# Acknowledgements

Hydrogeological Consultants Ltd. would like to thank the following people for their cooperation and helpful contributions on this project:

Mr. Terry Dash – AAFC-PFRA
Mr. Glen Brandt – AAFC-PFRA
Mr. Kim Nielsen – Clearwater County

***For additional copies of the report/CD-ROM, please contact the following***:

- 1-800-GEO-WELL
- The Groundwater Centre/Regional Groundwater Assessment
- Prairie Farm Rehabilitation Administration branch of Agriculture and Agri-Food Canada (AAFC-PFRA)

http://www.groundwatercentre.com/m_info_rgwa.asp

http://www.agr.gc.ca/pfra/water/groundw.htm

# 1 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 Clearwater County in managing their groundwater. It is also a guide for future groundwater-related projects.**

## 1.1 Purpose

This project is a regional groundwater assessment of Clearwater County prepared by Hydrogeological Consultants Ltd. (HCL) with financial and technical assistance from the Prairie Farm Rehabilitation Administration branch of Agriculture and Agri-Food Canada (AAFC-PFRA) and Clearwater County. The project study area (herein referred to as the County) includes the eastern half of the County, and the Sunchild and O'Chiese First Nation lands. 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 country residential, 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 used in the regional groundwater assessment for Clearwater County.

[1] See glossary
[2] See glossary

## 1.2 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 Familiarization 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.

## 1.3 About This Report

This report provides an overview of (a) the groundwater resources of Clearwater 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 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 files and ArcExplorer files. Likewise, all of the illustrations and maps shown in this report, plus additional maps, figures and cross-sections, are available on the CD-ROM. In order to avoid map-edge effects, all maps are based on an analysis of hydrogeological data for the portion of the County within townships 031 to 047, ranges 04 to 11, W5M plus a buffer area of 5,000 metres. 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. A plastic County map outline is provided to overlay the maps, and contains information such as towns, main rivers, etc.

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 *Water Act*
3) interpretation of chemical analysis of drinking water
4) 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 *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

# 2 INTRODUCTION

## 2.1 Setting

Clearwater County is situated in southwestern Alberta. The County is within the North Saskatchewan River and the South Saskatchewan River basins (see CD-ROM). The extreme northern boundary is the North Saskatchewan River; a part of the southeastern boundary is the Red Deer River and the James River. The other County boundaries follow township or section lines, which include parts of the area bounded by townships 031 to 047, ranges 04 to 11, W5.

Regionally, the topographic surface varies between 800 and 2,800 metres above mean sea level (AMSL). The lowest elevations occur in association with the North Saskatchewan River in the extreme northern part of the County and in the northeastern portion of the County; the highest elevations are in the southwestern parts of the County as shown on Figure 1 and page A-4.

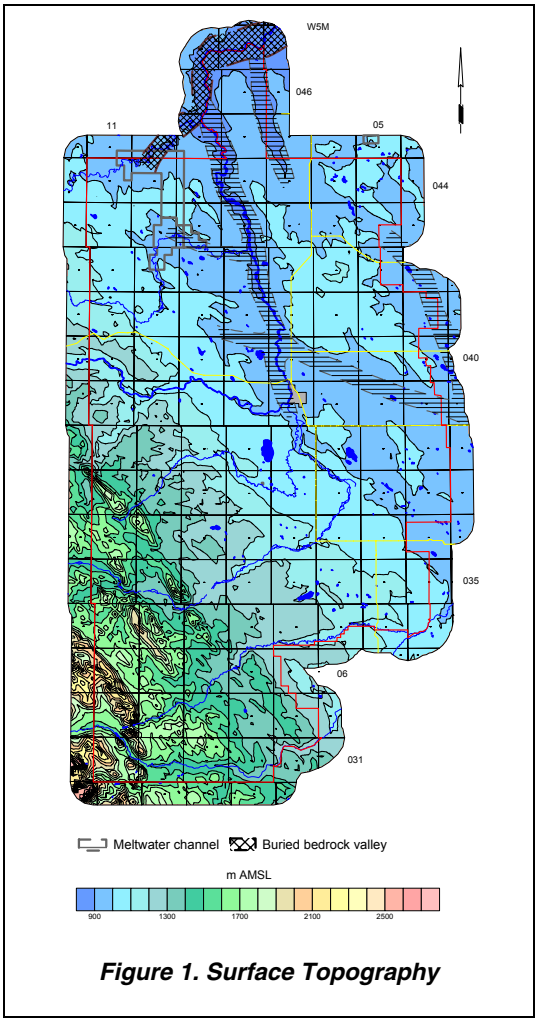


***Figure 1. Surface Topography***

## 2.2 Climate

Clearwater 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 Leggat, 1981) shows that the County is located mainly in the Low Boreal Mixedwood Region, and the Upper and Lower Boreal-Cordilleran regions; a small portion in the eastern part of the County is in the Aspen Parks Region and a small portion of the southwestern part of the County is in the Sub-Alpine Region. Increased precipitation and cooler temperatures, resulting in additional moisture availability, influence these vegetation changes.

