Advanced Condition Assessment & Pipe Failure Prediction

Optimal management of water infrastructure

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Progress on Activity 1

Pressure Transients monitoring in Hunter Water to verify causes for critical pipe failure

Objectives

As part of Activity 1 internal and external factors contributing to pipe failures are being studied extensively. Water pressure, including likely pressure transients, is identified as one of the most critical factors contributing to failure of large diameter pipes. Two sections (section A and B) of the Hunter Water network in Newcastle, Australia were selected to investigate the likely pressure transient development in typical water supply networks, where pumps are in operation. Two major activities were carried out. Firstly, water pressure was monitored at several strategic locations in the network. Secondly, computer hydraulic modelling was carried out to obtain the pressure distribution across the entire network section. This fact sheet provides a brief summary of the pressure monitoring program undertaken over the last year. The objectives of the pressure monitoring are to:

- Capture pressure transients generated in the water network during its operation; and
- Obtain a pressure transient data set for hydraulic model validation.

Methodology

Five sites were selected in each network section to measure pressure transients. The selection of sites was based on previous operational experience of water utility engineers and preliminary hydraulic modelling. Five high speed Radcom data loggers were installed at each site to measure pressure transients. This logger has the capacity to record 25 readings per second and its tolerance setting allows monitoring for a longer period of time without downloading the data. Tolerance setting is based on a specified range around previous recorded reading. In this case a recording frequency of 20 readings per second and a tolerance setting of ±5kPa were used.

Results of monitoring program

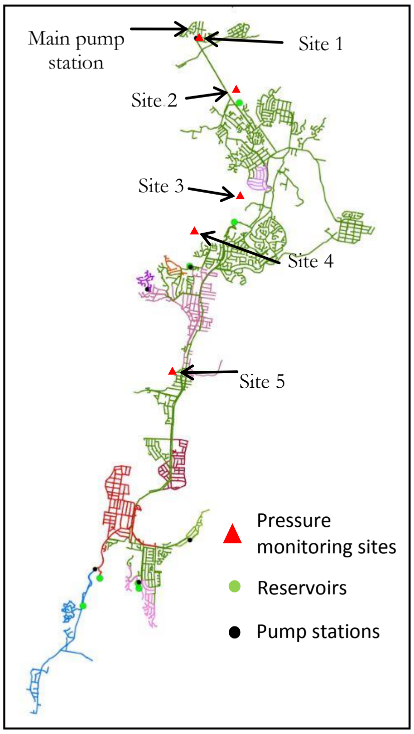

Figure 1. Monitoring locations in section A

Industry Partners

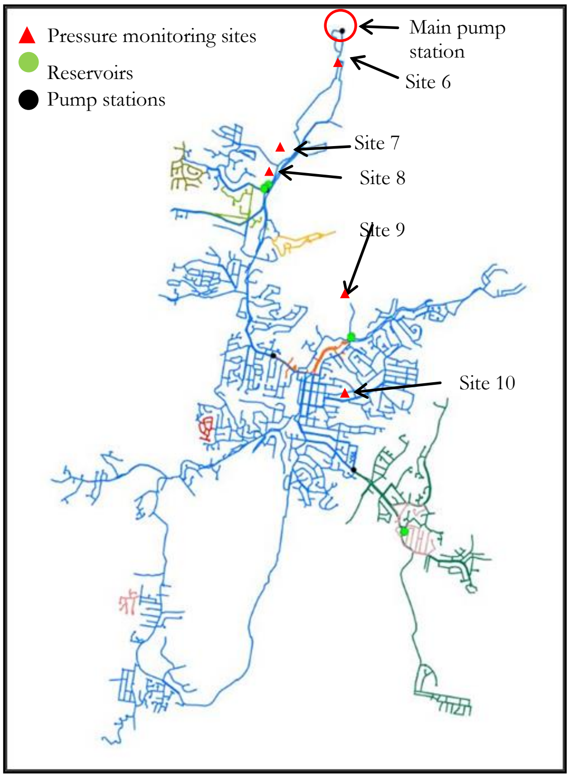

Figure 2. Monitoring locations in section B

Table 1. Summary of the pressure measurements

Site No.	Location	Max. Pressure in kPa (Head in m)	Average pressure in kPa (Head in m)
Site 1	Main pump station (section A)	512 (51)	242 (24)
Site 2	2.5 km downstream of main pump station (section A)	252 (25)	107 (11)
Site 4	Upstream of reservoir 3 Automated Inlet Valve (AIV)	535 (54)	403 (40)
Site 5	Upstream of Pressure Regulating Valve (PRV)	1012 (101)	848 (85)
Site 6	Main pump station (section B)	1489 (149)	1215 (122)
Site 7	2.7 km downstream of main pump station (section B)	396 (40)	243 (24)
Site 8	2.7 km downstream of main pump station (section B)	132 (13)	83 (8)
Site 9	Upstream of reservoir 8 AIV	209 (21)	158 (16)
Site 10	Upstream of reservoir 9 AIV	1079 (108)	488 (49)

