

# Global adoption of corrugated plastic stormwater pipes: Lessons for Australia



# Executive introduction

Across the country, engineers within councils and other infrastructure managers are facing increasing challenges around efficiency.

They're being asked to do more with less, to build faster and more sustainably in tighter budget environments, and to find innovative ways to disrupt communities less and engage them more, all in a safer and less resource and materials-intensive working environment.

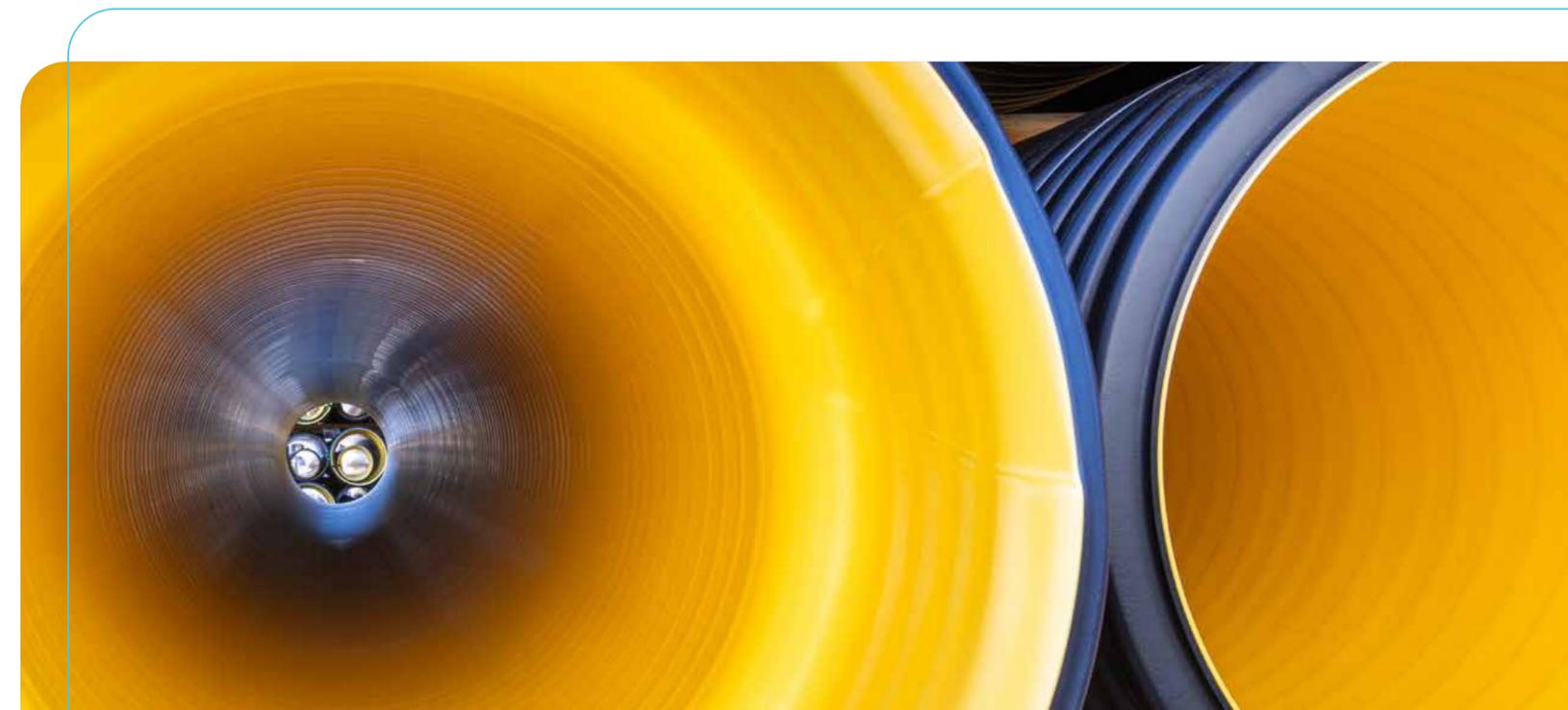
In this paper, we explore the ways plastic corrugated pipes made from polypropylene or polyethylene, such as Iplex's BlackMax range, help to provide a solution to many of these challenges in an underground, stormwater management application, including under roads.

