HUMES

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804+A2:2019 for:

Reinforced Concrete Pipes (RCP)

AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

Programme:	EPD Australasia, https://epd-australasia.com/
Programme operator:	EPD Australasia Limited
EPD registration number:	S-P-09349
Valid from:	2023-07-31
Valid until:	2028-07-31
Geographical scope of EPD:	New Zealand

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.epd-australasia.com

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General Information

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. The results for EN15804+A1 compliant EPDs are not comparable with EN15804+A2 compliant studies as the methodologies are different. EN 15804+A1 compliant results are included in this document to assist comparability across EPDs.

Declaration Owner	**Humes Pipeline Systems**	
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Geographical Scope	**New Zealand**	
Reference Year for Data	**2018-07-01 to 2019-06-30**	
EPD produced by	**thinkstep Ltd**	
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EPD programme operator:	**EPD Australasia Limited**	
	Website	http://www.epd-australasia.com
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	Post	EPD Australasia Limited, 315a Hardy Street, Nelson 7010, New Zealand
PCR	PCR 2019.14 Construction Products Version 1.11, 2021-02-05 c-PCR-003 Concrete and Concrete Elements (EN 16757:2017), 2019-12-20 (valid until 2024-12-30)	
PCR review was conducted by	The Technical Committee of the International EPD® System	
Chair	Claudia A. Peña. Contact via info@environdec.com	
Independent verification of the declaration and data, according to ISO 14025	☐ EPD process certification (Internal) ☑ EPD verification (External)	
Third party verifier	Rob Rouwette (start2see Pty Ltd) Email: rob.rouwette@start2see.com.au	
Verifier approved by	EPD Australasia	
Procedure for follow-up of data during EPD validity involved third-party verifier	☐ Yes ☑ No	

About us

Founded in 1923 by pioneering industrialist, Walter Hume, **Humes Pipeline Systems** is a company built on the principals of innovation, manufacturing expertise and quality products supported by a team of capable people who are proud to serve their customers

For over 100 years, Humes have been sourcing and distributing a range of products of various materials, and also manufactures a range of concrete pipe and precast structures for the infrastructure, drain laying and rural markets throughout New Zealand. Humes is a standalone business unit within the Concrete division of the Fletcher Building Group.

The Humes business is supported by a team of over 250+ employees working across 23 sites (manufacturing and sales) all over New Zealand providing extensive product and service coverage and is supported by a team in their Auckland Support Office.

- **Innovative expertise since 1923**
- **Connecting communities with smarter solutions**
- **Cleaning up waterways**
- **Pioneers in the industry**
- **Building lifelong assets**

Humes holds current certifications under AS/NZS ISO 9001 for Quality Management Systems, as well as being licensed under various product certification schemes.

Product Description

This EPD covers **reinforced concrete pipe products** manufactured by Humes, across three manufacturing locations in New Zealand – Hornby (Christchurch), Papakura (Auckland) and Te Rapa Park (Hamilton).

The product's intended use is for non-pressure stormwater drainage pipelines, sewerage pipelines and watertight pipe applications. Further details on product use and design for different applications can be found in Humes' Concrete Pipe brochure (see www.humes.co.nz). Reinforced Concrete Pipes are made from coarse and fine aggregates, cement, water, and hard-drawn plain or deformed steel reinforcement. Other material used can include supplementary cementitious materials (SCMs) and chemical admixtures which have varied effects on the concrete depending on the admixture used.

Humes manufactures pipes using both vertical casting (RCP - Roller Compacted Pipe and VT - Vibration Technology) and horizontal casting (Spun). Vertical Casting utilises single or double mould casting process to enable high production volumes while maintaining a high degree of accuracy, while spun pipe allows for a great degree of flexibility for specialised and high strength pipe.

Reinforced Concrete Pipes are manufactured with two basic joint types - Flush Joint (FJ) and Rubber Ring Joint (RRJ). FJ pipes provide an interlocking joint which allows for a small degree of flexibility in the pipeline alignment. RRJ pipes, either belled-socket or in-wall joint depending on the diameter of the pipe and its application, are designed to accommodate changes in pipeline alignment and settlement in a pipeline, whilst still maintaining a watertight joint.

All of Humes' vertically cast pipe is manufactured in 2.5 metre effective lengths in the DN300 to DN2400 diameter range, with DN225 having an effective length of 2.0 metres. Horizontal pipe effective length varies between 2.4 and 2.45 metres, depending on the pipe diameter and the joint type. Effective length is used to define a Reinforced Concrete Pipe's length as the physical length of the pipe includes the overlap of the joint. Reinforced Concrete Pipes are readily available in Classes 2 & 4, which are included in this EPD. High strength classes of 6 & 8 are available for specific projects in most size ranges and are not included in this EPD.

This EPD does not cover concrete sump and riser products or other precast products (covered under Humes Precast Concrete products EPD S-P-09350 and Humes Precast Concrete Sleepers EPD S-P-09351).

Table 1 – Industry Classification

PRODUCT	CLASSIFICATION	CODE	CATEGORY
Humes Titan Concrete Reinforced Pipe DN225-DN2400	UN CPC Ver.2	37550	Prefabricated structural components for building or civil engineering, of cement, concrete or artificial stone
	ANZSIC 2006	2034	Concrete Product Manufacturing

Table 2 – Summary of the Reinforced Concrete Pipe Range

FACTORY	HORNBY	PAPAKURA	TE RAPA PARK
Technology	Spun	Vibration Technology	Roller Compacted Pipe
Nominal Diameter	DN300-DN2300	DN675-DN2400	DN225-DN600
Joint	RRJ/FJ	RRJ	RRJ
Classes	2, 4 (6)	2, 4 (6, 8)	2, 4
Effective Length	2.4-2.45m	2.5m	2.5m DN300-DN600 0.6, 1.8, and 2.0 DN225

Declared Unit

Humes Reinforced Concrete Pipe is manufactured in accordance with AS/NZS 4058:2007 Precast Concrete Pipes (Pressure and Non-pressure) and is designed for a 100 year service life, when installed according to AS/NZS 3725:2007 Design for Installation of Buried Concrete Pipes.

Specialty pipes are available as required for specific projects, and can include lined pipes, jacking pipes, and pipes for aggressive environments. Unless specifically referenced in the documented information, specialty pipes are not covered by this EPD, although will have similar performance properties to the equivalent design, size and class of standard pipe.

Reinforced concrete pipes are available in various classes (impacting either thickness, reinforcing design or both) and diameters. Given the wide range of factors present, there is no single parameter that allows different pipes to be averaged while presenting impacts across a large part of their life cycle.

There is no single functional unit that allows pipe performance to be declared across the different aspects of its life cycle, and so two declared units have been applied:

- For production (A1-A3), distribution (A4), and end-of-life (C1-C4 + D), the declared unit is: 1 tonne of reinforced concrete pipework with a given capacity (class, dimensions and length of pipes shall be specified).
- For installation (A5), the declared units is: 1 equivalent metre of reinforced concrete pipework with a given capacity (class, dimensions and mass shall be specified).

A weight conversion factor (tonne/ equivalent metre) is provided for each pipe to ensure the results can be easily converted; e.g. for use in environmental calculators.

This EPD covers 111 pipe products. In order to simplify communication of environmental profiles, it is necessary to group products according to key characteristics. Grouping is based on the type of production process and class strength, with further grouping as needed using joint type, pipe diameter and/or length. The impacts are declared for a representative product for each group.

All products in this EPD are listed in tables 3 to 5, including the product specification and mass, weight conversion factor, and product group.

Product Specifications

Humes' reinforced concrete pipe products included in this EPD are listed below with separate tables for each production site. The tables include the conversion factors for product mass (kg) and for the mass per effective metre length (kg/eff m), and identification of the product group.

Table 3 - Humes Reinforced Concrete Pipes from Hornby - Spun

BRANCH	ITEM NUMBER	LOCATION	DESCRIPTION 1	DESCRIPTION 2	PRODUCT WEIGHT [KG]	MASS/EFF LENGTH (KG/LM)	GROUP	GROUP #
HHY	80074142	Hornby	CONCRETE TITAN PIPE	600.2440MM CLASS 2 FJ	561	230	Spun Class 2 FJ	1
HHY	80074147	Hornby	CONCRETE TITAN PIPE	900.2440MM CLASS 2 FJ	1063	436	Spun Class 2 FJ	1
HHY	80074149	Hornby	CONCRETE TITAN PIPE	1050.2440MM CLASS 2 FJ	1385	568	Spun Class 2 FJ	1
HHY	80074151	Hornby	CONCRETE TITAN PIPE	1200.2440MM CLASS 2 FJ	1730	709	Spun Class 2 FJ	1
HHY	80074154	Hornby	CONCRETE TITAN PIPE	1500.2440MM CLASS 2 FJ	2330	955	Spun Class 2 FJ	1
HHY	80074156	Hornby	CONCRETE TITAN PIPE	1650.2440MM CLASS 2 FJ	2800	1148	Spun Class 2 FJ	1
HHY	80074157	Hornby	CONCRETE TITAN PIPE	1800.2440MM CLASS 2 FJ	3275	1342	Spun Class 2 FJ	1
HHY	80074161	Hornby	CONCRETE TITAN PIPE	2300.2440MM CLASS 2 FJ	5938	2434	Spun Class 2 FJ	1
HHY	80074077	Hornby	CONCRETE TITAN PIPE J2	375.2440MM CLASS 2 RRJ	278	114	Spun Class 2 RRJ Small	2
HHY	80074079	Hornby	CONCRETE TITAN PIPE J2	450.2440MM CLASS 2 RRJ	395	162	Spun Class 2 RRJ Small	2
HHY	80074086	Hornby	CONCRETE TITAN PIPE J2	525.2440MM CLASS 2 RRJ	513	210	Spun Class 2 RRJ Small	2
HHY	80074088	Hornby	CONCRETE TITAN PIPE J2	600.2440MM CLASS 2 RRJ	625	256	Spun Class 2 RRJ Small	2
HHY	80074117	Hornby	CONCRETE TITAN PIPE	1350.2440MM CLASS 2 RRJ	2370	971	Spun Class 2 RRJ Large	3
HHY	80074121	Hornby	CONCRETE TITAN PIPE	1600.2440MM CLASS 2 RRJ	3100	1270	Spun Class 2 RRJ Large	3
HHY	80074123	Hornby	CONCRETE TITAN PIPE J2	1800.2440MM CLASS 2 RRJ	4370	1791	Spun Class 2 RRJ Large	3
HHY	80074092	Hornby	CONCRETE TITAN PIPE	675.2440MM CLASS 2 RRJ	755	309	Spun Class 2 RRJ Medium	4
HHY	80074096	Hornby	CONCRETE TITAN PIPE J2	750.2440MM CLASS 2 RRJ	900	369	Spun Class 2 RRJ Medium	4
HHY	80074099	Hornby	CONCRETE TITAN PIPE	825.2440MM CLASS 2 RRJ	1045	428	Spun Class 2 RRJ Medium	4
HHY	80074102	Hornby	CONCRETE TITAN PIPE	900.2440MM CLASS 2 RRJ	1363	559	Spun Class 2 RRJ Medium	4
HHY	80074104	Hornby	CONCRETE TITAN PIPE J2	900.2440MM CLASS 2 RRJ	1363	559	Spun Class 2 RRJ Medium	4
HHY	80074109	Hornby	CONCRETE TITAN PIPE	1050.2440MM CLASS 2 RRJ	1875	768	Spun Class 2 RRJ Medium	4
HHY	80074114	Hornby	CONCRETE TITAN PIPE J2	1200.2440MM CLASS 2 RRJ	2125	871	Spun Class 2 RRJ Medium	4
HHY	80089260	Hornby	CONCRETE 2Z PIPES	600MM RRJ	763	313	Spun Class 2 RRJ Medium	4
HHY	80074043	Hornby	CONCRETE SHORT TITAN PIPE	600.1220MM CLASS 2 RRJ	265	217	Spun Class 2 RRJ Short	5
HHY	80074045	Hornby	CONCRETE SHORT TITAN PIPE	675.1220MM CLASS 2 RRJ	320	262	Spun Class 2 RRJ Short	5
HHY	80074048	Hornby	CONCRETE SHORT TITAN PIPE	750.1220MM CLASS 2 RRJ	500	410	Spun Class 2 RRJ Short	5
HHY	80074051	Hornby	CONCRETE SHORT TITAN PIPE	825.1220MM CLASS 2 RRJ	586	480	Spun Class 2 RRJ Short	5
HHY	80074054	Hornby	CONCRETE SHORT TITAN PIPE	900.1220MM CLASS 2 RRJ	758	621	Spun Class 2 RRJ Short	5
HHY	80074056	Hornby	CONCRETE SHORT TITAN PIPE	1050.1220MM CLASS 2 RRJ	1035	848	Spun Class 2 RRJ Short	5
HHY	80074058	Hornby	CONCRETE SHORT TITAN PIPE	1200.1220MM CLASS 2 RRJ	1123	920	Spun Class 2 RRJ Short	5

