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Yarra Valley Water's Pressure Management Strategy

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EXECUTIVE SUMMARY

Yarra Valley Water has developed a Pressure Management Strategy to manage and operate its water supply assets within preferred pressure ranges while continuing to meet our customer service levels. Based on the results of case studies and trials, the strategy involves the creation of 64 new pressure zones in the northern and eastern suburbs of Melbourne.

The Strategy includes a $25M capital works program over the next 5 years and is expected deliver a 10% reduction in burst rates and up to a 3.0GLpa reduction in non revenue water. These savings will play a key role in meeting the State Government's target of a 15% per capita reduction in water usage by 2010. The first new zones are expected to be implemented by May/June 2004.

INTRODUCTION

Yarra Valley Water is one of three retail water companies in Melbourne and annually purchases approximately 190GL of water from our wholesaler, Melbourne Water. We supply retail water and sewerage services to 616,000 customers, comprising of 569,000 domestic customers and 47,000 industrial and commercial users. Of the 190GL's of water purchased, about 164GL are metered supplies to our customers, with the remaining 24GL or 12.4% as 'Non Revenue Water'.

Yarra Valley Water's water supply system comprises of a total of 8643 km of water mains of which 7823 km are reticulation mains of size less than 300mm diameter and 820 km are distribution mains of 300mm diameter and above.

Approximately 80% of Melbourne's water comes from the protected forests in the upper Yarra River and Thomson River catchments. The water is transferred from the Thomson dam (1068GL) to the Upper Yarra Dam (201GL) and then to Melbourne via the Silvan Reservoir (40GL), refer Figure 1 below.

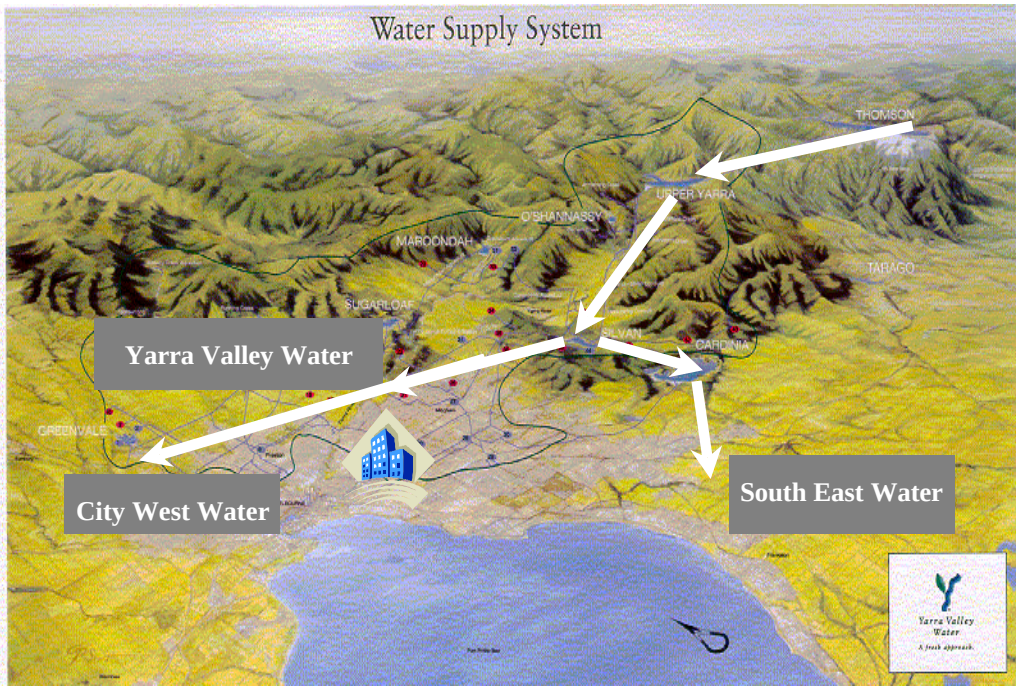

Figure 1: Water Supply System Overview

Melbourne's total system storage capacity is 1767GL compared to Melbourne's total annual supply of about 480GL. Silvan Reservoir is the key reservoir for distribution of water to system seasonal reservoirs including Cardinia, Greenvale and Yan Yean. Silvan Reservoir also supplies water to many of Yarra Valley Water's 106 pressure zones from Melbourne Water's transfer network and other local tanks/reservoirs, refer Figure 2 below.

