DIVERSION HARVESTING - AUTOMATIC IMPROVEMENTS

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ABSTRACT

In common with other water authorities, Barwon Water relies heavily upon harvesting water from catchments both with & without on-stream storages. A significant percentage of Barwon Water's yield is derived from tributaries of the Barwon River which have no discernable storage and have traditionally required close operator attendance to derive maximum yield. This close operator attention stems from the need to provide environmental flows as provided for by Bulk Water Licences via the manual operation of timber weir gates on the river diversion weirs.

Over the past few years, the focus on transforming our series of manually controlled diversion weirs into an automated system has grown from the need to better utilise our operators limited time, to one of ensuring the maximum yield is derived whilst maintaining the environment.

1.0 INTRODUCTION:

Barwon Water provides a water supply system to the city of Geelong and surrounding region with a population of over 250,000. Up to 80% of the Geelong region's supply is derived from the Barwon system which consists of it's main on-stream storage, the West Barwon Reservoir, diversion weirs on the East Barwon River, Callahans, Pennyroyal & Matthews Creeks, a groundwater production wellfield, a transfer channel system from West Barwon Reservoir & the diversion weirs to Geelong's largest reservoir, the off-stream storage of Wurdee Boluc Reservoir.

Water is typically harvested & transferred from West Barwon and the diversions during winter and spring and stored at Wurdee Boluc to provide a balancing supply to Geelong for the summer period. The surface water harvesting provides the majority of Geelong's supply, whilst the groundwater production wellfield provides drought relief during periods of lower than normal rainfall.

During the harvesting and transfer period, typically from June to December, operators would spend considerable time maintaining flows in the main supply channel from West Barwon and the tributary diversions, whilst maintenance works would be carried out during summer and autumn whilst the channel is out of operation.

2.0 DISCUSSION

In operating a water supply system, the authority and it's employees need to adapt to an ever changing environment. This environment combines climate, business and cultural aspects that all have to be addressed in order to successfully implement the changes. The drivers for these changes may alter the focus on why change is implemented, but the end result has to be one of overall improvement that benefits the authority in a number of areas.

With an ever increasing demand for water and the not so subtle strain on our current resources, the emphasis for improving how we harvest water from the catchments necessitated change as a result from the current climatic changes that are more frequently leading to lower than average yield from the catchments.

The need has arisen to try to derive as much water as possible from our catchments whilst maintaining compliance with our bulk water entitlement licences. In the past, these licences were met by over compensating the releases from our catchments and frequent operator attention. This resulted in a reduction in potential yield and a greater demand in man hours spent regulating these flows.

Whilst water demand and climatic change has demanded the greatest attention in developing an automated system for harvesting water from our diversion weirs, other beneficial spin-offs, which in themselves are important factors for automation, include reduced operator intervention, better monitoring & control and reduced OH&S risks.

2.1 Supply & Demand

The potential yield from Barwon Water's supply system is fixed by the catchments currently operated, and with further development of the harvesting areas unlikely to proceed in the near future, this yield will remain whilst demand is ever increasing.

One way of increasing the yield from the current supply system is to increase the efficiency in the way the water is harvested. Automation of the weir gates currently in operation allows the tolerances for environmental, or passing flows, to be closer set. This subsequently results in greater yield from each of the diversions fitted with them. Figure 1 below shows how the flow in Callahan's channel is maximised whilst maintaining environmental flow. The position of the weir gate is also shown as it automatically adjusts to rising & falling creek levels to maintain environmental flows.