We particularly look at this from an evidence-based point of view, including case study examples from Australia and globally and as an alternative to the heavy concrete option.

## The paper considers:

- **Current state of play:** Why some councils default to concrete, and why this is changing;
- **Ease of installation and safety:** Public work and sustainability benefits that come with plastic pipes;
- **Hydraulic and structural performance:** How plastic pipes enhance hydraulic capacity and structural integrity with an efficient use of raw material and high pipe stiffness;
- **Joint performance:** How the engineered rubber ring joint resists leakage and tree root intrusion, and;
- **Case studies:** Lessons Australia can learn from decades of experience around the globe.

With a range now expanded to DN1200 pipes, and therefore a broader application, BlackMax pipes help councils to do their work in a lower budget environment while increasing the speed, safety and sustainability of stormwater maintenance and management. It enables engineers and water managers to do more with less.



## State of play: Fit for purpose?

Familiarity drives the typical choice of concrete pipes for underground, and particularly under-road, application.

But for the last several decades, councils have been developing knowledge and experience around another option, one that in many cases is easier, safer, quicker, less disruptive and less costly to install.

Today, it is estimated that corrugated plastic solutions make up about 30% of the stormwater drainage market in Australia.

Australian engineers learn about rigid pipe design at university and from there, often consider concrete the safer, go-to material of choice.

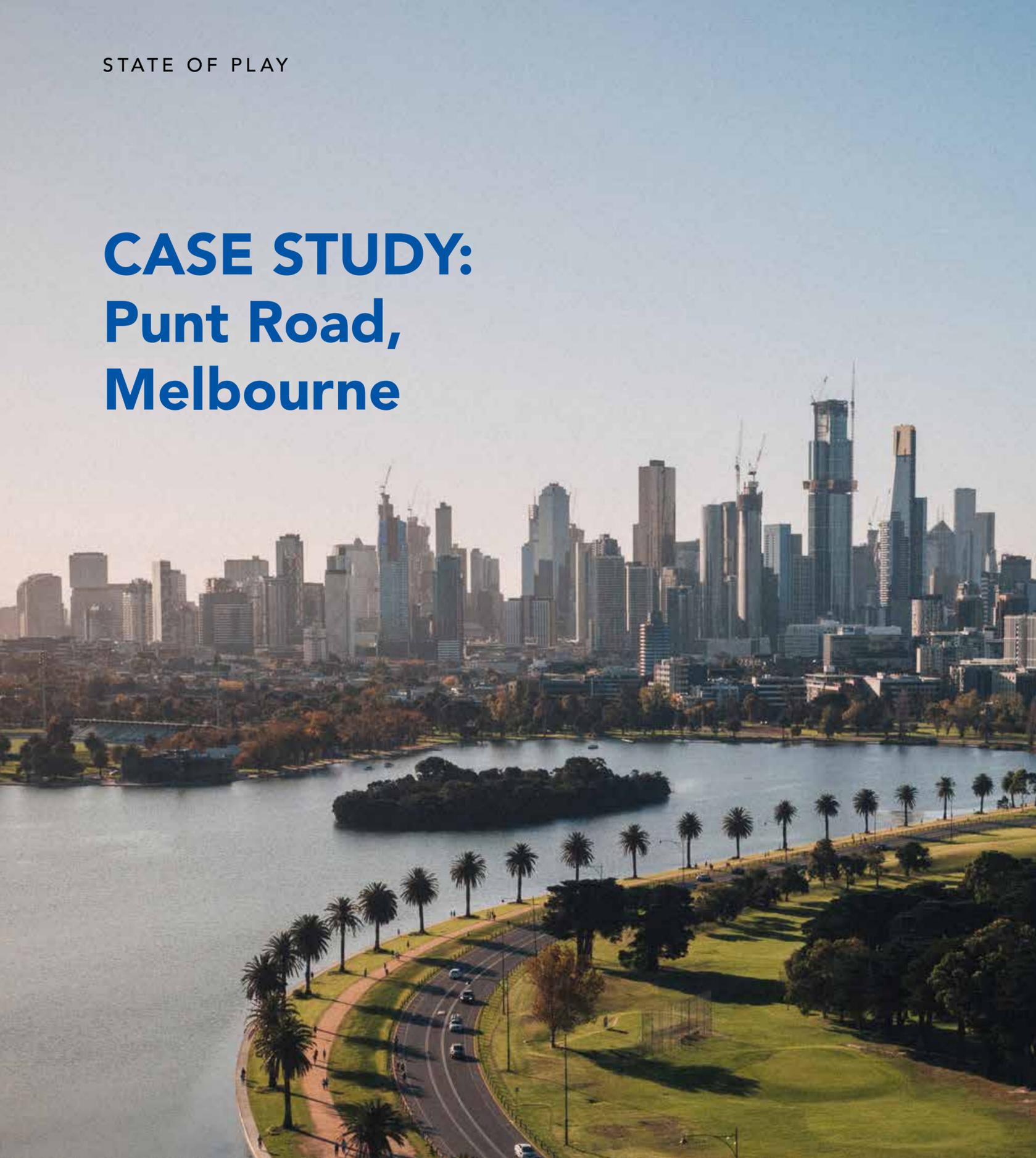
However, as flexible pipes have become better understood and more commonly specified for their benefits such as cost, sustainability, safety, labour issues and public expectation, a more innovative alternative is required.