Table 3 ctd - Humes Reinforced Concrete Pipes from Hornby - Spun

BRANCH	ITEM NUMBER	LOCATION	DESCRIPTION 1	DESCRIPTION 2	PRODUCT WEIGHT [KG]	MASS/EFF LENGTH (KG/LM)	GROUP	GROUP #
HHY	80074143	Hornby	CONCRETE TITAN PIPE	600.2440MM CLASS 4 FJ	690	283	Spun Class 4 FJ	6
HHY	80074146	Hornby	CONCRETE TITAN PIPE	750.2440MM CLASS 4 FJ	1023	419	Spun Class 4 FJ	6
HHY	80074148	Hornby	CONCRETE TITAN PIPE	900.2440MM CLASS 4 FJ	1338	548	Spun Class 4 FJ	6
HHY	80074150	Hornby	CONCRETE TITAN PIPE	1050.2440MM CLASS 4 FJ	1788	733	Spun Class 4 FJ	6
HHY	80074152	Hornby	CONCRETE TITAN PIPE	1200.2440MM CLASS 4 FJ	2188	897	Spun Class 4 FJ	6
HHY	80074153	Hornby	CONCRETE TITAN PIPE	1350.2440MM CLASS 4 FJ	2625	1076	Spun Class 4 FJ	6
HHY	80074155	Hornby	CONCRETE PIPE	1500.2440MM CLASS 4 FJ	3138	1286	Spun Class 4 FJ	6
HHY	80074158	Hornby	CONCRETE TITAN PIPE	1800.2440MM CLASS 4 FJ	4238	1737	Spun Class 4 FJ	6
HHY	80074160	Hornby	CONCRETE PIPE	2050.2440MM CLASS 4 FJ	5625	2305	Spun Class 4 FJ	6
HHY	80074162	Hornby	CONCRETE TITAN PIPE	2300.2440MM CLASS 4 FJ	6513	2669	Spun Class 4 FJ	6
HHY	80074078	Hornby	CONCRETE TITAN PIPE J2	375.2440MM CLASS 4 RRJ	300	123	Spun Class 4 RRJ	7
HHY	80074080	Hornby	CONCRETE TITAN PIPE J2	450.2440MM CLASS 4 RRJ	420	172	Spun Class 4 RRJ	7
HHY	80074087	Hornby	CONCRETE TITAN PIPE J2	525.2440MM CLASS 4 RRJ	583	239	Spun Class 4 RRJ	7
HHY	80074089	Hornby	CONCRETE TITAN PIPE J2	600.2440MM CLASS 4 RRJ	763	313	Spun Class 4 RRJ	7
HHY	80074094	Hornby	CONCRETE TITAN PIPE	675.2440MM CLASS 4 RRJ	910	373	Spun Class 4 RRJ	7
HHY	80074098	Hornby	CONCRETE TITAN PIPE J2	750.2440MM CLASS 4 RRJ	1125	461	Spun Class 4 RRJ	7
HHY	80074101	Hornby	CONCRETE TITAN PIPE	825.2440MM CLASS 4 RRJ	1298	532	Spun Class 4 RRJ	7
HHY	80074103	Hornby	CONCRETE PIPE	900.2440MM CLASS 4 RJ	1520	623	Spun Class 4 RRJ	7
HHY	80074106	Hornby	CONCRETE TITAN PIPE J2	900.2440MM CLASS 4 RRJ	1520	623	Spun Class 4 RRJ	7
HHY	80074110	Hornby	CONCRETE TITAN PIPE	1050.2440MM CLASS 4 RRJ	2078	852	Spun Class 4 RRJ	7
HHY	80074112	Hornby	CONCRETE TITAN PIPE	1200.2440MM CLASS 4 RRJ	2125	871	Spun Class 4 RRJ	7
HHY	80074115	Hornby	CONCRETE TITAN PIPE J2	1200.2440MM CLASS 4 RRJ	2495	1023	Spun Class 4 RRJ	7
HHY	80074119	Hornby	CONCRETE TITAN PIPE	1350.2440MM CLASS 4 RRJ	2900	1189	Spun Class 4 RRJ	7
HHY	80074122	Hornby	CONCRETE TITAN PIPE	1600.2440MM CLASS 4 RRJ	3875	1588	Spun Class 4 RRJ	7
HHY	80074124	Hornby	CONCRETE TITAN PIPE J2	1800.2440MM CLASS 4 RRJ	5025	2059	Spun Class 4 RRJ	7
HHY	80074040	Hornby	CONCRETE TITAN PIPE SHORT	375.1220MM CLASS 4 RRJ	128	105	Spun Class 4 RRJ Short 375	8
HHY	80074041	Hornby	CONCRETE SHORT TITAN PIPE	450.1220MM CLASS 4 RRJ	225	184	Spun Class 4 RRJ Short 450	9
HHY	80074042	Hornby	CONCRETE SHORT TITAN PIPE	525.1220MM CLASS 4 RRJ	260	213	Spun Class 4 RRJ Short 525	10
HHY	80074044	Hornby	CONCRETE SHORT TITAN PIPE	600.1220MM CLASS 4 RRJ	310	254	Spun Class 4 RRJ Short Medium	11
HHY	80074047	Hornby	CONCRETE SHORT TITAN PIPE	675.1220MM CLASS 4 RRJ	495	406	Spun Class 4 RRJ Short Medium	11
HHY	80074050	Hornby	CONCRETE SHORT TITAN PIPE	750.1220MM CLASS 4 RRJ	618	507	Spun Class 4 RRJ Short Medium	11
HHY	80074053	Hornby	CONCRETE SHORT TITAN PIPE	825.1220MM CLASS 4 RRJ	705	578	Spun Class 4 RRJ Short Medium	11
HHY	80074055	Hornby	CONCRETE SHORT TITAN PIPE	900.1220MM CLASS 4 RRJ	855	701	Spun Class 4 RRJ Short Medium	11
HHY	80074057	Hornby	CONCRETE SHORT TITAN PIPE	1050.1220MM CLASS 4 RRJ	1125	922	Spun Class 4 RRJ Short Medium	11
HHY	80074059	Hornby	CONCRETE SHORT TITAN PIPE	1200.1220MM CLASS 4 RRJ	1368	1121	Spun Class 4 RRJ Short Medium	11
HHY	80074125	Hornby	CONCRETE TITAN PIPE	2100.2440MM CLASS 2 SJ	5900	2418	Spun Skid Joint	12

Table 4 - Humes Reinforced Concrete Pipes from Papakura - VT

BRANCH	ITEM NUMBER	LOCATION	DESCRIPTION 1	DESCRIPTION 2	PRODUCT WEIGHT [KG]	MASS/EFF LENGTH (KG/LM)	GROUP	GROUP #
HPA	80074191	Papakura	CONCRETE TITAN PIPE VT	675.2500MM CLASS 2 RRJ	1400	560	VT Class 2	13
HPA	80074194	Papakura	CONCRETE TITAN PIPE VT	750.2500MM CLASS 2 RRJ	1572	629	VT Class 2	13
HPA	80074197	Papakura	CONCRETE TITAN PIPE VT	825.2500MM CLASS 2 RRJ	1735	694	VT Class 2	13
HPA	80074200	Papakura	CONCRETE TITAN PIPE VT	900.2500MM CLASS 2 RRJ	1910	764	VT Class 2	13
HPA	80074203	Papakura	CONCRETE TITAN PIPE VT	1050.2500MM CLASS 2 RRJ	2480	992	VT Class 2	13
HPA	80074206	Papakura	CONCRETE TITAN PIPE VT	1200.2500MM CLASS 2 RRJ	3130	1252	VT Class 2	13
HPA	80074209	Papakura	CONCRETE TITAN PIPE VT	1350.2500MM CLASS 2 RRJ	3560	1424	VT Class 2	13
HPA	80074212	Papakura	CONCRETE TITAN PIPE VT	1500.2500MM CLASS 2 RRJ	4030	1612	VT Class 2	13
HPA	80074215	Papakura	CONCRETE TITAN PIPE VT	1800.2500MM CLASS 2 RRJ	5540	2216	VT Class 2	13
HPA	80074220	Papakura	CONCRETE TITAN PIPE VT	2100.2500MM CLASS 2 RRJ	7080	2832	VT Class 2	13
HPA	80074222	Papakura	CONCRETE TITAN PIPE VT	2400.2500MM CLASS 2 RRJ	9400	3760	VT Class 2	13
HPA	80074231	Papakura	CONCRETE TITAN PIPE VT	1800.2500MM CLASS 4 IWJ	8480	3392	VT Class 4 IWJ	14
HPA	80074237	Papakura	CONCRETE TITAN PIPE VT	2400.2500MM CLASS 4 IWJ	13000	5200	VT Class 4 IWJ	14
HPA	80074192	Papakura	CONCRETE TITAN PIPE VT	675.2500MM CLASS 4 RRJ	1400	560	VT Class 4 RRJ Medium	15
HPA	80074195	Papakura	CONCRETE TITAN PIPE VT	750.2500MM CLASS 4 RRJ	1572	629	VT Class 4 RRJ Medium	15
HPA	80074198	Papakura	CONCRETE TITAN PIPE VT	825.2500MM CLASS 4 RRJ	1735	694	VT Class 4 RRJ Medium	15
HPA	80074201	Papakura	CONCRETE TITAN PIPE VT	900.2500MM CLASS 4 RRJ	1910	764	VT Class 4 RRJ Medium	15
HPA	80074204	Papakura	CONCRETE TITAN PIPE VT	1050.2500MM CLASS 4 RRJ	2480	992	VT Class 4 RRJ Medium	15
HPA	80074207	Papakura	CONCRETE TITAN PIPE VT	1200.2500MM CLASS 4 RRJ	3130	1252	VT Class 4 RRJ Medium	15
HPA	80089316	Papakura	CONCRETE TITAN PIPE VT	900.2500MM CLASS4 MICROSILICA	1922.5	769	VT Class 4 RRJ Medium	15
HPA	80089317	Papakura	CONCRETE TITAN PIPE VT	750.2500MM CLASS4 MICROSILICA	1625	650	VT Class 4 RRJ Medium	15
HPA	80089318	Papakura	CONCRETE TITAN PIPE VT	675.2500MM CLASS4 MICROSILICA	1400	560	VT Class 4 RRJ Medium	15
HPA	80074210	Papakura	CONCRETE TITAN PIPE VT	1350.2500MM CLASS 4 RRJ	3560	1424	VT Class 4 RRJ Large	16
HPA	80074213	Papakura	CONCRETE TITAN PIPE VT	1500.2500MM CLASS 4 RRJ	4175	1670	VT Class 4 RRJ Large	16
HPA	80074216	Papakura	CONCRETE TITAN PIPE VT	1800.2500MM CLASS 4 RRJ	5540	2216	VT Class 4 RRJ Large	16
HPA	80074218	Papakura	CONCRETE TITAN PIPE VT	1950.2500MM CLASS 4 RRJ	6190	2476	VT Class 4 RRJ Large	16
HPA	80074221	Papakura	CONCRETE TITAN PIPE VT	2100.2500MM CLASS 4 RRJ	7080	2832	VT Class 4 RRJ Large	16
HPA	80074223	Papakura	CONCRETE TITAN PIPE VT	2400.2500MM CLASS 4 RRJ	9400	3760	VT Class 4 RRJ Large	16
HPA	80089314	Papakura	CONCRETE TITAN PIPE VT	2100.2500MM CLASS4 MICROSILICA	7125	2850	VT Class 4 RRJ Large	16
HPA	80089315	Papakura	CONCRETE TITAN PIPE VT	1500.2500MM CLASS4 MICROSILICA	4050	1620	VT Class 4 RRJ Large	16
HPA	80089332	Papakura	CONCRETE TITAN PIPE VT	1200.2500MM CLASS4 MICROSILICA	3125	1250	VT Class 4 RRJ Large	16

