Groundwater — An Important Rural Resource

Protecting the Quality of Groundwater Supplies

H. Simpson, PhD

Factsheet

FACTSHEET 15-045 AGDEX 716/552 DECEMBER 2015
(replaces OMAFRA Factsheet 06-115 of the same name)

All Ontarians can play a role in protecting groundwater quality and quantity. The third of four in a series that will help Ontario's farmers and rural residents learn more about groundwater, this Factsheet provides an overview of groundwater protection including well capture zones and groundwater vulnerability to contamination.

Other Factsheets in this series include:

- *Understanding Groundwater*
- *Managing the Quantity of Groundwater Supplies*
- *Private Rural Water Supplies*

Groundwater is a precious resource for rural families and businesses. In some situations, it may be the only water source. When living in a rural area, it is important to understand what steps can be taken to help protect the integrity of groundwater supplies.

All natural waters such as rain, surface water and groundwater contain some amount of dissolved minerals. As groundwater seeps into the soil and travels through a geological formation, it may dissolve minerals. The amount and type of dissolved minerals contained in groundwater will depend on the type of minerals present in the formation, how long the water is in contact with those minerals and what other minerals were already dissolved in the water.

A formation is a layer of bedrock or sediment that consists of a certain type (or combination of types) of geological materials (e.g., rock, sand, gravel, clay). Aquifers are permeable formations at or below the ground surface that will yield useful amounts of water when pumped for water supplies. Aquitards are materials that prevent a significant flow of water. Water moves extremely slowly through aquitards. Aquifers and aquitards, and other groundwater concepts, are discussed in more detail in the OMAFRA Factsheet *Understanding Groundwater*.

Ontario's groundwater quality is generally good and suitable for use with little or no treatment. Regular testing is a good way to monitor water quality. One of the main benefits of drinking groundwater is that it is much less vulnerable to microbiological or pathogen contamination than surface water supplies. Naturally occurring minerals may occasionally adversely affect the water's aesthetics — its appearance, smell or taste — resulting in hardness, a rotten-egg smell or staining. In a small number of locations, dissolved minerals or natural materials (e.g., arsenic, salt or oil deposits) may make the water unsafe to drink. Examples of naturally occurring materials that can affect groundwater quality are listed in Table 1.

When a well produces water that is not potable (i.e., does not meet one or more of the Ontario Drinking Water Standards), the well owner may seek advice and take steps directed by the local Public Health Unit as an alternative to immediately abandoning the well. Information concerning testing the quality of water in a well is provided in an information kit from the Ministry of Health and Long-Term Care, *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well* (ontario.ca/publications).

Ministry of Agriculture, Food and Rural Affairs

Ontario

Table 1. Potential sources and pathways for materials found commonly in rural areas that can affect the quality of groundwater

Material	Potential Sources/Pathways
Pathogens	• septic systems • surface application of manure and municipal biosolids • municipal sewers • storage of manure and human wastes • poor well construction or maintenance
Nitrates	• lawn fertilizers • septic systems • surface application of manure and municipal biosolids • plowdown legume crops
Pesticides	• application to fields • leakage from bulk storage • spills during handling and application
Solvents	• leakage from workshops and bulk storage • discharge of hazardous household or farm wastes to septic systems or onto the ground • some septic system cleaners • discharge from dumps and landfills
Fuels	• leakage from vehicles, workshops and bulk storage • leakage from underground storage tanks and piping • accidental discharge to septic systems
Salt	• surface application of winter de-icing and dust suppression chemicals • naturally occurring formations
Chemicals	• leakage from dumps and landfills • surface application of manure and municipal biosolids • naturally occurring arsenic, fluoride, mercury, radon and uranium • mining wastes • wood preservatives

WELL CAPTURE ZONES

A capture zone is an area of land that provides water for a well. Groundwater found in the capture zone will eventually be drawn from the ground into the well ("captured") and pumped out of the well. Small domestic wells may have very small capture zones. Large municipal wells usually have large capture zones — greater than 1 km^2 in size; however, this may only affect a small part of the entire aquifer.

