M.D. of Brazeau No. 77

Part of the North Saskatchewan and Athabasca River Basins
Parts of Tp 045 to 050, R 03 to 11, W5M
Revised 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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The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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1 PROJECT OVERVIEW

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

How a M.D. 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 M.D. of Brazeau No. 77 toward the management of the groundwater resource, which is a key component toward the well-being of the M.D., 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 M.D. of Brazeau No. 77, (b) the processes used for the present project and (c) the groundwater characteristics in the M.D.

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 - Training Session

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

1.3 Purpose

This project is a regional groundwater assessment of the M.D. of Brazeau No. 77. The regional groundwater assessment provides the information to assist in the management of the groundwater resource within the M.D. Groundwater resource management involves determining the suitability of various areas in the M.D. 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 M.D.**

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 the 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 M.D. have been assembled. Where practical, the data have been digitized. These data are then being used in the regional groundwater assessment for the M.D.

[1] See glossary
[2] See glossary

2 INTRODUCTION

2.1 Setting

The M.D. of Brazeau is situated in central Alberta. This area is part of the Alberta Plains region. The M.D. is within the North Saskatchewan and Athabasca River basins. A part of the northeastern and southeastern boundary is the North Saskatchewan River. The other boundaries follow township or section lines. The area includes parts of the area bounded by township 050, range 11, W5M in the northwest and township 045, range 03, W5M in the southeast.

Regionally, the topographic surface varies between 650 and 1,050 metres above mean sea level (AMSL). The lowest elevations occur in the North Saskatchewan River Valley in the northeastern part of the M.D.; the highest are in the southwestern part of the M.D., as shown in Figure 1.

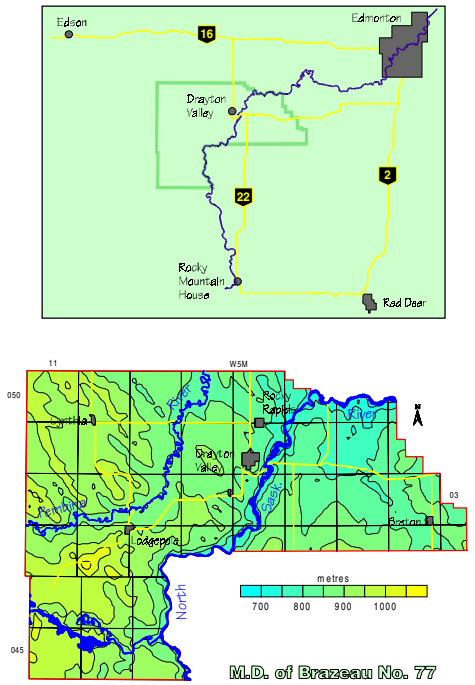

Figure 1. Index Map

2.2 Climate

The M.D. of Brazeau lies within the Dfb climate boundary. 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 M.D. 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 three meteorological stations within the M.D. measured 571 millimetres (mm), based on data from 1961 to 1993. The mean annual temperature averaged 3.2 °C, with the mean monthly temperature reaching a high of 16.1 °C in July, and dropping to a low of -10.3 °C in January. The calculated annual potential evapotranspiration is 511 millimetres.

2.3 Background Information

There are currently records for 3,571 water wells in the groundwater database for the M. D. Of the 3,571 water wells, 2,228 are for domestic/stock purposes. The remaining 1,343 water wells were completed for a variety of uses, including industrial, municipal and observation. Based on a rural population of 6,589, there are 1.3 domestic/stock water wells per family of four. The domestic or stock water wells vary in depth from less than two metres to 155.8 metres below ground level. Lithologic details are available for 2,948 water wells.

Data for casing diameters are available for 2,420 water wells, with 2,416 indicated as having a diameter of less than 330 mm and four having a diameter of more than 400 mm. The casing diameters of greater than 400 mm are mainly bored or dug water wells and those with a surface casing diameter of less than 330 mm are drilled water wells.

There are five different materials that have been used for surface casing over the last 40 years in water wells completed in the M.D. The three most common materials are galvanized steel, steel and plastic. Steel casing was in use in the 1950s and is still used in 53% of the water wells being drilled in the M.D. Galvanized steel surface casing was used in 4% of the new water wells in the early 1950s. By the early 1970s, galvanized steel casing was being used in 56% of the water wells. From 1975 onward, there was a general decrease in the percentage of water wells using galvanized steel, with the last reported use in March 1994. Plastic casing was used for the first time in August 1970. The percentage of water wells with plastic casing has increased and in the mid-1990s, plastic casing was used in 47% of the water wells drilled in the M.D.

