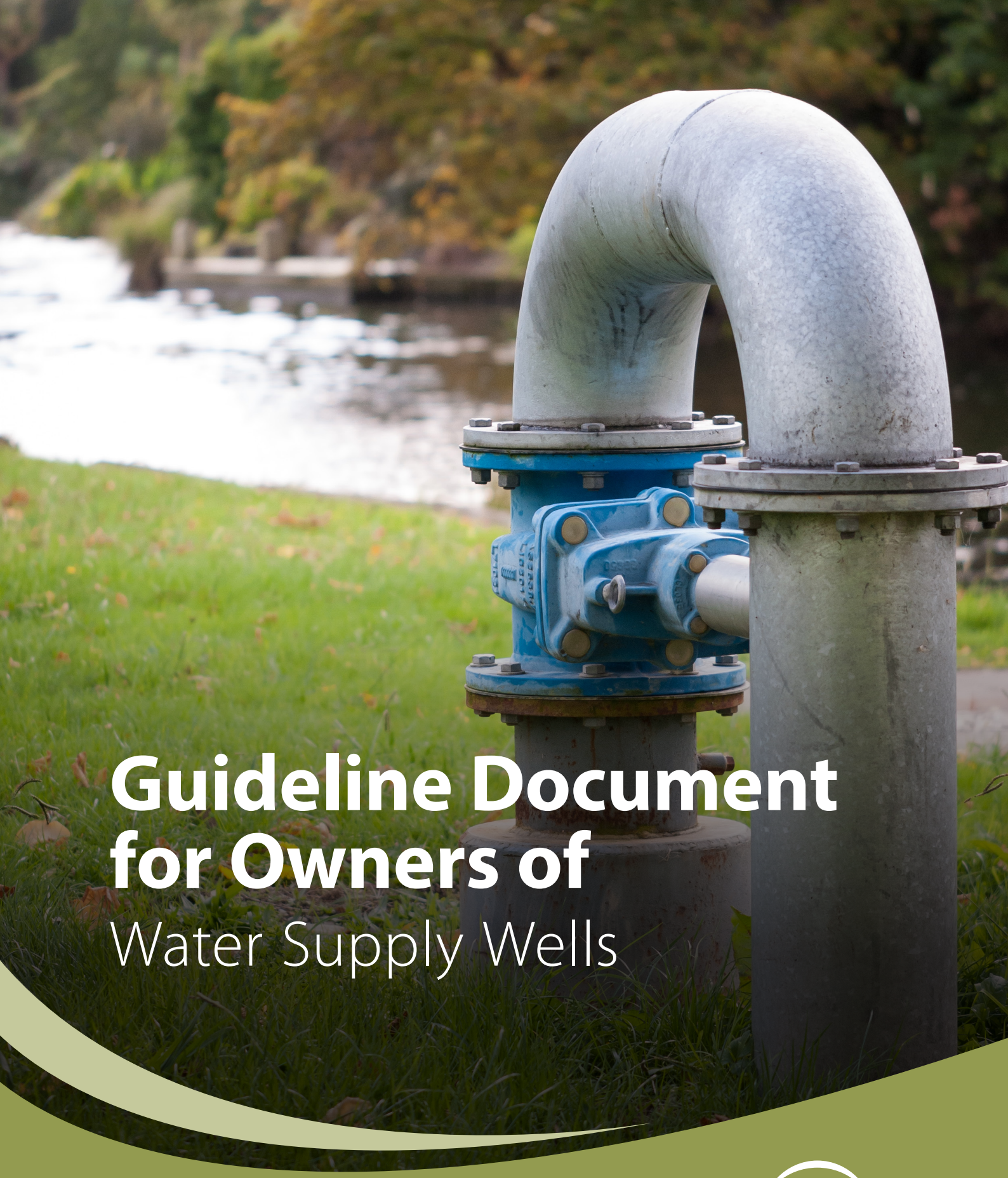


Guideline Document for Owners of Water Supply Wells

horizons regional council

2014/649

Table of Contents

1.0 Introduction

The strata beneath the Horizons Region contain groundwater that is accessed by hundreds of wells. Many of these wells provide the drinking water supply for private dwellings, groups of houses or towns and cities.

In most cases this water supply is of good quality, but in some circumstances water drawn from a well can be contaminated. It is important that well owners understand the likely causes of contaminated water and the checks they can carry out to determine if their water supply well is affected by contaminants.

Horizons carries out a regular monitoring programme to check on groundwater quality throughout the Region. A review of that programme by the environmental consulting firm Pattle Delamore Partners Ltd (PDP) identified the main circumstances where poor groundwater quality may occur.

This document has been prepared by PDP to provide additional technical information to support a public brochure on this topic and provide well owners with general information on:

- the origin of groundwater in the region (section 2);
- sources of poor quality groundwater (section 3);
- indicators of water supplies that might be affected by poor quality water (section 4); and
- suggestions for managing affected water supplies (section 5).

