

SWA INNOVATION HUB



**Market Sounding
Report of Current
Australian Solutions of
Recycled Plastic Pipes**



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1 Introduction

The content of this report consists of research into existing off-the-shelf solutions for stormwater drainage pipes made from materials alternative to concrete.

It has been prepared by Level5Design on behalf of the Sustainability Waste Alliance (SWA) for the South West Gateway Alliance (SWGGA).

As part of this exercise, a supplier outreach exercise was undertaken nationally supplemented by an online environmental scanning exercise, using the criteria of products given below -

- Has a manufacturing process that minimises carbon emissions,
- Made from 100% recycled material...
 - Solutions involving the reuse of post-consumer waste-derived material as well as reclaimed PVC have been included.
- Once in use...
 - Exhibits a high level of durability to ensure the longevity of operation,
 - Manufactured to minimise environmental impact (ensuring the material does not contaminate the surrounding environment).

Alongside the search criteria, the following information was sourced where it was available.

- Unique features of systems, e.g., fitments and accessories,
- Procurement costs,
- Maintenance costs (if any),
- The availability to deploy to Perth,
- The amount of time required to manufacture, ship, and install.

Four recycled plastic pipe products are presented including those from the following suppliers:

- The Green Pipe
- RPM Pipes
- iPlex Blackmax
- Vindex StormPRO

2 Background

2.1 Bunbury Outer Ring Road (BORR) Project

The Bunbury Outer Ring Road (BORR) project is a significant part of the Western Australian Recovery Plan for the South West. The \$1.25B BORR project is proposed to consist of 27 km of four-lane highway connecting Forrest and Bussell Highways and 21 km of local government (LG) roads. This is one of the key components in the long-planned transport network for South West Western Australia.

The objective of the BORR is to produce the necessary road infrastructure to support the increased traffic between regional areas and reduce the impacts of vehicle movements on the local residential population. Additionally, the project aims to enhance sustainability outcomes for the infrastructure associated with the Project.

The BORR program has local government road construction commencing in late 2021 with completion of pavements scheduled for late 2023. Other infrastructure elements will largely come later. The SWGA is tasked with the delivery of the BORR Project, which has set a sustainability commitment to incorporate into the works post-consumer recycled (PCR) waste plastics from the Greater Bunbury area that are not currently being recycled and destined for landfill.

2.2 SWA & SWGA

The Sustainability Waste Alliance is a collaboration of key agencies, working together across sectors and industries to achieve more than would otherwise be achieved in isolation. The SWA is focused on driving innovative outcomes via the SWA Innovation Hub.

The SWA was established by the Office of Major Transport Infrastructure Delivery (OMTID) and key stakeholders to deliver on the commitment made to the Department of Water and Environmental Regulations (DWER) to identify additional specific opportunities for using recycled materials in upcoming major infrastructure projects starting with the BORR.

The South West Gateway Alliance is a Consortium of both owner and non-owner participants established by the State Government to deliver the BORR Project.

SWGA and SWA have agreed to work together through a leadership governance group to optimise the delivery of the six waste focus materials identified in the document "Recycle First Plan", December 2020, for the BORR Project whilst ensuring the achievement of regional and Aboriginal business and employment opportunities in the South West.

SWGA and SWA wish to identify innovative practices to maximise opportunities for resource management, resource recovery and recycling on BORR that will lead to better, value-for-money outcomes for the road and waste industries in Western Australia. The BORR project will become a model for:

- Best practice in utilising applied road and waste recycling technology,
- Engagement with Local Government to apply best practices in resource recovery and recycling of road project waste,

- o And supply chain behavioural changes towards a 'Circular Waste Economy.'

2.3 Recycle First Plan for BORR

A Recycle First Plan (RFP) for BORR was produced by the SWA Innovation Hub for OMTID in December 2020 and was launched at the first SWA Summit in March 2021. The RFP is the first of its type in Western Australia and sets the fundamentals to commence actions on the BORR to fulfil the OMTID Recycle First Delivery Policy. OMTID has committed to identifying specific opportunities for using recycled materials in upcoming major infrastructure projects starting with the BORR as agreed with DWER.

The Recycle First Plan sets an aspirational starting point of 100% reused or recycled materials in road construction referred to as the "Towards100" approach.

It is proposed to demonstrate a *Towards100* outcome by using recycled and reused materials to the maximum extent possible over two demonstration sections on the BORR project. The demonstration projects will be in addition to the other sustainability actions using recycled materials in other parts of the BORR. For the first time, several technical specifications and performance frameworks will be implemented together in parallel as a demonstration for advancing the fundamentals of the RFP and the real-time development of new road products to other parts of the region and the state.

