6.5.2 Hussar Area

The Village of Hussar is in an area of low apparent groundwater yields. Is there an alternative groundwater supply?

The Village of Hussar is licensed to divert a total of 131.8 m³/day from four water supply wells, as shown below in Table 22.

WSW No.	Licensed Diversion (m³/day)	Legal	Completed Date	Completion Aquifer
#N/A	13.5	02-13-024-20 W4M	Aug-74	Middle Horseshoe Canyon
91-1	16.9	13-14-024-20 W4M	Apr-91	Middle Horseshoe Canyon
Old Brown No. 1	50.7	16-22-024-20 W4M	Dec-78	Upper Horseshoe Canyon
New Brown No. 2 (91-2)	50.7	16-22-024-20 W4M	Apr-91	Upper Horseshoe Canyon

Table 22. Village of Hussar Licensed WSW

Groundwater monitoring data from 1992 to 2000 were provided to HCL by the Village of Hussar. The data show that combined production data from Old Brown WSW No. 1 (WSW No. 1) and Old Brown WSW No. 2 (WSW No. 2) are recorded monthly; the annual groundwater production from 1992 to 2000 is given in the adjacent table. Water levels were recorded in WSW No. 1 seven times in 1994 and four times in 1995; in 2000, water levels were measured three times in WSW Nos. 1 and 2.

Year	Total Groundwater Production (m³/day) WSW No.1 and WSW No. 2
1992	19,893
1993	21,207
1994	21,892
1995	23,416
1996	21,715
1997	22,596
1998	25,786
1999	21,122
2000	23,155
Total	200,782

Table 23. Groundwater Production

The aquifer model, *IAAM,* was used to calculate water levels at a location corresponding to WSW No. 1. The model is based on the combined monthly recorded groundwater production from WSW Nos. 1 and 2. The model aquifer has an effective transmissivity of 30 m²/day, a corresponding storativity of 0.001, is homogeneous and isotropic, and behaves as an aquifer of infinite areal extent; the model does not account for recharge to the aquifer.

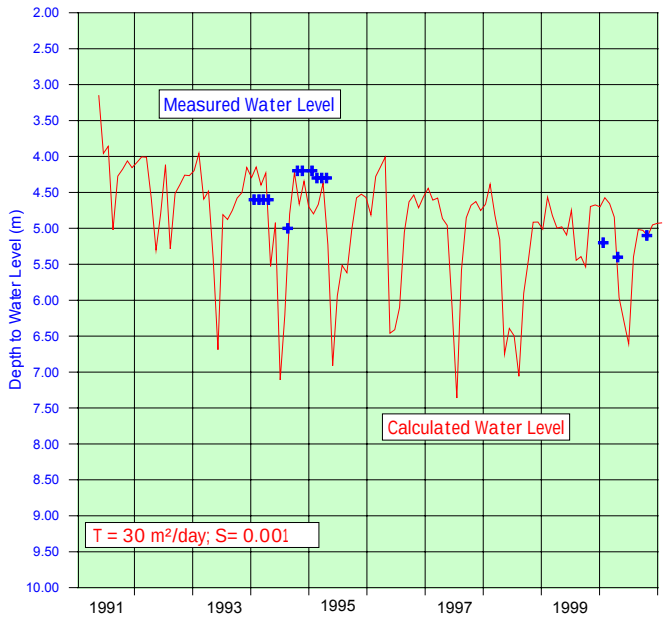

Figure 45. Water-Level Comparison – WSW No. 1

The adjacent figure shows there is a reasonable degree of comparison between the calculated and measured water levels in WSW No. 1.

In 2000, the average pumping from WSW Nos. 1 and 2 was 65 m³/day. The Hussar population of 157 has remained unchanged since at least 1997 (Phinney 1998, 2001-2002). Based on a continued average pumping rate of 65 m³/day for the next 20 years, an apparent transmissivity of 30 m²/day and a corresponding storativity of 0.001, the water level will decline to 5.6 metres below ground surface. If the combined pumping from WSW Nos. 1 and 2 is increased to the maximum licensed amount of 101.4 m³/day, the water level will decline to 7.78 metres below ground surface, or 76% of the available drawdown.

Water Supply Well Nos. 1 and 2 are the only two water wells in the Hussar Area that are completed in the Upper Horseshoe Canyon Aquifer. The Upper Horseshoe Canyon is of limited extent in the Hussar Area. WSW No. 1 is completed in shale and sandstone from 11.8 to 18.2 metres below ground surface and has an apparent yield of 105 m^3/day. WSW No. 2 is completed in sandstone from 14.0 to 16.8 metres below ground surface and has an apparent yield of 340 m^3/day. The closest water well outside the Hussar Area and completed in the Upper Horseshoe Canyon Aquifer is approximately four kilometres north in 04-04-025-20 W4M, and has an apparent yield of 320 m^3/day.