2.0 The Origin of Groundwater in the Horizons Region

In very broad terms, the geologic strata of the Region have been formed in three main sequences:

- the geological basement is largely made up of extremely low permeability and heavily inundated greywacke that has been uplifted by tectonic forces to form the Ruahine and Tararua Ranges. These rocks also occur at depth and underlie the younger geologic strata of the Region;
- the basement rocks are typically overlain by fine grained marine sedimentary strata. This is predominantly comprised of low permeability siltstone and/or mudstone, often described in drillers' logs as "papa". This strata does not generally support groundwater abstraction wells, although some coarser grained permeable shell beds and limestone layers are present at discrete locations such as those forming the Nukumaruan Aquifer in Wanganui;
- in more recent geologic time (over the last 360,000 years), alluvial deposits have been formed by the erosion of the greywacke ranges (a process that is continuing today). These alluvial deposits are highly variable in terms of both composition and deposition, but often contain zones where permeable gravelly strata predominate, forming high yielding productive aquifers. These productive

water bearing strata tend to be thinner close to the inland high country and thicken towards the coast. In the Tararua District these alluvial deposits are more limited to infill within valleys and flood plains and can extend up to 30 metres thick. In the western parts of the Region (particularly in the lower Manawatu and Rangitikei catchments) the alluvial deposits are much more widespread and their thickness can extend up to several hundred metres.

The groundwater used by water supply wells is abstracted from water that moves through the porous spaces within the strata. Figure 1 is a simplified geologic map of the Region showing the three types of strata listed above and the location of all the groundwater bores that are recorded on Horizons groundwater data base.

It shows how most wells occur within the more recent alluvial deposits that have the most permeable spaces where groundwater movement occurs. Groundwater is recharged by infiltration of rainwater through the ground surface and by seepage losses from rivers and streams, which commonly occurs where they emerge from their hill catchments and flow over the alluvial deposits.

