iPLEX Pipelines

EPD - PVC PIPES

Environmental Product Declaration
Polyvinyl Chloride PVC-O, PVC-M, PVC-U

Environmental Product Declaration
Produced under the Australasian EPD Programme in Accordance with ISO 14025 and EN15804:2012+A1:2013.

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DECEMBER 2021

The Iplex® vision is to be the leading manufacturer and supplier of plastic building materials in New Zealand.


AUCKLAND
PALMERSTON NORTH
CHRISTCHURCH
ASHBURTON

IPLEX EPD - PVC
CONTENTS

GENERAL COMPANY INFORMATION

Iplex Pipelines NZ is one of New Zealand's leading manufacturers of plastic pipeline systems. Iplex NZ is a wholly owned subsidiary of Fletcher Building Ltd. with manufacturing facilities in Palmerston North, Christchurch and Ashburton.

Iplex NZ manufactures pipeline systems for a range of industry sectors including; civil, rural, plumbing & rainwater, and energy & communications.

Iplex NZ manufactures PVC pipes with StandardsMark™ third party product certification in accordance with Australasian Standards,

- PVC-O Pressure Pipe – AS/NZS 4441 (Licence SMKP20682)
- PVC-M Pressure Pipe – AS/NZS 4765 (Licence SMK02570
- PVC-U Pressure Pipe – AS/NZS 1477 (Licence SMK02569 and SMKP20181)
- PVC-U – Gravity Sewer & DWV pipe – AS/NZS 1260 (Licence SMK20184 and SMK20185)
- PVC-U – Gravity Stormwater pipe – AS/NZS 1254 (Licence SMKP20126 and SMK20180)

Iplex PVC pipes do not contain any additives or compounds based on lead (Pb), cadmium (Cd) or mercury (Hg).

All Iplex NZ operations are conducted under a quality management system, accredited by SAI Global to ISO 9001, Licence QEC 4169.

Iplex NZ also participates in the Toitū Enviromark programme which requires a robust environmental management system at the manufacturing facilities.

Iplex NZ complies with Best Environmental Practice PVC (BEP PVC) - ApprovalMark™ Certificate of Compliance 067.

EPDs within the same product category from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. The EPD owner has the sole ownership, liability, and responsibility for the EPD.

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PRODUCT DESCRIPTION

Iplex PVC-O PRESSURE PIPE

Iplex PVC-O is a bi-axially oriented PVC pressure pipe for use in transmission, distribution and reticulation water supply, pressure sewer infrastructure, wastewater and irrigation. Iplex NZ manufactures the pipe using two patented processes known as Biax Extrusion and Super Socketing. This method of production results in an exceptionally tough, high performance thermoplastic pipe with greatly enhanced physical characteristics, including greater impact resistance, higher ductility, improved fatigue resistance and reduced weight when compared with other PVC pressure pipes. PVC-O to AS/NZS 4441 is an Acceptable Pipe Material in NZS 4404:2010 Appendix A, for pressure water supply and pressure sewer applications.

Iplex PVC-M PRESSURE PIPE

Iplex PVC-M is a modified PVC pressure pipe for use in transmission, distribution and reticulation water supply infrastructure, wastewater and irrigation. Modified PVC (PVC-M) utilises an impact modifier to alter the fracture mechanism, so the material behaves in a ductile manner. Iplex PVC-M pressure pipes provide superior characteristics compared with conventional PVC-U pressure pipes, including higher impact resistance and ductility, reduced weight and greater hydraulic capacity. PVC-M to AS/NZS 4765 is an Acceptable Pipe Material in NZS 4404:2010 Appendix A, for pressure water supply and pressure sewer applications.

Iplex PVC-U PRESSURE PIPE

Iplex PVC-U is an unplasticised PVC pressure pipe for use in transmission, distribution and reticulation water supply, pressure sewer infrastructure, wastewater and irrigation. Iplex PVC-U pressure pipes are manufactured from unplasticised polyvinyl chloride polymer (a thermoplastic material) using the continuous screw extrusion process. PVC-U to AS/NZS 1477 is an Acceptable Pipe Material in NZS 4404:2010 Appendix A, for pressure water supply and pressure sewer applications.

Iplex PVC-U GRAVITY SEWER DWV PIPE

Iplex PVC-U Gravity Sewer DWV pipe is an unplasticised PVC pipe for use in gravity transmission, and reticulation drainage of sewerage, and municipal or industrial wastewater. It is suitable for aggressive ground water, anaerobic conditions, and exposure to aggressive sewer gases encountered in wastewater applications. Iplex PVC-U Gravity pipes are manufactured from unplasticised polyvinyl chloride polymer (a thermoplastic material) using the continuous screw extrusion process. Iplex uses Sandwich Construction (SC) technology in the core of the pipe wall to accommodate high % content by weight of scrap PVC material. PVC-U material to AS/NZS 1260 is an Acceptable Pipe Material in NZS 4404:2010 Appendix A, for gravity waste water applications.

Iplex PVC-U GRAVITY STORMWATER PIPE

Iplex PVC-U Gravity Stormwater pipe is an unplasticised PVC pipe for use in buried gravity drainage under roads, of municipal stormwater, roading drainage and stormwater culverts. It complies with NZTA TNZ F/ 3 "Specification for road culvert construction". Iplex PVC-U Gravity Stormwater pipes are manufactured from unplasticised polyvinyl chloride polymer (a thermoplastic material) using the continuous screw extrusion process. Iplex uses Sandwich Construction (SC) technology in the core of the pipe wall to accommodate exceptionally high content by weight of rework PVC material. PVC-U material to AS/NZS 1254 is an Acceptable Pipe Material in NZS 4404:2010 Appendix A, for gravity stormwater applications.

