

NON-INVASIVE REHABILITATION TECHNOLOGIES



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ABSTRACT

Damaged pipes are generally repaired by the traditional methods of 'excavate and replace'. The benefits of non-invasive rehabilitation technologies, which apply to so many other aspects of society, are often overlooked.

Over time, pipe systems can develop problems, begin to fail and require attention. Replacing those pipes comes with the need to dig through roads and footpaths, which can be very time-consuming, costly and disruptive.

However, this can be avoided by using non-invasive technologies equivalent to angioplasty to clear pipes and install their version of a stent in order to rehabilitate failing lines and provide structural rehabilitation to weakened areas.

This paper evaluates the benefits of using non-invasive pipe lining technologies to repair damaged pipes and compares these methods to the "excavate and replace" methods traditionally used.

1.0 INTRODUCTION

As with the rest of the world, Australia is suffering from ageing infrastructure of both a commercial and domestic nature. This, combined with the ever increasing urban population is placing significant pressure on stormwater drainage networks. Many of these services are operating with pipe assets that may fail at any time.

Typically, 'excavate and replace' has been the preferred method of repair and this is understandable, as historically few other alternatives were available.

Now with non-invasive rehabilitation technologies, pipes can be repaired with minimal disturbance. The drainage industry has the option to completely reline a pipe with absolutely no digging. To rehabilitate a stormwater pipe for example, existing access points would be utilised as entry and exit points.

By utilising this rehabilitation method, there would be no requirement to excavate and replace. This is achieved by infusing a highly specialised epoxy resin into a liner; this is then placed over a bladder and pulled into place. The bladder is inflated and left to cure. Once the liner has cured, the bladder is removed leaving behind a structural repair. This results in a rehabilitated section or entire pipe from the inside, providing an increase in protection from deterioration and resulting in increased longevity to the original asset.

This paper will highlight some of the social and environmental impact of the traditional excavation and replace method. It will specifically address why cutting-edge non-invasive rehabilitation technologies, should be utilised rather than 'excavate and replace'. We will cover the benefits including saving money, increased safety and pipe longevity, versus the decreases in emergency spending, the poor media coverage from road closures and the backlash from the public due to what is usually deemed (correctly or not) as poor maintenance.

2.0 DISCUSSION

With an expected 50 per cent increase in urban population by 2050, providing safe, reliable and sustainable water services for Australia's cities is a major challenge for those in the stormwater drainage industry.

As cities expand, the generation of waste and stormwater runoff will continue to increase. These pressures will be exacerbated by an ageing infrastructure. Now more than ever, improvements in water infrastructure management are a critical necessity. New approaches to the management of pipe repairs are required to address the increasing inconvenience, damage and danger caused by collapsed and damaged stormwater pipes.

Rehabilitating pipes with non-invasive rehabilitation technologies needs to be seen as an investment; it saves time and saves money in the long run. It also reduces pressure being put on company and council resources, PR disasters and placing other assets at risk. An advantage of utilising non-invasive rehabilitation technologies is that an existing pipe in extremely poor condition can be cleaned out to its original state then relined to reinstate its structural integrity, extending the life of the asset.

Another advantage about this product is that unlike conventional repair and replace options that can often cause a whole site to be shut down whilst work is done, this process can be managed to ensure minimum disruption to operations. Non-invasive rehabilitation technologies have been used successfully in a variety of applications, both commercially and domestically.

One example of the use of this new technology was Mingaletta Street in Ashmore on the Gold Coast. Due to the quantity of rain endured over several months a large sinkhole had developed in the road above the stormwater pipe. The road appeared to settle further down after every rain event and in order to address this problem, bitumen was poured into the hole in the road. This bitumen eventually found its way into the stormwater pipe (Figure 2). After viewing CCTV footage of the pipe under the sinkhole, it was apparent that there was a substantial hole 12m in from the manhole (Figure 2). In addition to the sinkhole in the middle of a road, there were also two large electrical conduits sitting directly over the top of the pipe.

