Groundwater Treatment Fact Sheet

Introduction

Groundwater sources can be either shallow or deep. Groundwater from a shallow surface connected or unconfined aquifer can be contaminated with disease causing microorganisms or chemicals from surface activities. Groundwater from a deep or confined aquifer will be less likely to be contaminated with disease causing microorganisms, but may contain heavy metals, other chemicals and radioactivity, depending on the geology. Groundwater supplies should undergo comprehensive water quality testing to ensure suitability for drinking water purposes.

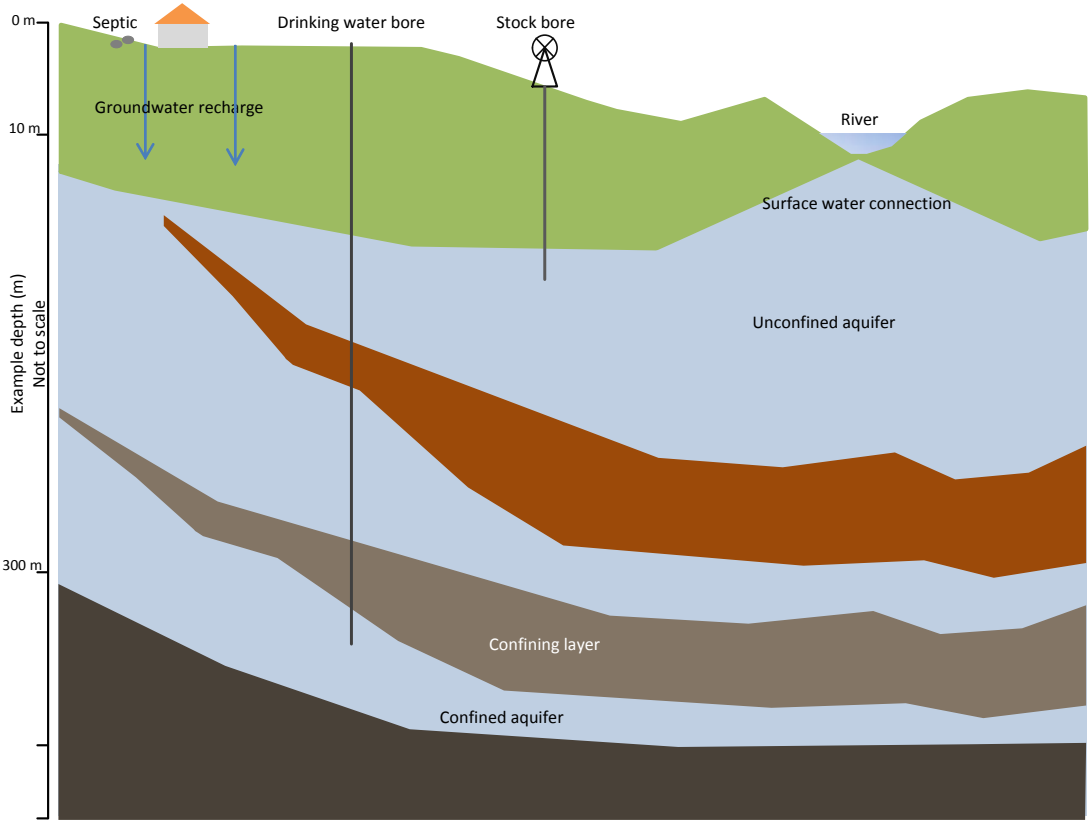

Figure 1 – Groundwater sources; example of an un-confined aquifer & confined aquifer

Groundwater supplies should be tested for *E. coli* and a comprehensive range of chemical and physical characteristics prior to use, including radioactivity. The water should be retested if there are any changes in water quality, such as the appearance of odours, taste or colour. Contact your local Public Health Unit for testing advice on 1300 066 055 and refer to the *NSW Private Water Supply Guidelines* for information on groundwater, hazards and testing.

It is important that any plumbing materials, together with appropriate water treatment and disinfection systems are correctly selected, installed and regularly maintained in order to protect drinking water quality.

NSW GOVERNMENT Health

Look for tanks, coatings and plumbing materials that have been tested for contact with drinking water to AS/NZS 4020:2005 and PVC-U pipes and fittings certified to AS/NZS 1477.

http://www.health.nsw.gov.au/environment/water/Documents/NSW-Private-Water-Supply-Guidelines.pdf

Groundwater Health Risks

Groundwater from a shallow surface connected or unconfined aquifer may be contaminated with disease causing microorganisms or harmful levels of chemicals from urban, agricultural or industrial activities.

Groundwater from a deep or confined aquifer, with an encased and well maintained bore may be free from disease causing microorganisms, but the chemical quality must be thoroughly checked to ensure it is suitable for drinking.

Groundwater may need to be disinfected before consumption to remove harmful microorganisms and should be disinfected to prevent any downstream contamination. Disinfection does not remove chemicals and other treatment processes may be necessary to manage any associated risks to health. If there are specific chemicals in your groundwater that may pose a health risk you are likely to need specialist advice on their removal. If your groundwater contains dissolved gases, such as hydrogen sulphide, or if it contains high concentrations of iron, it may be useful to pass it through an aerator before filtering. Advice from a specialist should also be sought on the installation of aerators or specialist treatment.

Groundwater Treatment Systems

There are several important actions that can be taken to reduce the risk of contamination in groundwater supply systems. These actions include;

Protect the bore from livestock and human access by erecting fencing to provide at least a 50 metre radius buffer zone around the bore. A larger buffer zone may be required for shallow bores, permeable soils and/or fractured rock aquifers

Protect the bore from surface water entry by installing a suitable watertight bore seal extending at least 3 metres in depth below the top of the bore and a surrounding concrete plinth at least 2 metres in diameter, sloping away from the bore head and extending at least 300 mm above the surrounding ground level.