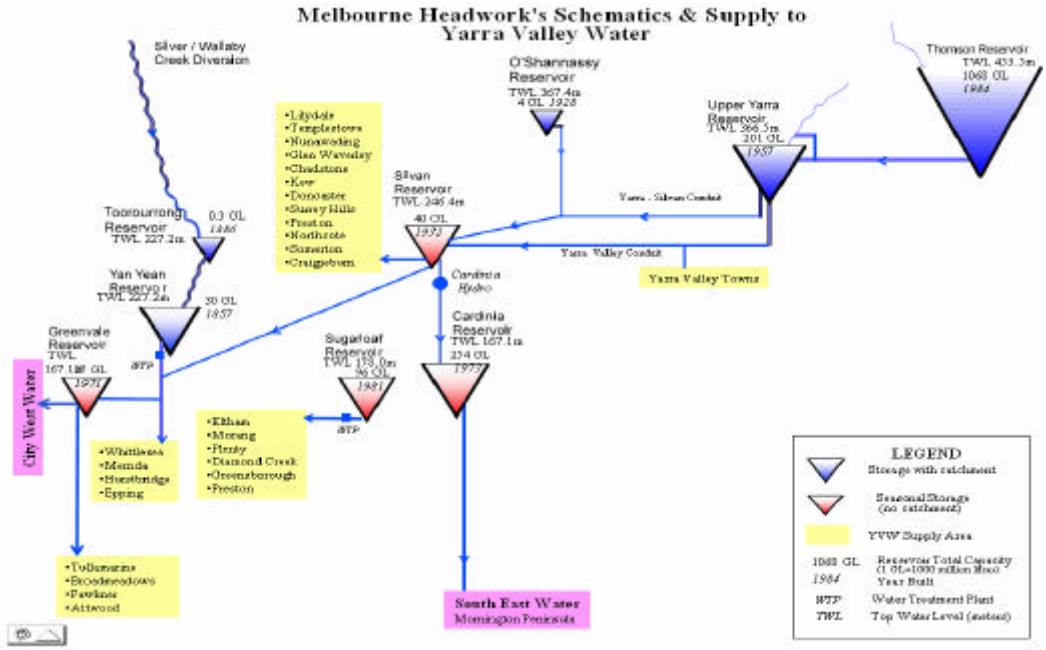

Figure 2: Headworks Storage Elevation Plan

Yarra Valley Water's water supply system has high pressures of supply compared to many other water supply systems. Although the pipe networks were originally designed and constructed to accommodate these high pressures, as the pipe assets age and naturally deteriorate their declining residual strength results in increasing burst rates, associated remedial repairs and replacement costs.

The varying topography across Yarra Valley Water's area from the hills in the east to the lower elevated inner suburbs means the pressures across and from zone to zone range from 20m to a maximum of 140m. The average pressure of supply for all customers is 73m which is very high by comparison with other water supply systems. The average water pressure in each supply zone is show in Figure 3 below.