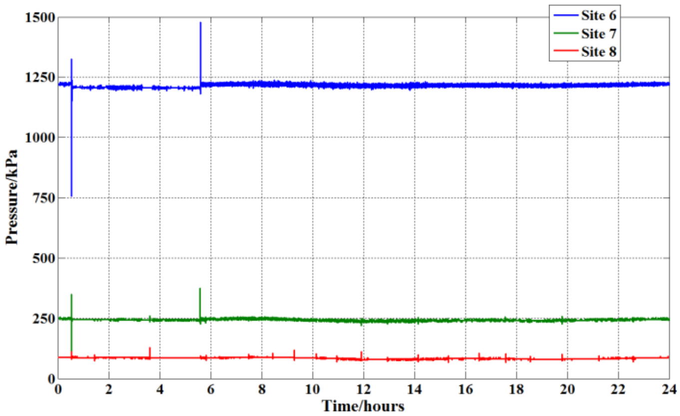

Figure 3. Overall pressure variation (inlcuding rise and fall) in section B during pump start-up events on the monitoring day 13/07/2013

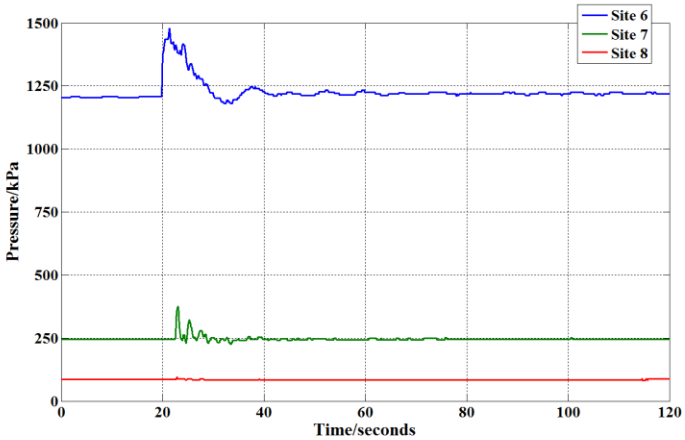

Figure 4. A signature of pressure rise occurring during pump start-up event in section B on the monitoring day 13/07/2013

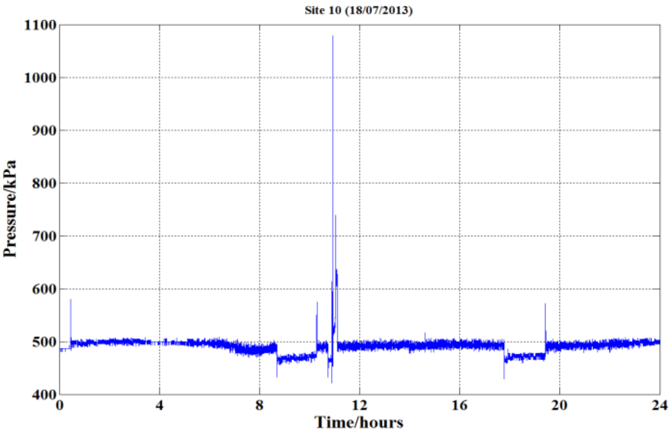

Figure 5. The highest pressure transient measured in section B; At site 10, upstream of reservoir 9 AIV

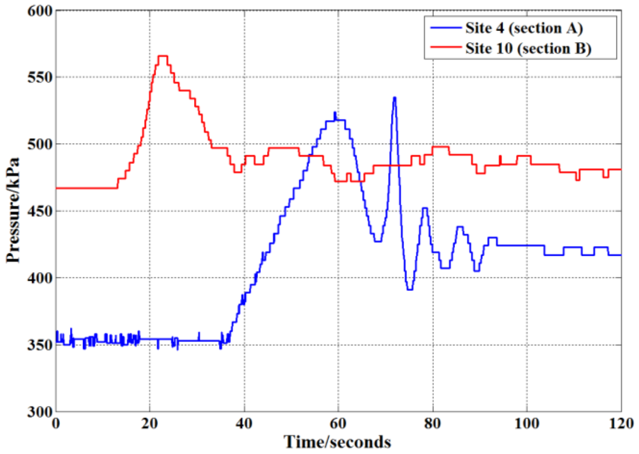

Figure 6: Typical pressure transients measured at upstream side of AIVs used to fill reservoir 3 (section A) and reservoir 9 (section B).

Concluding remarks

Significant pressure fluctuations, which were large enough to cause pipe failures, occurred during the monitoring period. One pipe failure occurred during a transient pressure event. Once a transient occurs, rapid dissipation of generated pressure was also observed. In most of the cases 40 to 50% reduction of pressure rise was observed within a distance of 2 to 3 km from the event origin. Pump start-up time had a significant impact on the magnitude of pressure transients generated. A significant steady state pressure rise was recorded, even several kilometers away from the pumps, when the pumps were in operation during periods of low system demand. For the positive pressure rises (i.e., a pressure rise from the steady state), the magnitude of the reflected wave was significantly lower than that of the main pressure wave and the subsequent reflected waves died down quite rapidly. On the other hand, the negative pressure wave (i.e., a pressure drop from the steady state) created by a pump shutdown event at main pump station (section 2) showed clearly a sizeable series of reflections. At the monitoring locations, pressure never dropped below zero (sub atmospheric) during the monitoring program.

Partners

The partners in this research project include Sydney Water Corporation, UK Water Industry Research Ltd, Water Research Foundation of the USA, Water Corporation (WA), City West Water, Melbourne Water, South Australia Water Corporation, South East Water Ltd and Hunter Water Corporation. Monash University leads the research supported by University of Technology Sydney and the University of Newcastle. Other collaborators include Dr Balvant Rajani from Canada.

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For information on data exchange for Activity 1 contact

Jayanhta.kodikara@monash.edu