### 6.2.1 Quantity of Groundwater

An estimate of the volume of groundwater stored in the sand and gravel aquifers in the surficial deposits is 0.5 to 3.0 cubic kilometres. This volume is based on an areal extent of 3,100 square kilometres and a saturated sand and gravel thickness of three metres. The variation in the total volume is based on the value of porosity that is used for the sand and gravel. One estimate of porosity is 5%, which gives the low value of the total volume. The high estimate is based on a porosity of 30% (Ozoray, Dubord and Cowen, 1990).

The adjacent water-level map has been prepared by considering water wells completed in aquifers in the surficial deposits. The map shows the highest level of groundwater in surficial deposits, and this level was used for calculation of saturated surficial deposits and for calculations of recharge/discharge areas.

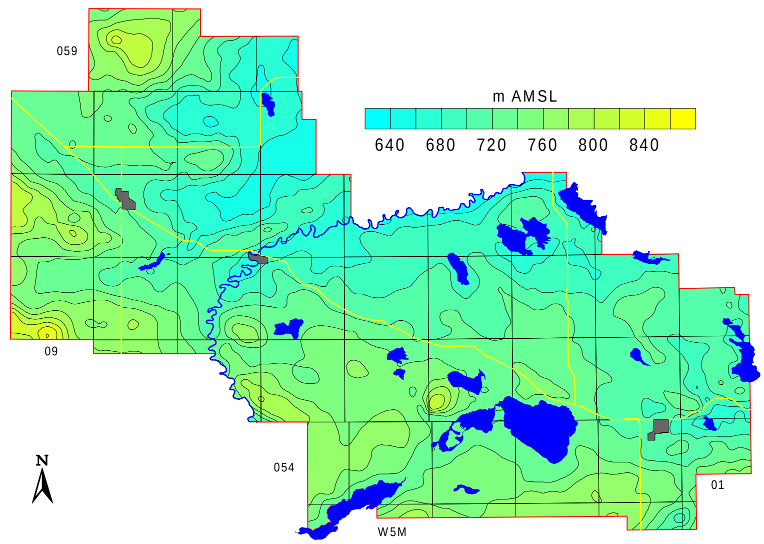


***Figure 25. Non-Pumping Water-Level Surface in Water Wells Completed in Surficial Aquifer(s)***

### 6.2.2 Recharge/Discharge

The hydraulic relationship between the groundwater in the surficial deposits and the groundwater in the bedrock aquifers is given by the non-pumping water-level surface associated with each of the hydraulic units. Where the water level in the surficial deposits is at a higher elevation than the water level in the bedrock aquifers, there is the opportunity for groundwater to move from the surficial deposits into the bedrock aquifers. This condition would be considered as an area of recharge to the bedrock aquifers and an area of discharge from the surficial deposits. The amount of groundwater that would move from the surficial deposits to the bedrock aquifers is directly related to the vertical permeability of the sediments separating the two aquifers.

When the hydraulic gradient is from the bedrock aquifers to the surficial deposits, the condition is a discharge area, relative to the bedrock aquifers.

### *6.2.2.1 Surficial Deposits/Bedrock Aquifers*

The hydraulic gradient between the surficial deposits and the upper bedrock aquifers has been determined by subtracting the non-pumping water-level surface, determined for all water wells in the surficial deposits, from the non-pumping water-level surface associated with all water wells completed in bedrock aquifers. The recharge classification on the adjacent map includes those areas where the water level in the surficial deposits is more than five metres above the water level in the upper bedrock aquifer(s). The discharge areas are where the water level in the surficial deposits is more than five metres lower than the water level in the bedrock. When the elevation of the water level in the surficial deposits is between five metres above and five metres below the elevation of the water level in the bedrock, the area is classified as a transition.

