Netley-Grassmere Watershed

Groundwater Input to Technical Process

Hydrogeology

The Netley-Grassmere watershed is underlain by bedrock consisting of limestone and dolostone inter-layered with several argillaceous units. The limestone and dolostone form a major fresh water aquifer, called the Carbonate aquifer, throughout the Interlake area that is the primary source of water supply in the region. The limestone and dolostone is underlain by shale and sandstone forming the Winnipeg Formation. While the sandstones are a productive aquifer, water quality is saline. Bedrock is overlain by a variable thickness of clay and glacial till (Figure #). Sand and gravel is found locally at the contact between the till and the limestone/dolostone bedrock and in some areas is sufficiently thick to form a productive aquifer.

A major argillaceous unit occurs in the upper part of the Stony Mountain Formation which underlies the western portion of the watershed (Figure #, bedrock geology of watershed - expect this to be provided by Mines Branch). This unit forms an extensive aquitard and restricts the movement of water between the overlying limestone and dolostone and the older carbonate rocks below the aquitard. In some areas it has been found that the portion of the Carbonate aquifer overlying the aquitard is contaminated but the aquifer beneath the aquitard has not been impacted. In these areas wells can be completed into the aquifer below the aquitard and obtain good quality groundwater.

Regional groundwater movement in the watershed is primarily from north-west to south-east; however, more local groundwater flow is developed in some areas such the Oak Hammock Marsh. The primary recharge area for the Carbonate aquifer is located in the central Interlake where a large groundwater mound has formed. Groundwater moves away from this mound in all directions, creating the dominant flow patterns observed in the Netley-Grassmere watershed (Figure #). Groundwater discharge is poorly understood, although it is known that discharge occurs as springs into a number of streams. This discharge forms the base-flow component of these streams. Groundwater may also discharge directly to the Red River in areas where the river bed has been scoured to bedrock. Flowing wells along the

western shore of Lake Winnipeg indicate an upward directed groundwater flow but thick clay deposits in this area and beneath the lake restrict discharge to diffuse seepage.

The Carbonate aquifer is generally highly productive with almost all wells drilled into the aquifer being capable of producing sufficient water for a single family dwelling. The aquifer has also been developed with a number of high capacity wells to provide for municipal, industrial and irrigation water supply. Municipal systems relying on groundwater service the City of Selkirk and the Towns of Stonewall and Stony Mountain. The aquifer also served as a water supply for the City of Winnipeg from about 1900 to 1919, through a series of wells drilled along Pipeline Road. Figure # shows licenced groundwater users in the watershed.

Although specific studies have not been undertaken to evaluate recharge rates to the Carbonate aquifer in the Interlake, long-term groundwater monitoring near areas of high use (Selkirk) and in more remote areas where little groundwater withdrawal is occurring do not show systematic water level declines which would indicate unsustainable withdrawal from the aquifer. Current rates of withdrawal are likely only a very small portion of the average recharge rates in the watershed. A long-term hydrograph for a provincial monitoring well located to observe background water level fluctuation is shown in Figure #. The locations of all provincial monitoring wells are shown on Figure #. This does not include monitoring wells established at contaminated sites or sites where a potential contaminating source is being monitored.

Groundwater quality is generally good, although the hardness is often high enough that a water softener may be required. Iron and manganese may also be present at concentrations that cause staining issues. Trace metal concentrations (arsenic, barium, boron, fluoride) have not been found to exceed drinking water guidelines but a small number of wells have been found to produce water with uranium concentrations slightly higher than the current drinking water guideline. Overall water quality is somewhat poorer along the western edge of the Red River between Winnipeg and Selkirk. In this area many wells produce water with elevated concentrations of sulphate, sodium and chloride, likely as a result of local recharge occurring through the clays which overlie the aquifer.