Table 5 - Humes Reinforced Concrete Pipes from Te Rapa Park (Interpipe) - HHM

ITEM NUMBER	DESCRIPTION 1	DESCRIPTION 2	PRODUCT WEIGHT [T]	MASS/EFF LENGTH (T/LM)	GROUP	GROUP #
80074062	Concrete Titan Pipe RCP	225.2000MM CLASS 2 RRJ	0.161	0.0805	RCP 225	17
80074063	Concrete Titan Pipe RCP	225.2000MM CLASS 4 RRJ	0.161	0.0805	RCP 225	17
80074066	Concrete Titan Pipe RCP	300.2500MM CLASS 2 RRJ	0.254	0.1016	RCP 300-600 Class 2	18
80074067	Concrete Titan Pipe RCP	300.2500MM CLASS 4 RRJ	0.254	0.1016	RCP 300-600 Class 4	19
80074068	Concrete Titan Pipe RCP	375.2500MM CLASS 2 RRJ	0.313	0.1252	RCP 300-600 Class 2	18
80074070	Concrete Titan Pipe RCP	375.2500MM CLASS 4 RRJ	0.313	0.1252	RCP 300-600 Class 4	19
80074071	Concrete Titan Pipe RCP	450.2500MM CLASS 2 RRJ	0.433	0.1732	RCP 300-600 Class 2	18
80074073	Concrete Titan Pipe RCP	450.2500MM CLASS 4 RRJ	0.433	0.1732	RCP 300-600 Class 4	19
80074084	Concrete Titan Pipe RCP	525.2500MM CLASS 2 RRJ	0.568	0.2272	RCP 300-600 Class 2	18
80074085	Concrete Titan Pipe RCP	525.2500MM CLASS 4 RRJ	0.569	0.2276	RCP 300-600 Class 4	19
80074090	Concrete Titan Pipe RCP	600.2500MM CLASS 2 RRJ	0.726	0.2904	RCP 300-600 Class 2	18
80074091	Concrete Titan Pipe RCP	600.2500MM CLASS 4 RRJ	0.727	0.2908	RCP 300-600 Class 4	19
80074064	Concrete Titan Pipe RCP	225.600MM CLASS 4 RRJ	0.068	0.1133	RCP 225	17
80074065	Concrete Titan Pipe RCP	225.1800MM CLASS 4 RRJ	0.148	0.0822	RCP 225	17

Content Declaration

Table 6 – Content Declaration (per 1 tonne product)

PRODUCT COMPONENTS	WEIGHT, KG	POST-CONSUMER RECYCLED MATERIAL, WEIGHT-%	RENEWABLE MATERIAL, WEIGHT-%
Steel (reinforcement)	14.2-78.6	0*	0
Cement	130-150	0	0
Aggregate	735-790	0	0
Admixtures	<0.734	0	0
Fly ash	<15.4	0	0
Silica fume	<11.8	0	0
Plastic sundries	0.0162-6.67	0	0
Galvanised steel	<2.10	0	0
Added Water	45.5-56.6	0	0
Total	1000		

Humes' reinforced concrete pipe products included in this EPD are listed below with separate tables for each production site. The tables include the conversion factors for product mass (kg) and for the mass per effective metre length (kg/eff m), and identification of the product group.

* The composition of the scrap input to the steel reinforcement is not known, so no post-consumer recycled material has been declared. The scrap input is 23.1% for rebar and 6.7% for steel wire, made up of a mix of pre-consumer and post-consumer scrap.

Table 7 – Packaging (per 1 tonne product)

PACKAGING MATERIALS	WEIGHT, KG	WEIGHT-% (VERSUS THE PRODUCT)	WEIGHT BIOGENIC CARBON, KG C/KG
Timber dunnage	2.96	0.3%	0.5
Total	2.96	0.3%	

Table 8 – Composition of Humes' synthetic rubber rings (per 1 tonne product)

PRODUCT COMPONENTS	WEIGHT, KG	POST-CONSUMER RECYCLED MATERIAL, WEIGHT-%	RENEWABLE MATERIAL, WEIGHT-%
Synthetic rubber ring	<1.92	0	0
Total	<1.92	0	

The product as supplied is non-hazardous. The products included in this EPD do not contain any substances of very high concern as defined by European REACH regulation in concentrations >0.1% (m/m). Precast concrete products and pipes are classified as non-dangerous goods according to the Land Transport Rule: Dangerous Goods 2005. When concrete products are cut, sawn, abraded or crushed, dust is created which contains crystalline silica, some of which may be respirable (particles small enough to go into the deep parts of the lung when breathed in), and which is hazardous. Exposure through inhalation should be avoided. Dust from this product is classified as Hazardous under the Hazardous Substances and New Organisms Act 1996 (HSNO Act) and is subject to Workplace Exposure Standards (WorkSafe NZ WES-BEI indices Edition 13, April 2022).

Manufacturing Process

Humes Spun Titan® Pipe has been manufactured in New Zealand for over 100 years. Spun pipes are manufactured to the AS/NZS4058:2007 standard.

Spun pipes are cast horizontally and normally stay in their moulds for up to 24 hours for the initial curing, which includes steaming. The spun process enables manufacturing of thin wall pipe with a smooth finish and achieves excellent crushing strength and durability characteristics. The spun pipe making process provides the highest degree of flexibility in the pipe making process. It is economical to make small quantities of pipe or specials where pipes require increased cover specifications or strength.

Humes VT Titan® Pipe is manufactured to the AS/NZS 4058:2007 standard but also complies with many recognised international standards. Most parts of the British and European standards BSEN 1916:2002 and BS 5911-1:2002 were developed around VT technology. VT pipes are made through a vertical casting process. Each pipe is produced from a dry mix concrete which is placed in the mould and the inner core is vibrated to ensure solid compaction of the concrete. The pipe is removed from the core and taken directly to the curing area by crane, where the outer mould is stripped from the pipe. This means there is minimum movement of the pipe in the initial curing phase of the casting process. As a result of the manufacturing process VT Pipes have a thicker wall providing increased cover to steel.

Humes Titan® Roller Compacted Pipe (RCP) is manufactured to the AS/NZS 4058:2007 standard. RCP is cast vertically using low water/cement ratio concrete and effective compaction methods. Compaction is achieved using a well proven computer controlled, counter rotating roller head and trowel (the Bi Directional process or BiDi). The BiDi process ensures consistent and accurate formation of collars and spigots which assures water tightness. The RCP pipe uses a “D” ring jointing system developed by Humes that provides secure and positive jointing. To ensure this is the case, a portion of every batch of the RCP pipe barrels are hydrostatically checked as part of the stringent quality assurance system. Like the VT production process the RCP manufacturing methodology means that substantial pipe numbers of the same diameter can be made each day. Humes has been supplying RCP pipe for over 25 years and RCP pipes are now the most commonly used pipes from DN 225 to DN 600 and are available in Load Class 2 and 4.

Figure 1 – Product lifecycle of steel reinforced pipes

System Boundaries

This EPD is of the type 'cradle-to-gate with options, modules C1-C4, module D, and with additional modules (A1-A3 + C + D and A4 + A5). Distribution (A4) and installation (A5) optional modules are also declared. Use phase (B1-B7) modules are dependent on particular scenarios and best considered at the project level.

The modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation are shown in Table 9.

Table 9 – Modules included in the scope of the EPD

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				RESOURCE RECOVERY
	Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to waste processing	Waste processing	Disposal	Reuse - Recovery- Recycling- potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	GLO	GLO	NZ	NZ	NZ								NZ	NZ	NZ	NZ	GLO
Specific data	>90%																
Variation - products	-14%/+10%*																
Variation - sites	N/A**																

X = included in the EPD; ND = Module not declared (such a declaration shall not be regarded as an indicator result of zero).

* Most product groups have a variation of less than 10%. This is the maximum variation across the declared product groups. The variation for each product group is provided in the Environmental Performance section.

** The pipe products are unique to each manufacturing site.

Production (Module A1-A3)

The production stage includes the environmental impacts associated with raw materials extraction and processing of inputs, transport to, between and within the manufacturing site, manufacturing of average product at the exit gate of the manufacturing site and transport of product to customer.

The raw materials are supplied by third parties and typically transported to site by truck. Concrete is batched onsite, and steel wire is shaped into cages onsite.

Distribution (Module A4)

Distribution distances vary from site to site and depend on construction site delivery locations. Transportation to the construction site is based on a scenario that provides the weighted average delivery scenario for each group of Concrete Pipe products. Impacts are inclusive of an empty return transport component. Transport to and from site occurs by articulated truck over a distance of 100 km.

Installation (Module A5)

The installation stage includes environmental impacts associated with a typical trench type installation scenario with an H1 support. The installation scenario is one of several currently in use in New Zealand. Other installation scenarios could lead to significantly different results.

Trench type installation uses imported aggregate for bedding and support (haunch), and with a rubber ring seal between each pipe. The excavated material is typically refilled around the pipe up to a minimum of 150mm above the pipe. Backfill may be placed above the overlay, which will vary depending on the final top surface for the project. This has been assumed as 0 backfill for this EPD.

Figure 2 shows typical pipe installation, where the trench size, excavation volume and aggregate quantity, scale with the outer diameter of the pipe (OD). The key parameters for pipe installation are shown in Table 10.

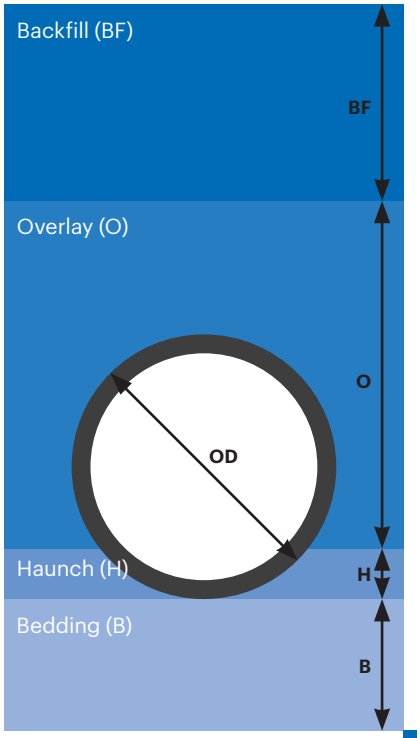
Installation processes include excavation of the trench, transport and placement of bedding materials, with diesel use of 0.309kg per m^3 of material production of rubber ring, placement of pipe, filling of the trench, transport of excess spoil for recycling or reuse.

The environmental impact values are expressed per metre of pipe of a particular diameter, regardless of the pipe production method and class.

Table 10 – Pipe Installation parameters, per effective metre

PARAMETER (ABB.)	DESCRIPTION	VALUE	UNITS
Outer Diameter (OD)	Outer diameter of pipe	Varies	mm
Bedding (B)	Underlay, composed of imported aggregate	100 150	mm (min) mm (max)
Haunch (H)	Support, composed of imported aggregate	10	% of OD
Overlay (O)	Excavated material replaced and compacted	90 + 150	% of OD + mm (min)
Backfill (BF)	Related to final surface preparation requirements and will vary by project.	0	Assumed 0 for EPD
Trench Depth	B + H + O + BF		
Trench Width	0.0013 x OD + 0.171		

Figure 2 – Trench Type Pipe Installation



End of Life (Module C)

At the end of their functional life, concrete pipes may be:

- Abandoned in their original installation site,
- Re-lined in-situ, entering a second life,
- Filled with grout to avoid collapse, or
- Exhumed and sent for recycling.

