

# International Water Infrastructure Project – Pangai-Hihifo water supply improvements, Lifuka Island, Kingdom of Tonga

Ecowise was commissioned to carry out an investigation of the water supply issues in the island of Lifuka in the Ha’apai group of Tonga and then oversee the implementation on the appropriate groundwater improvements.

Lifuka, a small low lying island with a maximum elevation of only 15 metres, has had a long history of using brackish water for water supply needs. Until recently, the people in the main town, Pangai-Hihifo, have relied on using a combination of groundwater, pumped from a series of wells at the eastern edge of the village, and household rainwater tanks. This public groundwater supply system is managed and operated by the Tonga Water Board (TWB). Rainwater collection systems - roofs, gutters, downpipes and tanks - are the responsibility of individual households. The TWB system exhibited high levels of salinity and leakage.

Rainwater tends to be used for drinking and cooking and, when rainfall is plentiful, for other uses such as washing. The groundwater (often

## Project summary

### Application type

Investigation, design and improvement of remote island village water supply system.

### Location

Pangai-Hihifo village, Lifuka Island, Kingdom of Tonga

### Contracting agency

Tonga Water Board via AusAID funding

### Description of services provided

- Inspection and review of current village water supply arrangements
- Detailed groundwater investigation to assess potential to improve water quality and reliability
- Design and installation of an appropriate solution using infiltration galleries and a combination of solar and powered pumps
- Provide recommendations on how to further improve the islands water supply and reticulation system.



*Aerial view of Lifuka Island.*



*Pangai-Hihifo village.*

called ‘TWB water’) has generally been used for washing during dry periods and for toilet flushing. In general, the local population prefers rainwater, as it has lower salinity and hardness than the groundwater.

Ecowise conducted a detailed study of the groundwater at selected sites using data logging conductivity sensors. The groundwater data was compared with tide measurements to determine the interaction between these two water bodies. The results confirmed the existence of a freshwater lens (i.e. a stable body of freshwater) under Pangai-Hihifo of around six metres thick.

Prior to the recent water supply improvements, the average salinity of the TWB water was 10-20 per cent of seawater salinity (depending on the prevailing rainfall conditions). In terms of electrical conductivity - a common measure of salinity, reported in units called micro-siemens per centimetre (or mS/cm) - the average salinity was in the range of 5,000-10,000 mS/cm. This range of salinity is well above the preferred and maximum limits adopted for ‘freshwater’ in Tonga (currently approximately three to five per cent of seawater salinity, or 1,500-2,500 mS/cm).

## Case Study

Based on the results of the investigations, a pilot project consisting of two 200 metre long, four metre deep, U-shaped infiltration galleries was developed. Each gallery was designed with two pumps. The design allowed for approximately 100 metres of gallery pipe per pump. Each pump was designed to pump approximately the same volume of water per day as the existing well pumps. Thus, the area of influence of each pump would be considerably greater than that from a single well.



*Digging of infiltration galleries.*

To reduce operating costs, each gallery was designed with one solar and one electric pump. The electric pumps were fitted with solar switches so that they can operate in automatic mode only at night and balance the flows from the daytime pumping from the solar pumps. The electric pumps can also be manually switched on to provide longer pumping periods at times when this is necessary (e.g. days with very low solar radiation). The solar pumps are each capable of pumping about 30,000 – 35,000 litres per day, while the electric pumps can pump approximately 20,000 litres per day if operated for 12 hours per day.

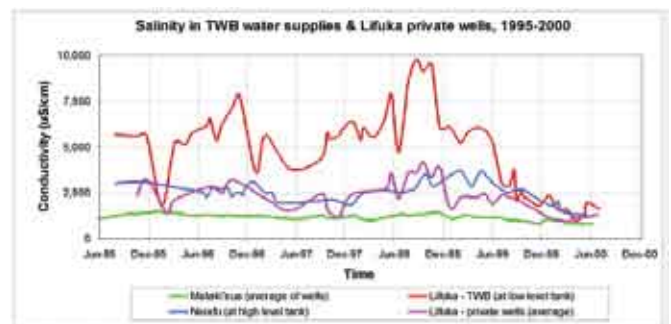


*Installation of infiltration gallery floor and pipe work.*

Since commissioning of the two galleries and solar and electric pumps in mid 1999 the salinity of the Pangai-Hihifo water supply has reduced appreciably. In the graph below, the average salinity at the gallery pump wells can be seen to be much lower than the salinity at the TWB wells over the past five years.



*Completed installation.*



*Average salinity levels have dropped noticeably since the installation of the new system.*

These improvements to the water supply system at Pangai-Hihifo means the TWB water is now much more acceptable and it is even used by some residents for cooking and drinking. The people of Pangai-Hihifo have noticed the improved water quality and have expressed their appreciation to the TWB.

The improvement in reliability of the water supply is also noticeable since the electric transfer pump was installed. As this pump is operated automatically from float controls in the high level tank it does not require an operator to switch on and off. Apart for a few occasions when the power has failed, the water has been supplied on a 24 hour basis since early 2000. Owing to the new high-level tank and the 24 hour operation, consumers in the higher areas of Pangai-Hihifo have also noted that the water pressure has improved.

Based on the salinity reductions and the noticeable improvements in reliability and pressure, the improved water supply system can be judged a great success. Subsequent upgrades to the water tank and distribution system, the implementation of a leak detection program, and the installation of more galleries mean that the water supply system will meet the islanders needs well into the future.