There was also root intrusion from trees in the vicinity of the pipe. In order to use the new technology to repair the pipe, it was first cleaned using a high pressure water jet. It was then re-inspected before commencing the reline.

Fifteen meters of 300mm reinforced concrete stormwater line was rehabilitated utilising non-invasive rehabilitation technologies. This repair was carried out utilising a fast cure resin resulting in the job being completed within 10 hours with minimal disruption to local residents and traffic. A catalyst is added to the resin, forming a fast cure resin, accelerating the curing process.

An alternative to the relining would be to excavate and repairing it the conventional way. This would have resulted in the need to close a section of the road, blocking off residential driveways, and several days of noise and mess for the duration of the repair. Additional infrastructure services may have been required at the time of the repair due to an electrical mains and communication conduits which were more than likely going to become affected.

Using the relining method to carry out this repair ensured that any inconvenience was kept to a minimum, that the root intruded areas were sealed and that the structural repair would

stop the need for the road to be patched every time it rained.

Utilising non-invasive rehabilitation technologies meant no excavation, and therefore no road closures. What was accomplished in one work day, would have normally taken several days to excavate, repair and replace the road, gutters and driveways.



Figure 2: *Before and After Images of Mingaletta Street, Gold Coast Utilising Non-Invasive Rehabilitation Technologies.*

2.1 Increase Pipe Longevity

Stormwater pipes are generally found to be in significantly worse condition than sewer pipes when it comes to rehabilitation. However, little funding has been put towards these assets in the past, with more focus placed on sewers which can have a much higher environmental impact ('Sydney stormwater pipes receive a makeover', Trenchless Australasia, December 2011). But stormwater pipes play a significant role in property damage by causing ground subsidence, structural cracks in properties, and localised flooding. The problems are generally exacerbated by the fact that stormwater pipes are mostly shallow and in close proximity to above ground structures.

The Brisbane City Council (BCC) owns approximately 2500km of stormwater pipeline. This pipe network is continually growing with the construction of new and relief drainage by Council and private developers. BCC has undertaken extensive research and investigation into the wide spread issue of premature cracking of concrete stormwater pipes with a diameter less than 900mm.

The problem of premature cracking in small diameter (<900mm) reinforced concrete drainage pipes was first brought to the Council's attention when an audit of subdivisions was undertaken. A CCTV investigation revealed extensive cracking in stormwater lines, even though many of the pipes had been installed only a few months earlier. This would result in long term asset management implications. ('The cracking of stormwater pipes and the significance of construction loads' - Brisbane City Council).

The major cause of the problem was established to be overload of the pipes during construction. Trench compaction and road construction equipment was often found to induce loads far greater than the typical service load for which the pipes were designed. ('The cracking of stormwater pipes and the significance of construction loads' Brisbane City Council). The significance of the cracking and its effect on the pipe's service life is a serious problem asset managers must address.

As most pipes have a recognised lifespan of 50 years, the application of non-invasive rehabilitation technologies would be able to rehabilitate the structural integrity of the pipes

and result in up to an additional 40 years in pipe performance.

2.2 Bad Press

On a regular basis there is negative publicity regarding the damage and disruption caused by failing stormwater pipes in the media. For example, the article below.

Water main bursts, damages Ferny Avenue

A BURST water main damaged about 30m of roadway in Surfers Paradise this morning. Ferny Avenue was closed after the incident, which happened near the QT around 4am. Traffic travelling southbound is being diverted at the Indy pits into the left lane and on to The Esplanade. One northbound lane on Ferny Ave is also closed.

Council staff at the scene said "huge spouts of water" poured over the road before parts of bitumen were lifted, and advised drivers to "avoid Ferny Avenue like the plague".

"There's unbelievable damage...there are bits of road all over the place," one worker told ABC radio. "It's quite the site." It is believed traffic may be disrupted for days while council workers repair the roadway. At least one telegraph pole will be taken down as part of the repairs. - Source: goldcoast.com.au

This kind of disruption and damage often results in public relations disasters for local authorities.

