systems include three Hutterite colonies, and the Town of Elm Creek which is allocated at 72 dam^3 per year.

The following tables present all of the projects on file with the Water Licensing Branch for Licensing in the La Salle River watershed:

Section 7.0 – Watershed Development

Licences:

Purpose	Licenses Issued		Total Licenses
	Groundwater	Surface Water	
Agricultural	6	2	8
Industrial	0	0	0
Irrigation	3	50	53
Municipal	4	3	7
Other	1	0	1
Total	**14**	**56**	**69**

Applications:

Purpose	Applications		Total Applications
	Groundwater	Surface Water	
Agricultural	2	1	3
Industrial	0	0	0
Irrigation	2	12	14
Municipal	0	0	0
Other	0	0	0
Total	**4**	**13**	**17**

Allocations:

Purpose	Allocated Under License (dam^3)		Total Allocation (dam^3)
	Groundwater	Surface Water	
Agricultural	160.9	120.8	281.7
Industrial	0	0	0
Irrigation	134.0	3376.6	3510.6
Municipal	149.4	842.5	991.9
Other	32.0	0	32.0
Total	**476.3**	**4339.9**	**4816.2**

State of the Watershed Report Card Recommendation:

☺ Based on the surface water availability figures provided by the Surface Water Management Section, there is 5685 dam^3 available for allocation in the LaSalle Watershed annually. At present, 4339.9 dam^3 of the 5685 dam^3 (76%) of the surface water available for allocation has been allocated.

Aquifer sustainable yield estimates and groundwater allocation budgets have not been established for the LaSalle River watershed.

SECTION 7.42

LaSalle Watershed Management Plan

Presentation by the Water Licensing Branch

January 19, 2007

Manitoba

The Water Licensing Branch:

- **The WLB is the regulatory body that is responsible for issuing authorizations (eg. Permits, licences, etc.) under *The Water Rights Act* for the use or diversion of water for any purpose; or construction, establishment, operation or maintenance of works for any purpose.**

Manitoba: A Prior Appropriation Province

- Water belongs to the Province
- All use, except domestic, requires a licence
- First in time – first in right
- Over allocation is not allowed
- The water must be put to beneficial use

Beneficial Uses Include:

- Domestic purposes (not licensed)
- Municipal purposes
- Agricultural purposes (e.g.. Livestock)
- Industrial purposes
- Irrigation purposes
- Other purposes (e.g. aquaculture, fire protection, recreation, water bottling, etc.)

Manitoba

Criteria for Issuance of a Water Rights Licence:

- Rights of prior appropriators will not be unduly affected
- Proposed means of diversion is adequate
- Proposed use of water is beneficial
- Proposed appropriation is in the public interest

Licensing Decisions are Based on:

- **Groundwater:**
  - geological information on aquifers
  - aquifer sustainable yield estimates and water allocation budgets where available
  - water use requirements of nearby senior licensed users and domestic water use needs

Licensing Decisions are Based on:

- **Surface Water:**
  - analysis of stream flow data
  - riparian needs
  - instream flow requirements
  - water use requirements of downstream senior licensed water users and downstream domestic water use needs

LaSalle Watershed:

Purpose	Licences Issued: Groundwater	Licences Issued: Surface Water	Total Licences
Agricultural	6	2	8
Industrial	0	0	0
Irrigation	3	50	53
Municipal	4	3	7
Other	1	0	1
Total	**14**	**55**	**69**

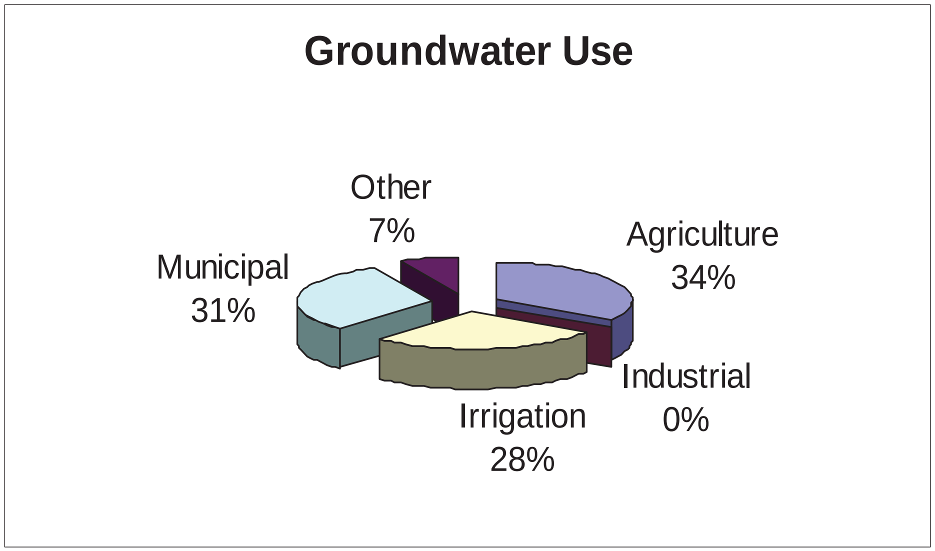
Purpose	Applications: Groundwater	Applications: Surface Water	Total Applications
Agricultural	2	1	3
Industrial	0	0	0
Irrigation	2	12	14
Municipal	0	0	0
Other	0	0	0
Total	**4**	**13**	**17**

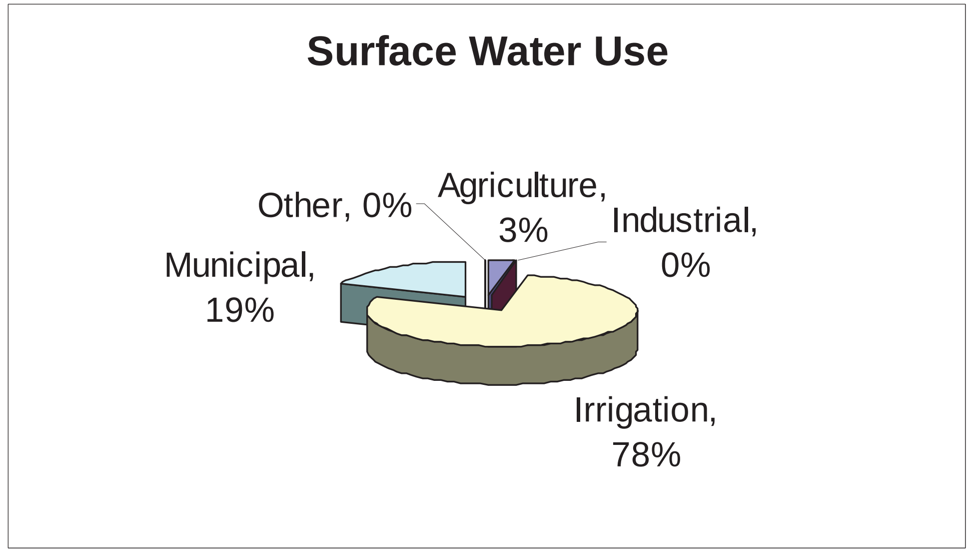
LaSalle Watershed:

Purpose	Allocated Under Licence (dam³)		Total Allocation (dam³)
	Groundwater	Surface Water	
Agricultural	160.9	120.8	281.7
Industrial	0	0	0
Irrigation	134.0	3376.6	3510.6
Municipal	149.4	842.5	991.9
Other	32.0	0	32.0
Total	**476.3**	**4339.9**	**4816.2**

1 dam^3 = 220,000 Imperial gallons
= 0.81 acre-feet

LaSalle Watershed:
Breakdown of Licensed Uses:





NOTE: Does not include domestic use

Manitoba

Questions?

Please visit our website at:

www.gov.mb.ca/waterstewardship

Section 7.0 – Watershed Development

Section 7.4.3 - Water Treatment Plants (source: Office of Drinking Water)

1. There are two (2) municipal WTPs in the watershed:

- **R.M. of MacDonald Regional WTP** (MRWTP) at Sanford – a class IV (4) lime-soda softening plant
- MRWTP location: SW 29-8-1E – latitude N 49* 40’ 56.2” and longitude W 97* 25’ 42.0”
- Water source – La Salle River (flow supplemented from the Assiniboine River)
- Serves 6 towns in RM of MacDonald and almost all rural areas. **Brunkhild, Domain, La Salle, Oak Bluff, and Starbuck** re-chlorinate the in-coming water and have treated water **reservoirs**, which re-pump to the respective town and surrounding rural area. **Sanford is fed directly from the MRWTP reservoir**.
- The MRWTP also supplies a reservoir serving a **truck-fill station in the RM of Cartier at Springstein**.
- Population served is probably approximately 5,000, nearly all the Rm residents RM population – 5,320)
- The RM of MacDonald could probably supply you with a map of the distribution system

And,

- **Elm Creek** – a class II (2) reverse osmosis plant
- Location: 190 Church Avenue – latitude N 49* 40’ 31.1” – longitude W 98* 00’ 12.2”
- Water source – a deep well two miles north on Hwy 13 at NE 36-8-5W at N 49* 41’ 40.4” – W 98* 00’ 22.9”
- Population served is about 350, which includes the village of Elm Creek (pop. 328) and about ten nearby rural connections

2. Other water service from outside the watershed:

- The **Cartier Regional WTP** (CRWTP) is just outside the watershed area, north of St. Eustache. The distribution system serves many towns and rural areas in the RMs of Cartier, Portage la Prairie and Grey. The **re-chlorinating storage reservoirs** are at **St. Eustache, Elie, Fannystelle and Oakville**.

- **Haywood and St. Claude** village and surrounding rural areas are served by the **Stephenfield Regional WTP**, owned by PVWC. Again, the MWSB could supply a map. There are re-chlorinating storage reservoirs at each village.

- **The City of Portage la Prairie WTP** serves a re-chlorinating reservoir at **Southport**. In this case, the surrounding rural areas are serviced directly from the City WTP main distribution lines, feeding branch lines in the rural areas.

Section 7.0 – Watershed Development

3. Semi-public systems:

- The semi-public systems known to me are **Hutterian communities**. I have not inspected these yet to confirm water source, treatment systems, certification application information and locations. There is quite a few. I hope to resume inspections in the spring. Each RM may be able to provide the exact locations of the colonies in their RM.

Section 7.0 – Watershed Development

Section 7.4.4 - Rural Water Pipelines (source: Manitoba Water Services Board)

MWSB Activities in the Study Area:

The Manitoba Water Services Board operates several programs under its mandate to address water problems in rural Manitoba. Under the Farm Water Source Program, MWSB in cooperation with the PFRA, provide a comprehensive water source development program to assist Manitoba farmers in developing a satisfactory water supply system to meet their farming needs.

In addition to the Farm Water Source program, MWSB and PFRA provide assistance to local governments to identify and develop water sources from which farmers can haul water to meet their farming needs. There are approximately 11 tank loading stations developed under this program and located in the Le Salle Redboine Conservation district still in operational to date.

Under the Agricultural Area Water Pipeline program operated under the MWSB, in cooperation with PFRA and the local governing bodies, pipelines carrying quality water is piped through water short areas of Manitoba to meet the needs of farmers, rural residents, and local communities. Because much of the Red River Valley has historically relied on dugouts to provide water to the rural area, water quality and shortages were often a problem for local residents. Over the years, approximately 300 miles of pipeline has been installed throughout the study area carrying good quality water to the rural residents with many more miles of pipe to still be installed over the next few years as the demand continues. Once piped water is installed to a farm or rural resident, water shortages and poor quality water problems will be alleviated.

RURAL WATER PIPELINE

The Rural Water Pipeline Program is a co-operative venture between Water Stewardship (The Manitoba Water Services Board) and Agriculture Canada (P.F.R.A.).

Manitoba is blessed with an abundance of good quality water. However, most of the agricultural areas do not have dependable water supplies.

The Manitoba Water Services Board and P.F.R.A. provide assistance to rural residents to develop rural water pipelines for domestic and livestock needs.

Technical Support

The M.W.S.B. and P.F.R.A. provide:

- Feasibility studies/options/costs
- Project planning and design
- Project management, including technical support during commissioning.

Trencher installs pipeline.

Financial Assistance

P.F.R.A.
A rebate is paid to a maximum of 33 1/3% on the actual construction costs.

M.W.S.B.
The M.W.S.B. generally acts as Project Manager and provides a grant of 33 1/3% toward all of the costs.

Applications
The M.W.S.B. and P.F.R.A. can assist municipal governments (see resolution #1) or legally incorporated non-profit organizations who have received authorization (see resolution #2) from the municipal government.

Sample Resolutions:

Resolution #1
Be it resolved the Rural Municipality of ________________________ requests technical and financial assistance from both The Manitoba Water Services Board and P.F.R.A. for development of a pipeline to supply water to the __________________ area.

Resolution #2
Be it resolved the Rural Municipality _________________________ authorizes a group of ratepayers known as ________________________ to apply to The Manitoba Water Services Board and P.F.R.A. for technical and financial assistance for the development of a pipeline to supply water to the ____________________ area.

How to Apply

A letter outlining details of the proposal should be attached to the appropriate resolution (requesting financial and technical assistance) and forwarded to both P.F.R.A. and The M.W.S.B. at the following addresses:

The Manitoba Water Services Board
2022 Currie Blvd.
P.O. Box 22080
Brandon, MB
R7A 6Y9

Phone: (204) 726-6076
Fax.: (204) 726-6290

E-mail: mwsb@gov.mb.ca

PFRA
Manager, Regional Water Program
200 - 303 Main St.
Winnipeg, MB
R3C 3G7

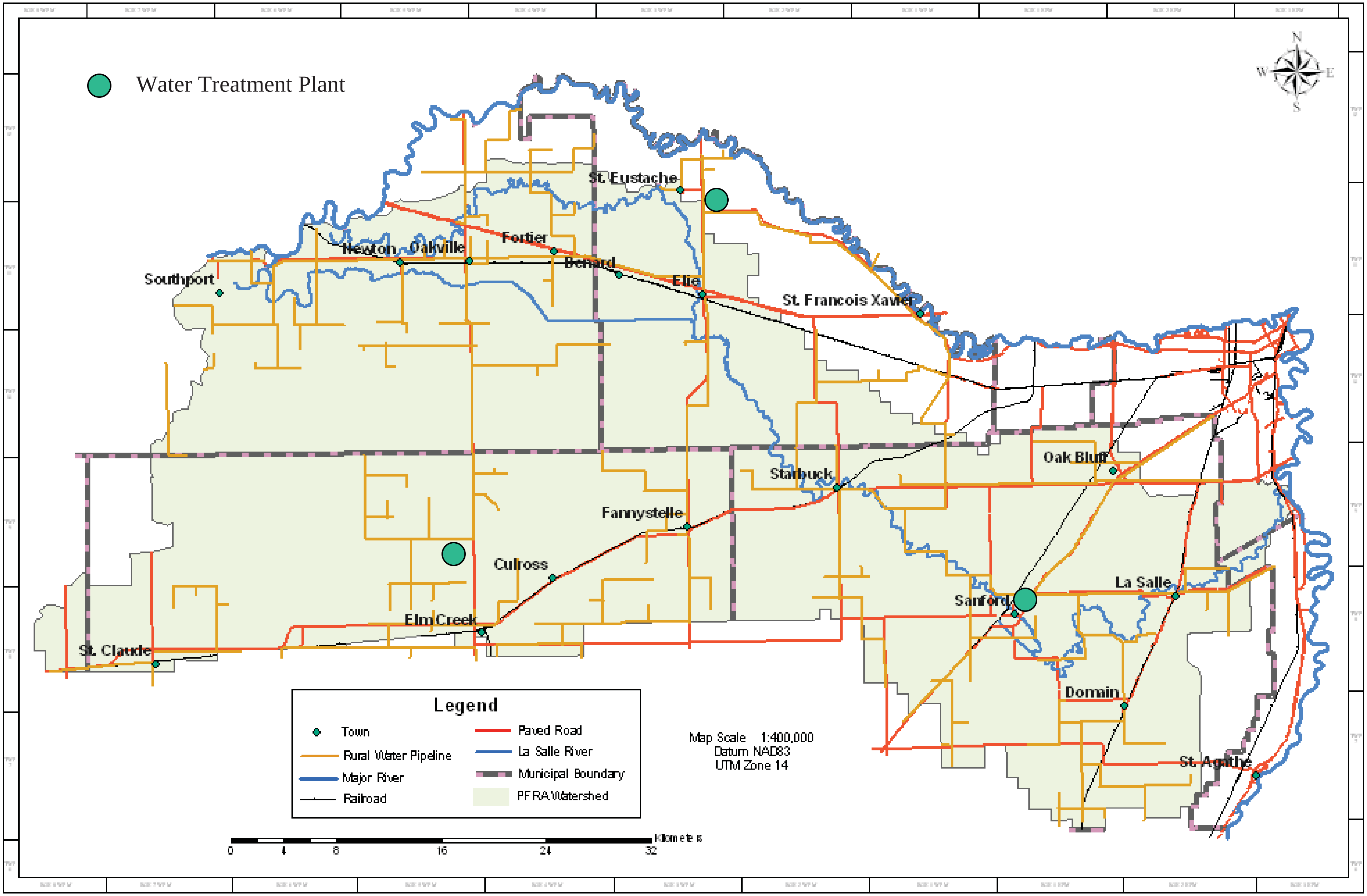
Phone: (204) 983-2243
Fax: (204) 983-2178

Backhoe installs wet well

Pipeline is tunnelled under highway.

SECTION 7.4.4.2

Rural Water Pipelines of the La Salle River Watershed



COMMUNITY WELL PROGRAM
BY MWSB

KEY / NOTE:

- Water Type : 1. Groundwater 2. Surface Water 3. Potable 4. Non Potable
- Source for: T - Tankloader, V - Village, P - Pipeline, ? - Operating Status Unknown, "-" - Not in Service
- Casing Material : FG - Fibreglass; PVC - PVC; BI - Black Iron G - Galvanized
- Rec. Capacity - Recommended Capacity
- Loader Access : K - Key lock, O - Open, C- Coin

-Tankloader located at the source unless otherwise stated in comments

Project Status As of: Aug 2006

MUNICIPALITY	NAME	LOCATION	WATER TYPE	YEAR OF INSTALL	SOURCE FOR	WELL REC. CAPACITY (USGPM)	LOADER ACCESS	COMMENTS
CARTIER	ELIE S.	NE.2-11-3W	2&4		T	300	O	From La Salle River
	ELIE GRAVEL PIT (N)	SE.19-11-2W	1&3	1987	T	45	K	combined capacity 90 GPM
	ELIE GRAVEL PIT (S)	SE.19-11-2W		1987		45		
GREY	ELM CREEK	NE.36-8-5W	1&4	1978	T	120	K	
	ST. CLAUDE	ST. CLAUDE	1&3	1983	T	100		Well is located S of Rathwell
PORTAGE LA PRAIRIE	DIVERSION	LOT 370	2&4	1974	T?			Loader status unknown
	HIGH BLUFF N	SW.13-12-6W	1&4	1984	T	42		Combined capacity 95 gpm
	HIGH BLUFF S	SW.13-12-6W		1984		42		
	MACDONALD 1	SE.2-13-8W	1&3	1975	T,**V**	20		Village supply, Loader at village cistern
	MACDONALD 2	SE.2-13-8W		1996		45		
	MACDONALD SOUTH N	NE.19-12-7W	1&4	1986	T	40		Combined capacity 80 gpm. (Belle Plain)
	MACDONALD SOUTH S	NE.19-12-7W		1986		40		
	OAKLAND-DELTA W	SE.2-14-7W	1&4	1993	T	60		Combined capacity 120gpm
	OAKLAND-DELTA E	SE.2-14-7W		1993		60		
	OAKVILLE E	SE.13-11-5W	1&4	1976	T	35		Combined capacity 75 gpm
	OAKVILLE W	SE.13-11-5W		1976		40		
	POPLAR POINT #1	32-12-4W	1&4	1977	T	40		
	POPLAR POINT #2	32-12-4W		1977		40		

May 2006

COMMUNITY WATER SOURCE DEVELOPMENT

The Community Water Source Development Program is administered jointly by Water Stewardship, through The Manitoba Water Services Board, and Agriculture Canada, through the Prairie Farm Rehabilitation Administration (P.F.R.A.).

Objectives

1) To assist local governments, or legally incorporated groups of five or more individuals who have obtained the permission of their local government, to identify and develop a water supply. Farmer groups and communities with populations less than 300 are eligible.
2) To provide a network of facilities from which farmers can haul or pipe quality water to meet farming and domestic needs.

Technical Assistance

The Manitoba Water Services Board and the P.F.R.A. provide the following:

- an evaluation of alternate water sources
- advice on obtaining permits and preparing cost estimates, tenders and contracts
- engineering designs as staff time permits
- construction supervision as staff time permits

Note: Due to the complexities of establishing a major water source of this nature and the need for proper development and assessment, a qualified groundwater engineer must be employed and supervise the development of all ground water sources.

Typical community water supply.

Financial Assistance

P.F.R.A. provides a rebate on all eligible costs on approved projects.

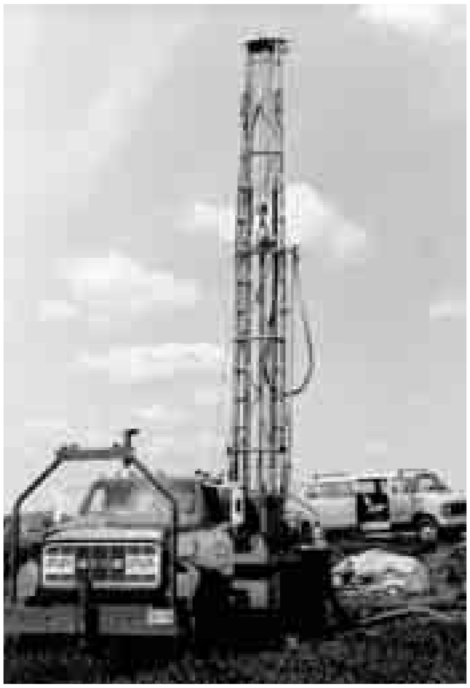
The Manitoba Water Services Board provides a rebate on all eligible costs in excess of any P.F.R.A. contributions on approved projects.

Eligible costs include:

- Groundwater Engineer consultant fees
- water source testing and development
- pumps and related equipment
- pipeline installation
- required land and rights-of-way (not eligible for P.F.R.A.)
- essential water conditioning (not eligible for P.F.R.A.).

Note:

Where a community water source which does not meet the stated objective or procedure is installed, The Manitoba Water Services Board will cost share the construction at the given rate, to a maximum of $2,000.



Well drilling equipment, used for both test drilling and well construction.

Applications

Local authorities should send a letter outlining details of the proposal with an appropriate resolution requesting financial and technical assistance, to both the P.F.R.A. and The Manitoba Water Services Board at the following addresses:

The Manitoba Water Services Board
P.O. Box 22080, 2022 Currie Blvd.
Brandon, Manitoba R7A 6Y9
Phone: (204) 726-6076
Fax: (204) 726-6290

E-mail: mwsb@gov.mb.ca

P.F.R.A.
Agriculture and Agri-Food Canada
200-303 Main Street
Winnipeg, MB
R3C 3G7

Sample Resolutions

1) Be it resolved that the Rural Municipality/L.G.D. of ______________________requests technical and financial assistance from both The Manitoba Water Services Board and P.F.R.A. for the development of a water source in the area of ________________.

2) Be it resolved that the Rural Municipality/L.G.D. of _________________________authorizes The Manitoba Water Services Board and P.F.R.A. to deal directly with __________________ (farmer group), re: technical and financial assistance for the development of the water supply in the area of ___________________________.

Other Related Programs

- Farm Water Source Program
- Agricultural Area Water Pipeline Program
- Community Water and Sewage Program
- P.F.R.A.

For more information contact:

The Manitoba Water Services Board
2022 Currie Blvd. P.O. Box 22080
Brandon, Manitoba R7A 6Y9
Phone: (204) 726-6076
Fax: (204) 726-6290

M.W.S.B.
27 – 2nd Avenue S.W.
Dauphin, Manitoba R7N 3E5
Phone: (204) 622-2116

M.W.S.B.
20 - 1st Street South
Beausejour, Manitoba R0E 0C0
Phone: (204) 268-6059

Section 7.0 – Watershed Development

Section 7.5.1 – Landcover Summary of the La Salle River Watershed as of 2001 (Source: Manitoba Conservation – Remote Sensing Branch)

The information below describes the landcover conditions of the La Salle River Watershed based on satellite imagery interpretation from 2001. The image these statistics are based on is contained in Section 7.5.2.

