6.5 Discussion of Specific Study Areas

As per the Request for Proposal, Cardston County requested that comments be made, where possible, on the following four study areas and issues. The issue is stated at the beginning of each of the following sections. Figure 39 shows the four specific study areas in the County; in Figure 40, the four specific study areas have been color outlined on the bedrock geology map; Figure 41 shows the apparent yield for water wells completed in the Sand and Gravel Aquifer(s); and Figure 42 shows the apparent yield for water wells completed in the Upper Bedrock Aquifer(s).

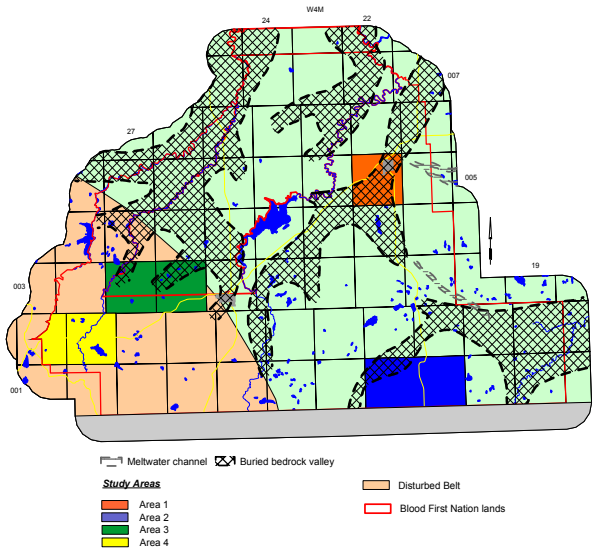

Figure 39. Specific Study Areas

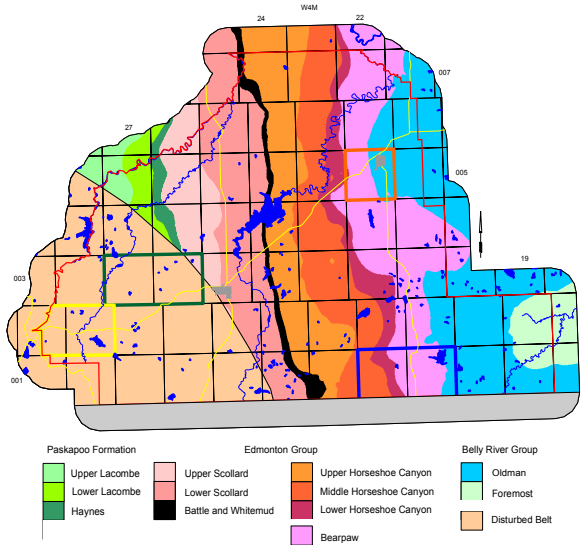

Figure 40. Bedrock Geology of Specific Study Areas

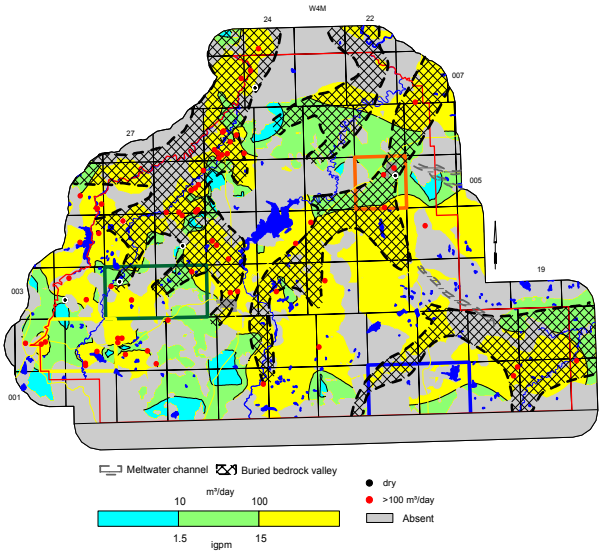

Figure 41. Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) - Specific Study Areas

