



# Over 60 Years of Direct Geothermal Use at Wairakei - Tauhara and Growing Stronger .....



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Presented 15 November 2018 by Brian Carey



Me .....

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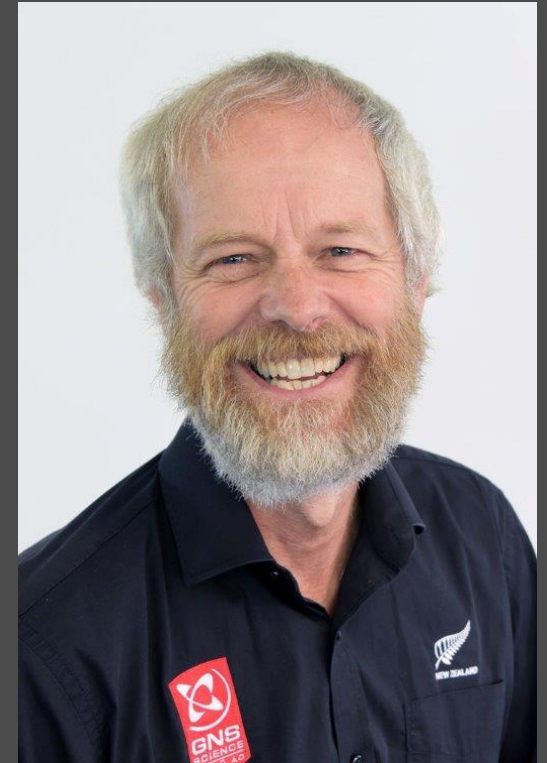


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**Enjoy the paper – 65**  
**Only snippets in the presentation**





# Wairakei

## Wonderland of New Zealand

- **Principal Sites**
  - Wairakei Geyser Valley
  - Waioira valley
  - Karapiti
  - Bathing in geothermal waters
    - Several pools in Te Kiri o Hinekai
    - Pool in the hotel grounds

Advertisements.

vii.

## W A I R A K E I ,

THE

Wonderland \* of \* New \* Zealand,

COMPRISES AN AREA OF 4,203 ACRES, ON WHICH ARE SITUATED ALL

### THE PRINCIPAL SIGHTS

IN THE

HOT LAKES DISTRICT:

Viz:—The Geyser Valley, Aratiatia Rapids,  
Karapiti or (The Devil's Trumpet), and Huka Falls.

Competent Guides accompany Visitors to the different places of  
interest, which cannot be described by the most facile pen.

## Geyser \* House \* Hotel

AND

S A N A T O R I U M

(SIX MILES FROM LAKE TAUPŌ)

Has Superior Accommodation and all the Comforts of a Home for  
**TOURISTS AND INVALIDS:**

Hot Swimming Baths. Magnificent Hot Douche Baths;  
Eclipsing the famous Massage Treatment.

Climate Dry and Bracing. Elevation 1,350ft. above sea level.

Central Depot of Main Roads leading to  
NAPIER, HUNTERVILLE, OR WANGANUI;  
ROTORUA OR LICHFIELD.

Coaches leave for Rotorua and Napier twice weekly; for Wanganui  
or Hunterville weekly.

POST AND TELEGRAPH OFFICE ON THE PREMISES.

TERMS MODERATE.

Telegrams addressed "Manager," Wairakei, will receive prompt  
attention.

MRS. R. GRAHAM, Proprietress.



# Geyser House Hotel



Look around the walls of the reception area  
and corridors for early photos



# Drive with AARD to the hotel in 1924

Maybe in a Hudson Super-Six Coach



WAIRAKEI  
THERMAL REGIONS  
NEW ZEALAND

TOURS  
NEW ZEALAND

Nga Tonga Video Clip from 1:16 to 2:05

[https://ngataonga.org.nz/collections/catalogue/catalogue-item?record\\_id=63284](https://ngataonga.org.nz/collections/catalogue/catalogue-item?record_id=63284)



# Early bathing in Geothermal water in Te Kiri o Hinekai



Alternative names Honeymoon pool and Avenue pool



Hotel grounds pool – stream flows through the pool  
Photo about 1920 - Now the lower pool



# The pool and log cabin - 1964



Selwyn Toogood video clip on the Wairakei Hotel  
from 12:10 to 12:37 <https://www.youtube.com/watch?v=vFCAONgdZU8>



