WURDEE BULOC INLET CHANNEL FAILURE

Paper Presented by:

Lincoln Thomson & Gwyn Hatton

Authors:

Lincoln Thomson, *Senior Engineer Network Operations,*
Gwyn Hatton, *Network Asset Coordinator – Headworks,*

Barwon Water

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Lincoln Thomson, *Senior Engineer Network Operations,* Barwon Water
Gwyn Hatton, *Network Asset Coordinator - Headworks,* Barwon Water

ABSTRACT

Approximately 80% of Geelong and the surrounding district's water supply is sourced from the West Barwon Reservoir and diversions on the Wurdee Buloc Inlet Channel (WBIC). The WBIC transfers water from the West Barwon Reservoir to the Wurdee Buloc Reservoir and Treatment Plant. It consists of approximately 52 kilometres of earthen and concrete lined channel and five kilometres of syphons. Water is typically harvested during the period of May to December, necessitating visual inspections of the channel to identify any issues.

On the 8th October 2014, a steep section of the WBIC embankment slipped, rendering the channel inoperable. The failure was attributed to several factors but principally due to a blockage of a downstream trash rack. The blockage caused water to bank up and eventually overtop the channel, undermining the embankment.

The WBIC channel failure necessitated extensive works in order to return it to operation by May 2015. After detailed investigation, it was determined to pipe the affected and adjoining sections in lieu of repairing the open channel as this eliminated the failure mode.

The failure highlighted many WBIC operational improvement opportunities, which Barwon Water has consequently implemented. Actions include increased / improved remote monitoring of channel levels, greater automated controls, a review of trash rack operations and an optimised visual inspection program.

1.0 INTRODUCTION

Originally constructed between 1927 and 1931, the WBIC was enlarged in the late 1950's to increase the rate of transfer to the Wurdee Buloc Reservoir. Construction practices during the enlargement, likely contributed to ongoing seepage problems as excavated spoil was utilised for embankment fill without proper soil separation or compaction. Even where concrete lined, moisture is able to pass through porous seams, further weakening the embankment structure. A number of channel lining trials have been conducted since the early 2000's, but none have provided a truly water tight seal required to protect the embankments.

The eastern section of the channel includes three syphons (East, Lynches and Kings Syphon) to transfer water beneath rivers / creeks, which transect the channel. Each of the syphons are fitted with trash racks to prevent large debris from blocking the syphon and to provide a physical barrier between the channel and syphon.

Trash racks are routinely cleared by operators as part of weekly channel inspections to ensure there is no build-up of debris, which could cause water to back up and overtop the upstream channel. Historically, remote monitoring devices called Blok-aids were employed to warn of high water levels in the channel. A sim card in the Block-aid allows it to alarm via Barwon Water's SCADA system in the event a float is tripped, indicating a high water level in the channel. Alarms are monitored 24/7 by Barwon Water's Duty Officers and referred to Operational staff as required for action.

On 8th October 2014, a significant embankment land slip occurred approximately 300m upstream of the Kings Syphon. The failure was the result of a blockage of the downstream trash rack, causing water to bank up and eventually overtop the channel and undermine the embankment.

Figure 1: ***Wurdee Buloc Inlet Channel Embankment Failure***

2.0 IMPROVEMENT ACTIONS

At the time of the WBIC failure, Barwon Water configured the Kings Syphon Blok-aid to alarm at pre-determined heights, firstly as a High Level, and if the water level further increased as a High-High Level alarm. A High Level Alarm required a site inspection the next working day, whilst a High-High Level alarm required immediate action (i.e. site inspection). At the time of the failure, only a High Level alarm was activated, despite the water over-topping the channel. It is not known as to why the block-aid did not alarm as a High-High level, however Barwon Water undertook a comprehensive review of its channel monitoring practices. This review has resulted in:

2.1 Live Channel Monitoring

"Live" monitoring of the WBIC has been achieved through the installation of hydrostatic level sensors at four strategic sites. The level sensors are solar powered with a battery back-up. Via Remote Terminal Units (RTU's) they are able to transmit channel level data every 15 minutes to Barwon Water's SCADA system. A “site sentinel”, which uses a sim card to transmit data to Barwon Water's SCADA system, was employed at one site (Lynches Syphon) as an RTU could not be economically installed.

Multiple alarm set points (Low, Low-Low, High and High-High) have been established to alert Operators of any abnormal water levels in the WBIC. These set points have been validated in the field by measuring free-board for each alarm level set point.