As all options are possible, they are presented as individual scenarios, allowing the EPD user to consider the impact of each option. All scenarios are currently in use in New Zealand and are representative for one of the most likely scenario alternatives. Actual scenarios will vary from project to project, and the reader should not rely on the listed values without asserting that they are valid for their situation.

The scenarios are summarised in Table 11, per tonne of pipe, including the process considered for each end-of-life module.

Table 11 – End of life scenarios, processes and parameters, per declared unit (1 tonne)

SCENARIO / MODULE	PARAMETER	LEFT IN GROUND	RE-LINED	FILLED WITH GROUT*	EXHUMED AND RECYCLED
DECONSTRUCTION (C1)	Process and assumptions	n/a	n/a	n/a	Lifting of pipe (assumed equivalent to 1m^3 using 0.309 kg diesel per m^3)
	kg collected separately	0	0	0	1000
TRANSPORT (C2)	Process and assumptions	n/a	n/a	n/a	Transport of pipe, 100km by truck
	kg transported	0	0	0	1000
WASTE PROCESSING (C3)	Process and assumptions	n/a	n/a (re-lining is part of next life cycle)	n/a	Crushing of concrete pipes, separation of reinforcing steel and crushed concrete aggregate using 0.811kg diesel per tonne
	kg for re-use	0	1000	0	0
	kg for recycling	0	0	0	1000
DISPOSAL (C4)	Process and assumptions	Pipe and rubber ring considered to be 'disposed' as inert material	n/a	Pipe is filled with conservative average 1.90m^3 Firth Flowable Fill. Pipe and rubber ring considered to be 'disposed' as inert material	Disposal of rubber rings in landfill; the greatest mass of ring per 1 tonne of pipe is used as a conservative assumption
	kg disposed	1002	0	1002	2

*Firth Flowable Fill is a low-strength mix of sand, cement, fly ash, admixtures and water. The highest volume of fill per tonne of pipe is used as a conservative measure. The type of fill chosen will have significant effect on the environmental impact. When the combined variation of grout volume per tonne of pipe and cement content of the grout are taken into account, it is clear that users of this LCA should look at their specific situation rather than rely on the generic values provided in this LCA.

Recovery and Recycling potential (Module D)

Module D declares a potential credit or burden for the net scrap associated with recyclable materials leaving a product system. The concrete rubble and steel scrap produced in module C3 can replace natural coarse aggregates (crushed rock) and virgin steel (after further processing). The steel credit considers net scrap after subtracting the amount of steel scrap used in production of the reinforcing steel in the first product life cycle. Concrete contains no recycled materials, and thus 100% of the concrete volume has been assumed to replace virgin crushed aggregates in module D. Reinforcing steel contains up to 23.1% recycled content, which means 76.9% of steel is credited in module D.

Module D is only relevant when pipes are exhumed and recycled.

Life cycle assessment methodology

Primary data were used for all manufacturing operations up to the factory gate. Primary data for Humes' operations was sourced from the period 01 July 2018 to 30 June 2019. Background data was used for input materials sourced from other suppliers.

All data in the background system were from the GaBi Life Cycle Inventory Database 2021.2 (Sphera, 2021) . Most datasets have a reference year between 2017 and 2020 and all fall within the 10 year limit allowable for generic data under EN 15804.

Upstream data

Data for steel input is taken from worldsteel LCI data. Data for cement input is taken from the Golden Bay cement EPD. Electricity and water were modelled to reflect New Zealand conditions.

Other upstream (supply chain) data used were Australian, or European due to a lack of consistent LCI data for New Zealand at the time this study was conducted.

Electricity

The composition of the electricity grid mix is modelled in GaBi and updated annually. The New Zealand electricity grid consumption mix (2017) is made up of hydro (59.30%), geothermal (17.96%) natural gas (12.93%), wind (4.66%), coal gases (2.15%) hard coal (1.36%), biomass (0.70%), biogas (0.69%), and photovoltaics (0.27%), lignite (0.05%) and fuel oil (0.03%). The emission factor for the New Zealand national grid mix 1kV-60kV for the GWP-GHG indicator is 0.145 kg CO2e/kWh.

Transport

Where transport data was not available for any material, a standard value of 100 km was used.

Explanation of Representative Products & Variation

This EPD covers 111 pipe products. Grouping is based on the type of production process and class strength, with further grouping as needed using joint type, pipe diameter and/or length. The impacts are declared for a representative product for each group.

For many groups, the GWP-GHG impacts for all products in the group fall within ±10% of the average impact. Some groups have products that sit outside this range. The range of GWP-GHG impacts for each group is detailed in the environmental performance section.

Cut off criteria

The cut-off criteria applied are 1% of cumulative mass input and 1% of cumulative energy usage, providing the minor flows do not have significant environmental relevance.

Inputs knowingly excluded from the inventory are packaging materials for minor inputs such as mould oil, which is used in small quantities. These materials are well below the materiality cut-off and have been excluded.

Personnel is excluded as per section 4.3.1 in the PCR (EPD International, 2021). thinkstep-anz consistently excludes environmental impacts from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process, ('capital goods') regardless of potential significance. High-quality infrastructure-related data isn't always available and there is no clear cut-off for what to include. For this reason, capital goods data are applied to LCA studies inconsistently. This is expected to lead to reduced consistency and comparability of EPDs. Capital goods were previously excluded from EPDs, thus including capital goods in current EPDs would further reduce their comparability.

Allocation

Humes' Papakura and Hornby production sites produce both pipes and other precast products. Where possible, data was collected to cover only a single production type, such as for Papakura pipe production. Where data was only available on a site-wide basis (e.g. waste), this was allocated by mass across all production from the site.

Hornby site data covered both the open air cured precast products and the diesel cured pipes. Diesel is used for other processes as well as pipe curing, and the diesel used for curing was not specifically measured. Papakura precast's diesel consumption per tonne was used to estimate the usage for Hornby precast, with the remainder allocated to Hornby pipes for curing.

The inputs and outputs for Te Rapa Park cover the total production for Humes and other resellers. All products use the same production line and there is no difference between the processes. No valuable by-products are produced and there is no meaningful difference in the value of the products between the various brands. All inputs and outputs were allocated by mass.

Allocation for input materials that contain secondary material occurs in the upstream datasets. Fly ash and silica fume used in the concrete mixes have environmental impacts allocated based on economic value in the background data.

Assumptions

The concrete composition for each product is taken from Humes' BOMs and is specific to each product and site.

All sites run on mains water, but not all sites have water meters, as water is often not charged on a usage basis in New Zealand. The measured water input for Papakura has been used as a proxy for water usage per tonne for Hornby and Te Rapa Park. Wastewater outputs are assumed to the be same as water inputs as a conservative assumption. No data was available for the quantity or waste treatment of excess reinforcing steel or concrete, and these have not been modelled.

The installation scenario for module A5 is based on a set of assumptions that may influence the outcome of the assessment. The end-of-life assumptions for the grout scenario consider an average volume of flowable fill, with a specific mix design, which will influence the results.

It is important to understand the scenarios before drawing conclusions based on this EPD.

Assessment Indicators

The results tables describe the different environmental indicators for each product per declared unit, for each declared module.

Tables 6 to 11 present the covered indicators, including the core and additional environmental impact indicators, life cycle inventory indicators, describing resource use and waste and other outputs, indicators used in the previous standard (EN15804+A1), and the biogenic carbon content of the product and its packaging.

For concrete pipes, the following indicators are not relevant, hence result in zero values:

- Components for re-use (CRU) is zero since there are none produced.
- Materials for recycling (MFR) is zero since no waste is available for recycling.
- Materials for energy recovery (MER) is zero since no waste is available for energy recovery.
- Exported electrical energy (EEE) is zero since there is none produced.
- Exported thermal energy (EET) is zero since there is none produced.

Table 12 - Assessment indicators

INDICATOR	INDICATORS, ABBR.	UNITS
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS		
Climate change – total	GWP-total	kg CO_2-eq.
Climate change – fossil	GWP-fossil	kg CO_2-eq.
Climate change – biogenic	GWP-biogenic	kg CO_2-eq.
Climate change – land use and land use change	GWP-luluc	kg CO_2-eq.
Ozone depletion	ODP	kg CFC11-eq.
Acidification	AP	Mole of H^+ eq.
Eutrophication aquatic freshwater	EP-freshwater	kg P eq.
Eutrophication aquatic marine	EP-marine	kg N eq.
Eutrophication terrestrial	EP-terrestrial	Mole of N eq.
Photochemical ozone formation	POCP	kg NMVOC eq.
Depletion of abiotic resources – minerals and metals*	ADP-m&m	kg Sb-eq.
Depletion of abiotic resources – fossil fuels*	ADP-fossil	MJ
Water Depletion Potential*	WDP	m^3 world equiv.
EN15804+A2 RESOURCE USE INDICATORS		
Renewable primary energy as energy carrier	PERE	MJ
Renewable primary energy resources as material utilization	PERM	MJ
Total use of renewable primary energy resources	PERT	MJ
Non-renewable primary energy as energy carrier	PENRE	MJ
Non-renewable primary energy as material utilization	PENRM	MJ
Total use of non-renewable primary energy resources	PENRT	MJ
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ
Use of non-renewable secondary fuels	NRSF	MJ
Use of net fresh water	FW	m^3
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW INDICATORS		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Components for reuse	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported electrical energy	EEE	MJ
Exported thermal energy	EET	MJ
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS		
IPCC AR5 Global Warming Potential **	GWP-GHG	kg CO_2-eq.
Particulate Matter emissions	PM	Disease incidences
Ionising Radiation – human health ***	IRP	kBq U235 eq.
Eco-toxicity (freshwater)	ETP-fw	CTUe
Human Toxicity, cancer *	HTPc	CTUh
Human Toxicity, non-cancer *	HTPnc	CTUh
Lan use related impacts / soil quality *	SQP	Pt
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS		
Biogenic carbon content - product	BCC-prod	kg C
Biogenic carbon content - packaging	BCC-pack	kg C
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS		
Global warming potential	GWP	kg CO_2 eq.
Ozone depletion potential	ODP	kg CFC 11 eq.
Acidification potential	AP	kg SO_2 eq.
Eutrophication potential	EP	kg $(PO_4)^{3-}$ eq.
Photochemical ozone creation potential	POCP	kg C_2H_4 eq.
Abiotic depletion potential for non-fossil resources	ADPe	kg Sb eq.
Abiotic depletion potential for fossil resources	ADPf	MJ

* The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.
** This indicator is calculated using the characterisation factors from the IPCC AR5 report (IPCC 2013) and has been included in the EPD following the PCR. The indicator is more likely to be in line with other GHG reporting in Australia and New Zealand.

*** This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and some construction materials, is also not measured by this indicator.

