Lacombe County

Part of the Red Deer River Basin
Tp 038 to 041, R 21 to 28, W4M & Tp 038 to 041, R 01 to 04, W5M
Regional Groundwater Assessment

Prepared for:

In conjunction with:

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada
Prairie Farm Rehabilitation Administration
Administration du rétablisseme agricole des Prairies

Canada

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PERMIT TO PRACTICE
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The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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Table of Contents

List of Figures

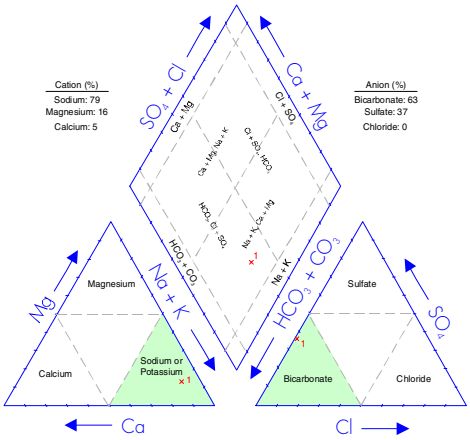
List of Tables

Appendices

Glossary

Aquifer	a formation, group of formations, or part of a formation that contains saturated permeable rocks capable of transmitting groundwater to water wells or springs in economical quantities
Aquitard	a confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer
Available Drawdown	in a confined aquifer, the distance between the non-pumping water level and the top of the aquifer
	in an unconfined aquifer (water table aquifer), two thirds of the saturated thickness of the aquifer
Borehole	includes all “work types” except springs
Dewatering	the removal of groundwater from an aquifer for purposes other than use
Evapotranspiration	a combination of evaporation from open bodies of water, evaporation from soil surfaces, and transpiration from the soil by plants (Freeze and Cherry, 1979)
Fluvial	produced by the action of a stream or river
Friable	poorly cemented
Hydraulic Conductivity	the rate of flow of water through a unit cross-section under a unit hydraulic gradient; units are length/time
km	kilometre
Kriging	a geo-statistical method for gridding irregularly-spaced data (Cressie, 1990)
Lacustrine	fine-grained sedimentary deposits associated with a lake environment and not including shore-line deposits
Lithology	description of rock material
Lsd	Legal Subdivision
m	metres
mm	millimetres
m^2/day	metres squared per day
m^3	cubic metres
m^3/day	cubic metres per day
mg/L	milligrams per litre
Obs WW	Observation Water Well

Piper tri-linear diagram	a method that permits the major cation and anion compositions of single or multiple samples to be represented on a single graph. This presentation allows groupings or trends in the data to be identified. From the Piper tri-linear diagram, it can be seen that the groundwater from this sample water well is a sodium-bicarbonate-type. The chemical type has been determined by graphically calculating the dominant cation and anion. For a more detailed explanation, please refer to Freeze and Cherry, 1979
Rock	earth material below the root zone
Surficial Deposits	includes all sediments above the bedrock
Thalweg	the line connecting the lowest points along a stream bed or valley; *longitudinal profile*
Till	a sediment deposited directly by a glacier that is unsorted and consisting of any grain size ranging from clay to boulders
Transmissivity	the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient: a measure of the ease with which groundwater can move through the aquifer
	Apparent Transmissivity: the value determined from a summary of aquifer test data, usually involving only two water-level readings
	Effective Transmissivity: the value determined from late pumping and/or late recovery water-level data from an aquifer test
	Aquifer Transmissivity: the value determined by multiplying the hydraulic conductivity of an aquifer by the thickness of the aquifer
Water Well	a hole in the ground for the purpose of obtaining groundwater; “work type” as defined by AENV includes test hole, chemistry, deepened, well inventory, federal well survey, reconditioned, reconstructed, new, old well-test
Yield	a regional analysis term referring to the rate a properly completed water well could be pumped, if fully penetrating the aquifer
	Apparent Yield: based mainly on apparent transmissivity
	Long-Term Yield: based on effective transmissivity
AENV	Alberta Environment
AMSL	above mean sea level
DEM	Digital Elevation Model
DST	drill stem test



