*Special Summarised Report from the Winner of the **2006 Kwatye Prize***
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The full version of the Report will be available from the WIOA website after the Conference

Anthony will do a short presentation on his project at the Meet the Trade Dinner on Wednesday evening.

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ABSTRACT

The prolonged drought has been the catalyst for much of the water industry to better manage our scarce resource. There has been a considerable re-education process for both the public and Water Corporation staff alike of the need to, and benefits of using water wisely.

There is a new emphasis on being able to account for all water from the time it is extracted from its source, until it comes out of the consumer's tap. There is also some major expenditure under way by the various Water Corporations on initiatives to minimise the losses from the systems.

So, in putting forward the project submission, I raised the question "is this a global train of thought, or is it merely confined to those areas which have been ravaged by the recent drought?" And the ideal follow on from this would be to investigate and report on exactly how organisations were dealing with this issue, if at all, and provide some ideas about how changes might be implemented to save more water. Many such initiatives are noted in the final report.

In undertaking this project, a number of organisations in both Australia and New Zealand were contacted and/or visited and they readily provided information relevant to the project. Interestingly, attitudes to water use and conservation still differ markedly depending on geographic locations. It is true to say though, that even in those places where water conservation is not a high priority at present, attitudes are changing and it is only a matter of time.

Armed with all the new found knowledge, the final part of the project involved trying to make a real difference in my local area – Wannon Water. We have reviewed what we do at a number of work sites and have been able to make some real savings.

1.0 INTRODUCTION

Historically, thinking in regard to water loss has been that there has always been a percentage of water that for a variety of reasons cannot be accounted for and provided it is a reasonable amount it is acceptable. As we move forward, water conservation is overtaking sustainability and viability as the popular catchphrase heading to the new century. With this shift in focus comes the recognition that there is no longer such thing as unaccounted for water. Perceptions have changed, and we now recognise new and emerging methods and technology that will help us to better understand and measure where our water is used and more importantly where and how much water is lost.

Everyday, the growing challenges of drought, customer expectations, aging infrastructure, public health issues, and in the last few years the security of our supplies, are confronted. Along with the recent political and social agendas of climate change and population growth, these factors are exerting pressure on our already suffering supplies. The hardships of drought conditions of the last 10 years have compelled improvements in public education and the research and development of water saving fixtures and practices within the home and workplace.

Water saving devices and initiatives has quickly become a part of our everyday life. This change in attitude is mirrored by a strong focus in the media to saving water as a precious

resource.
Water Corporations have become more involved in active loss control as supplies have become increasingly difficult to find and costly to develop. Government regulators have taken heed of this and in Victoria at the end of 2006, Water Corporations committed to reducing their annual water losses. This has provided a clear path for the future allowing budgeting and capital works programs to focus on preventing water loss over the next 10 to 50 years through the Water Plan.

As a Treatment Plant Operator for the last 10 years, the thought of having to save water along with the idea of loss management, had taken a back seat until water restrictions became a common talking point among friends and work colleagues alike. We have to now decide on work methods that will maintain water quality as well as conserve for future generations this precious resource.

2.0 SO HOW DO WE DEFINE WATER LOSS?

2.1 Terminology

In 1999 and 2000, International Water Association (IWA) Task Forces on Water Losses and Performance Indicators published their conclusions of over three years research, analysis and discussions, on the topics of ***Non-Revenue Water***, ***Water Losses*** and ***Apparent Losses*** and ***Real Losses***.

These included:

- A recommended standard terminology, with definitions and procedures for assessing these components of the Annual Water Balance;
- Recommended performance indicators for each of these components.

This work represents a major step forward in defining the "best practice" approach to assessing and presenting components of Non-Revenue Water, for more rational comparisons of performance in diverse systems within a single organisation, within the same country, and between countries.

In February 2000 the Water Services Association of Australia (WSAA) organised a national Workshop in Melbourne to discuss the IWA methodology. Following this Workshop, WSAA commissioned the production of customised Software and an Associated User Manual known as **"Benchloss"**, to promote and facilitate the application of the IWA recommended methodology throughout Australia.

The four basic methods used to determine and manage Real Losses are,

- Pipeline and Assets Management
- Pressure Management (may mean increasing or decreasing)
- Speed and quality of the repairs.
- Active Leakage Control to detect unreported leaks

2.2 Real Loss Management

As the infrastructure ages and deteriorates, the potential for Real Losses increases, due to the fact that not all leaks will be seen or detected until they move from a minor to major status. Because of the high costs involved with replacement, not all the infrastructure is replaced at a rate that will see a decline in Real Losses.