# Lower Pool – Today



Geothermal steam

Plate heat exchanger



Pool Water Pump



# Upper Pool - Today



Plant room

Geothermal / Pool Water  
Plate Heat Exchanger



# Visiting the sights - 1924



Nga Tonga Video Clip from 3:18 to 4:40

[https://ngataonga.org.nz/collections/catalogue/catalogue-item?record\\_id=63284](https://ngataonga.org.nz/collections/catalogue/catalogue-item?record_id=63284)

# Hotel connects .... to the first Geothermal Production Well at Wairakei

- WK1
- Drilled May 1950 - Depth 183m
- Small truck mounted drilling rig
- Deterioration in the casing
  - Bore plugged with cement in April 1962
- Subsequently steam supplied to the hotel from the pipelines supplying the Wairakei Power Station



## Added dimensions to the tourism experience

- **Geothermal Development – from 1950's to ...**
- **Visiting the Wairakei Steamfield**
- **Visiting the rogue bore (WK 204)**
  - The ground shock under your feet – tours 1968
  - The hotel wanted more of it when it ceased to rumble in 1973





## Bore 204



Video of this can be linked to <https://www.youtube.com/watch?v=ZfhXgIm-mMs>

Run from 0:15 to 3:18

## Tenon - Taupō



- 400,000 tonnes a year of logs processed
- Drying 150,000 m<sup>3</sup> timber per annum
- In 2006 moved to Geothermal Kiln Drying
  - Replaced a natural gas fired system
- Using two phase geothermal fluid to provide heat to the kilns
- 9 batch kilns
- Kilns run at 180 °C and 150 °C
- 265 Employees



# Tenon – Kiln Drying Timber



- Reducing greenhouse emissions

Geothermal replaced a natural gas fired system  
Reducing CO<sub>2</sub> emissions by 27,000 tonnes per year