“Engineers have always had a good understanding of concrete pipes,” says Michael Lancuba, Product Manager Engineered Products at Iplex.

“At one stage, plastic structured wall pipes were new, but not any more. These systems have been in use since the late 1980s in Australia and they work very well.”



# CASE STUDY: Punt Road, Melbourne



In 2020, Lancuba inspected an Iplex High-Density Polyethylene (HDPE) structured wall stormwater pipe under Punt Road and Swan Street in Melbourne's CBD that was installed in January 1989. The pipes were still structurally sound with virtually no deflections and no damage, he says.

"I could hear cars pounding overhead," he says. "I saw a couple of spots where tree roots had got in, but that was because a hole had been cut in the side of the pipe for a lateral connection years after the original installation, and they didn't weld it properly. Besides that, the entire pipeline was structurally sound."

Why was an Iplex HDPE structured wall pipe selected in the late 1980s for such a high traffic, under-road application?

Because "traditional methods and materials are not always suitable for every job and situation", a report titled Laying of high-density polyethylene pipe under a major urban intersection, presented to the 1990 Municipal Works Officers Conference, says.

"This means that we have to be on the lookout for new and innovative ways to ensure that the work is done efficiently and effectively."

The works required the replacement of two brick barrel drains, 1350 mm in diameter,

with 2100 mm and 1500 mm diameter pipes diagonally across the intersection. It also demanded the installation of a 1200 mm diameter new drain longitudinally within the existing northbound carriageway in Punt Rd.

At the time, this was one of Melbourne's busiest intersections, with over 100,000 vehicles per day. It was also a major tram route. "It was absolutely essential that the work be completed in the shortest possible time," the report says.

Tram tracks were removed after the last tram on a Friday night and had to be back in place for the first one on Monday morning. Overhead tram wires meant heavy lifting machinery was not an option.

And so the lighter, easier-to-handle Iplex HDPE structured wall pipes were laid in 6 m lengths and the job was completed on time, for \$250,000 less (in 1989 dollars) than a rigid pipe system would have cost.

"These savings were derived from reduced cost of pipe (i.e. a smaller pipe was possible due to superior hydraulic properties of HDPE), a saving of around 50% on plant hire and labour, and a 20% saving in time and materials as a result of a narrower and shallower trench," the report says.

# Quicker, safer and less disruptive

The resources, noise, silica dust, machinery and community disruption involved in concrete pipe installation and maintenance are significant. Plastic pipes, on the other hand, can be lighter, longer and easier to handle.

These features and more translate into benefits and advantages for councils, contractors and community members.