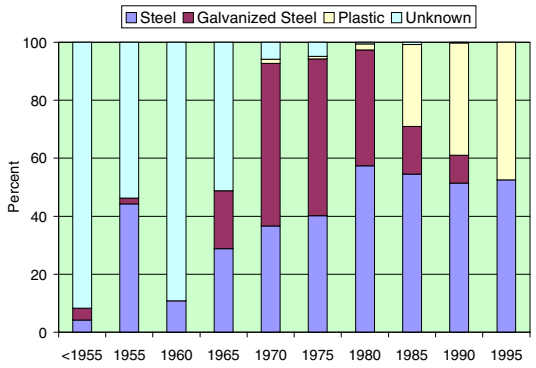

Figure 2. Surface Casing Types used in Drilled Water Wells

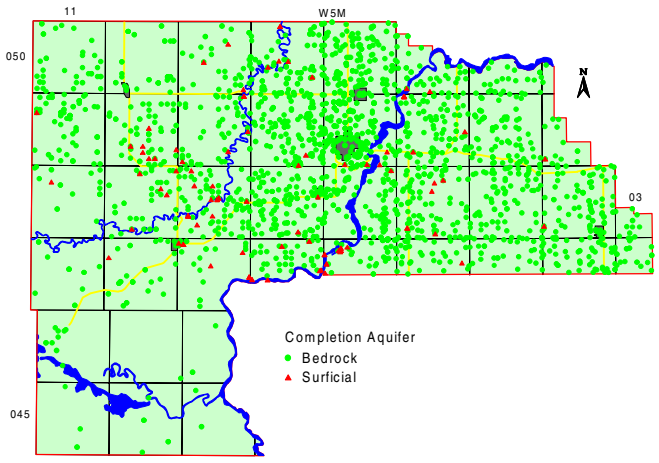

Figure 3. Location of Water Wells

There are 2,335 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 4%, a total of 104 water wells, with the majority occurring in the central part of the M.D. Approximately 60% of the water wells completed in the surficial aquifers have a completion depth of less than 30 metres.

The remaining 2,231 water wells have the top of their completion interval deeper than the depth to the bedrock surface. From the above map, it can be seen that water wells completed in bedrock aquifers occur over most of the M.D.

Water wells not used for domestic needs must be licensed. At the end of 1996, 250 groundwater diversions were licensed in the M.D. Of the 250 licensed groundwater users, 175 are for industrial purposes, 56 are for agricultural purposes, and the remaining 19 are for diversion, municipal and other purposes. The total maximum authorized diversion from the water wells associated with these licences is 23,943 cubic metres per day (m^3/day); 64% percent of the authorized groundwater diversion is allotted for industrial use. The largest licensed groundwater diversion within the M.D. is for Alberta Transportation, having a “diversion” of 3,009 m^3/day. When a groundwater use is listed as “diversion”, the activity is usually related to dewatering activities; in the case of Alberta Transportation, the diversion could be related to a gravel pit.

The adjacent table shows a breakdown of the 250 licensed groundwater diversions by the aquifer in which the water well is completed. The highest diversions are for licensed water wells completed in the Dalehurst Aquifer, of which the majority of the groundwater is used for industrial purposes.

	Licensed Groundwater Users (m³/day)						
Aquifer	Agricultural	Municipal	Industrial	Diversion	Other	Total	Percentage
Upper Sand and Gravel	10	0	88	0	0	98	0.4
Lower Sand and Gravel	0	0	913	0	0	913	4
Dalehurst	90	54	13,225	0	0	13,369	56
Upper Lacombe	212	91	433	2,789	0	3,525	15
Lower Lacombe	20	338	308	1,292	0	1,958	8
Haynes	44	0	7	659	0	710	3
Upper Scollard	0	0	40	3,009	61	3,110	13
Unknown	0	0	260	0	0	260	1
Total	376	483	15,274	7,749	61	23,943	
Percentage	1.6	2.0	63.8	32.4	0.2		

Table 1. Licensed Groundwater Diversions

Based on the 1996 Agriculture Census, the water requirement for livestock for the M.D. is in the order of 5,650 m³/day, which is fifteen times the licensed groundwater diversion for agricultural purposes. This result suggests many agricultural operations are not in compliance with the present regulations related to groundwater use.

At many locations within the M.D., 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 total dissolved solids (TDS) concentrations in the groundwaters from the upper bedrock in the M.D. are generally less than 1,000 milligrams per litre (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. Less than 10% of the chemical analyses indicate a fluoride concentration above 1.5 mg/L.

	Groundwater Concentrations from Bedrock Water Wells in the M.D.			Recommended Maximum Concentration
Constituent	Minimum	Maximum	Average	GCDWQ
Total Dissolved Solids	218	1855	665	500
Sodium	207	570	191	200
Sulfate	2.9	920	115	500
Chloride	0.35	373	11.4	250
Fluoride	0.03	4	0.4	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. Groundwater Concentrations from Water Wells Completed in Bedrock Aquifers

The minimum, maximum and average concentrations of TDS, sodium, sulfate, chloride and fluoride in the groundwaters from water wells completed in the bedrock in the M.D. have been compared to the Guidelines for Canadian Drinking Water Quality (GCDWQ) in Table 2. On the average, the groundwaters are below the GCDWQ; the exception is TDS, which exceeds the guideline slightly.

Alberta Environmental Protection (AEP) defines the Base of Groundwater Protection as the elevation below which the groundwater is expected to have more than 4,000 mg/L of total dissolved solids. By using the ground elevation, the bedrock surface and the Base of Groundwater Protection provided by the Alberta Energy and Utilities Board (EUB), a depth to the Base of Groundwater Protection can be determined. This depth, for the most part, would be the maximum drilling depth for a water well for agricultural purposes or for a potable water supply. Less than 0.1% of the water wells in the M.D. are completed below the Base of Groundwater Protection. If a water well is completed below the Base of Protection with the total dissolved solids of the groundwater exceeding 4,000 mg/L, then the groundwater use does not require licensing by AEP.