

Geothermal guideline 1

Efficiency of the Rotorua Geothermal System



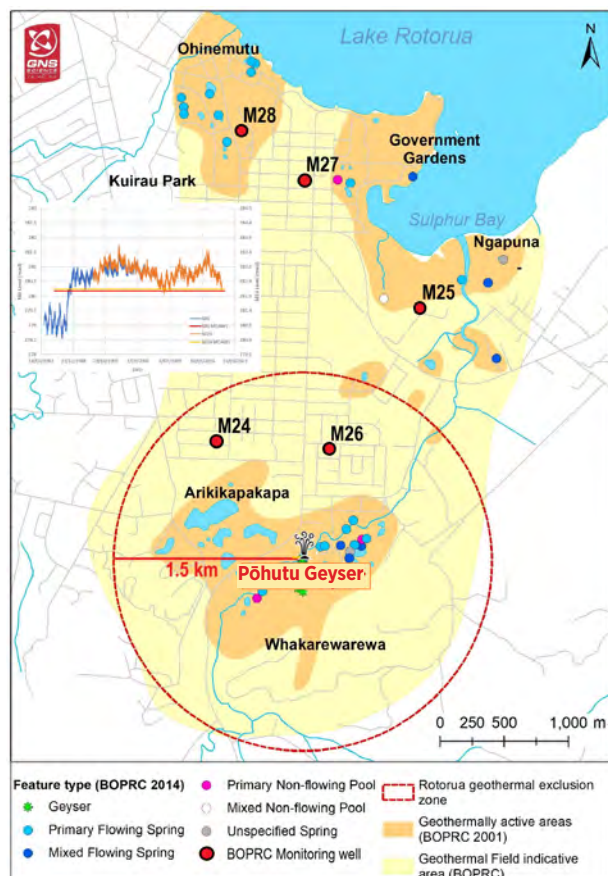
Our geothermal monitoring wells can sometimes show a decline in water levels. The science shows that this can sometimes be due to an extended dry period, rather than any changing use, but if a dry period lasts, our unique and vulnerable geothermal surface features might be at risk. This guideline, developed by Bay of Plenty Regional Council, provides an outline of what you can do to help improve the efficiency of the system.

What is the Rotorua Geothermal System and what is a geothermal reservoir?

The Rotorua Geothermal System (Ngā Wai Ariki o Rotorua) is a long-lived by-product of volcanism that occurred in the last hundreds of thousand years in the area. Fresh water penetrates through cracks and pores within hot volcanic rock, where it gets heated. This layer of heated water stored underground is called geothermal reservoir.

Where is the Rotorua Geothermal System?

The Rotorua Geothermal System underlies approximately 12 km² of Rotorua city, from the south-western end of Lake Rotorua to Whakarewarewa Valley.

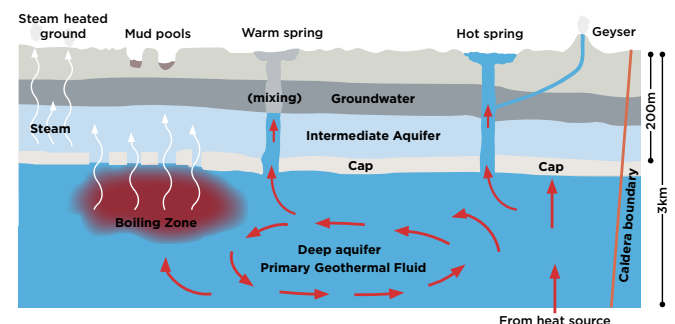


What are surface features and why do we need to protect them?

Surface features or ngāwhā are natural discharges of the geothermal water and steam above ground, which are fed by the geothermal reservoir. Surface features include hot springs, pools, steam-fed features and some of New Zealand's last remaining geysers, such as the Pōhutu Geyser. The surface features are important to the tourism industry and the science community, and are a taonga to Māori.

How are surface features affected by geothermal aquifer levels?

Each type of surface feature relies on a delicate balance of reservoir pressure (reported as water levels) and temperature. Changes to water levels affect how and if geysers and other surface features will 'play' in the long term. In the picture below you can see how the geothermal reservoir and some of the surface features that occur in Rotorua are connected.



How does Bay of Plenty Regional Council monitor the geothermal water levels?