TECHNICAL INFORMATION

TABLE 1 - PRODUCT CHARACTERISTICS OF PVC PRESSURE PIPES	
PRODUCT NAMES	Iplex PVC-O Pressure (Apollo® & Apollo Blue®), Iplex PVC-M Pressure (Rhino® & Blue Rhino®), Iplex PVC-U Pressure (Novakey®), Iplex PVC-U Gravity Sewer & DWV (Novadrain®), Iplex PVC-U Gravity Stormwater (Superstorm®)
DENSITY	1420-1500 kg/m^2
HYDROSTATIC DESIGN STRESS	11 to 12.3MPa PVC-U, 22.2 to 28MPa PVC-O, 17.5MPa PVC-M
COEFFICIENT OF LINEAR THERMAL EXPANSION	7 x 10^{-5} / °C
MAXIMUM WORKING TEMPERATURE	Pressure Pipe (50°C with rerating), Gravity Pipe (60°C - Continuous or 75°C - Intermittent
SPECIFIC HEAT	1045 J/kg.K
POISSON'S RATIO	0.38-0.45
FLEXURAL RING MODULUS, INITIAL	4200MPa PVC-O, 3000MPa PVC-M, 3200MPa PVC-U

INDUSTRY CLASSIFICATION

Product	Classification	Code	Category
Iplex PVC-O/ PVC-M/ PVC-U	UN CPC Ver.2	36230	Tubes, pipes and hoses, and fittings therefor, of plastics
	ANZSIC 2006	19120	Rigid and Semi-Rigid Polymer Product Manufacturing

The feed mix ingredients are mixed by frictional means until enough heat is generated to incorporate the stabiliser and lubricant necessary for uniform processing at the extruder. Once mixed the blended feed mix is stored in silos ready for extrusion – where the feed mix is gradually fed into the extruder via a gravimetric weighing system ensuring precise quantities. Through a combination of friction and heat, the feed mix is brought up to the ideal temperature for plastification, at which point it is forced through an annular die to form a tube. The newly formed pipe is then cooled by refrigerated water and the outside of the tube is subjected to a vacuum and brought in contact with a perfectly round sizing sleeve. The wall thickness is controlled with the computerised haul-off speed which also controls the saw which cuts the pipe at predetermined lengths. One end of the pipe is re-heated after cutting and expanded to form a socket to allow for pipe joining.

The lengths of pipe are packaged in crates with timber frames using chemical-free, biodegradable NZ grown softwood, with steel or PET strapping. The softwood timber is NZ grown exotic species, and not a NZ native, it contains no treatment or preservative chemicals and is biodegradable.

This production phase is captured in A3. Machine consumables, water use, and disposal of waste and wastewater is taken into account.

PRODUCT COMPOSITION

The pipes investigated are made from a polyvinyl chloride (PVC) granulate mixed with additives to introduce desirable properties such as stability, durability and colouration. A content declaration is indicated in Table 2 as per EN15804 requirements.

None of the products in this EPD contain hazardous materials identified in the European Chemicals Agency's Candidate List of Substances of Very High Concern (ECHA, 2020) at a concentration of greater than 0.1% of the mass.

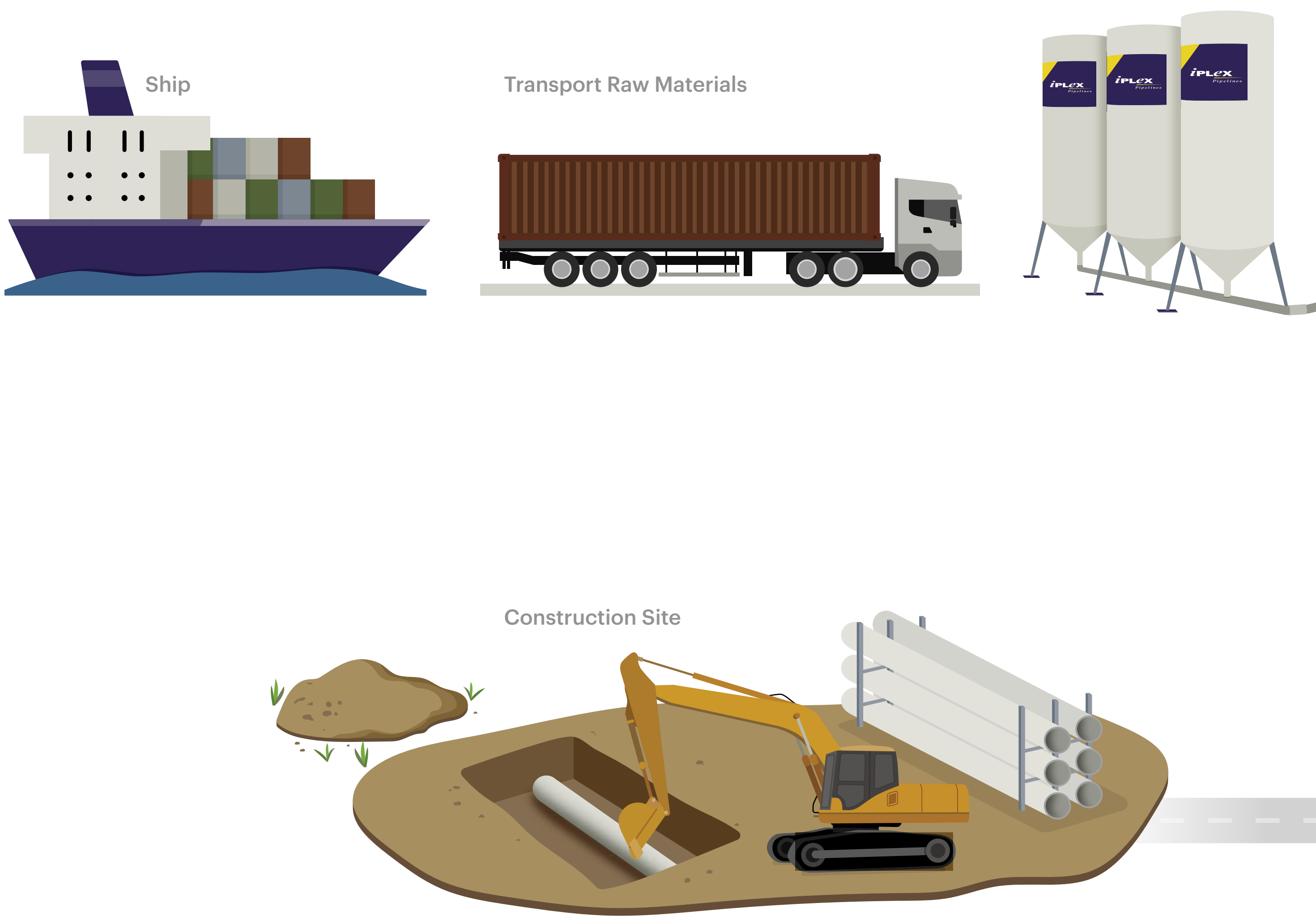
TABLE 2 - CONTENT DECLARATION

Material	PVC-U	PVC-M	PVC-O	CAS number
Polyvinyl chloride granulates	✓	✓	✓	9002-86-2
Calcium carbonate (filler)	✓	✓	✓	471-34-1
Organic based stabiliser	✓	✓	✓	Confidential (non-hazardous)
Pigment	✓	✓	✓	Various (non-hazardous)
Impact modifier	✗	✓	✗	64754-90-1
Titanium Dioxide	✓	✓	✓	CAS 13463-67-7