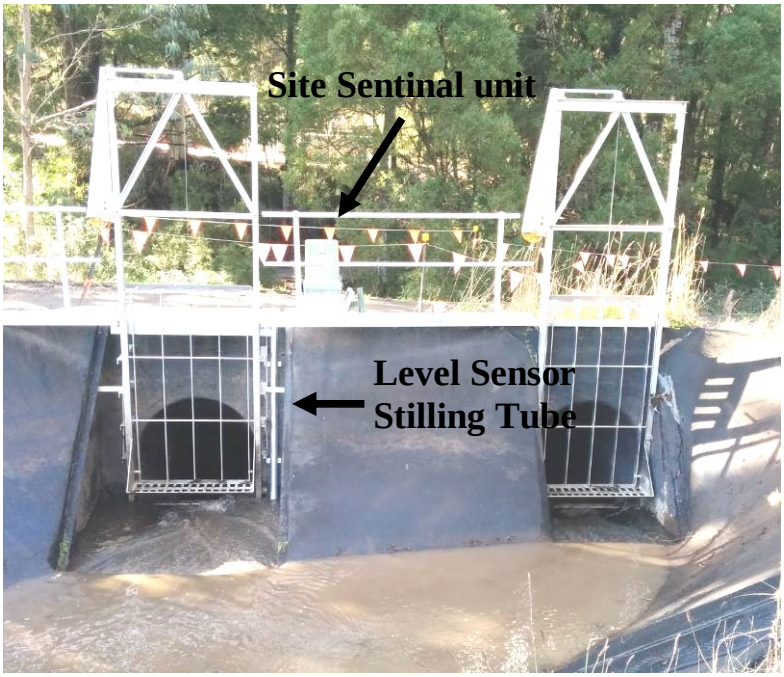

Figure 2: *Lynches Syphon*

2.2 Automated WBIC Shut Down

Automated shut down controls of the WBIC have also been implemented. In the event a High-High level is reached, control gates will progressively close, preventing flow through the channel. The control gates have been programmed to close gradually so as not to create an upstream embankment breach. Closing the gates allows flows to be diverted into environmental streams until such time the cause of the shutdown can be rectified or the discharge valves on the West Barwon Reservoir manually closed. A project is underway to install actuators on the two reservoir discharge valves to enable remote and / or automated operation.

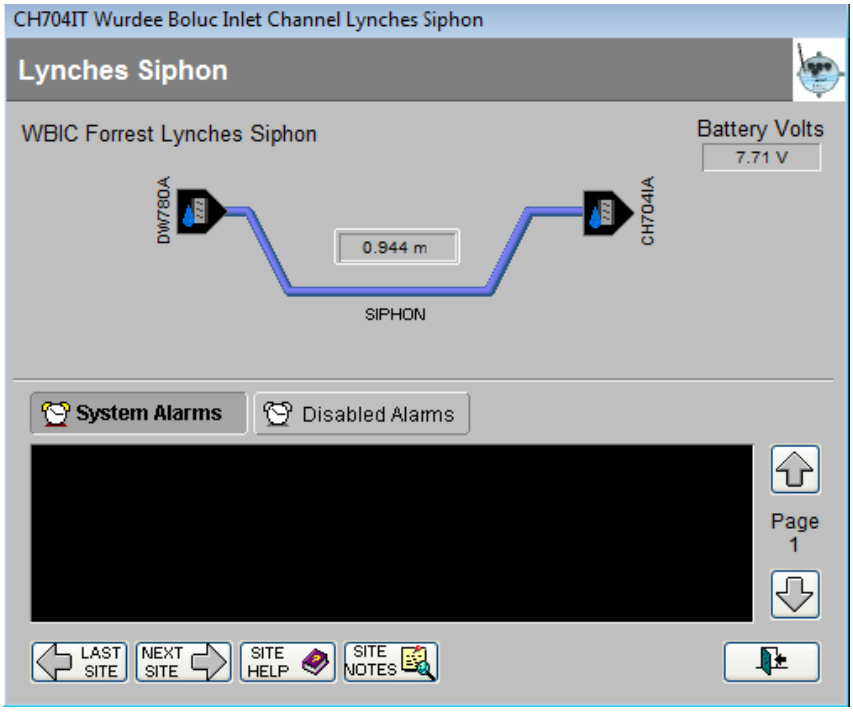

Figure 3: *Lynches Syphon Telemetry Page*

2.3 Trash Rack Review

Barwon Water is currently reviewing the design, location and maintenance practices of trash racks servicing the WBIC. There are presently trash racks upstream of each of the syphons, however in most cases they vary in design. Work is underway to standardise designs and ensure they are fit for purpose, specifically:

a) Determining the appropriate barrier / screen aperture and configuration to reduce the risk of syphon blockages by catching large debris but also minimising the potential for trash rack screen blockages by allowing small debris to pass through.
b) Consider the introduction of controlled overflows / by-passes at selected locations (where upstream channel embankment failures may occur).
c) Minimise manual handling associated with maintenance (ie. cleaning debris from the trash racks) through the use of winches and improved design.
d)

Figure 4: ***Old King's Syphon Trash Rack & Blok-aid***

2.4 Visual Inspection Program

Barwon Water has also reviewed its program of visual inspections of the WBIC and improved processes for hazard reporting. Pre the embankment failure in October 2014, Operators performed weekly inspections, however there was minimal recording of findings. Barwon Water is now recording all inspections via CMO Compliance Software, which allows Operators to upload photos directly to the inspection report and also raise and action any hazards identified.

3.0 CHANNEL REPAIR

A risk / cost analysis was undertaken comparing options to either repair the failed section of the embankment and reline the concrete channel or pipe approximately 700m with 2,000mm, fibre reinforced glass (FRG) pipe. As past rehabilitation attempts of the WBIC have only been moderately successful and given the poor structure condition of the embankment, piping was determined the better long term option.

Design and construction works were managed by Barwon Water's Delivery Team, design consultants, GHD and construction project managers, John Holland. The works were successfully completed by May enabling Barwon Water to start transferring water in time to avoid spilling at West Barwon Reservoir and maintain supply for Geelong and the surrounding areas.

Once constructed and operational, Operators performed daily inspections of the at risk section of the WBIC. Flows were gradually increased over a period of weeks until a flow rate of 120 ML/Day was achieved. Since this time, inspections have been reduced back to weekly.

Figure 5: ***Piping of the WBIC***

4.0 CONCLUSION

The embankment failure in October 2014, highlighted the vulnerability of the WBIC. As a result, Barwon Water has invested heavily in improving the level of automated monitoring and control as well as improving channel designs (ie. piping compromised embankment sections as opposed to lining, and the ongoing review of trash rack designs). Barwon Water's operational and design teams have learnt much from the failure and consequent actions should greatly mitigate the risk of a future event.

5.0 ACKNOWLEDGEMENTS

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GHD