Capture zones can change in size and shape in response to changes in pumping rate or recharge to the aquifer. Scientists use information about a well's construction, well pumping rate, water table elevations, drawdown cones and geological formations at the well owner's site to determine specific capture zones.

THREATS TO GROUNDWATER QUALITY

In a rural setting, there are potential contamination sources associated with human activity that may affect groundwater quality. These can be point sources where potential contaminants are concentrated or stored in one spot, such as a fuel storage tank. There are non-point sources where potential contaminants are spread over a wider area, such as applied nutrients on agricultural fields. Table 1 presents the types and potential sources of contaminants commonly found in rural areas. Figure 1 shows potential sources for groundwater contamination.

To help ensure a clean source of groundwater, it is important to know where aquifers are located so you can take steps to protect them — especially those areas that are within the capture zones of drinking water wells.

PROTECTING THE RURAL GROUNDWATER RESOURCE

The vulnerability of groundwater to contamination varies across the landscape. The vulnerability of each aquifer is unique, and determining factors include the type of formation, its depth and whether it is protected by a low-permeability aquitard (e.g., made of dense materials such as clay).

The effect of different types of formations on groundwater vulnerability is shown in Figure 1. As the thickness of a protective aquitard increases, the time it takes for water and any contaminants to move underground also increases. The longer it takes for water to infiltrate, the greater the potential for purification through prolonged contact with soil and subsurface materials. A shallow, unconfined aquifer is usually more vulnerable to potential contamination sources than a deep, confined aquifer. Water may have to pass through an aquitard to reach a deep, confined aquifer.

