

The Horseshoe Canyon Formation is the lower part of the Edmonton Group and is the upper bedrock in the extreme northeastern parts of the County. In the County, the Horseshoe Canyon Formation has a maximum thickness of 380 metres and has three separate designations: Upper, Middle and Lower. In Ponoka County, the Upper Horseshoe Canyon has a maximum thickness of 100 metres; the Middle Horseshoe Canyon has a maximum thickness of 80 metres, and the Lower Horseshoe Canyon has a maximum thickness of 200 metres.

The Horseshoe Canyon Formation consists of deltaic²² and fluvial sandstone, siltstone and shale with interbedded coal seams, bentonite and thin nodular beds of limestone and ironstone. Because of the low-energy environment in which deposition occurred, the sandstones, when present, tend to be finer grained. The lower 60 to 70 metres and the upper 30 to 50 metres of the Horseshoe Canyon Formation can include coarser grained sandstone deposits.

There will be no direct review of the Middle or Lower Horseshoe Canyon formations in the text of this report; there are insufficient or no hydrogeological data within the study area to prepare meaningful maps; the only maps associated with these formations to be included on the CD-ROM will be structure-contour maps.

5.3.3 Upper Bedrock Completion Aquifer(s)

Of the 7,839 water wells in the database, 4,805 were defined as being completed below the top of bedrock, based on lithologic information and water well completion details. However, at least a reported completion depth is available for 6,537 water wells completed below the bedrock surface. Of these 6,537 water wells, four are completed below the upper bedrock in saline formations, giving a total of 6,533 water wells completed in upper bedrock aquifer(s). Assigning a water well to a specific geologic unit is possible only if the completion interval is identified. In order to make use of additional information within the groundwater database, it was assumed that the top of the completion interval was 80% of the total completed depth of a water well. With this assumption, it has been possible to designate the specific bedrock aquifer of completion for an additional 319 bedrock water wells, giving a total of 5,124 water wells. The remaining 1,409 of the total 6,533 bedrock water wells are identified as being completed in more than one bedrock aquifer, as shown in Table 5. The bedrock water wells are mainly completed in the Dalehurst and Upper Horseshoe Canyon aquifers.

<u>Geologic Unit</u>	No. of Bedrock Water Wells
Dalehurst	2,726
Upper Lacombe	278
Lower Lacombe	116
Haynes	363
Battle and Whitemud	29
Upper Scollard	503
Lower Scollard	174
Upper Horseshoe Canyon	935
Multiple Completions	1,409
Total	6,533

Table 5. Completion Aquifer for Upper Bedrock Water Wells

²² See glossary

There are 2,718 records for bedrock water wells that have apparent yield values, which is 42% of the 6,533 bedrock water wells in the County. Yields for water wells completed in the upper bedrock aquifer(s) are mainly between 10 and 100 m³/day and have a median apparent yield of more than 60 m³/day. Some of the areas with yields of more than 300 m³/day indicated on the adjacent figure are in the vicinity of linear bedrock lows. These higher yield areas may identify locations of increased permeability resulting from the weathering process. In addition to the 6,533 records for bedrock water wells, there are 11 records that indicate that the water well/water test hole is dry, or abandoned with “insufficient water”. In order to depict a more accurate yield map, an apparent yield of 0.1 m³/day was assigned to the 11 dry water test holes prior to gridding.