Simplified Version: (Contains a condensed version of land cover classes which are found in the La Salle River Watershed)

LaSalle River Watershed (7 Class) - Area Calculation

Land Cover Class	Code	Pixels	Hectares	%Image
Agriculture	1	2120239	190821.52	79.09
Forested	2	172125	15491.25	6.42
Water Bodies	3	4724	425.16	0.18
Grassland	4	269116	24220.44	10.04
Wetlands	6	2452	220.68	0.09
Cultural	13	7528	677.52	0.28
Roads	16	104690	9422.10	3.91
		----------	-------------	------
Image total		*************	241278.67	100.00

Complete Version: (Contains all land cover classes from satellite image)

LaSalle River Watershed (17 Class) - Area Calculation

Land Cover Class	Code	Pixels	Hectares	%Image
Agriculture	1	2008804	180792.36	74.93
Deciduous	2	168853	15196.77	6.30
Water Bodies	3	4724	425.16	0.18
Grassland	4	269116	24220.44	10.04
Mixedwood	5	0	0	0.00
Marsh	6	2452	220.68	0.09
Treed Bog	7	0	0	0.00
Treed Rock	8	0	0	0.00
Coniferous	9	0	0	0.00
Burnt Areas	10	0	0	0.00
Open Deciduous	11	3272	294.48	0.12
Forage Crops	12	111435	10029.15	4.16
Cultural	13	7135	642.15	0.27
Forest Cutover	14	0	0	0.00
Sand Gravel	15	393	35.37	0.01
Roads	16	104690	9422.10	3.91
Fens	17	0	0	0.00
		----------	-------------	------
Image total		*************	241278.67	100.00

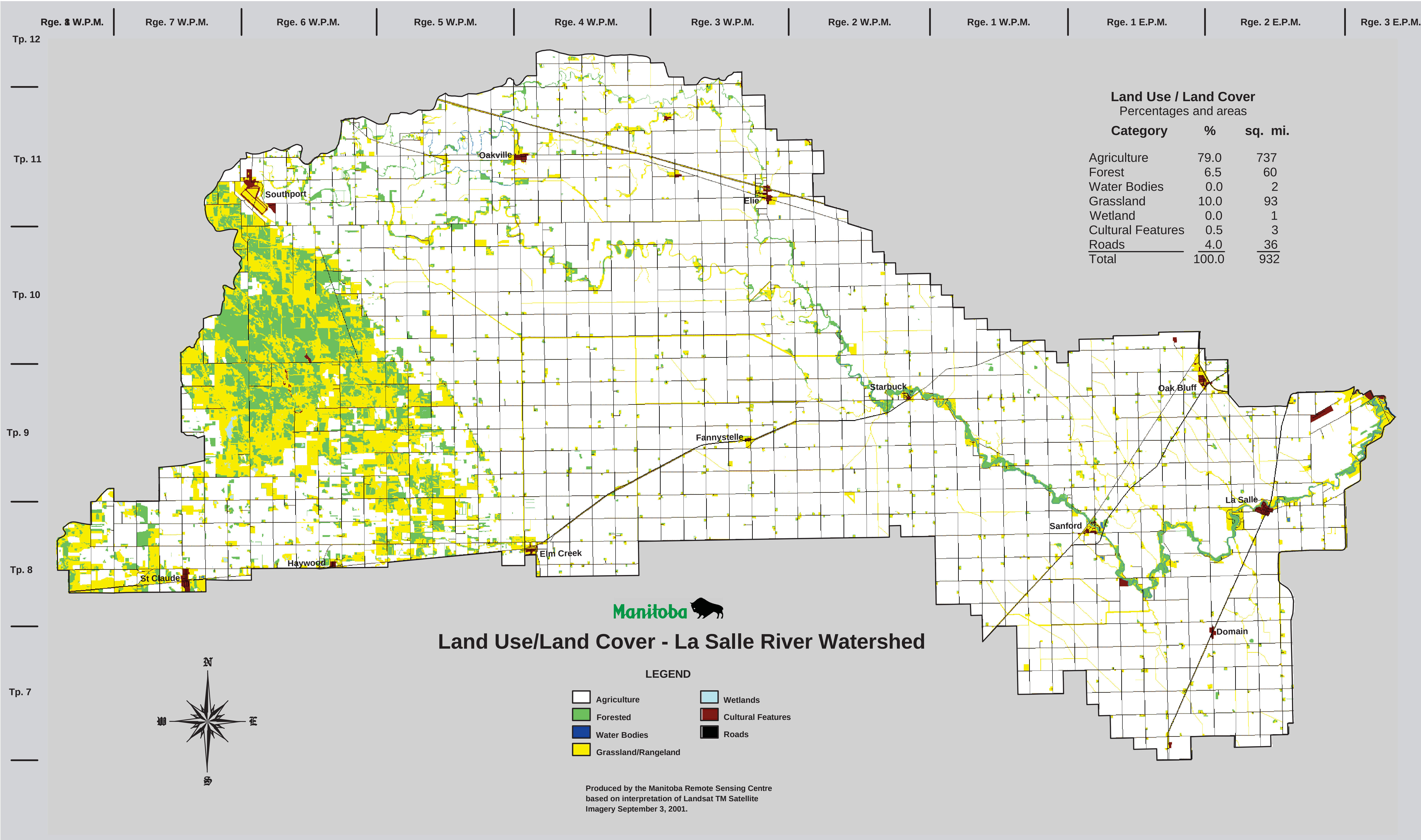
CLASSIFICATION SCHEME

LAND COVER MAPPING OF SOUTHERN MANITOBA

1.	AGRICULTURAL CROPLAND:	Consists of all lands dedicated to the production of annual cereal, oil seed and other speciality crops. These lands would normally be cultivated on an annual basis.
2.	DECIDUOUS FOREST:	Forest in which 75% to 100% of the canopy is deciduous. Dominant species are trembling aspen, balsam poplar and white birch. May include small patches of grassland, marsh or fens less than two hectares in size.
3.	WATER BODIES:	Consists of all open water - lakes, rivers, streams, ponds and lagoons.
4.	GRASSLAND/RANGELAND:	Consists of mixed native and/or tame prairie grasses and herbs. May also include scattered stands of associated shrubs such as willow, choke-cherry, saskatoon and pincherry. Many of these areas are also used for the cutting of hay while others are grazed. Both upland and lowland meadows fall into this class. There is normally less than 10% shrub or tree cover.
5.	MIXEDWOOD FOREST:	A forest type in which 25% to 75% of the canopy is coniferous. May include patches of treed bogs, marsh or fens less than two hectares in size.
6.	MARSH AND FENS:	Grassy, wet areas with standing or slowly moving water. Vegetation consists of grass and sedge sods, and common hydrophytic vegetation such as cattail and rushes. Areas are frequently inter-spersed with channels or pools of open water.
7.	TREED & OPEN BOGS:	Peat covered or peat-filled depressions with a high water table. The bogs are covered with a carpet of sphagnum spp. and ericaceous shrubs and may be treeless or treed with black spruce and/or tamarack.
8.	TREED ROCK:	Areas of exposed bedrock with less than 50% tree cover. The dominant species is jackpine and occasional areas of shrub.

9.	CONIFEROUS FOREST:	Forest in which 75% to 100% of the canopy is coniferous. Jackpine and spruce are combined under this class. May include patches of treed bogs, marsh or fens less than two hectares in size.
10.	BURNT AREAS:	Burned forested areas with sporadic regeneration and can include pockets of unburnt tree stands.
11.	OPEN DECIDUOUS:	Consists of lands characterized by rough topography, shallow soil or poor drainage which supports a growth of shrubs such as willow, alder, saskatoon and/or stunted trees such as trembling aspen, balsam poplar and birch. An area could contain up to 50% scattered tree or shrub cover.
12.	FORAGE CROPS:	Consists of perennial forage such as alfalfa and clover or blends of these with tame species of grass. Fall seeded crops such as winter wheat or fall rye are included here.
13.	CULTURAL FEATURES:	Built-up areas such as cities and towns, peat farms, golf courses, cemeteries, shopping centres, large recreation sites, auto wreckyards, airports, cottage areas, race tracks.
14.	FOREST CUTOVERS:	Areas where commercial timber has been completely or partially removed by logging operations. includes areas which have been replanted.
15.	BARE ROCK, GRAVEL AND SAND:	Exposed areas of bedrock with little or no vegetation, or exposed areas such as sand dunes and beaches. Also included are all gravel quarry/pit operations, mine tailings, burrow pits, and rock quarries.
16.	ROADS AND TRAILS:	All highways, secondary roads, trails and cut survey lines or right-of-ways such as railway lines and transmission lines.
17.	FENS:	Wetlands with nutrient-rich, minerotrophic water and organic soils composed of the remains of sedges and/or mosses. Sedges, grasses, reeds and mosses predominate, but could also include shrubs and sparse tree cover of black spruce and/or tamarack. Much of the vegetative cover composition of fens would be similar to the vegetation zones of marshes.

SECTION 7.5.2



Land Use/Land Cover - La Salle River Watershed

Land Use / Land Cover
Percentages and areas

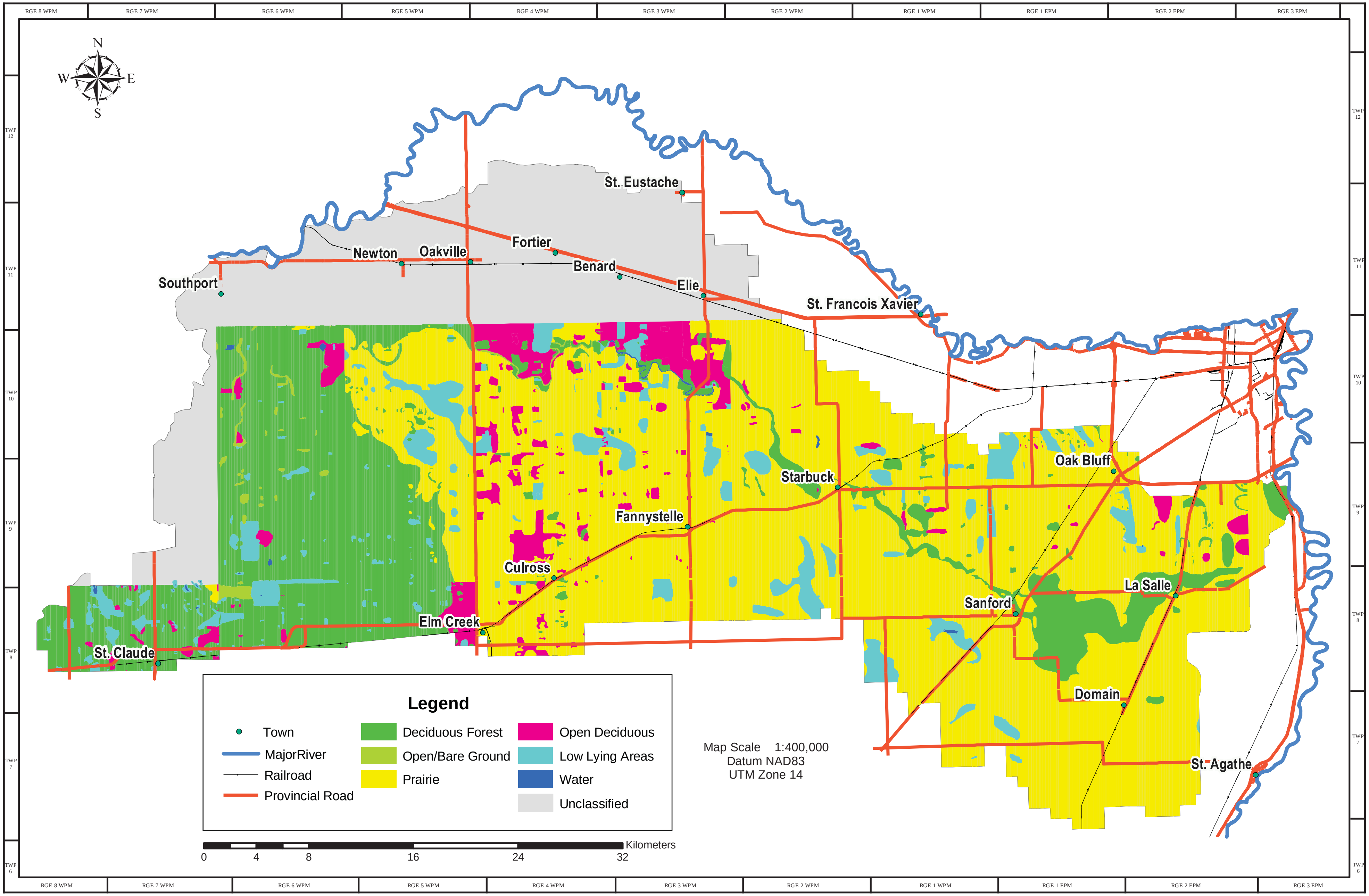
Category	%	sq. mi.
Agriculture	79.0	737
Forest	6.5	60
Water Bodies	0.0	2
Grassland	10.0	93
Wetland	0.0	1
Cultural Features	0.5	3
Roads	4.0	36
Total	100.0	932

LEGEND

- Agriculture
- Forested
- Water Bodies
- Grassland/Rangeland
- Wetlands
- Cultural Features
- Roads

Produced by the Manitoba Remote Sensing Centre
based on interpretation of Landsat TM Satellite
Imagery September 3, 2001.

Pre-Settlement Land Cover 1870 within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District

A.C. 2007

Section 7.6 – Environmental Licensing (source: Manitoba Conservation, Regional Operations, Portage la Prairie District)

Organisational Mandate:

The Portage District of the Manitoba Conservation's Red River Region covers the Rural Municipalities of Dufferin, Grey, Lakeview, North Norfolk, Portage la Prairie, South Norfolk, Victoria and Westbourne together with the City of Portage la Prairie, the Towns of Carmen and Gladstone, and the Villages of MacGregor, Notre Dame de Lourdes and St. Claude. The Portage office has three environment officers who are responsible for monitoring and enforcing the various acts and regulations, as follows:

The ***Environment Officer / Public Health Inspector*** (EO/PHI) is responsible for enforcing Public Health Act regulations on food service establishments, temporary food service, seasonal food service, food processing businesses, retail food stores, mobile food units, un-inspected meat processors, non-institutional care facilities, food-borne, waterborne and communicable disease investigations, insanitary conditions, housing, personal care services, public accommodations, recreational camps, swimming pools and whirlpools, water supplies, and atmospheric pollution. The EO/PHI is also responsible for enforcing the Non-Smokers Health Protection Act and Regulations.

The ***Environment Officer / Generalist*** (EO/G) is responsible for enforcing the Environment Act with regards to waste disposal grounds and transfer stations, environment act licenced developments, private sewage disposal systems and crop residue burning. The EO/G also has responsibilities for enforcing The Dangerous Goods Handling and Transportation Act regulations on petroleum retailers and bulk facilities, pesticide containers depots, and PCB storage sites, together with contaminated sites regulation under the Contaminated Sites Remediation Act.

The ***Environment Officer / Livestock*** is responsible for enforcing the Environment Act with regards to the Livestock Manure & Mortalities Regulation.

Description of Data Collected:

Data held in the Portage District office that is relevant to the La Salle River Watershed Management Plan includes:

Locations of municipal and private wastewater treatment systems within the western portion of the La Salle River Watershed. Files on the wastewater treatment systems include water quality data on discharges – typically BOD_5, Fecal Coliform and Total Coliform counts.
Locations of onsite waste management systems.

Locations of contaminated sites and petroleum storage facilities.

Locations of livestock operations (hog barns).

Section 7.0 – Watershed Development

Trends:

The most significant trend seen in the past 10 years has been the development of large scale livestock operations within the watershed. Typically these operations dispose of animal wastes on the land, usually by injection of liquid wastes into the soil.

Another trend that may affect surface water quality in the watershed is aging municipal and private wastewater treatment systems. Age-related deterioration of wastewater treatment facilities and lack of funding available to maintain the publicly owned ones may result in more discharge of nutrients to the watershed via groundwater seepage.

Areas of concern:

Areas of concern include non-point sources of nutrients going into the watershed such as run-off from farm fields that have received animal waste from livestock operations. Nutrients are also added to the watershed when municipal and private wastewater treatment systems discharge effluent to the watershed either through controlled discharges or groundwater seepage from leaking lagoons.

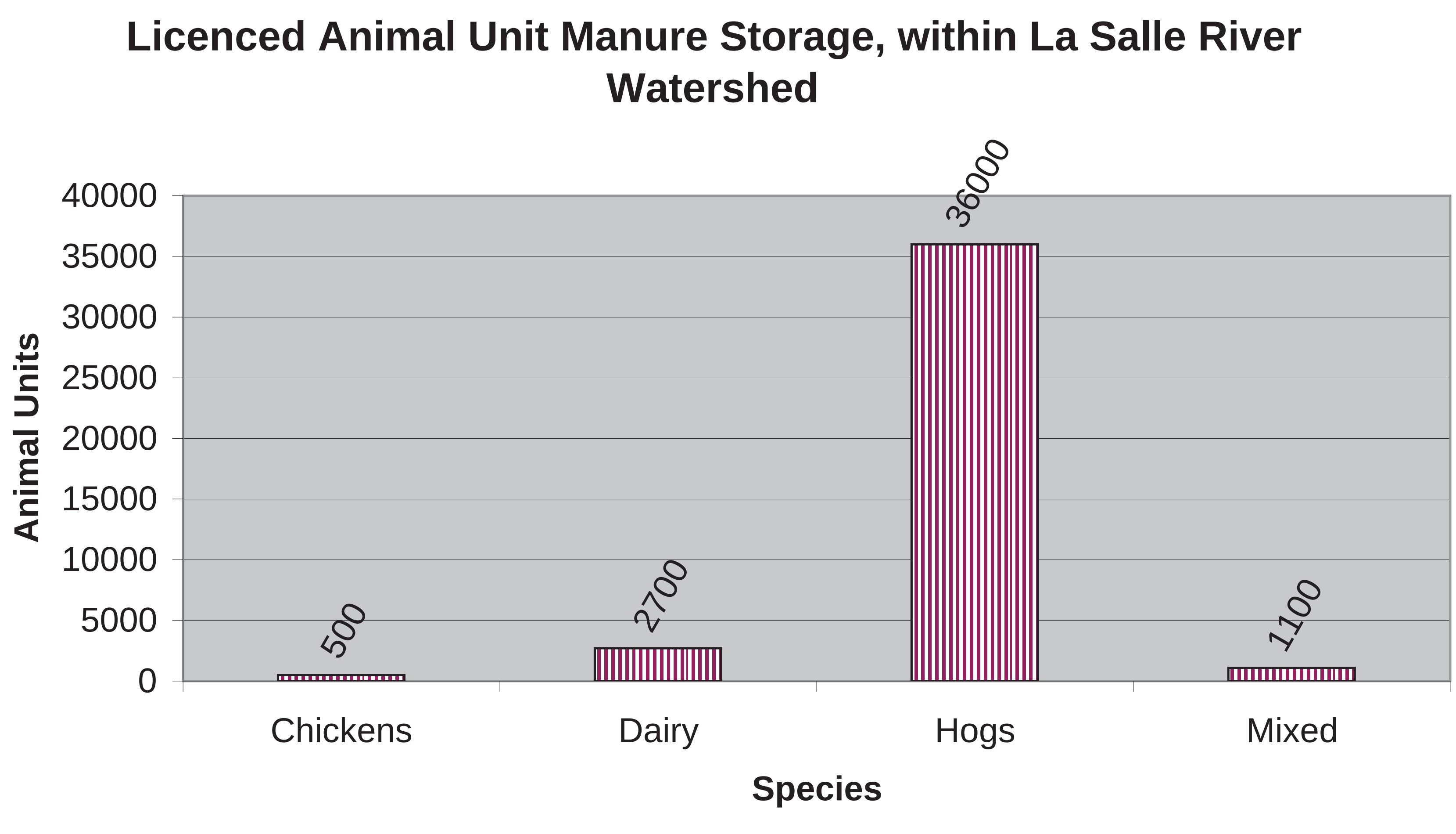
Besides nutrients, another other area of concern is from contaminated and impacted sites. Runoff and groundwater seepage from these sites in the watershed eventually reach the La Salle River and add to the contaminant load in the river. “Orphaned” sites where there are no responsible parties left who can pay for the clean-up are a Provincial responsibility, but funds for clean-ups are limited.

Information Gaps:

Current research within the watershed is addressing information gaps on the various non-point and point sources of biological loads on the La Salle River system.

Recommendations:

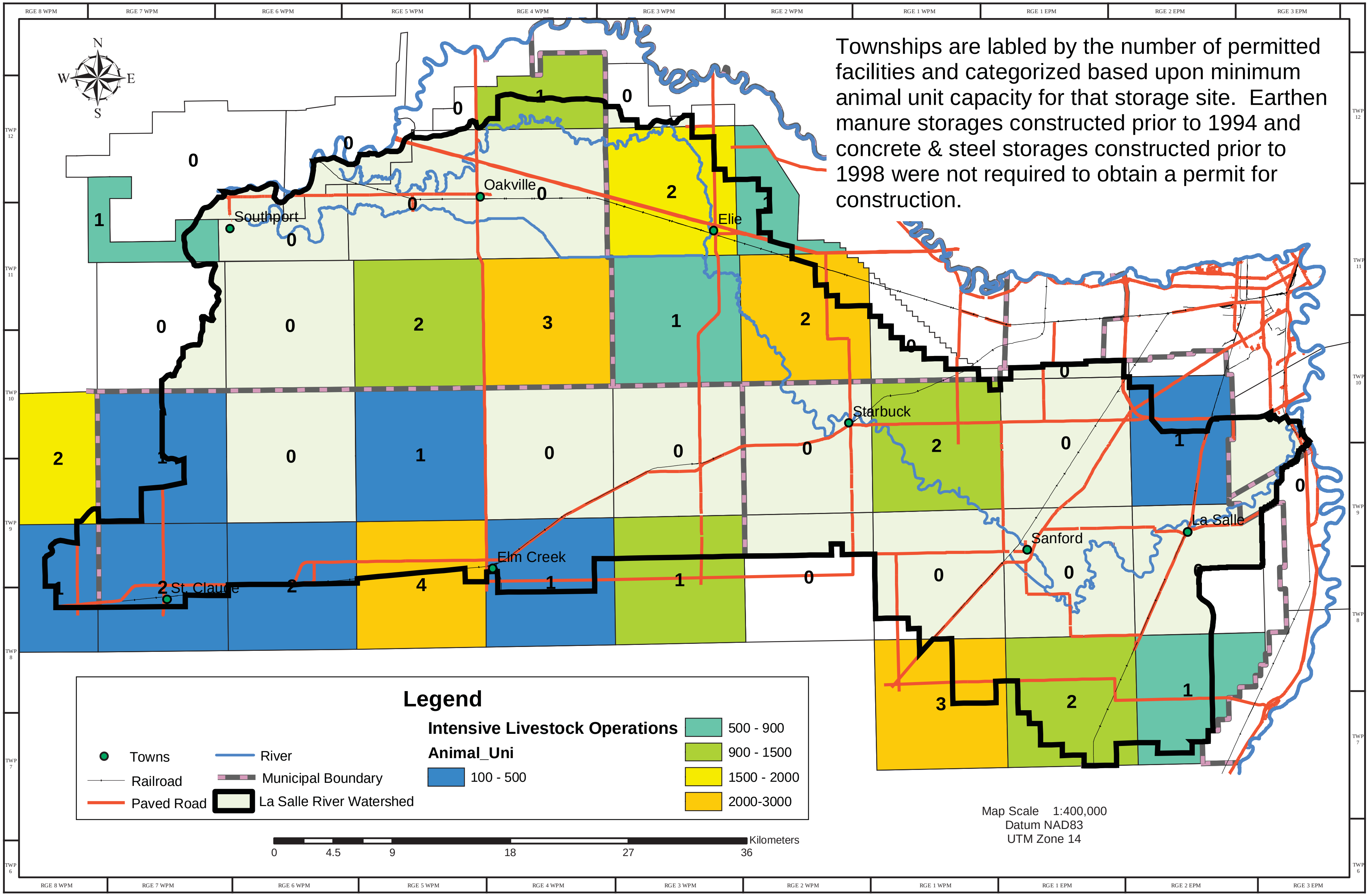
Institute “best practices” in agricultural, municipal and industrial management practices within the watershed.