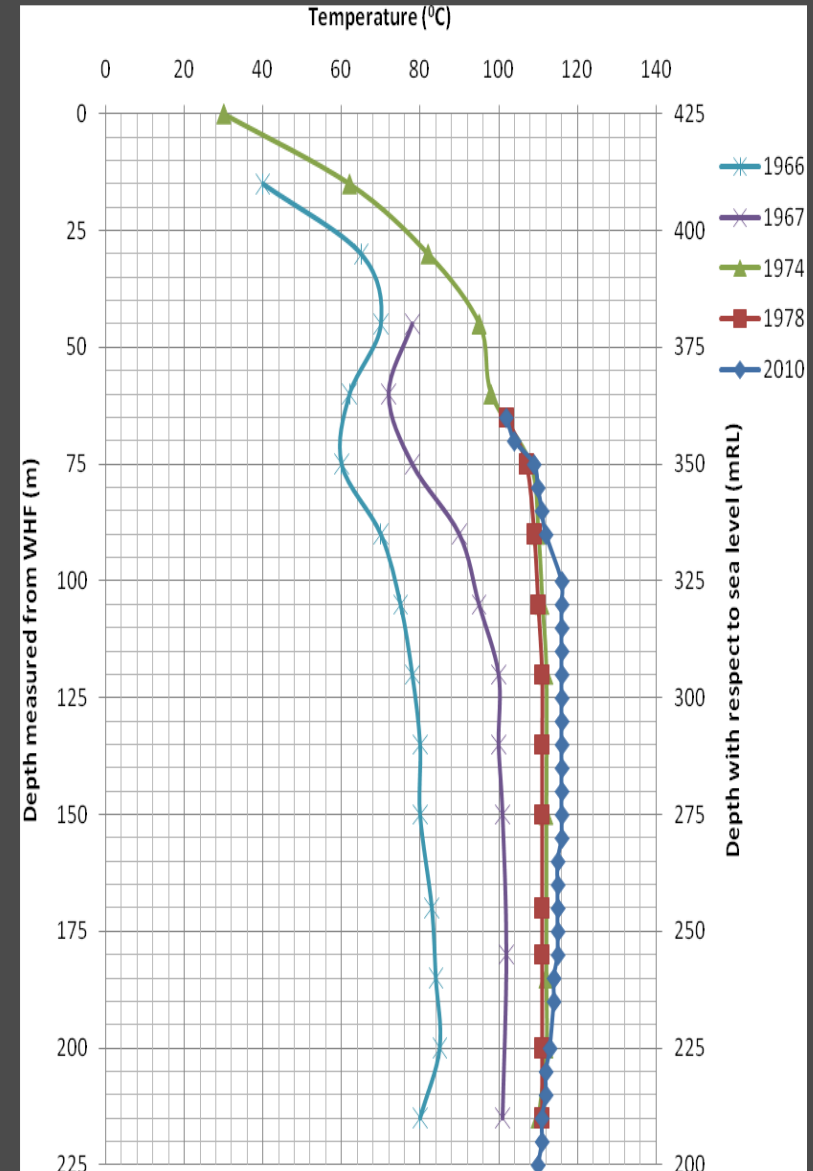
# Taupō Hospital - heating



Heat exchanger - up to ~400 kW

Improving the Environment  
Geothermal replaced a coal fired boiler  
Reduced CO<sub>2</sub> emissions by 700 t/year

