2.3 Background Information

2.3.1 Number, Type and Depth of Water Wells

There are currently 10,014 records in the groundwater database for the County, of which 7,839 are water wells[5]. Of the 10,014 records in the groundwater database for the County, 1,380 are within the Samson First Nation lands and 189 are within the Montana First Nation lands. Of the 7,839 water wells, 6,629 are for domestic/stock purposes. The remaining 1,210 water wells were completed for a variety of uses, including industrial, municipal, observation, agricultural, irrigation, investigation, dewatering, injection and monitoring; 759 of the 1,210 water wells have an "unknown" purpose, and 124 water wells are not in use. Based on a rural population of 8,852 (Phinney, 2003), there are three domestic/stock water wells per family of four. There are 5,881 domestic or stock water wells with a completed depth, of which 4,200 (71%) are completed at depths of less than 60 metres below ground surface. Details for lithology[6] are available for 5,782 water wells.

2.3.2 Number of Water Wells in Surficial and Bedrock Aquifers

There are 4,940 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 4,940 water wells for which aquifers could be defined, 135 are completed in surficial aquifers, with 109 (80%) having a completion depth of less than 50 metres below ground surface. The adjacent map shows that the water wells completed in the surficial deposits occur throughout the County, frequently in the vicinity of linear bedrock lows, and in the areas around, east and south of the Town of Ponoka.

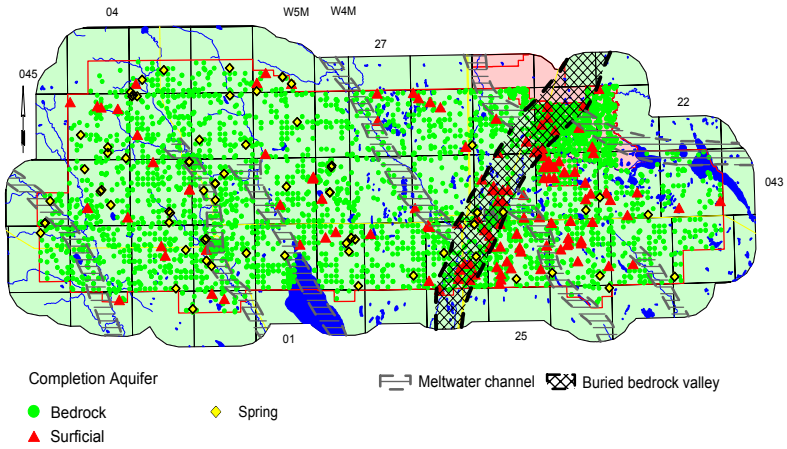

Figure 2. Location of Water Wells and Springs

The data for 4,805 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 Ponoka County, there are currently records for 71 springs in the groundwater database, including three springs that were documented by Borneuf (1983). There are 38 springs having at least one total dissolved solids (TDS) value, with 75% having a TDS of less than 500 milligrams per litre (mg/L). There are two springs in the groundwater database with flow rates/test rates of 36.4 and 90.9 litres per minute (lpm), respectively. In addition to the two springs having flow rates/test rates, there is the Paetkau (Lick) Spring that Mow-Tech Ltd.[7] monitored from 1989 to 1998. A detailed discussion regarding the Paetkau (Lick) Spring is on pages 40 and 41 in Section 6.0 (Groundwater Budget) of this report.

5 See glossary
6 See glossary
7 Mow-Tech Ltd. 1-800-GEO-WELL

2.3.3 Casing Diameter and Type

Data for casing diameters are available for 5,722 water wells, with 5,711 (99.8%) indicated as having a diameter of less than 275 mm and 11 (0.2%) having a diameter of more than 275 mm. The casing diameters of greater than 275 mm are mainly bored or dug water wells and those with a surface-casing diameter of less than 275 mm are mainly drilled water wells. The groundwater database suggests that the 11 above-mentioned water wells in the County were bored, hand dug, or dug by backhoe. The complete water well database for the County suggests that 98 of the water wells in the County were bored or hand dug.

For a water well with a small-diameter casing to be effective in surficial deposits and to provide sand-free groundwater, the water well must be completed with a water well screen. Some water wells completed in the surficial deposits are completed in low-permeability aquifers and have a large-diameter casing. The large-diameter water wells may have been hand dug or bored and because they are completed in very low permeability aquifers, most of these water wells would not benefit from water well screens. Within the County, casing-diameter information is available for 133 of the 135 water wells completed in the surficial deposits, of which 131 surficial water wells have a casing diameter of less than 275 millimetres and are assumed to be drilled water wells. Within the County, casing-diameter information is available for 4,780 of the 4,805 water wells completed below the top of bedrock, of which 4,778 have a surface casing diameter of less than 275 mm and have been mainly completed with either a perforated liner or as open hole; there are 20 bedrock water wells completed with a water well screen.