Note: There are 35 licenced manure storage facilities in the La Salle River Watershed

SECTION 7.6.2

Permitted Manure Storage Sites within the La Salle River Watershed

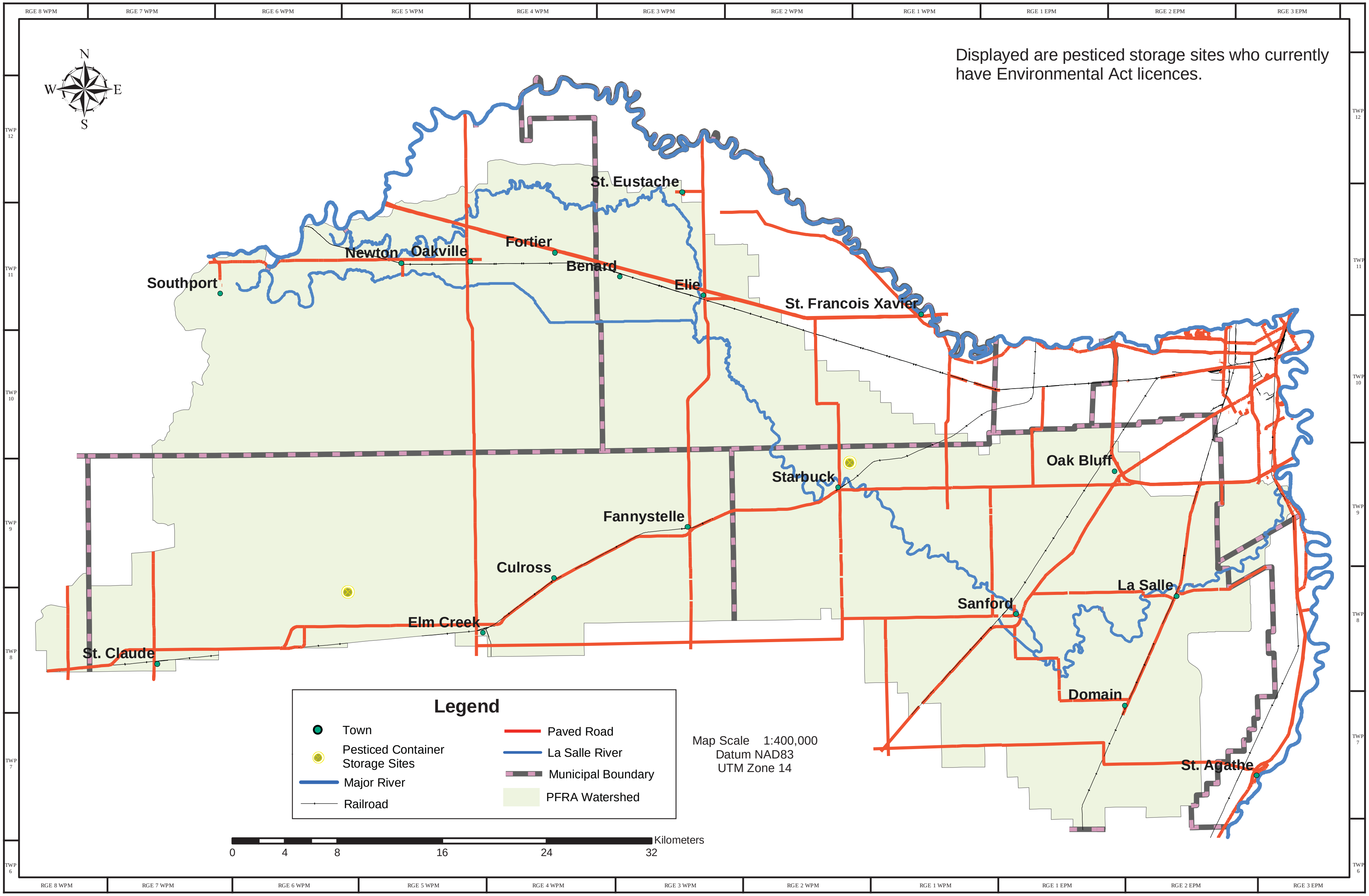


Source: Manitoba Land Initiative, La Salle Redboine Conservation District, Manitoba Conservation

Data Current to December 2006

SECTION 7.6.3

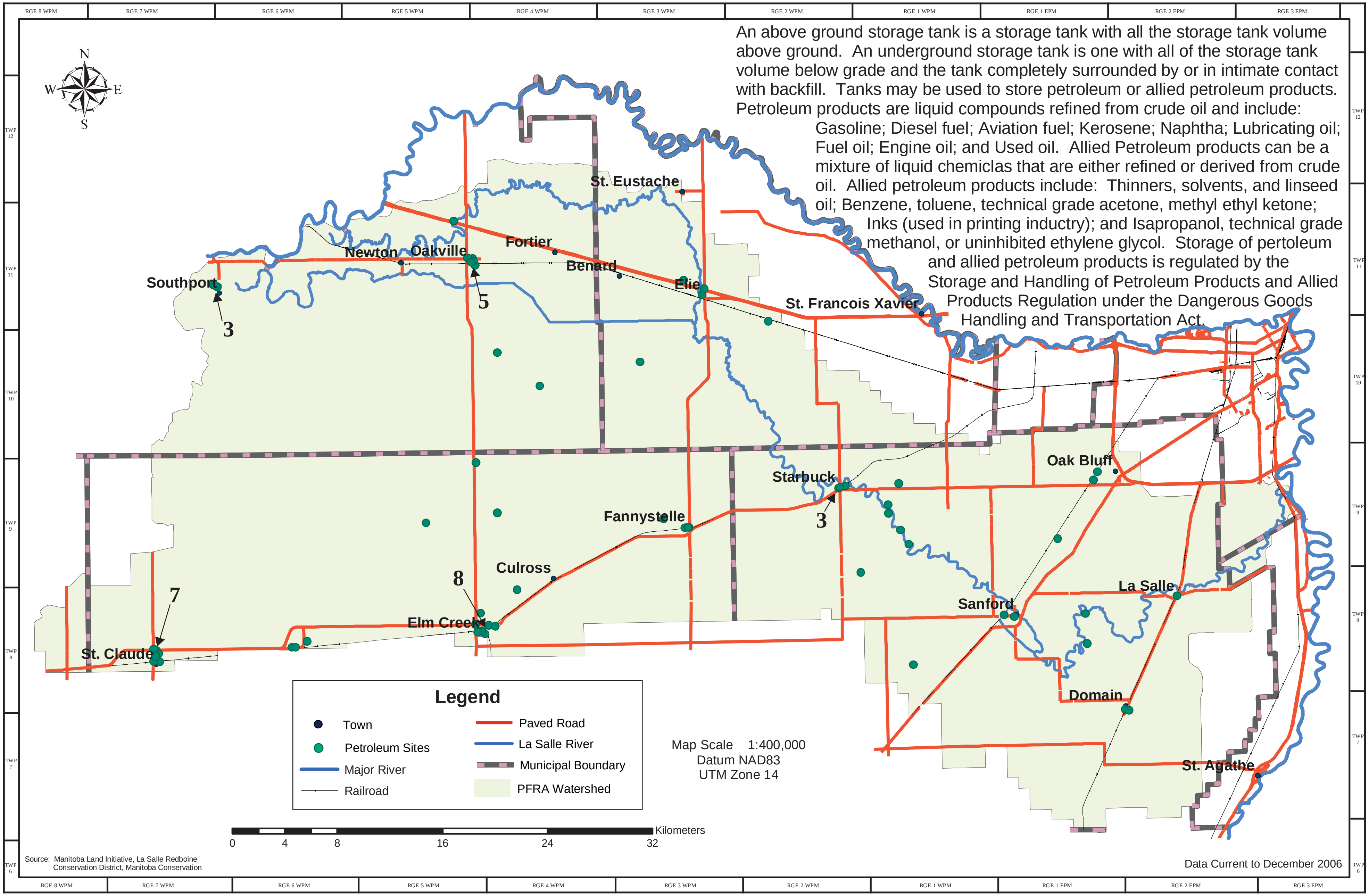
Pesticide Container Storage Sites within the La Salle River Watershed



Source: Manitoba Land Initiative, La Salle Redboine Conservation District, Manitoba Conservation

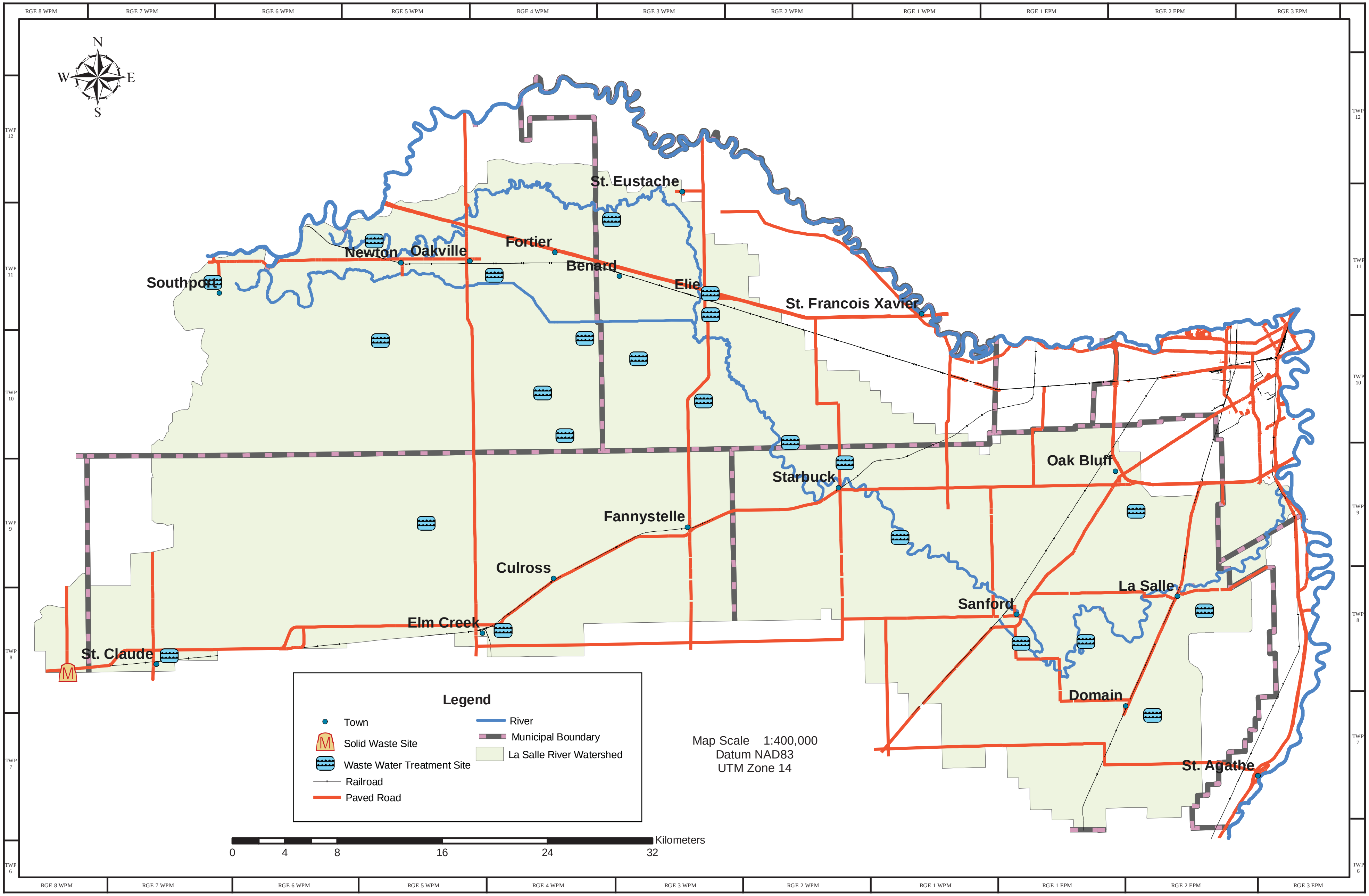
Data Current to December 2006

Petroleum Sites within the La Salle River Watershed



SECTION 7.6.5

Solid and Liquid Waste Sites within the La Salle River Watershed



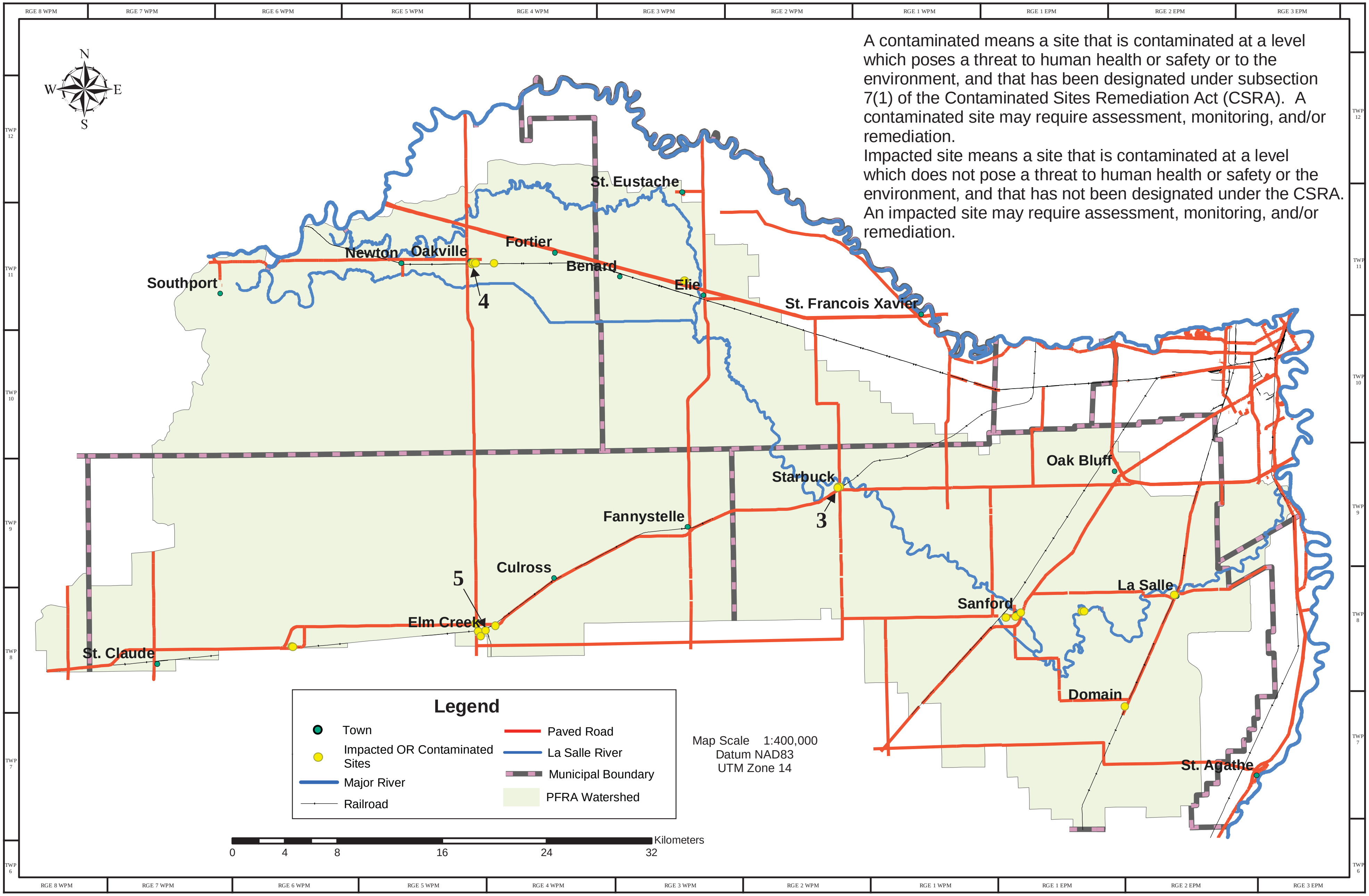
Source: Manitoba Land Initiative, La Salle Redboine Conservation District, Manitoba Conservation

A.C. 2007

Impacted and/or Contaminated Sites within the La Salle River Watershed

A contaminated means a site that is contaminated at a level which poses a threat to human health or safety or to the environment, and that has been designated under subsection 7(1) of the Contaminated Sites Remediation Act (CSRA). A contaminated site may require assessment, monitoring, and/or remediation.

Impacted site means a site that is contaminated at a level which does not pose a threat to human health or safety or the environment, and that has not been designated under the CSRA. An impacted site may require assessment, monitoring, and/or remediation.



Source: Manitoba Land Initiative, La Salle Redboine Conservation District, Manitoba Conservation

Data Current to December 2006

Section 7.7 – Agricultural Development

Section 7.7.1 – Agricultural Activities and Resources of the La Salle River Watershed (source: Joint Report from Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration and Manitoba Agriculture, Food and Rural Initiatives)

<u>Table of Contents</u>

Section 7.7 – Agricultural Development

6. Recommendations
7. Appendices

Section 7.7 – Agricultural Development

Preface

Although this document focuses on information about agricultural activities and resources in the watershed, it is important to note that there are many other industries, sectors, and users of the watershed's resources that have an impact, both positively and negatively.

Agriculture is only one component, with other human activities such as industry, recreation and residences contributing to degraded riparian areas. Due to scale and accuracy limitations, this report does not replace the need for site-specific analysis; rather, it serves as a guide for general planning purposes in the La Salle River watershed.

1) Federal-Provincial Agriculture Policy and Departmental Mandates

a) Federal-Provincial Agriculture Policy – Environment Chapter

The environment chapter of the current federal-provincial Agriculture Policy Framework has the following goals:

- Achieving meaningful and measurable improvements in soil, water, air quality and the industry's impact on biodiversity;
- Researching and developing new on-farm beneficial management practices, and
- **Making environmental information available for better land use planning and management (includes integrated watershed management)**.

b) Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration (PFRA) Mandate

PFRA's mission is to provide expertise and services to producers and stakeholders for the sustainable use of agricultural land and water resources. PFRA's focus is agricultural land, agricultural water, and resource analysis and interpretation.

c) Manitoba Agriculture, Food and Rural Initiatives (MAFRI) Mandate

MAFRI's mission is to assist with the compilation of a technical resource package and deliver expertise with the technical information to aid in issue identification, and to assist the proponent in completing the final Integrated Watershed Management Plan.

2) General Agriculture Overview of the Watershed

a) Agriculture Capability

Agriculture capability (Figure 1) is a seven-class rating of mineral soils based on the severity of limitations for dryland farming. This system does not rate the soil's productivity, but rather its capability to sustain agricultural crops based on limitations due to soil properties, topography and climate.

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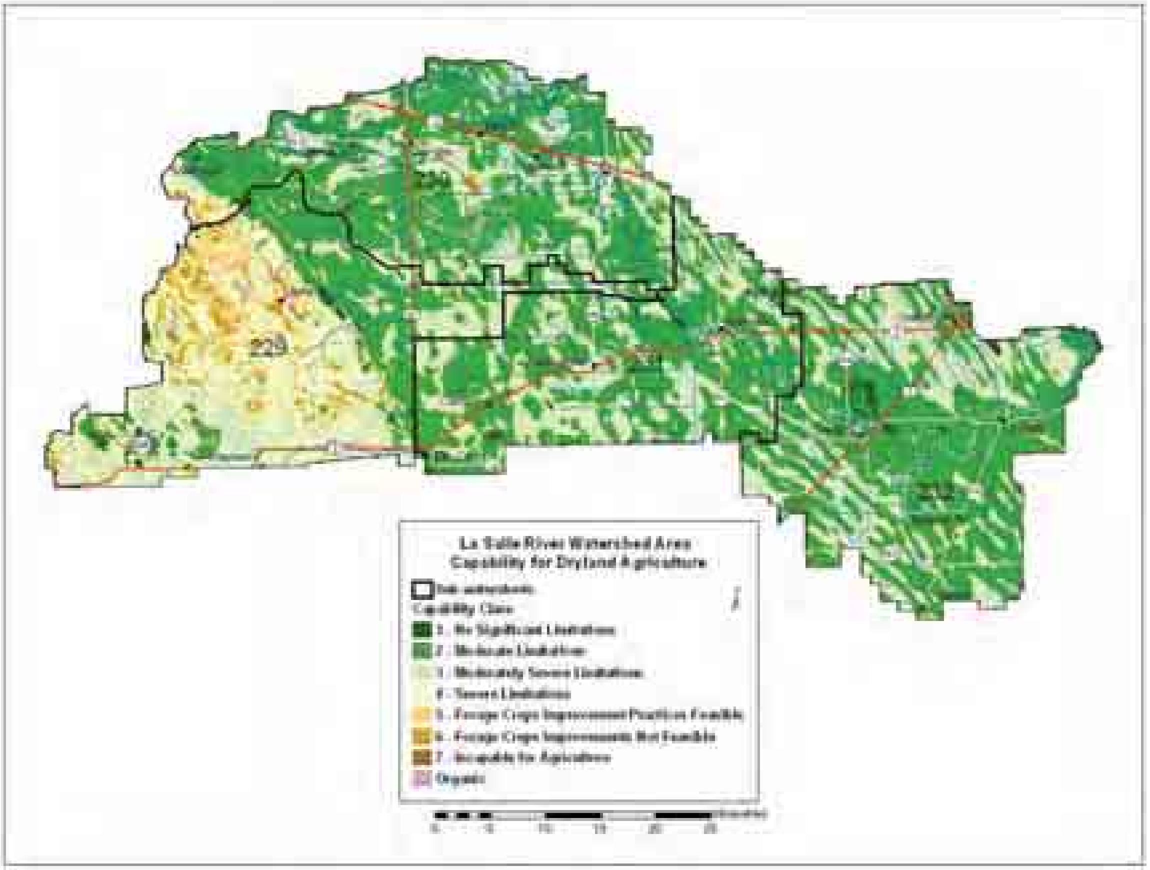
<u>Figure 1 – Capability for Dryland Agriculture</u>



(See also Figure A.1 in appendices for additional agriculture capability information).

Class 1 soils have no limitations, whereas class 7 soils have such severe limitations that they are not suitable for agricultural purposes. The general gradation of agriculture capability classes is as follows:

- Class 1, 2 and 3 soils are capable of sustained production of common field crops, and are thus considered as "prime agricultural lands".
- Class 4 soils are marginal for sustained arable agriculture and should be in permanent forage production.
- Class 5 soils are suitable only for improved permanent pasture.
- Class 6 soils are suitable only for native pasture use.
- Class 7 soils are incapable of use for arable agriculture or permanent pasture (i.e. it is nearly impossible to drive on class 7 soils, let alone try to farm them).

Agriculture capability subclasses identify the soil properties or landscape conditions that may limit use, such as: adverse climate (C); dense subsoils (D); erosion damage (E); inundation or flooding by streams or lakes (I); lack of soil moisture (M); salinity (N); stones (P); shallow depth to bedrock (R); topography or slopes (T); excess water other than from flooding (W); or two or more minor limitations in combination (X).

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In the La Salle River watershed, nearly 50% of the soils are **Class 2** in terms of their agriculture capability, followed by 36% of the soils as **Class 3**. Although not depicted on the map, most of the clay soils found in the eastern 2/3 of the watershed have an excess water (W) limitation due to the slow infiltration of water (i.e. 2W or 3W). The sandy soils in the western 1/3 of the watershed have a lack of soil moisture (M) limitation and, in some cases, a combination of M and W limitations due to their sandy textures and shallow water tables, respectively. These soils are referred to as “wet sands” and usually have an agriculture capability rating of 3MW or 4MW.

b) Land Use and Land Cover

<u>Figure 2 – Land Cover</u>

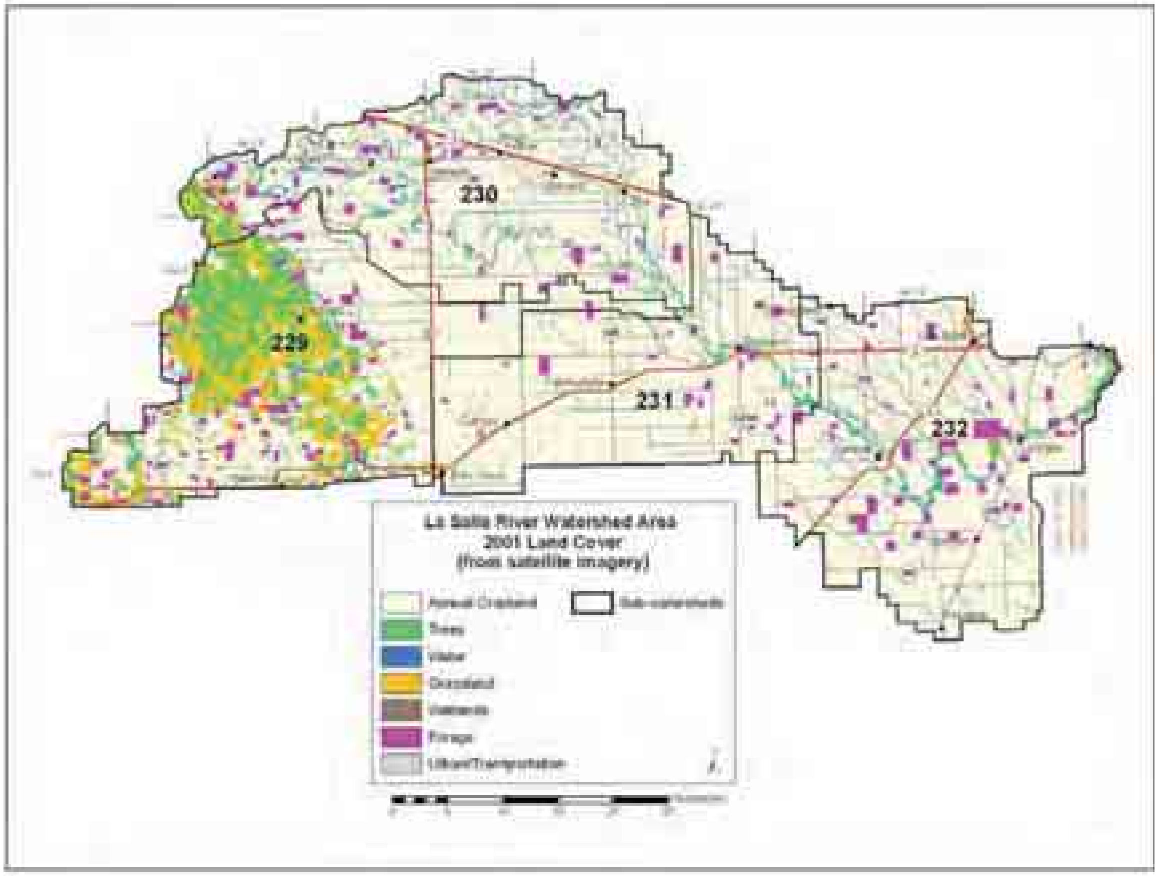

Figure 2 illustrates that the watershed is dominated by agricultural activity. Based on satellite imagery taken in 2001, the watershed’s land is covered by 75% annual cropland, 10% grass and pasture, and 4% forages. This translates to almost 90% of the land covered utilized for some form of agriculture with trees, residential uses and transportation infrastructure making up the majority of the remainder of the land cover. However, it is important to note that other land cover classes may be used for agricultural purposes as well. For example, areas with tree cover could be used as pasture land for livestock production. According to this data, wetlands make up only 0.1% of the watershed.