The *Towards100* demonstration project presents an excellent opportunity to showcase innovative and sustainable products that are presented in this report. It has the potential to drive genuine collaboration of the public, private and not-for-profit sectors to catalyse the Circular Economy in the South West and the State more widely.

TOWARDS 100

3 Option 1 - The Green Pipe

3.1 Company

Recycled Plastic Technology (RPT) Ltd. (HDPE material processor)

Circle P Pty Ltd. (Pipe manufacturer)

3.2 Product

The Green Pipe.

3.3 Links

Main Website - <https://www.thegreenpipe.com.au>

3.4 Material

- Contains 100% Recycled high-density polyethylene (HDPE), sourced from RPT Ltd.
- Made from 95% food-grade containers primarily sourced from post-consumer kerbside collections, including milk and juice containers.
- The remaining 5% is sourced from industrial waste applications.

3.5 Location

Moama, NSW.

This supplier has locally based resellers in the Southwest of Western Australia.

3.6 Durability

- Chemically resistant material, impervious to the highest-level acidic soils.
- The manufacturing substance will not polymerise over time. The only degrading forces the green pipe is subject to are physical stresses caused by ground movements.
- The estimated lifespan of the green pipe determined by certification processes is a minimum of 50 years but is expected to last more than 100 years.
- The pipe can be installed under roads and can support the heaviest legally loaded traffic, provided the minimum requirements for overhead coverage and side compaction are met (details for installation requirements are supplied in "The Green Pipe Info Book 2021").
- The Green Pipe exhibits greater stiffness and tensile toughness than conventional concrete equivalents.
- Durability certifications –
 - VicRoads - AS/NZS 1462.22:1997,
AS/NZS 2566.1:1998,
AS1462 & AS2566 for crush strength and life underground.
 - Swinburne University - AS 1145.1 – 2001 & AS 1145.2 – 2001.
 - CSIRO - AS/NZS 1462.22:1997
AS/NZS 2566.1:1998
AS 3572.10:2002
AS 3572.8:2002.

3.7 Environmental Impact

- The Manufacturing process uses renewable and non-renewable sources of electricity and LPG gas as a heat source.
- The embodied energy of the green pipe is 7.9mj/kg, which includes the collection of raw material and the manufacturing process, between 7% to 25% of that of major competitors.
- The plastic is tested by RPT Ltd to ensure no toxic chemicals leach into the soil.

3.8 Appearance & Features

- The manufacturer standard for the length of one pipe is 6 metres long, more than twice the length of the industrial standard for a concrete equivalent (2.44 metres long).
- The pipe assembles using a reliable bell-&-spigot system with an O-ring gasket.
- This style of assembly combined with pipe's longer standard lengths ensures fewer places of structural weaknesses and overall higher reliability than concrete pipes.
- Available in 6 sizes, between 250mm and 600mm in diameter -
 - 250mm – 45kg
 - 300mm – 55kg
 - 375mm – 75kg
 - 450mm – 110kg
 - 525mm – 165kg
 - 600mm – 220kg
- A range of fittings is also available via company catalogue and custom order, including bends, elbows, and 'T' intersections.
- Because the HDPE material is less dense than concrete, it may be cut down to size with common power-driven tools for onsite fabrication.
- Specifications of the Green Pipe's dimensions across varying sizes are available in "The Green Pipe Specifications.pdf."



Image above – a truck loaded with Pipes 375mm in diameter.

Limitations

- The green pipe is only suitable for gravity-flow drainage only, i.e., storm drains.
- Due to the internal surface texture of the pipe being rough, the pipe is not suitable to carry sewerage.
- The pipe is also not suitable to carry drinking water.

3.9 Occupational Health & Safety Concerns

- The Green Pipe weighs approximately 9 times lighter than the average concrete pipe given equal length, diameter and wall thickness.
- This results in less need for heavy equipment to transport and install the pipes, as well as any risk of physical injury occurring during handling.

- The pipe's lightness may also represent a convenience to workers as smaller pipes may be moved into position by hand.

3.10 Installation Examples

Westgate Freeway Project

The green pipe was used in segments along with the West Gate Freeway Project in 2017. Installations took place at the Montague Street, Todd Road, and Bolt Bridge intersections. A sum of 157m of green pipe length was installed.

- Between Bolte Bridge and Todd Road – 43.5m
- Between Bolte Bridge and Montague Street – 23.5m
- Montague Street intersection – 90m



Narromine Shire

Below are photos of the green pipe's installation in Narromine Shire in 2009. Here the pipe received approval for installation in an agricultural setting, satisfying regulations that ensure the plastic does not leach toxins into the ground. The 600mm diameter variation was used in this application.





