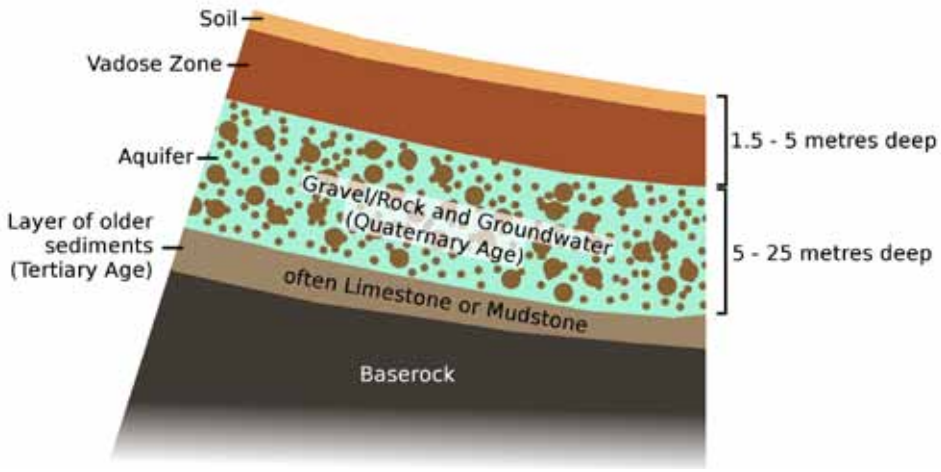
Learn more about the environment and find out what Environment Southland's scientists are up to.

Groundwater and Nitrate Movement

Groundwater is water that has made its way down through the soil to underground areas called 'aquifers'. Aquifers are not like areas of surface water, such as lakes. Instead they are areas filled with sand, gravel or rocks which 'hold' water. Water sits in the spaces between the gravel or rocks.

Groundwater provides an important source of drinking water for people and livestock in Southland. However, what we do on top of the land (land use) can affect the quality of the groundwater sitting below. Nitrate contamination of groundwater is a key issue as it affects the health of people, livestock and the broader environment.



Aquifers in Southland

Aquifers in Southland tend to be shallow. Many are only 1.5 to 5.0 metres below the ground. Elsewhere in the country, aquifers are often much deeper – up to 100 metres. Another key feature is their shape – in Southland they tend to be long and thin. They can cover a large area underground but don't tend to be very deep.

Remember – nitrate needs water to move.
Lots of rain + free-draining soil = lots of nitrate movement.

environment SOUTHLAND
Te Taiao Tonga

What is nitrate?

Nitrogen is an important ingredient in fertilisers and is extensively used in agriculture to promote grass growth. Although nitrogen is great for grass growth, we can have too much of a good thing. Plants can only take up so much nitrogen via their roots, with the remainder changing to nitrate in the soil. Nitrate dissolves in rainwater and starts to 'drain' down through the soil, eventually making its way down to the groundwater.

What are our scientists monitoring?

If too much nitrogen is entering the soil, how long does it take to find its way into groundwater? Environment Southland scientists have been investigating how long it takes for nitrate to move through the soil to underlying aquifers. This is known as 'lag time', and depends on rainfall, the type of 'substrate' (rock, gravel, sand, silt and clay) sitting below the soil and the depth to groundwater.

Southland has a mosaic of different soil types, as well as different types of rock and gravel sitting below. Factor in different average rainfall levels for different areas and a complex picture emerges. However there are some general patterns.

Scientists estimate that for about 80% of Southland it takes less than one year for nitrate to travel from the soil down to the groundwater. For 90% of Southland, it takes less than two years. The quickest draining areas tend to be found on 'young' substrates located in lowland areas. The slowest draining areas are found on 'old' substrates at higher elevations.

What does this mean for us?

