2 INTRODUCTION

2.1 Setting

Parkland County is situated in central Alberta, immediately west of the City of Edmonton. This area is part of the Alberta Plains region. The County is within the North Saskatchewan and Athabasca River basins. The western boundary is the Pembina River and the southern boundary is the North Saskatchewan River. The other boundaries follow township or section lines. The area includes some or all of townships 050 to 054, range 25, west of the 4th Meridian, to range 08, west of the 5th Meridian.

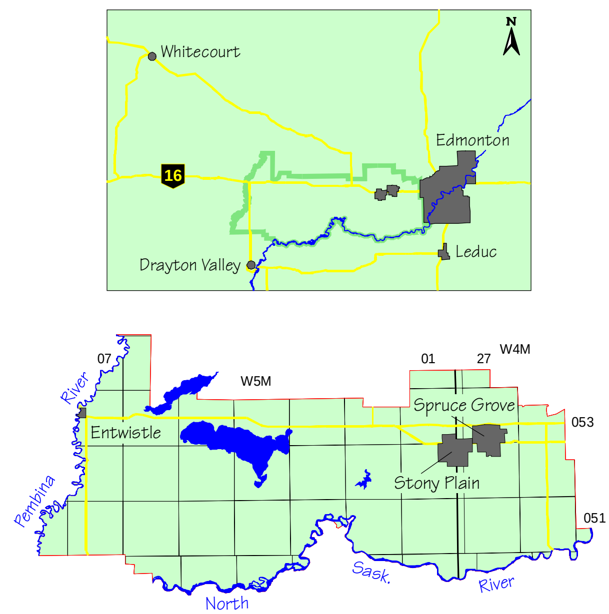

Figure 1. Index Map

The ground elevation varies between 630 and 910 metres above mean sea level (AMSL). The topographic surface generally decreases from west to east within the County.

2.2 Climate

Parkland County lies within the Dfb climate boundary. This classification is based on potential evapotranspiration values determined using the Thornthwaite method (1957), combined with the distribution of natural ecoregions in the area. The ecoregions map shows that the County is located in both the Mid-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 County measured 533 millimetres (mm), based on data from 1966 to 1993. The mean annual temperature averaged 3.1 °C, with the mean monthly temperature reaching a high of 16.2 °C in July, and dropping to a low of -11.7 °C in January. The calculated annual potential evapotranspiration is 525 millimetres.

2.3 Background Information

There are currently records for 3,107 water wells in the groundwater database for Parkland County. Of the 3,107 water wells, 2,755 are for domestic/stock purposes. The remaining 352 water wells were completed for a variety of uses, including investigation, observation and industrial purposes. Based on a rural population of 24,769, there are 0.4 domestic/stock water wells per family of four. This suggests that most domestic rural dwellings do not use groundwater and rely primarily on an alternate source. The domestic or stock water wells vary in depth from less than 2 metres to 162 metres below ground level. Lithologic details are available for 2,428 water wells.

Data for casing diameters are available for 2,231 water wells, with 72 indicated as having a diameter of more than 400 mm and 2,159 having a diameter of less than 180 mm. The casing diameters of greater than 400 mm are mainly bored water wells and those with a surface casing diameter of less than 180 mm are drilled water wells.

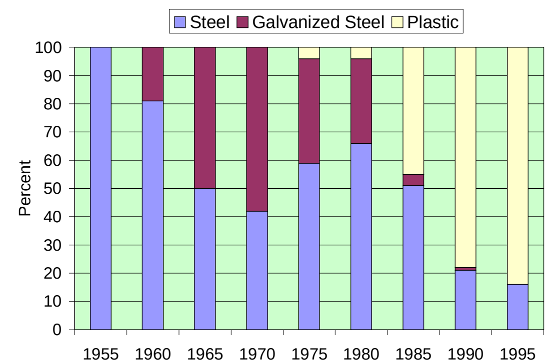

Figure 2. Surface Casing Types used in Drilled Water Wells

There are five different materials that have been used for surface casing over the last 40 years in water wells completed in the County. The three most common materials are galvanized steel, steel and plastic. Steel casing was in use in the 1950s and is still used in 16% of the water wells being drilled in the County. Galvanized steel surface casing was used in 19% of the new water wells in the early 1960s. By the early 1970s, galvanized steel casing was being used in 58% 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 September 1993. Plastic casing was used for the first time in August 1978. The percentage of water wells with plastic casing has increased and in the mid-1990s, plastic casing was used in 84% of the water wells drilled in the County.

