FIRE INCIDENT - EAGLEBY PRESSURE CONTROL AREA & THE BENEFITS OF USING FLOW MODULATION PRESSURE CONTROL OVER TRADITIONAL PRESSURE CONTROL

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EXECUTIVE SUMMARY

This paper describes the benefits of using flow modulation technology over traditional fixed outlet pressure reducing valves. A significant problem for water authorities is to get enough pressure into a system in the event of a fire. Fixed outlet pressure reducing valves of time controlled valves, do as they say.

This paper will discuss an actual fire incident which occurred at Eagleby Shopping Centre and show practical information of how the flow modulated pressure control dealt with this event.

This control method involves a more complex controller (the flow modulated controller) which provides greater flexibility and control than that offered by the simpler time modulated controller.

Flow modulating pressure is the best type of control for areas with changing conditions, variable head loss, and high fire flow requirements. Flow modulating pressure reduction provides advanced control of outlet pressure related to demand. The valve controller reads flow from a meter and uses this input to control the position of the valve, the greater the flow, the more the valve opens and thus the higher the pressure. The controller is normally supplied with a local data logger and optional remote communications. Water pressure can be controlled with a preset profile related to the changing relationship of demand and head loss in a zone.

By using flow modulation control we can increase the pressure with increased flow to a certain pre programmed flow and pressure profile. Therefore in the case of a fire there will be adequate pressure within the system to fight the fire. Such an incident happened on the Gold Coast in the Eagleby pressure management area.

INTRODUCTION – THE BASICS

Pressure management is an affective way to control the amount of water lost in a system. This can be implemented without affecting service levels when activated during low demand periods such as late night and early morning. It can also reduce consumption in networks with no intermediate storage. A small reduction in pressure can mean a significant reduction in real losses through leaks. It is important though, to comprehensively evaluate a service area and gain an understanding of its background losses, before or alongside introducing pressure control. The effect of pressure control on real losses can then be quantified. This has been proven in water supply networks around the world and in networks here in Australia such as the Gold Coast, Hervey Bay, Toowoomba to name a few in Queensland.

However, there is one issue that is always a concern when we talk about pressure management and control; these are as follows “what happens when there is a fire or when there is unusually high demand?”

Pressure in water network systems can be controlled in three ways using ***Pressure Reducing Valves and Smart Controllers***, the first is your basic fixed outlet type the second a little more advanced using time multipoint outlet regime and the totally advanced method of flow modulation

Pressure Reducing Valve (Fixed Outlet)

The traditional method of control is via a hydraulically operated control valve. This is effective for areas with low-pressure head losses, demand that does not greatly vary due to seasons and areas that have uniform supply characteristics. Fixed Outlet PRV’s are widely available commercially. The valve reduces the pressure of the incoming water to a pre-determined outlet value. Therefore, as the upstream pressure on the valve fluctuates due to different needs (varying levels within reservoirs and pump switching etc.) the downstream pressure remains constant. In a fire situation although the flow rates will rise the pressure will not increase and invariably will decrease as head loss in the water network increases with increased flow.

Modulated Pressure Reduction Valve (Multi Point control)

Time based modulation is the simplest form of Advanced Pressure Control and uses a controller with an internal timer. Pressure is controlled in time bands according to demand profiles. The method is suitable for areas with stable demand profiles and head losses and is usually used where cost is an issue but advanced pressure management is desired.

With time modulation although one has a degree of control in raising pressure during times of peak demand (the morning and afternoon peaks) the regime still remains as fixed outlet control. So at times of low demand when the pressure is set to a desired minimum the output will be similar to that of the basic control (fixed outlet) if there is unusually high demand. During times of peak demand the action would also be similar to that of a fixed outlet regime; however the pressure settings would be set higher to compensate for that period giving that extra pressure in the water supply system.

Flow Modulating Pressure Reduction Valves (Flow based Dynamic Modulation)

This control method involves a more complex controller (the flow modulated controller) which provides greater flexibility and control than that offered by the simpler time modulated controller.

Flow modulating pressure is the best type of control for areas with changing conditions, variable head loss, and high fire flow requirements. Flow modulating pressure reduction provides advanced control of outlet pressure related to demand.

