3) Upper Sand and Gravel Aquifer(s)

The Upper Sand and Gravel Aquifer(s) include saturated sand and gravel deposits in the upper surficial deposits. Typically, these aquifers are present within the surficial deposits at no particular depth. Saturated sand and gravel deposits are not continuous but are expected over approximately 15% of the County.

a) Aquifer Thickness

The thickness of the Upper Sand and Gravel Aquifer(s) is a function of two parameters: (1) the elevation of the non-pumping water-level surface associated with the surficial deposits; and (2) the depth to the bedrock surface or depth to top of lower surficial deposits when present. In the County, the thickness of the Upper Sand and Gravel is generally less than five metres, but can be more than ten metres in the vicinity of the Buried Buffalo Lake Valley (see CD-ROM).

b) Apparent Yield

The permeability of the Upper Sand and Gravel Aquifer(s) can be high. The high permeability combined with significant thickness leads to an extrapolation of high yields for water wells; however, because the sand and gravel deposits occur mainly as hydraulically discontinuous pockets, the apparent yields of the water wells are limited. The apparent yields for water wells completed in this Aquifer are expected to be mainly less than 300 m³/day, except adjacent to parts of the Buried Red Deer River Valley in the southeastern part of the County as shown on Figure 15. Licensed water wells completed in the Upper Sand and Gravel Aquifer(s) are also shown on the figure. Higher yields present in the eastern part of the County could be a result of the gridding procedure used to process a very limited number of data points. Where the Upper Sand and Gravel Aquifer(s) is absent and where the yields are low, the development of water wells for the domestic needs of single families may not be possible from these Aquifer(s), and construction of a water supply well into the underlying bedrock may be the only alternative, provided yields and quality of groundwater from the bedrock aquifers are suitable.

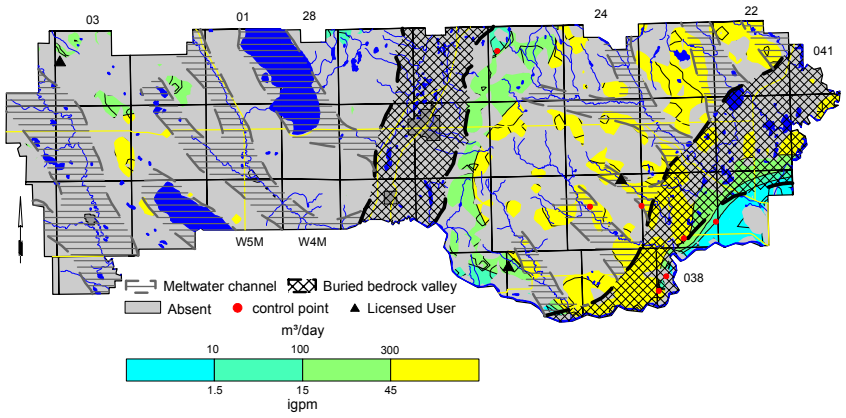

Figure 15. Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer(s)

In the County, there are three licensed water wells that are completed in the Upper Sand and Gravel Aquifer(s), with a total authorized diversion of 106 m^3/day. The highest allocation of 57 m^3/day is for a water well in 11-19-041-03 W5M used for stock purposes.

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 deepest part of the pre-glacial linear bedrock lows. The top of the lower surficial deposits is based on more than 1,000 control points across Alberta. In the County, there are two control points provided by Allong, 1967 and Sham, 1984a.

a) Aquifer Thickness

The thickness of the Lower Sand and Gravel Aquifer is mainly less than five metres. In the County, the thickness of the Lower Sand and Gravel Aquifer is generally less than five metres, but can be more than 15 metres in the Buried Red Deer River Valley (see CD-ROM).

b) Apparent Yield

Apparent yields for water wells completed in the Lower Sand and Gravel Aquifer range from less than ten m³/day to more than 300 m³/day. The highest yields are expected in the (1) extreme western meltwater channel, (2) a tributary meltwater channel to the Buried Buffalo Lake Valley in the northeastern part of the County, and (3) in the vicinity of the towns of Lacombe and Blackfalds.

