County of Paintearth No. 18

Part of the Battle River Basin
Parts of Tp 035 to 041, R 08 to 16, W4M
Regional Groundwater Assessment

Prepared for

In conjunction with

Agriculture and Agri-Food Canada
Prairie Farm Rehabilitation Administration

Agriculture et Agroalimentaire Canada
Administration du rétablisseme agricole des Prairies

Canada

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Table of Contents

List of Figures

List of Tables

Appendices

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. **This report, even though it is regional in nature, is the first step in fulfilling a commitment by the County of Paintearth toward the management of the groundwater resource, which is a key component toward the well-being of the County, and is a guide for future groundwater-related projects.**

1.1 About This Report

This report provides an overview of (a) the groundwater resources of the County of Paintearth, (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, and ArcView 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;
2) a table of contents for the Water Well Regulation under the Environmental Protection and Enhancement Act;
3) a flow chart showing the licensing of a groundwater diversion under the new Water Act; and
4) additional information.

The Water Well 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 E provides a list of water wells recommended for field verification.

1.2 The Project

It must be noted that the present project is a regional study and as such the results are to be used only as a guide. Detailed local studies are required to verify hydrogeological conditions at given locations.

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

Module 1 - Data Collection and Synthesis
Module 2 - Hydrogeological Maps
Module 3 - Covering Report
Module 4 - Groundwater Query
Module 5 - Familiarization Session

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

1.3 Purpose

This project is a regional groundwater assessment of the County of Paintearth. 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 includes:

- identification of the aquifers[1] within the surficial deposits[2] and the upper bedrock;
- spatial definition of the main aquifers;
- quantity and quality of groundwater associated with each aquifer;
- hydraulic relationship between aquifers; and
- identification of the first sand and gravel deposits below ground level.

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 the County.

[1] See glossary
[2] See glossary

2 Introduction

2.1 Setting

The County of Paintearth is situated in east-central Alberta. This area is part of the Alberta Plains region. The County is within the Battle River basin; a part of the County's northern boundary is the Battle River. The other County boundaries follow township or section lines. The area includes parts of the area bounded by township 041, range 16, W4M in the northwest and township 035, range 08, W4M in the southeast.

Regionally, the topographic surface varies between 600 and 850 metres above mean sea level (AMSL). The lowest elevations occur in the Battle River Valley in the northern part of the County and the highest are in the southwestern part of the County as shown in Figure 1.

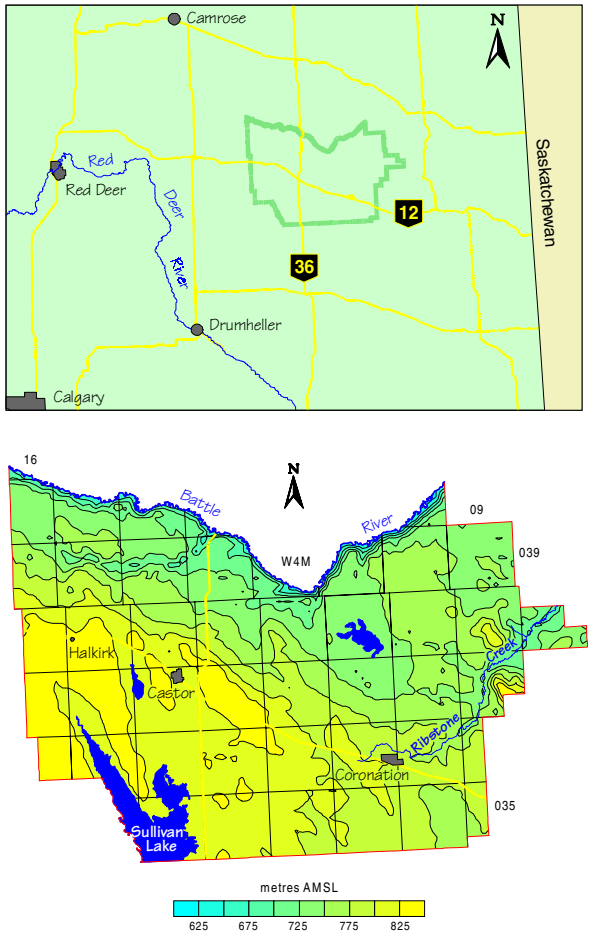

Figure 1. Index Map

2.2 Climate

The County of Paintearth lies within the transition zone between a humid, continental Dfb climate and a semiarid Bsk climate. This classification is based on potential evapotranspiration 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 Legatt, 1981) shows that the County is located in the Aspen Parkland region, a transition between boreal forest and grassland environments.