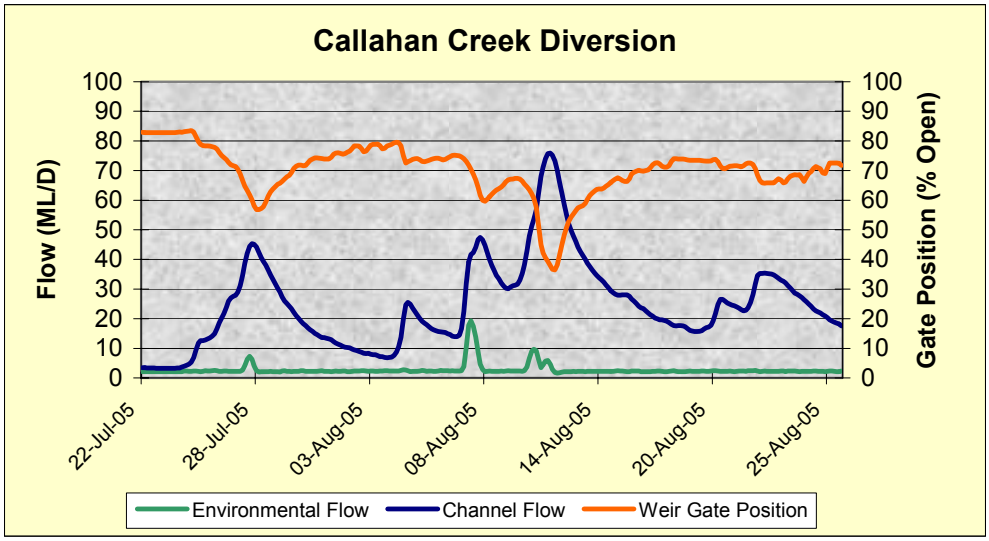
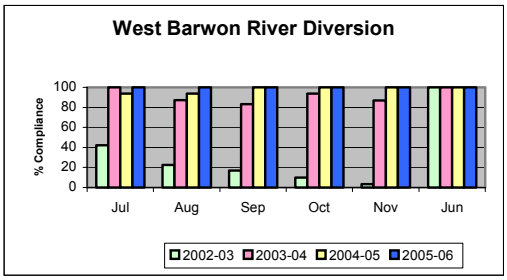


Figure 1: *Flows & Gate Position at Callahans Creek Diversion*

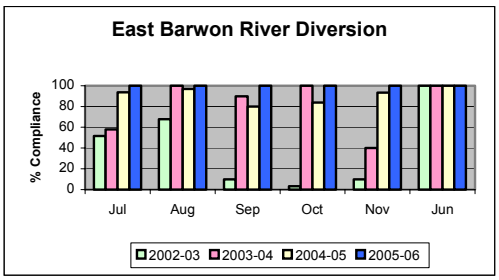
2.2 Environmental Compliance

An ever increasing focus is being placed on how water harvesting impacts on the environment from which it draws. Bulk entitlement licences regulate the quantity and way water is harvested from the rivers and creeks and reporting of these licences has taken a more formal approach over the preceding few years.

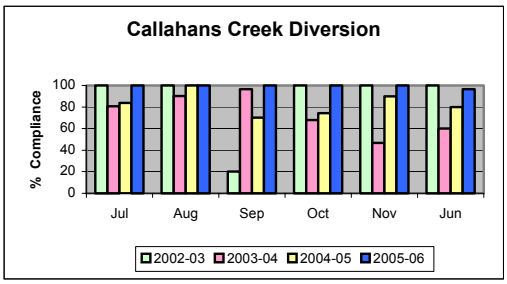
In moving from an operation where water harvesting was carried out without bulk entitlement requirements to one where every day of non-compliance is reported upon, required a significant change in how diversions were operated. As these increasing demands to meet compliance were being addressed, monthly compliance rates suffered, again forcing a need to change to meet statuary requirements. As automation of the gates is being implemented, a direct improvement of environmental compliance during operational months can be observed as shown in Figure 2 below.



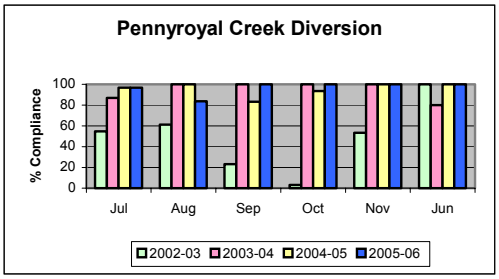
West Barwon – Gate automated 2004-05



East Barwon – Gates automated 2005-06



Callahans Creek – Gates automated 2005-06



Pennyroyal Creek – Gates automated 2006-07

Figure 2: ***Environmental Flow Compliance at Diversion Weirs, 2002 – 2006***

2.3 OHS Improvements

In an endeavour to meet our bulk entitlement licences whilst maintaining maximum yield from our diversions, operators attended sites up to four times per day as well as weekends to regulate flows. During after-hour high flow events, site visits were also required to prevent high levels of water entering the channel system which could threaten channel security via breaching. With all the diversion weir sites being in remote locations, operator safety was also a concern, so minimising attendances reduces operator risk. Reduction in manual handling issues by the introduction of solar powered gates also reduces OH&S risks. When solar power runs out, gates can be operated via rechargeable battery powered drills.

2.4 Developmental Improvements

In implementing such changes to an operating system, it is always important to involve the operators of the system. This is important as it provides the operators with ownership as well as a working knowledge of the changes. The installation works show the operators how the structures are put together, whilst the programming and telemetry developments improve the operators knowledge of computer based operating systems and help take some of the "fear" out of using them.