Pressure Management is more than just installing PRV's to sections of a system to lower that area pressure to acceptable levels. The flow on benefits are also noticed as reductions in surging become more controllable in areas that are supplied intermittently by pumping. "Reduce the surge and reduce the urge" is an old saying that was used commonly years ago when referring to leakage prevention.

Some of the benefits of Pressure Management are:

- Distribution infrastructure life extended
- New bursts on distribution mains and service connections reduced
- Leakage and burst flow rates within the system reduced
- Component failure due to pressure reduced.

While some countries in Europe and Asia have managed to successfully implement pressure management controls, Australia, while aware of the benefits of the practice, seems to have a relatively small number of projects in operation.

Real Loss components can consist of,

- Background leakage at joints and fittings - low flow rate for sonic detection if non visible.
- Reported leaks and bursts - typically high flow rates of short duration, the remaining events will be unreported and will need to be identified by a method of active leak control.

So essentially, ***Active Leak Control*** becomes a management tool for the duration of any unreported leaks and the most appropriate method along with the frequency of the activity becomes a matter of economics, efficiency and in some cases a resource issue.

Combining information from these components to create the Infrastructure Leakage Index, (ILI) and you are able to measure just how effectively the activities in the infrastructure, such as repairs, pipeline/assets management and active leakage control are being managed.

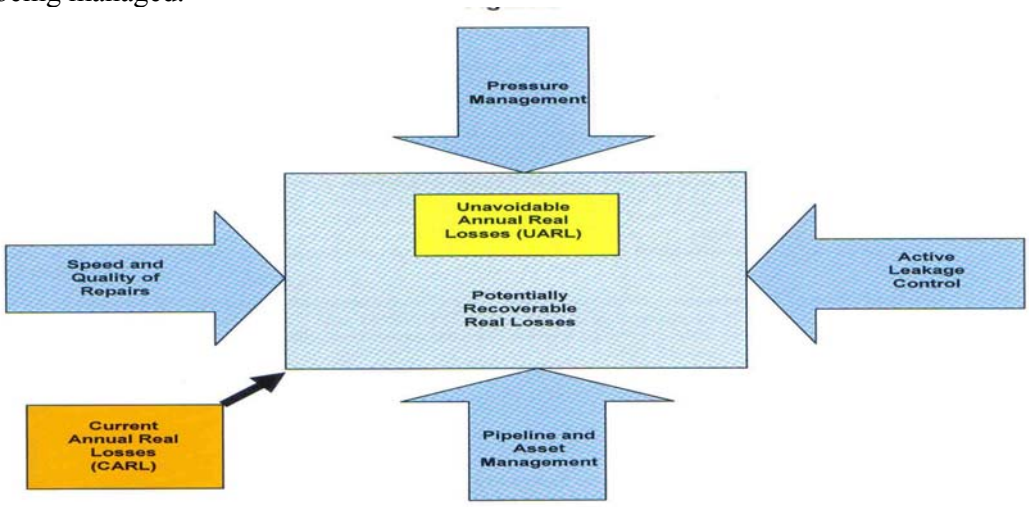

Figure 1: ***The four basic methods of managing Real Losses and the ILI***

The ratio of the Current Annual Real Losses (CARL) to the Unavoidable Real Losses (UARL) is the non dimensional Infrastructure Leakage Index (ILI). An ILI close to 1.0 is

considered to represent operational management of the highest standard.
Speed of repair from the time of a leak being reported to completed will impact slightly on the ILI as most major leaks are a high flow rate for a relatively short time due to the nature of the breakage.

Water Services Association of Australia (WSSA) monitors its members on a number of Performance Indicators including the ILI for each utility and the results are published annually in the publication, *The Australian Urban Water Industry*, *WSSA Facts.* Comparison of the WSAA members performance with the available International data shows that using the ILI, as Performance Indicator from ten of its members, several are ranked in the top level of performance while others are in the middle of the range.

Assesment of Real Losses can be subject to error and a report commissioned by IWA Task Forces on Water Losses and Performance Indicators outlines three methods of assessment:

- Water Balance
- Component Analysis
- Night Flow Analysis.

Results from Component Analysis confirmed that in a well run system the largest volume of Real Losses is likely to be associated with service connections rather than mains (in systems with density of connections >20/Km of mains).