DESCRIPTION OF MANUFACTURING PROCESS

Iplex PVC pipes are manufactured primarily from PVC resin along with additives including: calcium carbonate, titanium dioxide, organic stabiliser, lubricants and pigments. The PVC resin is sourced from offshore production facilities and delivered via container ship to New Zealand. The PVC resin is then delivered to the Iplex manufacturing sites by road transport and transferred into storage silos.

From the silos, the mixing system incorporates resin and additives via computer controlled weighing systems. Internal PVC pipe scrap is fed back into the feed mix and utilised in new pipe. The ingredients are then mixed by frictional means until enough heat is generated to incorporate the stabiliser and lubricant necessary for uniform processing at the extruder. Once mixed the blended feed mix is again stored in silos ready for extrusion – where the feed mix is gradually fed into the extruder via a gravimetric weighing system ensuring precise quantities. Through a combination of friction and heat, the feed mix is brought up to the ideal temperature for extrusion, at which point it is forced through an annular die to form a tube.



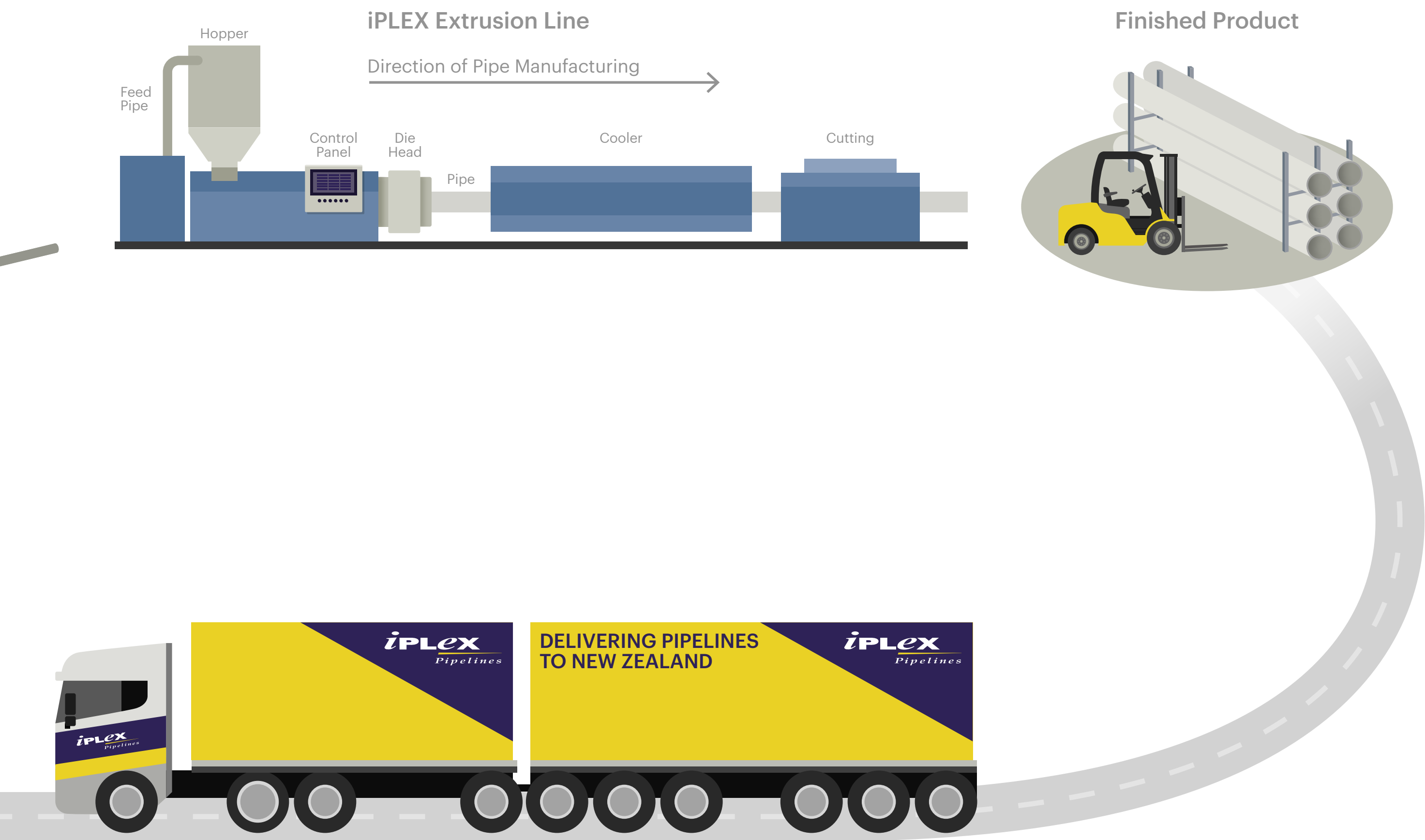
MANUFACTURING PROCESS

The newly formed pipe is then cooled by refrigerated water and the outside of the tube is subjected to a vacuum and brought in contact with a perfectly round sizing sleeve. The wall thickness is controlled with the computerised haul-off speed which also controls the saw which cuts the pipe at predetermined lengths. One end of the pipe is re-heated after cutting and expanded to allow for pipe joining.

Finally, the lengths of pipe are packaged in crates with timber frames using chemical-free, biodegradable NZ grown softwood, with steel or PET strapping.

DISTRIBUTION

Iplex PVC pipes are transported via road directly to the construction site or to reselling merchants. Finished products are typically distributed from the production facility closest to the customers site (subject to availability and production runs).