## Key benefits of flexible stormwater pipes



**Lightweight:** BlackMax drainage pipes weigh up to 90% less than concrete alternatives, meaning one or two people can carry and lift smaller diameter sizes and install them without heavy machinery.



**Pipe length:** With a typical length of 6 m, flexible drainage pipes require around 60% fewer joints than concrete, which is typically laid in 2.4 m lengths.



**Rubber ring joints:** Teams laying plastic pipes can easily assemble the joint as rubber ring joints enable fast, watertight assembly. No complex or new work practices are needed.



**No silica dust:** Crews and community members are increasingly aware of the dangers of silica dust during the cutting process. Plastic pipes are dust-free during cutting and are safer for all.

## Flexible vs concrete per 100 m trench

	6 M PLASTIC PIPE	2.4 M CONCRETE PIPE
<b>Pipe joints</b>	17	41
<b>Heavy lifting equipment</b>	Not required for smaller sizes	Yes
<b>Silica dust risk</b>	None	High
<b>Safety during handling</b>	High	Medium
<b>Install time</b>	Up to 30% faster	Slower

# Flexibility is a strength

When installed, operated and maintained in accordance with relevant product and installation standards and manufacturer’s guidelines, flexible, corrugated stormwater pipes have an expected service life in excess of 100 years.

They can also channel more water than a concrete pipe of the same internal diameter. This is explained by Manning’s Equation, which says pipes with smoother internal surfaces boast greater hydraulic efficiency.

The fact that flexible plastic pipes can actually deflect is sometimes misunderstood to be a weakness. But slight deformation under load means stress is distributed into the surrounding soil, creating a collaborative load-bearing environment that results in greater long-term stability.

Civil engineer Sandra Perez, Senior Global Product Manager for the Infrastructure Pipe Systems market segment at Orbia B&I (aka Wavin), explains the behavioural benefits of flexible stormwater pipes.

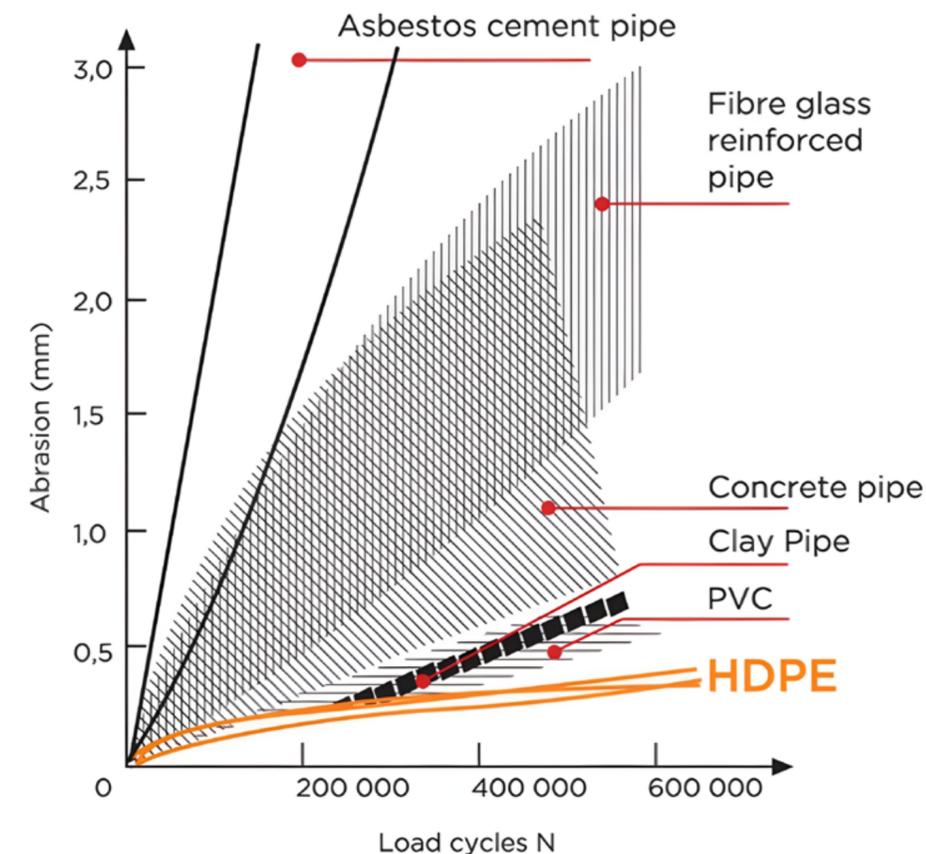
→ **Durability:** “Thermoplastic pipes (PVC, PE or PP) are known for having high durability. There are several studies concluding that 100 years lifetime can be guaranteed.”

