

# Livestock Operations & Groundwater Quality

REVISED JANUARY 2005

FACT SHEET #9

## Living WITH Livestock PRODUCTION



### Introduction

Most people living in rural areas of Manitoba rely on groundwater as their primary source of water. To protect and preserve the quality of below-ground water sources, it is important that agricultural producers operate in a responsible manner as stewards not only of the land but also of the water under the land.

### What is Groundwater?

Groundwater is defined as "all water below the surface of the ground". This includes water found in the unsaturated zone above the water table and water in the saturated zone beneath the water table. Rain or snow melt enters the subsurface in recharge

areas, then migrates to discharge areas where it comes out of the ground as springs or seepage or is used by plants.

Groundwater in the saturated zone can be found in aquifers or aquitards. An aquifer is an area of sand, gravel or bedrock that can provide sufficient water to wells or springs to supply at least a single family dwelling.

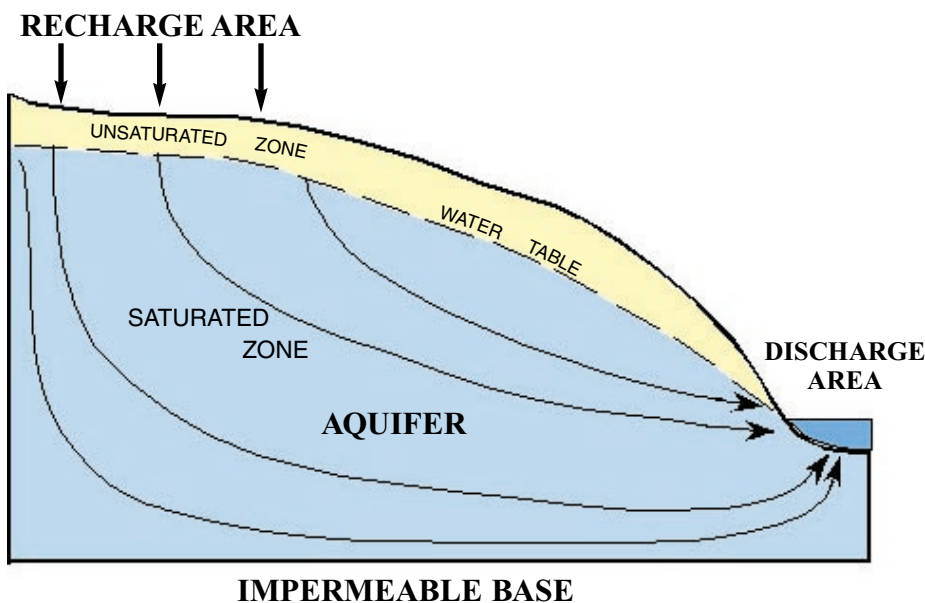
In contrast, groundwater can move only very slowly through aquitards. The heavy clay (gumbo) found in the Red River valley is a good example of an aquitard.

The rate of groundwater movement is generally slow except in coarse sand, sand and gravel, or bedrock aquifers which contain fractures, such as the Carbonate Rock aquifer.

Because of the very slow rate of water movement through aquitards, they protect underlying aquifers from surface contaminants.

MATERIAL	TYPICAL VELOCITY
Clay/till (unfractured)	<1 - 10 cm/yr
Clay/till (fractured)	10 - 100 cm/yr
Silt	10 - 100 cm/yr
Sand	1 - 100 m/yr
Sand and gravel	1 - 500 m/yr
Sandstone	10 - 500 m/yr
Limestone (fractured)	50 - 5,000+ m/yr

Typical velocities of groundwater in common aquifers and aquitards in Manitoba.



### GROUNDWATER FLOW SYSTEMS

Groundwater enters the subsurface in recharge areas and exits in discharge areas. The distance between recharge and discharge areas may be as little as a few hundred metres to as much as several thousand kilometres.



*The Carbonate Rock aquifer is the largest fresh water aquifer in Manitoba, stretching from the U.S. border on the south to north of The Pas.*

that are underlain by thick deposits of clay materials. Since the rate of water movement through these materials is very slow, they provide natural protection for underlying aquifers. In other areas, earthen manure storage structures must be adequately lined with compacted clay and/or synthetic liners to reduce or eliminate seepage. Additional protection can be provided by installing a collection system that will intercept seepage and return it to the storage structure. In some locations groundwater monitoring may also be required by Manitoba Conservation under the permitting process. Above-ground steel or concrete structures are other options.

Provincial regulations require a permit for construction, modification or expansion of any manure storage structure. The permitting process

## Protecting Groundwater

Livestock operations produce either liquid or solid manure. Manure contains nutrients, salts and micro-organisms so it is important to protect groundwater from being impacted by seepage from areas where manure is stored or applied to fields.