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. A Bsk climate is characterized by its moisture deficiency, where mean annual potential evapotranspiration exceeds the mean annual precipitation.

The mean annual precipitation averaged from three meteorological stations within the County measured 422 millimetres (mm), based on data from 1961 to 1993. The annual temperature averaged 2.9 °C, with the mean monthly temperature reaching a high of 17.1 °C in July, and dropping to a low of -13.6 °C in January. The calculated annual potential evapotranspiration is 529 millimetres.

2.3 Background Information

There are currently records for 2,136 water wells in the groundwater database for the County. Of the 2,136 water wells, 1,914 are for domestic/stock purposes. The remaining 222 water wells were completed for a variety of uses, including industrial, municipal and observation. Based on a rural population of 2,316, there are 3.7 domestic/stock water wells per family of four. The domestic or stock water wells vary in depth from 0.22 metres to 289.8 metres below ground level. Lithologic details are available for 1,180 water wells.

Data for casing diameters are available for 972 water wells, with 739 indicated as having a diameter of less than 275 mm and 201 having a diameter of more than 300 mm. The casing diameters of greater than 300 mm are mainly bored or dug water wells and those with a surface casing diameter of less than 275 mm are drilled water wells. Large diameter water wells are mainly present where the Lower Horseshoe Canyon Formation subcrops.

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 in the County. Until the 1970s, the type of surface casing used in drilled water wells was largely undocumented. Steel casing was in use in the 1950s and is still used in 45% of the water wells being drilled in the County. Steel and galvanized steel were the main casing types until the start of the 1980s, when plastic casing and steel casing replaced the use of galvanized steel.

Galvanized steel surface casing was used in a maximum of 8% of the new water wells from the 1950s to the early 1990s. Galvanized steel was last used in October 1991.

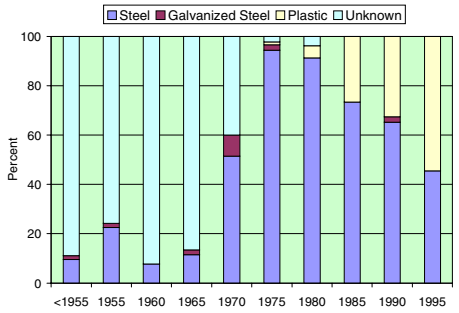

Figure 2. Surface Casing Types used in Drilled Water Wells

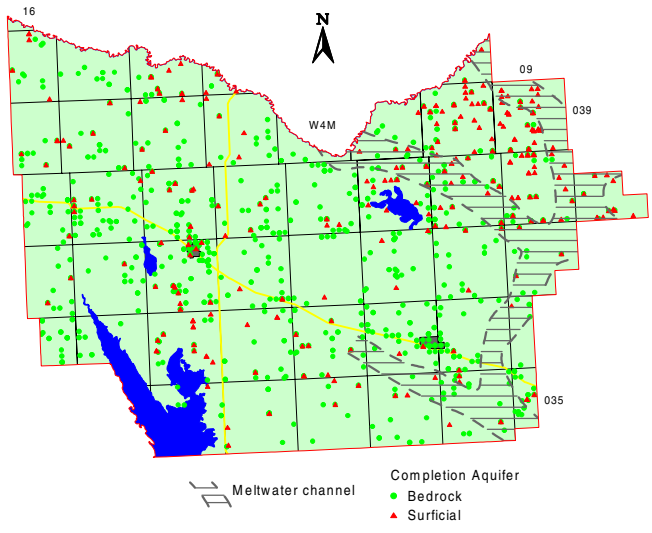

Figure 3. Location of Water Wells

There are 1,130 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 bedrock surface are water wells completed in surficial aquifers. The number of water wells completed in aquifers in the surficial deposits is 285. The adjacent map shows that these water wells occur mostly in the northeastern part of the County. Approximately 70% of the water wells completed in surficial aquifers have a completion depth of less than 30 metres.