Environmental Performance

Table 13 - Cradle-to-gate (A1-A3) per tonne

REP PRODUCT		HHY-80074151	HHY-80074077	HHY-80074096	HHY-80074121	HHY-80074048
GROUP DESCRIPTION		SPUN CLASS 2 FJ	SPUN CLASS 2 RRJ SMALL	SPUN CLASS 2 RRJ MEDIUM	SPUN CLASS 2 RRJ LARGE	SPUN CLASS 2 RRJ SHORT
GROUP		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
INDICATORS, ABBR.	UNITS					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	271	242	266	287	274
GWP-FOSSIL	kg CO_2-eq.	270	240	264	286	273
GWP-BIOGENIC	kg CO_2-eq.	1.30	1.53	1.46	1.31	1.48
GWP-LULUC	kg CO_2-eq.	0.0522	0.0481	0.0525	0.0551	0.0541
ODP	kg CFC11-eq.	1.39E-13	1.23E-13	1.38E-13	1.42E-13	1.37E-13
AP	Mole of H^+ eq.	0.837	0.807	0.860	0.887	0.892
EP-FRESHWATER	kg P eq.	2.34E-04	2.29E-04	2.37E-04	2.39E-04	2.39E-04
EP-MARINE	kg N eq.	0.329	0.310	0.325	0.338	0.329
EP-TERRESTRIAL	Mole of N eq.	3.58	3.38	3.54	3.68	3.58
POCP	kg NMVOC eq.	0.941	0.892	0.939	0.975	0.955
ADP-M&M	kg Sb-eq.	9.85E-05	6.30E-05	1.94E-04	1.22E-04	1.89E-04
ADP-FOSSIL	MJ	2,200	2,040	2,260	2,390	2,370
WDP	m^3 world equiv.	44.3	47.2	49.2	50.9	56.8
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE						
PERE	MJ	490	461	476	492	476
PERM	MJ	0	0	0	0	0
PERT	MJ	490	461	476	492	476
PENRE	MJ	2,190	2,010	2,230	2,380	2,350
PENRM	MJ	10.6	27.7	26.2	7.58	22.9
PENRT	MJ	2,200	2,040	2,260	2,390	2,370
SM	kg	2.15	3.46	2.92	2.39	3.98
RSF	MJ	326	270	291	325	285
NRSF	MJ	0	0	0	0	0
FW	m^3	1.74	1.76	1.83	1.89	2.01
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE						
HWD	kg	3.18E-07	3.13E-07	3.60E-07	3.92E-07	4.12E-07
NHWD	kg	18.1	18.7	17.1	18.3	17.8
RWD	kg	0.00777	0.00671	0.00746	0.00772	0.00733
CRU	kg	0	0	0	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	269	239	263	285	272
PM	Disease incidences	1.49E-05	1.46E-05	1.52E-05	1.54E-05	1.55E-05
IRP	kBq U235 eq.	1.18	1.03	1.11	1.16	1.09
ETP-FW	CTUe	1,130	1,060	1,120	1,150	1,120
HTPC	CTUh	5.09E-08	3.86E-08	5.70E-08	6.46E-08	5.87E-08
HTPNC	CTUh	1.17E-06	1.09E-06	1.30E-06	1.38E-06	1.40E-06
SQP	Pt	2,680	2,670	2,680	2,690	2,690
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS						
BCC-prod	kg C	0	0	0	0	0
BCC-pack	kg C	3.75	3.75	3.75	3.75	3.75
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	266	237	261	282	269
ODP	kg CFC 11 eq.	1.86E-13	1.64E-13	1.84E-13	1.90E-13	1.82E-13
AP	kg SO_2 eq.	0.617	0.597	0.639	0.658	0.667
EP	kg $(PO_4)^{3-}$ eq.	0.119	0.112	0.117	0.122	0.118
POCP	kg C_2H_4 eq.	0.0566	0.0549	0.0610	0.0637	0.0649
ADPE	kg Sb eq.	9.85E-05	6.30E-05	1.94E-04	1.22E-04	1.89E-04
ADPF	MJ	2,160	2,000	2,210	2,350	2,320

Table 13 ctd - Cradle-to-gate (A1-A3) per tonne

REP PRODUCT		HHY-80074153	HHY-80074106	HHY-80074040	HHY-80074041	HHY-80074042
GROUP DESCRIPTION		SPUN CLASS 4 FJ	SPUN CLASS 4 RRJ	SPUN CLASS 4 RRJ SHORT 375	SPUN CLASS 4 RRJ SHORT 450	SPUN CLASS 4 RRJ SHORT 525
GROUP		GROUP 6	GROUP 7	GROUP 8	GROUP 9	GROUP 10
INDICATORS, ABBR.	UNITS					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	272	295	430	278	347
GWP-FOSSIL	kg CO_2-eq.	271	294	429	277	345
GWP-BIOGENIC	kg CO_2-eq.	1.31	1.34	0.764	1.63	1.66
GWP-LULUC	kg CO_2-eq.	0.0524	0.0570	0.0802	0.0553	0.0678
ODP	kg CFC11-eq.	1.39E-13	1.58E-13	1.81E-13	1.28E-13	1.35E-13
AP	Mole of H^+ eq.	0.838	1.12	1.26	0.938	1.17
EP-FRESHWATER	kg P eq.	2.35E-04	2.44E-04	2.72E-04	2.41E-04	2.61E-04
EP-MARINE	kg N eq.	0.329	0.354	0.422	0.331	0.370
EP-TERRESTRIAL	Mole of N eq.	3.58	3.86	4.58	3.60	4.01
POCP	kg NMVOC eq.	0.943	1.04	1.23	0.975	1.11
ADP-M&M	kg Sb-eq.	9.98E-05	1.16E-04	1.87E-04	1.40E-04	2.13E-04
ADP-FOSSIL	MJ	2,210	2,820	3,660	2,540	3,360
WDP	m^3 world equiv.	44.5	51.5	95.6	66.6	103
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE						
PERE	MJ	489	498	578	460	473
PERM	MJ	0	0	0	0	0
PERT	MJ	489	498	578	460	473
PENRE	MJ	2,200	2,500	3,620	2,510	3,330
PENRM	MJ	6.98	325	39.8	24.6	26.9
PENRT	MJ	2,210	2,820	3,660	2,540	3,360
SM	kg	2.03	2.49	6.76	4.44	8.06
RSF	MJ	325	325	458	250	246
NRSF	MJ	0	0	0	0	0
FW	m^3	1.74	1.91	3.09	2.21	3.07
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE						
HWD	kg	3.25E-07	3.75E-07	7.31E-07	5.22E-07	8.27E-07
NHWD	kg	18.0	18.5	32.1	18.7	21.8
RWD	kg	0.00772	0.00835	0.0102	0.00634	0.00629
CRU	kg	0	0	0	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	270	293	427	275	342
PM	Disease incidences	1.49E-05	1.72E-05	1.93E-05	1.61E-05	1.86E-05
IRP	kBq U235 eq.	1.17	1.21	1.57	0.940	0.926
ETP-FW	CTUe	1,130	1,620	1,520	1,100	1,210
HTPC	CTUh	5.33E-08	6.79E-08	1.01E-07	7.53E-08	1.11E-07
HTPNC	CTUh	1.20E-06	1.56E-06	2.26E-06	1.66E-06	2.41E-06
SQP	Pt	2,680	2,690	2,750	2,690	2,720
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS						
BCC-prod	kg C	0	0	0	0	0
BCC-pack	kg C	3.75	3.75	3.75	3.75	3.75
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	267	290	421	272	338
ODP	kg CFC 11 eq.	1.86E-13	2.11E-13	2.42E-13	1.70E-13	1.80E-13
AP	kg SO_2 eq.	0.617	0.861	0.959	0.709	0.900
EP	kg $(PO_4)^{3-}$ eq.	0.119	0.128	0.153	0.118	0.131
POCP	kg C_2H_4 eq.	0.0574	0.0737	0.0949	0.0749	0.101
ADPE	kg Sb eq.	9.98E-05	1.16E-04	1.87E-04	1.40E-04	2.13E-04
ADPF	MJ	2,170	2,750	3,580	2,490	3,300

Table 13 ctd - Cradle-to-gate (A1-A3) per tonne

REP PRODUCT		HHY-80074044	HHY-80074125	HPA-80074206	HPA-80074237	HPA-80074201
GROUP DESCRIPTION		SPUN CLASS 4 RRJ SHORT MEDIUM	SPUN SKID JOINT	VT CLASS 2	VT CLASS 4 IWJ	VT CLASS 4 RRJ MEDIUM
GROUP		GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
INDICATORS, ABBR.	UNITS					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	258	256	184	201	210
GWP-FOSSIL	kg CO_2-eq.	257	255	185	201	210
GWP-BIOGENIC	kg CO_2-eq.	1.66	1.44	-0.160	-0.159	-0.162
GWP-LULUC	kg CO_2-eq.	0.0526	0.0500	0.0338	0.0368	0.0387
ODP	kg CFC11-eq.	1.32E-13	1.32E-13	1.71E-10	1.71E-10	1.72E-10
AP	Mole of H^+ eq.	0.886	0.812	0.403	0.455	0.483
EP-FRESHWATER	kg P eq.	2.39E-04	2.32E-04	2.18E-04	2.22E-04	2.25E-04
EP-MARINE	kg N eq.	0.320	0.320	0.120	0.129	0.135
EP-TERRESTRIAL	Mole of N eq.	3.48	3.48	1.29	1.39	1.44
POCP	kg NMVOC eq.	0.935	0.919	0.349	0.383	0.401
ADP-M&M	kg Sb-eq.	2.51E-04	9.99E-05	1.52E-04	1.65E-04	2.03E-04
ADP-FOSSIL	MJ	2,330	2,120	1,370	1,560	1,660
WDP	m^3 world equiv.	57.1	43.4	38.3	46.0	49.8
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE						
PERE	MJ	455	473	229	232	235
PERM	MJ	0	0	0	0	0
PERT	MJ	455	473	229	232	235
PENRE	MJ	2,300	2,120	1,370	1,560	1,660
PENRM	MJ	37.8	2.16	1.30	0.892	2.13
PENRT	MJ	2,340	2,120	1,370	1,560	1,660
SM	kg	4.07	1.88	1.97	2.54	2.88
RSF	MJ	242	293	245	246	247
NRSF	MJ	0	0	0	0	0
FW	m^3	1.98	1.69	1.42	1.61	1.70
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE						
HWD	kg	4.27E-07	3.28E-07	0.00155	0.00155	0.00156
NHWD	kg	17.8	16.3	28.9	29.5	30.0
RWD	kg	0.00673	0.00711	0.00457	0.00454	0.00467
CRU	kg	0	0	0	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	256	254	184	200	209
PM	Disease incidences	1.55E-05	1.46E-05	4.69E-06	5.26E-06	5.56E-06
IRP	kBq U235 eq.	0.977	1.07	0.630	0.622	0.634
ETP-FW	CTUe	1,080	1,070	647	671	687
HTPC	CTUh	6.36E-08	5.49E-08	4.45E-08	5.52E-08	6.05E-08
HTPNC	CTUh	1.47E-06	1.19E-06	8.86E-07	1.07E-06	1.17E-06
SQP	Pt	2,680	2,680	1,120	1,120	1,130
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS						
BCC-prod	kg C	0	0	0	0	0
BCC-pack	kg C	3.75	3.75	0.247	0.247	0.247
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	253	252	181	197	205
ODP	kg CFC 11 eq.	1.75E-13	1.76E-13	3.20E-10	3.21E-10	3.23E-10
AP	kg SO_2 eq.	0.666	0.598	0.315	0.358	0.382
EP	kg $(PO_4)^{3-}$ eq.	0.114	0.115	0.0473	0.0505	0.0523
POCP	kg C_2H_4 eq.	0.0669	0.0574	0.0325	0.0392	0.0425
ADPE	kg Sb eq.	2.51E-04	9.98E-05	1.52E-04	1.65E-04	2.03E-04
ADPF	MJ	2,290	2,090	1,340	1,530	1,620