The Middle Horseshoe Canyon Aquifer is present throughout the Hussar Area. The depth to the top of the Middle Horseshoe Canyon Formation is 18 metres below ground surface. In the Hussar Area, the expected apparent yield of water wells completed in the Middle Horseshoe Canyon Aquifer is in the order of 170 m^3/day.

The depth to the top of the Lower Horseshoe Canyon Formation in 16-22-024-20 W4M is 75 metres below ground surface. In the Hussar Area, the expected apparent yield of water wells completed in the Lower Horseshoe Canyon Aquifer is in the order of 26 m^3/day.

Based on the available data, apparent yields are expected to be the highest in the Upper Horseshoe Canyon Aquifer, which is the Aquifer in which the Hussar WSW Nos. 1 and 2 are completed. It is further recommended that monitoring of groundwater water levels be intensified to provide better data for assessing the long-term sustainability of the aquifers in the Hussar Area. Also, a more detailed assessment of groundwater availability in the general areas should be undertaken, using the present regional assessment as a starting point.

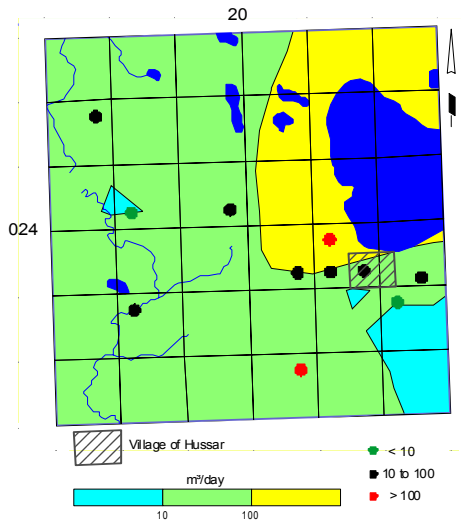

Figure 46. Apparent Yield for Water Wells Completed through Middle Horseshoe Canyon Aquifer – Hussar Area

6.5.3 Rosebud and Redland Areas

The Rosebud and Redland areas are adjacent to each other (see Figure 39) and in this report the two areas have been grouped together for purposes of discussion. The Rosebud Area is township 027, range 21, W4M and the Redland Area is township 027, range 22, W4M.

What is the approximate extent and potential (yield and water quality) of the aquifers in the Redland area?

The upper bedrock in the Redland and Rosebud areas is the upper and middle parts of the Horseshoe Canyon Formation.

In the Rosebud area, the Upper Horseshoe Canyon Aquifer is mainly absent (Figure 47). The expected yield for water wells completed in the Upper Horseshoe Canyon Aquifer in the Rosebud area is less than ten m³/day. Higher apparent yields are expected for water wells completed in the Upper Horseshoe Canyon Aquifer in the Redland area. However, the majority of the control points are in township 027, range 22, W4M in the Redland area (Figures 47 and 48).

The depth to the top of the Upper Horseshoe Canyon Formation in 16-14-027-20 W4M is 81 metres below ground surface. The expected apparent yield of water wells completed in the Upper Horseshoe Canyon Aquifer at this location is less than 20 m³/day.

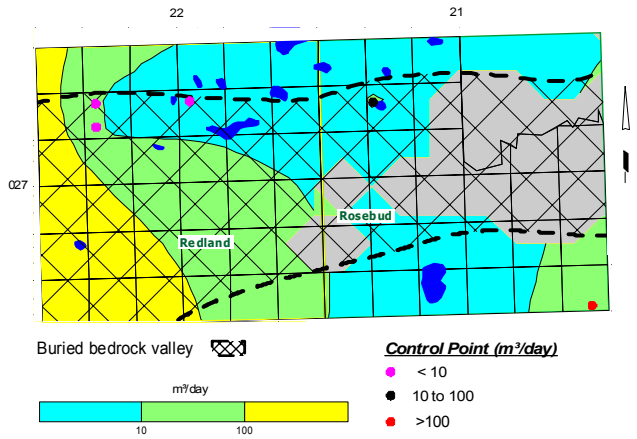

Figure 47. Apparent Yield for Water Wells Completed through Upper Horseshoe Canyon Aquifer - Redland and Rosebud Areas

