



## **2017 Community Report Covering Consents to Take and Discharge Geothermal Fluid from the Kawerau Geothermal System (24598 & 66862)**

## **Purpose**

This Community Report is written in partial fulfilment of the requirements of Resource Consent 66862 (section 17) and the Kawerau System Management Plan (section 7.14.2) to “*inform and update the Community Liaison Group, as well as interested and affected parties and the wider community about the state of the Kawerau Geothermal System on a regular basis.*” The information cited in this report is from reservoir and environmental monitoring results for the calendar year 2017.

## **Background**

Ngati Tuwharetoa Geothermal Assets Ltd. (NTGA) is an iwi-based geothermal energy supplier to the Kawerau Industrial Complex and to the TOPP1 Power Plant. The Kawerau Industrial Complex is the world’s largest industrial geothermal direct use operations, utilising geothermal steam from the Kawerau geothermal system to provide the process heat required by the various industrial operations. Utilising geothermal steam in place of fossil fuel-based energy sources enables geothermal energy customers to use an indigenous and renewable source of energy, reduce industrial green-house gas (GHG) emissions, and contribute to the decarbonisation of the New Zealand economy.

Resource consents authorise and set the conditions for NTGA’s activities related to the take of geothermal fluid from the Kawerau geothermal system for the Kawerau Industrial Complex, power generation, and other downstream or cascade uses.

In partial fulfilment of NTGA’s responsibilities as a sustainable geothermal operator, consent holder and community member, this community report has been prepared to provide updates on NTGA’s activities and to summarise the monitoring and scientific information and reports gathered in 2017 in the exercise of these consents.

### **NTGA’s geothermal fluid take from the Kawerau Geothermal System complies with its resource consents**

NTGA’s geothermal fluid take is limited to a consented volume based on the sustainable take that the Kawerau geothermal system can support.

In 2017, NTGA used around 57% of its consented volume. This is higher than 2016 due to a combination of increased geothermal energy demand from the Kawerau Industrial Complex and increase in the total volume required to generate geothermal steam. Future demand will be provided for by the remaining 43% consented geothermal volume.

### **Summary trends observed in the reservoir is consistent with expected trends**

#### *Trends in pressure*

The reservoir pressure of a geothermal system changes at a rate influenced by the volume of geothermal fluid produced and the rate of recharge/replenishment fluid including both natural recharge water and reinjected water. The Kawerau geothermal system has one of the smallest pressure changes related to the scale of geothermal development in New Zealand. The small pressure change has been maintained even after more than 60 years of continuous operation.

In 2017, the reservoir pressure change in the Kawerau geothermal system was comparable to the previous years and is within the expected sustainable pressure change for the year. This means that the volume of geothermal fluid taken was effectively replenished by natural recharge and reinjected water.

#### *Trends in enthalpy (temperature)*

The enthalpy trend of geothermal fluid produced describes the changes in the amount of thermal energy available for industrial use and electricity generation. Enthalpy trends determine whether the thermal energy of the produced fluid and the energy of the geothermal reservoir is being utilised at a sustainable rate.

In 2017, the enthalpy changes observed in most of the NTGA production wells were within the expected sustainable enthalpy change for the year. A few production wells have a higher change than others. NTGA is focused on

identifying the main factors that influence this change and on developing strategies to ensure that these enthalpy changes remain sustainable in the long term. These strategies are developed and implemented together with other geothermal field operators through the Kawerau System Management Plan.

### *Trends in chemistry of the geothermal fluid*

The chemistry trends of the produced geothermal fluid provide an indication of underground reservoir processes, e.g., chemistry trends could identify the type of fluid recharge that is influencing the produced enthalpy trends. Understanding the dominant reservoir processes helps in developing reservoir management strategies. Additionally, chemistry trends also provide information on changes to the chemistry of the produced fluid, e.g, increasing acidity, increasing mineral content, etc. This information ensures the safe and reliable operations of our geothermal energy supply network.

In 2017, chemistry trends indicate that the NTGA wells produced fluid with a high proportion of natural recharge as compared with reinjection fluid recharge. This is consistent with expected trends based on long-term baseline information. The chemistry trends also indicate ongoing potential for minerals to deposit in the wells and pipelines. Mineral deposition is effectively prevented through existing operational conditions and anti-scalant technology.