Table 13 ctd - Cradle-to-gate (A1-A3) per tonne

REP PRODUCT		HPA-80074221	HHM-80074062	HHM-80074068	HHM-80074091
GROUP DESCRIPTION		VT CLASS 4 RRJ LARGE	RCP 225	RCP CLASS 2 300-600	RCP CLASS 4 300-600
GROUP		GROUP 16	GROUP 17	GROUP 18	GROUP 19
INDICATORS, ABBR.	UNITS				
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE					
GWP-TOTAL	kg CO_2-eq.	260	235	239	272
GWP-FOSSIL	kg CO_2-eq.	260	233	237	270
GWP-BIOGENIC	kg CO_2-eq.	-0.154	1.51	1.52	1.53
GWP-LULUC	kg CO_2-eq.	0.0478	0.0394	0.0404	0.0467
ODP	kg CFC11-eq.	1.72E-10	4.06E-10	3.99E-10	3.96E-10
AP	Mole of H^+ eq.	0.645	0.618	0.637	0.752
EP-FRESHWATER	kg P eq.	2.39E-04	2.39E-04	2.41E-04	2.50E-04
EP-MARINE	kg N eq.	0.163	0.218	0.219	0.236
EP-TERRESTRIAL	Mole of N eq.	1.75	2.37	2.39	2.57
POCP	kg NMVOC eq.	0.505	0.616	0.624	0.685
ADP-M&M	kg Sb-eq.	2.40E-04	1.17E-04	1.17E-04	1.25E-04
ADP-FOSSIL	MJ	2,250	1,880	1,940	2,330
WDP	m^3 world equiv.	73.8	52.4	57.0	80.8
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE					
PERE	MJ	245	400	399	407
PERM	MJ	0	0	0	0
PERT	MJ	245	400	399	407
PENRE	MJ	2,250	1,880	1,940	2,330
PENRM	MJ	1.31	0	0	0
PENRT	MJ	2,250	1,880	1,940	2,330
SM	kg	4.63	5.60	6.27	9.72
RSF	MJ	247	283	278	276
NRSF	MJ	0	0	0	0
FW	m^3	2.28	1.87	1.97	2.55
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A1-A3, PER TONNE OF PIPE					
HWD	kg	0.00156	0.00369	0.00363	0.00361
NHWD	kg	31.7	40.3	40.3	43.2
RWD	kg	0.00456	0.00542	0.00535	0.00535
CRU	kg	0	0	0	0
MFR	kg	0	0	0	0
MER	kg	0	0	0	0
EEE	MJ	0	0	0	0
EET	MJ	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE					
GWP-GHG	kg CO_2-eq.	258	233	237	270
PM	Disease incidences	7.31E-06	9.95E-06	1.02E-05	1.15E-05
IRP	kBq U235 eq.	0.606	0.698	0.695	0.720
ETP-FW	CTUe	759	952	953	1,000
HTPC	CTUh	9.36E-08	1.52E-08	1.58E-08	1.94E-08
HTPNC	CTUh	1.75E-06	8.82E-07	9.38E-07	1.24E-06
SQP	Pt	1,150	2,490	2,480	2,490
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS					
BCC-prod	kg C	0	0	0	0
BCC-pack	kg C	0.247	2.71	2.71	2.71
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A1-A3, PER TONNE OF PIPE					
GWP	kg CO_2 eq.	253	231	235	267
ODP	kg CFC 11 eq.	3.23E-10	7.63E-10	7.49E-10	7.45E-10
AP	kg SO_2 eq.	0.517	0.467	0.483	0.581
EP	kg $(PO_4)^{3-}$ eq.	0.0621	0.0813	0.0818	0.0875
POCP	kg C_2H_4 eq.	0.0634	0.0351	0.0373	0.0487
ADPE	kg Sb eq.	2.40E-04	1.17E-04	1.17E-04	1.25E-04
ADPF	MJ	2,200	1,850	1,910	2,280

Pipe grouping and variation (A1-A3) per tonne

Table 14 - Range in GWP-GHG results (modules A1-A3)

GROUP #	GROUP NAME	REPRESENTATIVE PRODUCT CODE	PRODUCTION FACILITY	MIN DEV	MAX DEV
1	Spun Class 2 FJ	HHY-80074151	Hornby	-8%	7%
2	Spun Class 2 RRJ Small	HHY-80074077	Hornby	-3%	8%
3	Spun Class 2 RRJ Medium	HHY-80074096	Hornby	-7%	9%
4	Spun Class 2 RRJ Large	HHY-80074121	Hornby	-8%	0%
5	Spun Class 2 RRJ Short	HHY-80074048	Hornby	-11%	6%
6	Spun Class 4 FJ	HHY-80074153	Hornby	-13%	9%
7	Spun Class 4 RRJ	HHY-80074106	Hornby	-10%	6%
8	Spun Class 4 RRJ Short 375	HHY-80074040	Hornby	0%	0%
9	Spun Class 4 RRJ Short 450	HHY-80074041	Hornby	0%	0%
10	Spun Class 4 RRJ Short 525	HHY-80074042	Hornby	0%	0%
11	Spun Class 4 RRJ Short Medium	HHY-80074044	Hornby	-5%	8%
12	Spun Skid Joint	HHY-80074125	Hornby	0%	0%
13	VT Class 2	HPA-80074206	Papakura	-11%	10%
14	VT Class 4 IWJ	HPA-80074237	Papakura	-10%	0%
15	VT Class 4 RRJ Medium	HPA-80074201	Papakura	-12%	10%
16	VT Class 4 RRJ Large	HPA-80074221	Papakura	-9%	4%
17	RCP 225	HHM-80074063	Te Rapa Park (Interpipe)	-2%	1%
18	RCP Class 2 300-600	HHM-80074068	Te Rapa Park (Interpipe)	-2%	3%
19	RCP Class 4 300-600	HHM-80074091	Te Rapa Park (Interpipe)	-6%	6%

Distribution (A4) per tonne

Table 15 - Distribution (A4) per tonne

FROM SITE		PAPAKURA (HPA)	HORNBY (HHY)	TE RAPA (INTERPIPE JV)
INDICATORS, ABBR.	UNITS			
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A4, PER TONNE OF PIPE				
GWP-TOTAL	kg CO_2-eq.	9.22	16.4	13.6
GWP-FOSSIL	kg CO_2-eq.	9.22	16.4	13.6
GWP-BIOGENIC	kg CO_2-eq.	0.00465	0.00825	0.00683
GWP-LULUC	kg CO_2-eq.	1.86E-04	3.30E-04	2.73E-04
ODP	kg CFC11-eq.	1.36E-15	2.41E-15	2.00E-15
AP	Mole of H^+ eq.	0.0165	0.0294	0.0243
EP-FRESHWATER	kg P eq.	1.52E-06	2.70E-06	2.23E-06
EP-MARINE	kg N eq.	0.00688	0.0122	0.0101
EP-TERRESTRIAL	Mole of N eq.	0.0758	0.135	0.111
POCP	kg NMVOC eq.	0.0161	0.0286	0.0237
ADP-M&M	kg Sb-eq.	1.43E-07	2.53E-07	2.10E-07
ADP-FOSSIL	MJ	122	217	180
WDP	m^3 world equiv.	0.0604	0.107	0.0888
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A4, PER TONNE OF PIPE				
PERE	MJ	0.597	1.06	0.878
PERM	MJ	0	0	0
PERT	MJ	0.597	1.06	0.878
PENRE	MJ	122	217	180
PENRM	MJ	0	0	0
PENRT	MJ	122	217	180
SM	kg	0	0	0
RSF	MJ	0	0	0
NRSF	MJ	0	0	0
FW	m^3	0.00119	0.00211	0.00174
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A4, PER TONNE OF PIPE				
HWD	kg	4.42E-10	7.84E-10	6.49E-10
NHWD	kg	0.00293	0.00520	0.00430
RWD	kg	1.69E-05	3.00E-05	2.48E-05
CRU	kg	0	0	0
MFR	kg	0	0	0
MER	kg	0	0	0
EEE	MJ	0	0	0
EET	MJ	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A4, PER TONNE OF PIPE				
GWP-GHG	kg CO_2-eq.	9.21	16.3	13.5
PM	Disease incidences	1.18E-07	2.09E-07	1.73E-07
IRP	kBq U235 eq.	0.00198	0.00352	0.00291
ETP-FW	CTUe	46.8	83.0	68.7
HTPC	CTUh	7.99E-10	1.42E-09	1.17E-09
HTPNC	CTUh	2.89E-08	5.13E-08	4.25E-08
SQP	Pt	0.314	0.557	0.462
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A4, PER TONNE OF PIPE				
GWP	kg CO_2 eq.	9.10	16.2	13.4
ODP	kg CFC 11 eq.	1.81E-15	3.22E-15	2.66E-15
AP	kg SO_2 eq.	0.0119	0.0211	0.0175
EP	kg $(PO_4)^{3-}$ eq.	0	0	0.00344
POCP	kg C_2H_4 eq.	-0.00191	-0.00339	-0.00280
ADPE	kg Sb eq.	1.43E-07	2.53E-07	2.10E-07
ADPF	MJ	122	217	180

Installation (A5) per lineal meter

Table 16 - Installation (A5) per effective lineal meter of pipe

PIPE DIAMETER (mm)		225	300	375	450	525	600
INDICATORS, ABBR.	UNITS						
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP-TOTAL	kg CO_2-eq.	6.78	8.49	10.4	13.4	16.2	19.2
GWP-FOSSIL	kg CO_2-eq.	6.84	8.54	10.5	13.5	16.2	19.2
GWP-BIOGENIC	kg CO_2-eq.	-0.0704	-0.0746	-0.0808	-0.0853	-0.0935	-0.104
GWP-LULUC	kg CO_2-eq.	0.0184	0.0206	0.0229	0.0264	0.0297	0.0334
ODP	kg CFC11-eq.	1.55E-14	1.91E-14	2.24E-14	2.91E-14	3.39E-14	3.88E-14
AP	Mole of H^+ eq.	0.0181	0.0217	0.0258	0.0318	0.0376	0.0440
EP-FRESHWATER	kg P eq.	8.89E-06	1.03E-05	1.18E-05	1.44E-05	1.65E-05	1.87E-05
EP-MARINE	kg N eq.	0.00778	0.00924	0.0109	0.0134	0.0158	0.0185
EP-TERRESTRIAL	Mole of N eq.	0.0863	0.103	0.121	0.148	0.175	0.205
POCP	kg NMVOC eq.	0.0204	0.0241	0.0283	0.0346	0.0406	0.0473
ADP-M&M	kg Sb-eq.	5.17E-07	6.58E-07	7.79E-07	1.10E-06	1.28E-06	1.47E-06
ADP-FOSSIL	MJ	98.4	125	153	203	244	287
WDP	m^3 world equiv.	0.427	0.502	0.581	0.676	0.793	0.910
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE							
PERE	MJ	6.70	8.02	9.28	11.6	13.5	15.4
PERM	MJ	0	0	0	0	0	0
PERT	MJ	6.70	8.02	9.28	11.6	13.5	15.4
PENRE	MJ	98.5	125	153	203	244	287
PENRM	MJ	0	0	0	0	0	0
PENRT	MJ	98.5	125	153	203	244	287
SM	kg	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0
FW	m^3	0.0152	0.0184	0.0214	0.0272	0.0316	0.0361
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE							
HWD	kg	2.42E-08	3.59E-08	4.39E-08	7.76E-08	8.96E-08	1.02E-07
NHWD	kg	0.0188	0.0243	0.0288	0.0422	0.0489	0.0557
RWD	kg	0.00153	0.00183	0.00212	0.00261	0.00305	0.00348
CRU	kg	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP-GHG	kg CO_2-eq.	6.83	8.54	10.4	13.5	16.2	19.2
PM	Disease incidences	2.36E-07	2.78E-07	3.24E-07	3.92E-07	4.58E-07	5.29E-07
IRP	kBq U235 eq.	0.246	0.294	0.340	0.414	0.483	0.551
ETP-FW	CTUe	47.9	59.2	71.2	92.8	110	129
HTPC	CTUh	1.01E-09	1.26E-09	1.50E-09	1.99E-09	2.35E-09	2.73E-09
HTPNC	CTUh	5.21E-08	6.38E-08	7.53E-08	9.89E-08	1.16E-07	1.33E-07
SQP	Pt	13.2	15.1	17.0	20.2	22.9	25.9
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP	kg CO_2 eq.	6.65	8.33	10.2	13.2	15.9	18.8
ODP	kg CFC 11 eq.	2.07E-14	2.55E-14	2.98E-14	3.87E-14	4.52E-14	5.17E-14
AP	kg SO_2 eq.	0.0129	0.0155	0.0184	0.0227	0.0269	0.0315
EP	kg $(PO_4)^{3-}$ eq.	0.00276	0.00328	0.00387	0.00474	0.00559	0.00652
POCP	kg C_2H_4 eq.	-8.61E-05	-2.37E-04	-4.35E-04	-6.44E-04	-9.33E-04	-0.00125
ADPE	kg Sb eq.	5.26E-07	6.69E-07	7.92E-07	1.12E-06	1.30E-06	1.49E-06
ADPF	MJ	94.4	120	147	196	236	278

