5.2.4 Lower Sand and Gravel Aquifer

The Lower Sand and Gravel Aquifer is a saturated sand and gravel deposit that occurs at or near the base of the surficial deposits in the deeper part of the linear bedrock lows. The top of the lower surficial deposits is based on more than 1,000 control points across Alberta.

5.2.4.1 Aquifer Thickness

The thickness of the Lower Sand and Gravel Aquifer is mainly less than two metres, but can be up to ten metres in the linear bedrock lows (see CD-ROM).

5.2.4.2 Apparent Yield

Apparent yields for water wells completed through the Lower Sand and Gravel Aquifer range from less than 10 m³/day to more than 300 m³/day. The most notable areas where yields of more than 300 m³/day are expected are mainly in areas where the thickness of the Lower Sand and Gravel Aquifer is greater than five metres.

In the County, there are no dry water test holes completed in the Lower Sand and Gravel Aquifer.

In the County, there are 34 licences and/or registrations for water wells that are completed through the Lower Sand and Gravel Aquifer, for a total authorized diversion of 159 m^3/day.

Of the 34 water wells, three have been licensed for agricultural purposes, 28 are for registrations and are expected to be used for stock watering and/or crop spraying purposes, two are for commercial purposes and one is for recreation purposes. The highest groundwater authorization of 54 m³/day is for agricultural purposes for a water well in 13-18-040-04 W5M.

One water well used for commercial purposes is the 1984 Water Supply Well in 16-11-037-05 W5M licensed to Newalta Corporation to divert 6.8 cubic metres per day.

Twelve of the 34 licensed and registered water wells completed through the Lower Sand and Gravel Aquifer could be linked to a water well in the AENV groundwater database.

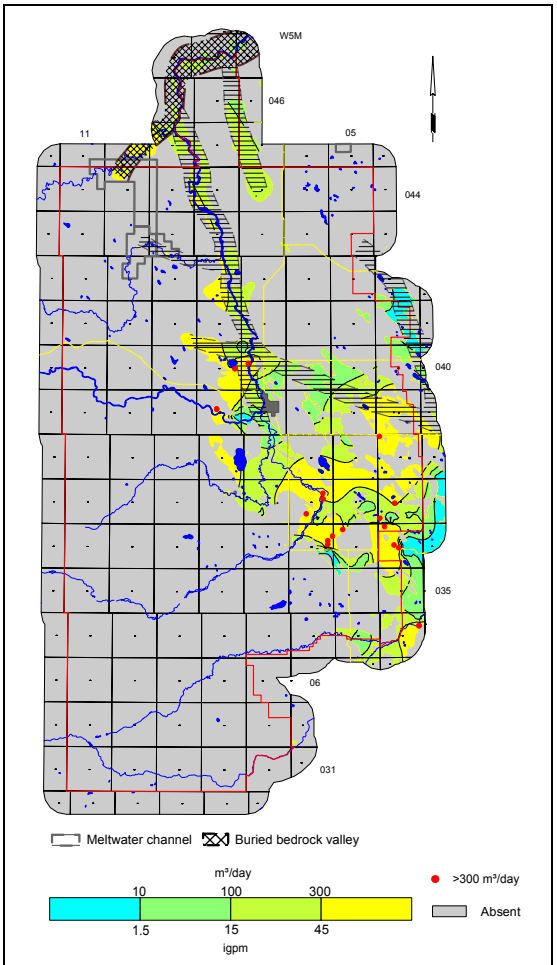

Figure 14. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer

5.3 Bedrock

5.3.1 Bedrock Aquifers

The upper bedrock includes formations that are generally less than 200 metres below the bedrock surface. In the County, the upper bedrock includes the Disturbed Belt and the Dalehurst Member of the Paskapoo Formation, as shown below on cross-section GG' (see page A-18). Some of this bedrock contains saturated rocks that are permeable enough to transmit groundwater for a specific need. Water wells completed in bedrock aquifers usually do not require water well screens, although some of the sandstones may be friable[20] and water well screens are a necessity.