Where the casing material is known, steel surface casing materials have been used in 80.3% of the drilled water wells over the last 50 years. For the remaining drilled water wells with known surface casing material, 10.4% were completed with galvanized steel casing, 9.1% with plastic casing, and 0.2% with wood, concrete or other surface casing materials (used mostly in the 1960s and 1970s). Prior to the mid-1960s, the type of surface casing used in drilled water wells was mainly undocumented. Steel casing was in use in the 1950s and is still used in 75% of the water wells being drilled in the County. Steel and galvanized steel were the main casing types until the start of the 1990s, at which time plastic casing started to replace the use of galvanized steel casing.

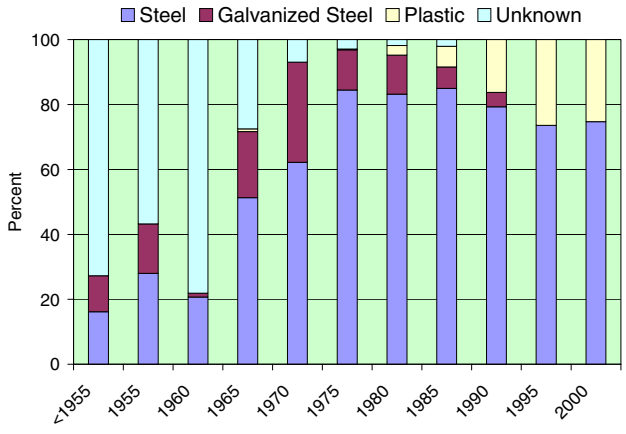

Figure 3. Surface Casing Types Used in Drilled Water Wells

Steel casing has been dominant in the County probably because it has resisted corrosion and also because water well drillers may be reluctant to use plastic (PVC) casing if there have been no documented problems with steel casing in the area.

2.3.4 Dry Water Test Holes

In the County, there are 10,014 records in the groundwater database. Of these 10,014 records, 19 are indicated as being dry or abandoned with "insufficient water"[8]. Also included in these dry test holes is any record that includes comments that state the water well goes dry in dry years. Of the 19 "dry" water test holes, 11 are completed in bedrock aquifers; the remaining eight "dry" water test holes are completed in surficial deposits. This is a remarkably low rate of dry or unsuccessful test holes or water wells. Only about 7% of all water wells with apparent yield estimates were judged to yield less than 6.5 m³/day (1 igpm).

[8] "dry" can be due to a variety of reasons: skill of driller, type of drilling rig/method used, the geology

2.3.5 Requirements for Licensing

Water well diversion starting after 01 Jan 1999 must have a non-exempt authorization to divert and use groundwater unless (1) the diversion is for household use in excess of 3.4 cubic metres per day (1,250 cubic metres per year) [m³/year] or 750 imperial gallons per day[9]), (2) the diversion is from saline groundwaters with total dissolved solids in excess of 4,000 mg/L, or (3) the diversion of groundwater is from a manually pumped water well. A person diverting groundwater for agricultural purposes before 01 Jan 1999 to a maximum of 6,250 m³/year can continue to divert the groundwater without a licence or a registration as long as the person continues to own or occupy the land. The diversion of groundwater under this exemption has no priority, the right is non-transferable and the exemption ceases when the person no longer owns or occupies the land.

