# Groundwater Sampling Procedures

**Overview:**

This document is intended to provide clear and brief procedures for Horizons Regional Council's Catchment Data Teams regular Groundwater Sampling Programmes – to ensure that they conform to the *National Protocol for SoE Groundwater Sampling in NZ (MFE, 2006).* For anything not covered in these procedures please refer to the *National Protocol for SoE Groundwater Sampling in NZ (MFE, 2006)* (see appendix 1 for the document location).

Currently there are six groundwater nitrate sites sampled every three months, and 25 groundwater SoE sites sampled every seven months. Horizons Regional Council also collects three groundwater samples every three months for IGNS. Every three years Horizons Regional Council also collects 44 bore samples across the region for the groundwater pesticides programme.

**Health and Safety:**

Horizons Regional Council staff are required to read, agree to, sign and follow all applicable health and safety plans that are relevant to the job they are undertaking. The location of the health and safety plans relevant to groundwater sampling is located in appendix 1.

All staff undertaking groundwater sampling should read the following health and safety plans

- Plan 4 - Excessive noise in the work environment
- Plan 12_2 – Working at night – General Staff
- Plan 16 – Working on roadsides
- Plan 17 – Ultraviolet radiation (sunlight)
- Plan 18 – Working around water
- Plan 20 – Motor vehicle use
- Plan 22 – Criminal activities
- Plan 24 – Working in isolation
- Plan 26 – Dangerous animals
- Plan 31 – Leptospirosis
- Plan 34 – Severe Winds
- Plan 35 – Sample bottle handling

**Specific Sampling Equipment**

The groundwater sampling equipment required will usually include some or all of the following:

- Calibrated Well Probe for obtaining Static Water Levels (SWL) from non-artesian bores
- Calibrated Druck for obtaining SWL from artesian bores
- Calibrated Handheld Water Quality Meter, for the field measurement of water temperature, conductivity, barometric pressure, dissolved oxygen, pH and ORP.

  - Note that membrane dissolved oxygen filters are not suitable for groundwater sampling unless the flow is greater than 0.3m/s. Optical dissolved oxygen sensors should be used.
- New plastic syringe (polyethelene, polypropolene or similar) if filtered samples are to be taken
- New disposable filters of 0.45 µm (for filtered samples), one for each sample
- Sterilisation solution of 70% (v/v) ethanol, for sterilisation of sampling point for taking sterile samples for microbiological analysis
- Submersible pump and charged battery
- Assorted taps, hose and pipe fittings etc
- A length of garden hose and 8mm tubing
- Tools such as pipe wrenches, adjustable spanners, screwdrivers etc
- Thread tape

**Determine Static Water Level:**

SWL is a term used to describe Groundwater level recorded under ambient (non-pumping) conditions. SWL is useful for Groundwater level monitoring and for the calculation of bore purge volumes for sampling purposes. The recording of SWL is not always possible due to bore access or pumping conditions.

The method used to determine the Static Water Level (SWL) will depend upon whether it is an artesian or non-artesian bore:

**Artesian**
For artesian bores a calibrated Druck (or other pressure transducer) can be used provided you have a tap fitting on the bore (or somewhere to attach a tap fitting) to attach the Druck to:

- Open the tap and run for a few seconds to clear any trapped air and to check you have water pressure.
- Set the Druck to record pressure in bar
- Zero the Druck at atmospheric pressure
- Attach the Druck to the closed tap fitting
- Hold the Druck level with the tap to get an accurate pressure reading
- Open the tap fully and wait for the pressure reading to stabilise
- Record the pressure reading on your field sheet
- To convert bar to meters of head the following conversion can be used:
  - 1 bar = 10.197m, or 1m = 0.981 bar

**Non-Artesian**
For non-artesian bores all that is required is an opening in the top of the bore casing where a well probe can be lowered. Be careful when lowering the probe not to get the probe stuck inside as it can become entangled on cables and/or pumps. A good technique is to ensure you feel the weight of the probe (a bit like a fishing line) as you lower it, and if the tape becomes slack wind it up and try again as it is caught on some obstruction.

Ensure you record a description of the datum from which the measurement is made, e.g. top of the well casing. The same measuring point should be used each time.

## Groundwater Sampling Procedures

### Calculation of Bore Purge Volume

Purging is the removal of standing water from a bore and its replacement with fresh formation water to ensure the water sampled is representative of the groundwater in the aquifer.

**To adequately purge a bore at least three times the standing bore volume of water must be removed prior to sampling.**

Formula to calculate standing bore volume:

*Standing water volume (in litres)* = $\boldsymbol{((\pi \times r^2) \times L) \times 1000}$

*Where:* $\pi = pi = 3.142$
$r$ = *radius of bore casing i.e. half the inner diameter (in meters)*
$L$ = *total bore depth subtract the depth to water (in meters)*

**Note:** Remember to multiply the standing water volume by three to get the required purge volume

### Determine Pumping Rate and Purge Time

Once the purge volume is known the pumping rate needs to be determined so that the time required to purge the bore is known. Pumping rate can be determined using a simple volumetric technique: e.g. time filling a vessel of known volume.