## Downhole temperatures

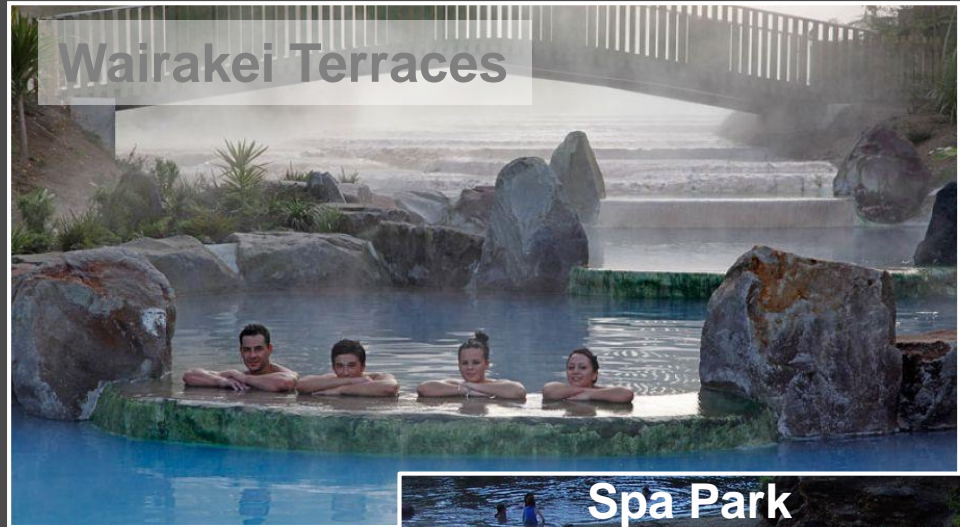


# Tourism and Spa Resorts

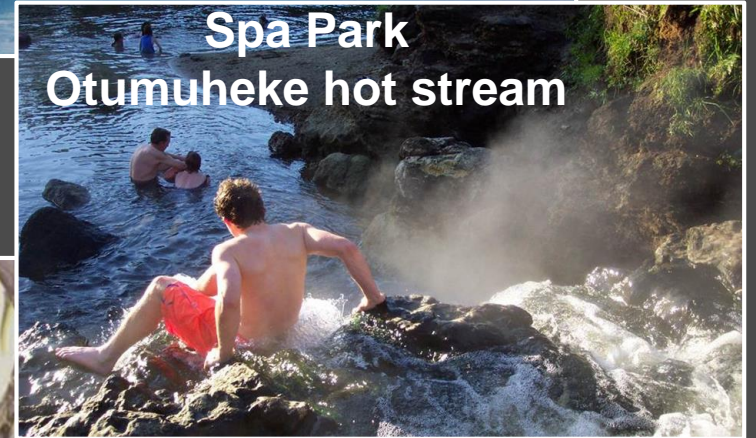
AC Baths



Wairakei Terraces



Spa Park  
Otumuheke hot stream

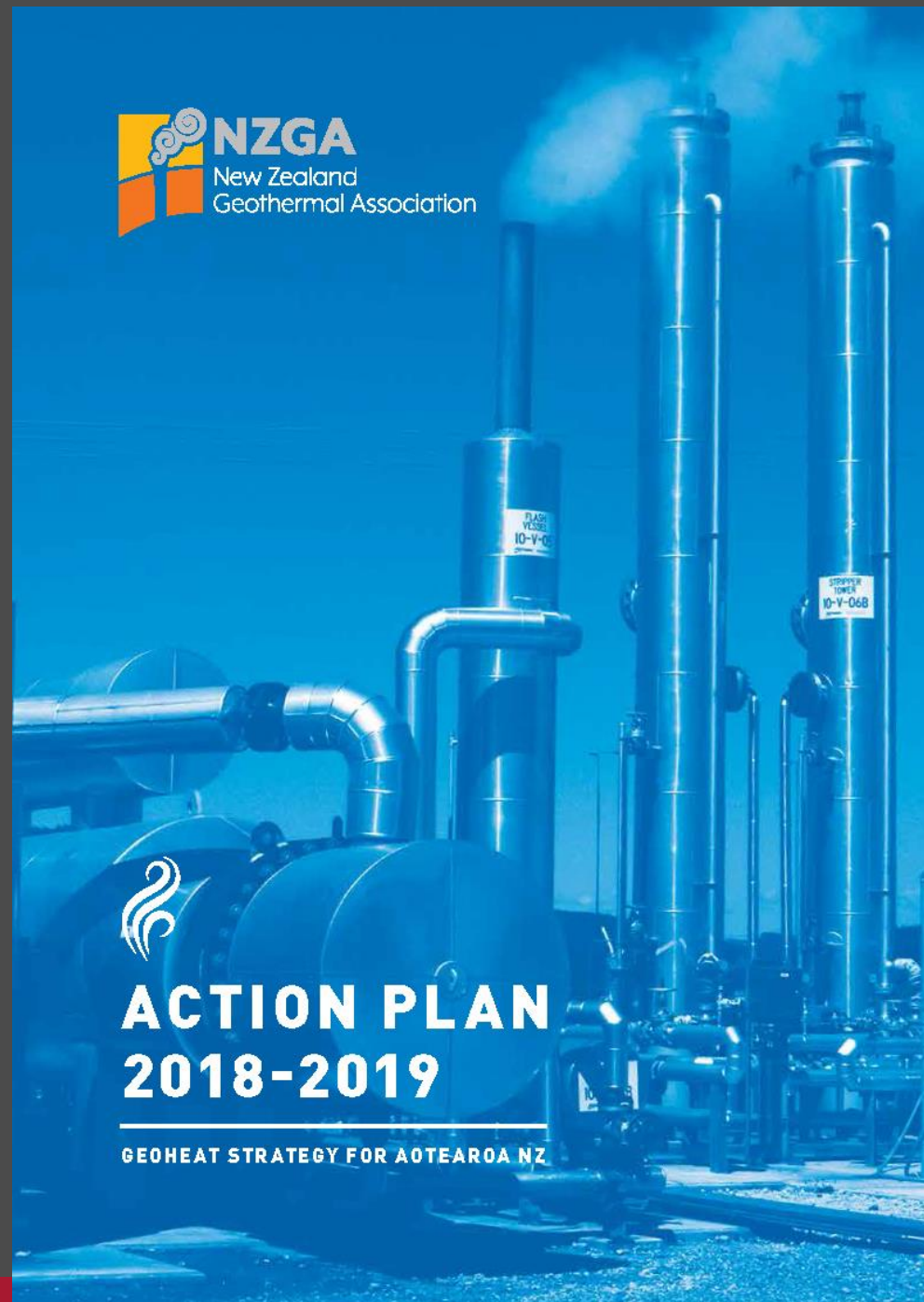


Motel thermal pools, Taupo



**More Direct Use to come**

# **Geoheat Strategy Action Plan**





# Geothermal Case Studies ....



## Tenon Manufacturing Ltd's Earth Energy Solution

Harnessing a naturally occurring energy source has proved a big plus for Tenon's wood processing plant on the Tauhara Geothermal Field near Taupo.

The move to eco-friendly and renewable geothermal energy for heating their nine timber-drying kilns has proved beneficial in terms of economics as well as productivity, says Darryl Robinson.

"Previously we burned natural gas to generate the heat required for the kilns. The geothermal steam is passed through the heat exchangers which heats the kiln's internal pressure system, in turn heating the kilns to dry the wood ready for further processing."

Darryl says an increase in cost of natural gas encouraged Tenon to look for alternative ways to heat the kilns. Kiln drying is a very important part of our process and finding way to reduce cost and be more competitive is part of our business plan.