These skills in installation & operation all form a part of operator development, which benefit not only the operators but the authority as well.

2.5 Business Improvements

A benefit of upgrading the weir gates that comes from reduced operator attendance is the time savings they provide. Each automated weir gate has the potential to reduce operator attendance by up to 2 hours per day during normal operating conditions. During a normal operating season of up to 5 months, this can achieve time savings of up to 20 days. The benefit of these savings is not in the reduced operator requirements, but the increased availability of the operators to attend to maintenance issues within their system. The increased maintenance availability of the operators subsequently prolongs the life of the authorities assets, reducing failure replacements and contractor costs.

2.6 How They Work

To operate, the weir gates need to know a number of parameters in order to direct water into the supply channel, maintain environmental flow, prevent over supply into the channel and minimise flood build-up behind the weir. This is achieved by the following instrumentation at the diversion weir:

- Flow monitoring on the river/creek downstream of the weir
- Flow monitoring in the channel
- Upstream level monitoring of water behind the weir
- Position sensoring of weir & channel control gates
- On site control cabinet with programmable "uni-op" and manual capability controls
- Solar panels & batteries for remote location power source
- RTU for remote monitoring & control

The most critical parameter the automated gates are in control of are the environmental flow requirements which are reported to externally by the authority. To monitor these flows, streamflow monitoring sites are set up as close as practical downstream of the diversion weirs. Typically these sites consist of a controlled creek bed width and small measuring weir to allow accurate rating of the flows. Streamflows are then measured via height conversion of the depth of the river/creek at that point, with the depth measured either ultrasonically or by float in a small adjacent well connected to the measuring weir.

Streamflow Measuring, Callahans Ck

Streamflow Measuring, East Barwon

The importance of keeping the streamflow measuring site as close as practical downstream of the diversion weir is to limit the delay between measuring the flow and

initiating a position change of the gate. This reduces the risk of undershooting or overshooting of environmental flows and subsequent "position hunting" of the weir gate to achieve the designated flow setpoint.

To ascertain the position of the weir gate, a position sensor is incorporated in the gate actuator. This position sensor allows the operator track the movement of the gate over a period, which helps with operation interpretation as well as allowing remote manual changes to gate position when required.

Automated gate right of picture at Callahans Creek Diversion

Automated gate right of picture at East Barwon River Diversion

The same level of monitoring is also required on the channel itself in order to determine flows in the channel. This allows total daily flows to be calculated as well as instantaneous flows in the channel. Instantaneous flows are important as they allow control of the channel gate to limit maximum flow in the channel. Controlling maximum flows in the channel prevents possible over-supply and potential breaches which could damage both channel assets and property alike. The same level of control and monitoring of the channel gate position is also possible via position sensors on the channel gate actuator.

The final level of monitoring & control installed at the diversion weirs is upstream level measuring. Monitoring of the upstream river level allows the gates to react to potential flood situations and lower the gates accordingly. Once the pre-determined flood level is reached, this overrides all other environmental controls as flood flows will exceed any environmental flow requirements.

East Barwon River Automated Channel Gates Controlling Floodwaters into Channel during flood

Pennyroyal Creek Automated Channel and Diversion Weir Gates

All of the monitoring & control of the diversion weir gates is able to be carried out off-site via Barwon Water's SCADA system. This allows the operators to check each of the weirs performance without necessarily attending the site. On site manual operation of the weir gates is also possible via the control cubicle or, in case of loss of solar & battery power, by means of a standard rechargeable drill.

2.7 Future Directions

As implementation of the automated gates expands to the remainder of the diversions currently in operation, further operating improvements are being considered. These considerations include the remote operation of the main outlet valve at West Barwon Reservoir, Geelong's major catchment storage, in conjunction with automated operation of the diversion gates from flow measurements taken in the main supply channel.

3.0 CONCLUSION

The installation of the automated weir gate system at Barwon Water has brought about many benefits to the way water is harvested including yield quantity, environmental compliance, OH&S improvements and increased maintenance opportunities, all of which are leading to improved business efficiency.

4.0 ACKNOWLEDGEMENTS

AWMA in providing the product & introducing the concept of automated control.

The operators of the Upper Barwon headworks system for their acceptance of the new technology and enthusiasm in utilising it.

Matthew Grills from Barwon Water's Technical Services section for bringing together the technology required to make the idea a reality.