SYSTEM BOUNDARIES

The life cycle of a building product is divided into three process modules according to the General Program Instructions (GPI) of the Australasian EPD Programme (AEPDP, 2015) and four information modules according to ISO 21930 and EN 15804 and supplemented by an optional information module on potential loads and benefits beyond the building life cycle. As shown in the table below, this EPD is of the 'cradle-to-gate' with options. The options include end-of-life processing (Modules C3-C4) and recycling potential (Module D). Use phase modules were deemed to be irrelevant for this study as Iplex's PVC pipes rarely require any maintenance during the service life.

TABLE 3 - SYSTEM BOUNDARIES

Product Stage			Construction Process Stage		Use Stage							End-of-Life-Stage				Recovery Stage
Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal	Future reuse, recycling or energy recovery potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

(X = declared module; MND = module not declared)

ASSUMPTIONS

Key modelling assumptions used to formulate this EPD are described in the following sections. Note that not all assumptions used in this LCA study are included in this EPD document.

Product stage

The PVC granulate comes from USA, Japan, and Thailand. Transport distances for PVC are based on product sourced from USA to be conservative. Iplex PVC pipes are manufactured primarily from PVC resin, with other additives to modify material properties. PVC has been modelled using Sphera's dataset 'US: Polyvinyl chloride granulate (S-PVC)'. The proportion of PVC resin used in formulating pipes differs slightly between product categories, which drives much of the variation in impact at the production stage.

The electricity used in the manufacturing of Iplex PVC pipe comes from the New Zealand national grid. The Sphera owned dataset 'NZ: Electricity grid mix' was used.

ASSUMPTIONS

Installation

Iplex PVC pipes are typically installed in an excavated open cut trench which has been prepared by a diesel excavator. The trench width and depth vary between pipe size and type. Diesel consumption from excavators governs most of the environmental burden for the installation phase and is strongly correlated to the required size of the trench.

For this EPD, DN150 PVC pipes were assumed. The selection of DN150 pipe is conservative because it is one of the smaller commonly used sizes that are commercially available for PVC pipes in New Zealand. Note that PVC pipes are available other sizes, but to achieve consistency between all product groups, DN150 is used instead.

LCA results for the installation phase are only valid for a PVC pipe matching these dimensions but can be used as a conservative estimate for larger pipes. The outer diameter and mass per linear meter of a DN150 pipe varies depending on the product group being considered. Table 4 provides the product category specific dimensions used in installation calculations.

TABLE 4 – PIPE SPECIFICATIONS USED IN THE LCA STUDY

Product	Pressure/ stiffness rating (PN/SN)	Outer Diameter (mm)	Mass per linear meter (kg/m)	Trench length per kg of pipe (m/kg)
PVC-O pressure	PN12.5	177.4	3.8	0.263
PVC-M pressure	PN12	177.4	4.6	0.0.217
PVC-U pressure	PN12	177.4	7.0	0.143
PVC-U non pressure	SN16	160.3	4.1	0.244
PVC-U stormwater	SN4	160.3	2.9	0.345

Trench dimensions follow minimum requirements plus 10 percent of the Australasian-based standard AS/NZS 2032: Installation of PVC pipe systems (Standards New Zealand 2016) Dimensions are presented in Fig.1.

The impacts of open-cut installations have been modelled based on the consumption of diesel by a 15kW excavator used to excavate the trench. Aggregate was used to partially refill the trench and provide side support to the pipe in compliance with AS/NZS 2032. Upstream impacts of aggregate production were modelled using the dataset 'BR: Crushed rock 16-32 mm' from Sphera. The remainder of the trench was backfilled with the previously excavated soil. Figure 1 provides a detailed illustration of the relevant dimensions for an installed PVC pipe, as modelled in this study.

A DN150 size Ethylene Propylene Diene Monomer (EPDM) rubber ring joint was used as the assumed fixing for a 6m effective length PVC. Pipe. All moving and joining of pipe during installation is assumed to be done by hand.

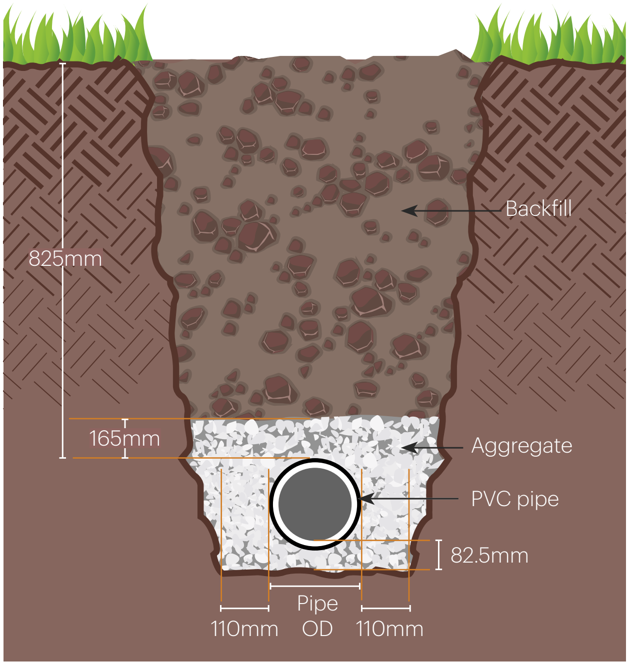


Fig. 1 Typical Open Cut Trench Installation

Transport

Distribution transport was calculated using a weighted average of product deliveries to regions around New Zealand. Averages distance for each product group is included in Table 5. Note that Iplex PVC-O Pressure pipes differ from other product groups because it is produced exclusively in Palmerston North.

TABLE 5 – DISTRIBUTION DISTANCES

Product group	Distribution distance (km)
PVC-O Pressure	365
PVC-M Pressure	324
PVC-U Pressure	324
PVC-U Non-Pressure	324
PVC-U Stormwater	324

End of Life and Recovery and Recycling Potential

PVC pipes are generally installed underground and tend to remain there at the end-of-life, which can logically be expected, for correctly manufactured and installed systems,to be well in excess of 100 years. PVC pipes are inert and there is no incentive to exhume them to send for recycling. Therefore, extraction, transport, and end-of-life treatment (C1-4) was assumed to be negligible. The PVC pipes are not economically viable for reuse or recycling, so the same assumption applies for recovery and recycling potential (Module D).

