Managing Water Loss from All Angles

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Introduction

Queenstown Lakes District Council (QLDC) engaged MWH to develop a water loss programme on leakage reduction through a variety of different measures. The four main objectives of the programme:

- Develop a programme of active leak detection and repair works in the areas of highest leakage in Queenstown.
- Attain an overall reduction in leakage levels of 25% from April 2008 to April 2009.
- Utilise the most effective water demand reduction measures
- Raise public awareness of water demand issues and encourage conservation.

Methodology

The demand reduction measures utilised in the programme are briefly outlined in Figure 1 and are largely focussed on leakage reduction.

By Gutermann Pty Ltd

Demand Reduction Measure	Description	Pressure Zone - this work was carried out in
Accuflow Testing	Innovative new technology measuring flow through isolation valves on the reticulation. This highlights areas of potential high leakage for detailed follow up work.	Fernhill and Kelvin Heights
Acoustic Logging	Targeted active leakage reduction measure using purchased Gutermann acoustic loggers. Carried out in an area sensitive to mains isolation (CBD).	Wakatipu
Leak Detection Pinpointing	Follow up work from Accuflow testing and acoustic logging using purchased ground microphone and correlator. This was followed up with timely repair work.	Fernhill Wakatipu and Kelvin Heights
Flow Modulated PRV	Pressure reducing valve that accommodates diurnal changes in flow and fire flow requirements. Reduces current leakage, prolongs pipe life and reduces pipe burst frequency. Installed in April 2009.	Larchwood
Commercial Metering	A pilot metering study of a range of commercial properties to understand current commercial demand in Queenstown and identity potential for demand reduction. Meters installed in February 2009.	Wakatipu
Sustainability Workshop	Workshop for local businesses to identify current practices, raise awareness of water demand management and provide commercial operators with a toolkit for water conservation ideas and implementation. Held in May 2009.	All of Queenstown
Night Flow Monitoring	Testing carried out at the end of the years work in April 2009 to estimate the current level of leakage for Queenstown. This testing will provide a comparison with the level of leakage measured in April 2008 and verily the success of the demand reduction work carried out.	All of Queenstown

Figure 1: Demand Reduction Measures

Results

Accuflow Testing: Accuflow testing was carried out in Fernhill, Kelvin Heights and Frankton pressure zones. These were chosen as they had the highest level of leakage along with Wakatipu pressure zone. Accuflow testing is a new technology that provides quantitative flow measurements without the need for expensive meter installations. It measures flow 'listening' to isolation valves as they are closed with the Accuflow valve key. Accuflow testing was chosen over traditional step testing as it offers accurate flow measurement without the necessity of installing expensive flow meters and with less supply interruption. QLDC were the first Council in New Zealand to use this method of flow measurement, however it has been used successfully in the UK for a number of years. In total 32 tests were carried out. The results show higher flows than legitimate night consumption in 21 areas tested. These results were used to determine which areas to follow up with further leak detection work. In each of the targeted areas at least one significant leak was found, although some of these proved to be private leaks. Only approximately 40% of the Fernhill pressure zone was Accuflow tested as Lakes Engineering developed an intensive approach to one discrete area with the pressure zone as their methodology. In Kelvin Heights and Frankton area a more holistic approach was developed by MWH to test the entire area. The latter methodology proved to be more suited to Accuflow testing as it is low impact and able to cover large areas quickly and provide valid results.

Acoustic Logging: QLDC purchased a set of 20 Gutermann Zonescan correlating loggers for United Water to use for the acoustic logging work. This was carried out in the Wakatipu pressure zone incorporating the Queenstown CBD as it is a less intrusive method of leak detection compared to Accuflow testing. Figure 2 shows

Figure 2: Installing an Acoustic Logger in Queenstown

United Water installing one of these loggers onto a hydrant. The Gutermann acoustic loggers work by being temporarily placed onto main fittings such as hydrants and valves. They are programmed to record noises on the main over a set period (i.e. 1am to 5am) when leakage is the highest percentage of total demand. The loggers are then downloaded either remotely or by manual collection. This downloaded data then indicates the possibility of leaks within approximately 80m of the logger.