Some of the more common methods used to reduce Real Losses in Australia are:

- Meter changing programs (customer and Corporation bulk and domestic)
- Meter correlation
- Night Time Flows
- Pressure Reduction
- Sonic Leak Detection, noise loggers
- Visual Inspection of trunk and feeder mains.
- Water balancing
- Component analysis.

A dedicated program to map and identify the areas that the losses are occurring in needs to be set up and all the information collated for later reference. The following is a rough guide to a loss reduction program:

- Conduct a water balance and grade the distribution system on the International Leakage Index.
- Determine the current levels of leakage, water losses and system pressure in the water supply distribution network.
- Get out into the field and conduct some tests on pressure and flow and record measurements and other relevant data
- Analyse this data and make assessment in regard to,
- Current leakage level
- Possible pressure management
- Devise a program for zoning of the network and installation of flow meters and pressure reducing valves if zones were to be established
- Train staff in analysis and demand management strategies.

Most Australian Water Corporations have practiced one or more of these measures in the hope of reducing their losses. As with all measures it is cost that will determine the

frequency and amount of time and resources that will be committed to any project.
In the long term the cost will in one way or another be borne by the customer, so it makes good business sense to trace, repair and reduce.

3.0 A LOOK AROUND

So how do you see the forest for the trees? Easy, start in one of the hottest, driest parts of Australia, Alice Springs.

3.1 Alice Springs

Fortunately I was able to meet up with John Day, who at that time was working for NT Power and Water Corporation, and his Operators and Engineering staff. It was almost the end of October 2006 with daily temperatures hovering around 38-40°C and the population boosted by around 3000 people attending the Alice Springs Master Games so demand was at a peak. After a quick look around town we ventured out to the bore fields and treatment plant. Water doesn't seem to have been an issue for Alice Springs residents until recent years.

"There is plenty of it and it is there to be used" is a common attitude expressed by townsfolk towards this precious resource.

Water is drawn from bores at a depth of 150-200m and delivered to town at a rate of 90-100L/s. Due to the large amount of water available there has never been a huge push to conserve and it is only in recent years that people moving from southern states and coastal areas have introduced water saving measures to the local population. The general consensus is that less than 20% of the customers are concerned with the high water usage. This is perhaps evident when a public meeting held to discuss future supply and direction was attended by only 100 "vocal" residents and Corporation employees.

The water is pristine to say the least with 0.5 mg/L of chlorine added at the bore field plant and the outer reaches of town returning 0.38mg/L at the meter. Flushing is only done on dirty water complaints, or as part of valve maintenance when hydrants are used to determine if the valves are working. Meter replacement programs, Ultrasonic Monitoring, Annual Reports, Customer Audits and Customer Awareness programs via the website and information mailed out with accounts are methods currently practiced to try and reduce water loss. Presently these measures have accounted for a reduction in losses from 7% to 4.2% and will continue to be used along with metering of water carting vehicles and metered hydrants for contractors. Audits, along with visual inspection of mains are also carried out at the time of breaks to determine condition and replacement timelines.

The majority of water is thought to be consumed by evaporative air conditioning units and topping up swimming pools.

Current Australian Bureau of Statistics data shows that average household water consumption in the NT is 399,000 litres each year. This compares with a national average of 268,000 litres.

3.2 Queenstown – New Zealand

From the NT to Queenstown, New Zealand; a long way as the crow flies, but the similarities are evident.

Queenstown is supplied with water from Lake Wakatipi, a magnificent stretch of water 80 km's (50 miles) long and up to 330m (1000') deep surrounded by mountains that in winter are covered in snow. In Queenstown the water is free! A charge is applied to return the money spent by the Council in providing and treating the water for consumption. For a fee of $200 p/a you can water away to your hearts content with the knowledge that the only restriction will be your service pipe size as you don't have a water meter. No promotion of water saving is done.

With this in mind, a lot of New Zealand is not so lucky and suffers dry conditions although not quite the same as we have become used to in Australia. The people are aware of our problems over the last few years and are starting to introduce water saving measures. Regional Councils are very proactive in water management as all the water is "owned" by the NZ Government and is managed with tradable water rights and as in some states in Australia, water management falls on the shoulders of the local councils.

Water loss has never been seriously considered mainly due to the fact of a seemingly endless supply. Some leak detection is carried out and it can be either visual, correlation or in some cases sonic.

