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Title of Paper: **From Zero to "Hero" – Queenstown Lakes District Council Faces up to the Challenge of Water Demand Management**

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ABSTRACT

The recent summer drought has highlighted the need for wise water use to ensure the sustainability of resources and water for the future. But how does this apply to a council like the Queenstown Lakes District Council (QLDC) where over 80% of the population are supplied water from large pristine lakes which are difficult to see as a limited resource?

The Queenstown Lakes District is the fastest growing area in the country with huge developer demands often swamping small communities. The QLDC is approaching a crossroads where uncontrolled demands have the potential to outpace the capacity of existing supply infrastructure. In addition, the new Drinking Water Standards will require construction of water treatment plants which will significantly increase the cost of water to the QLDC and the residents.

How much water do QLDC residents use? The total consumption including residential, industry, commercial, visitors, irrigation and leakage is estimated on an annual average as between 500 and 1,300 litres/person/day in the existing schemes. All existing QLDC reticulated schemes are on-demand, and the combination of the dry climate, lack of universal metering and a commonly held view that the water source is limitless has led to these very high demands.

MWH were commissioned to prepare a Water Demand Management Strategy and individual Plans for each scheme incorporating New Zealand and international best practices. Flow data indicated the potential for high leakage and a programme of night flow monitoring was initiated to determine the level of leakage and prioritise areas for repair. This paper will describe the journey that QLDC have started on towards sustainable water demands. It will discuss the findings of the Strategy and Plans including Queenstown's demand analysis and night flow monitoring results and the action plan for implementing the recommended measures.

KEYWORDS

Water demand management, water loss reduction, leakage

1 INTRODUCTION

The goal of water demand management is to make better use of the existing supply resource by reducing physical and/or economic waste. In areas like Queenstown, where water is plentiful, the implementation of demand management has been a low priority. The 2007 local government elections introduced a new Council and a new focus on sustainable management. The following paper describes the processes deployed and the anticipated benefits of the rapid deployment of water demand management in Queenstown.

2 SUMMARY OF WATER DEMAND INVESTIGATIONS

2.1 HISTORIC STUDIES

A QLDC working party set up in 1999 established a water demand reduction goal of 25% for Queenstown and Wanaka to minimise the financial impacts of growth by delaying the need to increase reservoir storage, transmission main and water treatment capacities. This target of 25% was first included in the QLDC Water Supply Asset Management Plan in 2000. In 2002, Opus International Consultants Ltd were commissioned to undertake a study to identify measures to achieve the 25% reduction. Their report "Water Supply Demand Management for Queenstown and Wanaka" recommended implementing a leak detection and repair programme along with metering of selected commercial properties. QLDC staff sought approval from Council in early 2006 to undertake a leakage investigation for the Queenstown water supply scheme, however funding was only approved for a desktop study. No further proactive leak detection and repair measures have been implemented in the Queenstown scheme to date.

2.2 INFRASTRUCTURE DESIGN

QLDC's current design criteria for water supply systems are based on the New Zealand Standard 4404:2004 Land Development and Subdivision Engineering with some specific amendments for QLDC that were documented in September 2005. The Peak Day and Peak Hour Factors represent the factors that need to be multiplied by the Average Day Flow rate to get either the. Infrastructure is sized using the Peak Day and Peak Hour flowrates which are predicted from the Annual Average Daily Demand using the factors in the table below.

Table 1: Current QLDC Water Demand Design Criteria

	Queenstown Criteria	Criteria for all other Schemes	NZS4404:2004
Residential Average Daily Demand (AADD)	700 L/capita/day	700 L/capita/day	250 L/capita/day
Occupancy per residence	3 people	3 people	-
High Density Accommodation AADD	350 L/capita/day	350 L/capita/day	-
Peak Day Factor	2.35	3.3	1.8
Peak Hour Factor	4	6.6	4

The QLDC design criteria are considered high when compared to the NZS4404:2004, especially from a water demand management framework. However, they are similar to recent demand figures from most of QLDC's water supply schemes as shown in the following sub-section. All QLDC's existing schemes are on-demand and without universal metering.