LIFE CYCLE INVENTORY

The life cycle inventory (LCI) is a step in the life cycle assessment methodology that draws together all relevant inputs and output flows for a product system. The inventory is built to simulate the process of producing Iplex PVC pipes by accounting for operations that fall under the modules specified within the system boundaries according to EN15804. A system diagram for the LCI used in this study is shown in Figure 2.

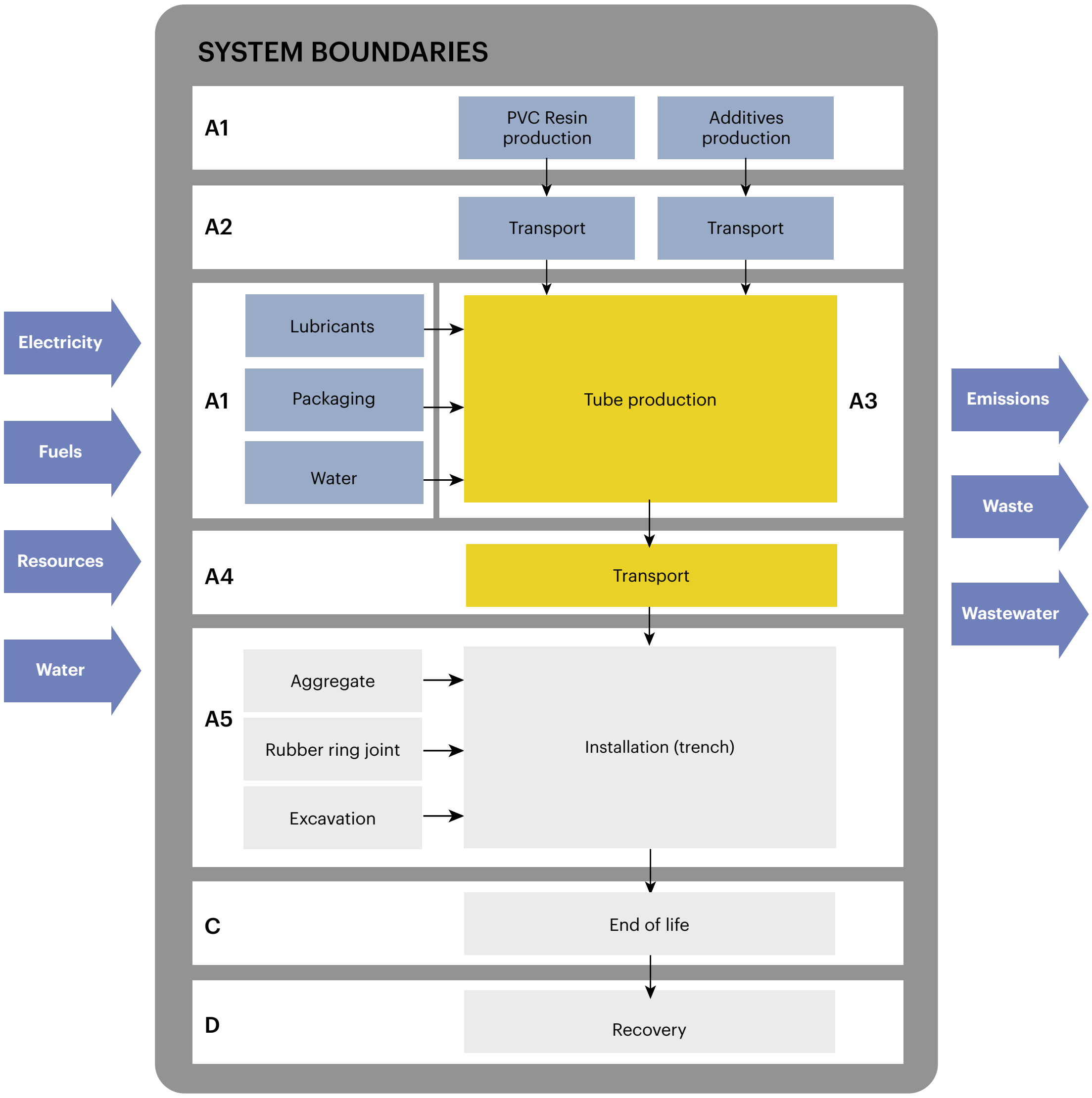


Fig. 2 System boundaries diagram

LIFE CYCLE ASSESSMENT METHODOLOGY

Declared unit

The products covered in this study are 5 varieties of synthetic PVC pipes, used for a variety of functions within the construction sector such as for civil, rural, plumbing, energy & communications.

TABLE 6 - DETAILS OF LCA	
Product Characteristics	
Declared unit	1 kg of installed pipeline
Geographical coverage	New Zealand
LCA scope	Cradle to grave with options
Reference service life	100 years

The declared unit is for 1kg of pipe and its packaging installed and then decommissioned. Impacts due to maintenance, repair and operation are excluded due to their negligible contribution to the overall impacts. Table 6 provides further details on product characteristics.

This EPD and the underlying LCA comply with the following standards:

- PCR 2012:01 Construction Products and Construction Services, Version 2.3 (EPD International, 2020)
- Instructions of the Australasian EPD Programme v3.0 (EPD Australasia, 2018)
- The International EPD System General Programme Instructions (GPI) v3.01 (EPD International, 2019)
- ISO standards on Life Cycle Assessment (ISO 14040, 2006) (ISO 14044, 2006)

Product categories

Five set of results are presented in this document. Product categories are required by EN 15804 to have results differing by no more than 10% to be amalgamated into a single set of results. Product category details are included in Table 7.

TABLE 7 – PRODUCT CATEGORIES USED IN THE LCA	
Product Category Name	**Relevant product lines**
PVC-O Pressure Pipe	Iplex Apollo® or Iplex Apollo Blue®
PVC-M Pressure Pipe	Iplex Rhino® or Iplex Blue Rhino®
PVC-U Pressure Pipe	Iplex Novakey®
PVC-U Gravity Sewer & DWV Pipe	Iplex Novadrain®
PVC-U Gravity Stormwater Pipe	Iplex Superstorm®

Data for core processes

Primary life cycle information has been sourced from material quantity data and production process data from Iplex's reporting systems and staff. Primary data for Iplex's operations was sourced for a 12-month period from 1 July 2019 to 30 June 2020.