Piper Tri-Linear Diagram

EUB	Alberta Energy and Utilities Board
GCDWQ	Guidelines for Canadian Drinking Water Quality
NPWL	non-pumping water level
PFRA	Prairie Farm Rehabilitation Administration
TDS	Total Dissolved Solids
WSW	Water Source Well or Water Supply Well

I. Project Overview

"Water is the lifeblood of the earth." - Anonymous

How a County takes care of one of its most precious resources - groundwater - reflects the future wealth and health of its people. Good environmental practices are not an accident. They must include genuine foresight with knowledgeable planning. Implementation of strong practices not only commits to a better quality of life for future generations, but also creates a solid base for increased economic activity. **Though this report's scope is regional, it is a first step for Lacombe County in managing their groundwater. It is also a guide for future groundwater-related projects.**

A. Purpose

This project is a regional groundwater assessment of Lacombe County prepared by Hydrogeological Consultants Ltd. (HCL) with financial assistance from Prairie Farm Rehabilitation Administration (PFRA). The regional groundwater assessment provides the information to assist in the management of the groundwater resource within the County. Groundwater resource management involves determining the suitability of various areas in the County for particular activities. These activities can vary from the development of groundwater for agricultural or industrial purposes, to the siting of waste storage. **Proper management ensures protection and utilization of the groundwater resource for the maximum benefit of the people of the County.**

The regional groundwater assessment will:

- identify the aquifers[1] within the surficial deposits[2] and the upper bedrock
- spatially identify the main aquifers
- describe the quantity and quality of the groundwater associated with each aquifer
- identify the hydraulic relationship between aquifers
- identify possible groundwater depletion areas associated with each upper bedrock aquifer.

Under the present program, the groundwater-related data for the County have been assembled. Where practical, the data have been digitized. These data are then being used in the regional groundwater assessment for Lacombe County.

[1] See glossary
[2] See glossary

B. The Project

This regional study should only be used as a guide. Detailed local studies are required to verify hydrogeological conditions at given locations.

The present project is made up of eight parts as follows:

Task 1 - Data Collection and Review
Task 2 - Hydrogeological Maps, Figures, Digital Data Files
Task 3 – Hydrogeological Evaluation and Preparation of Report
Task 4 - Groundwater Information Query Software
Task 5 – Review of Draft Report and GIS Data Files
Task 6 – Report Presentation and Training Session
Task 7 – Provision of Report, Maps, Data Layers and Query
Task 8 – Provision of Compact Disk for Sale to General Public.

This report and the accompanying maps represent Tasks 2 and 3.

C. About This Report

This report provides an overview of (a) the groundwater resources of Lacombe County, (b) the processes used for the present project, and (c) the groundwater characteristics in the County.

Additional technical details are available from files on the CD-ROM to be provided with the final version of this report. The files include the geo-referenced electronic groundwater database, maps showing distribution of various hydrogeological parameters, the groundwater query, ArcView and ArcExplorer files. Likewise, all of the illustrations and maps from the present report, plus additional maps, figures and cross-sections, are available on the CD-ROM. For convenience, poster-size maps and cross-sections have been prepared as a visual summary of the results presented in this report. Copies of these poster-size drawings have been forwarded with this report, and are included as page-size drawings in Appendix D.

Appendix A features page-size copies of the figures within the report plus additional maps and cross-sections. An index of the page-size maps and figures is given at the beginning of Appendix A.

Appendix B provides a complete list of maps and figures included on the CD-ROM.

Appendix C includes the following:

1) a procedure for conducting aquifer tests with water wells[3]
2) a table of contents for the Water (Ministerial) Regulation under the new Water Act
3) a flow chart showing the licensing of a groundwater diversion under the new Water Act
4) interpretation of chemical analysis of drinking water
5) additional information.