Sub-watershed Comparison

Table 1 - Comparison of 2001 Land Cover by Sub-watershed

Sub-watershed	Crop (%)	Grass (%)	Trees (%)	Forage (%)	Total (%)
229	51	25	16	5	97
230	81	6	4	4	95
231	90	3	1	2	96
232	84	4	2	4	94

Of the 4 sub-watersheds delineated for the La Salle River watershed (Table 1), three of them are strikingly similar in terms of land cover and are dominated by annual cropland while one (#229), the western most sub-watershed is not. This sub-watershed has significantly greater proportions of its land covered by grass (25%) and trees (16%). This characteristic can be at least partially explained by the inherent soil properties and associated land use that are discussed in more detail in later sections, but can be summarized as having more limitations to crop production and factors generally better suited to livestock production.

c) Agriculture and the Economy

Agriculture plays an important role in the national and local economies. Nationally, the agriculture and agri-food sector accounts for 8.3 % of Canada's Gross Domestic Product (GDP) that includes food service and distribution (4.3%), processing (2.3%) and primary agriculture (1.7%) sub-sectors (source: Statistics Canada 2000),. In Manitoba in 2005, agriculture's direct contribution to the provincial GDP was 3.5% while its indirect contribution was 11%.

Locally, agriculture is an extremely important contributor to the economy in the La Salle River watershed. The Census of Agriculture was applied to the Water Survey of Canada watershed boundary shown in Figure 3. Although it is a slightly different watershed boundary (a coarse national scale watershed), inferences about farming and trends in the watershed should still be valid. According to the Census for 2001, Gross Farm Receipts, or the income from all farm related goods and services, totalled nearly $180,000,000 that year. This highlights the importance of agriculture, arguably the largest contributor to the local economy.

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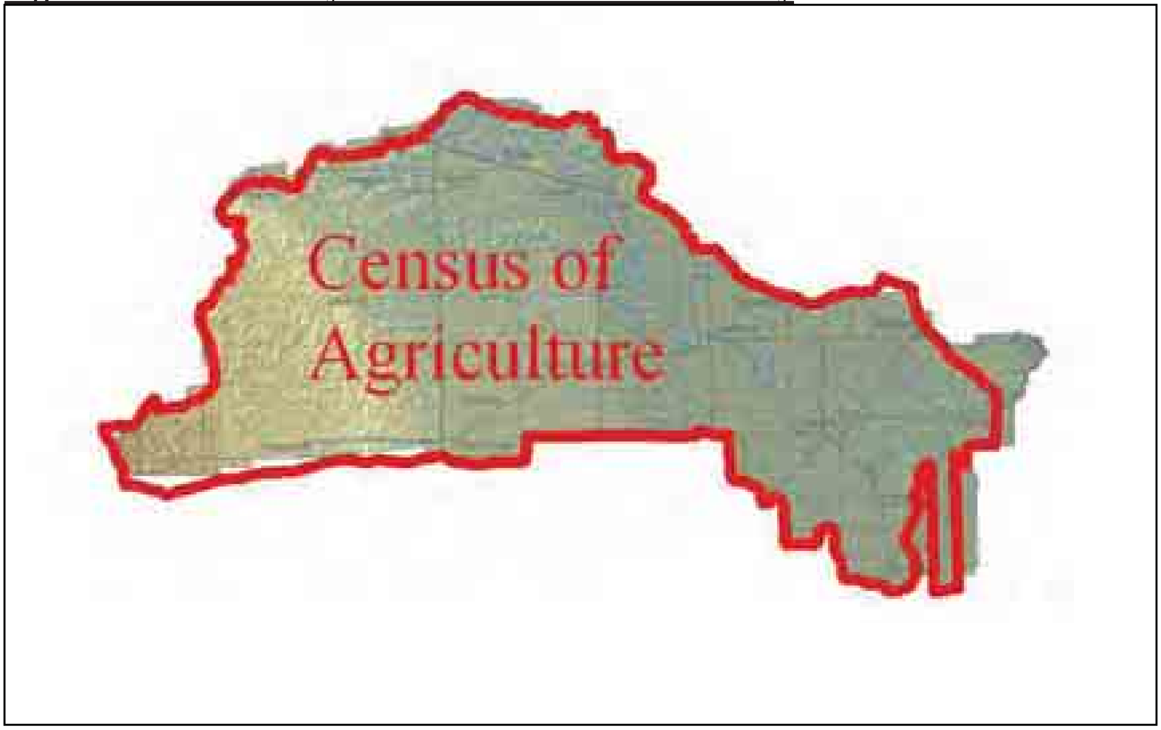
Figure 3 – Water Survey of Canada Watershed Boundary



d) General Agricultural Trends

Table 2 - Farm Number and Size - Census of Agriculture

CENSUS YEAR	Total Farms	Area (ac)	Avg. Farm Size (ac)
1971	963	518,814	539
1976	858	513,952	599
1981	816	513,650	630
1986	777	519,775	669
1991	743	522,869	704
1996	699	531,392	760
2001	627	539,867	861

Table 2 shows trends in the watershed relating to farm numbers and size from 1971 to 2001. During this period, the number of farms has been steadily decreasing in the watershed, but total acres farmed has increased by about 4% . This translates into the remaining farms getting larger with the average farm size growing from about 539 acres in 1971 to about 861 acres in 2001.

3) Agricultural Resources in the Watershed

a) Soil

i) Surface Texture (Figure A.2 in appendices)

Soil texture is the relative proportion of sand, silt and clay. The texture of a soil cannot be altered. In agriculture, soil texture is determined by measuring the size and distribution of particles less than 2 mm in diameter. Sandy soils are referred to as "light" soils because they are easily tilled; clay soils are referred to as "heavy" soils because of their difficult workability.

The map reports on surface texture of soils in the watershed because some soils have a change in texture from the surface layer to the texture found at depth.

In this watershed, about 74% of the area has a **clay** surface texture, with lighter soils (sands and coarse loamy soils) making up about 18% of the watershed, concentrated in the western areas.

Sandy soils (such as Almasippi sands) are more prone to leaching losses of soluble nutrients such as nitrogen fertilizers because water moves quickly through them (at about 2 inches per hour). By contrast, clay soils (such as Red River clays) have extremely slow infiltration rates (less than 0.04 inches per hour), which makes them more prone to water ponding and losses of soluble nutrients via runoff.

ii) Internal Drainage (Figure A.3 in appendices)

Soil drainage refers to the speed and extent of water removal from the soil by runoff (surface drainage) and downward flow through the soil profile (internal drainage). It also refers to the frequency and duration when the soil is not saturated. The drainage classes reported in the watershed map are as follows:

- Rapid – water is removed rapidly in relation to supply – very coarse textured soils in higher landscape positions have rapid internal drainage (about 1% of this watershed).
- Well – water is removed readily in relation to supply, such that there is development of a subsoil horizon which typifies well drained soils (about 5% of this watershed).
- Imperfect – water is removed somewhat slowly in relation to supply to keep the soil wet for a significant part of the growing season, either due to shallow water tables in sandy soils or slow infiltration rates in clay soils (about **61%** of this watershed).
- Poor – water is removed so slowly that the soil remains wet or the water table is near the surface for a large part of the time. These are usually the lower-lying areas where surface drainage improvements have not been made (about 2% of the watershed).
- Poor (Improved) – areas that were originally poorly drained but surface drainage improvements have resulted in soils behaving as if they have imperfect internal drainage characteristics, even though soil properties may still be indicative of poorly-drained conditions. These are usually

clay soils in lower-lying areas where surface drainage enhancements have been made (about 28% of the watershed).

- Very Poor – soils that are so poorly drained that peat material has built up and saturated conditions are prevalent. Very poorly drained soils are organic (peat) soils with no drainage improvements made (about 1% of the watershed).

iii) Irrigation Suitability (Figure A.4 in appendices)

Irrigation suitability is a general suitability rating for irrigated crop production. This classification system considers soil and landscape characteristics such as texture, drainage, depth to water table, salinity, geological uniformity, topography and stoniness and ranks them in terms of their sustained quality due to long term management under irrigation. It does not consider factors such as water application, water availability, water quality or the economics of this type of land use. Irrigation suitability classes are excellent, good, fair and poor.

Almost 73% of the watershed is rated as having **poor** irrigation suitability because the heavy clay soils present higher risks of problems occurring if irrigation is practiced on them, such as increased risk of excess water ponding, runoff of nutrients, and development of salinity. About 16% of the watershed has good irrigation suitability, concentrated in the sandy areas and especially where internal drainage improvements could easily be made.

iv) Salinity (Figure A.5 in appendices)

Soil salinity is a limitation where plant growth is reduced due to the presence of soluble salts in soil which holds water more tightly than the ability of plants to extract water from the soil. As a result, many plants will exhibit symptoms of droughtiness, but the soil is often relatively moist.

For soil salinity to occur, there must be the presence of soluble salts in the subsoil, groundwater or in both, and the presence of wet conditions, either as a shallow water table or frequently saturated conditions that can result in soluble salts moving into the root zone of the soil through the upward movement of water.

Approximately 84% of the watershed is considered **non-saline**, due to a lack of salts present in the bedrock and subsoil, or due to the absence of a shallow water table or shallow bedrock with salts present. What little salinity does occur is only weakly saline, significantly affecting only the most sensitive crops, such as pulse crops and vegetables, and these areas are mostly confined to locations adjacent to watercourses and drainage ditches. Individual aerial photos, soil testing and producer experience would give more detail of the salinity status of specific fields in the watershed.

v) Water Erosion Risk (Figure A.6 in appendices)

Water erosion is the detachment, movement and depletion of soil from the land surface by precipitation leaving the landscape as runoff. Soil erosion by water is often accelerated on agricultural lands by leaving insufficient cover on soils prone to runoff at crucial times (i.e. just prior to or just after spring seeding). A general rule of thumb is to maintain at least 35% cover on soils at all times.

In general, soil erosion by water is more of a concern on clays and loam soils than sands, because the slower infiltration rates on the heavier-textured soils leaves them more prone to runoff and subsequent erosion. Slope length and steepness are other important factors: doubling the length of the slope increases soil losses by 1.5 times; doubling the incline of the slope increases soil losses by 2.5 times.

Approximately 96% of the watershed is at either a **negligible or low** risk of soil erosion by water, even under bare soil conditions. This is largely the result of very flat topography and the presence of sandy soils in the western 1/3 of the watershed. Coupled with management practices that leave enough cover on the soil, the risk of water erosion goes down even further. The greatest risk of water erosion occurs during rapid spring snowmelts and along ditches and watercourses with greater slopes.

vi) Wind Erosion Risk (Figure A.7 in appendices)

Wind erosion is the detachment, movement and depletion of soil from the land surface by wind. Soil erosion by wind is often accelerated on agricultural lands by excessive tillage and by leaving insufficient cover on soils prone to wind erosion (i.e. just prior to or just after spring seeding). A general rule of thumb is to maintain at least 35% cover on soils at all times.

In general, soil erosion by wind is more of a concern on sands than on clays and loams, because sands tend to dry out quickly and what soils clods may form tend to break down easily into single-grained particles, which are highly prone to wind erosion.

About **65%** of the watershed is rated as **moderate** risk for wind erosion, mostly corresponding to the areas with a clay surface texture. Almost **27%** of the watershed is either at **high or severe** risk of wind erosion under bare soil conditions. The sandy surface texture is what makes these soils prone to wind erosion, but under management practices that promote adequate soil cover, such as forages and pasture, the risk of wind erosion is low. Extra care should be taken if some of these sandy soils are planted to low residue annual crops, such as field beans and potatoes. In these cases, shelterbelts and cover crops should be included and the crop rotation should include high residue crops preceding and following low residue crops.

b) Water

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i) Agricultural Water Demand

Water demands in agricultural areas of the watershed include needs for human and livestock consumption, irrigation, crop spraying, washing or processing crops, as well as cleaning of facilities and equipment. As the industry grows, especially irrigated agriculture and the livestock sector, increased demands will be placed on the water resource. According to Census data from 1971 to 2001, irrigated acres have increased from 185 to 2473 during that period. Using an estimate of 5 inches of water applied per irrigated acre per year, the water requirements for irrigation in the watershed have increased from about 77 acre-feet (95,000 cubic meters) per year in 1971 to about 1030 acre-feet (1.27 million cubic meters) per year in 2001.

Table 3 – Estimated Water Requirements

	gallons per day	litres per day
People (one person)	60	227
Beef - Feeder (to 1250 lb)	10	38
Beef Cow with Calf	12	45
Dairy Cow - milking*	30	114
Swine - breeding sows*	20	76
Swine - feeder (to 250 lb)	1.5	6
Swine - weaner (to 50 lb)	0.5	2
Sheep - ewes	2.5	9

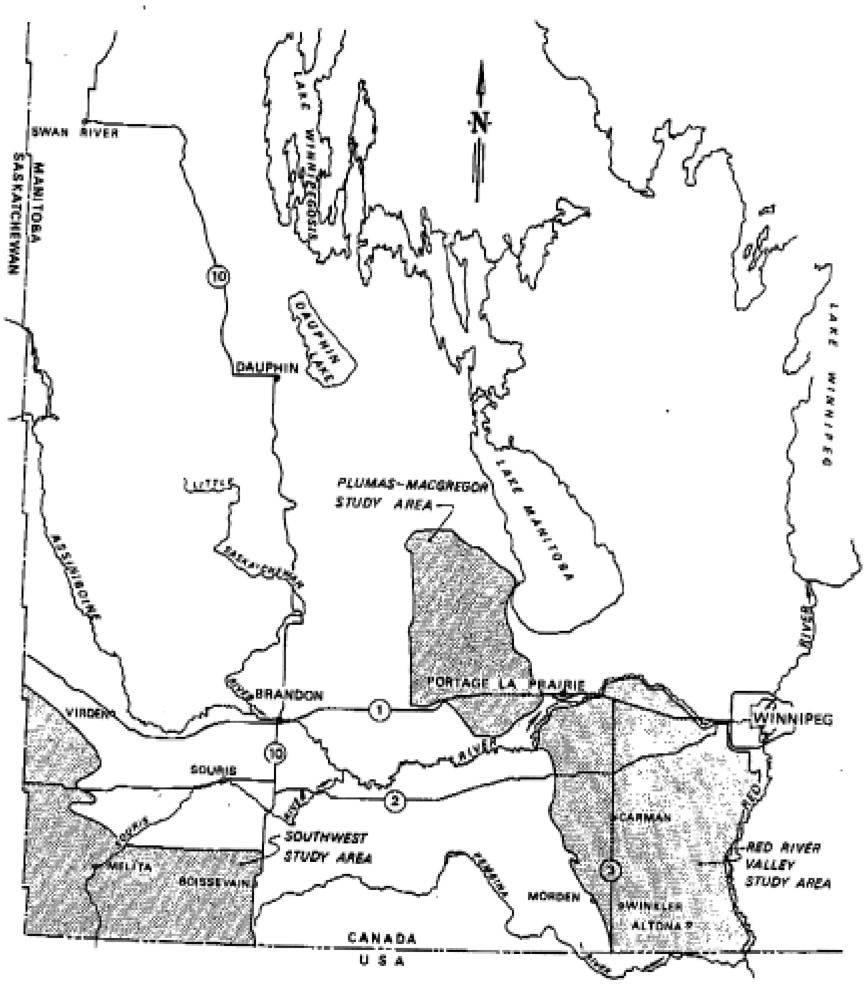
* includes wash water

Livestock numbers have also increased during that time, especially hogs, with numbers more than doubling from around 51,000 pigs in 1971 to over 117,000 in 2001. Using water requirement estimates for the various types of livestock from Table 3 and livestock numbers from the Census of Agriculture, water demand estimates for the industry can be calculated. The total water demand for the hog industry alone in the watershed has grown from about 221 million litres per year in 1971 to about 665 million litres per year in 2001. Estimated water requirements for the main types of livestock present in the watershed (hogs, cattle and sheep) have risen from about 666 million litres per year in 1971 to about 1.25 billion litres per year in 2001.

ii) Water Shortages (Drought) and Water Sourcing

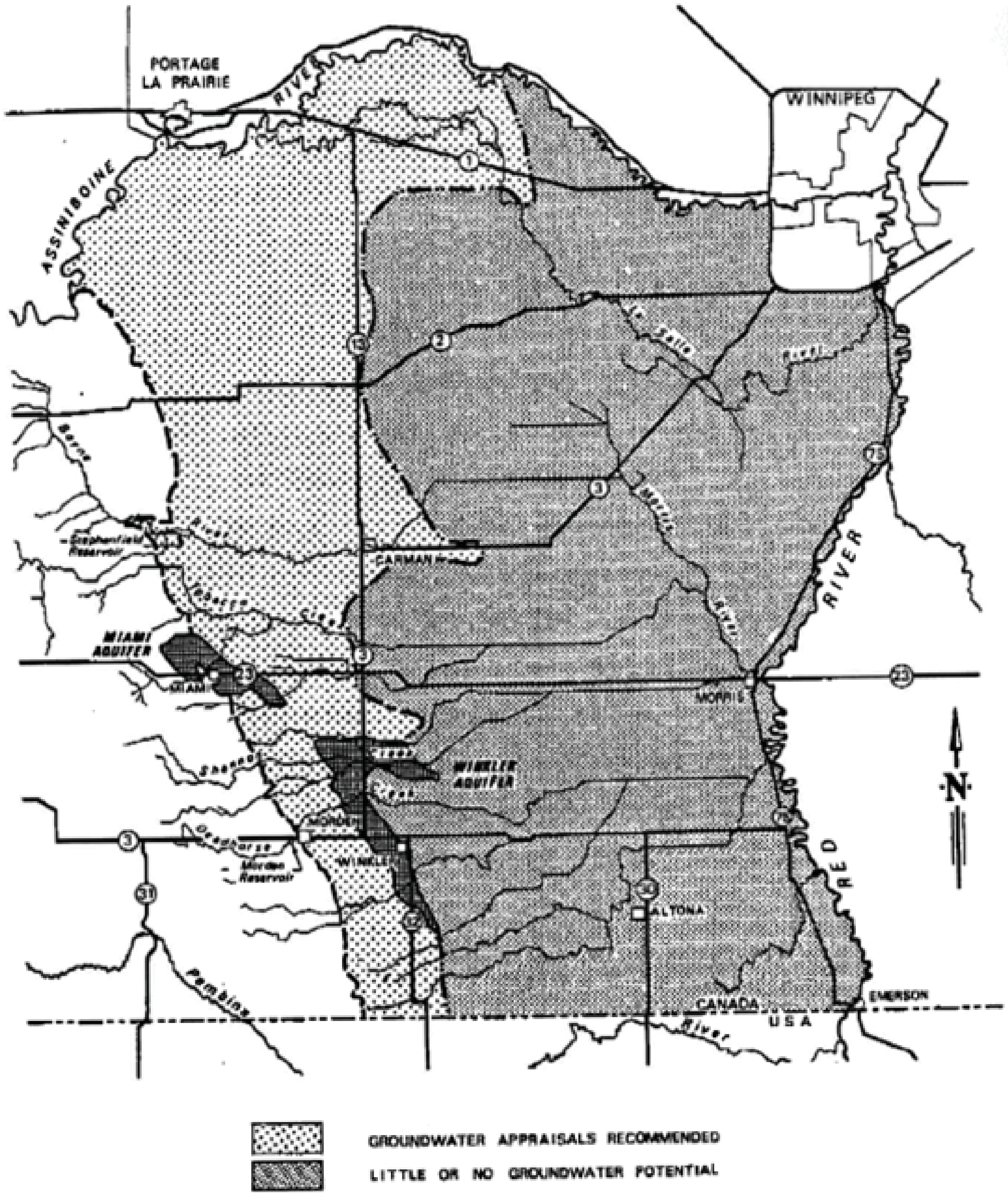
Periods of drought have also had significant impact on the industry by limiting available supplies. Figure 4, taken from Phase II of PFRA's Manitoba Water Sourcing Study, identifies areas in the province that are considered chronic drought areas, or areas that would become water deficient in drought periods. This information was based on previous studies and program data from a variety of agencies as well as knowledge gained from the severe drought of 1988. Figure 5 focuses on what was referred to as the Red River Valley region, which encompasses nearly the entire La Salle River watershed (Figure 6). Figure 5 also outlines areas in the study area with potential to access groundwater sources, note that site specific appraisals are recommended. This information was used to help guide programs and projects in subsequent years to help address the drought sensitivity in this region, including individual farm and community water source projects.

<u>Figure 4 – Chronic Drought Areas for Manitoba</u>



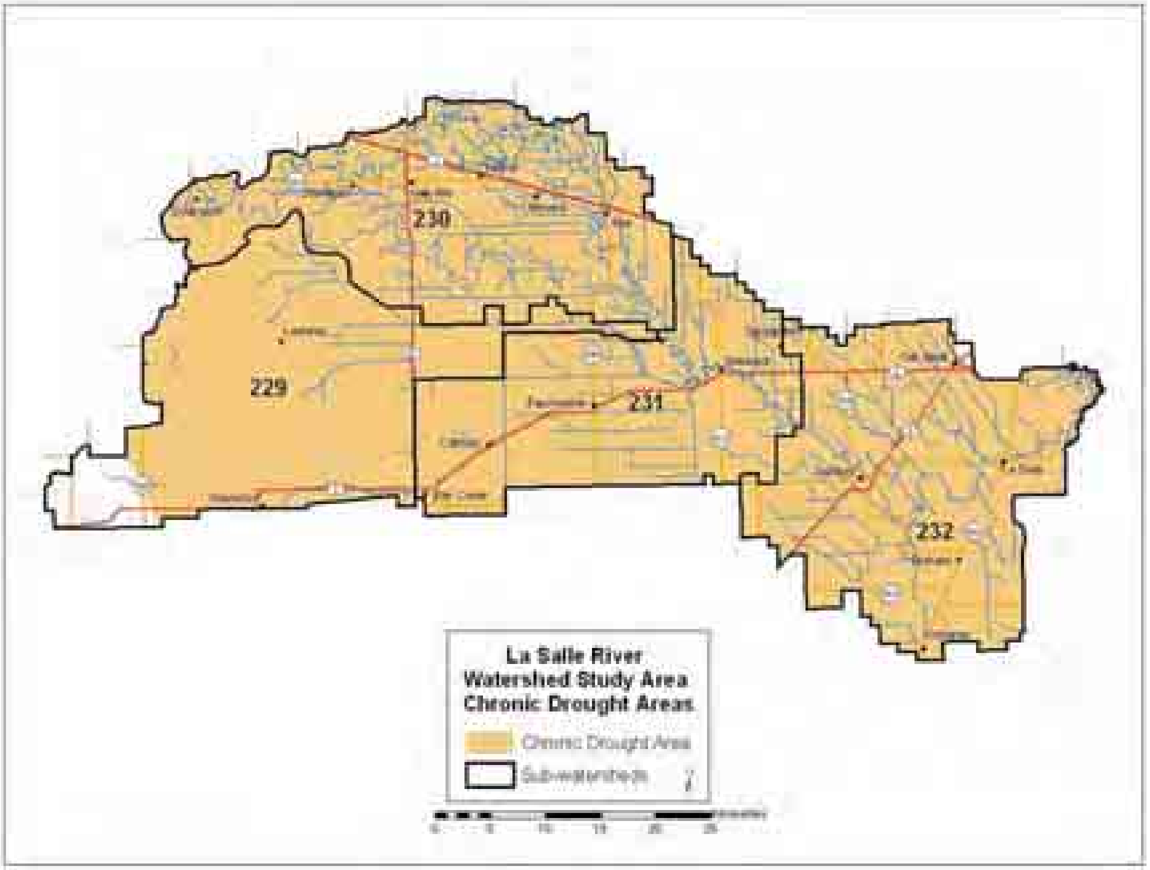
Source: Manitoba Water Sourcing Study Phase II, PFRA, January 1989

Figure 5 – Red River Valley Chronic Drought Area



Source: Manitoba Water Sourcing Study Phase II, PFRA, January 1989

<u>Figure 6 – La Salle River Watershed Chronic Drought Area</u>



Source: Manitoba Water Sourcing Study Phase II, PFRA, January 1989

iii) Surface Water Sources

Surface water is a very important source of water for producers in the watershed, especially in the western part of the watershed where cattle are more prevalent and dugouts are common (Figure 7). Of concern may be the fact that many of the dugouts in the watershed, particularly in the “wet sands” of the west, are fed by shallow groundwater. These shallow sources are both susceptible to water quality and quantity declines. They are susceptible to drought. They can also be susceptible to contamination by local runoff and potentially affect entire aquifers or portion of because of the interconnection of these surface features with the groundwater.