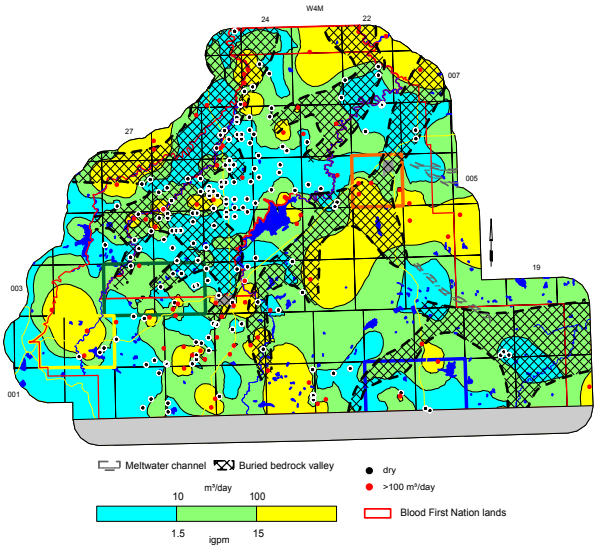

Figure 42. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Specific Study Areas

6.5.1 Area 1 - Township 005, Range 22, W4M

What is the approximate extent and potential (yield and water quality) of the aquifers in this area? What are the trends in water levels over time in the underlying aquifers?

The Lower Sand and Gravel Aquifer is expected to be present in most of Area 1. The lower sand and gravel deposits are expected to be mainly less than five metres thick. In Area 1, the apparent yields in the Lower Sand and Gravel Aquifer(s) are mainly less than 100 m³/day, as shown on the adjacent map.

There are indications that there has been a decline of more than five metres in the NPWL in Area 1 (see page A-76). However, the apparent decline is probably related to lack of spatial control rather than actual decline. In Area 1, there are five (two are at the same location) licensed water wells completed in the Lower Sand and Gravel Aquifer, of which the largest single potable groundwater allocation is for a water well licensed in 05-22-005-22 W4M that is authorized to divert 20.3 m³/day for agricultural purposes. It is unlikely that the decline in water level can be attributed to these licensed water wells.

Groundwaters from water wells completed in Area 1 in the surficial deposits are expected to have TDS concentrations of between 1,000 and 2,000 mg/L. There are 37 values for iron concentrations for water wells completed through the Lower Sand and Gravel Aquifer. Fourteen of the 37 values are greater than the SGCDWQ of 0.3 mg/L (see page A-77).

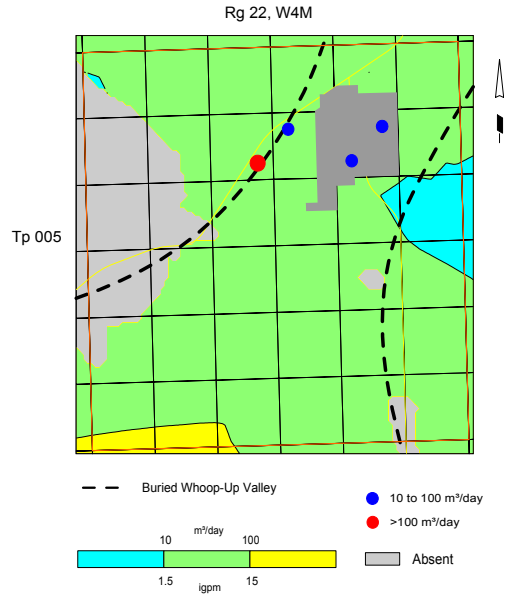

Figure 43. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer – Area 1

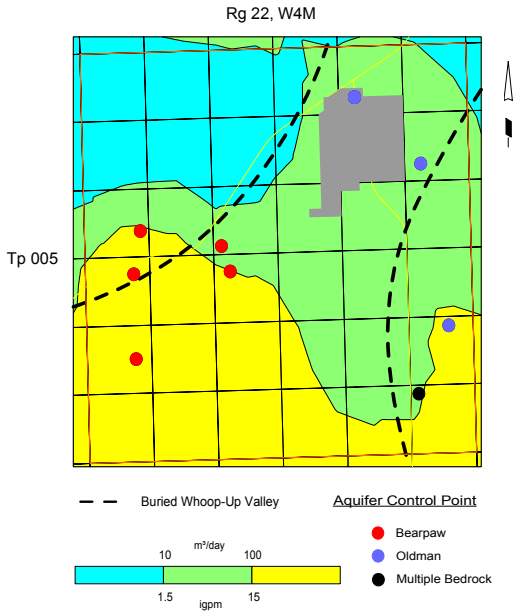

Figure 44. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) – Area 1

The upper bedrock in Area 1 is comprised of the Bearpaw and Oldman formations (see page A-72). The higher apparent yields of greater than 100 m³/day tend to be in water wells completed in the Bearpaw Aquifer, southwest of the Town of Magrath.