3.11 Procurement

- The Green Pipe has a relatively low cost of purchase compared to drainage systems made from conventional materials.
- The pipe is supplied via resellers nationwide for small orders or directly from the factory for large-scale projects.
- For large-scale projects, the pipe is manufactured in Moama to order, and the manufacturing plant can produce an average of 450m of pipe a day.
- Below provided is the wholesale price list for the Green Pipe.
-

The Green Pipe – Wholesale Pricelist					
Dimensions (mm)	Weight (kg)	Price Per Metre (1m)	Price Per Pipe (6m)	'O' Rings To Suit	Join Sleeves To Suit
250	45	\$30.30	\$181.80	\$4.00	\$70.00
300	55	\$37.25	\$223.50	\$6.00	\$80.00
375	75	\$51.00	\$306.00	\$9.00	\$90.00
450	110	\$74.00	\$444.00	\$10.00	\$100.00
525	165	\$110.00	\$660.00	\$11.50	\$110.00
600	220	\$140.00	\$840.00	\$13.00	\$120.00

- The document “1st January 2020 Price List - Wholesale.pdf” also includes the cost of fitments including elbow joints, ‘T’ joints, low-pressure water control valves, slide gates and headwalls.
- The cost of delivery is included separately from the cost of the pipe and is variable depending on how far the order must be transported.
- Transport quotations are provided by Des Hogan, sales manager for The Green Pipe, alongside each order placement.
 - Des.hogan@thegreenpipe.com.au
 - 0417 677 861

- o The following list includes resellers based in Western Australia (primarily in the southwest) –
 - Katanning H Hardware – Katanning - 08 9821 1411
 - Kojonup Agricultural Supplies – Kojonup - 08 9831 1022
 - Peter Graham Co - Albany - 08 9841 1011

4 Option 2 – RPM Pipes

4.1 Company

RPM Pipes.

4.2 Product

RPM Pipe.

4.3 Links

Main website - <https://rpmpipes.com.au>

4.4 Material

Made from 100% recycled post-consumer and industrial HDPE plastic. 90% of plastic is sourced from kerbside collection and 10% from industrial manufacturing waste.

HDPE includes plastic sourced from milk containers, hygiene product bottles, old and broken wheelie bins, industrial scrap plastic, etc.

One 6m standard length pipe with a 630mm diameter contains the equivalent of 5000 milk containers.

4.5 Location

Manufacturer based in Kyabram, Victoria.

4.6 Durability

The pipe wall is thicker than the standard, contributing to structural durability. The pipe may be handled with crowbars by workers without causing damage.

Durability Certifications

- The RPM Pipe meets all Australian standards for use as a gravity stormwater drain in civil projects.
- Approved for use by ACT TCCS
- Creep Ratio (2 years) – ISO 9967
- Buried Flexible Pipelines – AS/NZS 2566.2
- Ring Stiffness - (Short Term) >6,000 - AS/NZS 1462.2
- Ring Stiffness - (2 Year) >3,000 - AS/NZS 2566.1
- Ring Stiffness - (Short Term) >2,500 - AS/NZS 2566.1

Standards for Material & Chemical Properties		
Physical	Test Method	RPM HDPE Material
Density (g/cm ³)	ASTM D792	0.969
Water Absorption @ 24 hours (%)	D570	0
Ultra Violet Deterioration	Insignificant	
Mechanical		
Tensile Strength (N/mm ²)	D638	27
Tensile Elongation (%)	D638	900
Flexural Modulus (N/mm ²)	ISO 178	1100
Charpy Impact Strength	ISO 179	750
Moisture Content	D570	0%
Water Absorption	D570	0%
Abrasion Resistance	D2394	0.127-0.381mm P/1000 Rev

Brand new pipes are inspected after production completion to ensure their quality before installation. According to the supplier, RPM Pipes are expected to last more than 100 years, based on current research on the durability of appropriately manufactured HDPE products.

Following installation, pipes should undergo month-to-month inspection to ensure that no damage has occurred early on. Retired pipes can either be safely left in the ground with no known environmental consequences or recovered and broken down for reuse.

Reliability must be ensured by correct installation, and that specifications for the following are met –

- Side compaction material with a granular size of 5-7mm to 10mm.
- Depth of bedding and top overlay to meet AS/NZS 2566.2 underground pipe standard.