2.3 DEMAND MANAGEMENT STRATEGY AND PLANS

The QLDC commissioned MWH New Zealand Ltd in late 2007 to prepare a Water Demand Management Strategy to identify where there is inefficient use of water and to assess a range of water demand management options for each township within the District. Following the Strategy, MWH have prepared individual Water Demand Management Plans for each scheme, detailing an implementation plan for specific demand management measures. Both the Strategy and the Plans are living documents that will evolve and be updated as experience grows, and additional information becomes available, and can therefore be adapted to changing circumstances and improving outcomes.

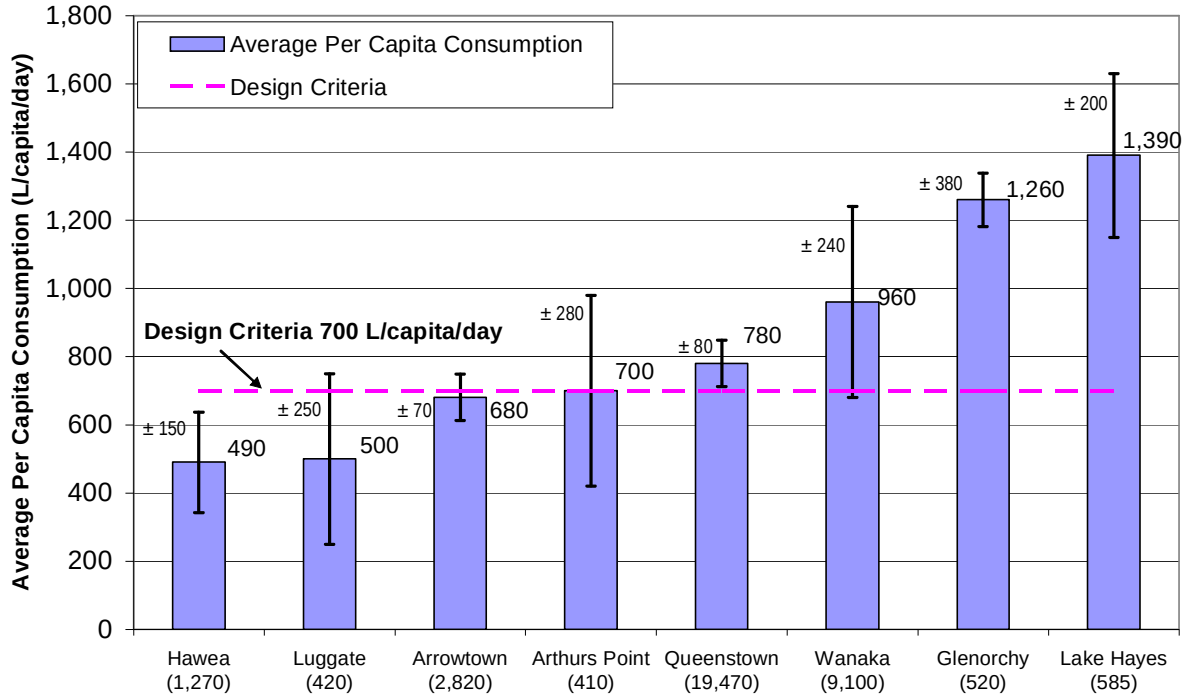
The current version of the Strategy was submitted to the Otago Regional Council (ORC) in May 2008 to address resource consent condition requirements (consents 2004.552 for water abstraction from the Queenstown Kelvin Heights intake) and 2007.049 for water abstraction from the Arrowtown bores).

The Strategy covers all water supplies within the District but focuses on the 8 schemes with existing reticulated water supplies. The water demand characteristics for each community were derived from population and connection data, climate data from NIWA and flow data provided by the maintenance contractors. The primary limitation is the lack of accurate flow information due to limited flow metering.