There are indications that there has been a decline in the NPWL within the Buried Whoop-Up Valley (see page A-79). Most of the areas that indicate there has been a rise in the water level reflect the nature of gridding a limited number of control points. In Area 1, there are two authorized non-exempt water wells completed in the upper bedrock aquifer(s), for a total of 1.2 m³/day. Both water wells are registrations. It is unlikely that the decline in water levels can be attributed to these authorized non-exempt water wells.

Groundwaters from water wells completed in Area 1 in the upper bedrock aquifer(s) are expected to have TDS concentrations of more than 1,000 mg/L. There are 23 values for iron concentrations for water wells completed through the upper bedrock aquifer(s). Fifteen of the 23 values are greater than the SGCDWQ of 0.3 mg/L (see page A-77).

6.5.2 Area 2 – Township 001, Ranges 21 to 22, W4M

What is the approximate extent and potential (yield and water quality) of the aquifers in this area? What are the trends in water levels over time in the underlying aquifers?

The Lower Sand and Gravel Aquifer is present over 30% of Area 2. The lower sand and gravel deposits are expected to be mainly less than five metres thick. In Area 2, the apparent yields for water wells completed through the Lower Sand and Gravel Aquifer are expected to be greater than ten m³/day.

There are indications that there has been a rise in the NPWL in the northern part of Area 2, and a decline in the NPWL in township 001, range 21, W4M where the Aquifer is present (see page A-82). In Area 2, there are two authorized non-exempt water wells completed through the Lower Sand and Gravel Aquifer, for a total of 3.4 m³/day. Both authorized non-exempt water wells are registrations. It is unlikely that the decline in water levels can be attributed to these two water wells.

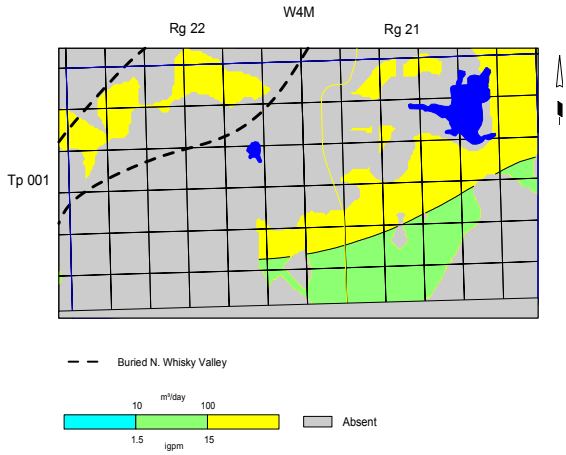

Figure 45. Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer – Area 2

Groundwaters from water wells completed in Area 2 in the surficial deposits are expected to have TDS concentrations that are less than 1,000 mg/L.

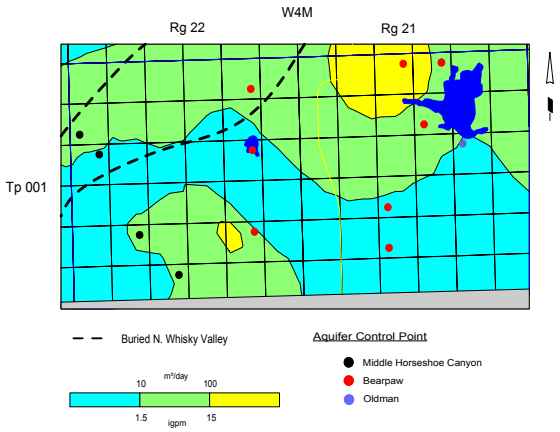

Figure 46. Apparent Yield for Water Wells in Upper Bedrock Aquifer(s) – Area 2

The upper bedrock in Area 2 is comprised of the Middle Horseshoe Canyon, Lower Horseshoe Canyon, Bearpaw and Oldman formations (see page A-72). In Area 2, there are no apparent yield values for water wells completed in the Lower Horseshoe Canyon Aquifer. The Bearpaw Aquifer is the main Aquifer present in Area 2. In Area 2, there are eight water wells completed in the Bearpaw Aquifer with apparent yield data. The apparent yields for water wells completed in the Bearpaw Aquifer are expected to be mainly less than 100 m³/day.