The Water (Ministerial) Regulation deals with the wellhead completion requirement (no more water-well pits), the proper procedure for abandoning unused water wells and the correct procedure for installing a pump in a water well. The new Water Act was proclaimed 10 Jan 1999.

Appendix D includes page-size copies of the poster-size figures provided with this report.

Appendix E provides a list of water wells recommended for field verification.

[3] See glossary

II. Introduction

A. Setting

Lacombe County is situated in south-central Alberta. Most of this area is part of the Alberta Plains region. The County is within the Red Deer River basin; a part of the County's southeastern boundary is the Red Deer River. The other County boundaries follow township or section lines. The area includes parts of the area bounded by township 038, range 04, W5M in the southwest and township 041, range 21, W4M in the northeast.

Regionally, the topographic surface varies between 740 and 1,100 metres above mean sea level (AMSL). The lowest elevations occur mainly in the eastern part of the County and the highest are in the western parts of the County as shown on Figure 1 and page A-2. The area is well drained by numerous streams.

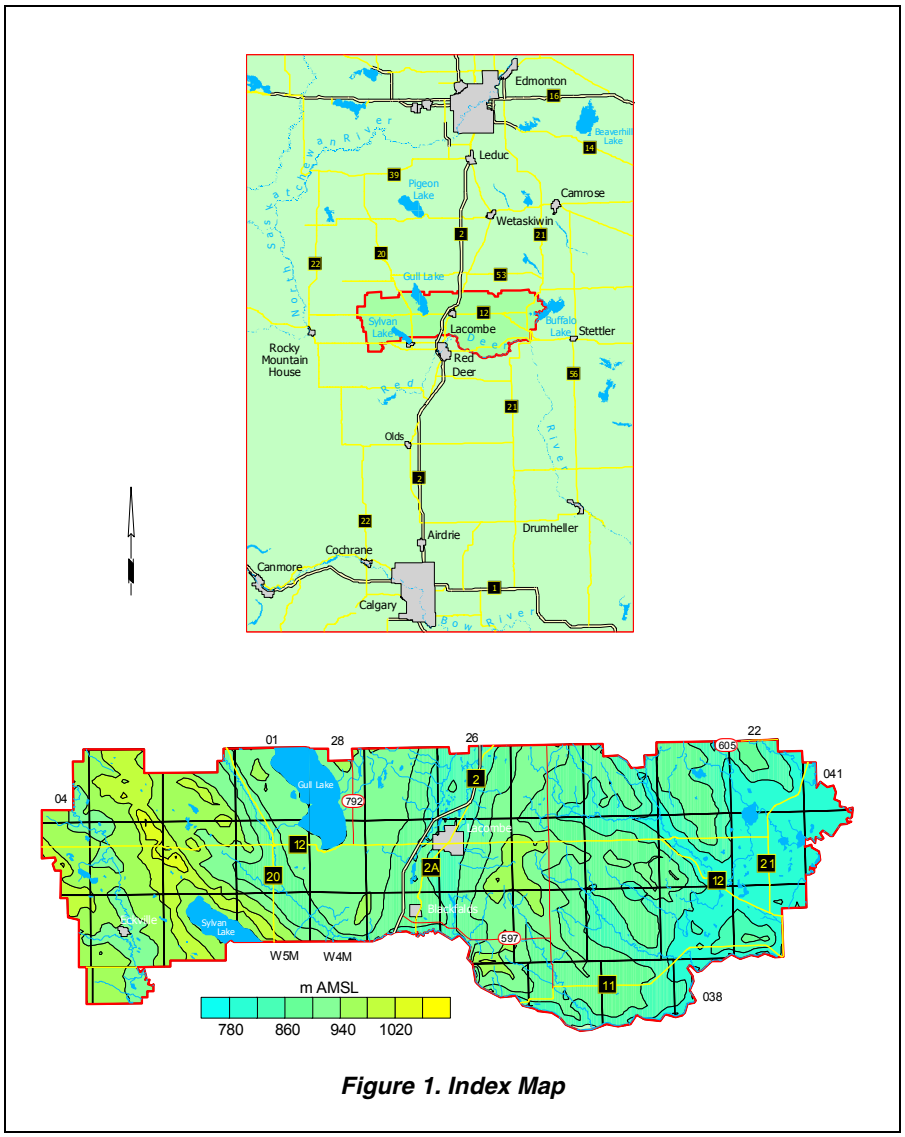


Figure 1. Index Map

B. Climate

Lacombe County lies within the Dfb climate boundary. This classification is based on potential evapotranspiration[4] values determined using the Thornthwaite method (Thornthwaite and Mather, 1957), combined with the distribution of natural ecoregions in the area. The ecoregions map (Strong and Leggatt, 1981) shows that the County is located in both the Low Boreal Mixedwood region and the Aspen Parkland region. Increased precipitation and cooler temperatures, resulting in additional moisture availability, influence this vegetation change.

A Dfb climate consists of long, cool summers and severe winters. The mean monthly temperature drops below -3° C in the coolest month, and exceeds 10° C in the warmest month.