All data in the background system was from the GaBi Life Cycle Inventory Database 2020 (Sphera, 2021). Most datasets have a reference year between 2016 and 2019 and all fall within the 10 year limit allowable for generic data under EN 15804.

Sphera's dataset 'BR: Crushed rock 16-32mm' is used as a proxy for production of aggregate that is used in installation (Module A5). The inclusion of this dataset provides explains why 'Renewable primary energy as energy carrier' (and subsequently 'Total use of renewable primary energy resources') and 'Use of net fresh water' are higher than would otherwise be expected from open trench pipeline installation.

LIFE CYCLE ASSESSMENT METHODOLOGY

Cut off criteria

Environmental impacts related to personnel, such as employee commuting, and infrastructure that is not directly consumed in the product's life cycle are excluded from the system. Data was modelled using the best available life cycle inventory data.

Allocation

Mass allocation is applied for manufacturing and installation life cycle stages. Allocation of background data (energy and materials) is specified in the GaBi documentation library (Sphera, 2021).

Explanation of average products and variation

For Iplex PVC pipes, this EPD represents an average of the Iplex sites in Christchurch and in Palmerston North. Flow quantities are weighted by the annual product output from each site. Iplex PVC-O is produced exclusively at Palmerston North.

Image 1. Iplex PVC-O Pressure Pipe being installed

Image 2. Iplex PVC-O stacked in yard

ENVIRONMENTAL IMPACT CATEGORY

The potential environmental impact categories, and references for the source of their characterisation factors, included in this EPD are described in the table below. See the References section for full details on characterisation methods. Life cycle inventory indicator results are also included in the EPD, but do not require characterisation factors for calculation.

TABLE 8 ENVIRONMENTAL IMPACT CATEGORY DESCRIPTIONS

Environmental Impact	Description	Unit	Reference
Global Warming Potential (GWP100)	A measure of greenhouse gas emissions, such as CO2 and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may in turn have adverse impacts on ecosystem health, human health and material welfare.	kg CO2 equivalent	(IPCC, 2013)
Abiotic Resource Depletion (ADP elements, ADP fossil)	The consumption of non-renewable resources leads to a decrease in the future availability of the functions supplied by these resources. Depletion of mineral resources and non-renewable energy resources are reported separately. Depletion of mineral resources is assessed based on ultimate reserves.	kg Sb equivalent, MJ (net calorific value)	(van Oers, de Koning, Guinée, & Huppes, 2002)
Eutrophication Potential	Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which nitrogen (N) and phosphorus (P). Nutrient enrichment may cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems. In aquatic ecosystems increased biomass production may lead to depressed oxygen levels, because of the additional consumption of oxygen in biomass decomposition.	kg PO43- equivalent	(Guinée, et al., 2002)
Acidification Potential	A measure of emissions that cause acidifying effects to the environment. The acidification potential is a measure of a molecule's capacity to increase the hydrogen ion (H+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline and the deterioration of building materials.	kg SO2 equivalent	(Guinée, et al., 2002)
Photochemical Ozone Creation Potential (POCP)	A measure of emissions of precursors that contribute to ground level smog formation (mainly ozone O3), produced by the reaction of VOC and carbon monoxide in the presence of nitrogen oxides under the influence of UV light. Ground level ozone may be injurious to human health and ecosystems and may also damage crops.	kg C2H4 equivalent	(Guinée, et al., 2002)
Ozone Depletion Potential (ODP)	A measure of air emissions that contribute to the depletion of the stratospheric ozone layer. Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the earth's surface with detrimental effects on humans and plants.	kg CFC-11 equivalent	(Guinée, et al., 2002)

EPD RESULTS - PVC-O PRESSURE PIPE

TABLE 9 - EPD RESULTS FOR 1KG OF PVC-O PRESSURE PIPE

		Production	Distribution	Installation	Decon strution	Waste Transport	Processing	Disposal	Recovery
Environmental Impact	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential (total)	kg CO_2-eq.	2.62	0.0427	1.09	0	0	0	0	0
Depletion potential of the stratospheric ozone layer	kg CFC11-eq.	1.74E-10	7.65E-18	9.01E-16	0	0	0	0	0
Acidification potential of land and water	kg SO_2-eq.	0.00639	9.09E-05	0.00482	0	0	0	0	0
Eutrophication potential	kg PO_4^{3-}-eq.	9.23E-04	1.94E-05	8.60E-04	0	0	0	0	0
Photochemical ozone creation potential	kg C_2H_4-eq.	9.16E-04	-2.57E-05	1.71E-04	0	0	0	0	0
Abiotic depletion potential – elements	kg Sb-eq.	1.16E-06	5.30E-10	7.98E-08	0	0	0	0	0
Abiotic depletion potential – fossil fuels	MJ	59.6	0.573	12.0	0	0	0	0	0
Resource use	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Renewable primary energy as energy carrier	MJ	7.27	0.00375	5.86	0	0	0	0	0
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	7.27	0.00375	5.86	0	0	0	0	0
Non-renewable primary energy as energy carrier	MJ	46.7	0.573	12.4	0	0	0	0	0
Non-renewable primary energy as material utilization	MJ	15.7	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	62.4	0.573	12.4	0	0	0	0	0
Use of secondary material	kg	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.0227	5.36E-06	0.0290	0	0	0	0	0
Waste categories and output flows	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	1.06E-06	3.49E-11	6.22E-09	0	0	0	0	0
Non-hazardous waste disposed	kg	0.0668	1.33E-05	0.0346	0	0	0	1.00	0
Radioactive waste disposed	kg	0.00110	6.08E-08	1.50E-04	0	0	0	0	0
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0