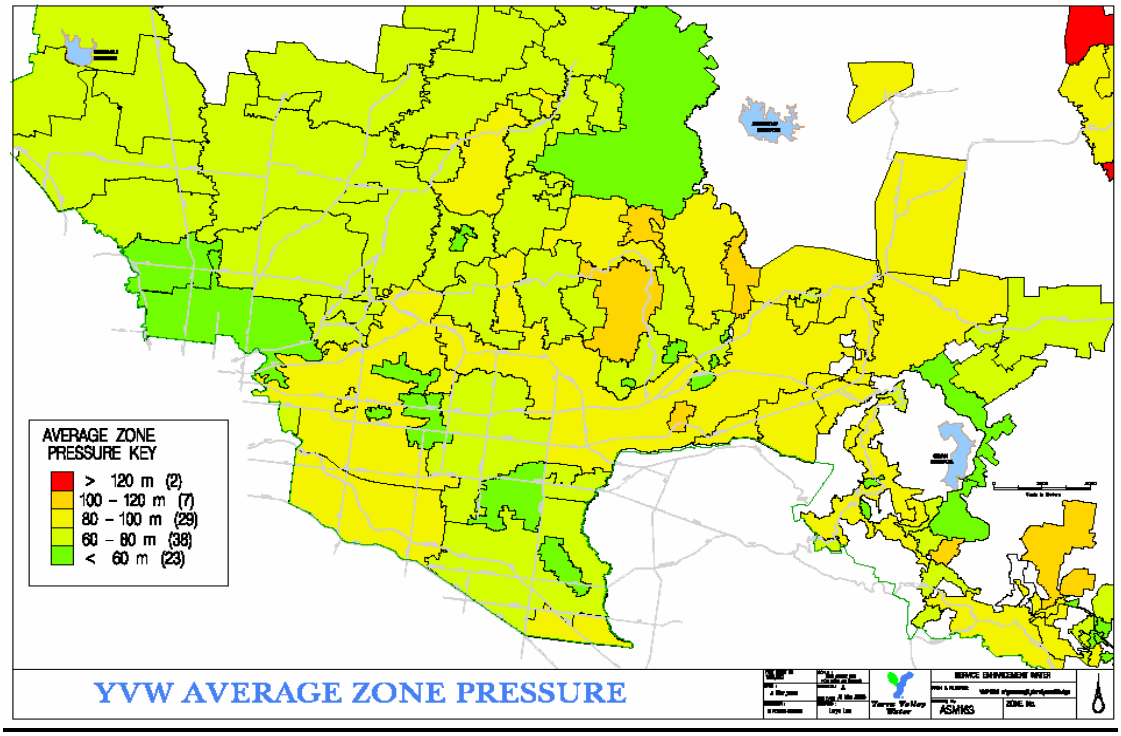

Figure 3: Average Pressures in water supply zones

Service Reliability To Customers

Yarra Valley Water experiences the second highest burst rate in Australia for large water supply systems, refer to Table 1 below *WSAA Facts 2003 Extract: Burst Rates for Retail Water Companies, pg 6.* This high burst rate is attributed to the variability of soils types, particularly expansive clays, the fact that the pipes were not sand bedded prior to 1970, the high pressure of supply and the type and age of pipe materials.

Table 1 WSAA Burst Rate Comparison /100km pa

	98/99	99/00	00/01	01/02	02/03
CWW	77	70	58	56	103
YVW	42	42	56	41	57
Sydney Water	43	41	38	38	51
Brisbane	32	36	37	38	39
Barwon	53	19	28	24	32
SEW	24	26	26	21	29
SA Water	31	25	25	22	24
Water Corp	11	12	13	13	13

The relationship between burst rates and supply pressure in Yarra Valley's system is illustrated in Figure 4 below. As expected with increasing pressures, burst rates rise up to 40/100km pa at pressure of about 50m. Beyond 50m pressure the burst rate remains relatively stable due to Yarra Valley Water's reticulation renewals program which targets mains with three or more bursts in the preceding 12 months. This effectively flattens the curve as poorer performing assets are retired.

The graph also shows the burst rates experienced by 20 large metered districts within Welsh Water UK with different average network pressures. The Welsh Water experience shows that as the water pressures increase for water supply areas so does the burst rate, similar results have been illustrated around the world and published by Lambert