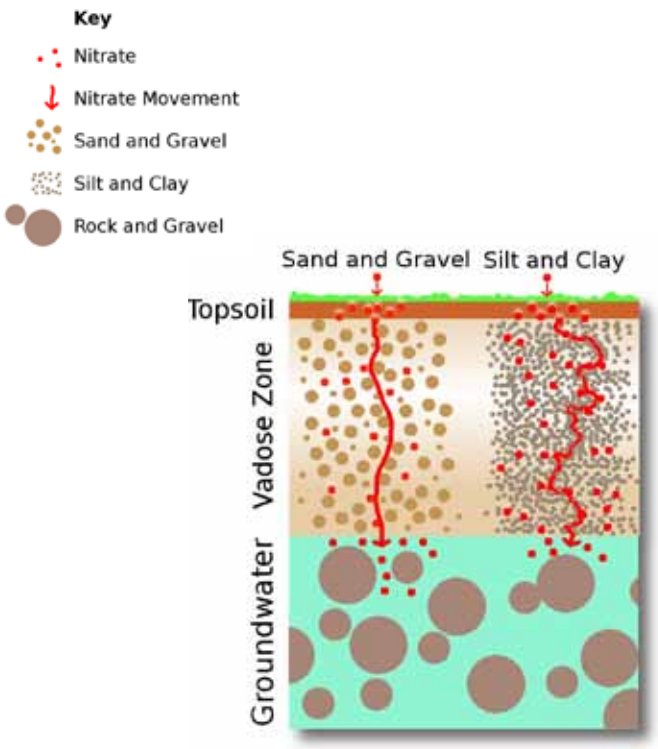
If Southlanders significantly reduced the amount of excess nitrate leaching down to groundwater today, we could expect to see a vast improvement in groundwater nitrate levels within five years. This is great news for those who rely on groundwater as their main source of water.

Elsewhere in New Zealand, aquifers are much deeper meaning improvements may not been seen for many generations

Nitrate management – saturated vs unsaturated soils

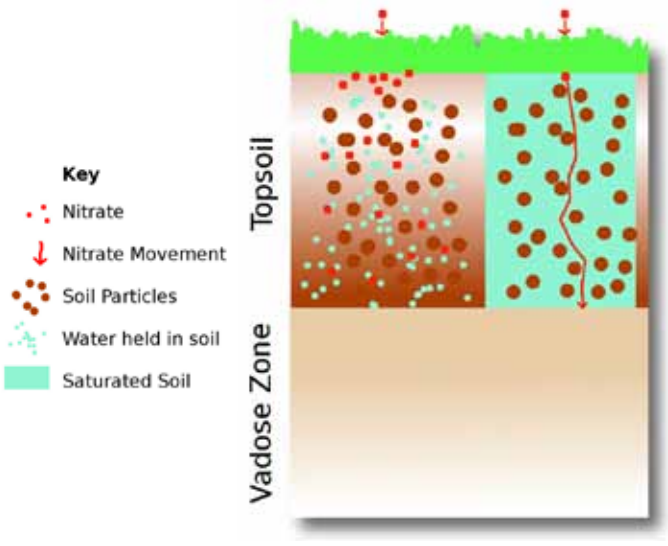
Nitrate management becomes a key issue during wetter months, particularly over autumn and winter. For good management it's important to understand how nitrate moves in saturated versus unsaturated soils.

It's important that good farm management practices are put in place before soils get saturated. By reducing the amount of nitrate build-up in the soil during autumn and winter when plant growth is slowing down, we can reduce the amount of nitrate 'flushing' down through the soil when it becomes saturated.



NITRATE MOVEMENT THROUGH SOIL

Unsaturated soil has the capacity to soak up and 'hold' more water. Water (and dissolved nitrate) tends to sit in the soil, rather than drain downwards. Soil is 'saturated' when it can't hold any more water. When more water is added (via rainfall); it will generally drain downward, run off the surface or turn the soil into mud.



NITRATE MOVEMENT TO GROUNDWATER

The area between the soil (top) and groundwater is called the 'vadose' zone. What happens here is key to estimating how quickly nitrate will move down to the groundwater. In general, areas with sand and gravel drain more quickly than those with silts and clays. Travel time through the vadose zone is also quicker in the wetter parts of Southland.

How does nitrate affect human health?

Groundwater with high levels of nitrates is unsuitable for drinking. Nitrate is particularly dangerous for young babies. Pregnant women also need to minimise their intake of nitrate in drinking water.

Babies

Young babies (under six months) are susceptible to 'Blue Baby Syndrome' from excess nitrate in drinking water. The baby's digestive system converts nitrate to nitrite, which affects the blood's ability to carry oxygen. 'Blue Baby Syndrome' doesn't affect older children or adults.

Adults

High nitrate intake by adults has been linked to higher risk of developing some cancers.

What next?

Environment Southland scientists will continue to monitor nitrate levels in groundwater. If we significantly reduce nitrate leaching today, we could see a vast improvement in groundwater quality across most of Southland in about five years.

*For further information, or to read the **Estimating Time Lags for Nitrate Response in Shallow Southland Groundwater** report, go to www.es.govt.nz*

Tips for reducing nitrate in groundwater

- *Avoid irrigating farm dairy effluent during wetter months (June/July) – most nitrate enters groundwater during this time*
- *Irrigate with farm dairy effluent during summer when there is less risk of leaching*
- *Develop a nutrient budget/nutrient management plan and wintering plan to minimise nitrate leaching*.

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