Pipe Diameter	315mm	400mm	450mm	630mm
Top Coverage	315mm	400mm	450mm	630mm
Trench Width	720mm	800mm	850mm	1030mm
Sideways Pipe Spacing	250mm	250mm	300mm	350mm

4.7 Environmental Impact

The pipe was certified and approved by VicRoads in 2019 for civil applications.

The consumption of energy over an RPM pipe's lifecycle is between 2.1 kWh and 7.8kWh's of energy per kg of pipe.

The manufacturing process of RPM releases 1kg less CO² gas per 1kg of pipe compared to pipes made from virgin plastic. Embodied carbon of RPM pipes also contains 1.9kg less CO² per 1kg of pipe than virgin pipes.

RPM diverts the equivalent of 22,000 plastic containers away from landfills with each tonne of the pipe manufactured.

Sorting and manufacturing take place in-house.

- Kerbside plastic is sorted and graded by colour, density, and type.
- The plastic is then shredded and washed.
- The material is then heated and moulded into the final product.

The manufacturing process' energy is supplied by the following -

- 50% of electrical energy in the manufacturing process comes from solar.
- The remaining 50% of electricity is supplied by bio-diesel power generation.
- LPG gas is used in the heating process when moulding the plastic into pipes.

The water used to wash the plastic is rainwater collected on the site of the manufacturing plant. 80% of The water used is recycled. Any wastewater is evaporated into lined dams. No potable water is consumed.

In terms of direct CO² emissions, RPM representatives provided reference to a research paper "*Estimate of energy consumption and CO₂ emission associated with the production, use and final disposal of PVC, HDPE, PP, ductile iron and concrete pipes*" (2005). The conclusion of the research report was that a product made from 80% recycled HDPE emits a total of 24.8kg of CO² per 3m of pipe, compared to 153.9kg of CO² from a concrete equivalent, that is, approximately 16% of the emissions.

4.8 Appearance & Features

The pipes are made at a standard length of 6m. Given below is the weight of each pipe section based on the standard length (approximations).

- 225mm (in development until mid to late 2022)
- 300mm – 72kg
- 315mm – 77kg
- 375mm – 92kg
- 400mm – 125kg
- 450mm – 145kg
- 525mm – (in development until mid to late 2022)
- 600mm – 238kg
- 630mm – 250kg

Limitations

- Pipes are designed for low-pressure applications, and are suitable for civil, mining and agricultural applications.
- The inner lining of the pipe is a rough texture. Suitable for stormwater drainage but not for sewerage.

Fitments & Accessories

RPM also provides custom joint fabrications and several accessories in addition to the pipes.

- Headwalls –
 - Made from Fibreglass
 - Come in two sizes. One to suit pipes 450mm and smaller, and one to suit 600mm and larger.
 - Weighing approximately 15kg.
- Bay outlets,
- Channel stops,
- Doors,
 - Vertical sliding door for controlling the flow of water through pipes.
 - Optional automated bracket.
- Bay pluggers & hinge flaps,
 - A seal on a lockable pivot mechanism to close the opening of a pipe.

Future Developments

Currently in development at RPM are headwalls and pits made from the same recycled plastic material as the pipes, which are currently undergoing approval processes. These items are not expected to receive approval before 2023. Due to the significant weight difference between plastic and concrete, plastic headwalls require additional measures to ensure solid fixtures to the earth.

4.9 Occupational Health & Safety Concerns

Due to the much lighter weight of the pipes compared to concrete equivalents, fewer heavy lifting resources are required. The lighter weight also means that the pipes are easier to handle and fewer OH&S concerns persist.

The material used for RPM pipes, which is 100% co-polymer ethylene, is non-hazardous according to the criteria of NOHSC Worksafe Australia.

- There are no known symptoms or carcinogenic risks caused by exposure to the pipe's material.
- Ingestion or exposure of the eyes or lungs to dust while cutting the pipe should require medical advice, but no adverse effects are known to exist.

Fire hazards & Extinguishing

- Flashpoint – 345-400°C
- Auto-ignition point – 370-455°C
- No known fire and explosion hazards exist with the pipe material
- Extinguisher Media – Dry chemical – water fog/foam/CO₂

Material Handling Protective Measures

- The Pipe should be stored away from any naked flame
- No personal protection is strictly required unless cutting the pipe, including gloves, protective clothing, and eye and respiratory protection.
- No special hygienic practices are required during or after the handling of pipes.
- *The information for this section of OH&S is sourced from "RPM Pipes MSDS," provided by RPM Pipes.*

4.10 Installation Examples

Henry Arthur Drive

In 2005 RPM pipes were installed at Diamond Creek in Victoria to provide stormwater drainage. Below is an annotated map displaying the location of the pipe installations and images taken in 2019. The photos show that the pipe's structure has not deteriorated from the time of installation proving material durability.