→ **Hydraulic smoothness:** “Plastic pipes’ smooth surfaces positively influence hydraulic capacity, resulting in low friction loss and steady flow. Because of this, the internal diameter of a plastic pipe can be 10% smaller than a concrete one and still transport the same flow.”

→ **Chemical resistance:** “Thermoplastics are inert to most of the chemical agents that can

be present in sanitary or rainwater drainage systems, or in the surrounding soil. They do not need any protective liner or additional wall thickness to resist chemical attacks.”

→ **Abrasion resistance:** “Thermoplastics are the pipe materials that suffer the lowest wall thickness decrease because of abrasion effects in their inner walls.” [see graph].



SOURCES: Hass, D.B. and Smith, L.G., “Erosion Studies – A Report to Dupont of Canada Ltd.”, Saskatchewan Research Council, E75-7, September, 1975

Kirschmer, O., “Problems of Abrasion in Pipes”, Steinzeugin Formationen, 1966, No. 1, pp 3-13.

→ **Fewer defects:** “A 2005 study called Sustainable Municipal Pipes Project was developed by The European Plastic Pipes & Fittings Association, comparing thousands of CCTV images from damaged pipes in sewer systems in Germany, Netherlands and Switzerland. The main conclusion was that plastic pipes presented a much lower rate of defects than rigid pipes.” [see graph]

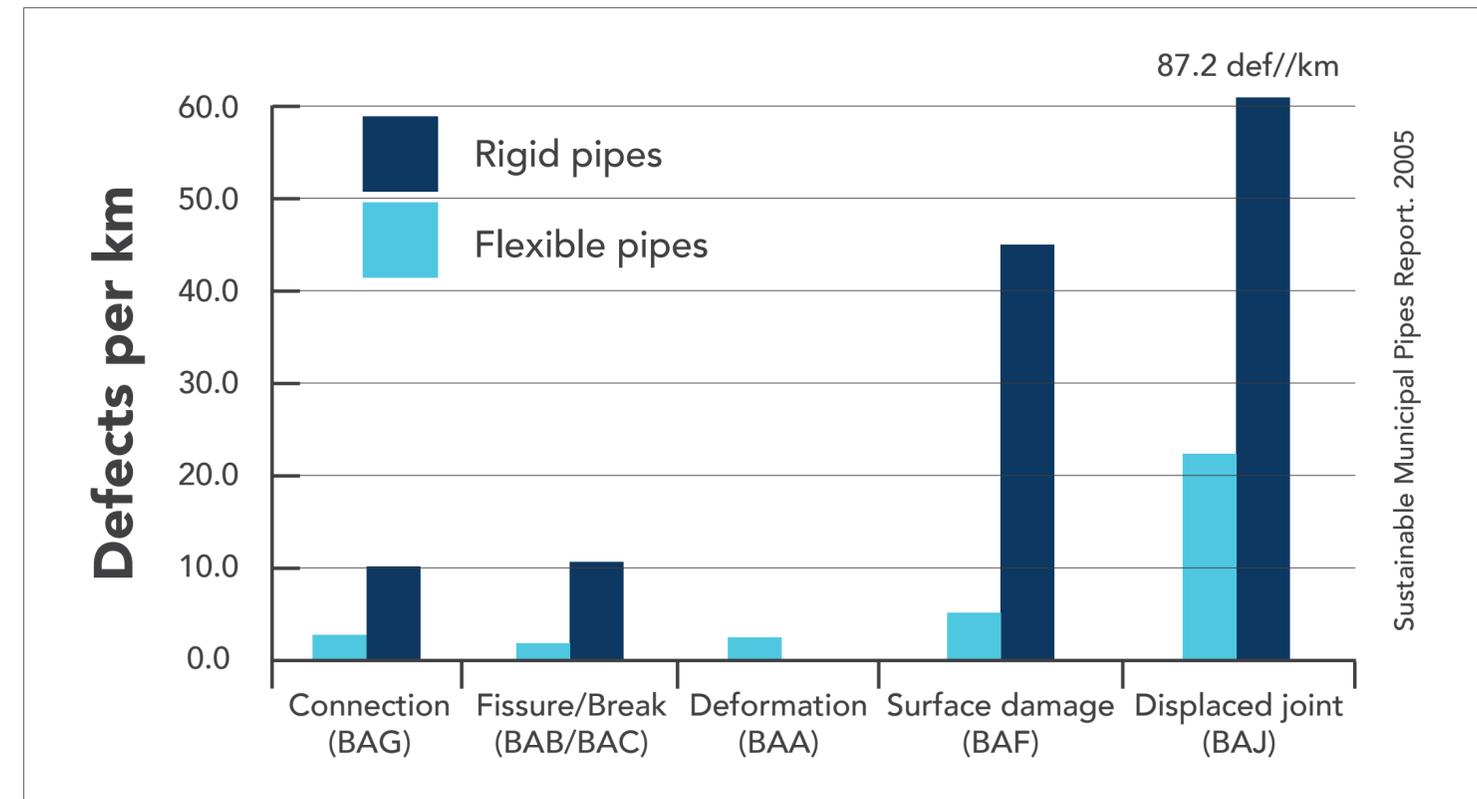
→ **Watertightness:** “Statistically, plastic pipes present 75% lower rate of leakages than other materials. This has to do with their flexibility, not breaking or presenting fissures when deformed, and with their similarly robust joining systems.”