The mean annual precipitation averaged from five meteorological stations within the County measured 469 millimetres (mm), based on data from 1907 to 1993. The mean annual temperature averaged 2.6° C, with the mean monthly temperature reaching a high of 16.3° C in July, and dropping to a low of -13° C in January. The calculated annual potential evapotranspiration is 508 millimetres.

[4] See glossary

C. Background Information

1) Number, Type and Depth of Water Wells

There are currently records for 7,388 water wells in the groundwater database for the County. Of the 7,388 water wells, 6,505 are for domestic/stock purposes. The remaining 883 water wells were completed for a variety of uses, including industrial, municipal, observation, injection, irrigation, investigation and dewatering. Based on a rural population of 10,081 (Phinney, 1999), there are 2.6 domestic/stock water wells per family of four. It is unknown how many of these water wells may still be active. The domestic or stock water wells vary in depth from 0.30 metres to 241 metres below ground level. Details for lithology[5] are available for 4,898 water wells.

2) Number of Water Wells in Surficial and Bedrock Aquifers

There are 4,357 water well records with sufficient information to identify the aquifer in which the water wells are completed. The water wells that were not drilled deep enough to encounter the bedrock plus water wells that have the bottom of their completion interval above the top of the bedrock are water wells completed in surficial aquifers. Of the 4,357 water wells for which aquifers could be defined, 123 are completed in surficial aquifers, with 65% having a completion depth of more than 20 metres. The adjacent map shows that the water wells completed in the surficial deposits occur throughout the County, frequently in the vicinity of linear bedrock lows. The map also shows a number of water wells located in the two main surface-water bodies. Some of the locations are a result of plotting in the centre of the quarter section; others have the incorrect location.

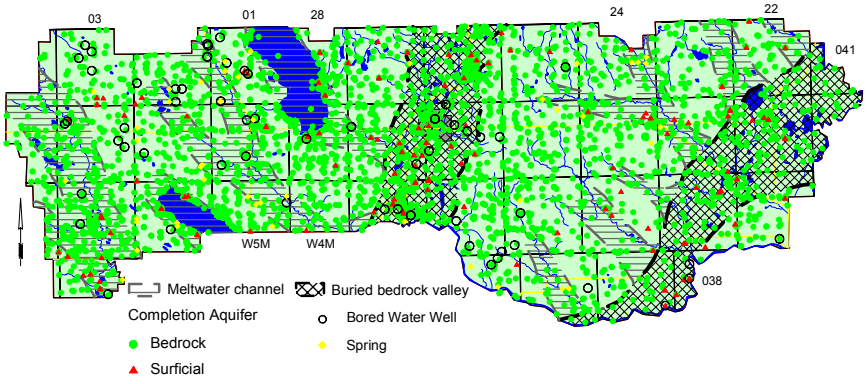


Figure 2. Location of Water Wells

The 4,234 water wells that have the top of their completion interval deeper than the top of the bedrock are referred to as bedrock water wells. From Figure 2, it can be seen that water wells completed in bedrock aquifers occur throughout the County.