Fitzgerald Road Level Crossing Removal Project (LXRP)

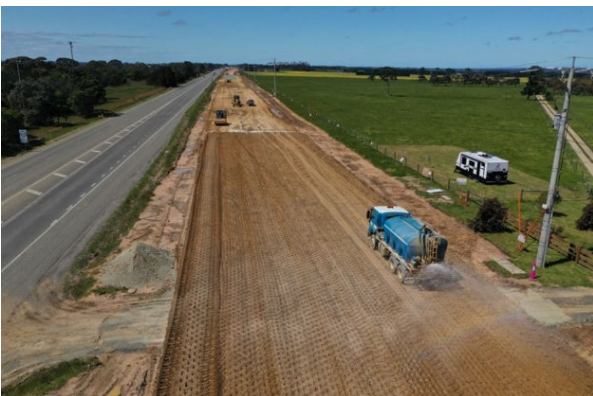


During the Fitzgerald Road LXRP in 2021, 438m of pipe were installed underneath the new level crossing.

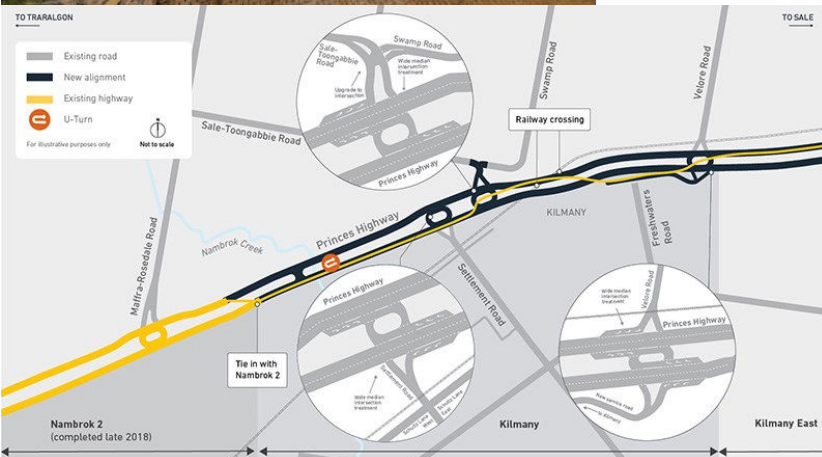
The manufacturing of the total amount of pipe required has consumed more than 240,000 plastic containers diverted from landfill and saved the emission of 10 tonnes of CO₂ gas that may have been released had the project used virgin plastic.



Princess Hwy Kilmany



The Princess Hwy needed a stormwater drain system running along the kerbside of the highway. In 2022, RPM was contracted to supply 1500 metres of RPM pipes to satisfy the needs of the project. The displayed map highlights the segment of roads equipped with RPM storm drains.



4.11 Procurement

Base prices for RPM Pipes are as follows -

- 300mm - \$43.00/m
- 375mm - \$58.00/m
- 450mm - \$77.00/m
- 630mm - \$137.00/m

Other pipe sizes are available on request and through quotation.

RPM sells pipes and accessories both directly and via resellers.

Direct Sales

- RPM has a storage facility based in Toowoomba and can supply any client nationwide via rail and semi-trailer if transportation is required. The cost of transportation varies significantly depending on the size of the order, the distance of the customer away from the manufacturer and the cost of fuel. One semi-truck travelling from the factory to WA in a previous order incurred costs of \$7,000 each way.
- RPM also has a warehouse based in Kyabram with stock to supply large projects immediately.

Direct orders may be discussed with Paul Dickens, RPM's sales manager.

- civilsales@rpmpipes.com.au
- 1300 890 979

Resellers

RPM does not have any resellers based in WA. However, the nearest ones from Bunbury include the following –

- | | | |
|-----------------------------|----------------|--------------|
| ○ Carrs' Seeds - | Cummins, SA - | 08 8676 2016 |
| ○ Platinum Ag Murraylands - | Adelaide, SA - | 08 8535 4188 |
| ○ Nutrien AG Solutions - | Adelaide, SA - | 08 8532 2622 |

RPM Pipes only manufactures and supplies pipes. They are not involved in any part of installation or groundwork.

5 Option 3 – iPlex Blackmax

5.1 Company

iPlex Pipes.

5.2 Product

Blackmax Range.