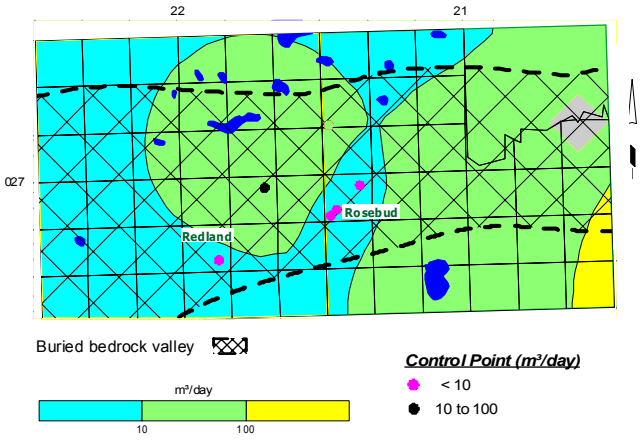

Figure 48. Apparent Yield for Water Wells Completed through Middle Horseshoe Canyon Aquifer – Redland and Rosebud Areas

Groundwaters from water wells completed in the Redland and Rosebud areas in the Upper Horseshoe Canyon Aquifer are expected to have TDS concentrations of 1,130 mg/L.

In the Redland and Rosebud areas, the values for apparent yield for water wells completed in the Middle Horseshoe Canyon Aquifer are less than ten m³/day (Figure 48) except for two Rosebud water supply wells in NE 14-027-22 W4M, which have apparent values of 22.3 and 40.6 m³/day, respectively.

The depth to the top of the Middle Horseshoe Canyon Formation in 16-14-027-20 W4M is 96 metres below ground surface. The expected apparent yield of water wells completed in the Middle Horseshoe Canyon Aquifer at this location is less than 30 m³/day.

Groundwaters from water wells completed in the Redland and Rosebud areas in the Middle Horseshoe Canyon Aquifer are expected to have TDS concentrations of 1,240 mg/L.

The County of Wheatland is licensed to divert a total of 6.8 m³/day for municipal purposes from two water supply wells located within the Rosebud Area in 03-18-027-21 W4M. There is no water well completion information in the AENV licensing database to determine the aquifer in which these two water supply wells are completed.

The County of Wheatland is licensed to divert groundwater from two water wells located within the Redland Area, but are used to supply groundwater to the Hamlet of Rosebud. Water Supply Well No. 1 in 16-14-027-22 W4M is licensed to divert 43.9 m³/day. A second water well (WSW No. 2) in 15-14-027-22 W4M is licensed by the County to be used as a standby water supply well for the Hamlet of Rosebud. Both water supply wells in NE 14-027-22 W4M are completed in the Middle Horseshoe Canyon Aquifer. There are no other licensed water wells completed in the Middle Horseshoe Canyon Aquifer in the Rosebud and Redland areas.

The available monitoring data provided to HCL by Wheatland County for the two Hamlet of Rosebud water supply wells in NE 14-027-22 W4M included two drillers' logs, an aquifer test conducted with WSW No. 1 in August 1995, chemical analyses, and monthly groundwater production for the 2000 monitoring year. In 2000, an average of 27.7 m³/day was diverted. No water-level data were provided by the County.

Water Supply Well No. 1, drilled in October 1987, is completed from 89.9 to 97.5 metres below ground surface in the Middle Horseshoe Canyon Aquifer and had a non-pumping water level of 51.8 metres below ground surface. WSW No. 2, drilled in October 1987, is completed from 91.4 to 97.5 metres below ground surface in the Middle Horseshoe Canyon Aquifer and had a non-pumping water level of 54.0 metres below ground surface.

An aquifer test with WSW No. 1 was conducted on August 21, 1995. The test consisted of 60 minutes of pumping at an average of 56.8 litres per minute and 60 minutes of recovery. The pre-test water level was 59.8 metres below ground surface. The water level drew down 24.6 metres during the pumping interval, with 7.7 metres occurring during the first two minutes of pumping. An effective transmissivity of 3.8 m²/day was obtained from the Jacob analysis of the water-level decline after ten minutes of pumping. After ten minutes of recovery, the water level recovered to within 4.1 metres of its pre-test water level. The effective transmissivity value calculated from the recovery data is 10.7 m²/day. The aquifer parameters obtained from the aquifer test with WSW No. 1 indicate that WSW No. 1 has a projected long-term yield of 39 m³/day, close to the licensed amount of 43.9 m³/day.