EPD RESULTS - PVC-M PRESSURE PIPE

TABLE 10 - EPD RESULTS FOR 1KG OF PVC-M PRESSURE PIPE

		Production	Distribution	Installation	Decon struction	Waste Transport	Processing	Disposal	Recovery
Environmental Impact	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential (total)	kg CO_2-eq.	2.59	0.0379	1.31	0	0	0	0	0
Depletion potential of the stratospheric ozone layer	kg CFC11-eq.	1.63E-10	6.80E-18	1.05E-15	0	0	0	0	0
Acidification potential of land and water	kg SO_2-eq.	0.00633	8.08E-05	0.00583	0	0	0	0	0
Eutrophication potential	kg PO_4^{3-}-eq.	9.59E-04	1.72E-05	0.00104	0	0	0	0	0
Photochemical ozone creation potential	kg C_2H_4-eq.	8.93E-04	-2.28E-05	2.04E-04	0	0	0	0	0
Abiotic depletion potential – elements	kg Sb-eq.	1.12E-06	4.71E-10	9.55E-08	0	0	0	0	0
Abiotic depletion potential – fossil fuels	MJ	59.1	0.509	14.4	0	0	0	0	0
Resource use	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Renewable primary energy as energy carrier	MJ	7.48	0.00333	7.09	0	0	0	0	0
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	7.48	0.00333	7.09	0	0	0	0	0
Non-renewable primary energy as energy carrier	MJ	47.1	0.509	14.9	0	0	0	0	0
Non-renewable primary energy as material utilization	MJ	14.7	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	61.8	0.509	14.9	0	0	0	0	0
Use of secondary material	kg	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.0238	4.76E-06	0.0352	0	0	0	0	0
Waste categories and output flows	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	9.93E-07	3.10E-11	6.98E-09	0	0	0	0	0
Non-hazardous waste disposed	kg	0.0737	1.18E-05	0.0352	0	0	0	1.00	0
Radioactive waste disposed	kg	0.00109	5.40E-08	1.80E-04	0	0	0	0	0
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0

EPD RESULTS - PVC-U PRESSURE PIPE

TABLE 11 - EPD RESULTS FOR 1KG OF PVC-U PRESSURE PIPE

		Production	Distribution	Installation	Deconstrution	Waste Transport	Processing	Disposal	Recovery
Environmental Impact	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential (total)	kg CO_2-eq.	2.55	0.0379	0.741	0	0	0	0	0
Depletion potential of the stratospheric ozone layer	kg CFC11-eq.	1.69E-10	6.80E-18	5.86E-16	0	0	0	0	0
Acidification potential of land and water	kg SO_2-eq.	0.00631	8.08E-05	0.00317	0	0	0	0	0
Eutrophication potential	kg PO_4^{3-}-eq.	9.08E-04	1.72E-05	5.66E-04	0	0	0	0	0
Photochemical ozone creation potential	kg C_2H_4-eq.	8.95E-04	-2.29E-05	1.17E-04	0	0	0	0	0
Abiotic depletion potential – elements	kg Sb-eq.	1.13E-06	4.71E-10	5.22E-08	0	0	0	0	0
Abiotic depletion potential – fossil fuels	MJ	58.0	0.509	7.87	0	0	0	0	0
Resource use	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Renewable primary energy as energy carrier	MJ	7.06	0.00333	3.86	0	0	0	0	0
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	7.06	0.00333	3.86	0	0	0	0	0
Non-renewable primary energy as energy carrier	MJ	45.5	0.509	8.13	0	0	0	0	0
Non-renewable primary energy as material utilization	MJ	15.2	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	60.7	0.509	8.13	0	0	0	0	0
Use of secondary material	kg	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.0219	4.76E-06	0.0191	0	0	0	0	0
Waste categories and output flows	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	1.02E-06	3.10E-11	3.95E-09	0	0	0	0	0
Non-hazardous waste disposed	kg	0.0663	1.18E-05	0.0336	0	0	0	1.00	0
Radioactive waste disposed	kg	0.00107	5.40E-08	9.80E-05	0	0	0	0	0
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0

EPD RESULTS - PVC-U GRAVITY SEWER & DWV

TABLE 12 - EPD RESULTS FOR 1KG OF PVC-U GRAVITY SEWER & DWV PIPE

		Production	Distribution	Installation	Decon strution	Waste Transport	Processing	Disposal	Recovery
Environmental Impact	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential (total)	kg CO_2-eq.	2.35	0.0379	1.15	0	0	0	0	0
Depletion potential of the stratospheric ozone layer	kg CFC11-eq.	1.55E-10	6.80E-18	9.35E-16	0	0	0	0	0
Acidification potential of land and water	kg SO_2-eq.	0.00602	8.07E-05	0.00507	0	0	0	0	0
Eutrophication potential	kg PO_4^{3-}-eq.	8.61E-04	1.72E-05	9.06E-04	0	0	0	0	0
Photochemical ozone creation potential	kg C_2H_4-eq.	8.32E-04	-2.28E-05	1.81E-04	0	0	0	0	0
Abiotic depletion potential – elements	kg Sb-eq.	1.04E-06	4.71E-10	8.34E-08	0	0	0	0	0
Abiotic depletion potential – fossil fuels	MJ	53.4	0.509	12.6	0	0	0	0	0
Resource use	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Renewable primary energy as energy carrier	MJ	6.90	0.00333	6.15	0	0	0	0	0
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	6.90	0.00333	6.15	0	0	0	0	0
Non-renewable primary energy as energy carrier	MJ	42.0	0.509	13.0	0	0	0	0	0
Non-renewable primary energy as material utilization	MJ	14.0	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	55.9	0.509	13.0	0	0	0	0	0
Use of secondary material	kg	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.0210	4.76E-06	0.0305	0	0	0	0	0
Waste categories and output flows	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	9.40E-07	3.10E-11	6.36E-09	0	0	0	0	0
Non-hazardous waste disposed	kg	0.0614	1.18E-05	0.0347	0	0	0	1.00	0
Radioactive waste disposed	kg	9.85E-04	5.40E-08	1.57E-04	0	0	0	0	0
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0