There are indications that there has been a NPWL decline over most of Area 2 (see page A-82). In Area 2, there are twenty bedrock water wells that are registered to divert up to 46.5 m³/day. It might be beneficial to the County to field-verify the water wells in Area 2. The level of verification should include obtaining meaningful horizontal coordinates for the water wells and verifying the water level and completed depth of the water wells.

Groundwaters from water wells completed in Area 2 in the upper bedrock aquifer(s) are expected to have TDS concentrations that are mainly less than 1,000 mg/L.

6.5.3 Area 3 – Township 003, Ranges 26 to 27, W4M

What is the approximate extent and potential (yield and water quality) of the aquifers in this area? What are the trends in water levels over time in the underlying aquifers?

The Sand and Gravel Aquifer(s) are present in approximately 75% of Area 3. The sand and gravel deposits are expected to be more than five metres thick in the Buried Northcliffe Valley within range 26, W4M. The apparent yields for water wells completed in the Sand and Gravel Aquifer(s) are greater than ten m³/day, as shown on the adjacent map.

In most of the buried bedrock valleys, there are indications that there has been a rise in the NPWL (see page A-88). In Area 3, there are two licences for water wells that are completed through the Upper Sand and Gravel Aquifer, for a total authorized diversion 0.6 m³day.

Groundwaters from water wells completed in Area 3 in the surficial deposits are expected to have TDS concentrations that range mainly between 500 and 2,000 mg/L.

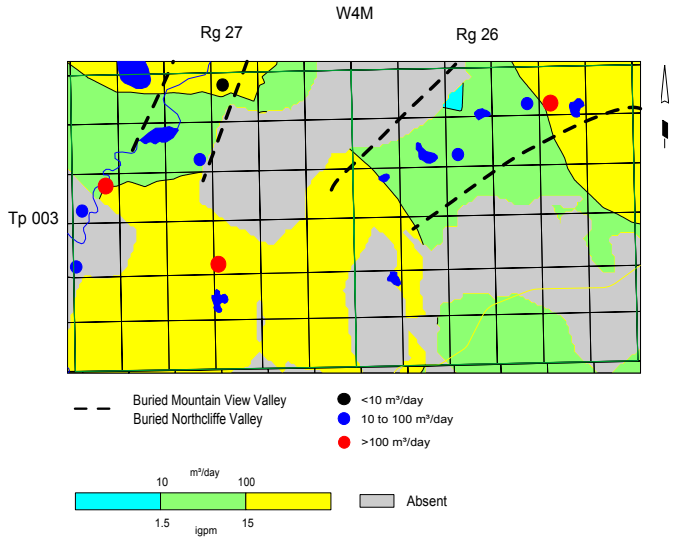

Figure 47. Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) – Area 3

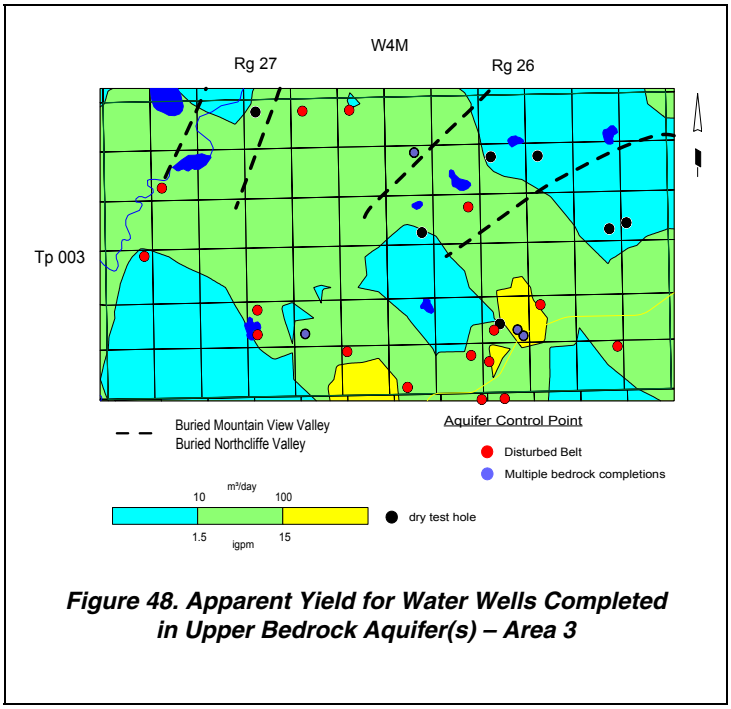

Figure 48. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) – Area 3

The upper bedrock over most of Area 3 is the Disturbed Belt Formation. The apparent yields for water wells completed through the upper bedrock aquifer(s) are expected to range between ten and 100 m³/day.