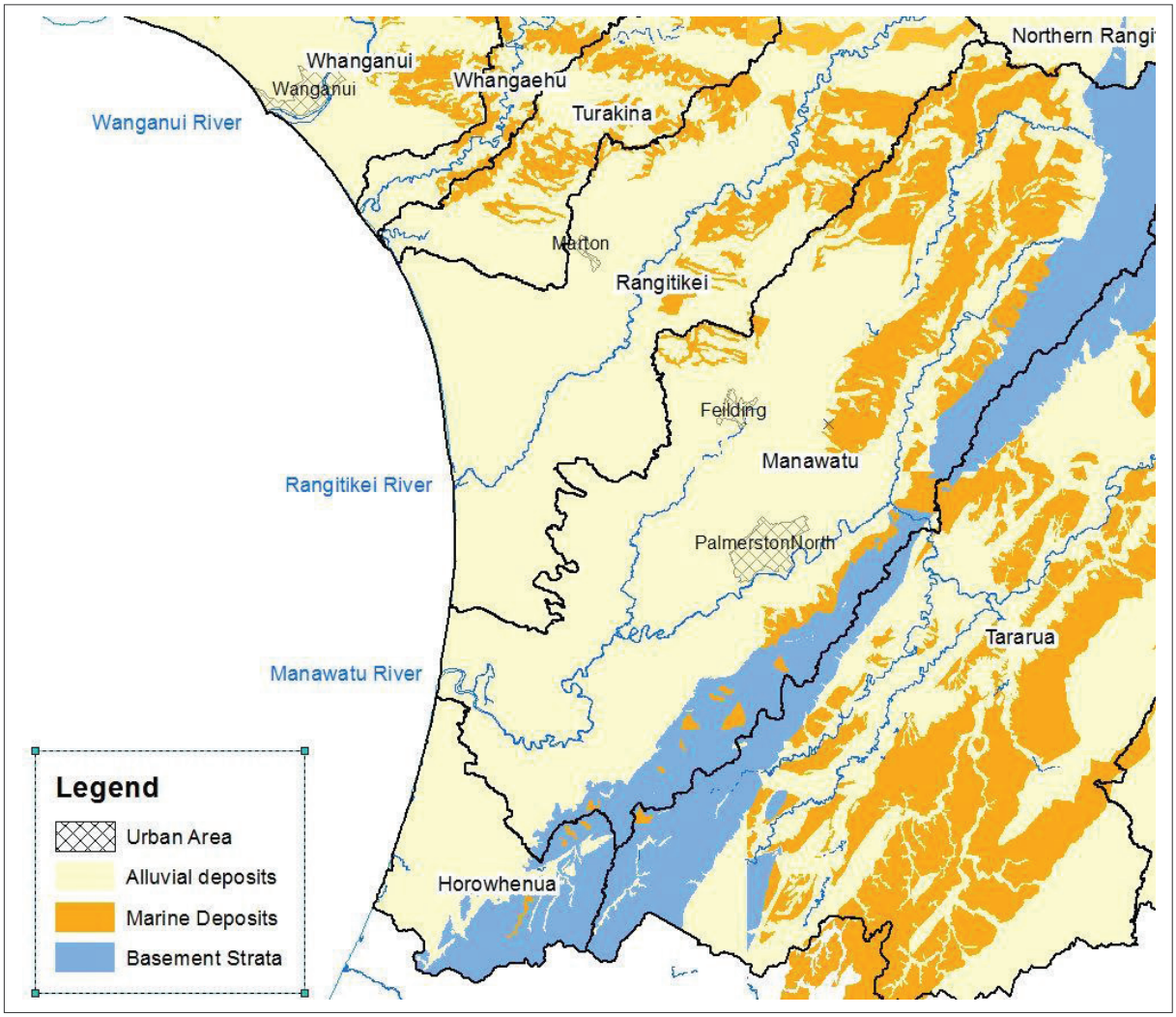


Figure 1: Simplified Geological map of the region

The general direction of groundwater movement is from the inland hills towards the coast. Groundwater discharge occurs into the sea and also into streams and lakes, particularly towards the coastal margins.

Groundwater is accessed by water supply bores that are drilled into the strata and have a perforated section, called a well screen, that allows water into the well. The well screens are placed across the most permeable strata encountered during drilling. At some locations the groundwater pressure under the ground is so great that the groundwater will flow freely out the top of the well to provide the supply. However, in most cases a pump must be installed to lift the water up to provide the required supply.