Bay of Plenty Regional Council has five geothermal monitoring wells across the Rotorua Geothermal System. Two of those wells are just north of Whakarewarewa (M24 and M26), one in Ngāpuna (M25), one west of Government Gardens (M27) and one east of Kuirau Park (M28). Water levels in those wells are collected continuously. The map to the left shows the location of the monitoring wells (marked as Ms), as well as a graph of the water level for one of them.

How do we know when the water levels are getting low?

Three of our monitoring wells (M24, M26 and M28) have minimum geothermal aquifer water levels (MGAWLs) set to ensure that surface activity is maintained and to give Bay of Plenty Regional Council early warning of dropping aquifer water levels. Levels were set in the Rotorua Geothermal Regional Plan based on the minimum level recorded during the system recovery phase after bore closures.

What affects geothermal water levels and are they getting low?

Water levels are affected by rainfall, and by how much water and heat is taken from the reservoir. While our take of geothermal water and heat has not changed much in the last few years, the rainfall has. The geothermal reservoir is replenished by the rain that passes through the ground and geothermal water levels respond quickly to rainfall changes. Since 2017 annual rainfall levels have dropped, as well as the geothermal water levels. This dry period may continue.

Why do people take water from geothermal aquifers and how it is used?

Geothermal water is extracted from the aquifer and the heat taken is used for domestic, commercial and municipal space and water heating. Geothermal water is also extracted for customary uses such as bathing, cooking and healing, and in health spas for treatment.

How is geothermal water and heat extracted?

Geothermal water is extracted from the reservoir through geothermal wells. The heat is taken from the hot geothermal water using a heat exchanger and the used (cooled) water is injected back into the reservoir. When reinjection is not possible, for example the geothermal water that has been bathed in, the fluid is discharged to waste. Down hole heat exchangers (DHX) extract heat from the reservoir without bringing fluid to surface.

Does taking geothermal heat affect our aquifer levels, or only taking geothermal water?

Taking heat from the geothermal system causes cooling of the reservoir. A drop in the reservoir temperature changes the geothermal fluid properties and pressure, thus the water levels locally and across the field.

Do we have a problem now?

One of our three monitoring wells had reached its MGAWL. We monitored the situation closely and levels did recover. Temporary fluctuations in water levels have happened before. We want to give people early warning when this happens so they can do their part to reduce risks of future temporary reductions on consent holder takes.

What can we do now to help reduce the risk of water levels dropping further?

While we cannot control the climate, we can control how much water and heat we are taking. Where possible, we are asking you to limit your geothermal water use and to think of ways to reduce waste. Check out how you can use the geothermal resource more efficiently in the next page.

What happens if a dry period continues?

If a dry period continues water levels may continue to drop. Under the Rotorua Geothermal Regional Plan all resource consent holders have conditions to protect our surface features when water levels drop below a sustainable level. At the moment only one well has reached its MGAWL. If the MGAWL in other wells is triggered for more than 20 days Bay of Plenty Regional Council will formally ask resource consent holders to voluntarily reduce their takes. If water levels don't recover, Bay of Plenty Regional Council can require a staged reduction in take for a set period of time.



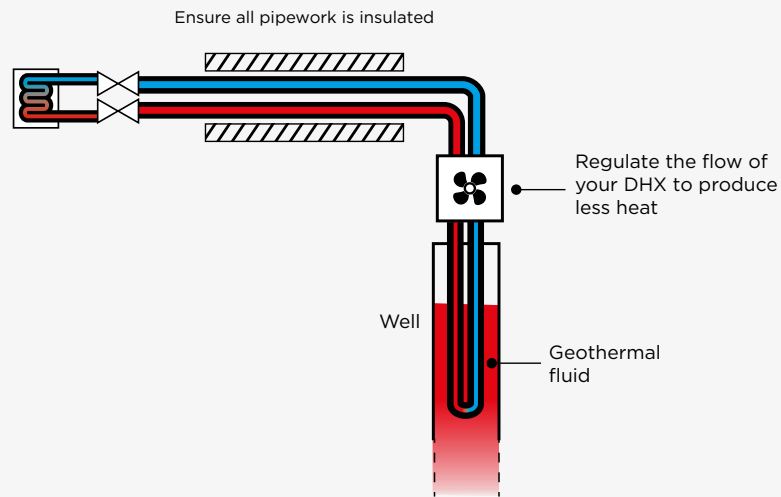
*Prince of Wales Feathers and Pōhutu geysers
Photo: Duncan Graham*