Flexibility is clearly an advantage, rather than a weakness. It lends durability, particularly when soils settle at different levels.

In fact, as was reported in the paper Pipeline performance experiences during seismic events in New Zealand, 1987 to 2015, “Flexible pipes such as PVC and PE generally performed well, with significantly fewer breaks and leaks observed compared with other commonly used non-flexible pipes”.

Thermoplastic pipes are also very forgiving, Perez says. “Even in the case of bad installation, this will not result in failure because of the high strainability of the material,” she says.

“During installation, flexible pipes make a ‘warning’ when they are poorly installed. Excessive deformations appear instantly, giving the contractor the chance to correct it. Rigid pipes, on the contrary, when badly installed do not present any visible problems, but internal fissures are generated and they end up failing later in time.”



SOURCE: Sustainable Municipal Pipes Project, 2005, The European Plastic Pipes & Fittings Association.

# Case studies: Global lessons for Australia

Around one third of all state departments of transportation in the US now allow plastic pipe “everywhere” and another third allow it in “restricted applications”, says Dan Currence, whose role as the Director of Engineering for the Drainage Division of the Plastics Pipe Institute covers the USA, Mexico and Canada.

“There’s plenty of independent research to support the use of plastic pipe under roadways,” Currence says.

States that enjoy competition amongst pipe materials, he says, value the economic benefit, ease of installation, joint integrity and material availability.

Examples of under-road use in the US and Europe are numerous.

## LaGuardia Airport

During the \$8 billion rebuilding of LaGuardia Airport, over 14 km of dual-wall, corrugated polypropylene and HDPE pipe was used for underground stormwater drainage under runways and roads on both the airside and the landside.

## Sunrail Stations, Florida

The Central Florida Commuter Rail Commission designed stormwater management capabilities under two stations, beneath parking lots and approach roads, specifying the use of HDPE corrugated pipes.

## Interstate 270, Missouri

The Missouri Department of Transportation, widening the I-270 through St Louis, finished its award-winning project two months quicker than it would have had it used concrete pipe by instead specifying corrugated polypropylene stormwater pipe.