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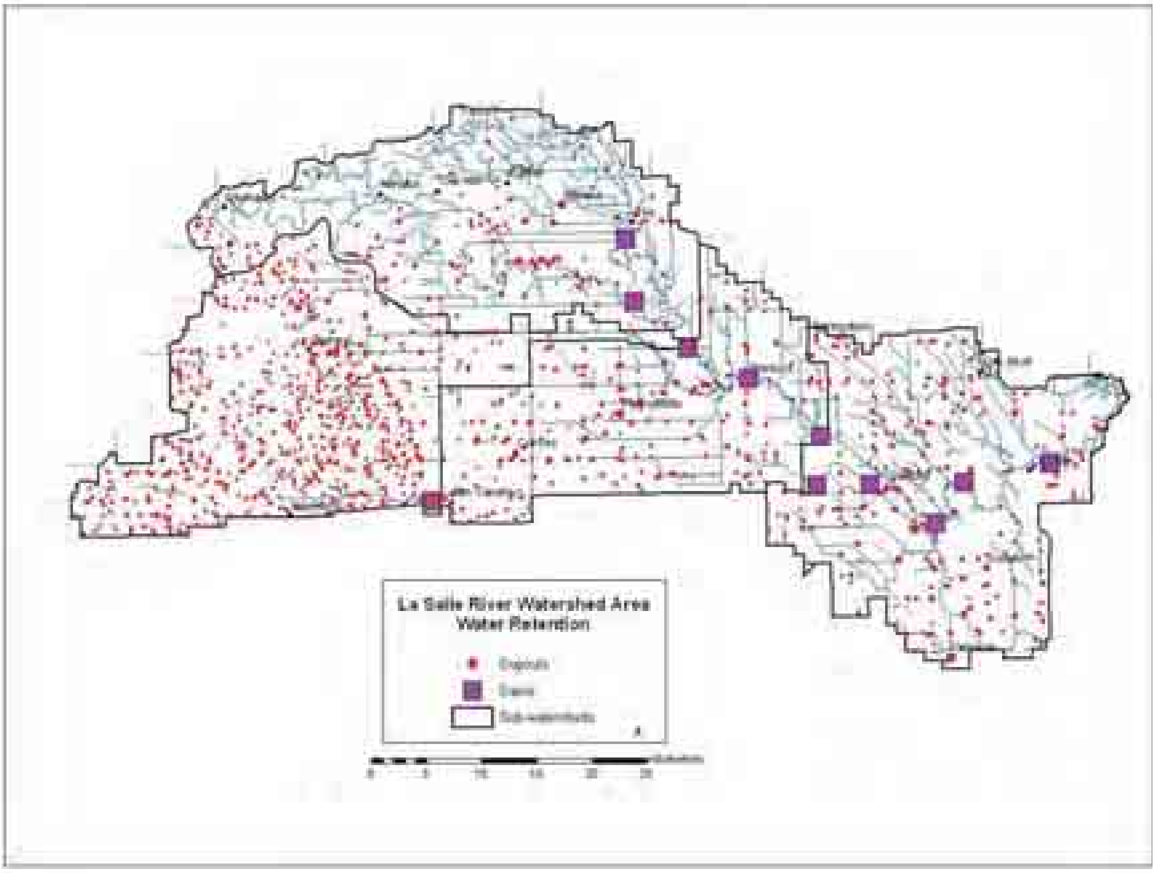
<u>Figure 7 – Surface Water Diversions – Dams and Dugouts</u>



source: Natural Resources Canada - National Topographic System of Canada

iv) Groundwater Sources

Groundwater is a valuable resource to many producers in the watershed, especially in the west and along the banks of the La Salle River. Figure 8 illustrates how there are very few sand and gravel aquifers present in the eastern part of the watershed and other sources of water are commonly required.

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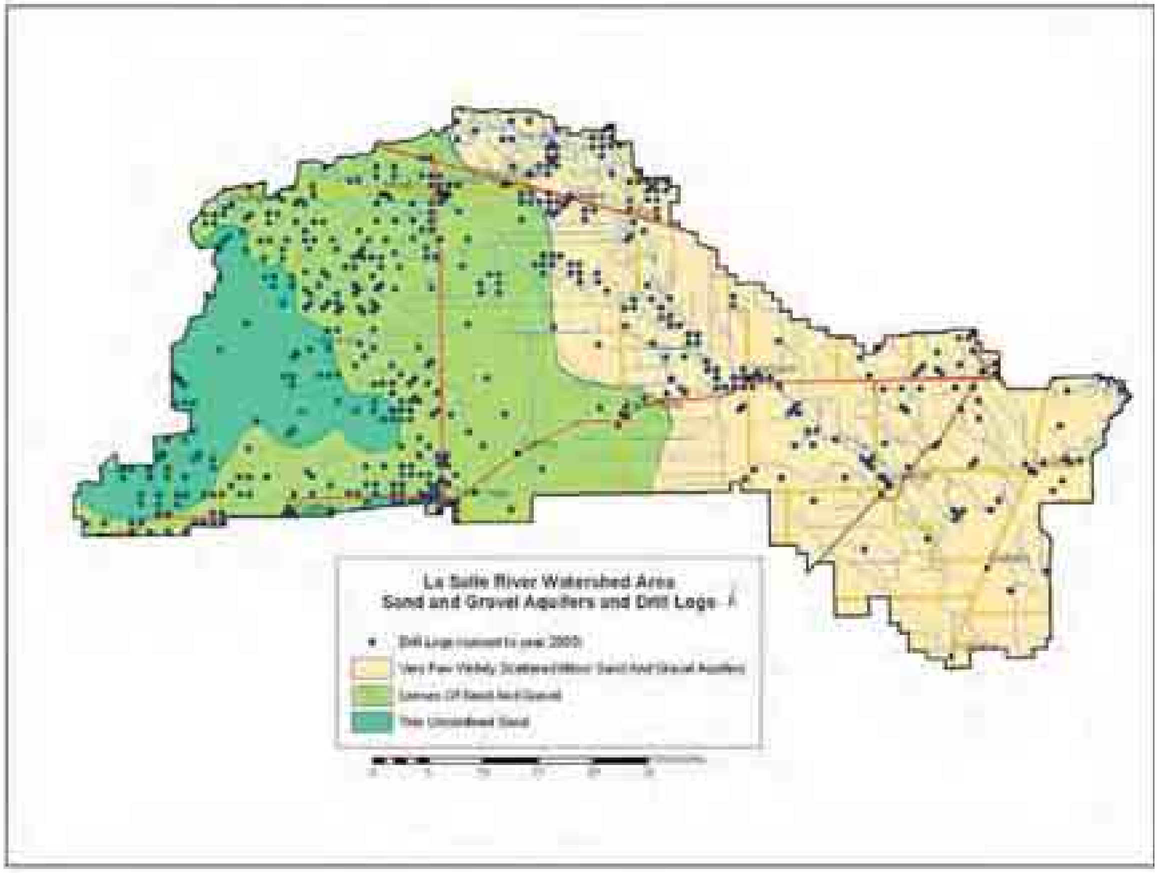
Figure 8 – Groundwater Sources – Sand and Gravel Aquifers and Drill Logs



v) Community Sources

Community water supplies represent a dependable source of water for the agriculture industry in the watershed, especially for operations requiring higher quality water such as for spraying and in some cases for livestock operations such as dairy and pigs. Figure 9 shows there is an extensive network of existing infrastructure to help address the water supply needs for much of the watershed.

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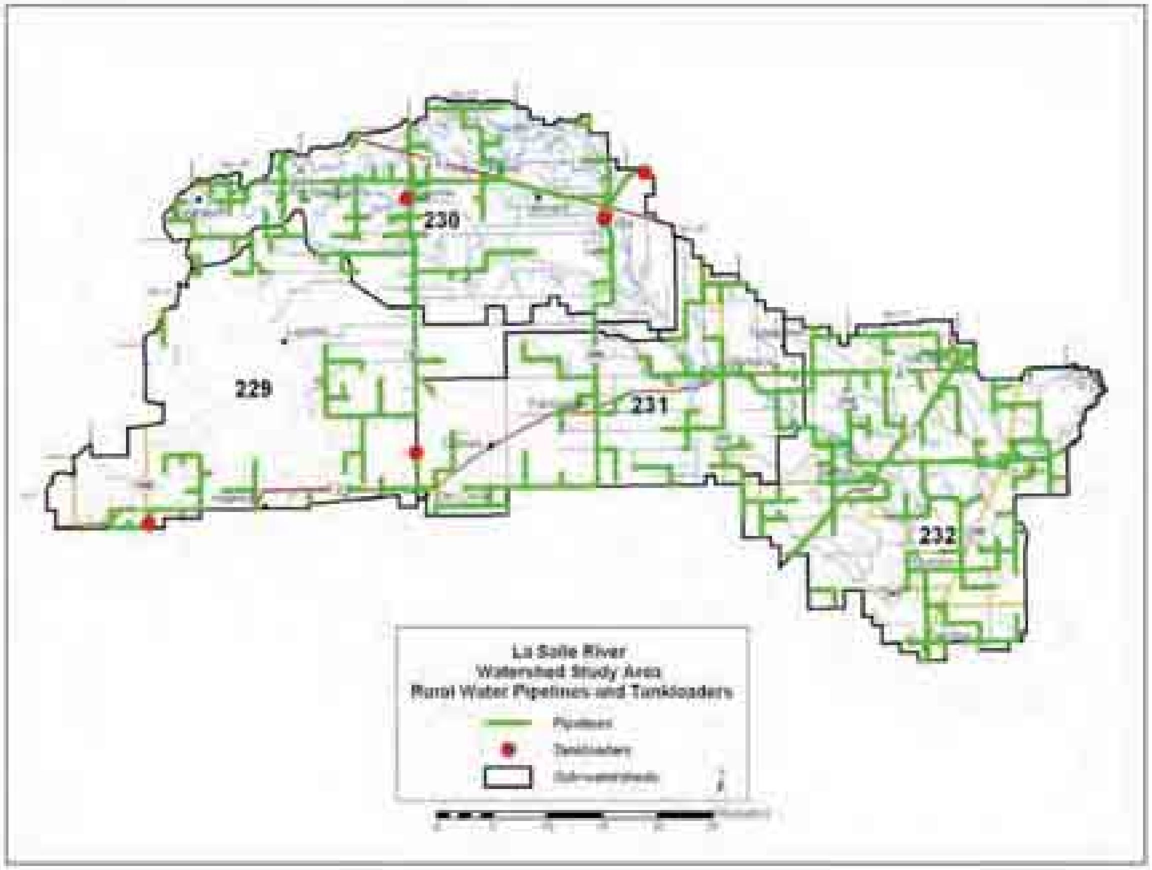
<u>Figure 9 – Community Water Sources – Rural Water Pipelines and Tankloaders</u>



4) Watershed Considerations

a) Land Use

The La Salle River watershed is a productive agricultural area. According to the 2001 Census, there were a total of 644 farms utilizing 90% (217,493 ha) of the land in the watershed. For the purpose of this report, farmland includes all land that is owned, rented, leased (including government land) or crop-shared by agricultural operations. Of this land, 5,431 ha (3%) is leased government land. Of the farmland, 172,751 ha (79%) were prepared for seeding in the fall of 2000 or spring 2001.

Land use and management practices of upland areas are important considerations in watershed planning. Crop type (permanent vs. annual, high residue vs. low residue), tillage practices, nutrient management, and conservation practices on the landscape are all activities that can affect water quality within the watershed.

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Table 4 – Cultivated Crop Types (2001 Census)*

Crop Type	Hectares[1]	Percent of Farm Land[1]	Percent of Watershed[1]
Cereals (wheat, barley, oats, buckwheat[2], canary seed)	107,693	49.5%	44.7%
Forages (corn for silage, alfalfa, forage for seed, other tame hay and fodder crops[3])	17,745	8.2%	7.4%
Oilseeds (canola, flaxseed, soybeans, sunflowers)	50,493	23.2%	21.0%
Potatoes[3]	986	0.5%	0.4%
Pulse Crops (dry field peas[2], dry beans[2])	5,035	2.3%	2.1%

1 - Numbers do not include suppressed data
2 - Data is suppressed for one farm reporting
3 - Data is suppressed for two farms reporting

*Source: Summary of Resources and Land Use Issues Related to Riparian Areas in the La Salle River Watershed Study Area, PFRA 2004

i) Nutrient sources

Table 4 – Cropping, Livestock and Nutrient Trends (Census of Agriculture)

	Canola/Mustard (ha)*	Cropland (ha)*	Pigs	Total Cattle	Manure (kg/yr)*	Manure N (kg/yr)*	Manure P (kg/yr)*
1976	1,886	166,870	37,406	23,327	325,948,049	2,010,406	570,124
1981	7,390	175,098	42,742	21,852	303,068,488	1,887,051	534,862
1986	13,754	181,789	60,764	19,535	304,410,660	1,927,311	564,221
1991	20,477	182,172	57,725	21,821	326,624,832	2,033,902	584,470
1996	28,283	179,833	101,164	27,558	442,684,816	2,756,924	807,563
2001	26,793	184,786	117,749	28,408	468,525,146	2,954,965	879,353
% Chg.	**1320%**	**11%**	**215%**	**22%**	**44%**	**47%**	**54%**

*see Table A.1 in appendix for imperial units

Table 4 highlights the most striking trends related to cropping, livestock and nutrient trends in the watershed from 1976 to 2001. The table shows the increase in popularity of canola (shown in the table as Canola/Mustard to accommodate changing terminology), the result of successful breeding programs in the 1970's to reduce acid content that culminated in the origin of the term canola in 1974. Compared to cereals, canola is generally considered to be a higher input crop, commonly requiring relatively high amounts of nutrients and pesticides to achieve desirable yields. Other significant trends highlighted in Table 4 include a steady increase in cropped acres (11% increase from 1976 to 2001) in the watershed, likely corresponding to land clearing and draining for crop production. Significant increases in livestock from 1976 to 2001 are also noted for the watershed. The total number of pigs and cattle in the watershed increased by 215% and 22% respectively over that period. Manure calculations, based on animal unit coefficients for each type of livestock present (Table 5), show significant increases in the watershed.

The total manure produced increased by about 44%. The total nutrient content of manure produced in the watershed was calculated based on the type of livestock and its animal unit coefficient, as nutrient concentrations differ between species and within species with different types of operations. These calculations suggested that the amount of nitrogen in the manure in the watershed increased by 47% and the phosphorous increased by 54% during the 25 year period.

Table 5 – Livestock by Animal Units (2001 Census)*

Livestock	Total Number of Farms[1]	Number of Animals[2]	AU Coefficient[3]	Total AU[2]
Total cattle and calves	219	27,965	--	
Total dairy cows	37	2,862	2	5,724
Total beef cows	175	9,330	1.25	11,663
Total heifers & steers for slaughter and feeding (1 yr and older)	--	3,596	0.631	2,269
Total pigs	47	124,014	--	
Total sows	25	17,216	0.313	5,389
Total nursing and weaner pigs	21	37,439	--	
Total grower and finisher pigs	39	69,006	0.143	9,868
Boars	21	353	0.2	71
Total hens and chickens	39	307,071	--	
Broilers and Roasters	13(4)	48,918	0.005	245
Layers (19 weeks and older)	30	162,103	0.0083	1,345
Pullets (under 19 weeks)	10(4)	34,700	0.0033	115
Turkeys	6(3)	23,440	0.014	328
Total sheep and lambs	10(3)	244	--	
Ewes	10(3)	140	0.2	28
Lambs	6(6)	0	--	0
Total horses and ponies	66	1,989	1	1,989
Bison	0	0	0.8875	0
Elk	2(2)	0	0.52	0
Goats	6(3)	95	0.143	14
				39,046

*Source: Summary of Resources and Land Use Issues Related to Riparian Areas in the La Salle River Watershed Study Area, PFRA 2004

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<u>Figure 10 - Livestock Density – 2001 Census of Agriculture by Sub-watershed</u>

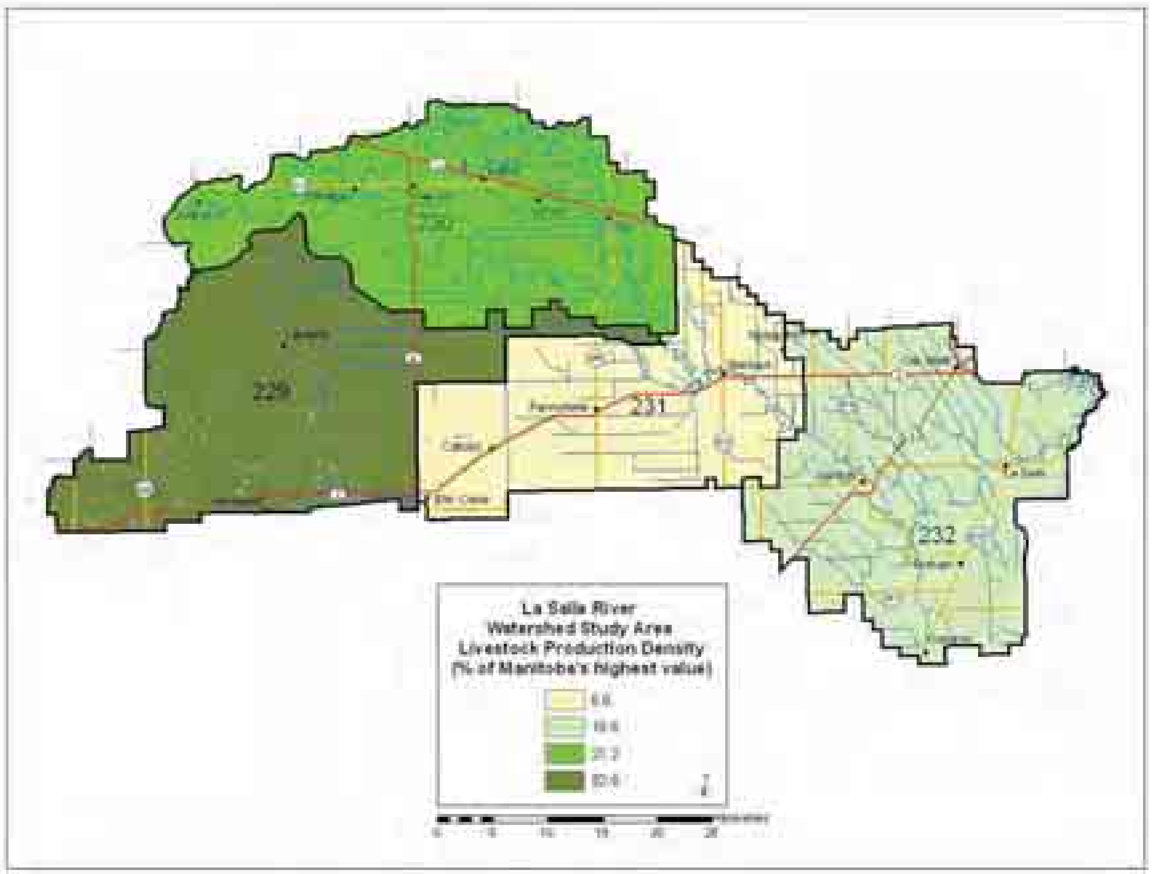

Figure 10 shows livestock density from the 2001 Census by sub-watershed as a percentage of the watershed in Manitoba with the highest livestock density of 0.98 Animal Units/hectare. Comparatively, the La Salle watershed does not have a very high livestock density with the highest sub-watershed (229) having only 32.6% of that value (or 0.32AU/ha). Figure 10 also shows in relative terms how livestock are distributed in the sub-watersheds by comparison, with sub-watershed 231 having only 6.6% of the highest value (or 0.06 AU/ha). Because sub-watershed 229 has the highest number of beef cattle present, riparian pastures are likely more common and riparian pasture management will be important to maintain or improve riparian health.

Although the La Salle River watershed has relatively low livestock density relative to other watersheds in the province, the trend indicates increasing amounts of livestock, especially pigs and to a lesser extent cattle. Manure represents a valuable fertilizer and proper application can improve soil quality related to the soil's tilth, structure, aeration and water movement, but improper application can result in unwanted odours, increased greenhouse gas release, and increased nutrient loading due to runoff and leaching.

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<u>**Figure 11 – Fertilizer Use – 2001 Census of Agriculture by Sub-watershed**</u>

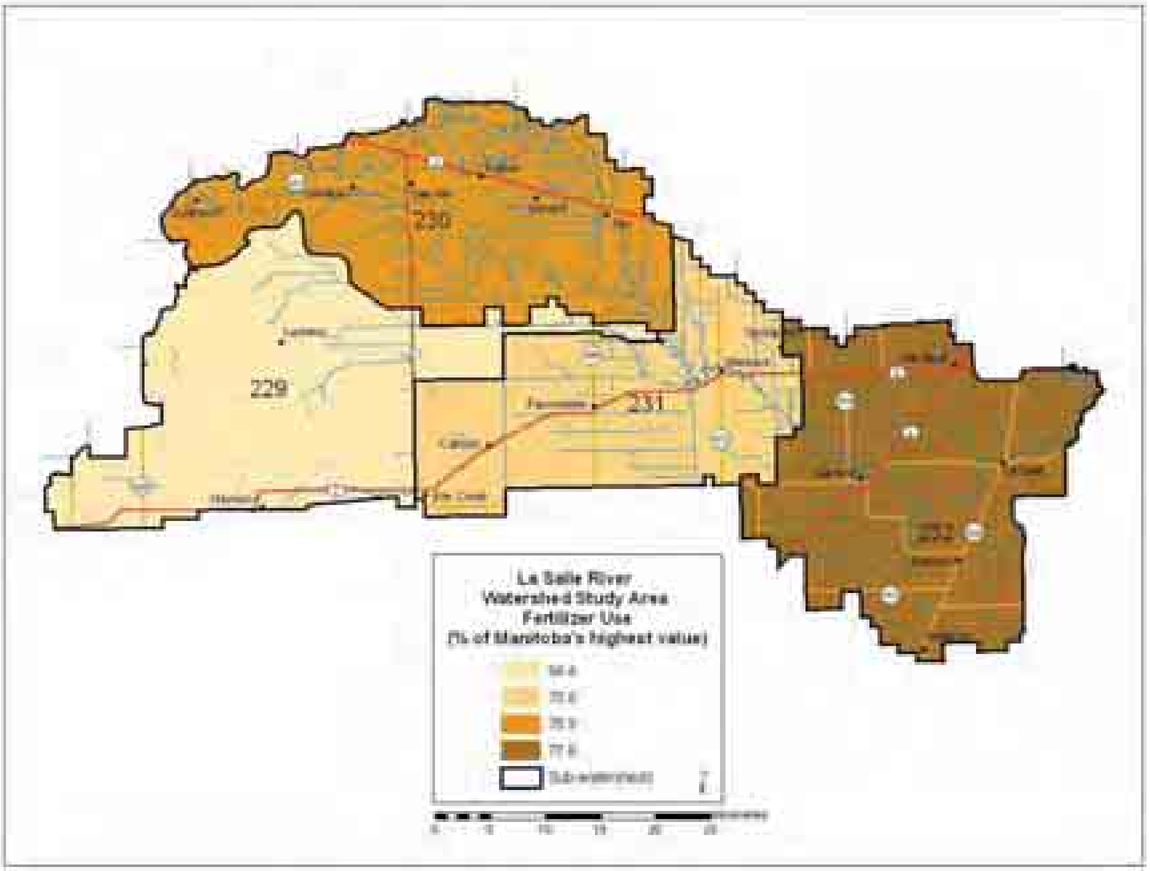


Figure 11 shows fertilizer use from the 2001 Census by sub-watershed as a percentage of the watershed in Manitoba with the highest fertilizer use expressed in terms of $101.23/hectare spent on fertilizer. Comparatively, the La Salle watershed appears to have significant levels of fertilizer use, as would be expected due to the relatively high percentage of productive crop land. The sub-watersheds range from 64.4% to 77.8% of Manitoba's highest value watershed (sub-watershed 229 = $65.23/ha, sub-watershed 232 = $78.76/ha). Sub-watershed 229 has the lowest value for fertilizer use. This is not surprising as it has the lowest percentage of annual cropland, more land used for forage production, and more manure available due to the higher livestock numbers, thereby reducing the demand for and use of commercial fertilizers.

ii) Nutrient Management

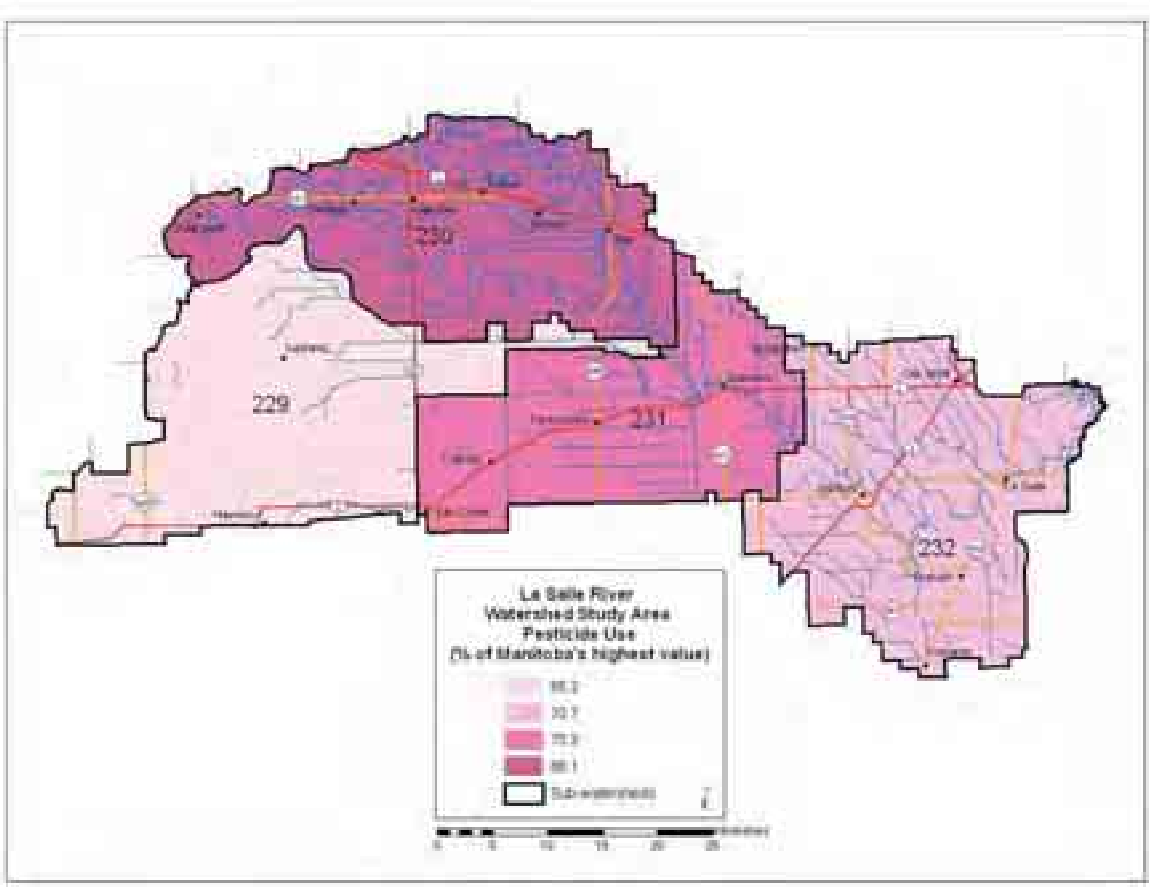
Utilizing nutrients, both in the form of manure and commercial fertilizers, to optimize crop production makes good economic and environmental sense. Avoiding unwanted nutrient loading in waterbodies requires balancing nutrients applied with crop requirements, while taking into account the residual nutrients left in the soil from the previous crop. Using the most appropriate method and timing of application is important to ensure nutrients are available for the crop and reduces amounts lost through runoff or leaching through the soil profile. This is especially true in areas of the La Salle watershed with high runoff potential like the majority of the clay soils in the Red River Valley region, but also true in areas where there are coarse soils and shallow aquifers like the western parts of the watershed where leaching to groundwater could be an issue.