In the larger towns, catering for tourism has seen construction increase ten fold. As a result of the construction, and the nature of foundation work, tending to "rattle" the ground, along with increased traffic flow, the leaks in mains have escalated. In Queenstown alone12,000 leaks have been repaired in ten years, the majority being small service connections and leaking valves.

Flushing is usually done only on dirty water complaints and in known problem areas but a regular program is carried out prior to summer. This programmed flushing is usually combined with the cleaning and inspection of the town's sewer mains, a great way to satisfy both requirements. Air scouring or pigging is not considered due to the risk associated with older infrastructure.

Pressure reduction is not considered as mains are designed for fire fighting purposes with around 70Kpa static pressure and 15L/s at the hydrant, adequate for domestic use.

The largest users of water are the industrial and domestic laundries with six operating in town using around 300 KL/d ea. The accommodation sector, although large, uses the equivalent of 0.7/person per room compared to the average household of 2.4 people using 1.5 KL/d per house. The net average loss of water in Queenstown, New Zealand is around 15%.

3.3 Wannon Water - Victoria

Wannon Water provides water and sewerage services that contribute to the sustainable growth, health and wellbeing of the community and environment in the south west of Victoria. Wannon Water services approximately 70,000 people in an area of over 24,000 square kilometres from the South Australian border in the west to Balmoral in the north, and from Lismore in the east to Port Campbell on the coast. Warrnambool is supplied with raw water from the Gellibrand and Arkins rivers in the Otway Ranges in the south

west of Victoria. The customers along the coastal fringe and in areas connected to this catchment have realized in the last 2-3 years the importance of water as a resource.

Customers in the northern parts of the Corporation have had to deal with stage 4 restrictions. The lack of supply of surface water has meant a change in lifestyle and a decline in the quality of water delivered to customers. The water supply to some of the region has become a very real issue that has been faced daily and looks set to continue unless a permanent supply can be established.

Wannon Water is committed to a program of loss reduction and it will continue to be a major part of operations. The leakage in Wannon Water's reticulation network ranges from 8% to 15%. Wannon Water has a leakage detection and reduction program which aims to reduce the volume and percentage of water lost to leakage. Acoustic equipment is used to identify hidden leaks (that do not appear at the surface), when a leak is detected, the pipe is repaired or replaced.

Water loss at Wannon Water will be combated using a system of

- Reticulation sub-system metering (particularly in porous areas)
- Routine bulk metering calibration
- Meter replacement in both the domestic and commercial and
- Replacement or calibration of bulk metering systems.

Limited scope is available to be able to implement pressure reduction as a means of loss prevention as higher water pressures and volumes are relied on to supply different areas and plants within the system. Due to construction restraints within some of the distribution systems, flow reversal as a method of mains cleaning would be almost impossible to manage.

Flushing has been carried out on dirty water complaints as they are received. This is in stark contrast to the regular flushing programs that were practiced up until the last few years, although regular flushing is still done in known problem areas. Wannon Water aims to improve the design of water reticulation systems to minimise the need for future flushing regimes.

Water Carters are required to be registered with the Corporation and have been issued with metered hydrants that are read at the end of the hire period. A list of the designated filling points is issued with the hydrants and areas that have been known for low chlorine residual have been targeted to assist with flushing. The benefit of this is two fold as these parts of the systems are often sparsely populated and tankers do not disturb customers through the night.

Water evaporating retardant was used as a method of saving water on some water supply basins. As yet the benefits have to be fully determined. As the drought continued more emphasis was placed on water reduction in the workplace so that Wannon Water could set an example for its customer base.

There were a number of additional sites studied as part of this project including Qld and other areas of Victoria. The findings from these areas are included in the full project report available from the WIOA website – www.wioa.org.au

3.4 Wastage Reduction in the Workplace -Wannon Water

An audit of water treatment plants at Warrnambool, Caramut, Purnim, Koroit was conducted and the results were surprising as indicated in Table 1.

Table 1: ***Water Wasted at Wannon Water Sites***

Location.	**Water Loss ML/Y**
WTP Lab – Site bowls	2.400
Warrnambool Cl_2, pH analysers	1.300
Purnim Cl_2,and pH analysers	0.825
Koroit Cl_2,analiser	0.890
Caramut Cl_2, analyser	0.830
Warrnambool WRP - Distilled Water Unit	0.120
Totals	**6.36 ML**

All of these plants have now been fitted with small tanks and pumps to transfer the previously "lost" water back to the head of the plant and at a relatively small cost.