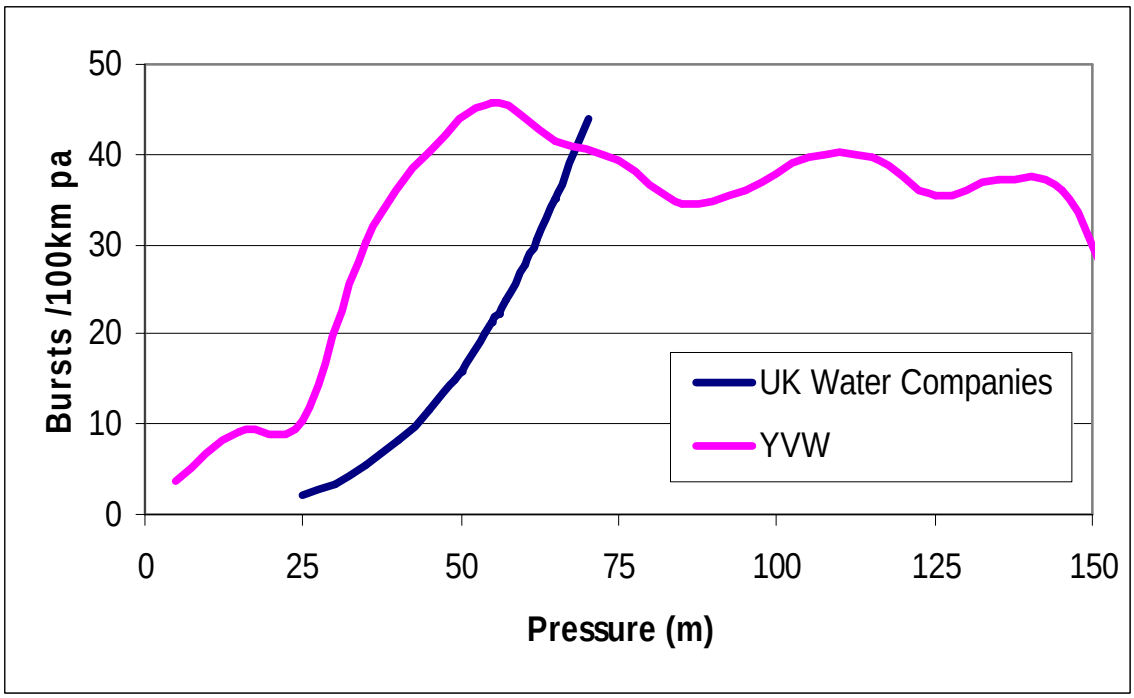

Figure 4: Yarra Valley Water Burst Rate Vs Pressure Profile

Water Conservation at Yarra Valley Water

The Victorian Government has recently released a Water Resource Strategy for Melbourne which outlines a number of key water conservation strategies to be pursued to ensure that Melbourne's existing water resources will be able to meet customer water requirements through to the year 2050.

The Government has also set a target for the Melbourne water companies to achieve a reduction in water consumption per capita of 15% by 2010. Yarra Valley Water is pursuing a number of initiatives to achieve this target which includes the reduction of non revenue water from our current level of 25GL (or 14% of all water purchased) in 2001/02 by one quarter by 2008.

Many large gains in reducing NRW from 22% in1995/6 have been achieved through meter replacement programs to provide for accurate bulk and customer metering, the installation of metered filling stations for water carters and leakage detection programs in areas with known high leakage rates. These existing programs are being continued and in some areas expanded, however one new key initiative for achieving the Government's water conservation target is to implement a large scale pressure management strategy across our water supply area.

Benefits of Managing Pressures

International studies have quantitatively demonstrated that higher network pressures inherently result in elevated burst and leakage rates, these studies bring together aggregated network relationships, based on physical principles, which can be applied to quantify the effects of changes in network pressures.

Pressure Management as an approach for reducing burst and leakage rates and extending pipe asset life, is not a new concept. It has been widely implemented throughout the UK over the past decade. Some of the most recent examples of its application have been in San Paolo, Brazil and by the Waitakere City Council in New Zealand. Yarra Valley Water has also undertaken a number of trials over the past 3 years.

PRESSURE MANAGEMENT TRIALS

Yarra Valley Water has undertaken three trials over the past 3 years to quantify potential benefits and costs of pressure management as a water conservation and asset management strategy.

These trials were as follows:

- Kew pressure management trial involving two subject areas, a control area remained on the normal operating pressures and an adjacent area where pressure reduced with installation of two pressure reducing stations. See Figure 5 below.

- The Yallambie area where the pressure of supply to a number of customers was reduced through changes in the zone boundary to a neighbouring zone of lower pressure.

- The Dublin Road area where peak hour pressures were reduced by changing from fixed speed pumping to variable speed drives.