Towns in the District typically have a high proportion of transient residents and high visitor numbers compared to many other New Zealand towns. This leads to high seasonal variations in population which makes it difficult to analyse water consumption per capita.

The overall key statistic for measuring water demands is the average consumption in litres per capita per day. Due to the general absence of individual property metering in the QLDC, the average consumption can only be presented as the total consumption not as the residential only consumption. The graph below shows the 2007 average per capita consumption for each scheme, compared to the design criteria of 700 L/capita/day. This graph also shows the estimated confidence levels for each scheme as error bars. These confidence levels are the best estimates based on knowledge of meter accuracy and population data limitations and are not statistically significant. The estimated 2007 average population in each scheme (including residents and visitors) is shown in brackets below the scheme label on the graph. Further analysis of the permanent and tourist population and connection data is recommended to improve the current version of the Strategy.

Figure 1: 2007 Average Per Capita Consumption for each Scheme (in increasing order)



The graph above shows that more than half of the schemes exceed the present QLDC design criteria. Lake Hayes has the highest consumption which is primarily due to a small number of very high use consumers on rural-residential properties.

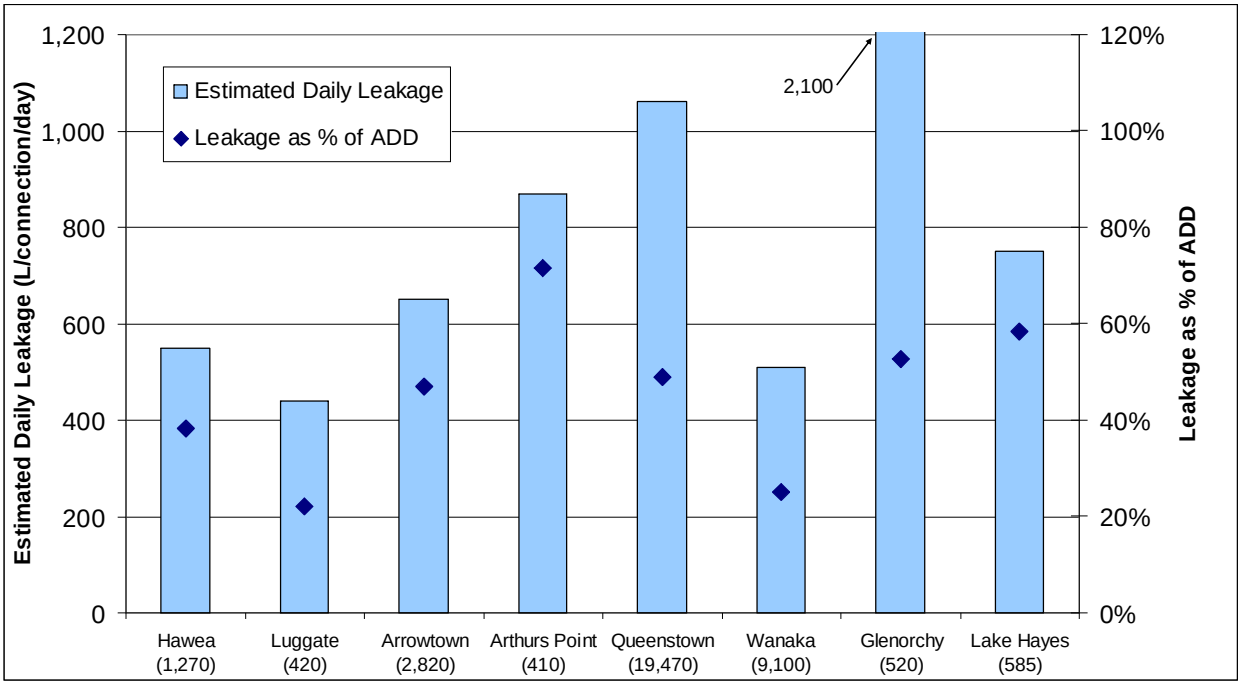
The Strategy identified that the single best opportunity for water demand reduction in the QLDC is to identify the level of leakage in every scheme through night flow monitoring, and then undertake proactive leak detection and repairs in those areas with high leakage. Additional bulk flow meters connected to SCADA are also required to improve the flow meter data and establish routine monitoring of demands.