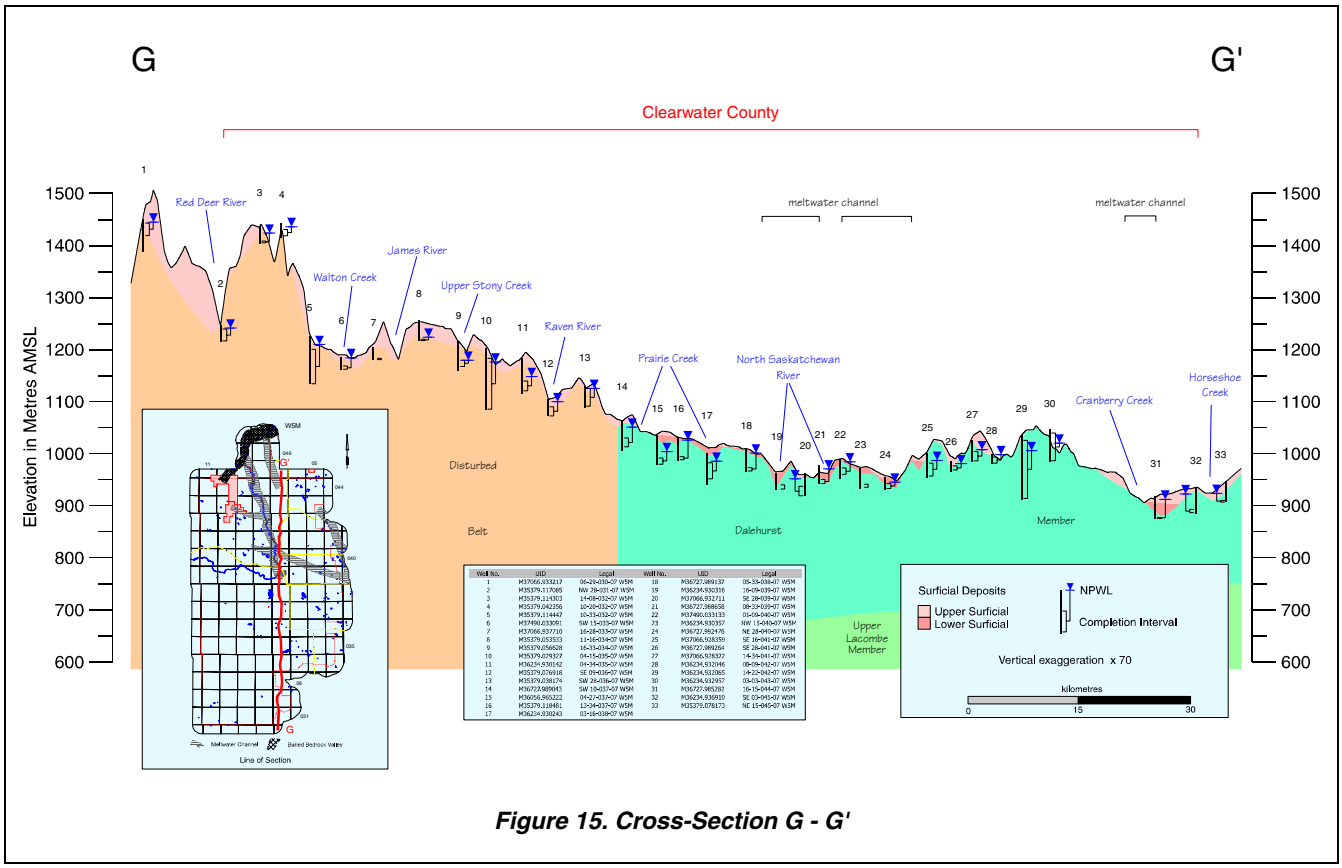

Figure 15. Cross-Section G - G'

[20] See glossary

5.3.2 Geological Characteristics

In the County, the upper bedrock comprises the Disturbed Belt, and the Dalehurst Member of the Paskapoo Formation.

The Disturbed Belt is the upper bedrock in the western half of the County. The outline of the Disturbed Belt has been defined based on the Geological Map of Alberta (Hamilton et al, 1998, and Green, 1972). The Rocky Mountains and Foothills together form the Disturbed Belt, which is an area that has been deformed by folding and thrust faulting (Tokarsky, 1971). Water wells that were located within the Disturbed Belt boundary were defined as being completed in surficial deposits or in the Disturbed Belt Aquifer. The Paskapoo Formation in central Alberta consists of the Dalehurst, Lacombe and Haynes members (Demchuk and Hills, 1991). A generalized geologic column is illustrated in Figure 6, in Appendix A, and on the CD-ROM.

The Dalehurst Member is the upper bedrock and outcrops or subcrops in the eastern half of the County. This Member has a maximum thickness of 220 metres within the County and is mostly composed of shale and siltstone with sandstone, bentonite and coal seams or zones. Two prominent coal zones within the Dalehurst are the Obed-Marsh Coal (up to 30 metres thick) and the Lower Dalehurst Coal (up to 50 metres thick). The bottom of the Lower Dalehurst Coal is the border between the Dalehurst and Lacombe members (Demchuk and Hills, 1991). In the County, the coal seams are not well developed. If the coal seams are not fractured, they are impermeable.

