M.D. of Provost No. 52

Part of the Battle River Basin
Parts of Tp 036 to 043, R 01 to 10, W4M
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 Municipal District (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 Provost No. 52 toward the management of the groundwater resource, which is a key component of 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 Provost No. 52, (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 provided with 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 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; and
3) 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.

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 Provost No. 52. 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 Provost No. 52 is situated in east-central Alberta. This area is part of the Alberta Plains region. The M.D. exists within the Battle River basin. The northwestern boundary of the M.D. is the Battle River. The other boundaries follow township or section lines. The area includes some or all of townships 036 to 043, ranges 01 to 10, west of the 4th Meridian.

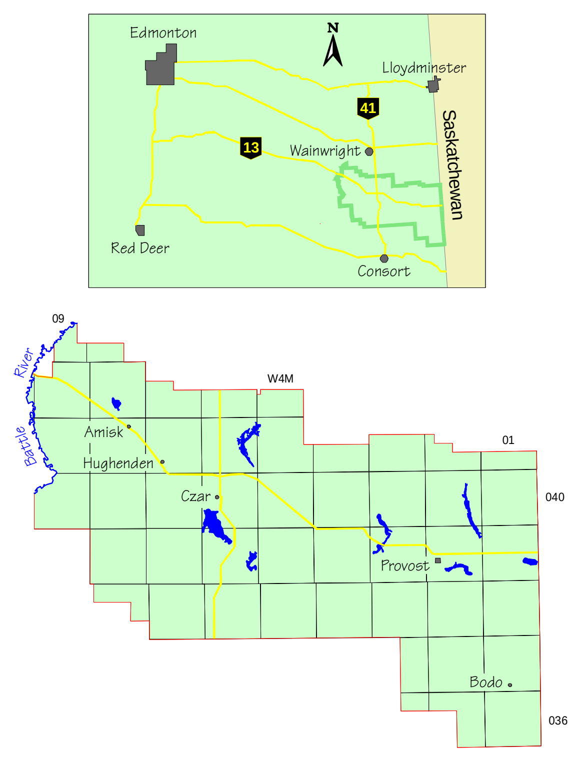

Figure 1. Index Map

The ground elevation varies between 580 and 820 metres above mean sea level (AMSL). Regionally the topographic surface generally decreases from west to east and from south to north. However, local drainage is toward the Battle River.

2.2 Climate

The M.D. 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 M.D. 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 four meteorological stations within the M.D. measured 417 millimetres (mm), based on data from 1967 to 1985. The mean annual temperature averaged 2.3 °C, with the mean monthly temperature reaching a high of 17.1 °C in July, and dropping to a low of -15.6 °C in January. The calculated annual potential evapotranspiration is 530 millimetres.

2.3 Background Information

There are currently records for 2,980 water wells in the groundwater database for the M.D. Of the 2,980 water wells, 2,628 are for domestic/stock purposes. The remaining 352 water wells were completed for a variety of uses, including municipal, industrial and observation purposes. Based on a rural and hamlet population of 2,705, there are 3.9 domestic/stock water wells per family of four. The domestic or stock water wells vary in depth from less than one metre to 213.4 metres below ground level. Lithologic details are available for 1,537 water wells.

Data for casing diameters are available for 1,567 water wells, with 391 having a diameter of more than 300 mm and 1,176 having a diameter of less than 300 mm. The casing diameters of greater than 300 mm are mainly bored water wells and those with a surface casing of less than 300 mm are drilled water wells.

Steel, plastic and galvanized steel represent 97% of the materials that have been used for surface casing in drilled water wells over the last 40 years in water wells completed in the M.D. From before 1950 to the mid-1960s, the surface casing used was unknown in the majority of the water wells drilled. Steel casing was in use in the 1950s and is still used in 4% of the new water wells being drilled in the M.D. Galvanized steel surface casing was used in 4% of the new water wells in the early 1960s. By the 1970s, galvanized steel casing was being used in 30% of the water wells. From 1980 onward, there was a general decrease in the percentage of water wells using galvanized steel, with the last reported use in May 1992. Plastic casing was used for the first time in April 1972. The percentage of water wells with plastic casing has increased and in the mid-1990s, plastic casing was used in 96% of the water wells drilled in the M.D.