Ways to reduce your take and get efficient

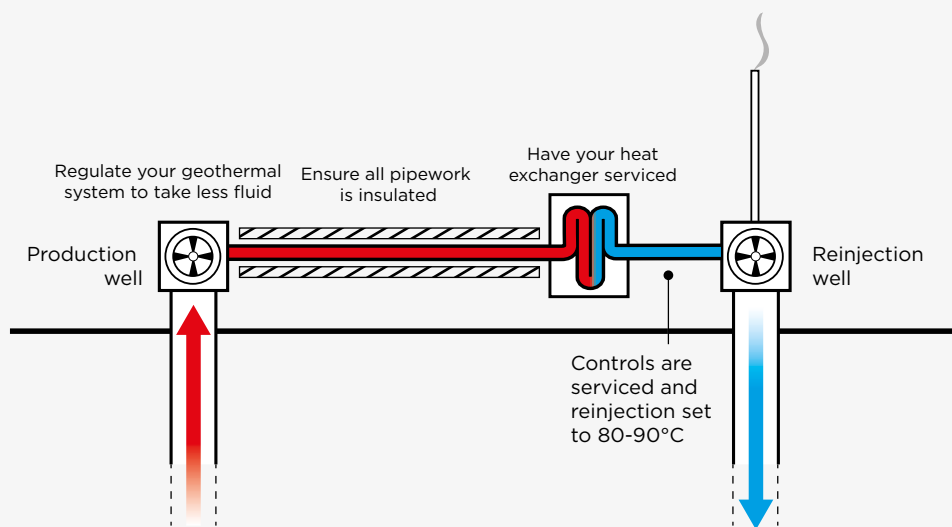
- ✓ **ALWAYS** seek advice from a **suitably qualified expert** to maintain and adjust your equipment as per the geothermal regulations.

In your production system	Production well or well with down hole heat exchanger (DHX) <ul style="list-style-type: none"> ✓ Regulate your geothermal heating system to produce less geothermal fluid. ✓ Regulate the flow of your DHX to produce less heat.
	Pipelines and heat exchanger <ul style="list-style-type: none"> ✓ Fix all leaking pipes and valves. Change them if they cannot be fixed. ✓ Fix any leaking heat exchanger gasket and replace any damaged plates. ✓ Clean your heat exchanger pipes. ✓ Install insulation on all hot and warm pipes.
	Your reinjection well <ul style="list-style-type: none"> ✓ If you are reinjecting water at more than 90°C, chances are you are wasting precious water as steam. Upgrade your geothermal heating system to reinject between 80 and 90°C. If you cannot do that, shut off your well during the drier months.
In your mineral pool	<ul style="list-style-type: none"> ✓ Only fill your mineral pool when you plan to use it. ✓ Reduce the pool temperature by 3°C or more.
In your indoor space	<ul style="list-style-type: none"> ✓ Only use the heat you need to be comfortable. Regulate your radiators. ✓ Keep your door and windows closed, apart from the middle of the day. This is to remove moisture. ✓ Heat only in mornings and evenings, unless occupied during the day too. ✓ If it gets too hot, shut off your well during the drier months and use an electric heater for the cooler times of the day.
In your hot water system	<ul style="list-style-type: none"> ✓ Think about ways to reduce hot water use. Use cold water to wash your hands, dishes and clothes when practical. ✓ Shower instead of bathing. Take showers 2-3 minutes shorter than you're used to. ✓ Reduce hot water waste. Turn off the hot tap when not using and fix dripping taps. ✓ Install insulation around the hot water equipment. ✓ Reduce the temperature of the hot water cylinder to 60°C.
In your heated pool	<ul style="list-style-type: none"> ✓ Turn the pool heating off if you are not using it frequently. ✓ Cover your pool and keep it covered as much as possible. ✓ Reduce the pool temperature by 2°C or more.

DOWN HOLE HEAT EXCHANGER (DHX)



PRODUCTION REINJECTION SYSTEM



You may also like to refer to our other geothermal guidelines

- Types of geothermal production systems in Rotorua
- Keeping your geothermal well fit for purpose and safe
- Managing geothermal discharges in Rotorua

For more information visit our website
www.boprc.govt.nz/geothermal
 or call 0800 884 880