The only part of Area 3 where there is sufficient data to determine if a NPWL change has occurred in the upper bedrock aquifer(s) is in the northwestern part of township 003, range 27, W4M. In this area, there are indications that a NPWL rise of less than five metres may have occurred. In Area 3, there are three licences for water wells that are completed through the Disturbed Belt Aquifer, for a total authorized diversion of 4.2 m³day.

Groundwaters from water wells completed in the upper bedrock aquifer(s) are expected to have TDS concentrations that range from less than 500 to more than 2,000 mg/L.

6.5.4 Area 4 – Township 002, Ranges 28 to 29, W4M

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

The Sand and Gravel Aquifer (s) are present in most of Area 4. The sand and gravel deposits are expected to be mainly less than five metres thick. In Area 4, the apparent yields in water wells completed in the Sand and Gravel Aquifer(s) are mainly less than 100 m³/day, as shown on the adjacent map.

There are indications that there has been a decline in the NPWL of more than five metres in the western two-thirds of Area 4 and a rise in the NPWL in the eastern third of Area 4 (see page A-94). In Area 4, there are three registrations for water wells that are completed through the Upper Sand and Gravel Aquifer, for a total authorized diversion 0.7 m³day. It is unlikely that the decline in water levels can be attributed to these three water wells.

Groundwaters from water wells completed in Area 4 in the surficial deposits are expected to have TDS concentrations that are mainly less than 500 mg/L.

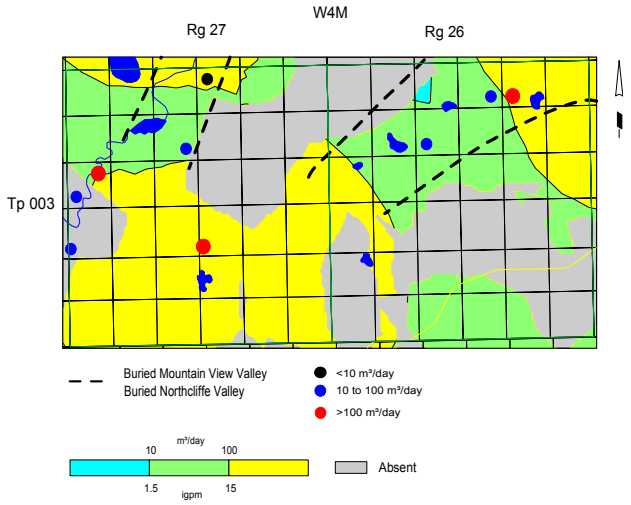

Figure 49. Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) – Area 4

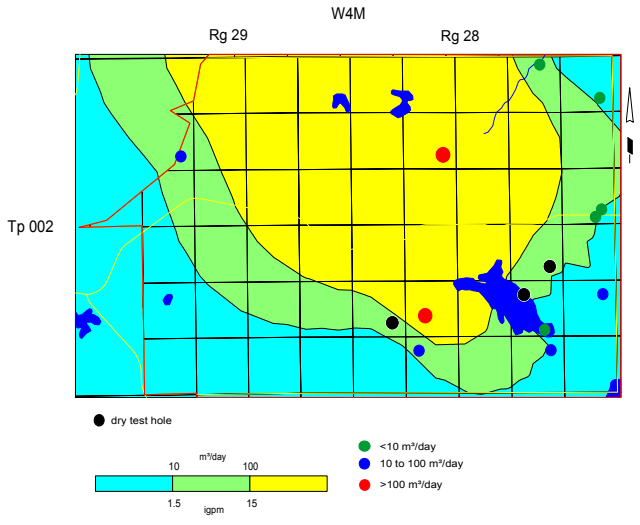

Figure 50. Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) – Area 4

The upper bedrock in Area 4 is the Disturbed Belt Formation (see page A-72). The apparent yields are mainly between 10 and 100 m³/day. In Area 4, there are three dry water test holes completed in the Disturbed Belt Aquifer.

