

and the remaining 4% of the declines occurred where the estimated groundwater use per section is greater than 50 m³/day, as shown in Table 19.

Of the 6,232 bedrock water wells with a non-pumping water level and date in the County and buffer area, there are 1,320 water wells with sufficient control to prepare the adjacent map. The adjacent map indicates that in 51% of the County it is possible that the non-pumping water level has declined. Of the authorized non-exempt groundwater users completed in upper bedrock aquifer(s) that are authorized to divert groundwater, most occur in areas where a water-level decline may have occurred.

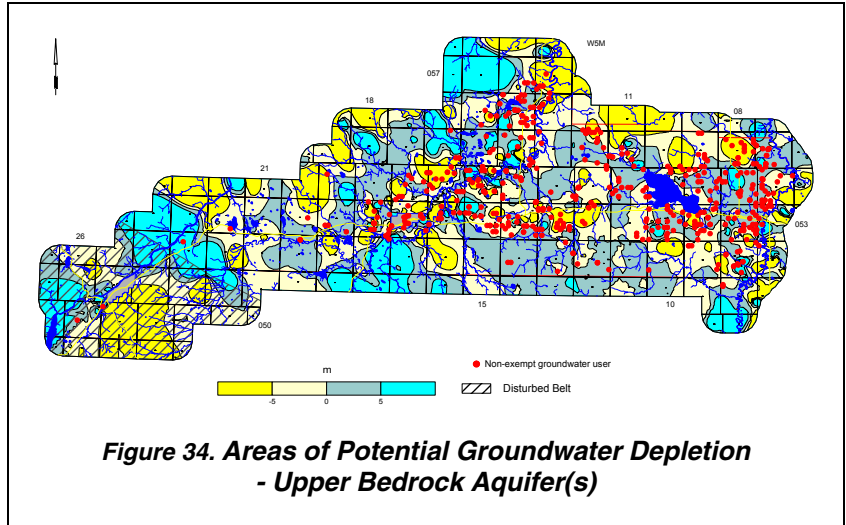


Figure 34. Areas of Potential Groundwater Depletion - Upper Bedrock Aquifer(s)

In areas where a water-level decline exists, 57% of the areas has no estimated water well use; 17% is less than 10 m³/day, 21% of the use is between 10 and 30 m³/day, 3% of the use is between 30 and 50 m³/day per section; and the remaining 2% of the declines occurred where the estimated groundwater use per section is greater than 50 m³/day, as shown below in Table 20. In the County where a water-level decline is indicated, most of the areas are where there is a non-exempt groundwater user.

Estimated Water Well Use Per Section (m ³ /day)	% of Area with More than a 5-Metre Projected Decline
<10	17
10 to 30	21
30 to 50	3
>50	2
no use	57

Table 20. Water-Level Decline of More than 5 Metres in Upper Bedrock Aquifer(s)

The areas of groundwater decline in the upper bedrock aquifer(s) where there is no estimated water well use suggest that groundwater production is not having an impact and that the decline may be due to variations in recharge to the aquifer or because the water wells are not on file with Alberta Environment.

7 POTENTIAL FOR GROUNDWATER CONTAMINATION

The most common sources of contaminants that can impact groundwater originate on or near the ground surface. The contaminant sources can include leachate from landfills, effluent from leaking lagoons or from septic fields, and petroleum products from storage tanks or pipeline breaks. Additional agricultural activities that generate contaminants include the improper spreading of fertilizers, pesticides, herbicides and manure. The spreading of highway salt can also degrade groundwater quality.

When activities occur that can or do produce a liquid that could contaminate groundwater, it is prudent (from a hydrogeological point of view) to locate the activities where the risk of groundwater contamination is minimal. Alternatively, if the activities must be located in an area where groundwater can be more easily contaminated, the necessary action must be taken to minimize the risk of groundwater contamination.

The potential for groundwater contamination is based on the concept that the easier it is for a liquid contaminant to move downward, the easier it is for the groundwater to become contaminated. In areas where there is groundwater discharge, liquid contaminants cannot enter the groundwater flow systems to be distributed throughout the area. In areas of groundwater recharge, low-permeability materials impede the downward movement of liquid contaminants. Therefore, if the soils develop on a low-permeability parent material of till or clay, the downward migration of a contaminant is slower relative to a high-permeability parent material such as sand and gravel of fluvial origin. Once a liquid contaminant enters the subsurface, the possibility for groundwater contamination increases if it coincides with a higher permeability material within one metre of the land surface.