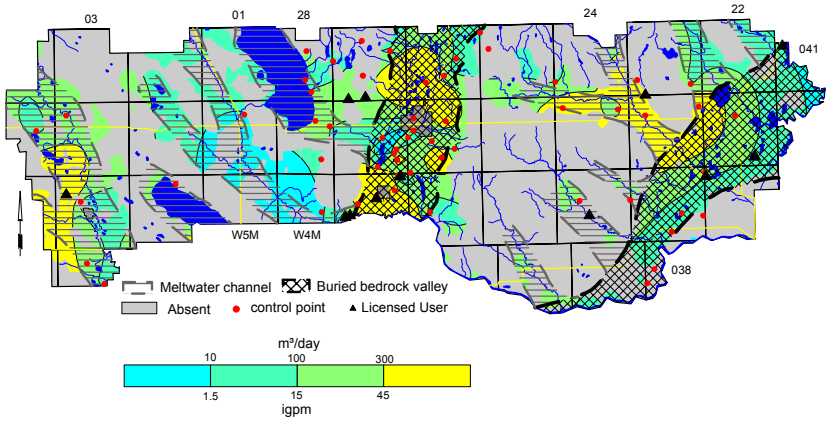

Figure 16. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer

In the County, there are 14 licensed water wells that are completed in the Lower Sand and Gravel Aquifer, for a total authorized diversion of 1,262 m^3/day. The highest allocation of 507 m^3/day is for a sand and gravel company licensed to divert groundwater for dewatering purposes in NW 17-039-27 W4M. The second highest allocation is for the Town of Blackfalds, which is licensed to divert up to 372 m^3/day for municipal purposes from a water supply well in 03-27-039-27 W4M.

There are no chemistry data available in the groundwater database for the Town of Blackfalds water supply well completed in the Lower Sand and Gravel Aquifer or the sand and gravel company dewatering water well.

C. Bedrock

1) Geological Characteristics

The upper bedrock in the County is the Paskapoo, Scollard, Whitemud, Battle, and Upper Horseshoe Canyon formations. The Paskapoo Formation in central Alberta consists of the Dalehurst, Lacombe and Haynes members (Demchuk and Hills, 1991). The Edmonton Group underlies the Paskapoo Formation. The Edmonton Group includes the Scollard, Battle, Whitemud and Horseshoe Canyon formations. A generalized geologic column is illustrated in Figure 6, Appendix A and on the CD-ROM.