The valve controller reads flow from a meter and uses this input to control the position of the valve, the greater the flow, the more the valve opens and thus the higher the pressure. The controller is normally supplied with a local data logger and optional remote communications. Water pressure can be controlled with a preset profile related to the changing relationship of demand and head loss in a zone.

Controller Profile		
Flow Modulation Profile		
Flow	Flow	Required
l/sec	m3/hr	Pressure
4.50	16.2	30
5.00	18.0	35
5.50	19.8	37
6.00	21.6	37
22.00	79.2	49
47.00	169.2	52
100.00	360.0	60

Figure 1

Pressure increases/decreases along curve profile with variable flow rates

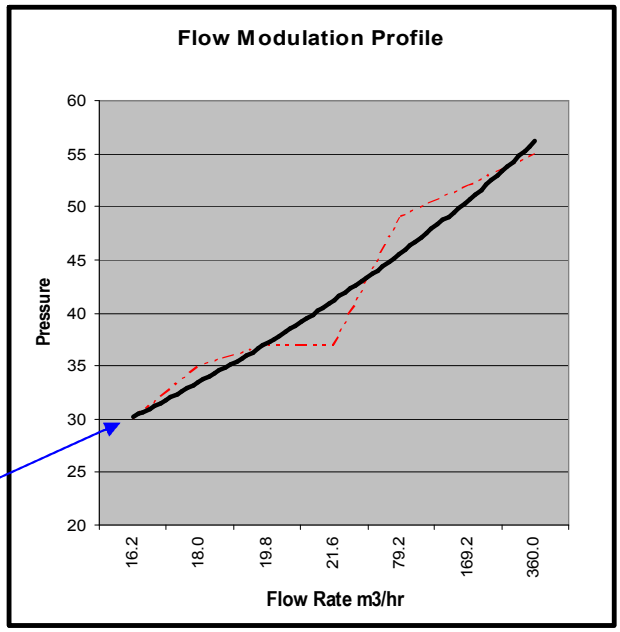


Figure 2

The profile can be set with up to ten points allowing for greater control at the lower flow rates (figure 1). At the high flow rates, points are profiled for adequate pressure during normal demand periods so as flow rates increases and decrease the outlet pressure follows the curve depending on the flow rate (figure 2).

An override setting is also programmed so that in an event of fire or unusual high demand, maximum pressure can be called upon automatically. Figure 3 shows a typical flow and pressure profiles for the Eagleby pressure management area. You can see from the profile as the flow rates starts to increase and decrease (black line) the pressure profile (red line) matches the flow rate.