The fate of nutrients in the environment is a complex issue and many factors need to be considered, such as climatic influences, crop yields and utilization, as well as complicated nutrient cycles and transport mechanisms. This is an area where future efforts could be focused to examine nutrient sources and sinks and establish a nutrient budget for the watershed.

The Red River valley Special Management Area (Figure A.8 in appendices) would include the eastern portions of the watershed, which would prohibit winter applications of nutrients and either injection or incorporation within 48 hours of fall applied manure on tilled soils.

iii) Pesticide Usage

<u>Figure 12 – Pesticide Use – 2001 Census of Agriculture by Sub-watershed</u>



Under certain conditions pesticides can enter the environment and have a negative impact on water quality and biodiversity. Using pesticides only when and where necessary, according to label directions and along with integrating non-chemical pest control methods where possible, reduces the potential risks and increases economic viability.

Figure 12 shows pesticide use from the 2001 Census by sub-watershed as a percentage of the watershed in Manitoba with the highest pesticide use expressed in terms of $81.65 per hectare spent on pesticide. Comparatively, the La Salle watershed appears to have significant levels of pesticide use, as would be expected due to the relatively high percentage of productive crop land. The sub-watersheds range from 68.2% to 88.1% of Manitoba's highest value watershed (sub-watershed 229 = $55.69/ha, sub-watershed 230 = $71.93/ha). Sub-watershed 229 has the lowest value for pesticide use as would be expected due to its low percentage of annual cropland and higher amounts of land covered by trees and land used for forage production, typically requiring less pesticide application.

For a comparison of livestock production density, fertilizer use, and pesticide use by Manitoba watersheds for the 2001 Census refer to Figures A.9 A.10 and A.11 in appendices.

b) Climate – runoff

The amount of water runoff has significant bearing on potential erosion as well as nutrient, pathogen and pesticide transport and is also an important consideration for surface water supply options (e.g. dugouts). Soil properties, ground cover, topography and drainage works can significantly influence the amount of runoff in a local area. Figure 13 shows runoff probabilities for the province. The amount of runoff in the La Salle River watershed generally increases as you travel east. Based on these probability isopleths, the easternmost sub-watershed (232) has in any given year, a 25% chance of exceeding 100 dam3/km2 (about 4 acre-inches) runoff and a 50% chance of exceeding 50 dam3/km2 (about 2 acre-inches) runoff. The westernmost watersheds (229 and 230) have only a 25% chance of exceeding 50 dam3/km2 (about 2 acre-inches) runoff and a 50% chance of exceeding just 30 dam3/km2 (about 1.2 acre-inches).

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Figure 13 – Annual Runoff in Southern Manitoba

c) Air

i) Odour

Odour is generally a localized issue. Odours associated with livestock operations and manure can be reduced by practices such as appropriate covers for manure storage facilities, consideration for wind speed and direction, and injection or incorporation in the fields as soon as possible.

ii) Particulates

Particulates in the air from agricultural activity is usually in the form of dust or smoke. The burning of crop residue creates smoke and tends to be worse in wet years when crops produce more straw and is more difficult to manage. Another concern would be blowing dust in the event of wind erosion occurrences during droughts. The sands and to a lesser extent the clay soils would be prone to blowing dust if inadequate ground cover is in place.

iii) Greenhouse Gases

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The most likely greenhouse gas of concern would be nitrous oxide (N2O) emissions if sustained wet periods occur in the clay soils in the watershed after nitrogen fertilization has taken place. While these losses tend to be small and limited in their extent, losses can range from 2-4 lb/ac/day and increase with increasing soil temperature. Nitrous oxide has 310 times the warming potential as carbon dioxide, so it is important to manage nitrogen fertilizers for maximum efficiency.

d) Biodiversity and Wildlife Habitat

<u>Figure 14 - Potential Wildlife Habitat</u>

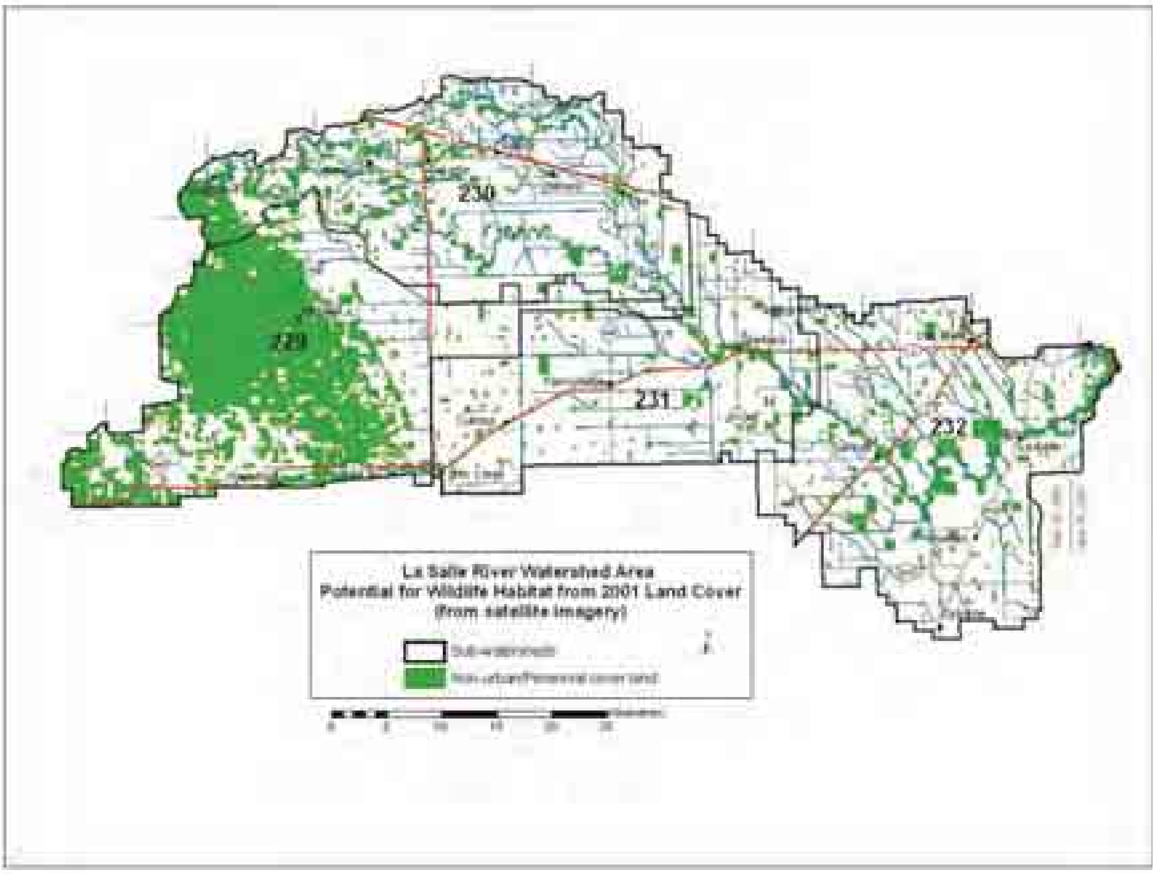

Figure 14 shows areas in the watershed that are **<u>not</u>** in annual crop production or in urban or transportation land use according to satellite data from 2001. These areas of perennial vegetative cover and water bodies are generally considered good habitat for many species of wildlife and occupy about 121 000 acres of the watershed or about 27% of its area.

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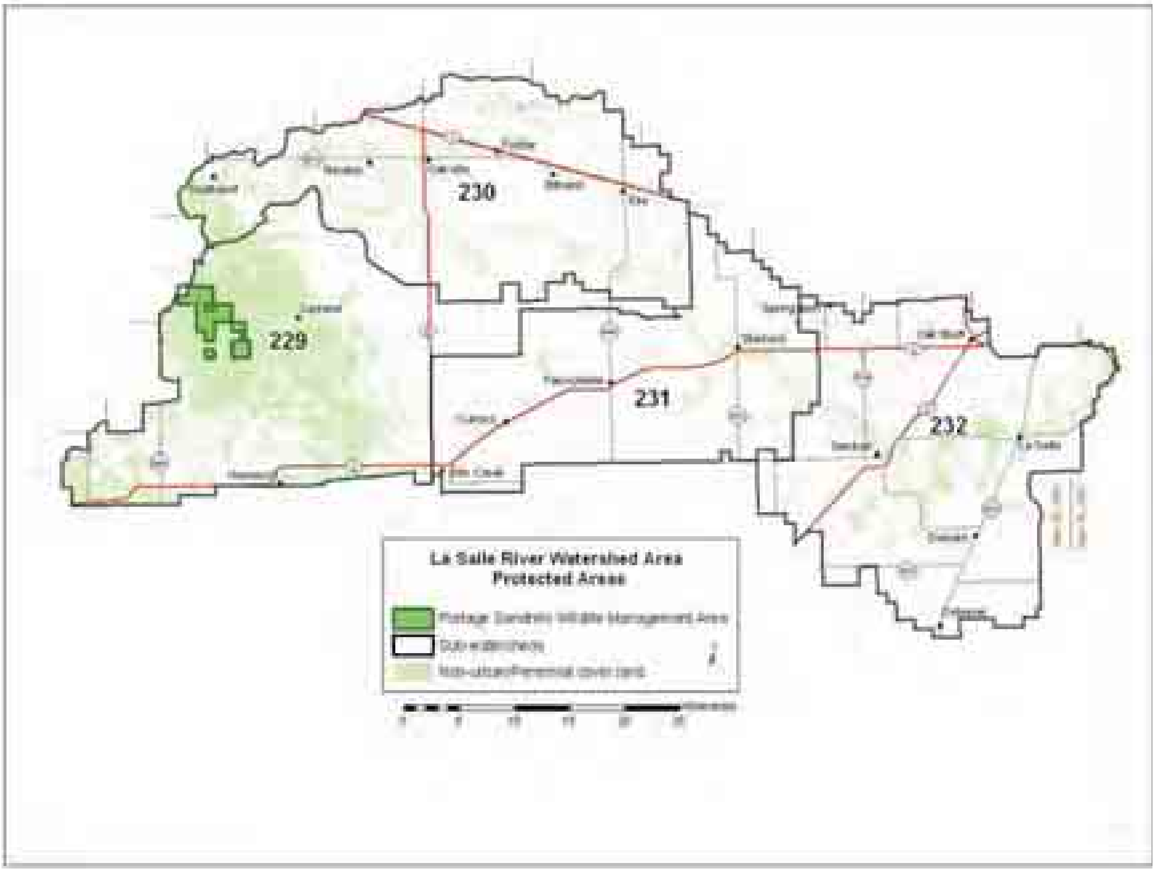
<u>Figure 15 – Protected Areas</u>



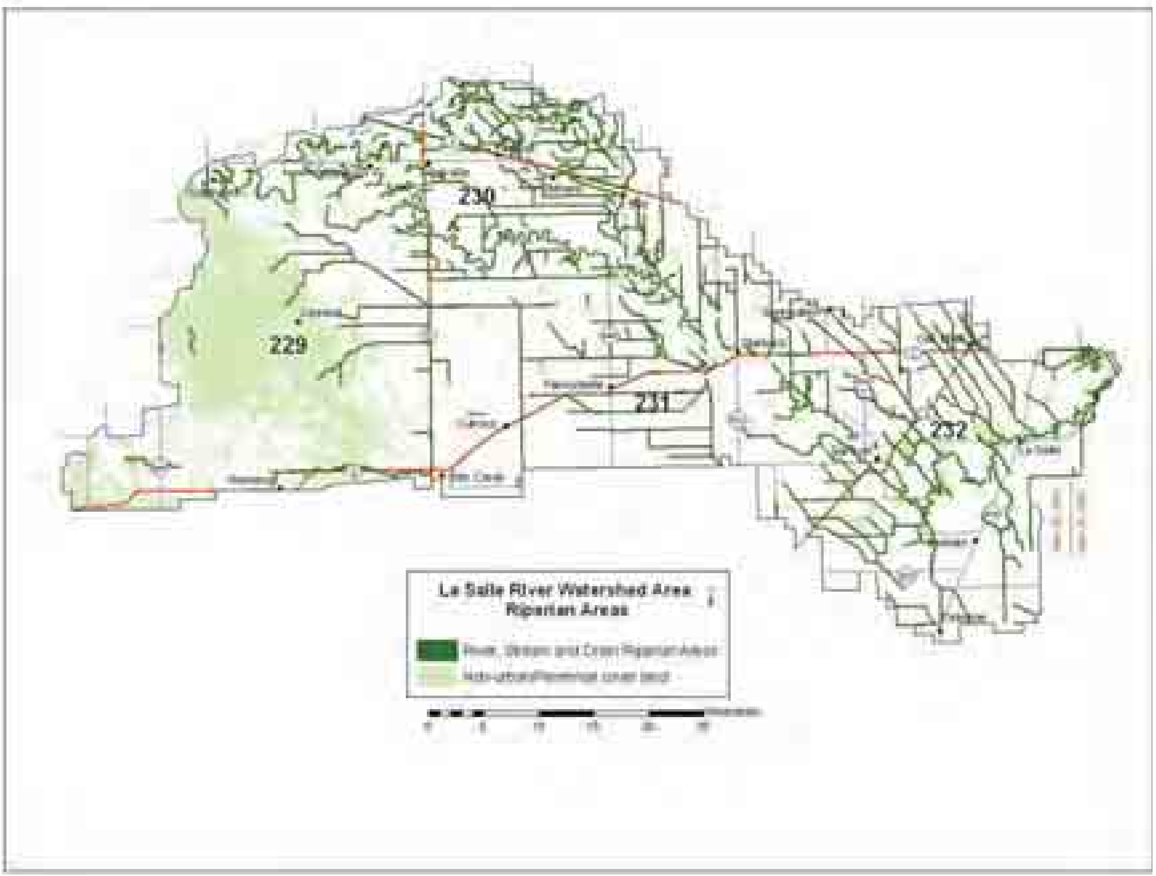
Protected areas in the watershed are restricted to the Portage Sandhills Wildlife Management Area, representing just under 4000 acres of the watershed. Although these areas occupy less than 0.7% of the watershed, they represent some of the largest blocks of contiguous natural lands in the watershed and have significant value in terms of wildlife habitat.

e) <u>Riparian Areas</u>

Figure 16 shows the locations of riparian areas associated with the watershed's many watercourses. Healthy riparian areas not only represent valuable wildlife habitat, but also play a very important role in reducing the impact of agriculture on surface water quality. Riparian areas reduce the amount of contaminants, nutrients, and pathogens reaching surface waters by trapping and filtering sediments and by absorbing excess nutrients. The health of a riparian area determines the extent to which the riparian area can perform its functions. Riparian health is generally determined by onsite assessment and evaluation. Trees are an important part of the riparian area. Tree roots help to stabilize banks and hold the soil in place while canopy cover provides protection from rain drops. Their sparse presence could be an indication of declining riparian health. Another indicator of potential decline in riparian health is the presence of annual crop land in the buffer area. Annual crop land can potentially impact water quality by allowing contaminated run-off to enter surface water.

Calculation of shoreline densities (Figure 17) provides information on areas where riparian areas are more concentrated. In the La Salle River watershed, rivers and creeks, including intermittent streams make up the majority of shoreline, although an area with a large amount of wetland shoreline is found in the western part. The 'Oakville' sub-watershed (#230) has the highest shoreline density. A higher shoreline density will indicate a greater concentration of riparian areas. Since riparian areas provide a buffer between upland areas and surface water, management practices (including riparian pasture management, buffer strips, and grassed waterways) become important to maintain this vegetated buffer area surrounding waterbodies and watercourses.

<u>**Figure 16 – River, Stream and Drain Riparian Areas**</u>



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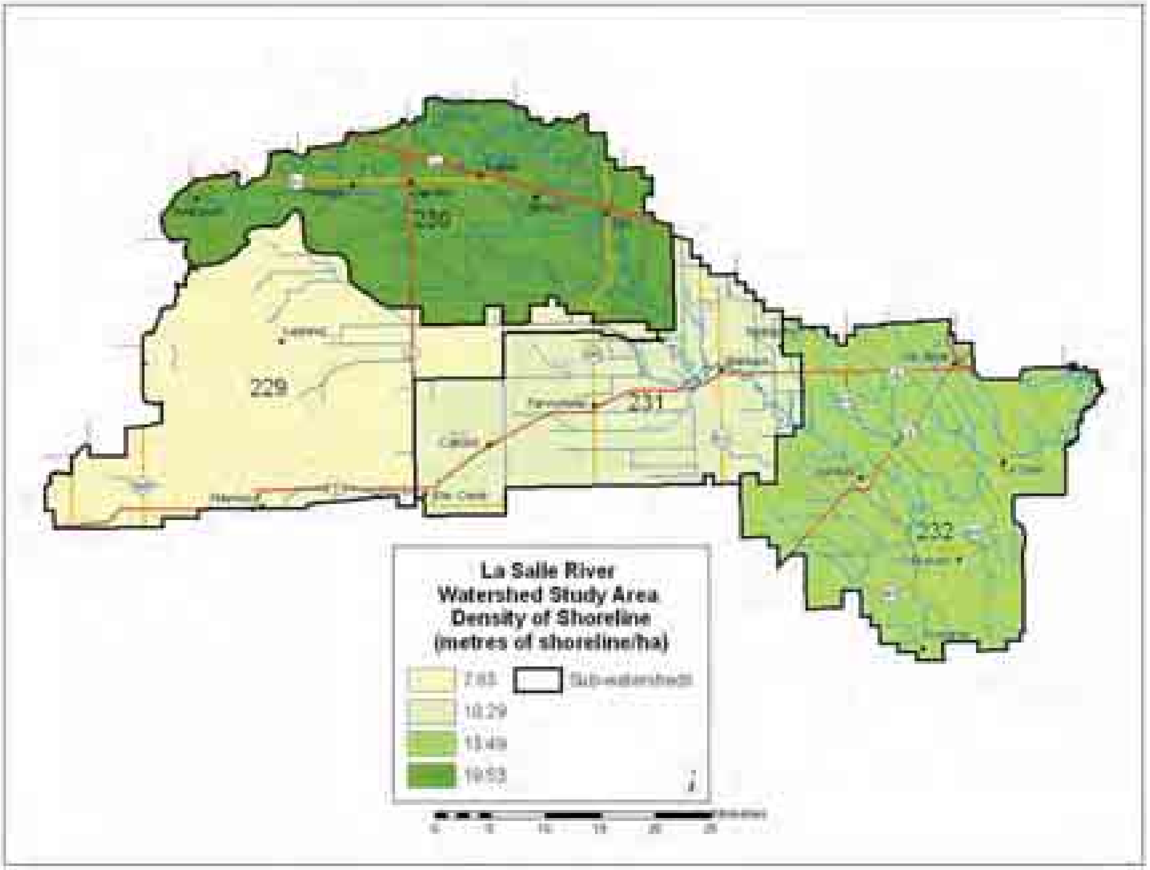
<ins>**Figure 17 – Shoreline Density**</ins>



f) Producer Awareness and Beneficial Management Practice Adoption

The Canada–Manitoba Environmental Farm Plan (EFP) Program was initiated in 2005 to help producers identify environmental strengths and weaknesses of their operations and develop an action plan to reduce any identified environmental risks. Figure 18 shows the distribution of workshops held by town and producer participants by rural municipality up to November 2006. The program was well received by La Salle watershed producers. Nine sets of two workshops were held in Starbuck during 2005 and 2006 and nearly 100 producers participated during that period. It is important to note that not all of these producers necessarily farm in the watershed and that producers from the watershed could have attended workshops held elsewhere.

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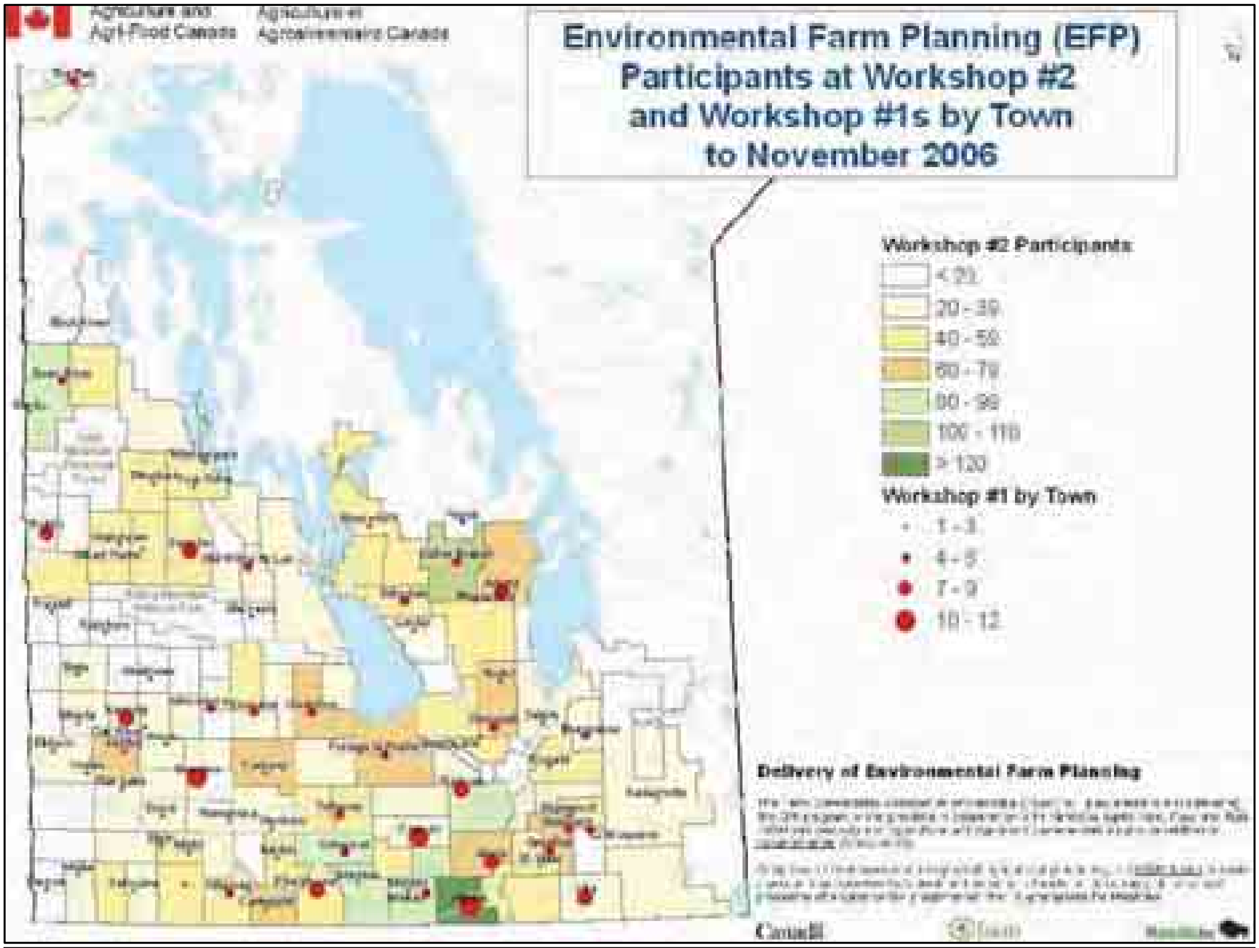
<u>Figure 18 – Producer Participation in Environmental Farm Plans</u>



The Canada-Manitoba Farm Stewardship Program (CMFSP) provides producers in Manitoba who have completed an EFP with financial and technical assistance to develop and implement viable and environmentally sustainable practices. Figure 19 shows program participation levels by Manitoba watersheds. There was a significant amount of Beneficial Management Practice (BMP) projects planned and implemented in the watershed with the assistance of CMFSP. By December 31, 2006, program records indicate about 120 projects were either approved for funding or completed in the watershed.