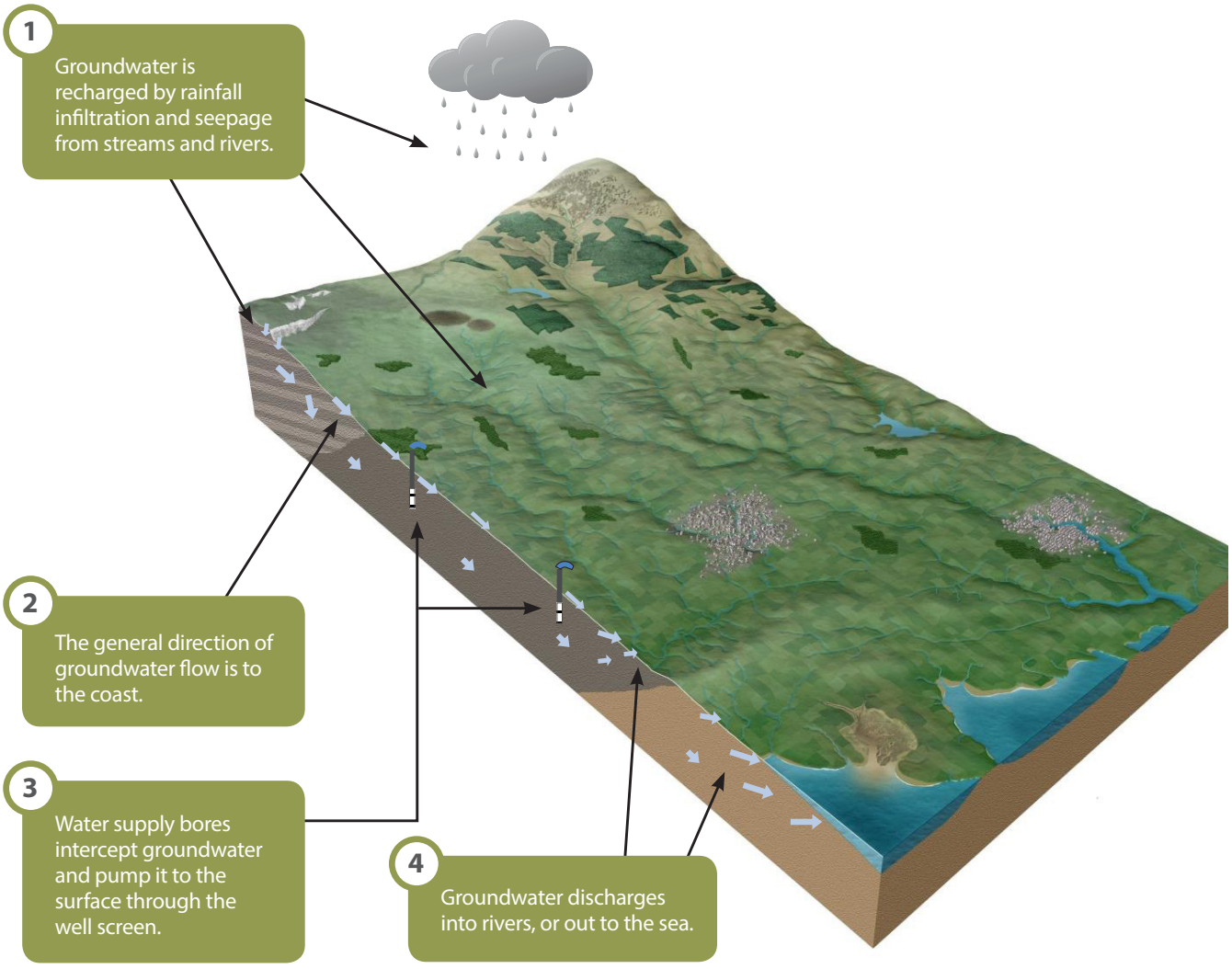


Figure 2: Simplified Schematic of Groundwater Flow

3.0 Sources of Poor Quality Water

As water moves from the ground surface to recharge the groundwater , it can become contaminated from a range of human activities at and just under the ground surface.

If water supply wells are located close to these contamination sources the quality of the supply could be affected, either by direct inflow of contaminated surface water into the well head (particularly during rainfall events) or via movement of water underground. This is particularly relevant to shallow wells with cracked well casings or gaps around the well casing that allow shallow water to move easily down to the well screen.

As water moves downwards through the ground many of the surface and near surface contaminants are reduced due to the filtering and chemical processes that occur between the water and the strata through which it moves. Therefore deeper wells with secure well heads and casings are at less risk from near surface sources of contamination.

The quality of the groundwater is also influenced by its interaction with the natural strata through which it moves. Whilst this interaction can help to remove surface man-made contaminants there are some naturally derived contaminants that leach from the strata and affect groundwater quality.

The Horizons groundwater quality monitoring programme has identified the following main categories of contaminants that could be affecting drinking water supply wells.

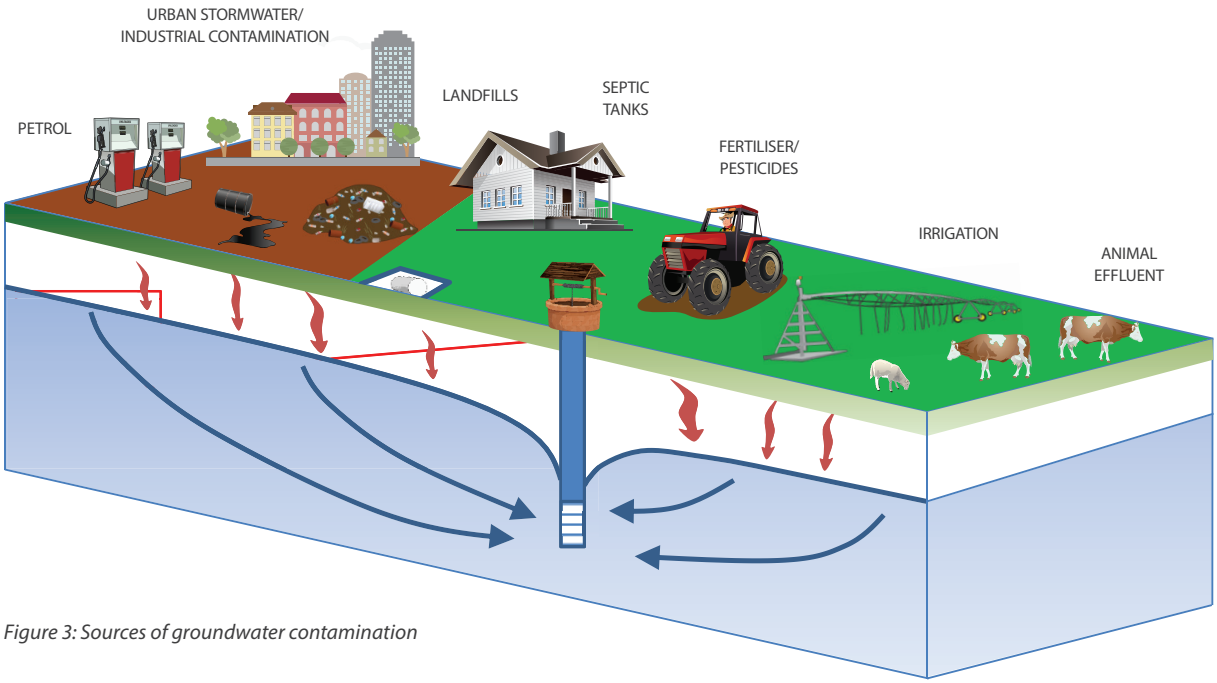


Figure 3: Sources of groundwater contamination

3.1 Bacteria

Escherichia coliform (*E.coli*) bacteria are an indicator of the presence of pathogenic (disease causing) faecal contaminants originating from warm-blooded animals (humans, birds, mammals). Their presence in well water poses an immediate risk of illness (such as vomiting and diarrhoea) to people drinking the water. The most common sources that affect water supply wells are surface water runoff entering openings around a well head or subsurface soakage areas for stormwater or septic tanks located near wells. Incidences of drinking-water contamination by *E.coli* can be quite variable and intermittent but often increase during heavy rainfall events.