Night flow monitoring tests were seen as the best method to quantify the current level of leakage in each system due to the lack of universal metering and district metered areas. These tests involve measuring the minimum flow at night (typically between 2am and 4am), during which time leakage is at the maximum percentage of the total flow. Council recognised the importance of reducing leakage and approved a night flow monitoring programme which took place during the autumn months of April and May 2008.

Estimates for legitimate night consumption were subtracted from the minimum night flows in each scheme, and average system pressure taken into consideration to calculate an estimate for the current daily real losses. This daily leakage estimate was taken from a 'snapshot' or small time frame at the time of the test, but gives a good indication of the scale of current losses. The methodology and analysis for the daily leakage estimates are based on the best practices

recommended by the New Zealand Water and Waste Association in the Benchmarking of Water Losses in NZ 2008 Manual.

Figure 2: 2008 Estimate Daily Leakage for each Scheme (in Increasing Order of Average Per Capita Consumption)



The graph above is in increasing order of the 2007 average per capita consumption to enable ready comparison with water demands. It can be seen that the schemes with higher demands typically but not always have higher leakage. Comparison of the percentage of the average daily demand attributable to leakage shows that Arrowtown, Queenstown, Arthur's Point, Glenorchy and Lake Hayes all had at least half the daily demand attributable to leakage.

MWH prepared a Night Flow Monitoring Results report in July 2008 which considered the four key strategies to reduce real losses:

1. Active Leakage Control
2. Pressure Management
3. Speed and Quality of Repairs
4. Pipeline and Assets Management

The Night Flow Monitoring Results report recommended active leakage control through leak detection and repair as the first priority. Water audits of high users and pressure management were also considered a priority in several schemes. An ongoing night flow monitoring programme was recommended followed by analysis of the economic level of leakage to assess the optimum level of future work.

3 WHY CONSIDER WATER DEMAND MANAGEMENT IN QUEENSTOWN?

3.1 PAST BARRIERS TO DEMAND MANAGEMENT

3.1.1 LOW PRODUCTION COST

The production of water in Queenstown has historically been a low-cost activity. The costs associated with providing water infrastructure have been moderated by the close proximity of development to Lake Wakatipu, which is in itself the water source. Ongoing operational costs for the water supply have been limited to the electricity supply for the intake and booster pumps, together with chlorine gas for water treatment. Wastewater disposal costs are similarly low.

The low unit rate for water production has meant that water rates have remained at low levels - typically $270 per residential property in 2008. In past years, the annual increase of water charges has consistently been less than the rate of inflation – implying that the cost of water production has actually been reducing.

3.1.2 PERCEPTION OF AN UNLIMITED WATER SOURCE

The Council and the general public have argued that the Lake Wakatipu water source is unlimited and therefore there should be no restrictions on water use. This has resulted in a proliferation of on-demand water supplies with no consumer metering. Although not all of Council's water supplies have such a plentiful source, this is certainly the case for Queenstown, as the peak day water demand accounts for just 0.2% of the mean daily inflow to Lake Wakatipu. The static storage volume of Lake Wakatipu of around 60 billion cubic metres is sufficient to meet the demands of the Queenstown water supply for the next 8,000 years (based on present peak monthly water demands).

3.1.3 A BOOMING LOCAL ECONOMY

Queenstown is a small, highly productive economy dominated by tourism related activity and expenditure and dependent on maintaining the delicate balance between economic development and environmental preservation. Evidence indicates that visitors are willing to pay premium prices so long as Queenstown is able to meet or exceed their expectations. This is one of the major challenges and economic opportunities facing Queenstown.