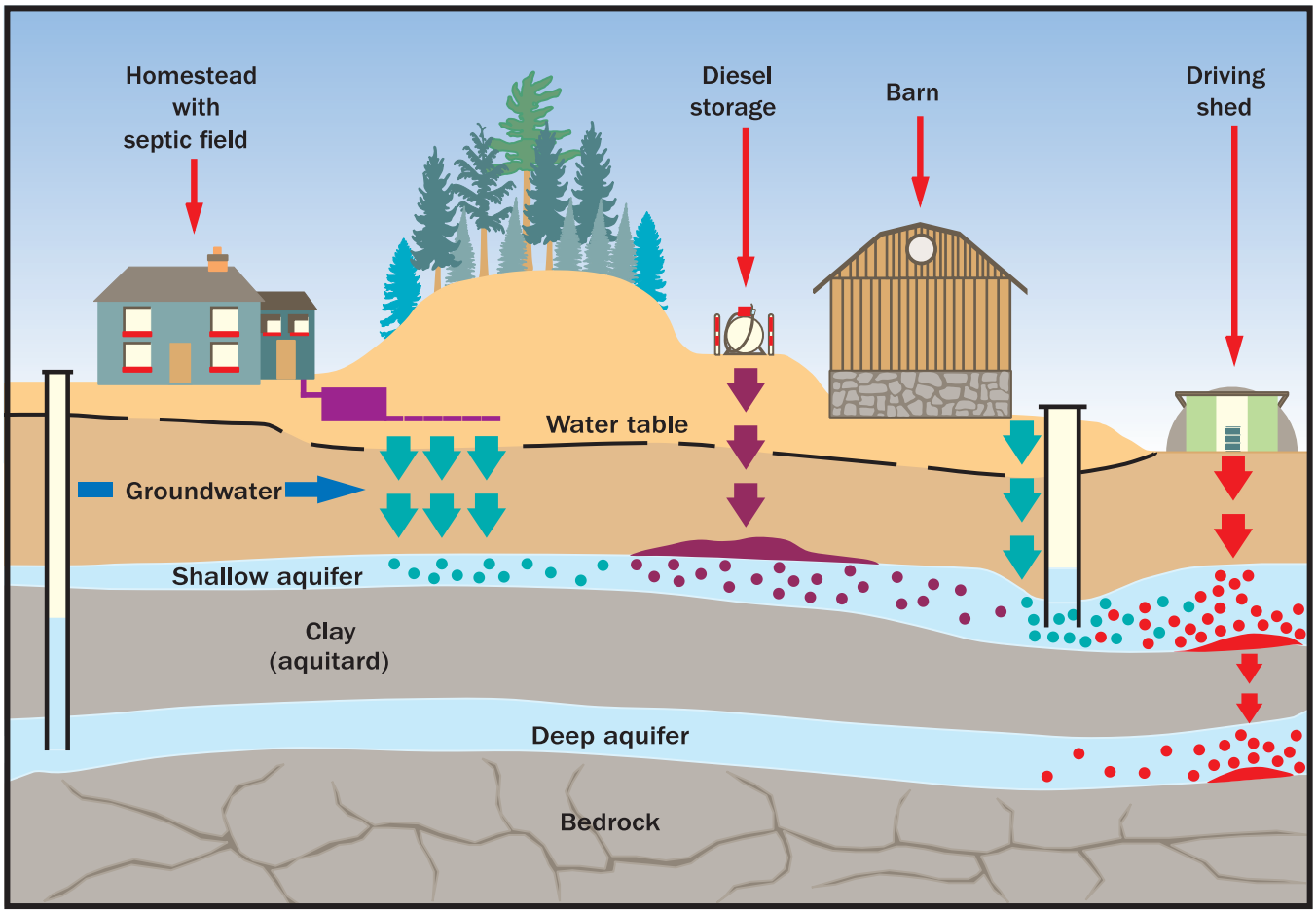

Figure 1. The vulnerability of groundwater is related to how rapidly water infiltrates to an aquifer.

Best management practices on farm and rural properties can minimize the impact of potential point and non-point contaminant sources. Proper construction and maintenance of a well will help to prevent it from becoming a pathway for surface water and contaminants to reach the groundwater. If a well is to no longer be used, it must be properly abandoned (plugged and sealed). Landowners have a legal responsibility for the condition of all wells on their property, under the authority of the Ontario Wells Regulation (ontario.ca/laws).

TAKE ACTION NOW

There are many sources of information for private water well owners in Ontario.

The information kit entitled *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well* (ontario.ca/publications), published by the Ministry of Health and Long-Term Care, provides in-depth guidance on how to maintain private water supplies. It also shows how and when to have water tested, and the acceptable levels of dissolved materials and indicator bacteria counts in drinking water.

Information on different types of wells and the management of highly vulnerable water supplies is provided in the OMAFRA Factsheet *Private Rural Water Supplies*.

Information on actions to take to protect the quality of groundwater and the drinking water supply is provided in the Canada-Ontario Environmental Farm Plan workbook and associated infosheets (ontario.ca/be5v). These resources are a useful guide to help avoid or deal with spills of fuel, nutrients, pesticides and other chemicals, on the farm or other rural properties.

ADDITIONAL RESOURCES

OMAFRA Factsheet *Pesticide Contamination of Farm Water Sources* (ontario.ca/omafra)

Ontario Ministry of the Environment and Climate Change (MOECC). *Well Aware – A Well Owner's Guide* (www.wellaware.ca).

This Factsheet was updated by Dr. Hugh Simpson, Program Analyst, OMAFRA, Guelph; Jim Myslik, JPM Consulting, Marden; Dr. Brewster Conant, Department of Earth Sciences, University of Waterloo. It was reviewed by Tim Brook, Water Management Engineer, OMAFRA, Elora; Rebecca Shortt, Water Quality Engineer, OMAFRA, Simcoe: and H.J. Smith, Environmental Management Specialist, OMAFRA.

Published by the Ontario Ministry of Agriculture, Food and Rural Affairs

ISSN 1198-712X
Également disponible en français (Fiche technique 15-046)

Agricultural Information Contact Centre:
1-877-424-1300
1-855-696-2811 (TTY)
E-mail: ag.info.omafra@ontario.ca

ontario.ca/omafra