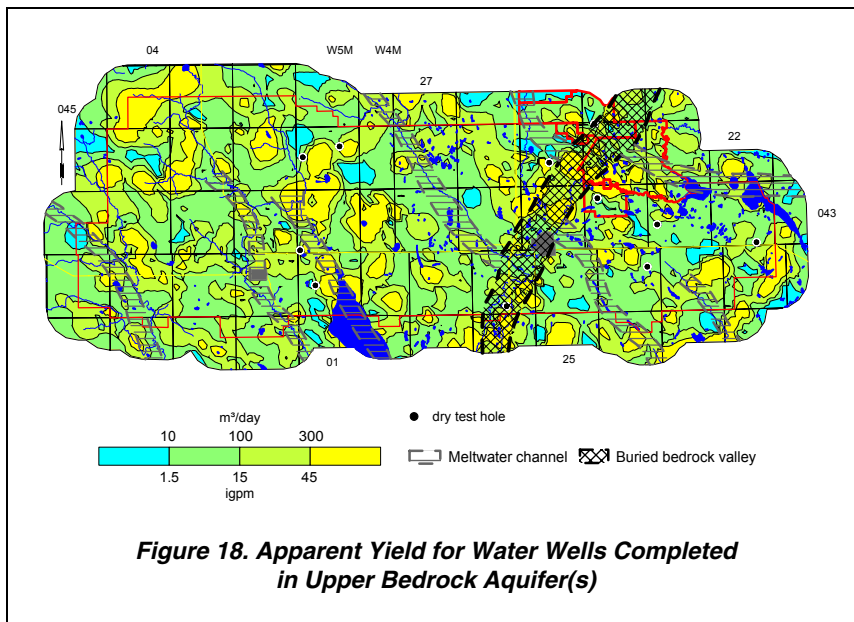


Figure 18. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

Of the 2,718 water well records with apparent yield values, 2,096 have been assigned to aquifers associated with specific geologic units. Eleven percent (296) of the 2,718 water wells completed in bedrock aquifers have apparent yields that are less than ten m³/day, 52% (1,422) have apparent yield values that range from 10 to 100 m³/day, 23% (611) have apparent yield values that range from 100 to 300 m³/day, and 14% (389) have apparent yields that are greater than 300 m³/day, as shown in Table 6. The water well records completed in the Battle and Whitemud aquifers showing apparent yield values that are greater than ten m³/day are suspect. In the Haynes Aquifer, nearly 50% of the apparent yield values are greater than 100 m³/day.

Aquifer	No. of Water Wells with Values for Apparent Yield (*)	Number of Water Wells with Apparent Yields			
		<10 m ³ /day	10 to 100 m ³ /day	100 to 300 m ³ /day	>300 m ³ /day
Dalehurst	1,026	79	555	221	171
Upper Lacombe	118	6	69	22	21
Lower Lacombe	27	3	18	5	1
Haynes	115	8	52	37	18
Battle and Whitemud	7	2	5	0	0
Upper Scollard	166	18	98	33	17
Lower Scollard	63	12	37	6	8
Upper Horseshoe Canyon	574	48	290	165	71
Multiple Completions	622	120	298	122	82
Totals	2,718	296	1,422	611	389

* - does not include dry test holes

Table 6. Apparent Yields of Bedrock Aquifers

5.3.4 Chemical Quality of Groundwater

The Piper tri-linear diagram for bedrock aquifers (page A-29) shows that all chemical types of groundwater occur in the bedrock aquifers. However, the majority of the groundwaters are sodium-bicarbonate types.

The TDS concentrations in the groundwaters from the upper bedrock aquifer(s) range from less than 500 mg/L to more than 1,500 mg/L, with most of the groundwaters with lower TDS concentrations occurring in the western half of County. The lower TDS concentrations may be a result of more active flow systems and shorter flow paths.

The relationship between TDS and sulfate concentrations shows that when TDS values in the groundwaters from the upper bedrock aquifer(s) exceed 1,100 mg/L, the sulfate concentrations exceed 400 mg/L. The sulfate concentrations in groundwaters from the upper bedrock aquifer(s) were compared to the distance of completion depth from the top of the Upper Lacombe Member. The maximum sulfate concentrations generally increase with depth, as shown below in Figure 20.