Jazz Pipe.*

5.3 Links

Blackmax Page on iPlex website - <https://www.iplex.com.au/products/pp-drainage-and-sewer-systems/blackmax/>

5.4 Material

The material used to manufacture Blackmax pipes is made from polypropylene plastic, and PVC. A high percentage of the PVC used to make the Blackmax pipes is sourced from recycled pipes made also from PVC or offcuts from different industries. iPlex also currently has a scheme in place, “Pipe-back,” which provides the public with a free service to dispose of old PVC pipes. These waste pipes are then processed and used to make more pipes. iPlex prioritises the consumption of reclaimed PVC before using virgin material for the manufacturing of pipes.

iPlex is also used to make another pipe called the ‘Jazz pipe,’ which comprised an inner and outer lining with a core made from post-consumer plastic and with an overall diameter of 375mm which was discontinued. However, after speaking with Brad (a sales representative), he mentioned he will investigate to see if production could be resumed for a demonstration project.

5.5 Location

Manufacturing of the pipe occurs in Strathpine Qld. A sales and distribution office exists in Jandakot, Perth for orders in WA. (08 9340 4890)

5.6 Durability

The material that Blackmax pipes are made from exhibits high physical durability to resist impacts and abrasions sustained during transport and handling. After installation, the pipe resists chemical corrosion from acids, alkalis and salts, as well as physical wear from the most aggressive soils. Additionally, the pipe has a tolerance for deformation while underground and can adapt to soil movements without incurring structural damage. The overall lifespan is quoted as being more than 100 years.

5.7 Environmental Impact

iPlex has stated that Blackmax products contain less embodied carbon than concrete equivalents. Specific CO² amounts are not quoted by the manufacturer.

At the end of the pipe’s life, a Blackmax pipe can either be retrieved from the ground to be recycled or left safely buried underground with no foreseeable

environmental consequences. The manufacturing material is inert and will not degrade over time.

5.8 Appearance & Features

Blackmax is suited for stormwater drainage, and the pipe comes with a variety of installation fittings and accessories for the construction of drainage systems. These include –

- Pipe bends,
- Tees & junctions,
- Couplings,
- Plugs,
- Adapters.

The fittings are made from PVC.

Blackmax comes in sizes 450, 525 and 600mm in diameter.

5.9 Occupational Health & Safety Concerns

iPlex recommends that proper handling techniques are used when manoeuvring and carrying pipes and to wear appropriate PPE during on-site fabrication. Overall the risk of injury to workers is minimised by the relatively low weight of Blackmax pipes compared to concrete.

5.10 Installation Examples

iPlex unfortunately does not provide any previous examples of installation of Blackmax pipes on their website. They have however featured various in-progress installations in marketing material and product documents, indicating their effective performance in urban and rural settings.

5.11 Procurement

iPlex does not openly advertise flat-rate prices for their Blackmax range and provides total cost estimates individually for each project, including product quantity, size and distance of transportation from the manufacturer.

Quotations are obtained via calling 1300 047 539 (for merchants), or 13 10 86 (for large scale civil projects).

Brad (sales or technical advisor) is currently exploring whether the production of their Jazz Pipe product can be restarted. (0437 133 072)



6 Option 4 – Vinidex StormPRO

6.1 Company

Vinidex (Alaxis).

6.2 Product

Vinidex make a variety of relevant products including the following –

- StormPRO – SN8
- StormFLO – SN8
- StormFLO – SN6

StormFLO SN8 is advertised as being the Vinidex stormwater drainage product based primarily on recycled material.

6.3 Links

Vinidex Recycling Efforts - <https://www.vinidex.com.au/sustainability/#cb-14>

PIPA PVC recycling initiative - <https://pipa.com.au/recycling/>

StormFLO SN8 - <https://www.vinidex.com.au/products/stormwater-and-underground-drainage-systems/stormflo-civil-sn8/>

Vinidex stormwater and underground drainage systems - <https://www.vinidex.com.au/support-2/stormwater-and-underground-drainage-systems/>

6.4 Material

- Vinidex's mid to large size stormwater drainage products are manufactured using Polyethylene, incorporating a mixture of recycled and virgin material.
- Vinidex is a stakeholder in the PIPA initiative, which represents similar efforts to iPlex's pipe-back scheme in retrieving old pipes to reuse their material.
- The percentage of the material which is recycled is dependent on the availability of recycled plastic, but it is theoretically possible for Vinidex to produce piping from 100% recycled material.
- Many of Vinidex's pipes are made from virgin material due to their intended application involving the transport of high-pressure fluids. Virgin plastic offers the high tensile strength necessary to perform this task while recycled plastic does not. However, as storm-water drainage is a relatively low-pressure application, recycled plastic provides sufficient material performance while repurposing post-consumer and industrial waste plastics.
- At the end of the pipe's life, 100% of its material is recyclable.
- It is manufactured to AS/NZS 5065.