Queenstown has experienced the highest rate of growth of any New Zealand district. Population growth has averaged 3.5% per year. Demand for additional water supply capacity has been driven largely by new development. Tourist operators and accommodation suppliers strive to provide exceptional facilities in a highly competitive market. Efficiency of commercial water use has not been a priority in the past, as council water rates are not linked to consumption and most properties do not have water meters fitted.

3.2 PRESENT DRIVERS FOR DEMAND MANAGEMENT

3.2.1 COST OF WATER PRODUCTION EXPECTED TO INCREASE

The costs associated with constructing new water infrastructure are expected to increase at a rate exceeding the rate of inflation due to a multitude of factors including:

- Higher cost of construction materials due to raw material cost and transportation costs.
- Higher labour costs due to the increasing cost of living.
- Increased costs of procuring land (including reservoir sites), as demand for building sites drives development further up the hillsides surrounding Lake Wakatipu.

The ongoing cost of operating the water supply will increase due to:

- Increasing electricity supply costs, as the South Island's energy needs are no longer met by electricity from low-cost hydrogeneration.
- Additional water treatment to achieve compliance with the Drinking Water Standards of New Zealand will necessitate the installation of UV disinfection and perhaps some form of filtration - adding to both capital and operational costs.
- Increased compliance and consenting costs are anticipated.

3.2.2 NEW EMPHASIS ON SUSTAINABILITY

The District's residents' perception of unlimited water sources is gradually changing to a greater desire to protect the environment and consider the impact of high water demands on all four well-beings. It is essential for QLDC to "walk the talk" on sustainability issues plus comply with resource consent conditions and new expectations for higher wastewater treatment.

3.2.3 GLOBAL ECONOMIC DOWNTOWN

Queenstown has recently had a booming local economy and the global economic downturn has not yet had any apparent effects. However the longer term effects on tourism and growth are uncertain.

4 THE BUSINESS CASE

The present rate of daily water losses in the Queenstown water supply is estimated to be almost 50% of the annual average daily demand (AADD). It has been theorised that the implementation of demand management measures has the potential to halve the rate of water loss to achieve a 25% decrease in consumption within three years.

Demand for water is expected to grow substantially over the next 20 years, as both resident and peak day populations are projected to increase by a further 200%.

4.1 FUTURE CAPITAL EXPENDITURE AND OPERATIONAL COST SAVINGS

Preliminary estimates of the savings that could be reflected in the Queenstown water capital expenditure and operational budgets were calculated by consultants GHD Ltd by compiling a schedule of the proposed 10 year capital programme for Queenstown water supply using information submitted for inclusion in the draft 2009/19 Long Term Council Community Plan (LTCCP). It was identified that the key cost savings would arise from:

- Ability to defer project implementation (calculated as cost of capital saved)
- Designing assets with less capacity (cost of capital saved and lower long term replacement costs)
- Decreased depreciation costs
- Electricity savings

In considering the potential impact of reduced consumption on the LTCCP budgets, a number of assumptions were made. The results of the preliminary exercise suggest that a $9M overall saving is possible over a ten year period from the proposed 2009/19 LTCCP Queenstown Water Capital Programme, subject to achievement of the target to reduce water loss by half.

In the event that the demand reduction target is achieved, it is expected that further savings may be possible. Reduced future consenting and compliance costs were not covered in the Strategy but may also be possible as a result of the demonstration of efficient water supply management.

5 THE PROCESS OF CHANGE WITHIN COUNCIL

In previous years the attention of council staff and elected representatives has been directed to meeting the immediate needs generated by rapid growth in Queenstown. There has been no substantial driver to divert time or resources to the complex and politically sensitive area of water demand management.