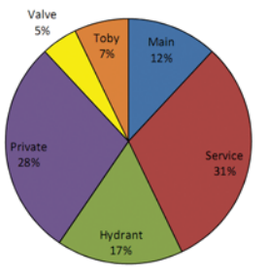

Figure 3: Leak Detected by Type

Leak Detection Pinpointing and Repair

QLDC purchased a Gutermann Aquascope 3 ground microphone and listening stick and Gutermann Aquascan 610 analogue correlator for United Water to use. Training was provided by Gutermann on the effective use of all the equipment. The areas identified by acoustic logging in the Wakatipu area and by the Accuflow testing in Fernhill pressure zone were followed up by United Water. A total of 21 leaks were inputted into the United Water Maximo system for repair, with twelve of these being repaired prior to the night flow testing. After the Accuflow testing a further 21 leaks were located, with seven of these being on private connections, in total twelve were repaired prior to the night flow testing. ☞ www.gutermann.net.au

Flow Modulated Pressure Reducing Valve (PRV)

A flow modulated Bermad 720.100mm PRV with Modulo control unit and Meistream 100mm Class B inline meter was purchased by QLDC and installed at the intersection of Windsor Place and Edinburgh Drive on a water main that feeds a total of 110 residential properties in the Larchwood pressure zone. This area was chosen following hydraulic model work by Tonkin and Taylor, pressure logging and numerous site checks as it provided a discrete area with high night flows requiring a significant pressure reduction. Figure 5 shows the PRV after the Modulo controller unit has been fitted. A normal PRV just reduces pressure in an area to a set downstream pressure. A flow modulated PRV works by monitoring the flow into