There are currently records for 45 springs in the groundwater database, located mainly in the vicinity of linear bedrock lows. More than 80% of the 18 available chemical values for springs indicate the groundwaters have total hardness concentrations of more than 200 milligram per litre (mg/L) and total dissolved solids (TDS) concentrations ranging from 350 to 850 mg/L.

[5] See glossary

3) Casing Diameter and Type

Data for casing diameters are available for 5,193 water wells, with 5,133 (99%) indicated as having a diameter of less than 275 mm and 60 having a diameter of more than 275 mm. The casing diameters of greater than 275 mm are mainly bored or dug water wells and those with a surface-casing diameter of less than 275 mm are drilled water wells. There are 60 large-diameter or bored water wells in the County and they are mainly in the areas where major meltwater channels are present in association with river valleys as shown on Figure 2.

In the County, steel, galvanized steel and plastic represent 99% of the materials that have been used for surface casing in drilled water wells over the last 40 years. Until the 1960s, the type of surface casing used in drilled water wells was mainly undocumented. Steel casing was in use in the 1950s and is still used in 70% of the water wells being drilled in the County in the 1990s. Steel is the main casing type used since surface casing type has been documented.

Galvanized steel was a maximum of 22% of the drilled water wells from the 1950s to the early 1990s. Galvanized steel was last used in July 1993.

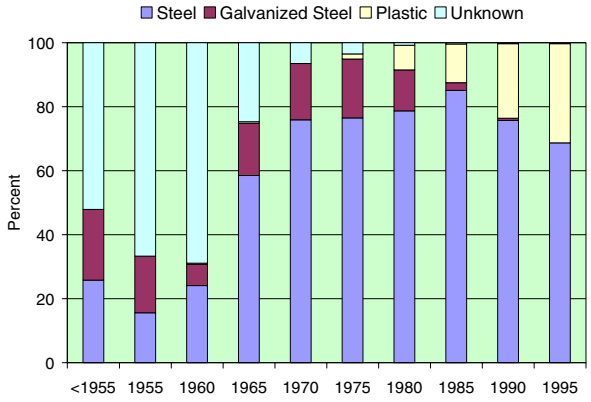


Figure 3. Surface Casing Types Used in Drilled Water Wells

4) Requirements for Licensing

Water wells used for household needs in excess of 1,250 cubic metres per year and providing groundwater with TDS of less than 4,000 mg/L must be licensed. At the end of 1999, 409 groundwater allocations were licensed in the County. Of the 409 licensed groundwater users, 271 could be linked to the Alberta Environment (AENV) groundwater database. Of the 409 licensed groundwater users, 319 are for agricultural purposes, and the remaining 90 are for commercial, industrial, municipal, recreation, fishery, exploration and dewatering purposes. The total maximum authorized diversion from the water wells associated with these licences is 16,963 cubic metres per day (m^3/day), although actual use could be less. Of the 16,963 m^3/day, 50% is allotted for municipal use, and 28% is allotted for agricultural use. The remaining 22% has been licensed for commercial, industrial, recreation, fishery, exploration and dewatering as shown in Table 2 on the following page; a figure showing the locations of the licensed users is in Appendix A (page A-5) and on the CD-ROM.

The largest single potable groundwater allocation within the County is for the Village of Alix, having a diversion of 1,146 m^3/day. The Alix water supply well, used for municipal purposes, is completed in the Upper Scollard Aquifer.