3.2 Nitrate

Nitrate is the common form of nitrogen that occurs in oxygenated groundwater environments and is typically derived from agricultural land use (fertiliser, stock effluent and certain crops) and from human wastewater (septic tanks). It poses a health risk to pregnant women and bottle-fed infants up to six months of age resulting in methemoglobinemia (blue-baby syndrome). It is most likely to occur in shallow wells where the groundwater is mostly recharged by rainfall infiltrating through land used for intensive agriculture or wells sited close to septic tanks.

3.3 Ammonia

Ammonia is another form of nitrogen, derived from the same sources as nitrate, but occurs in groundwater with low oxygen content (i.e. reducing conditions). It causes the water to have an unpleasant odour.

3.4 Iron-Manganese -Arsenic

In natural strata comprising old swamp deposits and low dissolved oxygen levels chemicals such as iron, manganese and arsenic can leach out of the strata and into the groundwater. This is a natural occurrence which can affect water supplies causing discolouration, unpleasant taste or health risks.

3.5 pH

pH measures whether the water is acid or alkaline and is primarily determined by the natural characteristics of the water and the strata through which it flows. High pH water (alkaline) has a soapy taste and feel. Low pH water (acidic) can have a corrosive effect on plumbing and heating cylinders causing dissolved metals to be present in water that has been in contact with these metals for prolonged periods.

3.6 Hardness

Hardness is the combined content of calcium and magnesium in the water. Elevated hardness is most commonly present in groundwater due to leaching from the natural strata through which it moves (particularly limestone) although localised contamination from artificial fill can also be a cause. Elevated hardness in a water supply can lead to build up of scale on pipes, unpleasant taste and reduced lather from soap.

Other contaminants affect the aesthetic quality of a water supply (e.g. taste, smell, colour) but do not cause known health problems. The map in Figure 4 shows the broad areas where groundwater has been found to more commonly have low dissolved oxygen (reducing conditions) or high dissolved oxygen (oxidising conditions). In areas with reducing conditions, iron, manganese, arsenic and ammonia may more commonly be present. In the areas within oxidising conditions, nitrate and low pH might be a more common problem.