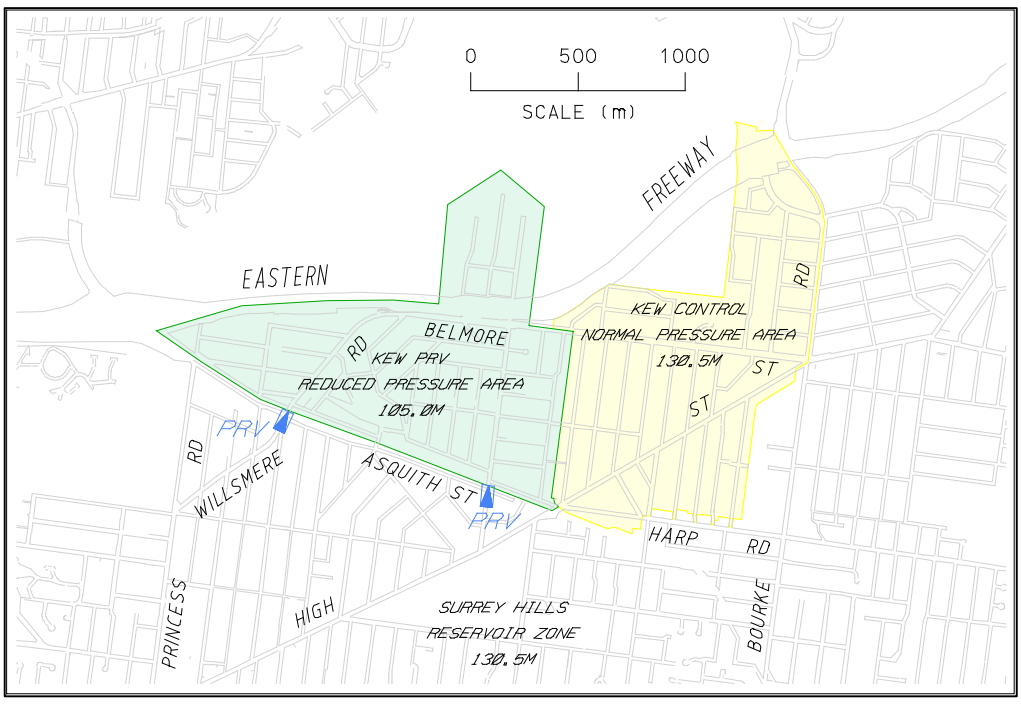

Figure 5 Pressure Management Trial Area in Kew

Based on the trials Yarra Valley Water has conducted, it is clear that managing pressures to lower levels does yield significant savings in the form of reduced burst rates and thereby improved service levels to customers and water loss reductions from pipe failures. The true impacts on reduced consumption, network capacity, fire services, pipe leakage reduction and increased pipe asset expected life span were not quantified through these trials.

Table 2 YVW Pressure Management Trial Paramters

Zone	Start	Properties	Length of Main (km)	Old P Ave (m)	New P Ave (m)	? P (m)
Kew Control	Dec-2000	1200	20	105	105	0
Kew PRV	Dec-2000	1200	15	105	75	25
Yallambie	Apr-2001	1800	25	119	75	44
Dublin Rd	Feb-2001	1500	19	89	64	25

Table 3 YVW Pressure Management Trial Results

	Pressure Burst Rate/100km pa		Unplanned Cust Ints pa		Reduction in Unplanned Cust Ints
Zone	**Pre**	**Post**	**Pre**	**Post**	
Kew Control	18	25	977	645	331
Kew PRV	20	10	1005	224	781
Yallambie	30	5	1349	519	830
Dublin Rd	40	25	1010	565	445

Kew Pressure Management Trial

The Kew Pressure Management Trial was a study specifically designed to collect and analyse data on the effects of pressure management and included a control area for baseline referencing. The data from the other trial areas tended to be collected and analysed after an operational change had been made for other purposes, ie improved pumping efficiencies and was not considered completely ‘clean’ data set. An analysis of the burst data for a period of 22 months before and after pressure reduction in the Kew trial area produced results as illustrated in the graphs below.

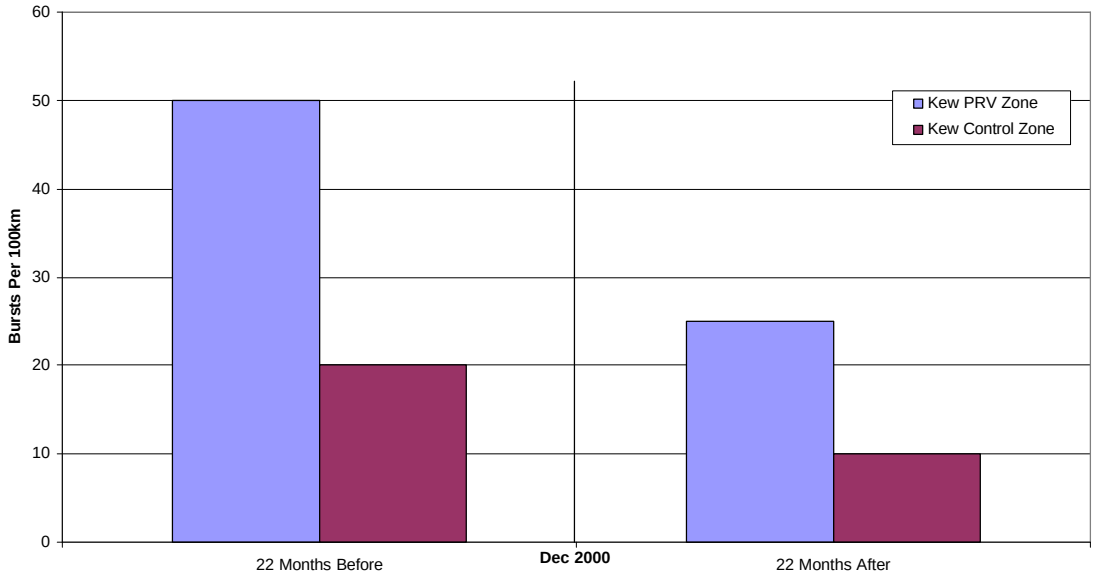

Figure 6 Soil Movement Related Bursts (Broken Backs) /100km pa

As would be expected, there was a similar ratio demonstrated via the rates of soil movement bursts between control and pressure reduced areas for the 22 months before and after the reduction in pressures was implemented.