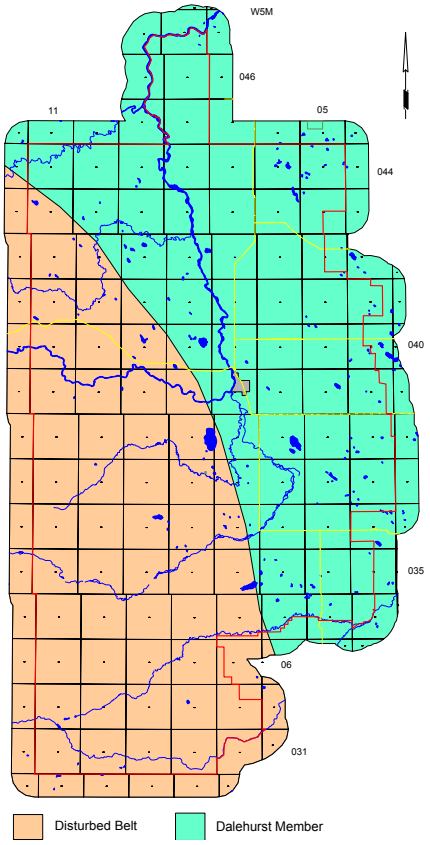

Figure 16. Bedrock Geology

There will be no direct review of the Lacombe and Haynes members of the Paskapoo Formation 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 8,283 water wells in the database, 5,257 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 6,938 water wells completed below the bedrock surface. Of these 6,938 water wells, five are completed below the upper bedrock in the Lacombe Member and three are in saline formations, giving a total of 6,930 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 831 bedrock water wells, giving a total of 6,088 water wells. The remaining 842 of the total 6,930 upper 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 Aquifer.

Geologic Unit	No. of Bedrock Water Wells
Disturbed Belt	1,195
Dalehurst	4,893
Multiple Completions	842
Total	6,930

Table 5. Completion Aquifer for Upper Bedrock Water Wells

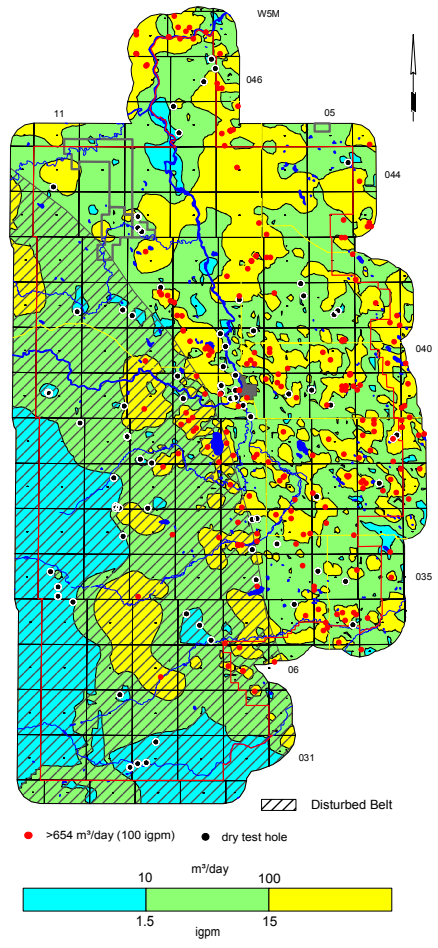

Figure 17. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

There are 2,287 records for bedrock water wells that have apparent yield values, which is 33% of the 6,930 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 45 m³/day. Apparent yield data are largely available for bedrock water wells completed below an elevation of 1,500 metres AMSL. The areas of apparent yields of less than ten m³/day in the southwestern part of the County are a result of the gridding process using limited data control. In addition to the 2,287 records for bedrock water wells with apparent yield values, there are 96 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 96 dry water test holes prior to gridding.

Aquifer	No. of Water Wells with Values for Apparent Yield (*)	Number of Water Wells with Apparent Yields <10 m³/day	10 to 100 m³/day	>100 m³/day
Disturbed Belt	488	99	268	121
Dalehurst	1,960	292	1,082	586
Upper Lacombe	1	1	0	0
Lower Lacombe	2	0	2	0
Multiple Completions	324	80	164	80
Totals	2,287	373	1,248	666

* - does not include dry test holes

Table 6. Apparent Yields of Bedrock Aquifers

Of the 2,287 water well records with apparent yield values, 1,963 have been assigned to aquifers associated with specific geologic units. Sixteen percent (373) of the 2,287 water wells completed in bedrock aquifers have apparent yields that are less than ten m³/day, 55% (1,248) have apparent yield values that range from 10 to 100 m³/day, and 29% (666) have apparent yield values that are greater than 100 m³/day, as shown in Table 6.

5.3.4 Chemical Quality of Groundwater

The Piper tri-linear diagram for bedrock aquifers (page A-30) shows that all chemical types of groundwater occur in the bedrock aquifers. However, the majority of the groundwaters are bicarbonate types, with no dominant cation.