To determine the nature of the materials on the land surface, the Agricultural Region of Alberta Soil Inventory Database (AGRASID) (CAESA, 1998), (Alberta Geological Survey, 1970) have been reclassified based on the relative permeability. The classification of materials is as follows:

- 1) high permeability - sand and gravel
- 2) moderate permeability - silt, sand with clay, gravel with clay, and bedrock
- 3) low permeability - clay and till.

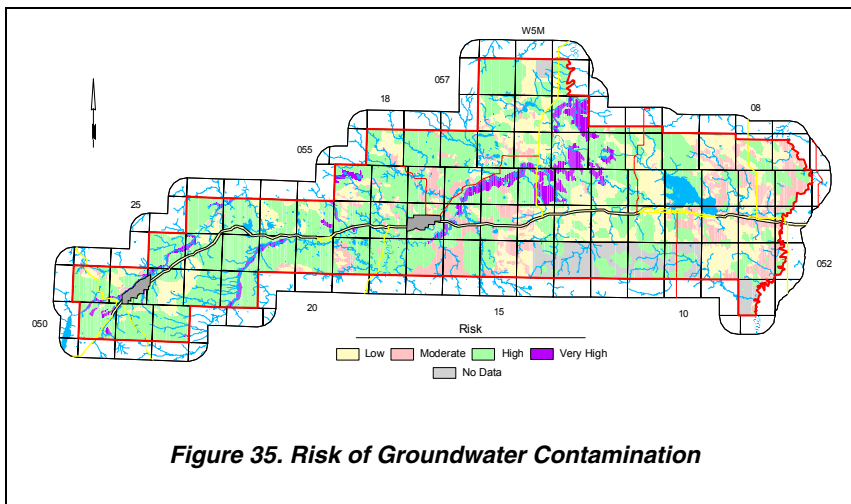
To identify the areas where sand and gravel can be expected within one metre of the ground surface, all groundwater database records with lithologies were reviewed. From a total of 5,400 records with lithological descriptions in the area of the County, 832 have the top of a sand and gravel deposit present within one metre of ground level. In the remaining 4,568 records, the first sand and gravel deposit is deeper than one metre or not present. This information was gridded to prepare a distribution of where the first sand and gravel deposit could be expected within one metre of ground level.

7.1.1 Risk of Groundwater Contamination Map

The information from the reclassification of the soil map is the basis for preparing the initial risk map. The depth to the first sand and gravel is then used to modify the initial map and to prepare the final map. The criteria used for preparing the final Risk of Groundwater Contamination map are outlined in the adjacent table.

Surface Permeability	Sand or Gravel Present - Top Within One Metre Of Ground Surface	Groundwater Contamination Risk
Low	No	Low
Moderate	No	Moderate
High	No	High
Low	Yes	High
Moderate	Yes	High
High	Yes	Very High

Table 21. Risk of Groundwater Contamination Criteria



The Risk of Groundwater Contamination map shows that, in 60% of the County, there is a high or very high risk for the groundwater to be contaminated. These areas would be considered the least desirable ones for a development that has a product or by-product that could cause groundwater contamination. However, because the map has been prepared as part of a regional study, the designations are a guide only. Detailed hydrogeological studies must be completed at any proposed

development site to ensure the groundwater is protected from possible contamination. At all locations, good environmental practices should be exercised in order to ensure that contaminants will not affect groundwater quality.

8 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 220 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 220 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 most notable areas where surficial water wells are completed in the Sand and Gravel Aquifer(s) are where the thickness of the Sand and Gravel Aquifer(s) is greater than five metres, particularly in the Buried Edson Valley. The median apparent yield value from surficial water wells in these areas is greater than 100 m³/day (15 igpm).

The results of the present study indicate that the main source of groundwater in the County is aquifers in the upper bedrock aquifer(s). The median apparent yield value from all water wells completed in the upper bedrock aquifer(s) is in the order of 70 m³/day (10.5 igpm). More than 30% of the water wells completed in the upper bedrock aquifer(s) have an apparent yield of greater than 100 m³/day.

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 220 water wells listed in Appendix E for which water well drilling reports are available, plus the one 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 221 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 43% successful in this study (see CD-ROM); sixty-five percent of the 559 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.

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