EPD RESULTS - PVC-U GRAVITY STORMWATER

TABLE 13 - EPD RESULTS FOR 1KG OF PVC-U GRAVITY STORMWATER PIPE

		Production	Distribution	Installation	Deconstrution	Waste Transport	Processing	Disposal	Recovery
Environmental Impact	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential (total)	kg CO_2-eq.	2.35	0.0378	1.59	0	0	0	0	0
Depletion potential of the stratospheric ozone layer	kg CFC11-eq.	1.55E-10	6.79E-18	1.32E-15	0	0	0	0	0
Acidification potential of land and water	kg SO_2-eq.	0.00601	8.07E-05	0.00716	0	0	0	0	0
Eutrophication potential	kg PO_4^{3-}-eq.	8.60E-04	1.72E-05	0.00128	0	0	0	0	0
Photochemical ozone creation potential	kg C_2H_4-eq.	8.31E-04	-2.28E-05	2.50E-04	0	0	0	0	0
Abiotic depletion potential – elements	kg Sb-eq.	1.04E-06	4.71E-10	1.18E-07	0	0	0	0	0
Abiotic depletion potential – fossil fuels	MJ	53.4	0.509	17.8	0	0	0	0	0
Resource use	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Renewable primary energy as energy carrier	MJ	6.90	0.00333	8.70	0	0	0	0	0
Renewable primary energy resources as material utilization	MJ	0	0	0	0	0	0	0	0
Total use of renewable primary energy resources	MJ	6.90	0.00333	8.70	0	0	0	0	0
Non-renewable primary energy as energy carrier	MJ	41.9	0.509	18.3	0	0	0	0	0
Non-renewable primary energy as material utilization	MJ	14.0	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ	55.9	0.509	18.3	0	0	0	0	0
Use of secondary material	kg	0	0	0	0	0	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0
Use of net fresh water	m^3	0.0210	4.75E-06	0.0431	0	0	0	0	0
Waste categories and output flows	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	9.39E-07	3.10E-11	8.96E-09	0	0	0	0	0
Non-hazardous waste disposed	kg	0.0614	1.18E-05	0.0360	0	0	0	1.00	0
Radioactive waste disposed	kg	9.84E-04	5.39E-08	2.21E-04	0	0	0	0	0
Components for re-use	kg	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0	0
Exported electrical energy	MJ	0	0	0	0	0	0	0	0
Exported thermal energy	MJ	0	0	0	0	0	0	0	0

PIPE CONVERSION TABLES
PIPE TYPE, OD & WEIGHTS.

The tables below are a comparison of mean OD dimensions and minimum weights per lineal metre of pipe, for the representative pipe classes. They allow the designer to perform calculations for pipe diameters other than the baseline size of DN150.

SERIES 1 PRESSURE	PVC-U/ PN12 AS/NZS 1477		PVC-M/ PN12 AS/NZS 4765		PVC-O/ PN12.5 AS/NZS 4441	
DIN	Mean OD (mm)	Weight (kg/m)	Mean OD (mm)	Weight (kg/m)	Mean OD (mm)	Weight (kg/m)
100	114.3	2.9	114.3	1.9	114.3	1.4
150	160.3	5.7	160.3	3.7	160.3	2.8
200	225.3	10.3	225.3	7.4	225.3	5.5
225	250.4	12.6	250.4	9.2	N/A	N/A
250	280.4	15.8	280.4	11.5	N/A	N/A
300	315.5	20.1	315.5	14.6	315.5	10.8
375	400.5	32.4	400.5	23.5	N/A	N/A
450	500.5	50.6	500.5	36.6	N/A	N/A
500	N/A	N/A	N/A	N/A	N/A	N/A
600	N/A	N/A	N/A	N/A	N/A	N/A

SERIES 2 PRESSURE	PVC-U/ PN12		PVC-M/ PN12		PVC-O/ PN12.5	
DIN	Mean OD (mm)	Weight (kg/m)	Mean OD (mm)	Weight (kg/m)	Mean OD (mm)	Weight (kg/m)
100	121.9	Not currently manufactured	121.9	2.2	121.9	1.8
150	177.4		177.4	4.6	177.4	3.8
200	232.3		232.3	7.9	232.3	6.6
250	286.2		286.2	12.0	286.2	10.0
300	345.4		345.4	17.5	345.4	14.5
375	426.2		426.2	26.7	N/A	N/A

GRAVITY (SW & DWV)	SN4 (DWV OR SW) AS/NZS 1260 OR AS/NZS 1254		SN16 (DWV) AS/NZS 1260	
DIN	Mean OD (mm)	Weight (kg/m)	Mean OD (mm)	Weight (kg/m)
150	160.3	2.9	160.3	4.1
175	200.3	4.2	200.3	6.5
225	250.4	6.6	250.4	9.9
300	315.5	10.4	315.5	15.9
375	400.5	17.4	400.5	25.3
475	500.5	27.1	500.5	39.6
500	560.5	33.2	560.5	N/A
600	630.5	42.6	630.5	N/A

(shaded) = baseline

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PIPA (Plastics Industry Pipe Association of Australia Ltd) issues the publication titled - Industry Guidelines POP004 Polyethylene Pipe & Fittings Compounds – Issue 26/ September 2021.

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ADDITIONAL INFORMATION

Toitū Environmark Gold - Iplex was awarded gold certification on 15 April 2021

GOLD DEFINITION: Toitū environmark gold certified organisations have developed a comprehensive plan to help them achieve their goals outlined in their formal environmental policy. They are measuring their impacts so that they can manage them. The organsation has the basis of a robust environmental management system in place.

Best Environmental Practice & Greenstar

In 2010 the New Zealand Green Building Council, NZGBC, reviewed its Green Star NZ PVC credit and a new approach, the use of Iplex PVC pressure and non-pressure pipe, conduit and fittings can assist buildings to qualify for up to three positive credit points towards their green star rating, where pipe and fittings can be shown to comply with the NZGBC credit - MAT-4 PVC (2012).

As a means of demonstrating Best Environmental Practice PVX (BEP PVC), Iplex was subjected to an extensive audit process by independent third party certifier, ApprovalMark International. On 16 July 2012 Iplex was issued with BEP PVC Certificate of Compliance No. 67. The certificate is available from Iplex Pipelines, at www.iplex.co.nz/contact/

The NZGBC has recognised environmental advances made by Iplex and others and has based its revision on a series of PVC Expert Reference Panel (ERP) meetings, site visits, discussions with key stakeholders and examination of international studies. This process has shown the lifecycle of PVC - from raw materials and production through use to end-of-life, recycling and disposal - has changed considerably in recent years and there is a clear rationale for favouring PVC products that are manufactured and reclaimed through Best Environmental Practice production and end of life product management processes.

More information can be found on the following websites:
Plastics Industry Pipe Association (PIPA)
www.pipa.com.au/index.php/sustainability/best-environmental-practice-pvc/

Pipelines

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0800 800 262
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PALMERSTON NORTH: PRIVATE BAG 11019, 67 MALDEN STREET
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