2.3 Reactionary Management

When a pipe fails, those responsible go into reactionary management. This puts huge pressure on resources, and often results in significant disruption. For example the management required on a damaged water pipe in on the Gold Coast, as reported on goldcoast.com.au.

Water main bursts at Nerang

NERANG residents could be without water for up to three hours this afternoon after a water main pipe burst on Southport-Nerang Road after 11am.

Gold Coast City Council offices at Nerang, the Prana Centre, Town and Country Motel and Restaurant, and residents in both Riverdale and River Park estates will be affected this afternoon while the damaged water main is being repaired. It is believed the water pipe burst when SEQ Water workers were performing a maintenance check on the raw water main which runs from Hinze Dam to Molendinar.

Hundreds of litres of water erupted from beneath the ground for more than 15 minutes, creating a 5m fountain spectacle before SEQ Water workers were able to stem the flow. An Allconnex spokesperson said pipes bursting were a regular occurrence on the Coast, with more than 12,000km of piping across the city.

Crews are on site fixing the pipe, opposite Gold Coast City Council's Nerang office, and traffic management is in place. Traffic delays are also expected and commuters are asked to avoid the area if possible. - Source: goldcoast.com.au

Power still out after water main bursts

POWER is still out at a Gold Coast apartment block after a burst water main caused

flooding to its basement.

Up to 25 cars were damaged along with several bikes and personal property after about 1m of water inundated the Amira apartment block's car park around 2am. Residents of Amira, on the corner of Cable St and Main Beach Parade, woke to find their basement flooded and power out after the water main burst near a construction site opposite the 10-storey building. It took crews hours to pump out the water, with workers still cleaning up at the scene at noon.

The Gold Coast City Council said the incident happened after "a water main was damaged by a third party contractor". Water has been restored but Energex has advised power may be off for most of today. Water Services Committee Chair Councillor Paul Taylor said Council's first priority was safety and restoration of service. "Once the water service has been reinstated and the water main is safe, control of the site will revert back to the third-party contractor who will continue with the site restoration, and Energex will continue to work on restoring power," he said.

Council's legal services advise that residents should contact their insurance companies or the Body Corporate in regard to damage to personal property.

Resident Duncan Wallis said his wife was woken by the sound of gushing water. "My wife woke me saying she could hear the water but I went back to sleep...I wish I'd moved the car now," Mr Wallis said. Mr Wallis had a car and a boat in the car park. "It's just an inconvenience. I have two kids to get to school," he said. Mr Wallis said his boat was damaged as he'd forgotten to put the bung in. - Source: goldcoast.com.au

In another example, during the construction of the Tugun Bypass, water monitoring stations observed an increase in the flow of water through the storm water system even during times of minimal rain fall.

With only two weeks until the official opening and pressure to complete the project on time, the contractors were looking for a way to stop the large amount of groundwater infiltrating through joints in the large bore pipes underneath the newly finished motorway. There had been a number of attempts to fix the problem from other contractors using putty, expanding foam, injection or grouting. None were successful due to the water pressure pushing through the gaps back into the pipe.



Figure 3: *Before and after images of Tugun Bypass, Gold Coast utilising non-invasive rehabilitation technologies.*

The pipe was repaired utilising a non-invasive rehabilitation technology, this successfully prevented water from infiltrating into the 600mm diameter steel reinforced concrete storm

water pipe. The relining saved over three months delay in the opening of the Tugun Bypass. The cost savings was in the \$100,000's compared to conventional excavation options.

2.4 Increased Safety

An advantage of non-invasive rehabilitation technologies, is that unlike conventional repair and replace options that can often cause a whole street or building to be excavated, this process can be managed to ensure minimum disruption to operations. Excavation work can cause significant traffic delay due to lane closures or complete road closures. Pedestrians also can be forced to detour because of lane closure and other construction activities.