The remaining 845 water wells have the top of their completion interval deeper than the top to the bedrock surface. From Figure 3, it can be seen that water wells completed in bedrock aquifers occur over most of the County, but percentage wise, there are fewer water wells completed in bedrock aquifers in the northeastern part of the County.

Water wells not used for domestic needs and providing groundwater with total dissolved solids (TDS) of less than 4,000 milligrams per litre (mg/L) must be licensed. At the end of 1996, 76 groundwater diversions were licensed in the County. Of the 76 licensed groundwater users, 45 are for agricultural purposes, and the remaining 31 are for industrial, municipal and other purposes. The total maximum authorized diversion from the water wells associated with these licences is 3,050 cubic metres per day (m^3/day); 48% percent of the authorized groundwater diversion is allotted for industrial use, 37% is allotted for municipal use, and 14% is allotted for agricultural use. The largest potable groundwater diversion licensed within the County is for the Town of Coronation, having a diversion of 483.5 m^3/day. The largest licensed industrial groundwater diversion within the County is for a saline water source well in 11-03-031-10 W4M owned by Fletcher Challenge Petroleum.

The adjacent table shows a breakdown of the 76 licensed groundwater diversions by the aquifer in which the water well is completed. With the exception of the saline source wells, the highest licensed diversions are for water wells completed in the Lower Horseshoe Canyon and Bearpaw aquifers; the majority of the groundwater is used for industrial and municipal purposes.

	Licensed Groundwater Users (m^3/day)					
Aquifer	Agricultural	Industrial	Municipal	Other	Total	Percentage
Upper Sand and Gravel	61	0	0	0	61	2
Lower Horseshoe Canyon	274	3	592	0	869	28
Bearpaw	95	47	531	10	683	22
Oldman	0	433	0	0	433	14
Foremost	0	0	0	0	0	0
Saline Source Wells	0	994	0	0	994	33
Unknown	10	0	0	0	10	0
Total	440	1,477	1,123	10	3,050	
Percentage	14	48	37	0		

Table 1. Licensed Groundwater Diversions

Based on the 1996 Agriculture Census, the water requirement for livestock for the County is in the order of 8,798 m^3/day, which is twenty times the amount of the groundwater diversion that is licensed for agricultural purposes.

At many locations within the County, more than one water well is completed at one legal location. Digitally processing this information is difficult. To obtain a better understanding of the completed depths of water wells, a digital surface was prepared representing the minimum depth for water wells and a second digital surface was prepared for the maximum depth. Both of these surfaces are used in the groundwater query on the CD-ROM. When the maximum and minimum water well depths are similar, there is only one aquifer that is being used.

Groundwaters from the surficial deposits can be expected to be chemically hard with a high dissolved iron content. The TDS concentrations in the groundwaters from the upper bedrock in the County are generally less than 1,500 mg/L. Groundwaters from the bedrock aquifers frequently are chemically soft with generally low concentrations of dissolved iron. The chemically soft groundwater is high in sodium concentration. Approximately 10% of the chemical analyses indicate a fluoride concentration above 1.5 mg/L.

The minimum, maximum and average concentrations of TDS, sodium, sulfate, chloride and fluoride in the groundwaters from water wells completed in the upper bedrock in the County have been compared to the Guidelines for Canadian Drinking Water Quality (GCDWQ) in Table 2. Of the five constituents compared to the GCDWQ, only average values of TDS and sodium concentrations exceed the guidelines.

	Groundwater Concentrations from Bedrock Water Wells in the County			Recommended Maximum Concentration
Constituent	Minimum	Maximum	Average	GCDWQ
Total Dissolved Solids	335	5652	1414	500
Sodium	20	1723	486	200
Sulfate	4	3509	342	500
Chloride	1.0	1712	157	250
Fluoride	0.1	5.6	0.7	1.5

Concentration in milligrams per litre unless otherwise stated
Note: indicated concentrations are for Aesthetic Objectives

GCDWQ - Guidelines for Canadian Drinking Water Quality, Sixth Edition
Minister of Supply and Services Canada, 1996

Table 2. Concentrations of Constituents in Groundwaters from Upper Bedrock Aquifer(s)