## **Summary trends observed in the environment is consistent with expected trends**

### *Trends in groundwater monitoring*

The groundwater system overlying the Kawerau geothermal system is monitored using a wide network of shallow bores. Monitoring activities detect changes to the interaction between the groundwater and the geothermal system as a response to the geothermal field operations over time. To detect these changes, groundwater monitoring includes continuous water level and temperature measurements as well as six-monthly or yearly groundwater chemical analyses. The current groundwater monitoring program started in the 1990s.

In 2017, monitoring data indicated no notable changes to the interaction between the groundwater and the geothermal system. The groundwater trends were as expected. This means that groundwater areas with geothermal influence continue to be influenced by geothermal fluids while groundwater areas with minimal geothermal influence have remained relatively the same. The water level of the groundwater monitoring bores also correlates quite strongly with the trends in the water level of the Tarawera River, indicating a stronger groundwater response to changes in the river flow than to changes in geothermal operations. The temperature measured at the groundwater monitoring bores have remained relatively stable (changes of less than 1°C).

### *Trends in surface thermal features monitoring*

Surface thermal features in Kawerau include fumaroles, hot pools, heated ground and natural seeps. The thermal features located within the Parimahana and Te Kauahiwi o Tirotirowhetu Scenic Reserves are monitored through photographic surveys and temperature measurements. These measurements aim to detect changes to expected trends in surface thermal activity as a response to geothermal operations.

In 2017, monitoring results indicated no notable changes to the expected surface thermal feature activities in the observation locations. The activities of the surface thermal features have been naturally declining since the 1900s and the 2017 geothermal operations have not notably changed this trend.

### *Trends in ground surface elevation*

The ground surface elevation overlying geothermal systems might change as a response to geothermal operations, either as a downward trend (subsidence) or an upward trend (swelling) due to changes in the underlying reservoir pressure and temperature. Ground surface elevation is monitored in Kawerau due to the presence of industrial equipment that are sensitive to ground surface elevation changes. Ground level monitoring includes annual measurements of elevation benchmarks over an area of approximately 36 km<sup>2</sup>. In addition, there is a higher level of

monitoring around a relatively large “bowl” of slowly subsiding ground above the reservoir, within which four localised subsiding areas are of interest.

In 2017, the survey identified the same localised subsiding areas above the reservoir but with a generally reduced rate of subsidence and tilt (slope of the ground change).

### *Trends in air emissions*

Renewable energy from geothermal systems do release a relatively small amount of greenhouse gases to the atmosphere, mainly as carbon dioxide (CO<sub>2</sub>) and hydrogen sulphide (H<sub>2</sub>S). The emissions from an average New Zealand geothermal field is a small fraction of the emissions for an equivalent amount of energy from a fossil fuel-based source.

In 2017, the air emissions from NTGA’s operations has stabilised at its lowest level following a declining trend starting in 2008 during the start-up of the KGL power plant. The low-level emissions benefit the Kawerau industries that continue to reduce their GHG emissions by increasing their use of geothermal energy supplied by NTGA.

### **Updates to the Numerical Reservoir Model**

As agreed within the Kawerau System Management Plan, a geothermal reservoir simulation computer model is maintained by all geothermal tappers in Kawerau to help manage the geothermal system in a sustainable manner. This model helps simulate physical changes in the geothermal reservoir as a response to the geothermal operations carried out by multiple consent holders and operators. It uses the latest temperature, pressure and chemistry trends as well as geological and geophysical information collected over time to update the model and improve its predictive capability.

In 2017, the numerical model was updated to the Kawerau Reservoir Model v3 (KRMv3) to be maintained by Mercury NZ on behalf of the multiple consent holders. The KRMv3 model will be used to forecast reservoir trends (pressure, temperature, chemistry) and develop reservoir management strategies that would ensure the efficient and sustainable development of the Kawerau geothermal system.

### **Summary**

NTGA’s geothermal operations continue to provide an indigenous, renewable, reliable, and low-carbon energy supply to New Zealand process industries for the last 61 years. In the last 10 years since NTGA’s purchase of the Crown steam field assets and steam supply business, it has continuously improved its capability to monitor, understand, and manage its operations in the Kawerau geothermal system.

In 2017, NTGA’s geothermal operations complied with the requirements of its resource consents and the relevant reservoir and environmental monitoring trends are within the expected trends.

NTGA will continue to engage and collaborate with all stakeholders to ensure that its activities in the Kawerau geothermal reservoir is carried out in a manner that is sustainable to the geothermal resource, the environment, and the community that it supports.