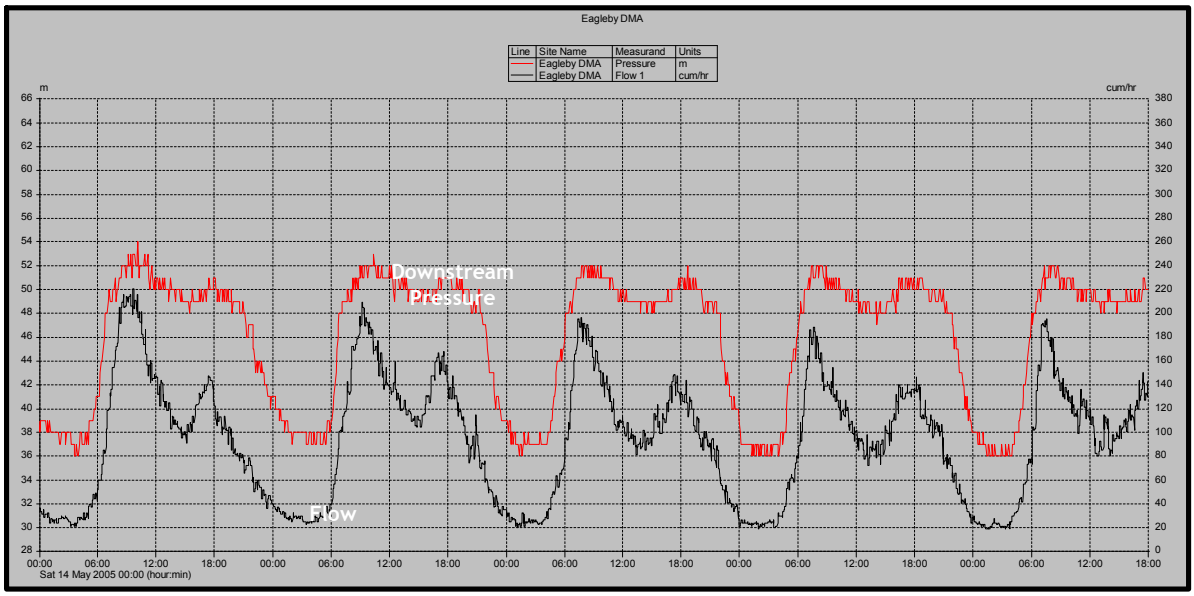


Figure 3

EAGLEBY PRESSURE MANAGEMENT AREA

As a part of the Gold Coast Water trials through pressure management and leakage control the Eagleby pressure management area was set up with an advanced pressure controller (flow modulation). Eagleby is located at the northern part of the Gold Coast Water supply area, predominantly residential (figures 4).