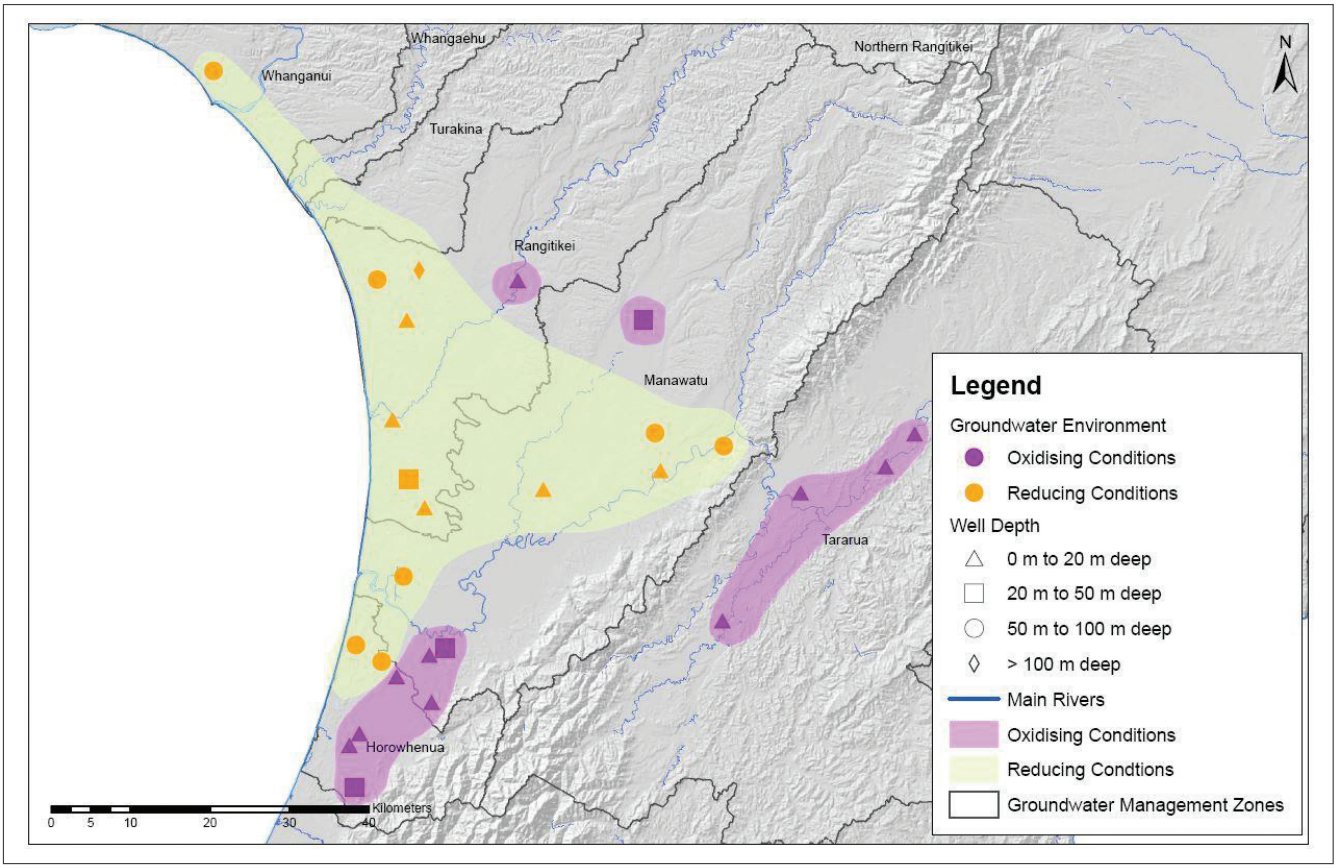


Figure 4: Map of oxidising and reducing groundwater zones

3.7 Contaminated Sites

In addition to the common and sometimes widespread effects on groundwater quality described above, there can be localised sources of contamination from specific land activities or wastewater discharges that can generate a wide range of potentially contaminating chemicals. Examples of such sources include:

- leaks from underground fuel storage tanks and refuelling areas;
- soakage disposal of wastewater or waste products from industrial activities;
- rubbish dumps;
- sheep dips;
- offal pits and agricultural waste dumps;
- septic tank soakage areas;
- stormwater soakagel; and
- chemical storage

It is important to understand the existing and historical land practices that have occurred near any water well sites to determine if these sources of contamination could affect groundwater supply wells.

4.0 How to know if your water supply is at risk of contamination

The sources of potential contamination described in this report fall into the following categories:

- **Point sources** – these are specific local discharges that typically occur within a few tens of metres of a well such as soakage areas for wastewater (e.g. septic tanks) or stormwater, leaking storage and filling areas for fuel and other chemicals, waste dumps or contaminated soil from current or past land use activities.
- **Wide-spread sources** – these are typically related to intensive agricultural land use or large scale waste water disposal onto land (if it is not properly designed and managed).
- **Natural contamination** – that is derived from the natural strata and the groundwater chemistry that interact with it.

It is important for well owners to understand the current and past land uses that have occurred in and around their wells, so as to identify potential sources of contamination that may be present.

It is also important for well owners to understand the construction and operation details of their well. In particular:

- Most wells will have a well driller's log prepared at the time the well was drilled which describes the type of well screen intake, the depth at which it occurs and the strata encountered during drilling. This helps to understand the type of strata through which the groundwater flows to enter the well.
- Information on the pumping rate and water level drawdown, the type of pump and depth at which it is set also indicates the pattern of water movement into the well.
- It is important to check the construction and location of the well head to ensure it does not contain any openings into which surface water can enter the well casing or the annular space between the well casing and the ground around it.

Direct signs of a contaminated water supply can be observed from the colour, odour and taste of the water supply or the occurrence of turbid water.

The NZ Drinking Water Standards note the following aesthetic effects from some contaminants:

- iron- staining of laundry and sanitary ware
- manganese – staining of laundry
- ammonia – odour
- hardness – scale deposition and scum formation

Any localised contamination from fuel or other chemicals can create a particular tainting or oily film that will affect the taste and odour of the water.

Of particular concern will be the occurrence of illness on a regular basis or after heavy rainfall events that could be related to the water supply.

The best method to check potential water quality issues is by collecting a water sample and having it tested by a laboratory that is independently accredited by IANZ (International Accreditation New Zealand) or an equivalent system. Information on an appropriate testing laboratory can be provided by Horizons, the local Environmental Health Officer (EHO) at the District Council, or from a Health Protection Officer (HPO) at Mid Central District Health, Wanganui Public Health Centre or Waikato District Health.

Particular sampling procedures and bottles are required for the water sampling and information about this should be sought from the testing laboratory.

The laboratory will have a range of standard analyses for potable supply, but requests for specific analyses related to the local conditions in and around a particular well can also be made. Advice on the most appropriate analyses can be obtained from Horizons, the EHO, HPO or the testing laboratory.

It is a good idea for every drinking water supply to have at least one sample collected and analysed to check its potability. Ongoing sampling is appropriate if there are clear indications of contamination risk or if there is an obvious change that is observed in the quality of the supply.