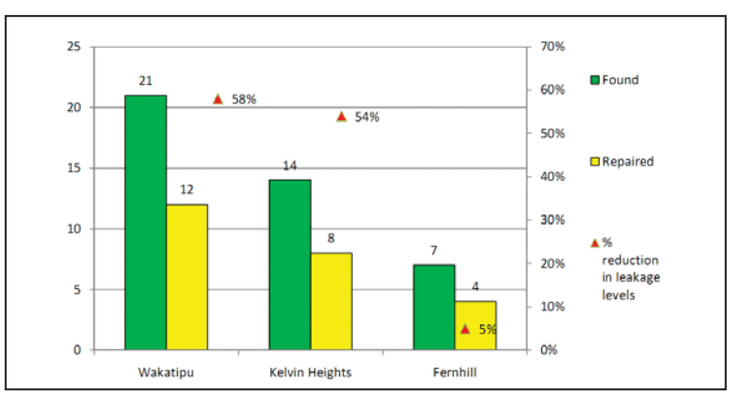

Figure 4: Numbers of Leaks found and repaired by Pressure Zone

Figure 5: Flow Modulated PRV on Windsor Drive

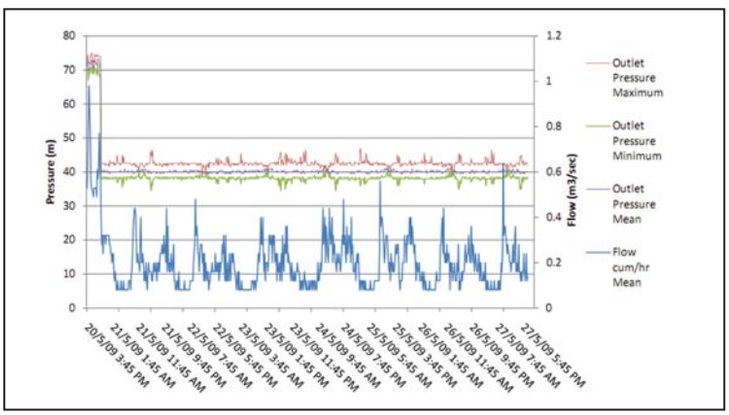

Figure 6: Pressure and Flow during Commissioning of Flow Modulated PRV

an area and adjusting the pressure accordingly to pre-set levels. This means at times of low flow, typically during the night, the pressure level drops to a set minimum to ensure lower flow through existing leaks. During times of high demand, typically during the day or in the occurrence of a fire, the pressure reducing valve will open to meet demand. The meter that was installed adjacent to the PRV measures the total flow into the area. Readings were taken before any pressure reduction occurred and with the flow modulation unit installed. This clearly shows a reduction in pressure of approximately 30m. Figure 6 shows the dramatic reduction in flow and pressure that occurred when the flow modulated PRV was commissioned on the afternoon of 20th May. Due to delays in installation the Modulo control unit was not installed in time for the final night flow testing. This means the PRV was working as a normal pressure reducing valve, but the gains made overnight were not realised in the testing. Further savings of up to 20% would be expected from the shutting down of the PRV during low flow conditions.

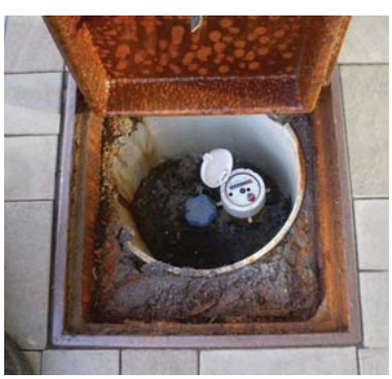

Figure 7: Commercial Water Meter Installed on Camp Street

Commercial Metering

A total of seventeen commercial water meters were read for the commercial metering programme over a 2 month period, twelve of these were installed as part of this programme. There was a variety of commercial user types which were split into three categories, hotels, restaurants/bars and light commercial. Figure 7 shows a typical commercial water meter installed on Camp Street. Figure 8 shows the results of the average flows from all of these readings by commercial user type. These readings were based on readings taken between 6th March 2009 and 1st May 2009. The time of year the readings were taken is the end of the summer main season into one of the shoulder seasons, so results would likely be higher over an annual average. There were a total of three large hotels, nine light commercial properties and five restaurant / bars that made up the data sets.

	Light Commercial	Restaurant Bar	Large Hotel
Daily Flow (m^3day)	2	11	91
Daily Flow (L/hr)	90	460	3780
Daily Flow (L/hr)	30	140	1140

Figure 8: Commercial Meter Reading Average Daily Flow Results

These flows were higher than anticipated for the light commercial and restaurant/bar categories compared to the figures previously assumed. Most noticeable was the restaurant/bar category with an average daily usage of 11m^3/day. The hotels actually had a lower night flow than recorded last April in Queenstown. These results were used to calculate the legitimate night consumption for the night flow testing. To calculate the night consumption from daily metered data without having hourly data figures, an assumption has to be made. The figure of 30% of the average daily flow in L/hr is an estimate for night flow based on industry best practice from Benchmarking of Water Losses in NZ 2008.

Conclusions

The graph below shows the costs related to raw water production based on daily flows from the minimum night flow calculations. These costs are represented as the annual difference in water production costs based on the calculation of one cubic metre of water costing $0.24. This shows the significant savings that can be made from leakage reduction, and this is not taking into account any maintenance, labour or equipment costs. As an example the total cost of the work carried out in Kelvin Heights pressure zone was just over $55,000, whereas a saving in raw water costs alone of over $73,000 has been attained, giving an immediate payback with a saving of over $17,000.

About the Author

The article was contributed by Gutermann Pty Ltd, Australia. Leading Swiss enterprise, since 1948 Gutermann Messtechnik has been designing and manufacturing data acquisition and leak location equipment for the World's water industry. With Headquarters in Zurich, Switzerland, Regional Offices in the United Kingdom and North America, and an International network of Authorised Distributors, Gutermann offers the highest level of local Customer Service and support in more than 30 countries across 5 Continents

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