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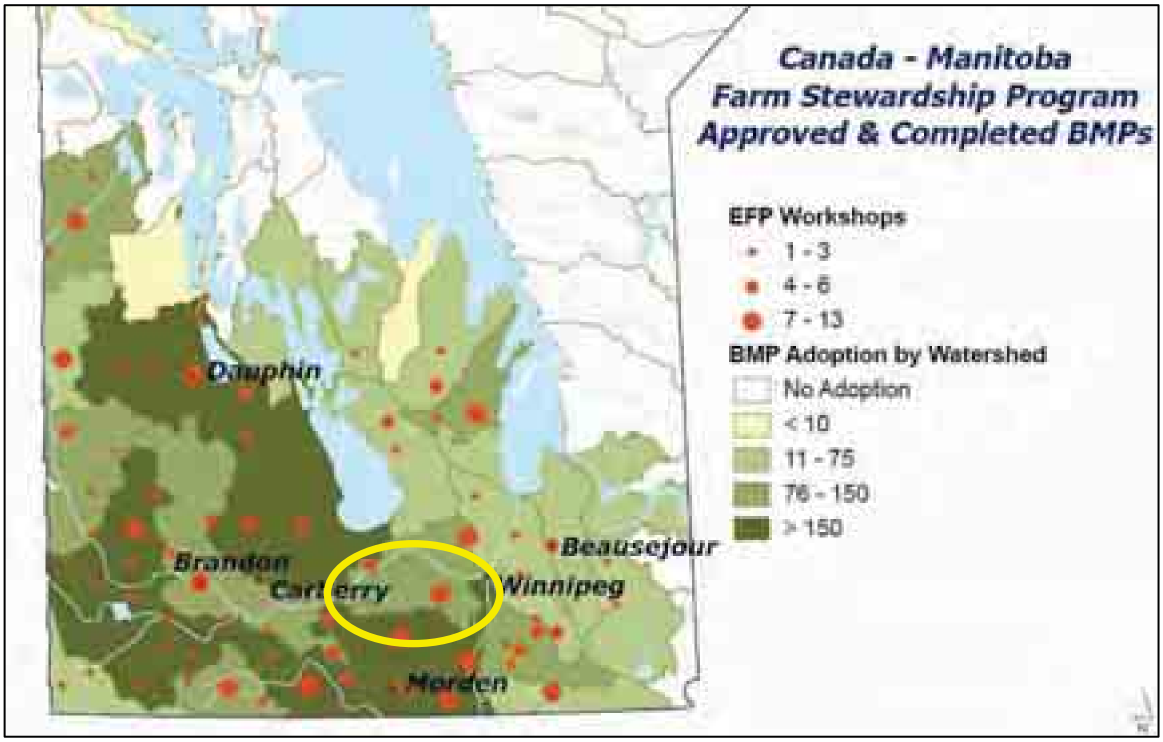
Figure 19 – Producer Participation in the Canada-Manitoba Farm Stewardship Program to December 31, 2006



5) Information Gaps

General information is available for agricultural activity and resource use and has been presented in this document, but there is limited knowledge of more site specific land management and the impact it is having on water quality, water quantity, air quality, and biodiversity. Detailed and current information on resource use in the watershed, specifically the impacts they may have on water quality and quantity may also be lacking. Some of these potential gaps and activities to address them may include:

a) Watershed Assessment of Agricultural and Non-Agricultural Impacts
   - sub-watershed monitoring, may require revised sub-watershed delineations based on existing stream and drain network and water quality monitoring program
   - assessment of cropping trends and pesticide usage
   - assessment of point-source contributors to water quality (e.g. municipal and private lagoon discharge, other point and non-point sources, etc.)
   - watershed nutrient budget

b) Watershed Scale Evaluation of Select Beneficial Management Practices (BMPs)
   - buffers – assessment based on high vs. low overland flow areas (focus on areas with significant flow vs. areas where little runoff – may require detailed elevation data to assess)
   - risks to groundwater in Almasippi sands area

- excess water – sediment and drainage problems – erosion control structures and wetland restoration as potential solutions
- riparian area management for filtration of sediment and nutrient removal as well as wildlife habitat

c) Watershed Assessment of Water Demands and Availability– especially large users such as RMs, Towns, Irrigators, Livestock Producers, etc..
   - Potential impact of declining water quality (in some cases potentially quantity and allocations) on agriculture

6) Recommendations

Determine the most effective BMPs for addressing the priority issues identified by stakeholders in the watershed (e.g. nutrient loading and riparian health are potential priorities) in the watershed and develop methods to facilitate their adoption. Information gaps (Section 5) will need to be addressed in order to determine the best course of action to achieve results.

Reliable sources of water are a necessity for the agriculture industry. Ensuring the quality and quantity of water needed to meet the demands of an expanding industry is important to the health of the local economy. To this end, a water management strategy could be developed that outlines distinct courses of action to address not only wet years (e.g. improved drainage), but also dry years (e.g. water storage).

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7) Appendices

Soils Maps
Note: map scale

Approximately the western 2/3 of the watershed (RMs of Grey and Portage la Prairie, along with small portions of Cartier and Macdonald) have been mapped at a "detailed" scale of 1:20 000 (i.e. approximately 32 inspection sites per section of land were used to map the soils of the area). The remaining eastern 1/3 of the watershed (largely the majority of Cartier and Macdonald municipalities) has been mapped at a "general" or reconnaissance level of 1:126 720 (i.e. approximately 1-6 inspection sites per section of land).

Detailed soil survey maps identify more of the variation in soil types across smaller landscapes. As a result, detailed soil survey maps are much more accurate and reliable for making decisions at the farm-level. Reconnaissance or general soil surveys give only a broad picture of the dominant soil types and distribution of soils that occur over relatively large areas. The landscape may actually include fairly significant areas of different soils that are not identified on the map. As such, reconnaissance soil surveys are best suited to making general comparisons of soil capabilities and limitations on a regional or national scale.

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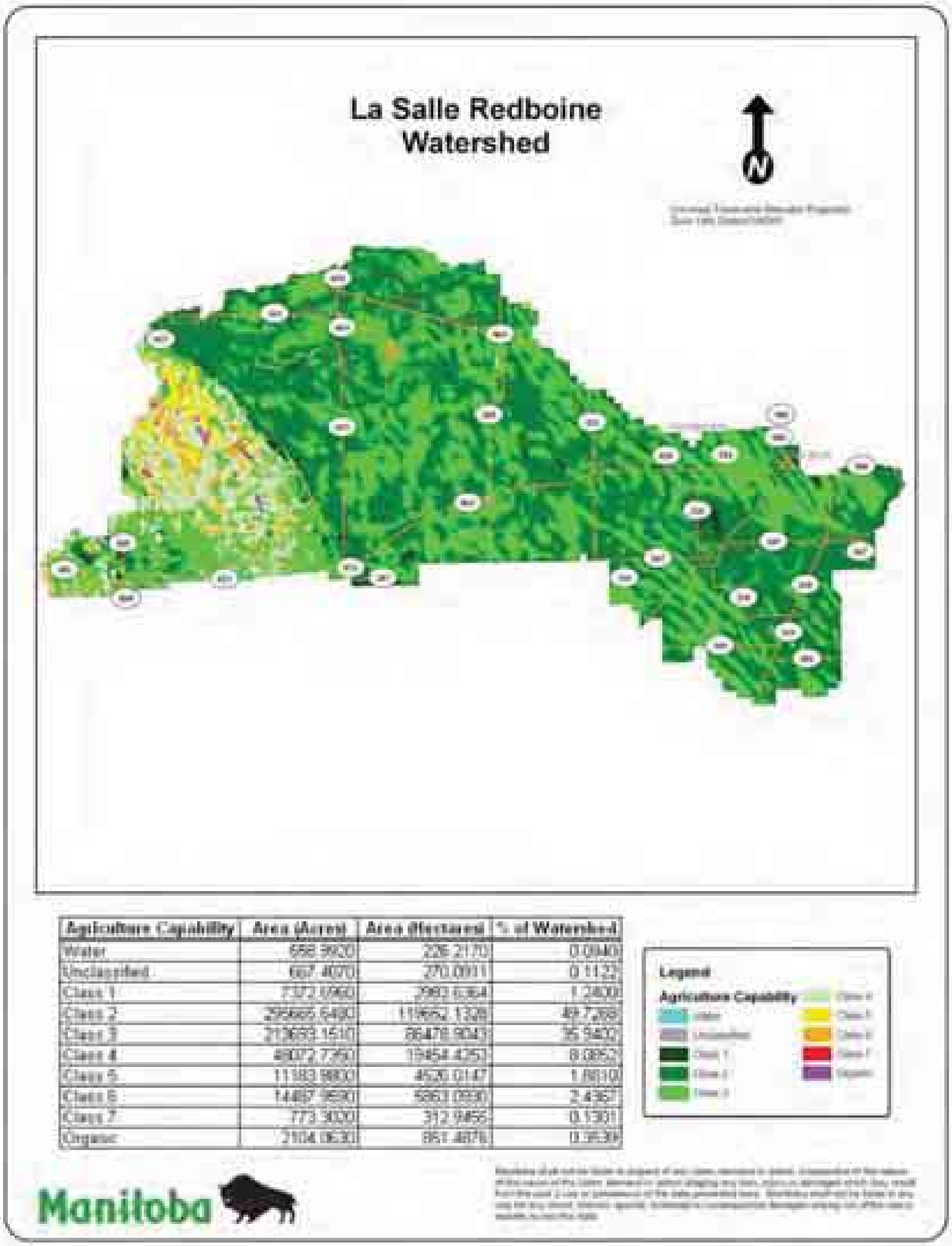

Agriculture Capability	Area (Acres)	Area (Hectares)	% of Watershed
Water	558.9920	226.2170	0.0940
Unclassified	667.4070	270.0911	0.1122
Class 1	7372.0960	2983.6364	1.2400
Class 2	295665.6480	119652.1328	49.7268
Class 3	213693.1510	86478.9043	35.9402
Class 4	48072.7350	19454.4253	8.0852
Class 5	11183.9800	4526.0147	1.8810
Class 6	14487.9590	5863.0930	2.4367
Class 7	773.3020	312.9456	0.1301
Organic	2104.0630	851.4876	0.3539

Figure A.1. Agriculture Capability of soils in the La Salle River watershed.

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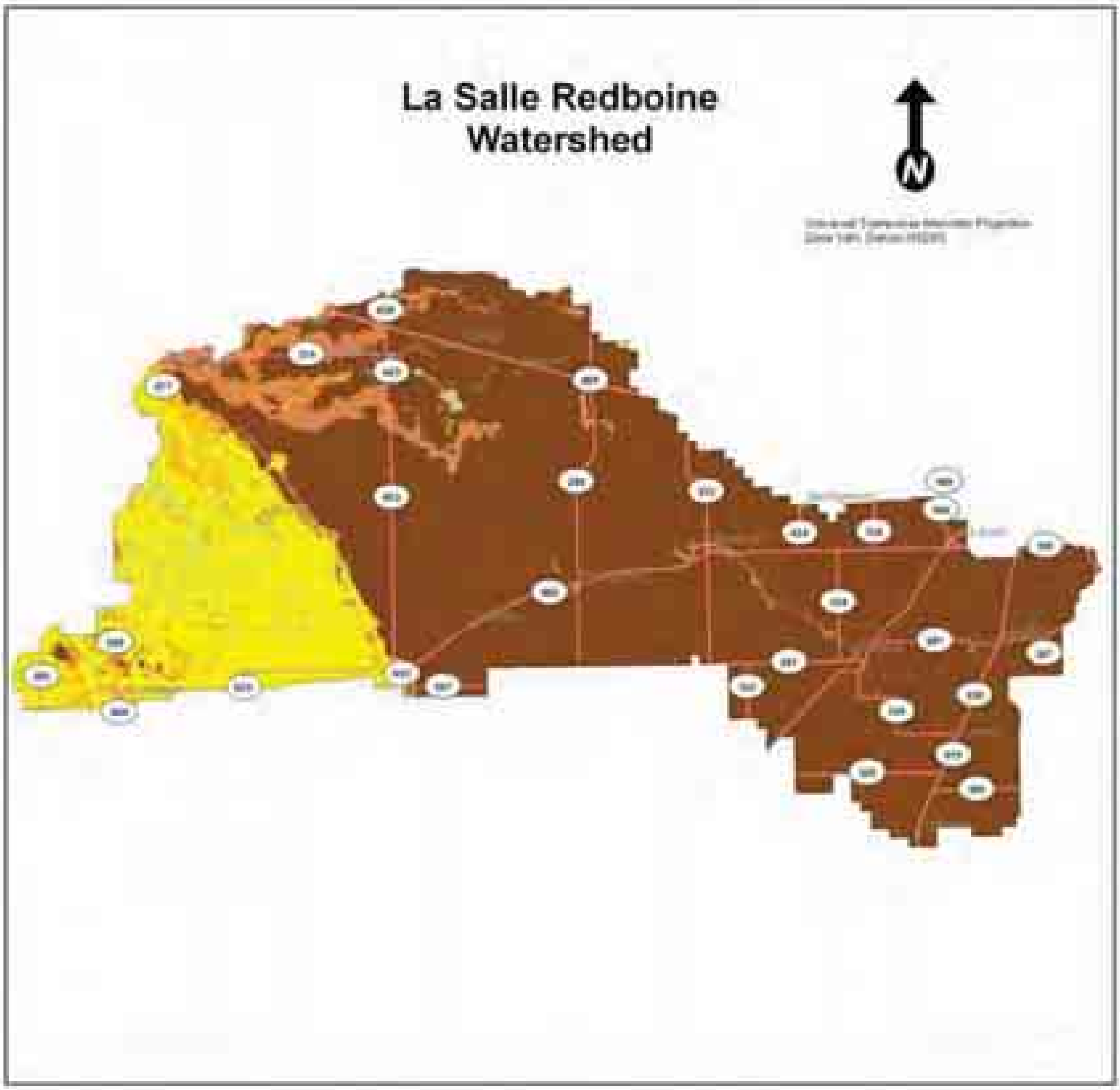

Surface Texture	Area (Acres)	Area (Hectares)	% of Watershed
Water	558.9920	226.2170	0.0940
Unclassified	667.4070	270.0911	0.1122
Clayey	439486.0370	177854.4177	73.9154
Loamy	32306.4650	13074.0161	5.4336
Coarse Loamy	27075.9750	10957.3032	4.5538
Sands	84119.9960	34042.2937	14.1478
Organic	10365.0620	4194.6090	1.7433

Legend
Surface Texture

Manitoba

Figure A.2. Surface Texture of soils in La Salle River watershed.

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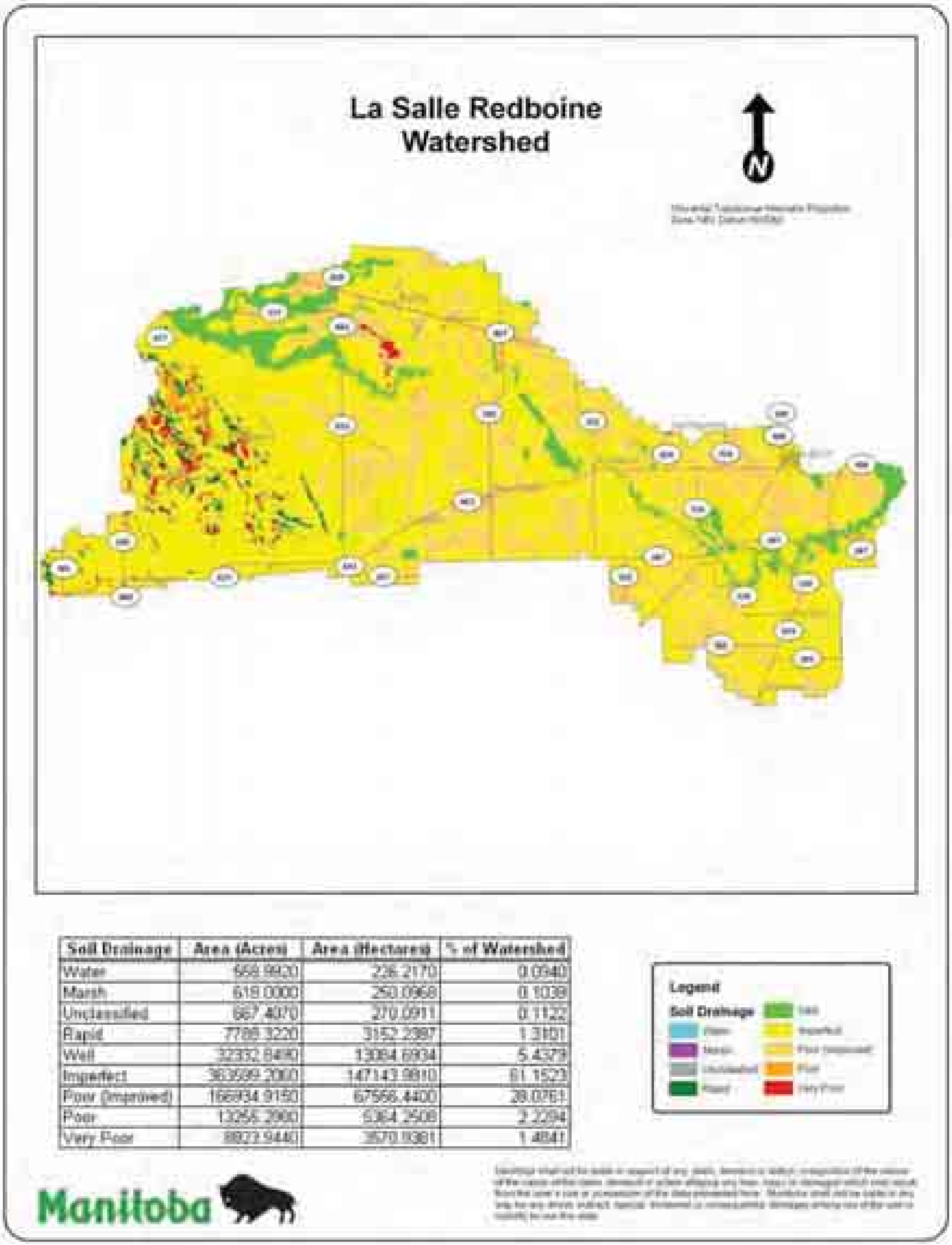

Soil Drainage	Area (Acres)	Area (Hectares)	% of Watershed
Water	559.9920	226.2170	0.0940
Marsh	618.0000	250.0968	0.1038
Unclassified	667.4070	270.0911	0.1122
Rapid	7789.3220	3152.2987	1.3101
Well	32332.8480	13084.6934	5.4379
Imperfect	363599.2060	147143.9810	61.1523
Poor (Improved)	166934.9150	67556.4400	28.0761
Poor	13256.2960	5364.2508	2.2294
Very Poor	8823.9440	3570.9381	1.4841

Figure A.3. Internal drainage of soils in the La Salle River watershed.

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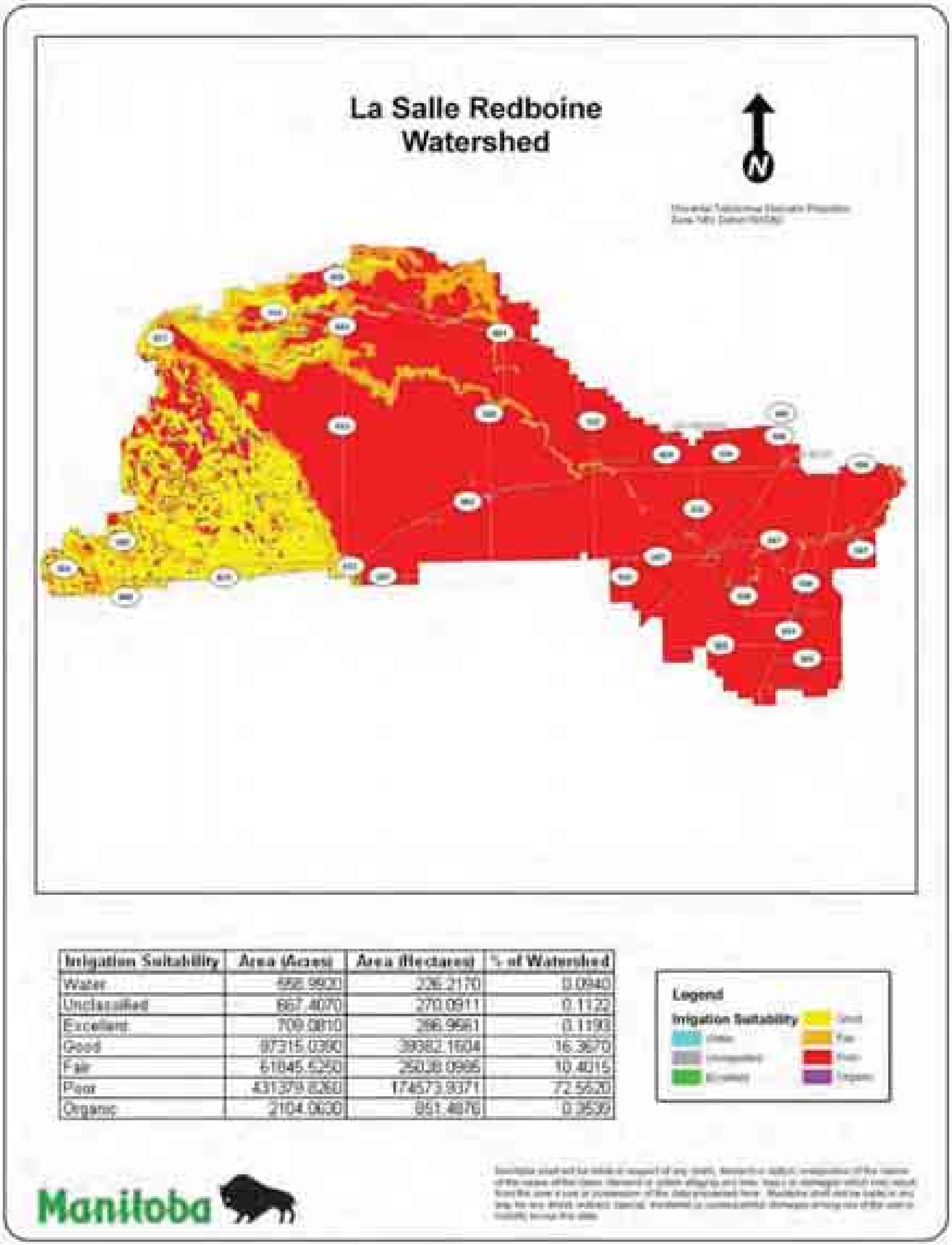

Figure A.4. Irrigation suitability of soils in the La Salle River watershed.