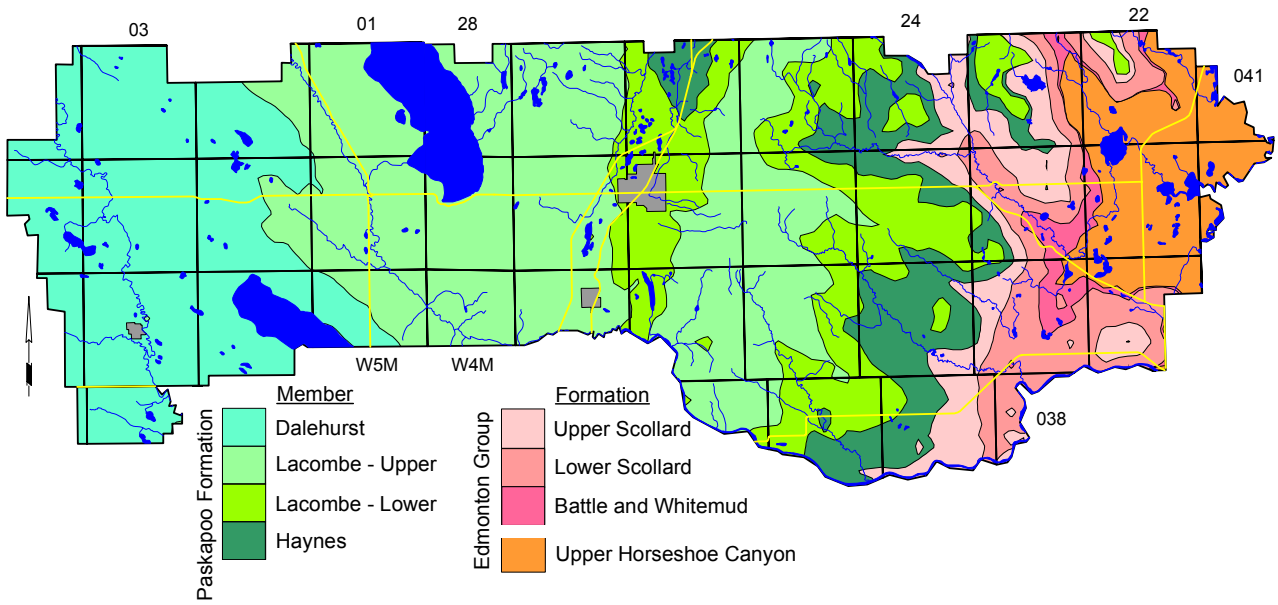

Figure 17. Bedrock Geology

The Paskapoo Formation is the upper bedrock and subcrops mainly west of range 23, W4M in the County. The Paskapoo Formation consists of cycles of thick, tablular sandstones, siltstone and mudstone layers (Glass, 1990). The maximum thickness of the Paskapoo Formation can be 800 metres, but in the County, the thickness is from 0 to 500 metres.

The Dalehurst Member is the upper bedrock and subcrops mainly west of Range 02, W5M. This Member has a maximum thickness of 300 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.

The Lacombe Member underlies the Dalehurst Member and subcrops mainly between range 01, W5M and range 24, W4M, within the County border. The Lacombe Member has a maximum thickness of 350 metres. The upper part of the Lacombe Member is mostly composed of shale interbedded with sandstone and has a maximum thickness of 250 metres. The lower part of the Lacombe Member is composed of sandstone and coal layers. In the middle of the lower part of the Lacombe Member there is a coal zone, which can be up to five metres thick. The lower part of the Lacombe Member has a maximum thickness of 100 metres. If the coal seams are not fractured, they are impermeable.

The Haynes Member underlies the Lacombe Member and subcrops mainly in range 24, W4M, within the County border. The Haynes Member has a maximum thickness of 100 metres and is composed mainly of sandstone with some siltstone, shale and coal. In the County, the Haynes Member has an average thickness of 40 metres.

The Scollard Formation underlies the Haynes Member and subcrops mainly in range 23, W4M. The Scollard Formation has a maximum thickness of 160 metres and has two separate designations: Upper and Lower. The Upper Scollard has an average thickness of 75 metres in the County and consists mainly of sandstone, siltstone, shale and coal seams or zones. Two prominent coal zones within the Upper Scollard are the Ardley Coal (up to 20 metres thick) and the Nevis Coal (up to 3.5 metres thick). The bottom of the Nevis Coal Seam is the border between the Upper and Lower Scollard formations. The Lower Scollard Formation has an average thickness of 50 metres in the County, and is composed mainly of shale and sandstone.

Beneath the Scollard Formation are two formations having a maximum thickness of 30 metres; the two are the Battle and Whitemud formations. The Battle Formation is composed mainly of claystone, tuff, shale and bentonite, and includes the Kneehills Member, a 2.5- to 30-cm thick tuff bed. The Whitemud Formation is composed mainly of shale, siltstone, sandstone and bentonite. The Battle and Whitemud formations are significant geologic markers, and were used in the preparation of various geological surfaces within the bedrock. Because of the ubiquitous nature of the bentonite in the Battle and Whitemud formations, there is very little significant permeability within these two formations.

The Horseshoe Canyon Formation is the lower part of the Edmonton Group and subcrops in Ranges 21 and 22, W4M. The Horseshoe Canyon Formation has a maximum thickness of 350 metres and has three separate designations: Upper, Middle and Lower. The Upper Horseshoe Canyon, which can be up to 100 metres thick, is the uppermost bedrock in the eastern part of the County. The Middle Horseshoe Canyon, which is up to 70 metres thick, does not subcrop in the County.

The Horseshoe Canyon Formation consists of deltaic[14] 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; the only maps associated with the Middle Horseshoe Canyon Formation to be included on the CD-ROM will be structure-contour maps.