## Berlin-Brandenburg International Airport

Beneath Berlin’s new airport, opened in 2011, is one of Europe’s largest rainwater infiltration schemes. Using polypropylene pipes, it harvests rainwater from runways and access roads and releases it slowly, to mitigate flooding and subsidence.

**“We take plastic sewer and drainage pipes for granted. Though buried and out of sight, their contribution to sanitation and public health should not be overlooked. Wherever water flows – from the drains of Scotland to the plains of Spain, plastics have become the pipe material of choice. Their versatility and smooth performance are the product of significant technical expertise and inspiration.”**

– Ludo Debever, The European Plastic Pipes and Fittings Association General Manager

*Source: Plastic pipe data around Europe, The European Plastic Pipes and Fittings Association (TEPPFA)*

## Australia's lower-emissions solution: BlackMax

When several independent research institutes – including GUA (Corporation for Comprehensive Analyses), the Flemish Institute for Technological Research and the Austrian Denkstatt sustainability consultancy – measured the environmental footprint of various types of plastic pipes systems based on full lifecycle assessment, the excellent environmental performance of plastic pipes was confirmed. This was reported in The European Plastic Pipes and Fittings Association's *The Benefits of Plastic Pipes* paper.

Taking the entire lifecycle into account, including "raw material extraction, manufacturing, transformation into products, all transportation costs, installation, the product's lifetime of use, and disposal or transformation into other products at the end of life", the paper says, "...plastic pipes have a lower carbon footprint through their whole lifecycle than other materials for pipes".



# Lifecycle sustainability

PHASE	FLEXIBLE PIPES	CONCRETE PIPES
<b>Material</b>	Recyclable PP/PE	Steel-reinforced concrete
<b>Transport</b>	Light weight = lower emissions	Heavy = greater fuel use
<b>Install</b>	Fast, low-emissions, less machinery, less fuel to operate machinery	Crane-reliant, noisy, dusty, slow, more fuel to operate machinery and equipment
<b>Operation/ maintenance</b>	100+ years (assuming installation as per manufacturer guidelines and standards)	Susceptible to corrosion and other chemical attack, especially in coastal regions with acid sulphate soils
<b>End of life</b>	Recyclable	Some recycling, often landfill

## Flexible pipes in Australia

Australia has its own lines of plastic corrugated pipes for stormwater and sewer applications, particularly the Iplex BlackMax and SewerMax ranges.

BlackMax offers exceptional hydraulic and structural performance, and a range of installation, performance, environmental and other benefits.

All BlackMax pipes and fittings are manufactured in Australia and are resistant to corrosion and other aggressive ground conditions. With pipe diameters ranging from DN225 to DN1200, there are options to suit every need. Plus, BlackMax pipes are recyclable.

Importantly, [the BlackMax range has an Environmental Product Declaration \(EPD\)\\* from EPD Australia](#). An EPD is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as PCR (Product Category Rules), and in accordance with ISO 14025 and EN 15804:2012 + A2:2019.

All of this means engineers, councils, water authorities and water managers can design solutions confident in the knowledge that they are meeting, and often exceeding, regulatory and market requirements for sustainability.

*\* EPD currently applies to BlackMax polypropylene pipes manufactured in Brisbane.*



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## Conclusion

As Iplex's BlackMax now offers an extended range of sizes up to DN1200, the applicability of structured wall plastic pipes is broader than ever before.

With the increasing use of structured wall plastic pipes below roads, runways and more in territories such as the US and Europe, there are numerous best-practice examples for engineers to draw from.

### Structured wall plastic pipes:

- are safer, cleaner and quicker to install;
- provide excellent hydraulic performance;
- can be structurally superior to and more resilient than concrete options;
- are superior in terms of lifecycle sustainability;
- are globally proven, and
- align closely with Australia's net-zero goals.

Plastic pipes offer councils a practical and innovative option that has been globally proven to perform well over time.

**Find out more about BlackMax at [www.iplex.com.au/blackmax](http://www.iplex.com.au/blackmax) or contact Iplex on 13 10 86 to find out more.**

**Find out more**