The local body election of October 2007 has brought a new focus on sustainability to the Council table. There is a new emphasis on managing the impacts of development to protect existing community values. During the first six months of 2008, several workshops were held with Council's Utilities Committee to seek feedback on the demand management project together with key documents, including the "QLDC Water Supply Bylaw". It has also been recognised that a common understanding of the demand management project is necessary to obtain buy-in across the Council organisation. A facilitated internal workshop on the topic of demand management was conducted by research consortium Beacon Pathway Limited in April 2008. The attendees included representatives from functional areas including policy, planning, compliance, reserves, communications and engineering.

6 WHICH ARE THE BEST OPPORTUNITIES FOR QUEENSTOWN?

Each Water Demand Management Plan presents both a short-term (over the next 6 months to 1 year) and a long-term (over the 1 to 5 year timeframe) action plan for implementation. This paper presents the best water demand management opportunities identified for the Queenstown scheme. The focus of the implementation plan is to get Council's own house in order first and to address expected high consumption by commercial properties as they represent 40% of the total water customers in the Queenstown scheme. Specific actions for residential properties will be prioritised at a later date, and following on from a full cost-benefit analysis.

Queenstown's short-term action plan includes four key measures as follows:

1. Water Loss Reduction Programme

As a first priority, step testing is recommended to highlight sub-zones of higher leakage for leak location (using acoustic logging) and repair. A pilot pressure management area is also recommended for implementation. An ongoing annual night flow monitoring programme will be necessary to track the progress of water loss reduction programme. After the proactive leak detection and repair work is completed, the economic level of leakage should be calculated to determine the extent of ongoing proactive leak detection and repair.

2. Public Education

A District wide public education programme is recommended. The programme could include: A mobile water saving service with Council staff educating public on water conservation measures and property leakage; Undertaking water audits; Running seminars; Working with schools; and Distributing low cost water saving devices and relevant pamphlets.

3. Targeted Education for Commercial Properties

Commercial properties are expected to be high users, particularly hotels, and this is supported by limited metered data available. Industry specific workshops are recommended with attendance by industry staff (e.g. operators of hotels, restaurants), with the purpose of identifying opportunities and barriers for reducing water demands.

The workshops will aim to provide a toolkit for water conservation ideas and measures for businesses to implement, for example retrofit of low-flow showerheads, checking taps and toilets for leakage. Following the workshop, it is recommended that Council staff work directly with commercial properties to undertake water audits to identify on-site the best water conservation practices for that property, and assess potential for property leakage.

4. Metering Without Charging for New Properties

Council may require meters to be installed on all new residential and commercial properties as the incremental cost is negligible at the construction stage. This work will assist Council to

categorize property types and improve understanding of consumption through monitoring a sample of properties.

Queenstown's long-term action plan includes:

- Metering without Charging for Existing Properties (& Commercial Volumetric Pricing)
- Installation of Water Efficient Fixtures (e.g. through a subsidised retrofit programme)

The Queenstown Draft Water Demand Management Plan also includes two recommendations for improvements to the Plan:

1. Undertake a full cost-benefit analysis of short-listed demand management options.
2. Classify different consumer types and undertake monitoring of per property consumption.

7 CONCLUSIONS

The Council's management, staff and elected representatives now accept that more efficient utilization of the existing water supplies has the potential to minimise future costs while protecting community values.

The Council has taken the first step by making a separate budget allocation for water loss reduction in Queenstown for the 2008/09 financial year. Council staff have also requested funding to support demand management on an ongoing basis.

Based on current water use, there appears to be high potential to reduce water losses from the present figure of 50% of average day demand through the implementation of the "Queenstown Water Demand Management Plan". Initial indications are that it may be achievable to reduce water loss by half (from 1,060 to 530 L/connection/day) over the next three years. Further work over the next year will provide a better indication of the potential water savings and confirm an acceptable benefit/cost ratio.

Through this recent work, Council has realised that water demand management has relevance for all water supplies, not just those in areas with water shortages. It is also been shown that implementation can be rapid when there is a clear strategy supported by organizational commitment.

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