



Case Study – Investigating Failures on a 900mm GRP Rising Main

AESL carry out condition assessment projects on sewer rising mains to determine their structural and leakage performance, and also investigate rising mains failures. Rising main failure rates can be high, being influenced by effluent related internal pipe wall deterioration, and large surge pressures related to pumping cycles and trapped gases.

AESL investigated three failures of a 900mm diameter GRP rising main that occurred over a three-month period. The main, constructed between 1997 and 2000, operates at 2bar and is around 6.7km long, with a 4.7km long buried GRP section, the remainder being above ground steel. The main has ten air valves fitted, two combined gas release and air ingress valves, and the remainder gas release only.



The three failures involved longitudinal fractures, which in two cases, were seen to have initiated from external cracking associated with GRP delamination. Potential causes of localised GRP pipe wall deterioration were investigated and eliminated:

- Strain corrosion can result from low pH (acidic) surrounding soils, but the pH levels from in situ testing were too high to cause strain corrosion.

Longitudinal cracking of GRP pipe

- Star cracking indicating impact damage was not found.
- A maximum ovality of 0.4% measured on the failed pipe samples, indicates no significant permanent deformation

Samples from the failed pipes sections were mechanically tested to determine the strain at failure. These were then compared to the calculated strain levels under the actual external loading and allowable surge loading at each site. The calculated pipeline strain levels were lower than the failure strain levels from the mechanical tests, confirming that a 50-year pipeline working life should have been achievable.



Both the failed pipeline sections and the mechanically tested samples showed external star cracking defects. On the failed pipeline this was considered to indicate pipe wall delamination, possibly due to low internal pipe pressures during surge events. Together with the propagation of the fractures, this suggested that high dynamic loading due to inoperative air valves may have contributed to the pipeline failures. Each of the air valves were inspected and only two were found to be operating.

GRP pipe wall delamination

A programme of air valve maintenance was then carried out, following which no failures have occurred.