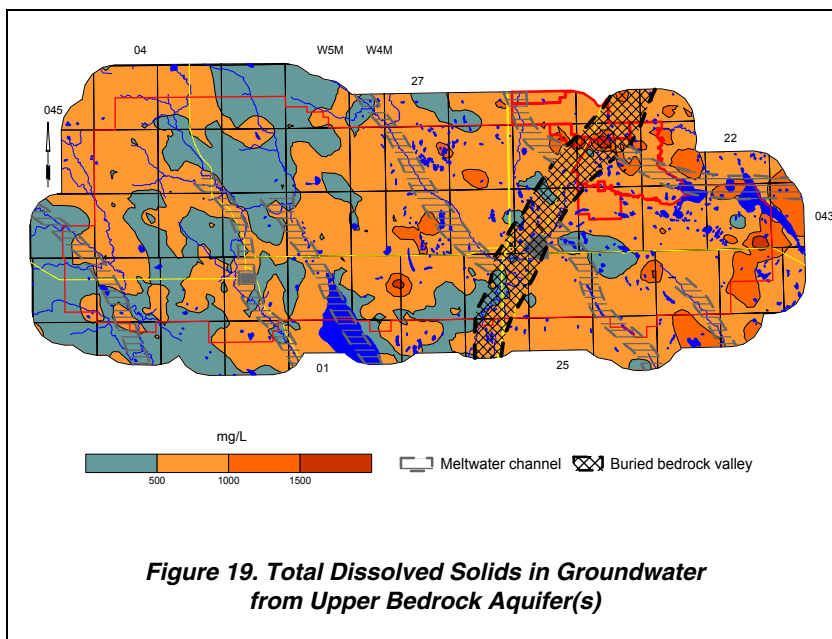


Figure 19. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

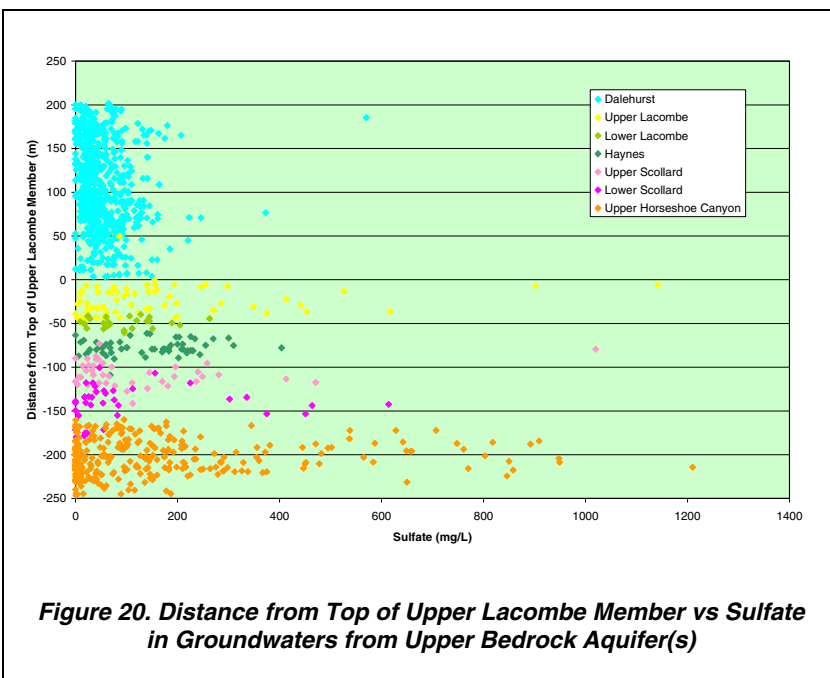


Figure 20. Distance from Top of Upper Lacombe Member vs Sulfate in Groundwaters from Upper Bedrock Aquifer(s)

In the County, nearly 95% of the chloride concentrations in the groundwaters from the upper bedrock aquifer(s) are less than 50 mg/L. Chloride concentrations of greater than 50 mg/L are mainly associated with groundwaters from the Upper Horseshoe Canyon Aquifer.

The nitrate + nitrite (as N) concentrations are less than 0.1 mg/L in 84% of the chemical analyses for upper bedrock water wells. Approximately 70% of the total hardness values in the groundwaters from the upper bedrock aquifer(s) are less than 200 mg/L.

In the County, approximately 65% of the groundwater samples from upper bedrock aquifer(s) have fluoride concentrations that are too low (less than 0.5 mg/L) to meet the

recommended daily needs of people. Approximately 15% of the groundwater samples from the entire County are between 0.5 and 1.5 mg/L and approximately 20% exceed the maximum acceptable concentration for fluoride of 1.5 mg/L. Fluoride concentrations of greater than 1.5 mg/L are mainly associated with groundwaters from the Upper Horseshoe Canyon Aquifer.

5.3.5 Dalehurst Aquifer

The Dalehurst Aquifer comprises the permeable parts of the Dalehurst Member, as defined for the present program. The Dalehurst Member subcrops under the surficial deposits in the western half of the County. The thickness of the Dalehurst Member varies from less than two metres at the eastern edge of the subcrop to 220 metres in the western part of the County. The regional groundwater flow direction in the Dalehurst Aquifer is toward the Blindman and Battle rivers (see CD-ROM).

5.3.5.1 Depth to Top

The depth to the top of the Dalehurst Member is mainly less than 30 metres and is a reflection of the thickness of the surficial deposits.

5.3.5.2 Apparent Yield

The apparent yields for individual water wells completed through the Dalehurst Aquifer are mainly in the range of 10 to 100 m³/day. The higher yielding areas appear to be random, as shown on Figure 21.