With a natural resource right under its feet, Tenon moved to geothermal energy in 2006 after discussions with Contact Energy. We still get overseas visitors and have ongoing interest from local and central government.

### KEY BENEFITS:

- Reduced running costs
- Increased productivity
- Renewable and eco-friendly
- Easy to operate
- Very reliable

### KEY FEATURES:

- Commissioned in 2006
- Geothermal heat plant with an installed capacity of 27 MW to heat 9 timber drying kilns
- 150,000m<sup>3</sup> of timber dried on an annual basis
- Uses a natural source of energy



## Geothermal Hot House for Gerberas

For Rotorua gerbera growers, Harald and Connie Esendam of PlentyFlora, making use of the area's geothermal energy is key to offsetting the harsh winter conditions.

"To grow gerberas successfully for a commercial operation a main requirement is to avoid too many, or too fast, fluctuations in temperature. Gerberas are a sub-tropical plant from South Africa so creating a similar climate in the greenhouse is vital."

"We are fortunate to have ready access to geothermal energy which assists in creating the right environment for the flowers," says Harald.

Commercial gerbera growing operations are mainly in Auckland and while Harald says they too require heating, there it is not as cold as in Rotorua.

"The majority of other gerbera glasshouses around New Zealand would use waste oil as the source for their heating requirements."

PlentyFlora's greenhouse is heated by geothermal energy from two shallow geothermal bores.

### KEY BENEFITS:

- Geothermal energy provides heat to keep the temperature above the minimum essential temperature of 14°C
- Reduced cost for heating requirements

### KEY FEATURES:

- More than 600,000 gerberas grown annually at PlentyFlora
- Geothermal heating has been used year round since business commenced in 2002
- A shading/energy system prevents heat loss during the night
- Second bore drilled in 2009



## Geothermal Energy Helps to Grow Prawns

The only geothermally heated prawn farm in the world is right here in New Zealand and it harnesses renewable earth energy as a secret to its success.

The Huka Prawn Park, near Taupo, was built in 1987. Current managing partner, Richard Klein, took over the project in 1991 and began to turn the park into an aquaculture tourism venture.

"Contact Energy owns the Wairakei Geothermal Power Station situated next door to the park, and we've been able to make an arrangement to make use of discharge water from the station. The discharge from the Ormat Binary Plant sits between 96°C to 98°C with a flow rate of 450 tonnes per hour in winter when night time ambient temperatures may fall to -2°C. This arrangement provides us with access to low cost and environmentally friendly heated water."

The geothermal fluid is passed through a heat exchanger to heat water for grow-out ponds and tanks in the hatchery and nursery as part of the process of growing prawns for the on-site restaurant. The park has 15 prawn production ponds and 4 dedicated prawn fishing ponds that remain between 27°C to 31°C.

### KEY BENEFITS:

- Easy to meet required temperature
- Controlled optimal growth temperature
- Economically viable

### KEY FEATURES:

- Founded in 1987
- Aquaculture tourism venture uses geothermal waste heat from adjacent geothermal power station
- Supplies an eco-friendly 7.8 tonnes of prawns produced from 2.75 hectares of ponds to the park restaurant

# Geothermal - Fact Sheets

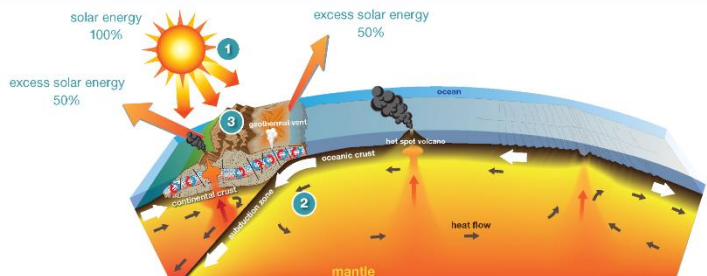


## Geothermal: The Earth's Energy

Geothermal energy is heat energy stored in the Earth. It is a renewable, earth-friendly resource that is accessible throughout New Zealand.