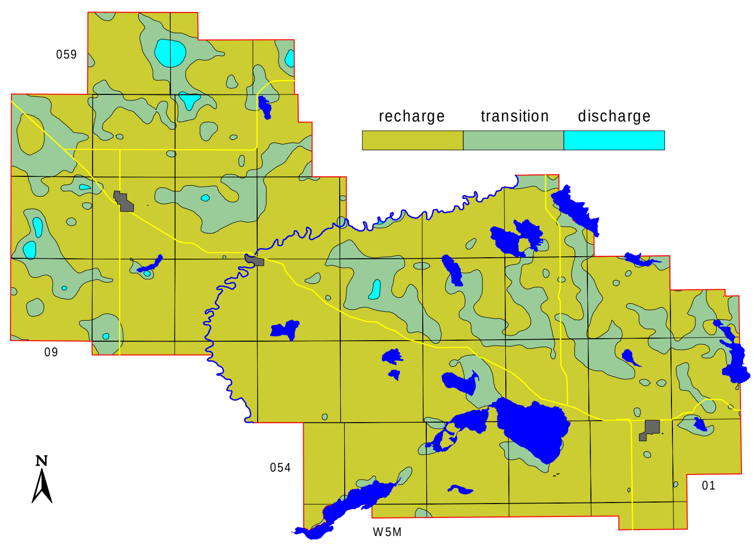


***Figure 26.Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)***

The adjacent map shows that in more than 80% of the County there is a downward hydraulic gradient between the surficial deposits and the upper bedrock aquifer(s). Areas where there is an upward hydraulic gradient, discharge from the bedrock, are very few. The areas of discharge from the bedrock are mainly in the northwestern part of the County. The remaining parts of the County are areas where there is a transition condition. The extensive areas of transition conditions may be a result of the topographic relief and/or the limited amount of data for both aquifer conditions generally and specifically for the surficial deposits.

Because of the paucity of data, a calculation of the volumes of groundwater entering and leaving the surficial deposits has not been attempted.

## 6.3 Bedrock Aquifers

Recharge to the bedrock aquifers within the County takes place from the overlying surficial deposits and from flow in the aquifer from outside the County. The recharge/discharge maps show that generally for most of the County, there is a downward hydraulic gradient from the surficial deposits to the bedrock. On a regional basis, calculating the quantity of water involved is not possible because of the complexity of the geological setting and the limited amount of data. However, because of the generally low permeability of the upper bedrock materials, the volume of water is expected to be small.

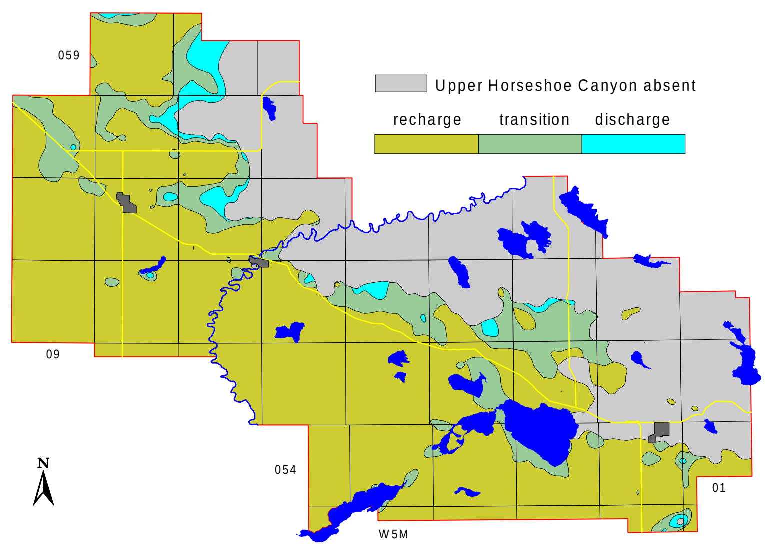


*Figure 27. Recharge/Discharge Areas between Surficial Deposits and Upper Horseshoe Canyon Aquifer*

The hydraulic relationship between the surficial deposits and the Paskapoo Aquifer indicates that in 50% of the County where the Paskapoo is present, there is a downward hydraulic gradient. Discharge areas are present at the northern and easternmost edges of the Paskapoo Formation.

The hydraulic relationship between the surficial deposits and the Upper and Lower Scollard Aquifer indicates that in 90% of the County where the Aquifer is present, there is a downward hydraulic gradient. Discharge or transition areas are present mainly at the eastern edges of the Formation.

The recharge/discharge configuration for each of the Upper, Middle and Lower Horseshoe Canyon formations and the surficial deposits shows that, generally, discharge from the bedrock occurs over an area of less than 10% of the central and northwestern parts of the County. The discharge in these parts of the County is associated with the edges of each of the Horseshoe Canyon formations.

## 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. The agricultural activities that generate contaminants include spreading of fertilizers, pesticides, herbicides and manure. The spreading of highway salt can also degrade groundwater quality.

When activities occur that do or can produce a liquid which 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. When there are groundwater recharge areas, low-permeability materials impede the movement of liquid contaminants downward. 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 surficial geology map prepared by the Alberta Research Council (Shetsen, 1990) has 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; and
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 4,071 records in the area of the County with lithology descriptions, 467 have sand and gravel within one metre of ground surface. In the remaining 3,604 records, the first sand and gravel is deeper 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 surficial geology 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 2. Risk of Groundwater Contamination Criteria***

The Risk of Groundwater Contamination map shows that, in less than 35% of the County, there is a high or very high risk of the groundwater being 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 groundwater contamination would not affect groundwater quality.