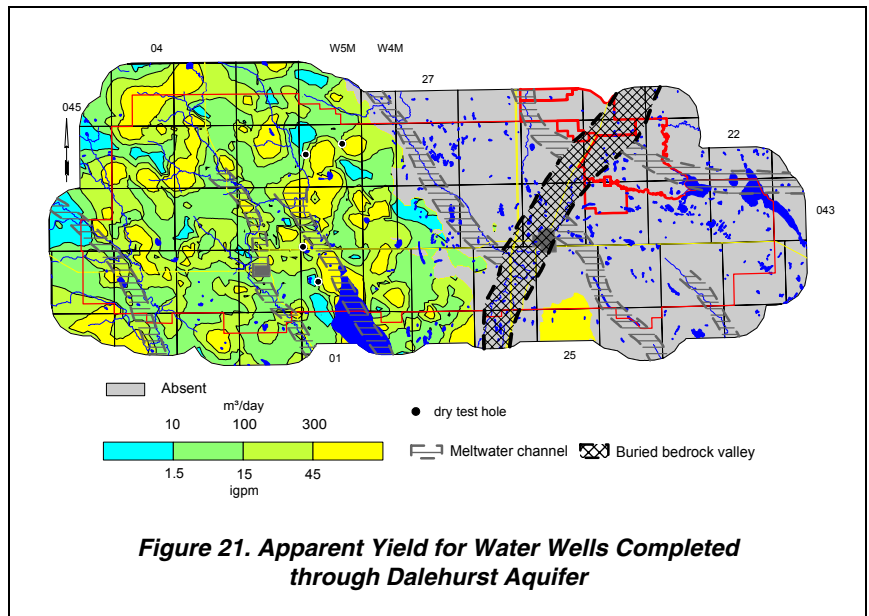
Shown on the adjacent map are the locations of the four dry water test holes.

There are 595 non-exempt groundwater users that have water wells completed through the Dalehurst Aquifer, for a total groundwater diversion of 6,660 m³/day.

The highest non-exempt groundwater use is for seven authorizations that allow Gulf Canada Resources Inc. to divert up to 2,747 m³/day for industrial purposes in sections 5 and 6, township 044, range 01, W5M. The Town of Rimbey has five authorizations to divert up to 1,027 m³/day from water supply wells for municipal purposes.

Of the 595 non-exempt authorizations, 178 could be linked to water wells in the AENV groundwater database.

An extended aquifer test conducted with a Town of Rimbey water supply well completed in the Dalehurst Aquifer in August 1972 indicated a long-term yield of 210 m³/day based on an effective transmissivity of approximately 22.5 metres squared per day (m²/day) (Winner and Tokarsky, 1977).



5.3.5.3 Quality

The groundwaters from the Dalehurst Aquifer are mainly a bicarbonate type, with no dominant cation (see Piper diagram on CD-ROM), with 40% of the groundwater samples having TDS concentrations of less than 500 mg/L (page A-36). Ninety-nine percent of the sulfate concentrations in groundwaters from the Dalehurst Aquifer are less than 200 mg/L. Nearly 90% of the chloride concentrations from the Dalehurst Aquifer are less than ten mg/L.

A chemical analysis of a groundwater sample collected in February 1988 from the PanCanadian Petroleum Limited Battery Domestic Water Well in 01-23-043-28 W4M indicates the groundwater is a sodium-bicarbonate type, with a TDS concentration of 518 mg/L, a sulfate concentration of 43 mg/L, a chloride concentration of less than 1 mg/L, and a fluoride concentration of 0.09 mg/L (HCL, November 1989).

Of the five constituents that have been compared to the SGCDWQ, the median value of **TDS** exceeds the guidelines. The median concentrations in the Dalehurst Aquifer are all below the median concentrations from water wells completed in all upper bedrock aquifer(s).

Constituent	No. of Analyses	Range for County in mg/L			All Bedrock Median	Recommended Maximum Concentration SGCDWQ
		Minimum	Maximum	Median		
Total Dissolved Solids	750	7	1,218	532	629	500
Sodium	585	0	3,059	153	239	200
Sulfate	748	0	570	41	52	500
Chloride	735	0	200	1	3	250
Fluoride	675	0	9	0.2	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 Subcommittee on Drinking Water, April 2002

Table 7. Apparent Concentrations of Constituents in Groundwaters from Dalehurst Aquifer