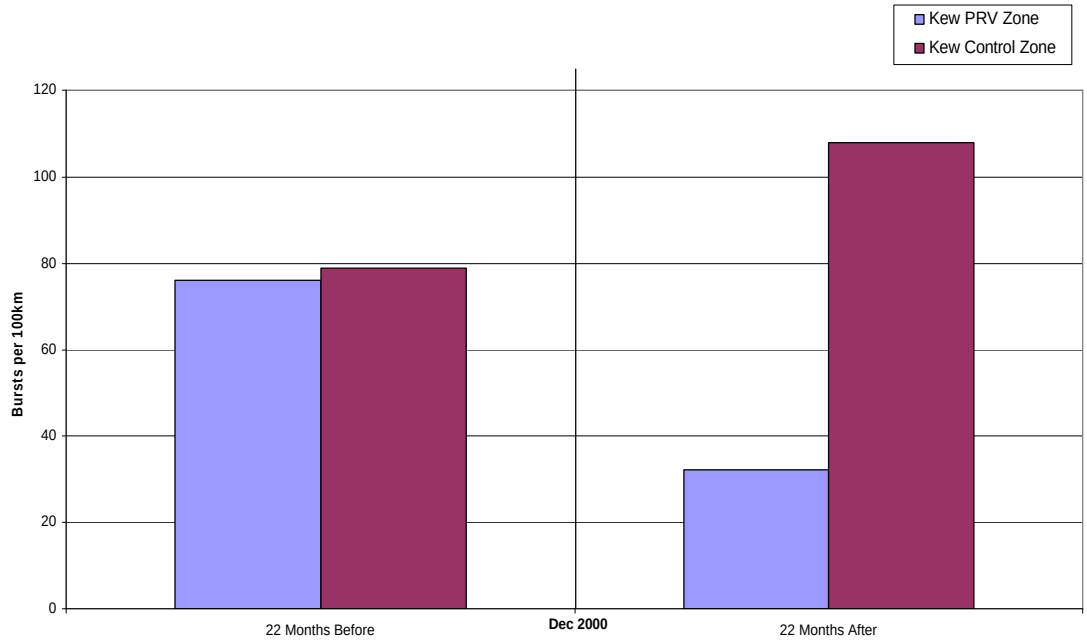

Figure 7 Pressure Related Bursts /100km pa

For the period of analysis there was a 58% reduction in pressure related bursts for the Kew PRV Zone whilst over the same period there was a 38% increase in the control zone.

DEVELOPING A PRESSURE MANAGEMENT STRATEGY

Based on the positive results from the initial pressure management trials of Kew, Yallambie and Dublin Road, Yarra Valley Water has developed a Pressure Management Strategy which has the potential to provide the following benefits: -

- customer service level improvements by reducing unplanned interruptions;
- environmental water conservation benefits through reduced leakage and some savings in individual consumption; and
- savings to Yarra Valley Water via reduced maintenance costs and renewal deferments.

The strategy provides for managing and operating our water supply assets within preferred pressure ranges to achieve the savings and benefits while continuing to meet our customer service obligations under our customer charter.

Selection Criteria For Defining a Pressure Management Area

The following design criteria were developed for identifying and designing the creation of pressure management area (PMA) across Yarra Valley Water's water supply system:

1. The PMA zones must have a size from 1,000 to 10,000 customers;
2. The zone needs to exclude large clusters of fire services or commercial customers;
3. The zone must have two or more sources of supply;
4. The zones pipe network must ensure that for a 1 in 20 year peak day, the peak hour pressure is greater than 20m across the zone;
5. For a 95%ile day, the peak hour minimum pressure is to be greater than 30m, wherever practicable;
6. The maximum static pressure at any point across the zone is to be reduced to 60m and the average static pressure is to be 50m;
7. The PMA design must improve pipe network capacity across the zone to ensure that supply can be maintained in the event of the loss of supply from one of the other pressure reducing stations supplying the zone; and
8. The PRVs maybe operated with time, flow & remote pressure modulation and will be linked to YVW's SCADA system with realtime monitoring.