5.0 Managing Your Drinking Water Supply

The best way to manage your drinking water supply is to avoid likely sources of contamination. In particular:

- wells should be located away from local sources of contamination such as septic tanks, stormwater or wastewater soakage areas;
- wells should be screened at sufficient depth to avoid shallow groundwater that is most likely to be contaminated and, where possible, the placement of the well screen should avoid the types of strata where naturally derived contaminants may be present;
- well heads should be elevated above ground level and fully sealed to prevent the ingress of surface water with a concrete pad around them and an elevated location that sheds stormwater away from the well.

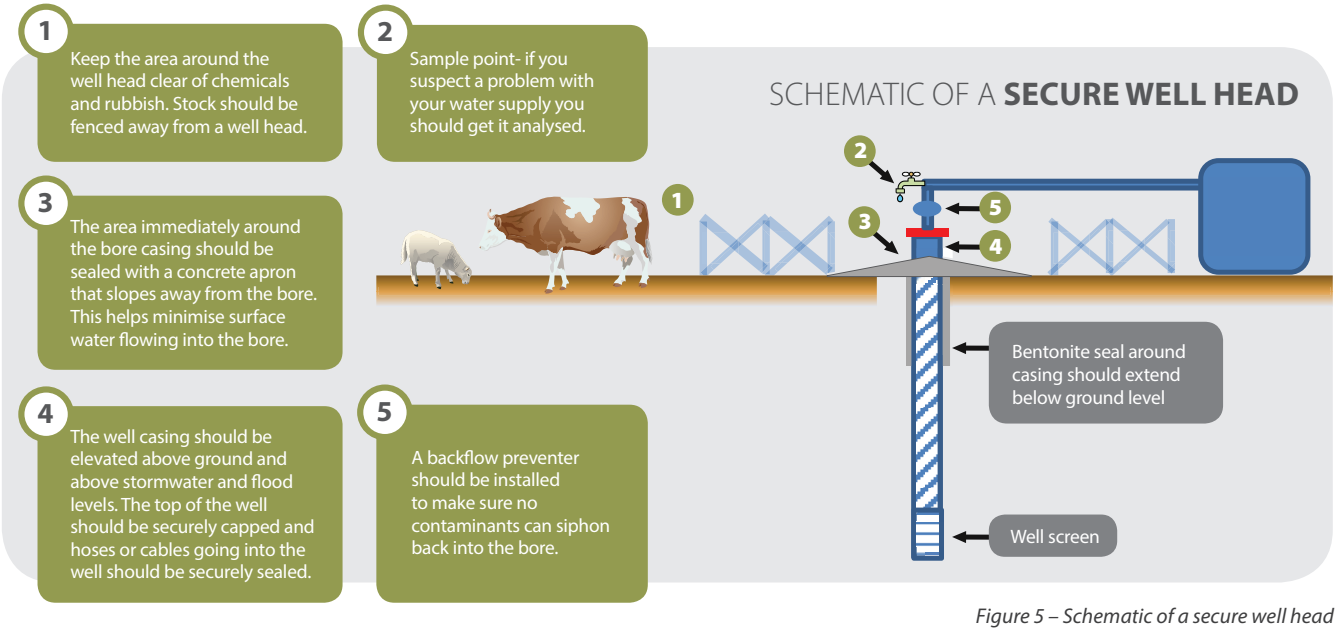


Figure 5 – Schematic of a secure well head

At least one water sample should be collected from the well to check for the presence of contamination.

When using the water it is good practice to let it run for a short period of time so that a small volume of water, approximately 500ml, is flushed from the tap before water is drawn for drinking, cooking or other consumptive uses. This will avoid ingesting water that has been sitting in contact with the tap fittings for a prolonged period.

If the well is at risk of bacterial contamination then all water that is used for drinking water should be boiled for one minute before drinking. It is ok to use jugs with an automatic cut-off switch as long as they are full.

On no account should the switch be held down to increase boiling time.

If the well is at risk of high nitrate concentrations then bottle–fed infants and pregnant women should avoid the supply and use bottled water or an alternative secure water supply. Known elevations of nitrate occur around the Horowhenua area.

Water treatment systems are available for some problem contaminants, such as *E.Coli*, pH, iron, manganese and arsenic. It is important to ensure that any treatment system is appropriately dimensioned for the type and scale of contamination that is present in the well.