Groundwater Vulnerability and Contamination Issues

Groundwater is considered vulnerable to contamination where, under a given classification scheme, contaminants may leach into the aquifer from the ground surface relatively more quickly than in other areas. In the Netley-Grassmere watershed, the primary areas where groundwaters would be considered vulnerable to contamination occur where the bedrock aquifer is found at surface or is covered with only shallow deposits of clay, till or sand/gravel. These areas are show on Figure # where the occurrence of nitrate in groundwater is also plotted. Elevated nitrate concentrations are typically found in areas where there is less than about 6 m of clay and glacial till overlying the bedrock aquifer, indicating that this is a reasonable criterion for vulnerability mapping.

Bacterial contamination of groundwater is also associated with areas of thin overburden cover; however, the relationship is not very strong. While some wells may produce bacterially contaminated groundwater as a result of direct entry of bacteria into the aquifer, in most cases other factors are also responsible. This may include the installation of only a short length of well casing in areas of shallow bedrock, failure to adequately grout the borehole annulus, inadequate well maintenance, leakage at the snappy connection, or failure of the casing through corrosion. Bacteria may also be introduced directly into the bedrock aquifer via rock quarries, although the author is not aware of any studies which have shown this to be a significant issue in Manitoba. It is interesting to note that the Gunton area has been subject to several well contamination events due to excessive rainfall over the past few years, with reports of vegetation being washed into the aquifer along with so much air that pumps became air locked. Runoff is gaining direct access to the aquifer at some as yet undetermined location.

There are numerous potential sources of groundwater contamination in the watershed. These include waste disposal grounds, manure solid or liquid storage sites, agricultural practices, direct recharge to the aquifer through sinkholes, abandoned wells or drainage wells, municipal lagoons, and industrial activities. While many potential sources of contamination exist, it is generally only in areas with thin overburden cover over the bedrock that contamination of groundwater in the aquifer actually occurs. In areas with thick clay and till overburden, transport of contaminants to the aquifer may take decades or even thousands of years. Appropriate engineering practices can also reduce the risk of leaching and groundwater contamination, for instance by installing a liner in municipal or agricultural lagoons.

A well documented case of groundwater contamination from an industrial facility occurred at the Bristol Aerospace plant just north-east of Stony Mountain. The facility was located in an area where bedrock is found at shallow depth. Inappropriate handling of the organic solvents TCA and TCE at the plant resulted in a significant plume of groundwater contamination, extending over many square kilometres. A "pump and treat" facility consisting of 3 pumping wells and an aeration tower has been operating at the site since 1994 and appears to have successfully contained the contaminant plume. Provincial legislation requires a permit to drill or modify a well within and immediately adjacent to the contaminated area.

Groundwater Concerns in the Watershed

The main groundwater concern in the watershed remains the vulnerability of groundwater to contamination in areas with thin overburden overlying the bedrock aquifer. This is most applicable to communities in these areas relying on individual wells for water supply, particularly if there are livestock operations in the immediate vicinity. Rural residents relying on wells for water supply in these vulnerable areas should also be concerned about their water quality. The province is currently reviewing the Ground Water and Water Well Act and Regulations and will be considering requiring a minimum casing length for new wells in these areas and cement or bentonite grouting of the casing annulus.

Programs and Recommendations

1. The existing cooperative program between the East Interlake Conservation District and Manitoba Water Stewardship to inventory and sample rural private wells in the watershed should continue.
2. The EICD program to seal abandon wells should continue as should the cooperative program to seal nuisance flowing wells along the west shore of Lake Winnipeg. A concerted effort should be made to find and seal any drainage wells that may still exist in the watershed. The watershed group should open discussions with the City of Winnipeg to seal the abandoned municipal wells along Pipeline Road that serviced the City until 1919.
3. As part of the development of a watershed plan, current activities that may cause groundwater contamination that are being carried out in areas of the watershed with thin overburden over the bedrock aquifer

should be mapped. This would include all quarries, whether active or abandoned.

4. The watershed plan should encourage studies be carried out to examine the interaction between surface water and groundwater in this watershed and other parts of the Interlake. It should also encourage studies be undertaken to examine recharge processes and rates, and groundwater quality in recharge areas.