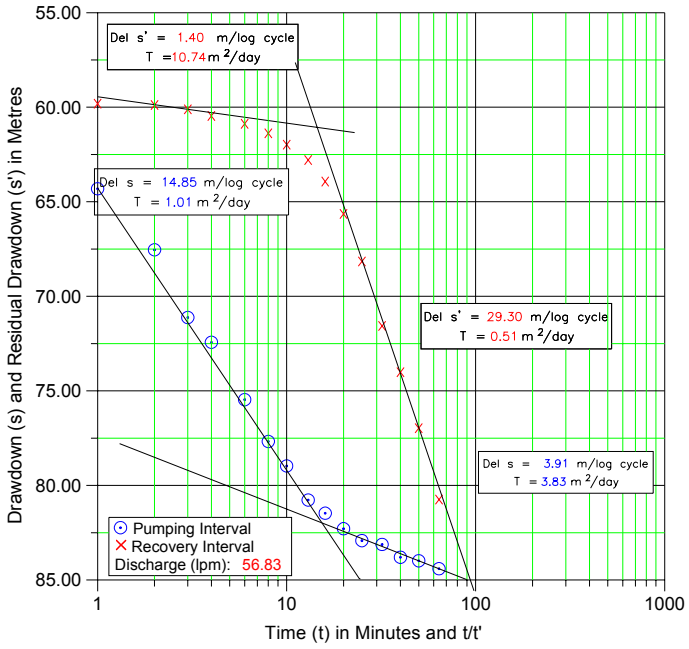

Figure 49. Aquifer Test with WSW No. 1

A groundwater sample collected in December 1998 from WSW Nos. 1 and 2 in NE 14-027-22 W4M has a TDS concentration of 1,018 mg/L, a sulfate concentration of 105 mg/L, a chloride concentration of 31.3 mg/L, and a fluoride concentration of 0.84 mg/L.

The water level recorded prior to the aquifer test with WSW No. 1 in 1995 is eight metres lower than the non-pumping water level measured in WSW No. 1 in 1987. Additional groundwater monitoring data would need to be made available in order to provide a reasonable interpretation regarding the apparent water-level decline at the sites of WSW Nos. 1 and 2.

What comments can be made regarding the apparent water-level decline in the aquifer supplying the Rosebud community.

Water-level monitoring data from the two Hamlet of Rosebud water supply wells would need to be provided in order to determine if there has been a water-level decline.

It might be beneficial to the Hamlet of Rosebud to field-verify the water wells within the Area. The level of verification should include obtaining meaningful horizontal coordinates for the water wells and verifying the water level and completed depth.

7. Recommendations

The present study has been based on information available from the groundwater database. The database has three problems:

1) the quality of the data
2) the coordinate system used for the horizontal control
3) the distribution of the data.

The quality of the data in the groundwater database is affected by two factors: a) the technical training of the persons collecting the data, and b) the quality control of the data. The possible options to upgrade the database include the creation of a “super” database, which includes only verified data. The first step would be to field-verify the 122 existing water wells listed in Appendix E. These water well records indicate that a complete water well drilling report is available along with at least a partial chemical analysis. The level of verification would have to include identifying the water well in the field, obtaining meaningful horizontal coordinates for the water well and the verification of certain parameters such as water level and completed depth. There are 13 water wells for which the County has responsibility, of which eleven satisfy the above criteria; the 13 County-operated water wells are included in Appendix E. It is recommended that these 13 County-operated water wells plus the 122 water wells be field-verified, water levels be measured, a water sample be collected for analysis, and a short aquifer test be conducted. An attempt to update the quality of the entire database is not recommended.

Before an attempt is made to provide a major upgrade to the level of interpretation provided in this report, the accompanying maps and the groundwater query, it is recommended that the 122 water wells listed in Appendix E for which water well drilling reports are available, plus the 13 County–operated water wells, be subjected to the following actions (see pages C-2 to C-3):

1) The horizontal location of the water well should be determined within ten metres. The coordinates must be in 10TM NAD 27 or some other system that will allow conversion to 10TM NAD 27 coordinates.
2) A four-hour aquifer test (two hours of pumping and two hours of recovery) should be performed with the water well to obtain a realistic estimate for the transmissivity of the aquifer in which the water well is completed.
3) Water samples should be collected for chemical analysis after five and 115 minutes of pumping, and analyzed for major and minor ions.

This additional information would provide a baseline to be used for comparison to either existing chemical analyses or aquifer tests, or to determine if future monitoring would be necessary if significant changes in the aquifer parameters had occurred.

A list of the 133 water wells that could be considered for the above program is given in Appendix E and on the CD-ROM.

An attempt to link the AENV groundwater and licensing databases was 67% successful in this study (see CD-ROM); thirty-three percent of licensed water wells do not appear to have corresponding records in the AENV groundwater database. There is a need to improve the quality of the AENV licensing database. It is recommended that attempts be made in a future study to find and add missing drilling records to the AENV groundwater database and to determine the aquifer in which the licensed water wells are completed.