6.0 Further Information

The information provided in this report is of a general nature. It is important to obtain specific information about particular contaminants, individual water supply wells and conditions. Advice on this matter can be obtained from the following organisations:

Health Protection Officers

- ✓ Health and aesthetic concerns
- ✓ Sampling
- ✓ Water quality testing
- ✓ Interpretation of testing results
- ✓ Compliance with NZ Drinking Water Standards
- ✓ Advice on water treatment options
- ✓ Historical land use and potential contaminated land issues

MidCentral District Health Board
Palmerston North
Phone: 06 350 9110

Whanganui Public Health Centre
Wanganui
Phone: 06 348 1775

Waikato District Health Board
Hamilton
Phone: 07 839 8666

Environmental Health Officer

Contact your city or district council

- ✓ Health and aesthetic concerns
- ✓ Sampling
- ✓ Water quality testing
- ✓ Interpretation of testing results
- ✓ Compliance with NZ Drinking Water Standards
- ✓ Advice on water treatment options
- ✓ Historical land use and potential contaminated land issues

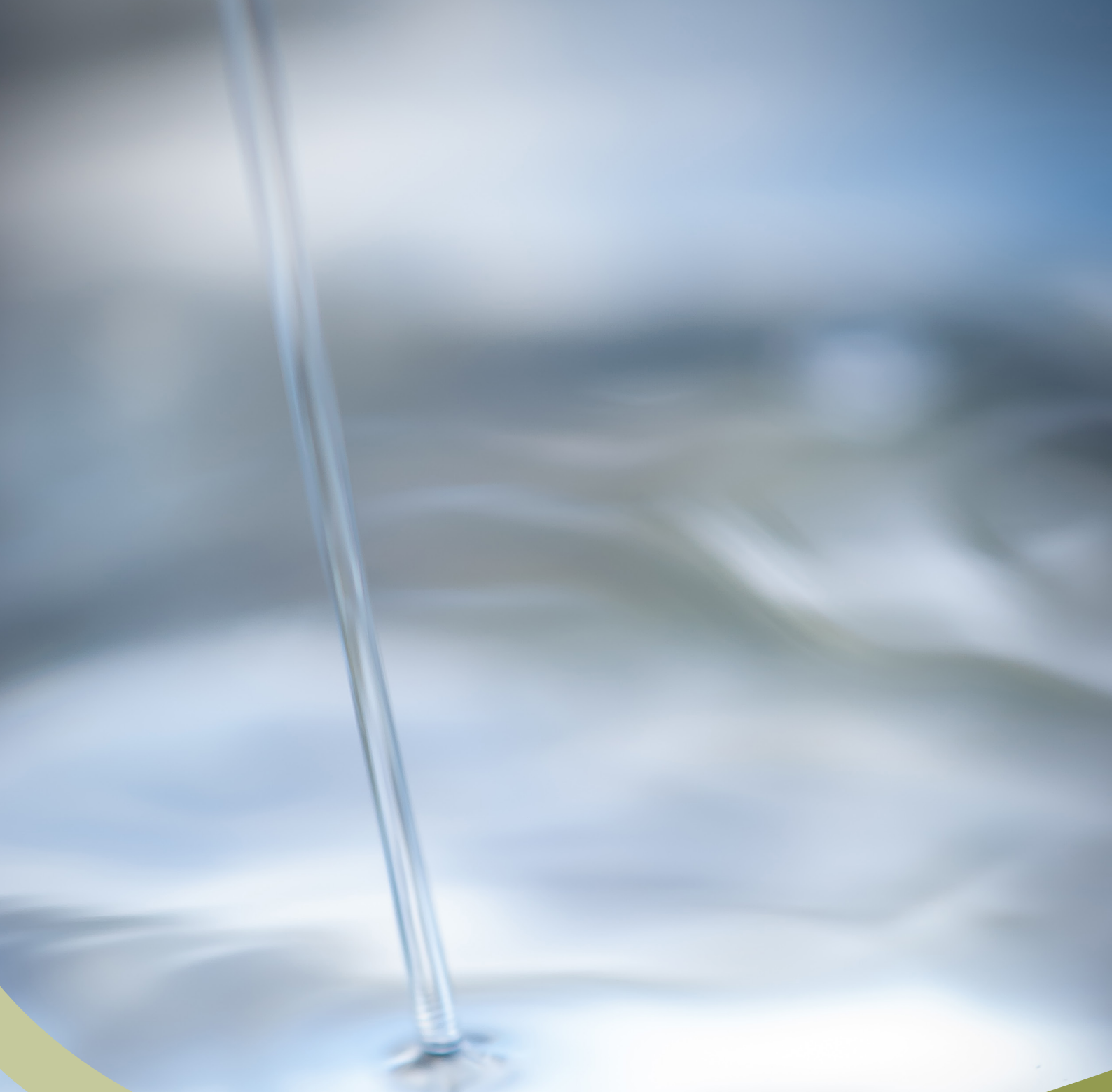
Groundwater Scientist

- ✓ Well sitting
- ✓ Well construction
- ✓ Groundwater quality data
- ✓ Availability of groundwater

Horizons Regional Council
Palmerston North
Phone: 0508 800 800

Notes

Notes



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