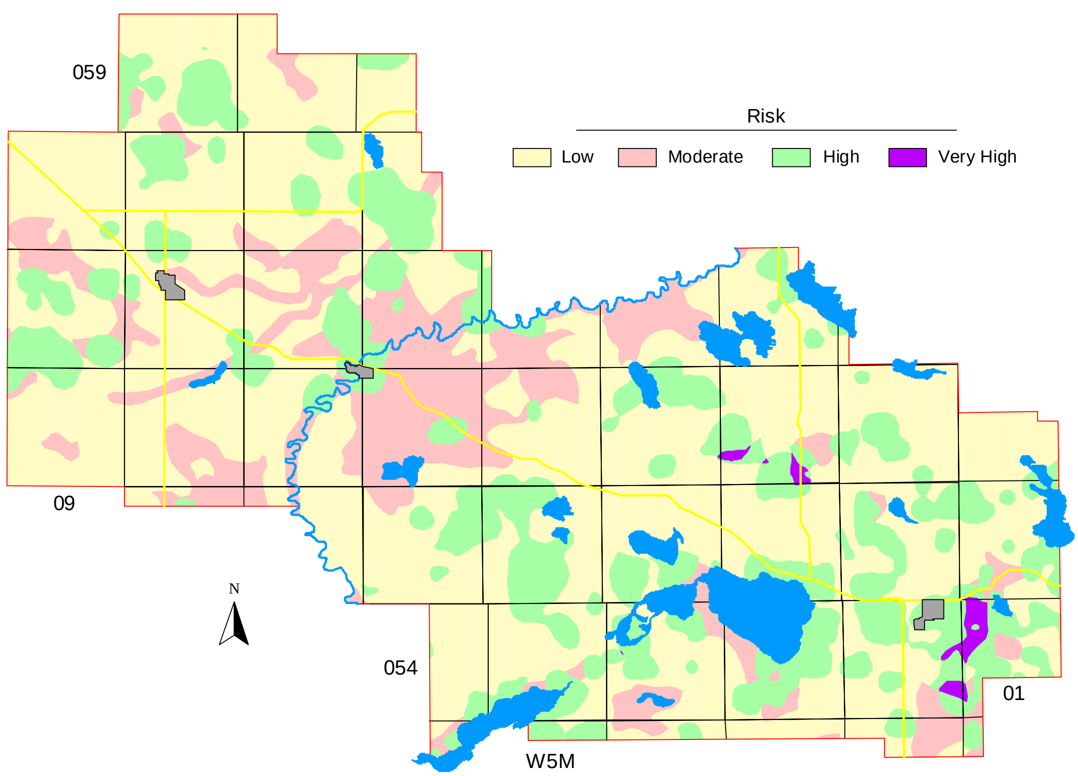


***Figure 28. Risk of Groundwater Contamination***

## 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; and
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 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. An attempt to update the quality of the entire database is not recommended.

The results of the present study indicate that the only readily identifiable aquifers in the surficial deposits are the sand and gravel deposits associated with the Buried Onoway Valley and the buried valley that underlies the Town of Mayerthorpe. It is recommended that the surficial deposits along the linear bedrock lows be further investigated.

There are indications that significant aquifers may be present in the bedrock where fracturing has occurred. This is most evident in the western part of the County where the Scollard Formation subcrops. The results of water test holes drilled for the Town of Mayerthorpe indicated that high yields can be expected from water wells completed in the Lower Scollard Aquifer. However, because of the generally low permeability that is characteristic of the Lower Scollard Aquifer, it is recommended that lineament analyses be conducted prior to any drilling program in the area where the Scollard Aquifer subcrops.

Another area where insufficient data are available is for the determination of a groundwater budget. There are only two observation water-well data sources in the County from which to obtain water levels for the 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, water well owners are being provided with a tax credit if they accurately measure 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.

**In general, for the next level of study, the database needs updating. It requires more information from existing water wells, and additional information from new ones.**

Before an attempt is made to upgrade the level of interpretation provided in this report and the accompanying maps and groundwater query, it is recommended that all water wells for which water well drilling reports are available be subjected to the following actions:

1. The horizontal location of the water well should be determined within 10 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 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 5 and 115 minutes of pumping, and analyzed for major and minor ions.

In addition to the data collection associated with the existing water wells, all available geophysical logs should be interpreted to establish a more accurate spatial definition of individual aquifers.

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. The water well drilling reports should be submitted to the AEP Resource Data Division in an electronic form. The money presently being spent by AEP and Prairie Farm Rehabilitation Administration (PFRA) 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 drilling of hydrocarbon wells and conducting of seismic programs.

**Groundwater is a renewable resource and it must be managed.**

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