### Bore Purge Example

Here is a worked example:

Bore of 100mm diameter, 30m deep, Static Water Level is -5m below well casing.
Standing Water Volume = $((3.142 \times 0.05^2) \times 25) \times 1000$
= 196 litres
Purge Volume = 196 litres x 3 = 588 litres
Pump Rate = 0.5 litres/second = 30 litres/minute
Purge Time = 20 minutes

### Monitor Field Parameters while Purging

Temperature, Conductivity, Barometric Pressure, Dissolved Oxygen, ORP (eh) and pH must be monitored during purging to assess the adequacy of purging.

It is recommended that four separate readings of these values be taken and that these readings should correspond to the initiation of pumping, and after extraction of about one, two, and three standing water volumes.

A simple technique is to place the sensor(s) in an open container such as a measuring jug, and run the water into the jug – ensuring continuous laminar flow, and allowing the water to spill over from the jug. The flow needs to be quick enough to prevent temperature change but slow enough to avoid air bubbles etc.

## Groundwater Sampling Procedures

**Assess Adequacy of Purging**

Purging is complete when:

The bore has been purged of three times the standing bore volume, and

Field values of temperature, conductivity and pH have simultaneously stabilised to within the following limits:

- Temperature ±0.2 ºC
- Conductivity ±3% (±5% if ≤100µS/cm at 25 ºC)
- pH ±0.1 pH unit

**Groundwater SoE specific sample collection**

When collecting a sample for the groundwater SoE project specific purge times are outlined in the run guides. Most of the wells in this project are used for domestic purposes and it is assumed they are well purged. Each well must be run for a minimum time (usually 20 minutes) to "flush" the system.

Parameters will be recorded at five-minute intervals for a minimum of 20 minutes until the readings have stabilised – these readings must be taken after the system is flushed/purged.

**Sample Collection**

When collecting samples it is important to collect any sterile samples for microbiological analysis last, for other samples the order of collection is not important.

Collect samples directly from the pump outlet, and as close to the bore as possible. Do not collect samples after pressure tanks etc if possible. If you need to sample after a pressure tank then refer to the *National Protocol for SoE Groundwater Sampling in NZ (MFE, 2006) Appendix 5 – Instructions for isolating a pressure tank, pg 51.*

During collection a continuous laminar flow of water is required; the flow rate can be reduced to achieve this. Fill the bottles quickly and carefully, taking care to avoid aeration and avoid any contact with your hands or the sampling point with the mouth of the sample bottle.

**Filtered samples**

Fill the syringe directly from the pump outlet, fill and flush the syringe three times.

After filling syringe for the fourth time, attach a new filter, taking care to avoid contact with the syringe inlet and outlet. Fill the sampling bottle through the filter.

If the syringe needs to be refilled during sampling remove the filter and place somewhere clean and dry (a good idea is to use the filter package). Then refill the syringe, reattach filter and continue.

If the sample bottle contains acid preservative, only fill the bottle to the shoulder.

**Sterile Samples**

Sterile samples for microbiological analysis have special requirements:

## Groundwater Sampling Procedures

- The sample must be taken last, as the procedures for sterilisation of the sampling point may affect cation, metal and anion concentrations in samples collected afterwards
- The Sampling point must be sterilised:
  - Turn the pump off, then immerse, spray, or swab the outside and as much of the inside of the sampling point as possible using a solution of 70% (v/v) ethanol. Allow the disinfectant to act for 2 to 3 minutes
- After sterilisation turn the pump back on and allow sufficient water to pass to flush any residual ethanol out
- Put on a pair of clean (preferably sterile), powder-free, latex gloves
- Fill the sterile micro sample bottle the same way as other sample bottles, but leave an air space in the bottle
- Be sure not to contact the inside of the bottle lid, or the mouth of the sampling bottle with hands or the sampling point etc

**Tritium Sampling**

The bore should be purged before sampling to ensure the samples are collected and are representative of the water in the aquifer. Purge the bore at least three times and until the temperature, conductivity and pH are stable.

One litre of water is necessary for tritium analysis. Glass or plastic bottles are fine for sampling as long as they are air/water tight. 1L Nalgene bottles are best, but any bottle type will be fine. Flush the bottle several times with the sample water. Fill to the top (avoid excess air bubbles during filling as air contains tritium.

**Note: Ensure that nobody with a luminous watch is nearly during sampling. The light source of some of these watches is Tritium. Due to Tritium gas leaking from these watches it is possible for the sample to become contaminated.**

Tighten the bottle cap fully; when the bottles are not tight the sample water can exchange with atmospheric moisture and the sample can become contaminated with Tritium. Check by pressing on the bottle; you should not hear or see any air or water escaping. Retighten the lid after 4 hours as the plastic can settle and become loose. **Do not use thread tape**. Taping the lid from the outside is recommended.

Store all samples upright in a dark, room temperature area. Do not chill or expose to excessive heat. Ship as soon as possible.