In the last update from the Alberta Environment (AENV) groundwater database in January 2003, 1,270 groundwater allocations were shown to be within the County, with the most recent groundwater user being authorized in November 2002. Of the 1,270 authorized non-exempt groundwater users (licences and registrations), 892 are registrations for traditional agriculture use under the *Water Act*. These 892 users will continue to have an industry activity code of 'registration' but the groundwater will be used for stock and/or crop spraying. Typically, the groundwater diversion for crop spraying is less than one m³/day. Of the 892 registrations, only 208 (23%) could be linked to the AENV groundwater database. Of the remaining 378 from the 1,270 authorized non-exempt groundwater users, 315 are for agricultural purposes (mainly stock watering), 35 are for municipal purposes (mainly urban), 16 are for industrial purposes (mainly oil injection), five are for commercial purposes, four are recreation purposes, two are dewatering purposes, and the remaining one is for exploration purposes. Of these 378 licensed groundwater users in the County, 221 (58%) could be linked to the AENV groundwater database. The total maximum authorized diversion from the water wells associated with these licences and registrations is 19,650 m³/day, although actual use could be less. Of the 19,650 m³/day, 7,180 m³/day (36.5%) is authorized for municipal purposes, 4,488 m³/day (22.8%) is for industrial purposes, 3,984 m³/day (20.3%) is authorized for agricultural purposes, 2,817 m³/day (14.3%) is for registrations, 824 m³/day (4.2%) is authorized for dewatering purposes, 286 m³/day (1.5%) is authorized for commercial purposes, 41 m³/day (0.2%) is authorized for exploration, and the remaining 30 m³/day is allotted for recreation use (0.2%), as shown below in Table 1. A figure showing the locations of the authorized non-exempt groundwater users is in Appendix A (page A-7) and on the CD-ROM. Table 1 also shows a breakdown of the 1,270 groundwater allocations by the aquifer in which the water well is completed. Approximately fifty-seven percent of the total authorized groundwater allocations are in the Dalehurst and Upper Scollard aquifers. The 59 users where an aquifer cannot be determined is because there is no completion information available.

Aquifer **	No. of Diversions	Registrations (m³/day)	Licensed Groundwater Users* (m³/day)							Authorized Non-Exempt Total	Percentage
			Agricultural	Municipal	Industrial	Commercial	Recreation	Dewatering	Exploration		
Multiple Surficial Completions	1	3	0	0	0	0	0	0	0	3	0.0
Upper Sand and Gravel	2	5	0	0	0	0	0	0	0	5	0.0
Lower Sand and Gravel	15	27	54	11	0	74	0	0	0	166	0.8
Multiple Bedrock Completions	168	404	602	970	531	94	0	657	0	3,258	16.6
Dalehurst	595	1,312	1,221	1,027	2,882	0	10	167	41	6,660	33.9
Upper Lacombe	110	277	362	0	602	0	0	0	0	1,241	6.3
Lower Lacombe	46	131	97	0	0	0	0	0	0	228	1.2
Haynes	63	102	653	0	0	0	20	0	0	775	3.9
Upper Scollard	104	225	675	3,501	0	118	0	0	0	4,519	23.0
Lower Scollard	30	50	131	0	0	0	0	0	0	181	0.9
Battle and Whitemud	5	6	7	0	0	0	0	0	0	13	0.1
Upper Horseshoe Canyon	70	156	112	1,173	0	0	0	0	0	1,441	7.3
Middle Horseshoe Canyon	1	0	0	0	0	0	0	0	0	0	0.0
Saline	1	0	0	0	473	0	0	0	0	473	2.4
Unknown	59	119	70	498	0	0	0	0	0	687	3.5
Total	1,270	2,817	3,984	7,180	4,488	286	30	824	41	19,650	100
Percentage		14.3	20.3	36.5	22.8	1.5	0.2	4.2	0.2	100	

* - data from AENV ** - Aquifer identified by HCL

Table 1. Authorized Non-Exempt Groundwater Diversions

[9] see conversion table on page 64

Based on the 2001 Agriculture Census (Statistics Canada), the calculated water requirement for 956,153 livestock for the County (including the First Nation lands) is in the order of 30,000 m³/day. This value includes intensive livestock use but not domestic animals and is based on an estimate of water use per livestock type. Of the 30,000 m³/day average calculated livestock use, AENV has authorized a groundwater diversion of 6,801 m³/day (agricultural and registration) (23%) and licensed a surface-water diversion based on consumptive use of 197 m³/day (<1%). the remaining 76% of the calculated livestock use would have to be mainly from unlicensed sources.

2.3.6 Groundwater Chemistry and Base of Groundwater Protection

Groundwaters from an aquifer in the surficial deposits can be expected to be chemically hard, having a total hardness of at least a few hundred mg/L, and a dissolved iron concentration such that the groundwater must be treated before being used for domestic needs. High nitrate + nitrite (as N) concentrations were evident in 2% of the available chemical data for the surficial aquifers and fewer than 1% of the available chemical data for the upper bedrock aquifer(s); a plot of nitrate + nitrite (as N) in surficial aquifers is on the accompanying CD-ROM. The TDS concentrations in the groundwaters from the upper bedrock in the County range from less than 500 to more than 1,500 mg/L (page A-31). Groundwaters from the bedrock aquifers frequently are chemically soft, with generally low concentrations of dissolved iron. The chemically soft groundwater is high in concentrations of sodium. Nearly 20 percent of the chemical analyses for upper bedrock water wells indicate a fluoride concentration above 1.5 mg/L, with most of the exceedances occurring in the northeastern part of the County (page A-33).