### RENEWABLE HEAT

1. From the sun: About half of the solar energy that reaches the Earth's surface is absorbed and stored by the land and the oceans. Solar energy captured by the land is held within a few meters of the land surface.
2. From the Earth's core: Heat is generated deep within the earth. Away from areas of volcanic or geothermal activity, this heat moves slowly and continually to the surface. The ground temperature increases by about 30°C for every 1000 metres depth.
3. From volcanic systems: Localised areas of higher heat flow occur with volcanic and geothermal activity, where tectonic plates move apart or collide, or in hot spots under mid-ocean volcanic islands. Faults and fractures act as channels for heat to flow to the surface. In places, permeable formations store some of the rising fluids, forming reservoirs of heat.
4. From energy purposefully delivered to the ground for later recovery: heat or cold can be delivered underground (ca. 200m) for later recovery when the energy is needed. Man made ground energy storage significantly reduces the amount of energy required by a building or in an integrated district energy scheme.



Miraka, using geothermal energy to process milk at Mokai

## Using Geothermal Energy Directly

Geothermal energy is widely accessible, providing earth-friendly domestic, commercial and industrial energy for a range of applications.

### FINDING THE PERFECT TEMPERATURE

Energy in the ground is available across New Zealand (see regions shown on map, right). Heat generated by volcanic systems can be taken from geothermal water and steam circulating in pores and fractures in the rock, or directly from the rock itself.

New Zealand's most recognised geothermal area is the Taupō Volcanic Zone, a 100 km wide by 350 km long volcanic region of the central North Island, abundant with geothermal activity. Warm and hot waters are also discharging from springs throughout the country, including Ngāwhia and Northland, East Cape, the Hauraki and Auckland regions, around Tauranga and along the Alpine Fault in the South Island.

### HARNESSING THE HEAT

Readily available equipment is suitable for geothermal direct use projects.

- Geothermal wells
- Downhole and circulation pumps
- Heat exchangers and distribution pipelines



Queenstown home heated by geothermal heat pump

## Geothermal Heat Pumps For Heating And Cooling

Geothermal heat pumps move renewable energy to provide a whole of building heating and cooling solution in homes, businesses, schools, and other public and private facilities.

### FREE RENEWABLE ENERGY

About half of the solar energy that reaches the Earth's surface is absorbed and stored by the land and the oceans. Heat also continuously moves to the surface from the Earth's core. Heat is also contained in water bodies. Geothermal heat pump systems harness heat from the ground and the water.

### INSTALLATION

Trained and experienced installers will design and install the right system. Ground loops can be installed vertically, horizontally or in a series of coils (slinky), and as an open (extracting fluid and heat) or closed (extracting heat only) system.

Installers will determine your building's heat balance, the site's soil type and temperature, and the heat capacity and thermal conductivity of the ground. They will then calculate the optimum length of piping for your ground loop, and the correct size of heat pump for your building.

### YEAR ROUND COMFORT

Heat is extracted from the ground or water, and delivered to the building. These systems can be reversed in summer to discharge heat into the earth or water cooling the building.

### ENERGY EFFICIENT TECHNOLOGY

A geothermal heat pump uses one unit of electricity to move 3 or more units of heat energy from the heat source. Since the ground and water remain at a relatively constant temperature throughout the year, warmer than the air above it during winter and cooler in the summer the systems more energy efficient than air-sourced heat pumps. Compared to conventional electrical heating devices geothermal heat pumps can reduce energy consumption by up to 70%.

### Advantages

- Whole-building conditioning solution
- High energy efficiency
- Long life span
- Low electricity use
- Low maintenance
- Year-round comfort
- Quiet operation
- Low environmental impact
- Low annual operating cost
- Reliable energy source

### Challenges

- High upfront capital cost
- May require resource consent

<https://www.gns.cri.nz/Home/Learning/Science-Topics/Earth-Energy/Case-Studies>



# Back to the Wairakei Resort





# Direct Geothermal Heat is used today for ....



- **Facility heating**
  - Distributed hot water radiators through out the hotel and
  - Air handling plant for the conference rooms
- **Domestic hot water**
- **Dishwashing in the Hotel Kitchen**
- **Swimming pool heating (two pools – upper and lower)**
- **Six hot tubs + spa facility**
- **Several plant rooms with heat exchangers, storage tanks, pumps and flow control based on controlling temperature**

# Te Kiri o Hinekai walk

- **Established around 2000**
  - When geothermal water was returned to the stream
  - Go for a walk
  - Start by the lower pool





**Whilst here for NZGW 2018 .....**

**Enjoy the direct use geothermal energy  
around the Wairakei Resort**







# Kia Ora