The TDS concentrations in the groundwaters from the upper bedrock aquifer(s) range from less than 200 mg/L to more than 1,000 mg/L, with 98% of the values being less than 1,000 mg/L (page A-32). Ninety-five percent of the sulfate concentrations in upper bedrock aquifer(s) are less than 100 mg/L.

In the County, more than 95% of the chloride concentrations in the groundwaters from the upper bedrock aquifer(s) are less than 50 mg/L.

The Nitrate + Nitrite (as N) concentrations are less than 0.1 mg/L in 65% of the chemical analyses for upper bedrock groundwaters. Approximately 65% of the total hardness values in the groundwaters from the upper bedrock aquifer(s) are less than 250 mg/L.

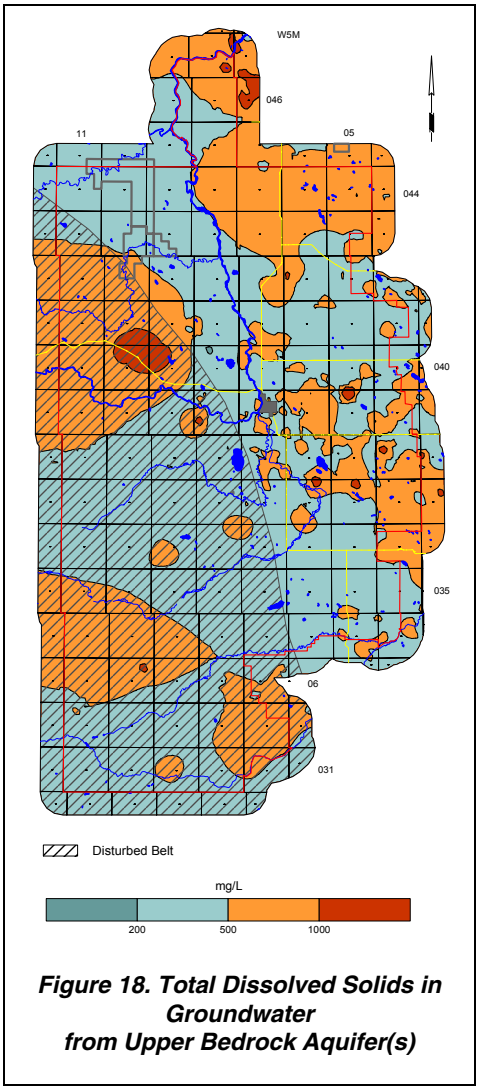

Figure 18. Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)

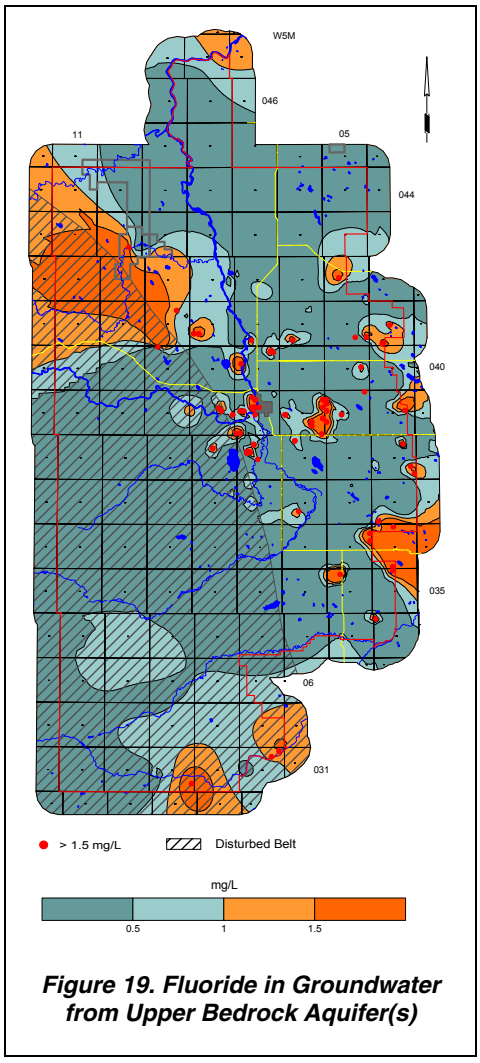

Figure 19. Fluoride in Groundwater from Upper Bedrock Aquifer(s)

In the County, approximately 81% 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 11% of the groundwater samples from the entire County are between 0.5 and 1.5 mg/L and approximately 8% exceed the maximum acceptable concentration (MAC) for fluoride of 1.5 mg/L. Fluoride concentrations of greater than 1.5 mg/L are mainly associated with groundwaters from the Dalehurst Aquifer.