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 six meteorological stations within the County measured 503 millimetres (mm), based on data from 1958 to 1993. The mean annual temperature averaged 2.1° C, with the mean monthly temperature reaching a high of 13.7° C in July, and dropping to a low of -11.5° C in January. The calculated annual potential evapotranspiration is 429 millimetres.

[4] See glossary

## 2.3 Background Information

### 2.3.1 Number, Type and Depth of Water Wells

There are currently 11,708 records in the groundwater database for the County, of which 8,283 are water wells. Of the 8,283 water wells, there are records for domestic (4,388), domestic/stock (1,096) or stock (623) purposes. The remaining 2,176 water wells were completed for a variety of uses, the main ones being industrial (1,578) municipal (102) and observation (101); 216 of the 2,176 water wells have an "unknown" purpose. Based on a rural population of 11,505[5] (Phinney, 2003), there are two domestic/stock water wells per family of four. In the groundwater database for the County, there are 5,695 domestic or stock water wells with a completed depth, of which 5,012 (88%) are completed at depths of less than 50 metres below ground surface. Details for lithology[6] are available for 6,643 water wells.

### 2.3.2 Number of Water Wells in Surficial and Bedrock Aquifers

There are 5,434 water wells with completion interval and lithologic information, such that the aquifer in which the water wells are completed can be identified. 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 5,434 water wells for which aquifers could be defined, 177 are completed in surficial aquifers, with 139 (78%) having a completion depth of less than 30 metres below ground surface. The adjacent map shows that the water wells completed in the surficial deposits occur mainly in the southeastern part of the County, and frequently adjacent to creeks and rivers.

The data for 5,257 water wells show that the top of the water well completion interval is below the bedrock surface, indicating that the water wells are completed in at least one bedrock aquifer. From Figure 2 (also see page A-6), it can be seen that water wells completed in bedrock aquifers occur throughout the County.

Within Clearwater County, there are currently records for 159 springs in the groundwater database, including 23 springs that were documented by Borneuf (1983). There are 135 springs having at least one total dissolved solids (TDS) value, with 85% having a TDS of less than 500 milligrams per litre (mg/L). There are 21 springs in the groundwater database with flow rates that range from less than two to more than 10,000 litres per minute (lpm). The flow rates were measured mainly in November and December 1969.

A large spring, an outcrop of the Dalehurst Member, flows in the order of 10,000 lpm near the Raven River in 03-05-036-05 W5M. The spring is fed by overlying gravels of 11 metres thickness, and is used to supply water to the Raven trout fish hatchery.

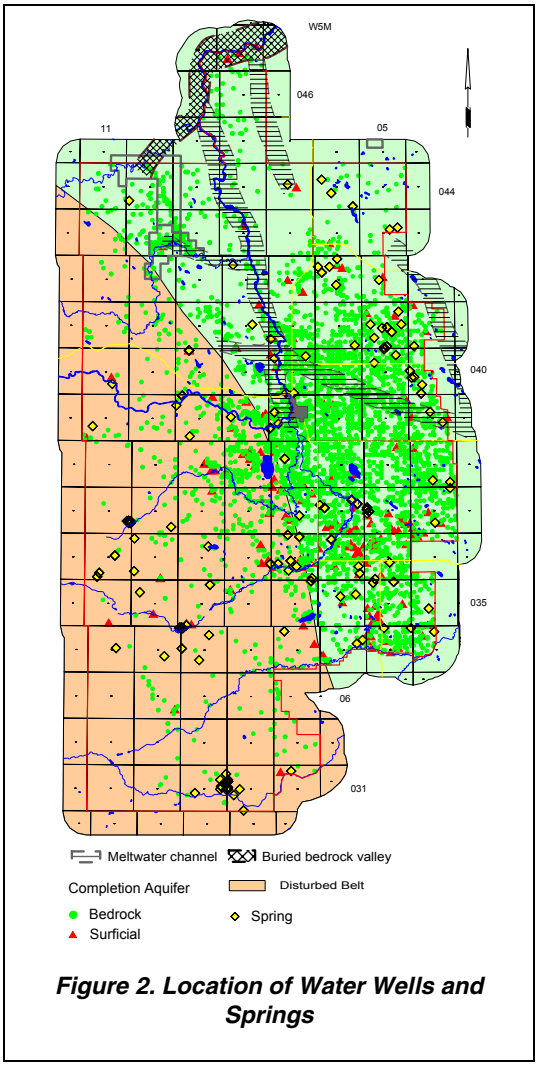


***Figure 2. Location of Water Wells and Springs***

[5] Mr. Kim Nielsen estimates that the rural population of the study area would be closer to 11,380
[6] See glossary