Constituent	No. of Analyses	Range for County in mg/L Minimum	Maximum	Median	Recommended Maximum Concentration SGCDWQ
Total Dissolved Solids	1,600	0	4,537	629	500
Sodium	1,330	0	31,510	239	200
Sulfate	1,599	0	2,812	52	500
Chloride	1,587	0	205	3	250
Fluoride	1,464	0	8.8	0.3	1.5

Concentration in milligrams per litre unless otherwise stated
Note: indicated concentrations are for Aesthetic Objectives except for Fluoride, which is for Maximum Acceptable Concentration (MAC)

SGCDWQ - Summary of Guidelines for Canadian Drinking Water Quality
Federal-Provincial-Territorial Committee on Drinking Water, April 2002

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

The minimum, maximum and median[10] 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 Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ) in Table 2. Of the five constituents compared to the SGCDWQ, median concentrations of TDS and sodium exceed the guidelines.

[10] see glossary

In general, Alberta Environment defines the Base of Groundwater Protection as the elevation below which the groundwater will have more than 4,000 mg/L of total dissolved solids. By using the ground elevation, formation elevations, and Alberta Energy and Utilities Board (EUB) information indicating the formations containing the deepest useable water for agricultural needs, a value for the depth to the Base of Groundwater Protection can be determined. These values are gridded using the Kriging[11] method to prepare a depth to the Base of Groundwater Protection surface. 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. If a water well has total dissolved solids exceeding 4,000 mg/L, the groundwater use does not require licensing by AENV. In the County, the depth to the Base of Groundwater Protection ranges from less than 50 metres in the northeastern part of the County and along parts of the Battle River, to more than 490 metres in the western parts of the County, as shown on Figure 4, on some cross-sections presented in Appendix A, and on the CD-ROM.

There are 7,180 water wells with completed depth data, of which 113 are completed below the Base of Groundwater Protection. Most of these water wells are located within or adjacent to the Buried Red Deer Valley or meltwater channels and in other areas where the depth to Base of Groundwater Protection is less than 150 metres. Of the 113 water wells completed below the Base of Groundwater Protection, 13 are/were used for industrial purposes, and two water wells do not have a proposed use. Chemistry data are available for 18 of the 113 water wells, which provided groundwaters with TDS concentrations of less than 1,200 mg/L.

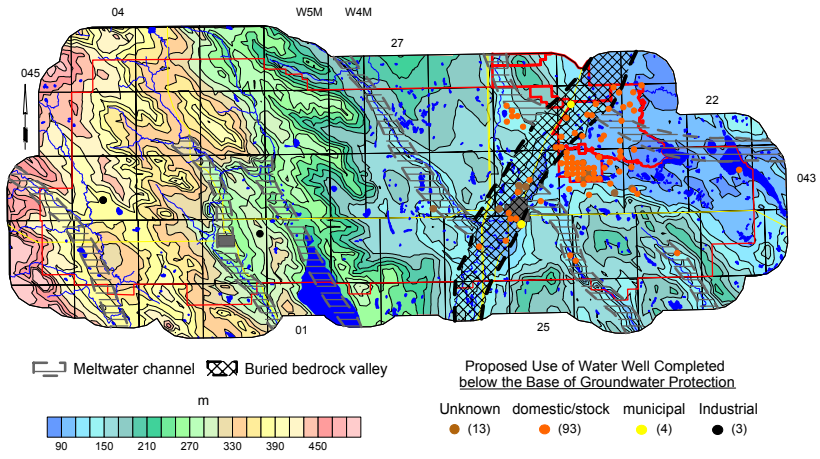

Figure 4. Depth to Base of Groundwater Protection (after EUB, 1995)

Proper management of the groundwater resource requires water-level data. These data are often collected from observation water wells. At the present time, there are three AENV-operated observation water wells (within the County (see page A-57 for observation water well locations). Additional data can be obtained from some of the authorized non-exempt groundwater diversions. In the past, the data for authorized diversions have been difficult to obtain from AENV, in part because of the failure of the applicant to provide the data.

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 (see section 6.0 of this report). 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, as has been the case in the Wildrose Country Ground Water Monitoring Association and Flagstaff County.

[11] See glossary