6.5 Location

The three nearest suppliers of Vinidex are a manufacturing plant based in Perth and a distribution facility in Darwin and Adelaide.

6.6 Durability

The StormFLO pipe exhibits high resistance to chemicals and erosion from aggressive soils. The pipes' material contains an additive to increase resistance to UV exposure, improving resistance to weathering. The pipe is expected to last more than 100 years.

The material of the pipe has some ability to deflect, relying on side support provided by embedded material to preserve form when subject to vertical loads. Given the appropriate side support, even high vertical loads do not affect the pipe. The rate of deflection is enough to resist fracture without deforming entirely and offers a buffer for minor soil shifts over time. The performance of the pipe however is dependent on the quality of the installation, as excessive deflections caused by the settling of trench beds that are not flat may compromise structural integrity.

The European Plastic Pipe and Fitting Association (TEPPFA) studied the durability of Vinidex's Storm range of pipes and determined that the reliability of the pipes was determined by the level of potential deflection caused by the surrounding soil. The reliability of the pipe can be ensured by proper installation following the AS/NZS 2566.2 standard.

During installations between 0.8 and 6 metres in depth, no additional considerations or engineering calculations are necessary. If an installation of the pipe lies outside this range or if the soil condition is poor, then further design considerations outlined in AS/NZS 2566.1 "Buried flexible pipelines. Part 1: Design" are recommended to be followed.

During storage and transportation, Vinidex recommends that pipes should not be exposed to any sharp projections, be dragged along the ground, or suspended higher than 1m. Any of these scenarios present a risk of damaging the integrity of the pipe. Despite these, the pipes may generally be lifted and placed without any worry. Any grommets must also be stored out of direct sunlight or heat to prevent weathering.

6.7 Environmental Impact

Vinidex does not provide specific details on the carbon emissions produced during the pipe's production, except that the manufacturing process is advertised as being material and energy-efficient.

6.8 Appearance & Features

StormFLO pipes are twin-wall, corrugated polypropylene pipes tailored for non-pressure applications. It can be used in a variety of civil settings, including under road pavements and trafficable areas. It can be cut and fabricated on-site to form joins and junctions similarly to the other pipe options in this report.

StormFLO S8 Dimension Varieties

Nominal Diameter (mm)	Effective Length (m)	Overall Length (m)	Approximate Pipe Mass (kg/6m)
225mm	5.96m	6.10m	19
300mm	5.88m	6.05m	26
375mm	5.79m	6.02m	47
450mm	5.78m	6.00m	73
525mm	5.69m	5.96m	100
600mm	5.56m	5.90m	113

For on-site fabrication, Vinidex conveniently supply drill saw attachments and grommets to integrate with the pipes. Vinidex also supplies slip couplings for cutting out segments of damaged pipe and substituting new pipe.

Pipe Installation Specifications

Diameter	Trench Width	Minimum Pipe Bedding	Minimum Pipe Overlay	Minimum Side-Spacing (for parallel pipes)
225mm	560mm	100mm	150mm	150mm
300mm	745mm	100mm	150mm	200mm
375mm	830mm	100mm	150mm	200mm
450mm	1115mm	150mm	150mm	300mm
525mm	1200mm	150mm	150mm	300mm
600mm	1280mm	150mm	150mm	300mm

StormFLO embedment material must be free-flowing granular material to minimise soil shifts and effort into compacting. Specifications of the required embedment material are provided in the StormFLO Installation guide.

6.9 Occupational Health & Safety Concerns

The StormFLO pipes are light enough to be lifted and manipulated by hand, though PPE and safe lifting practices are recommended.

Adequate care to ensure the stability of trenches should also be ensured for the protection of workers on site. Trenches should be narrow as possible for project convenience, but wide enough to provide working room for pipe installation and joining. Minimum trench dimensions should also follow the standard outlined in AS/NZS 2566.2.

For the protection of workers on installations involving deep stormwater drains that require trench shields, Vinidex will change the length of their pipes to ensure greater ease of handling while installing. (See Gen Fyansford Estate installation for further details.)

6.10 Installation Examples

Applications of the StormFLO pipe include -

- Land development – residential and industrial
- Roads – infrastructure, stormwater, asset renewal
- Rail – stormwater run-off, culverts under rail
- Mining – stormwater and aggressive ground
- Rural - Culverts and heavy rural load applications

The following installation examples feature Vinidex's StormPRO product which contains a higher percentage of virgin material to provide a more rigid structure. In general applications, StormPRO and StormFLO pipes perform equally as well as each other with StormFLO providing a budget alternative to StormPRO.