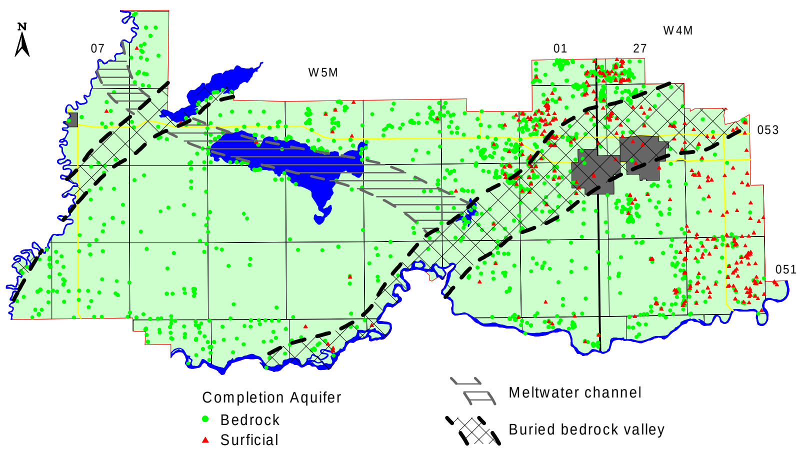

Figure 3. Location of Water Wells

There are 2,024 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 20%, a total of 407 water wells. Ninety-five percent of the surficial water wells occur in the eastern three ranges of the County.

The remaining 1,617 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 County.

Water wells not used for domestic needs must be licensed. At the end of 1996, 153 groundwater diversions were licensed in the County. The total maximum authorized diversion from the water wells associated with these licences is 11,760 cubic metres per day (m³/day); 8.7 percent of the authorized groundwater diversion is allotted for agricultural use. The largest licensed groundwater diversion within the County is for the Town of Stony Plain, having a diversion of 5,882 m³/day for their dewatering program. The user with the second largest authorized diversion is Alberta Transportation at a location adjacent to the North Saskatchewan River.

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 surface was prepared representing the minimum depth for water wells and a second 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, the impression is that only one aquifer is being used. Over approximately 30% of the County, the difference between the maximum and minimum depth is more than 30 metres. In the vicinity of linear bedrock lows, the greatest differences between minimum and maximum depth occur. Generally this occurs because aquifers are developed in both the surficial deposits and the bedrock deposits.

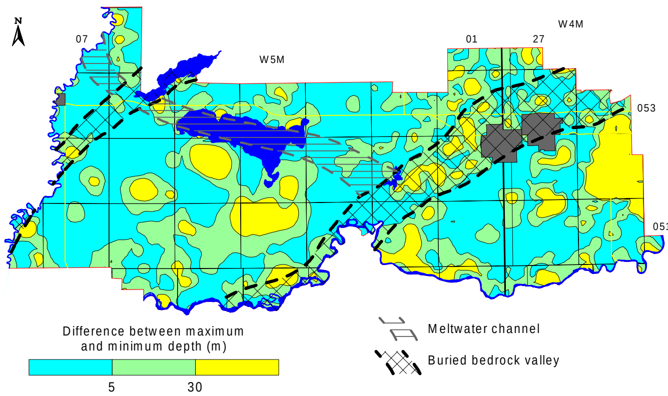

Figure 4. Depth of Existing Water Wells

The total dissolved solids (TDS) concentration in the groundwaters from the upper bedrock in the County are generally less than 1,000 milligrams per litre (mg/L). Groundwaters from the surficial deposits can be expected to be chemically hard with a high dissolved iron content. Groundwaters from the bedrock aquifers frequently are chemically soft with concentrations of dissolved iron generally less than 0.5 mg/L. The chemically soft groundwater can be high in sodium concentration. Approximately 15% of the chemical analyses indicate a fluoride concentration above 1.5 mg/L.