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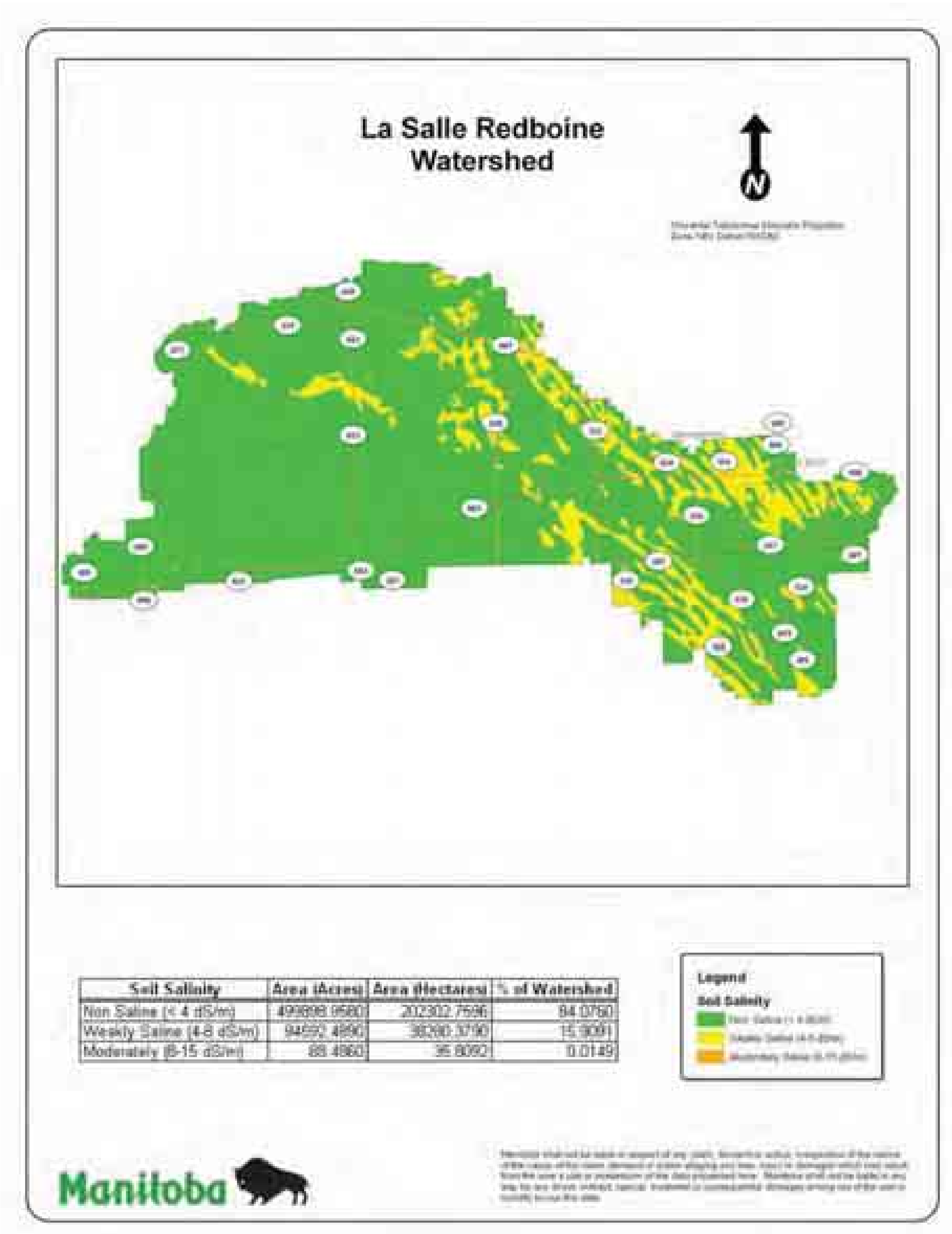
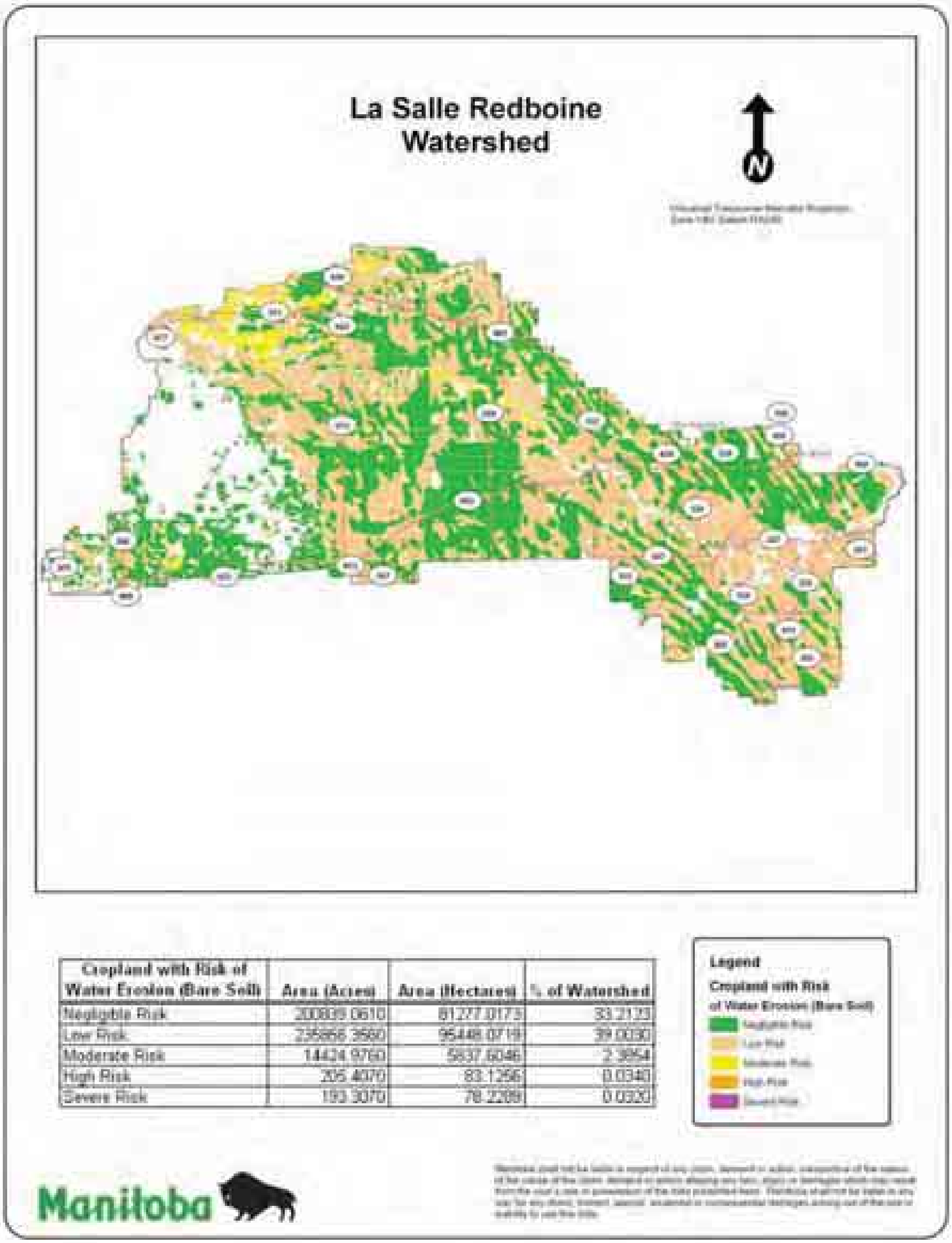
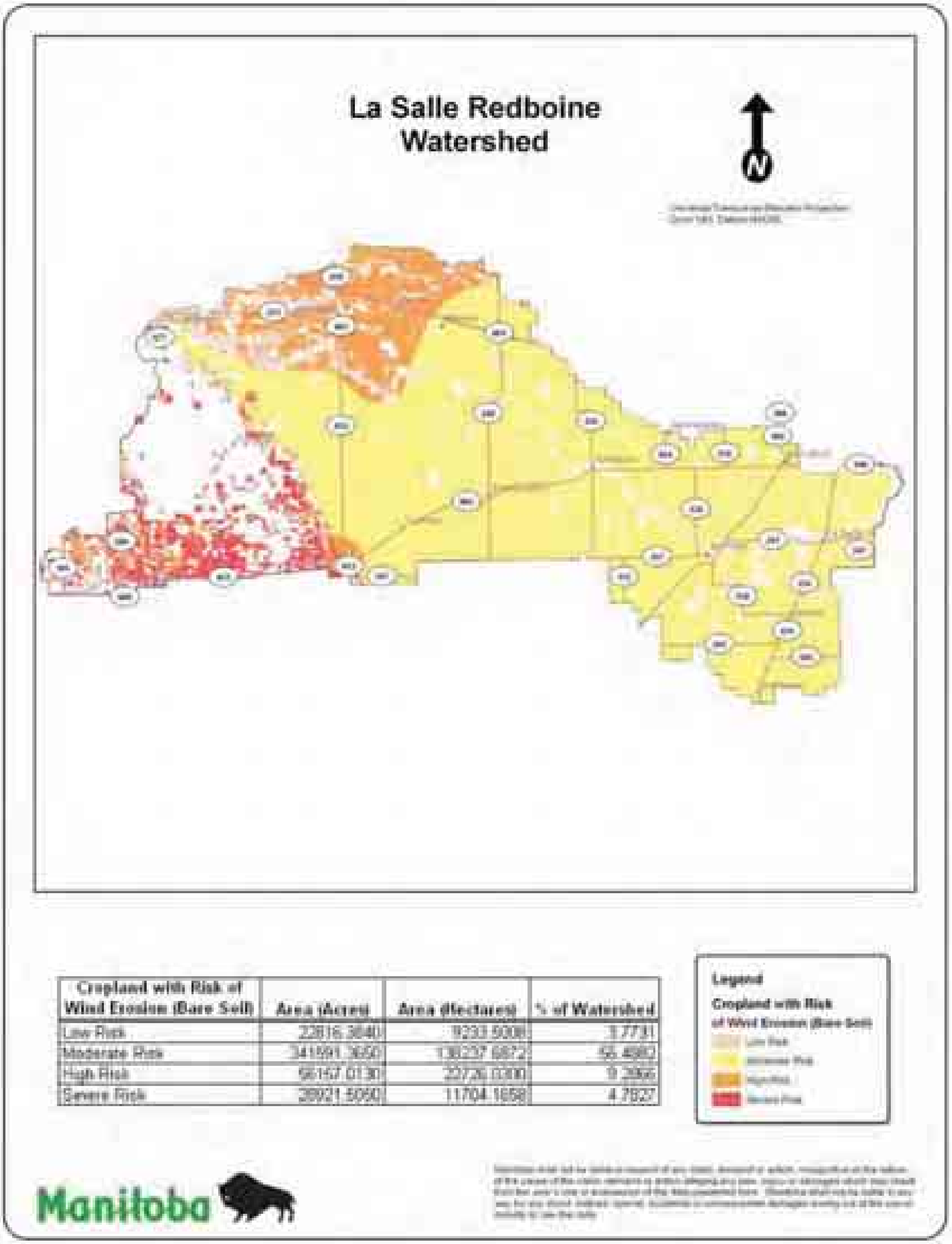


Figure A.5. Degree and extent of soil salinity in La Salle River watershed.



Cropland with Risk of Water Erosion (Bare Soil)	Area (Acres)	Area (Hectares)	% of Watershed
Negligible Risk	200839.0610	81277.0173	33.2123
Low Risk	235866.3560	95448.0719	39.0030
Moderate Risk	14424.9760	5837.6046	2.3854
High Risk	205.4070	83.1256	0.0340
Severe Risk	193.3070	78.2289	0.0320

Figure A.6. Risk of soil erosion by water in the La Salle River watershed.



Cropland with Risk of Wind Erosion (Bare Soil)	Area (Acres)	Area (Hectares)	% of Watershed
Low Risk	22816.3840	9233.9008	3.7731
Moderate Risk	341591.3650	138237.6872	56.4982
High Risk	56167.0130	22726.0300	9.2066
Severe Risk	28921.5050	11704.1658	4.7827

Figure A.7. Risk of soil erosion by wind in the La Salle River watershed.

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Table A.1 – Cropping, livestock and nutrient trends – Converted to Imperial Units (Census of Agriculture)

	Canola/Mustard (ac)	Cropland (ac)	Pigs	Total Cattle	Manure (t/yr)	Manure N (t/yr)	Manure P (t/yr)
1976	4,661	412,329	37,406	23,327	320,798	1,979	561
1981	18,261	432,662	42,742	21,852	298,280	1,857	526
1986	33,986	449,196	60,764	19,535	299,601	1,897	555
1991	50,598	450,141	57,725	21,821	321,464	2,002	575
1996	69,886	444,362	101,164	27,558	435,690	2,713	795
2001	66,204	456,600	117,749	28,408	461,122	2,908	865
% Chg.	**1320%**	**11%**	**215%**	**22%**	**44%**	**47%**	**54%**

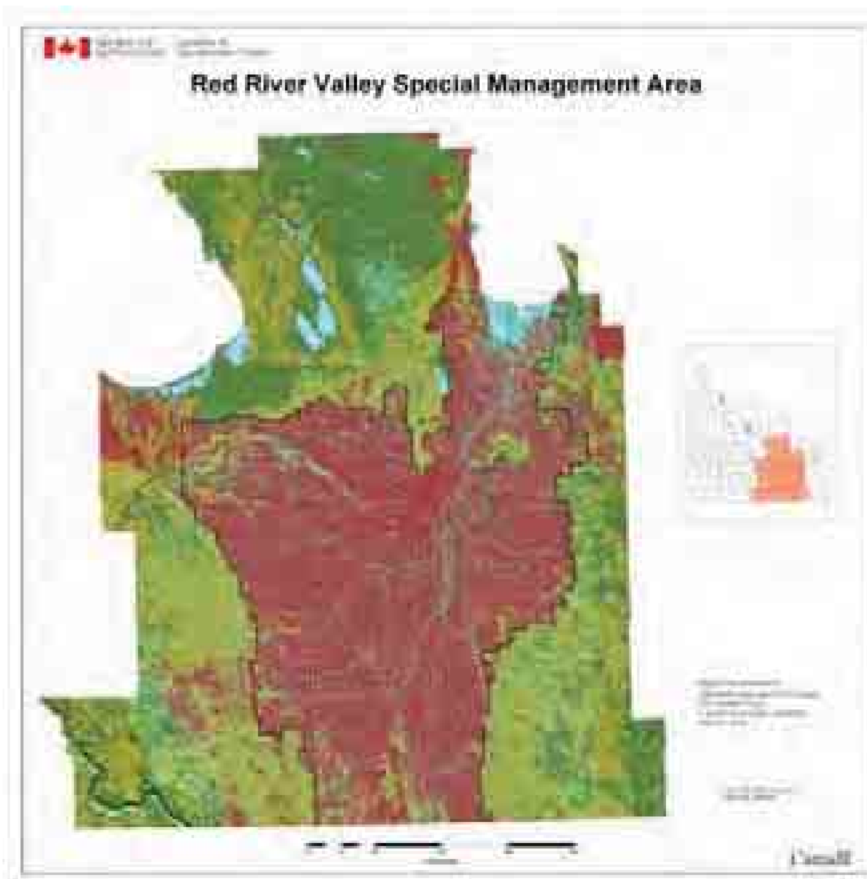

Figure A.8 Red River Valley Special Management Area

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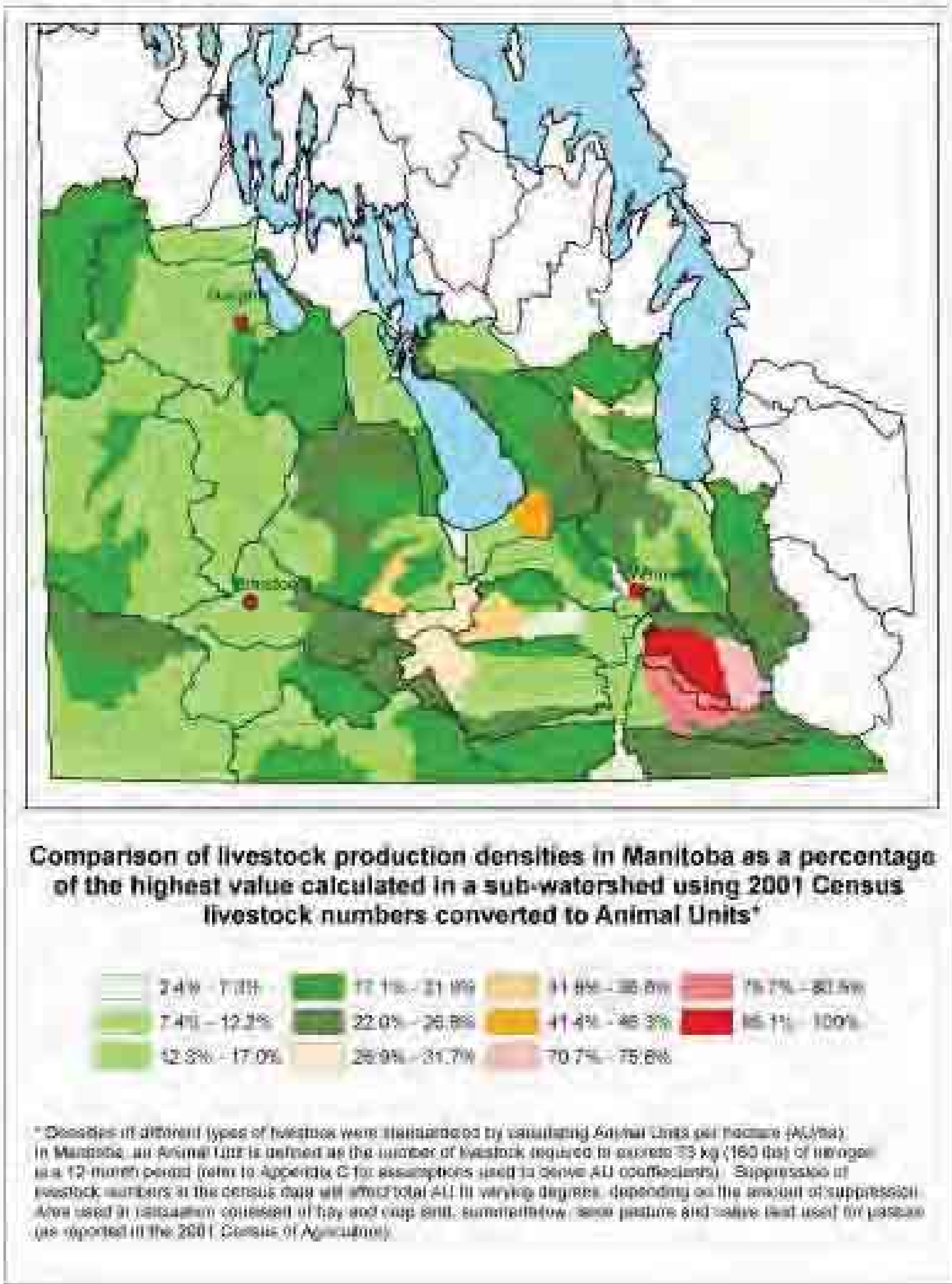
Figure A.9 Livestock production density by Manitoba watershed



*Source: Summary of Resources and Land Use Issues Related to Riparian Areas in the La Salle River Watershed Study Area, PFRA 2004

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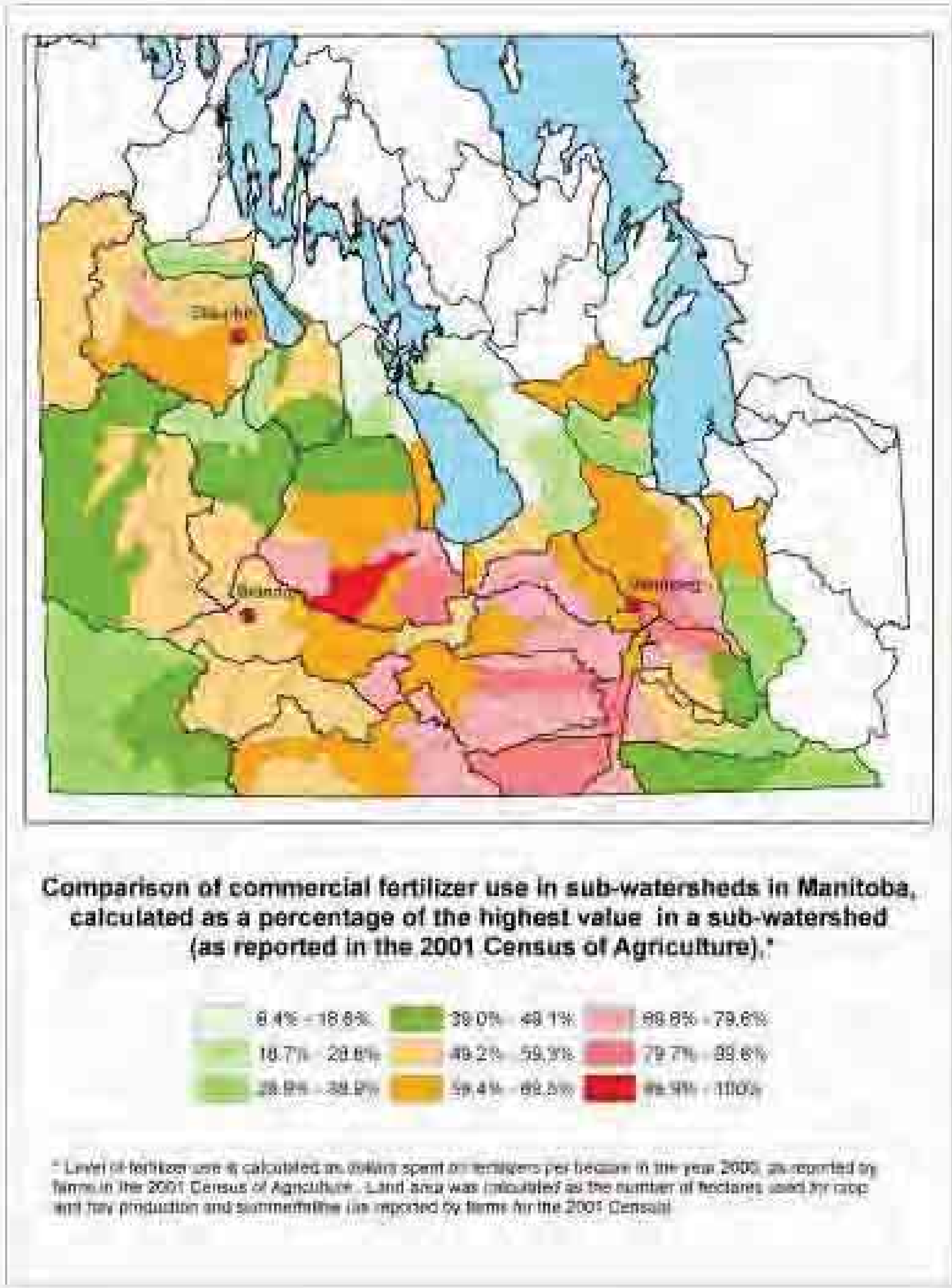
Figure A.10 Fertilizer use by Manitoba watershed



*Source: Summary of Resources and Land Use Issues Related to Riparian Areas in the La Salle River Watershed Study Area, PFRA 2004

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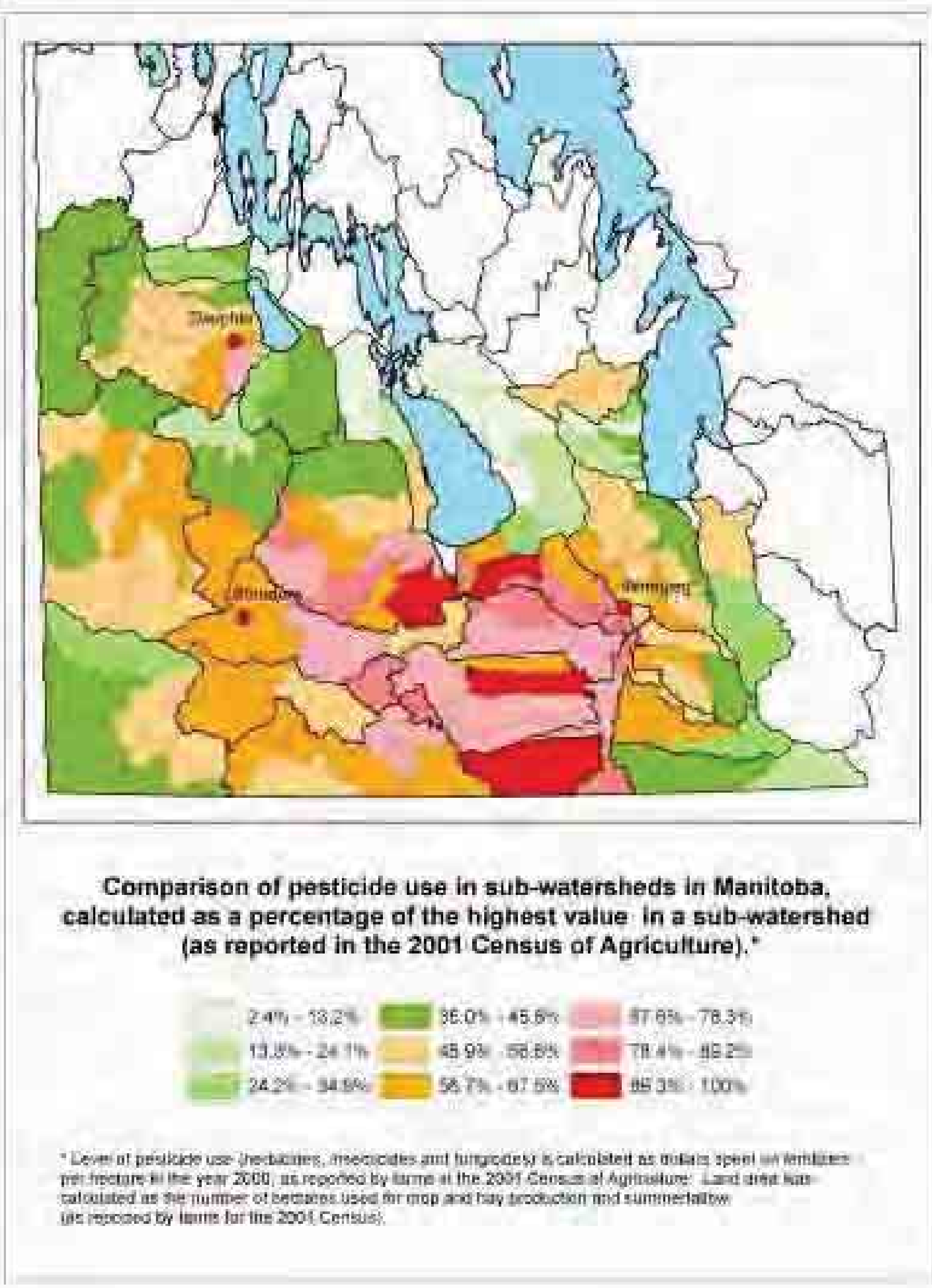
Figure A.11 Pesticide use by Manitoba watershed



*Source: Summary of Resources and Land Use Issues Related to Riparian Areas in the La Salle River Watershed Study Area, PFRA 2004