Utah Point Access Road Drainage

The pipe installation in this project had many criteria to suit. The area was subject to flooding which needed for water to be diverted. Haul trucks carrying hundreds of tonnes of iron-ore would also need to drive over the site of installation with no problems.



The pipe installation needed to support a high level of water flow, resist chemically and physically aggressive soil and support the weight of mining vehicles driving overtop. StormPRO pipes ranging in size from 450mm to 750mm in diameter were able to meet these conditions due to the corrosion-resistant properties of the pipes' material as well as the corrugated structure of the pipe contributing to structural rigidity.

Wallan - Springridge Estate

During the construction of Springridge in Wallan Victoria, project managers wanted to incorporate the surrounding natural environment into the estate. This meant that the addition of a drainage system to the area needed to have as little interference with the environment as possible.

A solution was needed for a drainage system that provided installation flexibility and was easy to handle onsite. It was also a necessity to keep the use of heavy machinery to a minimum. Vinidex's 375mm pipes were able to satisfy the needs of the estate's drainage system and each pipe weighed less than 50kg, ensuring ease of handling for site workers.



Wallan – Wallan Place Residential Subdivision

Wallan Place required the installation of a kerbside storm drain system. During this project, Vinidex collaborated with Aus Pits to engineer the integration of the StormPRO pipes with Aus Pits' storm drain pits. The final solution was a new product that could suit existing industry parameters, took less time to install and required little to no long-term maintenance.



Gen Fyansford Estate

Gen Fyansford is a new development in Geelong containing approximately 1000 homes, which required storm drainage to exist along kerbsides and underneath roads. The StormPRO pipe has sufficient structural rigidity to support the weight of any traffic load making it ideal for many civil applications.

It was identified that in this application, deep stormwater drains were necessary. This then required the use of trench shields to protect workers on the pipe installation. As the trench shields were approximately 3 metres long, Vinidex reconfigured the production of the StormPRO to produce pipes that were 3 metres long instead of 6 metres to make installation easier for workers.



6.11 Procurement

On the Vinidex website is advertised "availability in VIC and TAS, coming soon to other states." Vinidex customer service has however recommended contacting local WA suppliers for quotations. A further response including specific details for suppliers is pending.

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7 Price Comparison

Prices for the recycled plastic pipes were compared against standard reinforced concrete pipes (RCP).

Dimensions (mm)	Price Per Meter					
	Green Pipe	RPM Pipes	RCP ³ Class 2 Class 4	RCP ⁴ Class 2 Class 4	iPlex ⁷ Blackmax	Polypropylene ⁸ (iPlex Blackmax)
250	\$30.30	-				
300	\$37.25	\$43.00	<i>Redacted</i>	\$132.00	\$83.88	\$112.00
				\$155.00		
375	\$51.00	\$58.00		\$160.00	\$144.16	\$132.00
				\$180.00		
450	\$74.00	\$77.00		\$215.00		\$162.00
				\$260.00		
525	\$110.00	-		\$250.00		\$205.00
				\$310.00		
600	\$140.00	-		\$290.00		\$260.00
				\$360.00		
630		\$137.00		-		

Notes:

1. The Green Pipe 2020 price list has been used.
2. The RPM Pipes only provided a price guide based on small to medium volume orders. There is a potential for further price reduction for bulk or bigger volume orders.
3. This RCP 2021 price list includes Class 2 and 4 pipes. Class 4 pipes have been shaded in grey for easy identification. This price list is for bulk purchasing of large volumes of RCP and was provided by SWGA.
4. This RCP 2020 price list includes Class 2 and 4 pipes. Class 4 pipes have been shaded in grey for easy identification. This price list is for retail purchases of small quantities of pipe and has been taken from Rawlinsons Australian Construction Handbook Edition 38.
5. Bulk purchase prices are estimated to be considerably lower than retail prices for small quantities. This is evidenced by the RCP and BlackMax retail and bulk pricing in the table.
6. Green Pipes and RPM Pipes are 6 m in lengths as opposed to the 2.34 m RCP.
7. This price list for iPlex Blackmax is a retail price obtained through one of their WA resellers.
8. This price list is for retail purchases of pipe and has been taken from Rawlinsons Australian Construction Handbook Edition 38. It is for Blackmax/StormPRO non-pressure corrugated pipe with smooth internal wall and rubber ring joints.
9. The retail price of 100% recycled plastic pipe is lower than for RCP or Polypropylene.
10. Installation costs are lower for the recycled plastic pipes compared to RCP.
11. All costs exclude trench excavation, backfilling and transport.