Proper management of the groundwater resource requires water-level data. These data are often collected from observation water wells. At the present time, data are available from three **Alberta Environmental Protection** (AEP)-operated observation water wells within Parkland County. Additional data can be obtained from some of the licensed groundwater diversions. In the past, these data have been difficult to obtain from AEP, in part because of the failure of the licensee to provide the data.

However, even with the available sources of data, the number of water-level data points relative to the size of the County is too few to provide a reliable groundwater budget. The most cost-efficient method to collect additional groundwater monitoring data would be to have the water well owners measuring the water level in their own water well on a regular basis.

3 TERMS

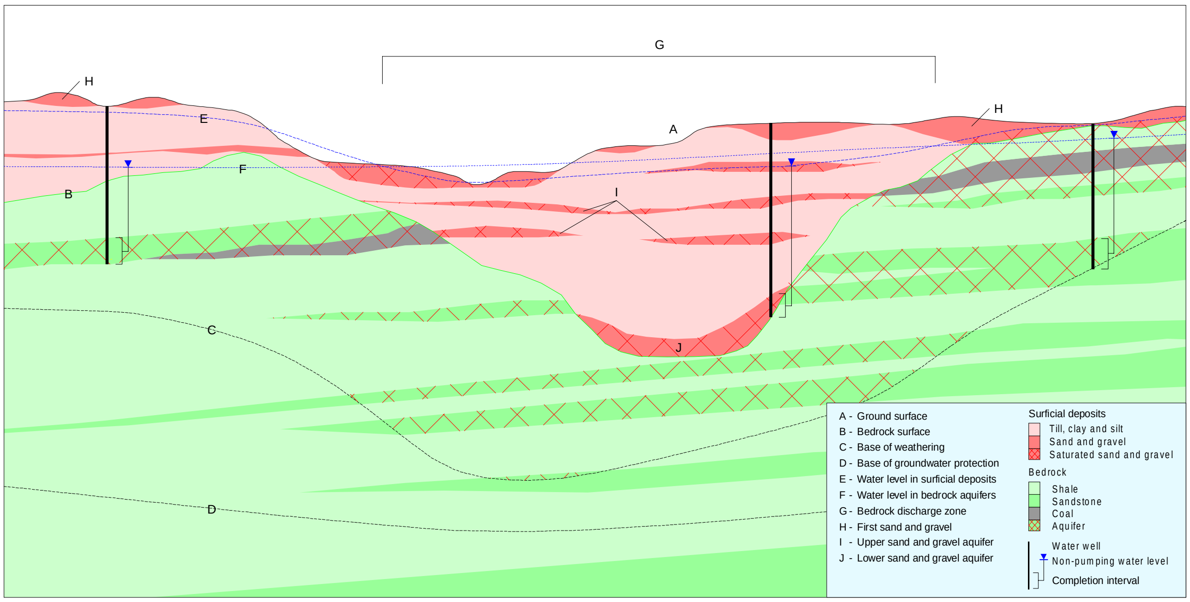

Figure 5. Generalized Cross-Section (for terminology only)

Depth (m)	Lithology	Lithologic Description	Group and Formation: Thickness	Group and Formation: Designation	Member: Thickness	Member: Designation	Zone: Thickness	Zone: Designation
0		sand, gravel, till, clay, silt	<80	Surficial Deposits	<40	Upper	<30	First Sand and Gravel
					<60	Lower		
100–300		sandstone, shale, coal	<800	Paskapoo Formation				
400		shale, sandstone, coal	60-150	Edmonton Group: Scollard Formation	40-100	Upper	<2	Upper Ardley Coal Zone
							~20	Ardley Coal Zone (main seam)
							<1	Nevis Coal Seam
					20-60	Lower		
500		shale, clay, tuff	~25	Edmonton Group: Battle Formation	<0.3	Kneehill Member		
		shale, siltstone, sandstone	5-10	Edmonton Group: Whitemud Formation				
600		shale, sandstone, coal, bentonite, limestone, ironstone	300-380	Edmonton Group: Horseshoe Canyon Formation	~100	Upper		
700					~100	Middle		
800					~170	Lower		
900–1000		shale, sandstone, siltstone	60-120	Bearpaw Formation				

Figure 6. Geologic Column

4 METHODOLOGY

4.1 Data Collection and Synthesis

The AEP groundwater database is the main source of available groundwater data. The database includes the following:

1) water well drilling reports;
2) aquifer test results from some water wells;
3) location of some springs;
4) water well locations determined during water well surveys;
5) chemical analyses for some groundwaters;
6) location of flowing shot holes;
7) location of structure test holes; and
8) a variety of data related to the groundwater resource.