In the County, the Base of Groundwater Protection is below the Haynes Member where present. A map showing the depth to the Base of Groundwater Protection is given on page 7 of this report, in Appendix A, and on the CD-ROM.

[14] See glossary

2) Aquifers

Of the 7,388 water wells in the database, 4,234 were defined as being completed below the top of bedrock and 325 completed in surficial aquifers. However, at least a reported completion depth is available for the majority of the remaining 2,829 water wells. Assigning the water well to specific geologic units 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 if the total drilled depth of a water well was more than ten metres below the top of a particular geologic unit, the water well was assigned to the particular geologic unit. With this assumption, it has been possible to designate the aquifer of completion for 837 additional water wells for a total of 5,071 water wells. There are 702 water wells that have been identified as being completed in more than one bedrock aquifer.

Geologic Unit	No. of Bedrock Water Wells
Dalehurst	931
Upper Lacombe	2,255
Lower Lacombe	514
Haynes	485
Upper Scollard	282
Lower Scollard	215
Upper Horseshoe Canyon	370
Other	19
Multiple Completions	702
Total	5,773

Table 4. Completion Aquifer

The bedrock water wells are mainly completed in the Dalehurst and Lacombe aquifers, as shown in the above table.

There are 2,795 records for bedrock water wells that have apparent yield values, which is 48% of all bedrock water wells. In the County, yields for water wells completed in the upper bedrock aquifer(s) are mainly between ten and 100 m³/day. Some of the areas with yields of more than 100 m³/day indicated on the adjacent figure are in the vicinity of linear bedrock lows. These higher yield areas may identify areas of increased permeability resulting from the weathering process. In addition to the 2,795 water wells, there are records for 100 dry or abandoned water wells with “insufficient water”. In order to depict a more accurate yield map, an apparent yield of 0.1 m³/day was assigned to the 100 dry holes prior to gridding. Also included in these postings is any record that includes comments that state the water well goes dry in dry years.

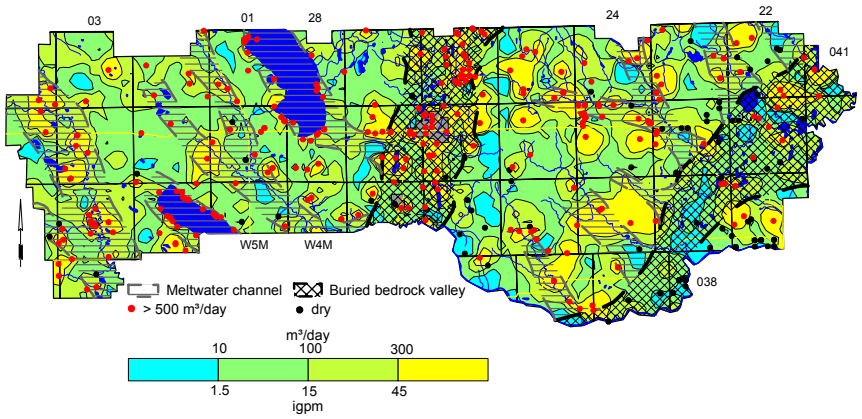

Figure 18. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)

Of the 2,795 water well records with apparent yield values, 2,504 have been assigned to aquifers associated with specific geologic units. Fifty percent (1,390) of the water wells completed in the bedrock aquifers have apparent yields that range from ten to 100 m³/day, 20% (549) have apparent yield values that range from 100 to 300 m³/day, and 18% (505) have apparent yields that are greater than 300 m³/day, as shown in the adjacent table. In the Haynes and Upper Scollard aquifers, there are more yield values that are greater than 100 m³/day than are less than 100 m³/day.

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 to 300 m³/day	>300 m³/day
Dalehurst	364	31	178	89	66
Upper Lacombe	1182	165	618	235	164
Lower Lacombe	279	43	140	55	41
Haynes	241	7	107	52	75
Upper Scollard	141	4	58	24	55
Lower Scollard	103	16	57	15	15
Upper Horseshoe Canyon	194	27	96	37	34
Other	1	0	1	0	0
Multiple Completions	290	58	135	42	55
Totals	2,795	351	1390	549	505

Table 5. Apparent Yields of Bedrock Aquifers