Key components of these criteria were defined by the completion of a hydraulic computer modelling assessment of each potential PMA. Outlined below is the four stage process that was developed for the hydraulic analysis by consultants for each potential PMA.

Stage One - Review of Hydraulic Model & Data Provided

Review of the adequacy of the relevant water supply zone hydraulic model and the consultant certified that the model was satisfactory for the purposes of designing the PMAs. Yarra Valley Water has been building and calibrating its 49 hydraulic models for its 106 water supply zones since 1996. The access to calibrated hydraulic models was essential to investigate and define areas suitable to be pressure managed and to scope out the relevant infrastructure requirements to meet the above design criteria.

Stage Two – Initial pressure and flow analysis and selection of areas for pressure management

The consultant undertook pressure and flow analysis for both the 95%ile day demands and the 1 in 20 year peak summer day demands for a 25-year design demand horizon and reported on the following information:

- Any supply deficiencies where the peak hour pressures were below 20m;
- Where static pressures were greater than 60m;
- Where any pipe headlosses were greater than 10m/1000m at peak hour demands;
- If there were any pipe velocities greater than 2 m/sec;
- If the historical fire service pressure and flow requirements are contravened and to provide recommendations as to how to correct such deficiencies; and
- If the Yarra Valley Water's charter/contract was contravened, to provide recommendations on system improvements.

Pressure management areas were selected utilising the results from the pressure and flow analysis on a 95%ile day and the peak summer day over the 25 year design horizon to achieve the 8 design criteria for PMA's as defined above.

Stage three – Functional Designs.

A minimum of three functional design options for different water supply arrangements to supply the PMA were undertaken to identify the preferred functional design. The selected solution was based on the practicality and least cost for establishing and maintaining the pressure management area to meet the above requirements.

Stage four - Sensitivity Analysis.

A sensitivity analysis was undertaken to assess various demand sensitivities (low, medium & high) for the 25-year design horizon.

POTENTIAL PRESSURE MANAGEMENT AREAS

A total of 64 Pressure Management Areas have been identified which cover 46 per cent of Yarra Valley Water's customers and 34 per cent of the total length of water mains or 38% of reticulation mains. Refer to plan in Figure 8 below.

These PMAs will have an average reduction in pressure of 25m and this will reduce the average pressure across Yarra Valley Water's water supply system from 73m to 63m.

The management of pressures will be implemented over a period of 5 years and it is estimated that savings of up to 3.0 Gigalitres per year in reduced leakage will be achieved by the end of year 5.