There are indications that there has been a rise in the NPWL in the southwestern half of Area 4, and a decline in the NPWL in the northeastern half of Area 4. In Area 4, there are two authorized non-exempt water wells completed in the Disturbed Belt Aquifer, for a total 0.4 m³/day. Both water wells are registrations. It is unlikely that the decline in water levels can be attributed to these two water wells.

Groundwaters from water wells completed in the upper bedrock aquifer(s) are expected to have TDS concentrations that are mainly less 500 mg/L.

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 88 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 is one water well for which the County has responsibility; the County-operated water well is included in Appendix E. It is recommended that the County-operated water well plus the 88 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.

The results of the present study indicate that the main source of groundwater in the County is aquifers in the surficial deposits, which are the sand and gravel deposits associated with the lows in the bedrock surface. The median apparent yield value from all water wells completed in the Lower Sand and Gravel Aquifer that have an apparent yield, is in the order of 55 m^3/day (8.4 igpm). Fifty percent of the water wells completed in the Lower Sand and Gravel have an apparent yield of 52 m^3/day. The most noteworthy bedrock lows include the Buried Stand Off Valley and its tributary, the Buried Cochrane Valley; and the Buried Whoop-Up Valley and its tributary, the Buried Kimball Valley.

Of the 201 dry water test holes completed in bedrock, 48% of the dry water test holes are completed in the Scollard aquifers. The median apparent yield value of water wells completed in the Scollard aquifers is in the order of 15 m^3/day. The median value of fluoride concentrations (2.4 mg/L) from water wells completed in the Upper Scollard Aquifer is greater than the median concentrations (0.4 mg/L) from water wells completed in all upper bedrock aquifer(s). The areas underlain by the Scollard aquifers may need to investigate supplementing their present groundwater supply (e.g. rural pipeline).

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 88 water wells listed in Appendix E for which water well drilling reports are available, plus the County–operated water well, 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 89 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 35% successful in this study (see CD-ROM); sixty-five percent of authorized non-exempt 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 authorized non-exempt water wells are completed.

While there are a few areas where water-level data are available at different times, on the overall, there are an insufficient number of water levels to set up a groundwater budget. One method to obtain additional water-level data is to solicit the assistance of the water well owners who are stakeholders in the groundwater resource. In the M.D. of Rocky View and in Flagstaff County, water well owners were being provided with a tax credit if they accurately measured the water level in their water well once per week for a year. A pilot project indicated that approximately five years of records are required to obtain a reasonable data set. The cost of a five-year project involving 50 water wells would be less than the cost of one drilling program that may provide two or three observation water wells. Monitoring of water levels in domestic and stock water wells is a practice that is recommended by PFRA in the “Water Wells That Last for Generations” manual and accompanying videos (Buchanan, Bob (editor). Alberta Agriculture, Food and Rural Development, 1996).

A second approach to obtain water-level data would be to conduct a field survey to identify water wells not in use that could be used as part of an observation water well network. County personnel and/or local residents could measure the water levels in the water wells regularly.

Communities that are concerned about apparent water-level declines in the aquifers in which their water supply wells are completed should implement a conscientious groundwater monitoring program.

There is also a need to provide the water well drillers with feedback on the reports they are submitting to the regulatory agencies. The feedback is necessary to allow for a greater degree of uniformity in the reporting process. This is particularly true when trying to identify the bedrock surface. One method of obtaining uniformity would be to have the water well drilling reports submitted to the AENV Resource Data Division in an electronic form. The money presently being spent by AENV to transpose the paper form to the electronic form should be used to allow for a technical review of the data and follow-up discussions with the drillers.

An effort should be made to form a partnership with the petroleum industry. The industry spends millions of dollars each year collecting information relative to water wells. Proper coordination of this effort could provide significantly better information from which future regional interpretations could be made. This could be accomplished by the County taking an active role in the activities associated with the construction of lease sites for the drilling of hydrocarbon wells and conducting of seismic programs.

In summary, for the next level of study, the database needs updating. The updating of information for existing water wells requires more details for the water wells listed in Appendix E; the additional information for new water wells is mainly better spatial control.

Groundwater is a renewable resource and it must be managed.