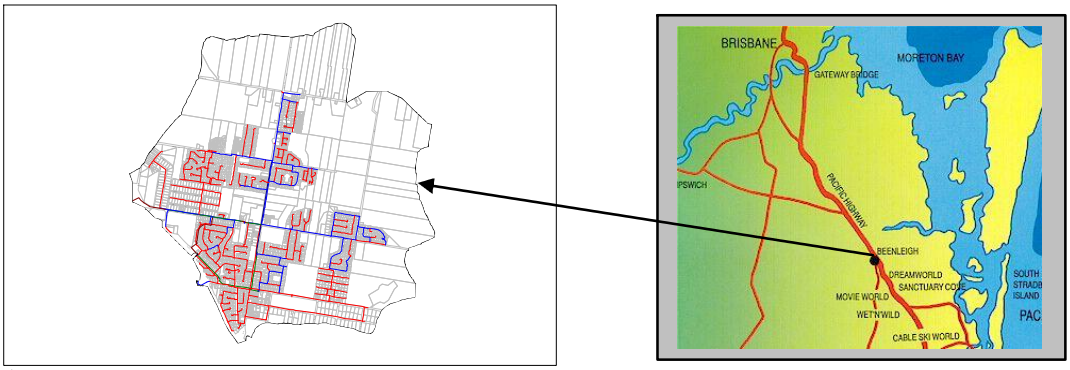


Figure 4

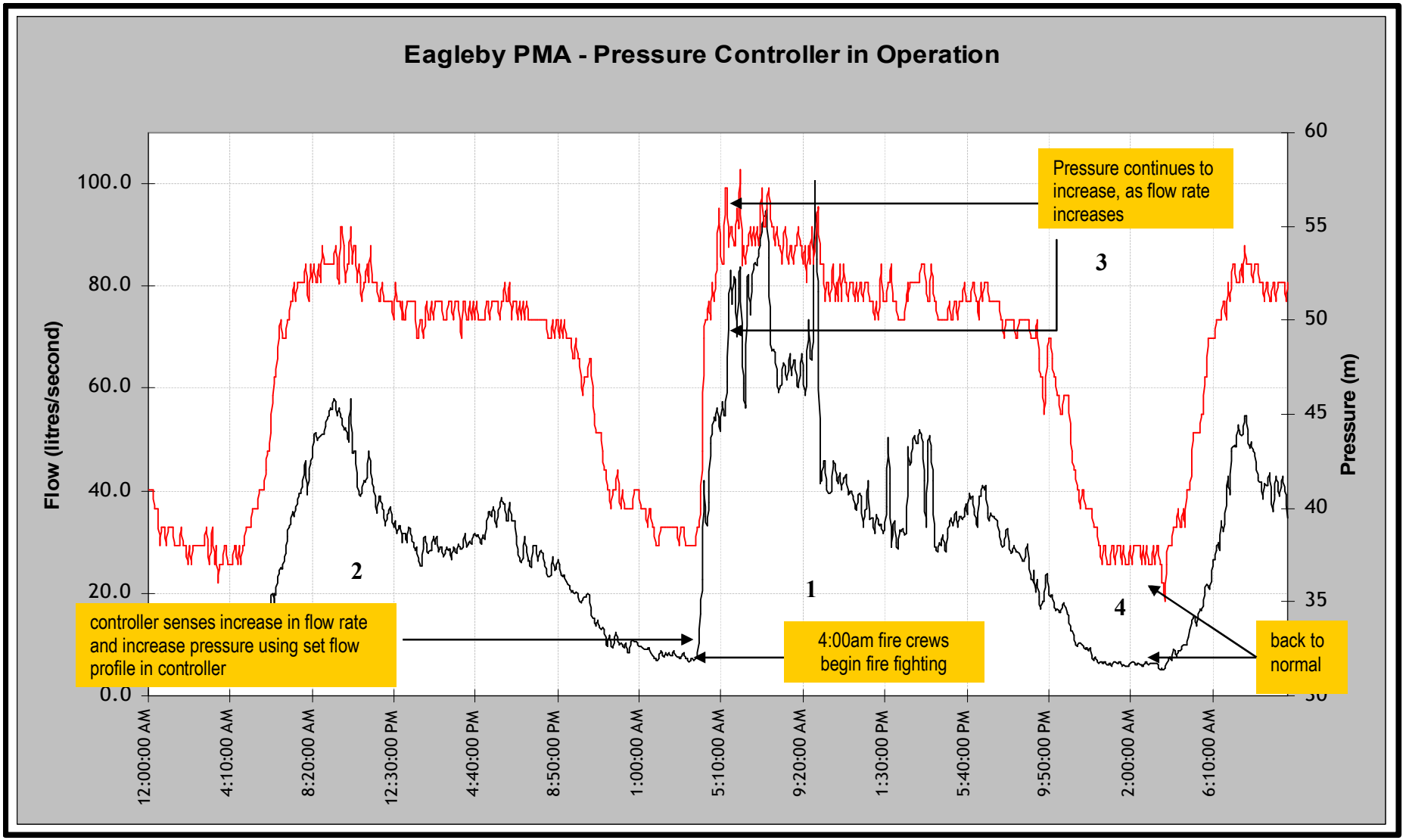
The pressure management area is supplied via a 200mm flow meter and a 200mm pressure reducing valve which in turn is retro-fitted with a flow modulation controller. The flow and pressure data is sent back to a central computer on a daily basis via text message through the mobile GSM network, this allows for constant monitoring of current flows and pressure in the PMA.

Flow Meter

Pressure Reducing Valve

FIRE INCIDENT – EAGLEBY PRESSURE CONTROL AREA

In the early hours of Sunday 10th April a fire broke out at an Eagleby shopping centre, fire service appliances were on the scene to start fire fighting. Upon hearing the news later that day a sense of “PANIC” dawned. Using the GSM network the overnight flow and pressure profiles were downloaded and the following events took place.


Eagleby PMA - Pressure Controller in Operation
Flow (litres/second)
Pressure (m)
100.0
80.0
60.0
40.0
20.0
0.0
60
55
50
45
40
35
12:00:00 AM
4:10:00 AM
8:20:00 AM
12:30:00 PM
4:40:00 PM
8:50:00 PM
1:00:00 AM
5:10:00 AM
9:20:00 AM
1:30:00 PM
5:40:00 PM
9:50:00 PM
2:00:00 AM
6:10:00 AM
Pressure continues to increase, as flow rate increases
3
2
1
4
controller senses increase in flow rate and increase pressure using set flow profile in controller
4:00am fire crews begin fire fighting
back to normal

1. Prior to 04:00am the controller was operating within the profile settings, the minimum night flow was down to the expected levels and the output pressure was set according to the flow rates between 36 and 38 m. At around 04:00am fire service appliances started drawing water to fight the fire.

2. As the flow increases the controller senses the sudden increase in flow rates and starts to ramp up the pressure accordingly.