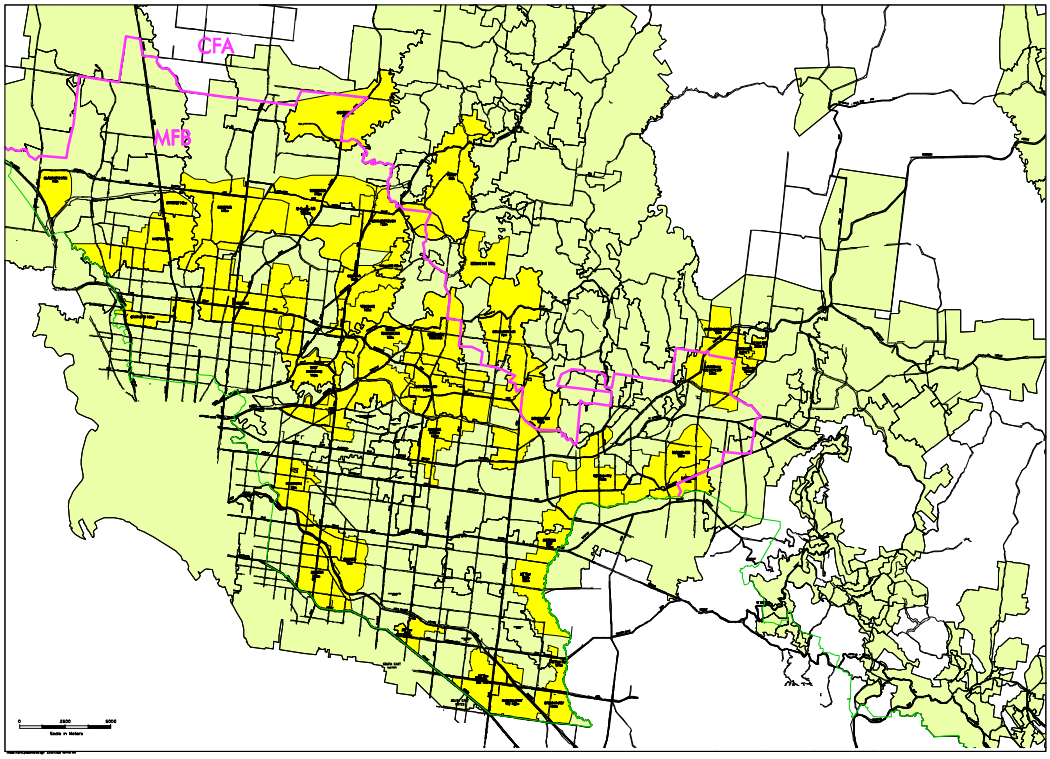

Figure 8: Map of Potential Pressure Management Areas

The first areas to be pressured managed during 2003/04 will be within the suburbs of Ashburton, East Malvern, Hawthorn, Ivanhoe, Kew and West Heidelberg. The construction and commissioning of these pressure managed areas (PMAs) will be commenced after the completion of our customer consultation process.

CONSULTATION PROCESS

Yarra Valley Water is implementing a consultation process that covers the following key stakeholder groups:

- Key stakeholders including the Minister of Water, the relevant Government Departments (DSE), the Ombudsman, the Fire Fighting Brigades (MFB and CFA), Fire Protection Association of Australia (FPAA), Building Commission, Municipal Building Surveyors, Plumbing Industry Commission (PIC), Local Councils and other Melbourne Water Companies.
- General Media Releases with availability of Managing Director for a presentation.
- Internal Communication across the business for staff awareness. This included Team Brief article, questions and answers and facts sheets, information on the internet and intranet and briefings to Team and Divisional meetings. and
- Communications to each pressure managed area on a case by case basis. This includes advertising in the local press and letters sent to non domestic customers with follow up support to resolve issues associated with customer's fire and general services and service levels.

ECONOMICS OF IMPLEMENTING PRESSURE MANAGEMENT

The key elements of the economic evaluation are the initial capital cost of building Pressure Reducing Stations, installing new boundary valves, expected replacement of old main to meter service pipes and remedial works to fire services. An allowance must also be made for ongoing maintenance of PRVs and loss of revenue, but offsetting all this are the expected savings from reduced burst rates, leakage and asset renewals.

Summary of Economic Evaluation

- Estimated CAPEX $ 25.0m; (PRV@$100k)
- approx 120 PRV Stations;
- Estimated PRV maintenance of $ 250k pa; and
- NPVs summarized in Table 4 below.

Table 4 NPV Summary

	Worst Case	Likely Case	Best Case
Revenue Loss	2.0%	1.5%	1.5%
Burst Reduction	8.0%	10.0%	12.0%
Leakage Savings	2.0GL	2.5GL	3.0GL
Deferred CAPEX	$1m for 5 Yrs	$1.5m for 5 Yrs	$1.5m for 10 Yrs
Revenue Loss	2.0%	1.5%	1.5%
NPV $M	-6.3	-2.3	10.7

Sensitivity Analysis

The following senistivity analysis was carried out on the NPV for the strategy:

- The impact of revenue loss being ignored;
- CAPEX increased to $ 32.5m; and
- The impact of revenue loss being ignored with the CAPEX increased to $ 32.5m

Table 5 Sensitivity Analysis

NPVs in $M	Worst	Likely	Best
The impact of revenue loss being ignored	2.0	8.6	14.9
CAPEX increased to $ 32.5m	-11.9	-3.2	5.2
The impact of revenue loss ignored with the CAPEX increased to $ 32.5m	-3.6	3.0	9.3

CONCLUSION

Yarra Valley Water has determined from three trials that there are water conservation and service reliability benefits from reducing pressures of supply to customers. Yarra Valley Water has developed a Pressure Management Strategy that it will implement over a 5 year period to reduce its overall average pressure of supply from 73m to 63m. This strategy provides for establishing 64 pressure managed areas covering 46% of customers and 36% of reticulation water mains. The economics of the strategy depends on the assumptions relating to the amount of benefits to be achieved, particularly relating to the reduction in pipe burst rates and the associated deferral of water main renewals. The actual benefits of the strategy will be established over the implementation period of the strategy.

ACKNOWLEDGEMENTS

Yarra Valley Water and the authors would like to thank Mr Tim Waldron, Chief Executive Officer of Wide Bay Water and Mr Alan Lambert, Member of the International Water Association Water Losses Taskforce for their advice and assistance in the investigations and development of our Pressure Management Strategy.