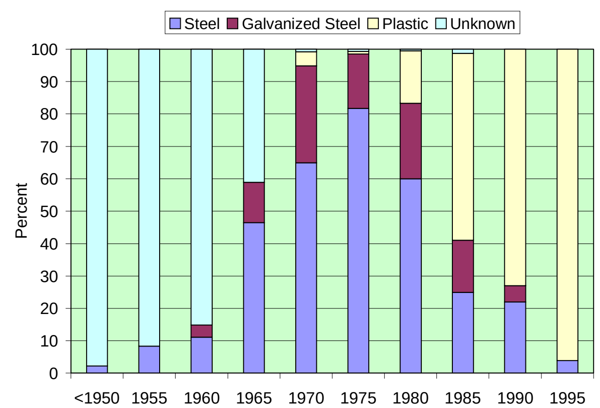

Figure 2. Surface Casing Types used in Drilled Water Wells

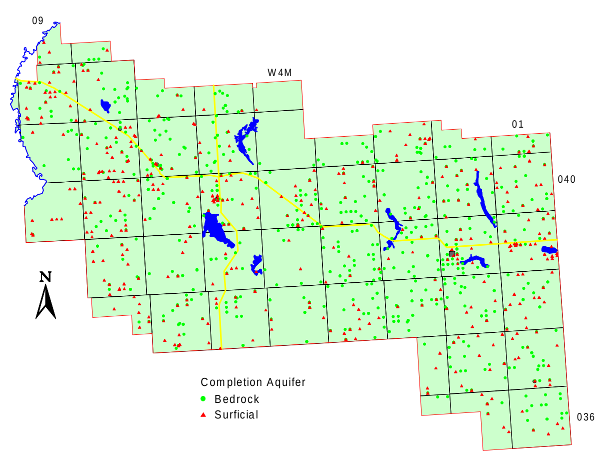

Figure 3. Location of Water Wells

There are 1,272 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 540. The adjacent map shows that these water wells occur over most of the M.D. Approximately 70% of the water wells completed in the surficial aquifers have a completion depth of less than 40 metres and 30% have a completion depth of more than 40 metres. The remaining 732 water wells have the top of their completion interval deeper than the depth to the bedrock surface. From Figure 3, 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, 212 groundwater diversions were licensed in the M.D. The total maximum authorized diversion from these 212 water wells is 9,008 cubic metres per day (m³/day); 48% of the authorized groundwater diversion is allotted for industrial use. The largest licensed groundwater diversion within the M.D. not used for industrial purposes is for the Town of Provost, having a combined diversion of 957 m³/day from four water supply wells completed in a sand and gravel aquifer.

The largest licensed industrial groundwater diversion within the M.D. is 500 m³/day, for a PanCanadian Petroleum (PCP) water source well in 07-04-041-03 W4M. The water source well is completed at a depth of more than 800 metres below ground surface, in the Dina Member of the Mannville Group.

The adjacent table shows a breakdown of the 212 licensed groundwater diversions by the aquifer in which the water well is completed. The highest aquifer diversions are for licensed water wells completed in the Oldman Aquifer, of which most of the groundwater is used for agricultural and municipal purposes. The licensed water wells that are completed in the Ribstone Creek and Victoria aquifers are all used for industrial purposes. A detailed discussion of the individual aquifers can be found later in this report.

	Licensed Groundwater Diversions (m³/day)					
Aquifer	Agricultural	Domestic	Industrial	Municipal	Other	Total
Upper Sand and Gravel	564	3	0	1,024	54	1,645
Lower Sand and Gravel	47	0	0	0	0	47
Bearpaw	90	0	0	0	0	90
Oldman	1,877	0	3	110	10	2,000
continental Foremost	151	0	0	0	0	151
Milan	49	0	0	0	0	49
marine Foremost	96	0	0	9	0	105
Birch Lake	384	0	81	172	0	637
Ribstone Creek	0	0	730	0	0	730
Victoria	0	0	1,529	0	0	1,529
Unknown	0	0	2,025	0	0	2,025
Total	3,258	3	4,368	1,315	64	9,008

Table 1. Licensed Groundwater Diversions

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. The area where the greatest differences between the minimum and maximum depth occur most often is in areas where water wells completed in aquifers in the surficial deposits are most common.

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. Approximately 15% of the chemical analyses indicate a fluoride concentration above 1.0 mg/L.