Internal audits also identified and required water saving shower roses and dual flush cisterns to be fitted at all facilities with the exception of the showers at the waste reclamation plants. These were all identified by the operators.

Wannon Water recycles reclaimed water for irrigation purposes at 13 plants. Iluka Mineral Sands at Hamilton use water processed at a Class A Membrane Filtration Plant and the availability of this supply was a major factor in the location of Illuka's plant.

Wannon Water has released its Water Supply Demand Strategy, a 50 year plan to identify demand management initiatives, to promote more efficient water use and assess potential new sources of water to meet the future needs of communities in south west Victoria.

Wannon Water is focusing on undetected water leaks as thousands of litres of water unknowingly go to waste. Wannon Water's compliance officer has visited 25 high water consumption customers in Hamilton in the past month to assist in water saving actions and leak detection. During these visits 16 undetected leaks were found, with over 31,000 litres of water going to waste each day.

4.0 RESHAPING WATER SAVING ATTITUDES

Reshaping Water Saving Attitudes is a three year project aimed at developing sustainable water use across regional and rural Victoria starting in the South West. The project is being undertaken by Deakin University in partnership with Wannon Water, the Victorian Water Trust, SmartWater! and Alcoa.

The aim is to reduce water demand and ensure supply security for the future of the region by looking at water consumption in the region to identify the high and low water users. After comparing the differences between these groups the goal will be to develop strategies to encourage high users to reduce their use. Consumers will be asked what their attitudes are to water saving behaviours, what things they are currently doing to save water and what things are stopping them from saving water.

The next step will be to use behaviour change tools to reshape water saving attitudes and help people overcome the barriers so they can minimize their water use. In many cases,

people know that they should reduce their use, so we want to encourage them to change their behaviour by making it easier for them to do so. This project will encourage behaviour that saves water easier so we can all lessen the demand on the region's water supply.

6.0 CONCLUSION

So after a year of scrutinizing and fact finding what have I learnt?

It would seem that the drought has been the catalyst for Water Corporations and Governments to work together to make the end users more aware of their responsibilities and become more efficient with water use. We have also been bombarded daily in the media with ways and means of reducing water loss and amazingly journalists have become experts in this field and even offer advice to Corporations on how to operate successfully.

In a situation reminiscent of farm kids knowing that milk comes from a cow not the fridge the whole of Australia now realizes that water comes from a somewhere other than the tap. Eventually though, we will reach a point when demand will outstrip supply and this has been forecast to happen as early as 2019.

I have discussed the issue of water with a lot of people from the farming community and their answer to the shortage is to increase the storage available to be able to sustain a prolonged dry period. This view is not shared by a lot of people in government in different states but the reality is, at some point, we will have to increase dam capacities if we are to continue supplying our major cities and towns.

While acknowledging that our Engineering Departments must have had a method of determining loss, I was unaware of the existence of the (ILI) Infrastructure Leakage Index, (CARL) current Annual Real Losses, (UARL) Unavoidable Real Losses, Benchloss and BABE, just to name a few. After discovering these systems, I realised just how much work had been put into loss management in the last 7 to 10 years. I have also found some people that are very passionate about water conservation and this is evident by the quality of the programs they have produced to assist utilities in all facets of reduction.

Look at the website of any authority and you will find a lot of information is now available to assist customers with water conservation in and around the house. This information is teamed with current water restriction information and links to other helpful sites. This technology is proving to be a very useful tool in customer awareness.

Closer to home, after standing back and having a look the operation of some of our systems I have been able to make some surprising reductions in the workplace. When a lot of our plants were constructed water supply was deemed to be endless, so if it went down the drain it didn't matter. Fortunately these attitudes have changed and we all look at new and different methods and technology to reduce not only water loss but energy consumption as well.

A lot of the information that I have been able to gather is to a lot of people common sense – the formalisation of these facts in this forum can only benefit those who read it and their workplaces in turn. As a treatment plant operator the drought and the Corporations reaction to the lack of water have forced the collection and implementation of these water

saving measures. I have only scratched the surface in a relatively short time but the opportunity to continually improve and change work practices will remain with me for the rest of my working life.

7.0 ACKNOLEDGEMENTS / REFERENCES

I would particularly like to thank the Water Industry Operators Association (WIOA) and the sponsors of the Prize, Environmental & Process Technologies (Division of Biolab), for providing the opportunity for me to undertake this project. It has been a great experience for me and I trust that some other organisations will benefit from the information collected.

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