Installation (A5) per lineal meter

Table 16 ctd - Installation (A5) per effective lineal meter of pipe

PIPE DIAMETER (mm)		675	750	825	900	1050	1200
INDICATORS, ABBR.	UNITS						
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP-TOTAL	kg CO_2-eq.	22.2	26.8	29.8	35.4	46.1	55.3
GWP-FOSSIL	kg CO_2-eq.	22.3	26.9	29.9	35.5	46.2	55.4
GWP-BIOGENIC	kg CO_2-eq.	-0.117	-0.122	-0.131	-0.142	-0.165	-0.191
GWP-LULUC	kg CO_2-eq.	0.0373	0.0421	0.0451	0.0513	0.0626	0.0722
ODP	kg CFC11-eq.	4.24E-14	5.23E-14	5.59E-14	6.63E-14	8.44E-14	9.69E-14
AP	Mole of H^+ eq.	0.0508	0.0597	0.0659	0.0772	0.0988	0.118
EP-FRESHWATER	kg P eq.	2.07E-05	2.45E-05	2.64E-05	3.08E-05	3.87E-05	4.48E-05
EP-MARINE	kg N eq.	0.0214	0.0250	0.0276	0.0322	0.0412	0.0492
EP-TERRESTRIAL	Mole of N eq.	0.237	0.276	0.305	0.357	0.456	0.544
POCP	kg NMVOC eq.	0.0544	0.0636	0.0701	0.0819	0.104	0.124
ADP-M&M	kg Sb-eq.	1.53E-06	2.05E-06	2.20E-06	2.70E-06	3.55E-06	4.06E-06
ADP-FOSSIL	MJ	326	404	446	535	701	834
WDP	m^3 world equiv.	1.06	1.18	1.27	1.43	1.74	2.04
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE							
PERE	MJ	17.0	20.4	21.8	25.5	32.1	37.0
PERM	MJ	0	0	0	0	0	0
PERT	MJ	17.0	20.4	21.8	25.5	32.1	37.0
PENRE	MJ	326	404	446	536	701	834
PENRM	MJ	0	0	0	0	0	0
PENRT	MJ	326	404	446	536	701	834
SM	kg	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0
FW	m^3	0.0399	0.0482	0.0516	0.0606	0.0765	0.0880
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE							
HWD	kg	9.38E-08	1.52E-07	1.60E-07	2.09E-07	2.87E-07	3.20E-07
NHWD	kg	0.0569	0.0785	0.0837	0.104	0.137	0.156
RWD	kg	0.00391	0.00458	0.00489	0.00566	0.00704	0.00811
CRU	kg	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP-GHG	kg CO_2-eq.	22.3	26.8	29.9	35.5	46.1	55.3
PM	Disease incidences	6.07E-07	7.02E-07	7.66E-07	8.88E-07	1.12E-06	1.32E-06
IRP	kBq U235 eq.	0.623	0.721	0.772	0.889	1.10	1.27
ETP-FW	CTUe	146	179	197	235	305	361
HTPC	CTUh	3.03E-09	3.79E-09	4.14E-09	4.96E-09	6.46E-09	7.59E-09
HTPNC	CTUh	1.46E-07	1.83E-07	1.99E-07	2.38E-07	3.08E-07	3.60E-07
SQP	Pt	28.8	33.2	35.6	40.9	50.4	58.1
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP	kg CO_2 eq.	21.8	26.3	29.2	34.7	45.2	54.3
ODP	kg CFC 11 eq.	5.66E-14	6.98E-14	7.46E-14	8.84E-14	1.13E-13	1.29E-13
AP	kg SO_2 eq.	0.0363	0.0427	0.0472	0.0554	0.0709	0.0846
EP	kg $(PO_4)^{3-}$ eq.	0.00753	0.00881	0.00973	0.0114	0.0145	0.0173
POCP	kg C_2H_4 eq.	-0.00169	-0.00198	-0.00237	-0.00284	-0.00387	-0.00497
ADPE	kg Sb eq.	1.55E-06	2.08E-06	2.23E-06	2.74E-06	3.59E-06	4.11E-06
ADPF	MJ	315	391	433	520	682	812

Installation (A5) per lineal meter

Table 16 ctd - Installation (A5) per effective lineal meter of pipe

PIPE DIAMETER (mm)		1350	1500	1600	1650	1800	1950
INDICATORS, ABBR.	UNITS						
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP-TOTAL	kg CO_2-eq.	66.2	84.0	91.9	104	118	139
GWP-FOSSIL	kg CO_2-eq.	66.3	84.2	92.1	104	118	139
GWP-BIOGENIC	kg CO_2-eq.	-0.224	-0.248	-0.286	-0.292	-0.352	-0.402
GWP-LULUC	kg CO_2-eq.	0.0845	0.103	0.112	0.126	0.144	0.166
ODP	kg CFC11-eq.	1.13E-13	1.47E-13	1.54E-13	1.89E-13	2.06E-13	2.40E-13
AP	Mole of H^+ eq.	0.141	0.176	0.193	0.217	0.249	0.291
EP-FRESHWATER	kg P eq.	5.25E-05	6.66E-05	7.11E-05	8.19E-05	9.12E-05	1.06E-04
EP-MARINE	kg N eq.	0.0587	0.0729	0.0805	0.0899	0.103	0.121
EP-TERRESTRIAL	Mole of N eq.	0.650	0.807	0.891	0.994	1.14	1.34
POCP	kg NMVOC eq.	0.148	0.184	0.203	0.226	0.260	0.304
ADP-M&M	kg Sb-eq.	4.73E-06	6.62E-06	6.67E-06	7.84E-06	8.24E-06	9.80E-06
ADP-FOSSIL	MJ	994	1,290	1,390	1,570	1,760	2,080
WDP	m^3 world equiv.	2.40	2.77	3.12	3.92	4.54	5.17
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE							
PERE	MJ	43.2	55.0	58.3	70.9	78.3	90.9
PERM	MJ	0	0	0	0	0	0
PERT	MJ	43.2	55.0	58.3	70.9	78.3	90.9
PENRE	MJ	994	1,290	1,390	1,580	1,760	2,080
PENRM	MJ	0	0	0	0	0	0
PENRT	MJ	994	1,290	1,390	1,580	1,760	2,080
SM	kg	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0
FW	m^3	0.103	0.132	0.139	0.171	0.187	0.217
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE							
HWD	kg	3.68E-07	5.74E-07	5.41E-07	6.38E-07	6.23E-07	7.59E-07
NHWD	kg	0.181	0.258	0.256	0.304	0.315	0.375
RWD	kg	0.00947	0.0117	0.0126	0.0158	0.0176	0.0202
CRU	kg	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP-GHG	kg CO_2-eq.	66.3	84.1	92.1	104	118	139
PM	Disease incidences	1.56E-06	1.92E-06	2.11E-06	2.44E-06	2.78E-06	3.24E-06
IRP	kBq U235 eq.	1.48	1.81	1.96	2.47	2.76	3.17
ETP-FW	CTUe	429	556	597	677	758	893
HTPC	CTUh	8.97E-09	1.18E-08	1.25E-08	1.43E-08	1.58E-08	1.87E-08
HTPNC	CTUh	4.23E-07	5.59E-07	5.88E-07	6.77E-07	7.42E-07	8.76E-07
SQP	Pt	68.0	84.0	90.6	105	118	137
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE							
GWP	kg CO_2 eq.	65.0	82.5	90.3	102	116	136
ODP	kg CFC 11 eq.	1.51E-13	1.96E-13	2.05E-13	2.52E-13	2.74E-13	3.20E-13
AP	kg SO_2 eq.	0.101	0.126	0.139	0.156	0.179	0.209
EP	kg $(PO_4)^{3-}$ eq.	0.0206	0.0257	0.0283	0.0317	0.0363	0.0426
POCP	kg C_2H_4 eq.	-0.00617	-0.00747	-0.00873	-0.00971	-0.0117	-0.0138
ADPE	kg Sb eq.	4.79E-06	6.69E-06	6.74E-06	7.94E-06	8.35E-06	9.93E-06
ADPF	MJ	968	1,260	1,350	1,530	1,720	2,030

Installation (A5) per lineal meter

Table 16 ctd - Installation (A5) per effective lineal meter of pipe

PIPE DIAMETER (mm)		2050	2100	2300	2400
INDICATORS, ABBR.	UNITS				
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE					
GWP-TOTAL	kg CO_2-eq.	151	157	183	200
GWP-FOSSIL	kg CO_2-eq.	151	158	184	201
GWP-BIOGENIC	kg CO_2-eq.	-0.442	-0.462	-0.541	-0.603
GWP-LULUC	kg CO_2-eq.	0.180	0.187	0.215	0.235
ODP	kg CFC11-eq.	2.57E-13	2.65E-13	3.01E-13	3.23E-13
AP	Mole of H^+ eq.	0.317	0.330	0.385	0.421
EP-FRESHWATER	kg P eq.	1.15E-04	1.19E-04	1.37E-04	1.48E-04
EP-MARINE	kg N eq.	0.132	0.137	0.160	0.175
EP-TERRESTRIAL	Mole of N eq.	1.46	1.52	1.77	1.94
POCP	kg NMVOC eq.	0.331	0.345	0.402	0.439
ADP-M&M	kg Sb-eq.	1.05E-05	1.08E-05	1.22E-05	1.30E-05
ADP-FOSSIL	MJ	2,260	2,350	2,720	2,960
WDP	m^3 world equiv.	5.59	5.80	6.69	7.28
EN15804+A2 RESOURCE USE PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE					
PERE	MJ	97.6	101	115	124
PERM	MJ	0	0	0	0
PERT	MJ	97.6	101	115	124
PENRE	MJ	2,260	2,350	2,720	2,960
PENRM	MJ	0	0	0	0
PENRT	MJ	2,260	2,350	2,720	2,960
SM	kg	0	0	0	0
RSF	MJ	0	0	0	0
NRSF	MJ	0	0	0	0
FW	m^3	0.233	0.241	0.274	0.295
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES A5, PER LINEAL METER OF PIPE					
HWD	kg	7.99E-07	8.20E-07	9.01E-07	9.43E-07
NHWD	kg	0.399	0.412	0.461	0.490
RWD	kg	0.0217	0.0225	0.0256	0.0276
CRU	kg	0	0	0	0
MFR	kg	0	0	0	0
MER	kg	0	0	0	0
EEE	MJ	0	0	0	0
EET	MJ	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE					
GWP-GHG	kg CO_2-eq.	151	158	184	200
PM	Disease incidences	3.51E-06	3.65E-06	4.23E-06	4.62E-06
IRP	kBq U235 eq.	3.41	3.53	4.03	4.35
ETP-FW	CTUe	968	1,010	1,160	1,270
HTPC	CTUh	2.01E-08	2.09E-08	2.41E-08	2.61E-08
HTPNC	CTUh	9.44E-07	9.78E-07	1.12E-06	1.21E-06
SQP	Pt	148	153	176	191
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES A5, PER LINEAL METER OF PIPE					
GWP	kg CO_2 eq.	148	155	180	197
ODP	kg CFC 11 eq.	3.42E-13	3.54E-13	4.01E-13	4.30E-13
AP	kg SO_2 eq.	0.228	0.237	0.277	0.302
EP	kg $(PO_4)^{3-}$ eq.	0.0463	0.0483	0.0563	0.0616
POCP	kg C_2H_4 eq.	-0.0152	-0.0160	-0.0191	-0.0211
ADPE	kg Sb eq.	1.06E-05	1.09E-05	1.23E-05	1.32E-05
ADPF	MJ	2,200	2,290	2,650	2,880