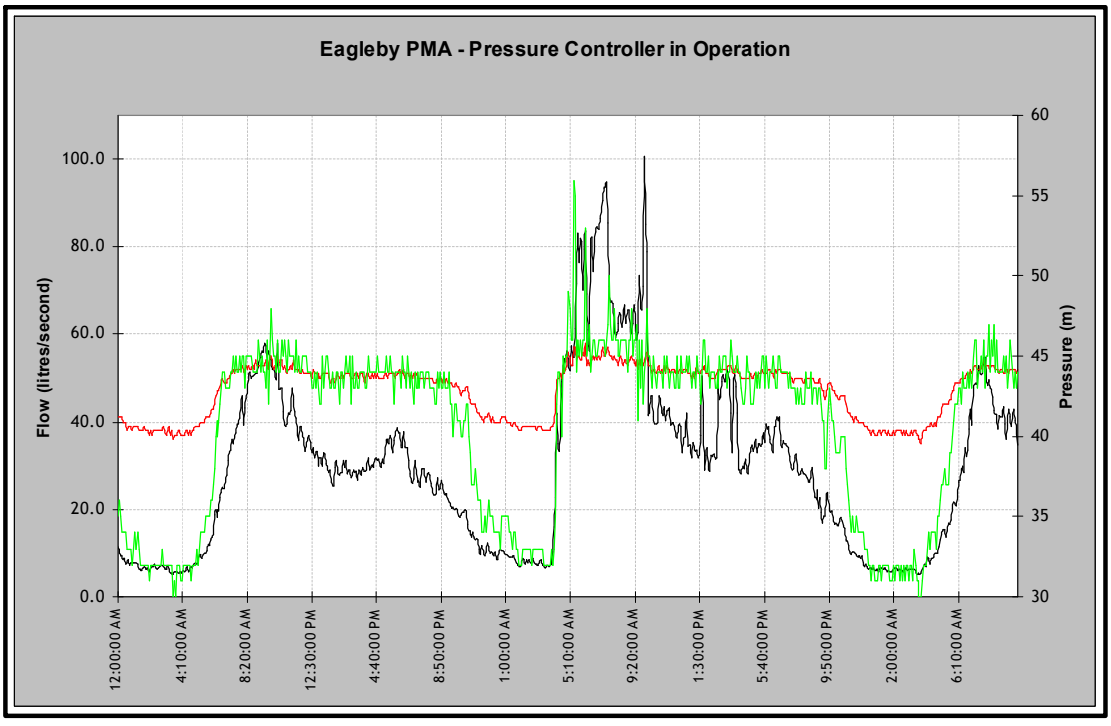
3. The chart below shows the controller operation.

Max Flow Rate	**- 342 m3/hr (95 litres/sec)**
Max Pressure reached	**- 56m**
Max Pressure available	**- 60m**
04:00 – flow 28m3/hr	pressure - 39m
04:05 – flow 82m3/hr	pressure - 43m
04:10 – flow 150m3/hr	pressure - 49m
04:45 – flow 203m3/hr	pressure - 53m
05:30 – flow 299m3/hr	pressure - 55m + demand
07:20 – flow 342m3/hr	pressure - 56m + demand

The maximum pressure available in the system is 60m, at the peak of the incident the maximum that was reached was 56m with 4m remaining head available if required the programmed maximum flow rate was set to 100 litres/second or 360m3/hr this also was not reached, thus allowing for extra flow and if required. It must be also noted that during the latter part of this event the usual morning demand was also added to the load.

CRITICAL POINT PRESSURE

During this period the critical point pressure data was also analysed this is indicated by the green line in the graph we can see that the pressures at this point have not been affected.



CONCLUSION

From the above experiences we can see the benefits of pressure control through flow modulation, not only is it an effective way to control:

- The amount of water lost in a water supply system
- Keep lower pressures in water networks
- Reduce burst frequency
- Reduce consumption

It is highly flexible in the events such as the Eagleby fire incident, variable head loss and changing conditions. This system operates stand-alone and pressures are adjusted automatically according to demand. The built in fail safes are also advantageous over traditional pressure control. **"So all up Flow Modulation is the way to go!!!"**

References:

Eagleby Pressure Control Area – Gold Coast Water (Wide Bay Water Corporation Report)(2005)

Pressure Management Project – Gold Coast Water

Managing Pressures – Manual 5 - Wide Bay Water Corporation

Channel 7 News – Video Clip (Fire Incident Eagleby)

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