The following are potential seepage sources:

- manure storage structures;
- solid manure piles;
- outdoor pens or exercise areas;
- runoff retention ponds; and
- fields where manure is applied.

### Manure storage structures

Where possible, manure storage structures should be located in areas



*Studies are currently underway in Manitoba to examine whether seepage beneath outdoor cattle pens poses a significant risk to underlying groundwater.*



*Shallow sand aquifers that extend to the ground surface are susceptible to contamination and are referred to as "sensitive" aquifers. Deeply buried aquifers, on the other hand, are well protected from surface contaminants and are termed "insensitive."*

requires test drilling at the site to evaluate geological conditions, and appropriate engineering design. Manitoba Conservation conducts site inspections during construction to ensure the storage structure is properly built. Livestock producers are responsible for regular inspections and maintenance to ensure the integrity of their storage facility. Manitoba Conservation also carries out an annual inspection program.

#### **Storage of solid manure**

Solid manure should be stored in areas where thick clay deposits overlie any aquifers. Solid manure should not be stored in areas underlain by coarse sand, sand and gravel or shallow bedrock aquifers. In sensitive groundwater areas, solid manure piles should be stored on a concrete pad or other impermeable base. A properly constructed retention pond may be required to gather runoff for later land application.

Locations where solid manure is temporarily stored in the field prior to spreading should be rotated annually, with crops allowed to grow at older sites to utilize nutrients left in the soil.

#### **Outdoor pens and exercise areas**

Outdoor areas where livestock are confined in high densities should be located where the subsurface contains a considerable thickness of clay materials overlying any aquifer. Areas where the subsurface materials consist of sand, sand and gravel, or where bedrock aquifers are found close to ground surface, should be avoided.

Producers who propose to construct certain types of confined areas such as feedlots that are capable of housing 300 or more animal units, must obtain a permit from Manitoba Conservation before construction begins.

To minimize seepage, pens should be sloped to promote runoff. Runoff should be directed to a properly

constructed runoff retention pond or area with deep-rooted grasses or legumes. As well, the use of bedding materials should be maximized, and annual cleaning of the pens should be carried out. In sensitive groundwater areas, compacted clay or artificial liners should be installed beneath pens.

#### **Land application of manure**

Liquid or solid manure and runoff from pens or storage sites for solid manure must be applied to fields as a fertilizer. The rate of application must not exceed the crop's requirement for nitrogen.

Particular caution must be exercised in sandy soils and areas with shallow bedrock aquifers. In these areas, leaching to the water table may occur quite rapidly.

To minimize the potential for groundwater impacts in these areas, operators should:

- sample the soil beyond 60 cm (2 feet) to determine if rapid downward movement of nutrients is occurring below the root zone;
- apply manure in the spring or summer rather than fall, and avoid manure applications prior to expected significant rainfall;
- develop and follow an appropriate manure management plan.

## Summary

- Livestock operations are a potential source of groundwater contamination.
- The risk of impacts on potable groundwater supplies can be minimized by:
  - locating manure structures, outdoor pens and field manure storage in areas underlain by thick clay materials
  - minimizing the duration of field manure storage before spreading
  - applying manure at proper agronomic rates as a fertilizer with due consideration for crop requirements, soil texture and sensitivity of underlying aquifers.

## Further Information

Other titles in the series: "Living with Livestock Production" are available from Manitoba Agriculture, Food and Rural Initiatives offices.

1. *Health Issues and Livestock Production*
2. *Livestock Odours – Sources, Concerns & Solutions*
3. *Surface Water Issues*
4. *Nitrates in Soil and Water*
5. *Land Application of Manure*
6. *Siting Livestock Production Operations*
7. *Understanding Anti-microbial Resistance*
8. *Food Safety on the Farm*
9. *Livestock Operations and Groundwater Quality*

10. *Livestock Pathogens - A Natural Occurrence*

11. *Managing Livestock Mortalities*

12. *Livestock Manure Storage*

13. *Confinement of Livestock*

14. *Phosphorus in Soil and Water*

More detailed information can be found on the Internet at [www.gov.mb.ca/agriculture/livestock](http://www.gov.mb.ca/agriculture/livestock). Copies of the *Farm Practices Guidelines\* for Hog Producers in Manitoba (1998 edition)* and *Poultry Producers (2000 edition)* are available from Manitoba Agriculture, Food and Rural Initiatives offices in rural Manitoba and from Agriculture Publications at 8th Floor, 401 York Avenue, Winnipeg MB R3C 0P8 (FAX: 204-948-2498)

\*The 1995 edition for the other titles of the series are presently available; they are being updated.