The main disadvantage to the database is the absence of quality control. Very little can be done to overcome this lack of quality control in the data collection, other than to assess the usefulness of control points relative to other data during the interpretation. Another disadvantage to the database is the lack of adequate spatial information.

The AEP groundwater database uses a land-based system with only a limited number of records having a value for ground elevation. The locations for records usually include a quarter section description; a few records also have a land description that includes a Legal Subdivision (Lsd). For digital processing, a record location requires a horizontal coordinate system. In the absence of an actual location for a record, the record is given the coordinates for the centre of the land description.

The present project uses the 10TM coordinate system. This means that a record for the NW ¼ of section 02, township 053, range 01, W5M, would have a horizontal coordinate with an Easting of 63,316 metres and a Northing of 5,931,510 metres, the centre of the quarter section. Once the horizontal coordinates are determined, a ground elevation is obtained from the 1:20,000 Digital Elevation Model (DEM) from the Resource Data Division of AEP.

After assigning spatial control to the records in the groundwater database, the data are processed to determine values for hydrogeological parameters. As part of the processing, obvious keying errors in the database are corrected.

Where possible, determinations are made from individual records for the following:

1) depth to bedrock;
2) total thickness of sand and gravel;
3) thickness of first sand and gravel when present within one metre of ground surface;
4) total thickness of saturated sand and gravel; and
5) depth to the top and bottom of completion intervals.

Also, where sufficient information is available, values for apparent transmissivity[3] and apparent yield[4] are calculated, based on the aquifer test summary data supplied on the water well drilling reports. The apparent transmissivity results are used to estimate a value for hydraulic conductivity[5]. The conductivity values are obtained by dividing the apparent transmissivity by the completion interval. To obtain a value for regional transmissivity of the aquifer, the hydraulic conductivity is multiplied by the effective thickness of the aquifer based on nearby e-log information. Where valid detailed aquifer test results exist, the interpreted data provide values for aquifer transmissivity and effective transmissivity.

The Alberta Energy and Utilities Board (EUB) well database includes records for all of the wells drilled by the oil and gas industry. The information from this source includes:

1) spatial control for each well site;
2) depth to the top of various geological units;
3) type and intervals for various down-hole geophysical logs; and
4) drill stem test (DST) summaries.

Unfortunately, the EUB database contains very little information from above the base of groundwater protection. Because the main interest for a groundwater study comes from data above the base of groundwater protection, the data from the EUB database have limited use.

Values for apparent transmissivity and hydraulic conductivity are calculated from the DST summaries.

Published and unpublished reports and maps provide the final source of information to be included in the new groundwater database. The reference section of this report lists the available reports. The only digital data from publications are from the Geological Atlas of the Western Canada Sedimentary Basin (Mossop and Shetsen, 1994). These data are used to verify the geological interpretation of geophysical logs but cannot be distributed because of a licensing agreement.

4.2 Spatial Distribution of Aquifers

Determination of the spatial distribution of the aquifers is based on:

1) lithologs provided by the water well drillers;
2) geophysical logs from structure test holes;
3) wells drilled by the oil and gas industry; and
4) data from existing cross-sections.

The identification of aquifers becomes a two-step process: first, mapping the tops and bottoms of individual geological units; and second, identifying the porous and permeable parts of each geological unit in which the aquifer is present.

After obtaining values for the elevation of the top and bottom of individual geological units at specific locations, the spatial distribution of the individual surfaces can be determined. Digitally, establishment of the distribution of a surface requires the preparation of a grid. The inconsistent quality of the data

[3] For definitions of Transmissivity, see glossary
[4] For definitions of Yield, see glossary
[5] See glossary