There are several methods for treating groundwater and professional advice should be sought for the design and installation of an appropriate water treatment system, to remove any contaminants that may present a health risk. These treatment methods may include:

Filtration to remove particulate matter from water. There are many filtration devices available and microorganism and particle removal varies with the filter type. Some filter systems will require a power supply

UV disinfection by ultraviolet (UV) light irradiation is effective against most bacteria, viruses and protozoa. UV systems require relatively low maintenance, do not require the addition of chemicals and can include warning alarms to indicate equipment faults. Specialist UV chambers for treating groundwater are designed to provide a dosage of UV light at a given flow rate. UV systems are most effective when the water is clear and free of particles. Groundwater supplies will often need filtration prior to UV disinfection due the presence of chemicals and particles. UV treatment does not remove

chemicals from water. UV systems will require a power supply. Water that has been disinfected using UV should be used straight away, not stored in tanks.

Chlorine disinfection is a common form of disinfection that is effective against harmful bacteria, viruses and *Giardia*, but has limited effect against *Cryptosporidium*. Groundwater supplies will commonly require filtration prior to chlorination due the presence of chemicals (e.g. iron and manganese) that should be removed in order for the chlorination process to be effective. A storage tank is also needed, to provide adequate chlorine contact time. Details for hand dosing chlorine can be found on page 25 of the *NSW Private Water Supply Guidelines*.

Filtration Treatment Systems Include

Polypropylene & ceramic cartridge type filters can effectively treat water by removing sediment and bacteria, but will not remove viruses

Activated carbon filters are most effective in removing and/or reducing chemicals such as iron and hydrogen sulphide, objectionable tastes, odours and colour, but will not remove bacteria or viruses. NSF/ANSI Standard 42 refers to the removal of specific aesthetic or non-health-related contaminants (chlorine, taste, odour and particulates)

Micro/Ultra filtration membrane filters (0.1 - 0.01 micron) can effectively treat water by removing sediment and bacteria. Ultrafiltration membrane filters may also remove viruses. Installations should include a pre-filtration stage of 30 micron rating, an automatic filter backwash cleaning function and a suitable disposal method for the small amount of dirty backwash water from the filters. NSF/ANSI Standard 53 refers to the removal of specific health related contaminants

Reverse osmosis filters (0.001 micron) are the most sophisticated and are extremely efficient and effective for the removal of microorganisms and most residual chemicals from water. The filters produce a constant waste stream when operating, and usually need to be connected to a drain and a power supply. Installations should include a pre-filtration stage of 5 micron rating, an automatic filter backwash cleaning function, and suitable disposal method for the waste stream and small amount of dirty backwash water from the filters. NSF/ANSI Standard 58 refers to the removal of total dissolved solids and other optional reduction claims.

Checklist for selection and purchasing a filtration system

- Determine the volume of water to be treated and ensure the filtration equipment has the capacity (e.g. litres/hour) to treat all the water needed. The smaller the micron size, the finer the filtration, the greater the reduction of the flow rate and available pressure through the filter resulting in a higher the frequency of maintenance
- Determine the type of pre-treatment required for any chemicals of health concern, or iron and manganese present in the water
- Determine any pre-filtration screening requirements to remove dirt, debris and larger solid particles to prevent fouling or clogging of the filter
- Ensure that the filtration system carries the WaterMark or Plumbing Safety Type Test Mark and it complies with at least one of the following standards, ANSI/NSF Standard 53 or AS/NZS4348. Filters being installed to remove a specific contaminant should have been tested to demonstrate their effectiveness against that contaminant

Where the filtration equipment may be subject to normal water mains pressure (i.e. greater than 150 kPa) then the filtration equipment must comply with AS/NZS 3497.

Checklist for selection and purchasing a UV disinfection system

- Determine the volume of water to be treated and ensure the equipment has the capacity (e.g. litres/hour) to treat all the water needed
- It is equipped with a pre-filter to remove any dirt and debris that can either absorb or scatter the UV light. Generally a 20 micron filter is installed between the pump and the UV unit
- It is equipped with a second stage filter (1 micron) before the UV unit to reduce parasitic cysts such as *Cryptosporidium* and *Giardia* that are more resistant to UV light than bacteria and viruses
- It has a built in light sensor that can monitor the UV intensity, connected to an alarm system to alert the user in case of low UV level
- It has a safety control system that can shut off the water supply in case of a low UV level alarm or loss of power
- It is connected to a constant power supply of sufficient capacity to suit the system
- The UV disinfection system carries the WaterMark or Plumbing Safety Type Test Mark and at least one of the following standards, ANSI/NSF Standard 55 Class A systems (40 mJ/cm^2), AS/NZS 3497 or AS/NZS 4348 and treatment classification level.

Checklist for selection and purchasing a chlorine disinfection system

- Determine the volume of water to be treated and ensure the equipment has the capacity (e.g. litres/hour) to treat all the water needed
- It is equipped with a pre-filter to remove any iron, manganese and other dirt and debris that can either absorb and/or deplete chlorine residual levels
- Adequate post chlorine dosing detention time is available within the water supply system, typically at least 30 minutes is required to complete the disinfection process and ensure a minimum free residual chlorine level of 0.5 mg/L
- Includes a residual chlorine test kit to be used for regular monitoring (e.g. daily or weekly) of residual chlorine levels in the supplied drinking water
- The chlorine disinfection system carries the WaterMark or Plumbing Safety Type Test Mark and AS/NZS4348.

Before purchasing a treatment system it is recommended that the following information be obtained from the supplier

- Product specifications – including the contaminant removal claims and data
- Product certifications
- Maintenance and replacement requirements and associated costs
- Operating costs.