The use of these technologies also assists with public and worker safety. There are less traffic congestions, disruption to pedestrians, no large open holes and the reduced chance of land collapses. A less exposed work site reduces dangers to both workers and the community as site safety is more effectively managed due to localised stationary worksites. Open trenches pose a higher risk to workers and pedestrians than trenchless technologies. Accidents related to trenching are about 112% higher than the average value for construction work in general. Each year more than 60 workers are killed in trenching accidents (Jung and Sinha, 2004).

The below images are an example of the significant disruption caused by the damaged pipe in Surfer Paradise on the Gold Coast in April.



(Source: Gold Coast Bulletin, April 2013)

In another example, a busy rail route (Zillmere Train Station, Brisbane, see Figure 4) was under threat of collapsing as the tracks ran over a stormwater line that was in extremely poor condition. Closing the tracks would have resulted in major disruptions to commuters and would have involved a significant amount of excavation works.

The pipe ran from one manhole, underneath two sets of railway tracks, to another manhole located in a car park. It was several meters deep and excavation would have meant closing down the train lines that run from Brisbane to the Gold Coast. The line was cleared and 41 meters of stormwater line with seriously displaced joints was relined utilising a non-invasive rehabilitation technology, without any excavation and disruption to the rail system while the works were undertaken.

Using our latest resin technologies, and Hot Water Cure Systems, the line was structurally relined in less than 24 hours using a 3 man crew.



Figure 4: *Images of Zillmere Train Station, Brisbane utilising non-invasive rehabilitation technologies. This illustrates how utilising an existing access point, a line and bladder is inserted into the pipe and inflated, creating a structural repair.*

Some Councils and Utilities are choosing to utilise non-invasive rehabilitation technologies to reline asbestos stormwater pipes as this type of work is dangerous for personnel. (Bursting through asbestos health risks, Trenchless Online, March 2012). When excavation and replacing is utilised this exposes people to the dangerous asbestos particles that are created. Relining will rehabilitate the pipe without the need to handle the pipe. Additionally, these pipes typically cross under busy roads and non-invasive pipe rehabilitation technology will mean no road closures and minimal impact on the day-to-day life of residents in the area.

2.5 Non-invasive Rehabilitation Technologies are an Eco Trend

Lining is an eco-friendly solution that creates little waste for landfills or for recycling and generates no carbon emissions during manufacturing. Revolutionary, green technologies such as epoxy lining have are replacing temporary, out-dated pipe replacement methods as an eco-friendly trend that efficiently and economically controls pollution.

The traditional method of excavate and replace has multiple effects on the surrounding environment. The use of heavy construction equipment results in a higher noise level in the vicinity of the work area. In addition construction work may lead to a higher noise pollution due to changing traffic conditions compared to the ‘normal’ situation.

The environmental benefits of non-invasive rehabilitation technologies will be attractive to those cities that are ‘going green’. Current research shows that CO₂ emissions are reduced when trenchless methods are used versus open-cut. This translates to a direct-cost benefit for companies that are facing carbon taxation.

In addition, Nuflow offers an alternative to the harsh social and environmental impacts of ‘traditional’ excavation. Non-invasive pipe rehabilitation is environmentally friendly with no digging or disturbance to ecosystems. An enhanced wet-out process helps us reduce waste during installation. Less equipment on the job site means less energy usage and less emission.

3.0 CONCLUSION

Non-invasive rehabilitation technologies are an ideal solution for all water asset owners in the future. It is a preventative technique that provides peace of mind in terms of the assets function.

With an expanding urban population, the demand for reliable infrastructure will continue to increase. Due to ageing infrastructure, we are replacing much more pipe now than ever before, when we should be doing the complete opposite, and relining them instead.

We must act now to provide safe, reliable and sustainable water services for Australia's cities. This includes choosing a preventative measure over reactionary remedies. There are significant benefits to relining, including increases in safety, pipe longevity, and water quality. This results in a decrease in emergency spending, the poor media coverage from road closures, and the backlash from the public.

The aim of relining is very simple, to provide the ability to secure an asset and its operation and prevent future problems from occurring.

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