Culvert renewal: a growing market for Trenchless Technology

While there many technologies have been used over the past twenty years to repair aging sewer infrastructure, recent times have highlighted that they are by no means the only type of pipe system in dire need of preventative maintenance and renewal.

Stormwater pipe systems represent a major investment in infrastructure. They are, however, only in the public eye when they fail. As with all buried pipe systems, repairs can be a costly and disruptive process. In order to mitigate the high capital cost of repairing or replacing these assets, it has been common practice to schedule works to coincide with road resurfacing and highway widening. This was predominantly due to the requirement for traffic control whilst performing work on the infrastructure.

The consequence of this practice is that delays waiting for the major works program may allow the pipes or culverts to deteriorate to a point where they become dangerously close to catastrophic failure. As Trenchless Technologies are becoming more economic and versatile, this need no longer be the case.

The fact is that a large percentage of the stormwater and culvert pipe infrastructure that was installed in the past 30 to 50 years is reaching the end if its service life. This is a problem – ignoring it will not make it go away and places lives and infrastructure at risk.

If not properly designed, installed and maintained, any pipe type can fail

Structural failure of the pipe system can arise from a number of sources related to a loss of structural integrity either from corrosion or loss of support from the pipe backfill. The main reasons are abrasion and corrosion.

Culverts can be particularly susceptible to debris carried in high flow storm events, such as tree branches, boulders or any other substantial debris can impact on the pipe walls causing serious damage.

Pipe material is obviously of great importance in pipe design. Corrugated steel culverts are generally accepted as being the most susceptible to the actions of abrasion in conjunction with corrosion – this has led to a wide range of protective coatings being offered. Aluminium, whilst useful as a coating to prevent corrosion, displays worse abrasion characteristics than steel. Plastics offer good abrasion resistance and are not subject to corrosion effects. While concrete exhibits reasonable abrasion and corrosion resistance, though variable depending on the aggregates used in the material composition.

Levels of corrosion are influenced by the structure of the soil, particularly pH levels, soil resistivity, levels of chlorides and sulphates. Other factors that can influence corrosion rates are the effects of runoff from land use, industrial effluents or stray electrical currents in close proximity to the pipe. Stray current sources include electricity transmission lines, electrified rail lines and the like.

Importantly, corrosion is not always evident prior to substantial investigation, hence an ongoing monitoring schedule is recommended.

Once a pipe or culvert wall has been penetrated, the surrounding embedment washed into the pipe can lead to external voids forming. As well as reducing pipe support, these voids can lead to catastrophic failure of the road surface.

Rehabilitating early has the potential to save big money!

A structurally sound pipe that is showing early signs of scour or abrasion will typically only require a liner material which offers abrasion resistance. Costs will increase where the invert is lost, joints separated, voids are present, surround material has been lost, the pipe has deformed, the inlet or outlet has eroded or where a pipe creates a disruption to the hydraulic conditions.

It is not often practical or desirable to dig up and replace these conduits. With the range of trenchless options available today it should rarely be necessary to burden constituents with the tremendous social cost of open cut pipe replacement.

New technologies are emerging which accommodate modern design criteria, but still have regard for environmental, logistic and economical requirements of a project.

Australian developed technologies offered by Interflow, principally for structural lining of deteriorated sewers, have also proven suitable for lining of deteriorated culverts, often in difficult circumstances.

Interflow's range of Expanda Pipe, Rotaloc and Ribline wound-in-place liners offer trenchless renewal of culverts from small sizes up to over 2 metres in diameter, designed to meet the project's structural requirements. They are made from plastic materials with high resistance to abrasion and corrosion. The smoothness of the interior means flow capacity is usually increased.

These are circular liners with maximum diameter, irrespective of the shape of the deteriorated host culvert. Typically, and particularly in corrugated metal culverts, they are grouted after installation, with the grout filling any voids in the host culvert and the embedment around it.

The capacity to be installed with only a small site footprint is important in congested conditions, offering another of the benefits of genuinely Trenchless Technology.

The onus is clearly on infrastructure owners to fully understand the extent of the work required on a given project. Once all contributing external factors are considered a determination can be made of the technologies available to match the project needs. The design should maximise the technical benefits of the system whilst considering the total economics of the asset renewal process.