End-of-Life (Modules C & D), per tonne

Table 17 - Left in ground

		C1	C2	C3	C4	D
INDICATORS, ABBR.	UNITS					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	0	0	0	0	0
GWP-FOSSIL	kg CO_2-eq.	0	0	0	0	0
GWP-BIOGENIC	kg CO_2-eq.	0	0	0	0	0
GWP-LULUC	kg CO_2-eq.	0	0	0	0	0
ODP	kg CFC11-eq.	0	0	0	0	0
AP	Mole of H^+ eq.	0	0	0	0	0
EP-FRESHWATER	kg P eq.	0	0	0	0	0
EP-MARINE	kg N eq.	0	0	0	0	0
EP-TERRESTRIAL	Mole of N eq.	0	0	0	0	0
POCP	kg NMVOC eq.	0	0	0	0	0
ADP-M&M	kg Sb-eq.	0	0	0	0	0
ADP-FOSSIL	MJ	0	0	0	0	0
WDP	m^3 world equiv.	0	0	0	0	0
EN15804+A2 RESOURCE USE PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
PERE	MJ	0	0	0	0	0
PERM	MJ	0	0	0	0	0
PERT	MJ	0	0	0	0	0
PENRE	MJ	0	0	0	0	0
PENRM	MJ	0	0	0	0	0
PENRT	MJ	0	0	0	0	0
SM	kg	0	0	0	0	0
RSF	MJ	0	0	0	0	0
NRSF	MJ	0	0	0	0	0
FW	m^3	0	0	0	0	0
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
HWD	kg	0	0	0	0	0
NHWD	kg	0	0	0	1,000	0
RWD	kg	0	0	0	0	0
CRU	kg	0	0	0	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	0	0	0	0	0
PM	Disease incidences	0	0	0	0	0
IRP	kBq U235 eq.	0	0	0	0	0
ETP-FW	CTUe	0	0	0	0	0
HTPC	CTUh	0	0	0	0	0
HTPNC	CTUh	0	0	0	0	0
SQP	Pt	0	0	0	0	0
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	0	0	0	0	0
ODP	kg CFC 11 eq.	0	0	0	0	0
AP	kg SO_2 eq.	0	0	0	0	0
EP	kg $(PO_4)^{3-}$ eq.	0	0	0	0	0
POCP	kg C_2H_4 eq.	0	0	0	0	0
ADPE	kg Sb eq.	0	0	0	0	0
ADPF	MJ	0	0	0	0	0

End-of-Life (Modules C & D), per tonne

Table 18 - Re-Lined

		C1	C2	C3	C4	D
INDICATORS, ABBR.	UNITS					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	0	0	0	0	0
GWP-FOSSIL	kg CO_2-eq.	0	0	0	0	0
GWP-BIOGENIC	kg CO_2-eq.	0	0	0	0	0
GWP-LULUC	kg CO_2-eq.	0	0	0	0	0
ODP	kg CFC11-eq.	0	0	0	0	0
AP	Mole of H^+ eq.	0	0	0	0	0
EP-FRESHWATER	kg P eq.	0	0	0	0	0
EP-MARINE	kg N eq.	0	0	0	0	0
EP-TERRESTRIAL	Mole of N eq.	0	0	0	0	0
POCP	kg NMVOC eq.	0	0	0	0	0
ADP-M&M	kg Sb-eq.	0	0	0	0	0
ADP-FOSSIL	MJ	0	0	0	0	0
WDP	m^3 world equiv.	0	0	0	0	0
EN15804+A2 RESOURCE USE PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
PERE	MJ	0	0	0	0	0
PERM	MJ	0	0	0	0	0
PERT	MJ	0	0	0	0	0
PENRE	MJ	0	0	0	0	0
PENRM	MJ	0	0	0	0	0
PENRT	MJ	0	0	0	0	0
SM	kg	0	0	0	0	0
RSF	MJ	0	0	0	0	0
NRSF	MJ	0	0	0	0	0
FW	m^3	0	0	0	0	0
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
HWD	kg	0	0	0	0	0
NHWD	kg	0	0	0	0	0
RWD	kg	0	0	0	0	0
CRU	kg	0	0	1,000	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	0	0	0	0	0
PM	Disease incidences	0	0	0	0	0
IRP	kBq U235 eq.	0	0	0	0	0
ETP-FW	CTUe	0	0	0	0	0
HTPC	CTUh	0	0	0	0	0
HTPNC	CTUh	0	0	0	0	0
SQP	Pt	0	0	0	0	0
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	0	0	0	0	0
ODP	kg CFC 11 eq.	0	0	0	0	0
AP	kg SO_2 eq.	0	0	0	0	0
EP	kg $(PO_4)^{3-}$ eq.	0	0	0	0	0
POCP	kg C_2H_4 eq.	0	0	0	0	0
ADPE	kg Sb eq.	0	0	0	0	0
ADPF	MJ	0	0	0	0	0

End-of-Life (Modules C & D), per tonne

Table 19 - Filled with Grout

		C1	C2	C3	C4	D
INDICATORS, ABBR.	UNITS					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	0	0	0	129	0
GWP-FOSSIL	kg CO_2-eq.	0	0	0	129	0
GWP-BIOGENIC	kg CO_2-eq.	0	0	0	0.0912	0
GWP-LULUC	kg CO_2-eq.	0	0	0	0.100	0
ODP	kg CFC11-eq.	0	0	0	1.42E-12	0
AP	Mole of H^+ eq.	0	0	0	0.156	0
EP-FRESHWATER	kg P eq.	0	0	0	6.53E-05	0
EP-MARINE	kg N eq.	0	0	0	0.0549	0
EP-TERRESTRIAL	Mole of N eq.	0	0	0	0.613	0
POCP	kg NMVOC eq.	0	0	0	0.151	0
ADP-M&M	kg Sb-eq.	0	0	0	7.32E-06	0
ADP-FOSSIL	MJ	0	0	0	1,810	0
WDP	m^3 world equiv.	0	0	0	9.38	0
EN15804+A2 RESOURCE USE PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
PERE	MJ	0	0	0	110	0
PERM	MJ	0	0	0	0	0
PERT	MJ	0	0	0	110	0
PENRE	MJ	0	0	0	1,810	0
PENRM	MJ	0	0	0	0	0
PENRT	MJ	0	0	0	1,810	0
SM	kg	0	0	0	0	0
RSF	MJ	0	0	0	2.20	0
NRSF	MJ	0	0	0	0	0
FW	m^3	0	0	0	0.358	0
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
HWD	kg	0	0	0	2.32E-05	0
NHWD	kg	0	0	0	2,020	0
RWD	kg	0	0	0	0.0327	0
CRU	kg	0	0	0	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	0	0	0	128	0
PM	Disease incidences	0	0	0	2.96E-06	0
IRP	kBq U235 eq.	0	0	0	5.29	0
ETP-FW	CTUe	0	0	0	277	0
HTPC	CTUh	0	0	0	1.44E-08	0
HTPNC	CTUh	0	0	0	7.42E-07	0
SQP	Pt	0	0	0	115	0
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	0	0	0	126	0
ODP	kg CFC 11 eq.	0	0	0	2.50E-12	0
AP	kg SO_2 eq.	0	0	0	0.116	0
EP	kg $(PO_4)^{3-}$ eq.	0	0	0	0.0223	0
POCP	kg C_2H_4 eq.	0	0	0	0.00922	0
ADPE	kg Sb eq.	0	0	0	7.52E-06	0
ADPF	MJ	0	0	0	1,710	0

End-of-Life (Modules C & D), per tonne

Table 20 - Exhumed and recycled

		C1	C2	C3	C4	D
INDICATORS, ABBR.	**UNITS**					
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-TOTAL	kg CO_2-eq.	1.11	8.79	2.94	0.0295	-32.6
GWP-FOSSIL	kg CO_2-eq.	1.15	8.79	2.94	0.0302	-32.6
GWP-BIOGENIC	kg CO_2-eq.	-0.0505	0.00443	3.52E-04	-8.79E-04	-0.0406
GWP-LULUC	kg CO_2-eq.	0.00910	1.77E-04	4.45E-05	8.89E-05	-0.0270
ODP	kg CFC11-eq.	1.42E-16	1.29E-15	3.32E-16	1.18E-16	-1.50E-13
AP	Mole of H^+ eq.	0.00548	0.0158	0.0140	2.15E-04	-0.0634
EP-FRESHWATER	kg P eq.	3.30E-06	1.45E-06	5.18E-07	5.08E-08	-2.33E-05
EP-MARINE	kg N eq.	0.00258	0.00656	0.00676	5.59E-05	-0.0147
EP-TERRESTRIAL	Mole of N eq.	0.0285	0.0723	0.0740	6.14E-04	-0.157
POCP	kg NMVOC eq.	0.00725	0.0154	0.0189	1.69E-04	-0.0546
ADP-M&M	kg Sb-eq.	8.46E-08	1.36E-07	4.80E-08	2.85E-09	-6.61E-05
ADP-FOSSIL	MJ	14.8	117	39.2	0.401	-358
WDP	m^3 world equiv.	0.00965	0.0576	0.0229	0.00325	-73.9
EN15804+A2 RESOURCE USE PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
PERE	MJ	0.826	0.569	0.113	0.0541	-15.7
PERM	MJ	0	0	0	0	0
PERT	MJ	0.826	0.569	0.113	0.0541	-15.7
PENRE	MJ	14.8	117	39.2	0.401	-359
PENRM	MJ	0	0	0	0	0
PENRT	MJ	14.8	117	39.2	0.401	-359
SM	kg	0	0	0	0	0
RSF	MJ	0	0	0	0	0
NRSF	MJ	0	0	0	0	0
FW	m^3	9.45E-04	0.00113	3.44E-04	9.90E-05	-1.74
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW PARAMETERS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
HWD	kg	7.47E-10	4.21E-10	1.18E-10	4.26E-11	3.65E-08
NHWD	kg	0.00220	0.00279	6.20E-04	2.00	3.21
RWD	kg	1.79E-05	1.61E-05	9.18E-07	4.21E-06	-0.00966
CRU	kg	0	0	0	0	0
MFR	kg	0	0	1,000	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP-GHG	kg CO_2-eq.	1.15	8.78	2.93	0.0301	-32.0
PM	Disease incidences	6.20E-08	1.12E-07	1.59E-07	2.68E-09	-1.48E-06
IRP	kBq U235 eq.	0.00257	0.00189	1.03E-04	4.43E-04	-1.11
ETP-FW	CTUe	10.7	44.6	10.5	0.229	-69.8
HTPC	CTUh	2.16E-10	7.61E-10	1.77E-10	3.37E-11	-1.57E-08
HTPNC	CTUh	1.30E-08	2.76E-08	1.08E-08	3.72E-09	-4.06E-07
SQP	Pt	5.08	0.299	0.0815	0.0810	-28.5
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS, MODULES C1-C4 AND D, PER TONNE OF PIPE						
GWP	kg CO_2 eq.	1.08	8.68	2.90	0.0287	-31.3
ODP	kg CFC 11 eq.	1.89E-16	1.73E-15	4.43E-16	1.57E-16	-2.00E-13
AP	kg SO_2 eq.	0.00381	0.0114	0.00970	1.71E-04	-0.0512
EP	kg $(PO_4)^{3-}$ eq.	9.04E-04	0.00223	0.00226	1.94E-05	-0.00515
POCP	kg C_2H_4 eq.	3.87E-04	-0.00182	9.41E-04	1.32E-05	-0.0117
ADPE	kg Sb eq.	8.47E-08	1.36E-07	4.80E-08	2.88E-09	-6.61E-05
ADPF	MJ	14.7	117	39.1	0.390	-336

Calculating the life cycle impact of a product

An example calculation is provided for the life cycle impact of a product, per effective linear metre of pipe. The example given is to calculate GWP-GHG, but the calculation methodology is the same regardless of the desired indicator.

The calculations require the product specifications, including diameter and conversion factor from tonnes to linear metre, and the product group. The intended end-of-life scenario must also be selected.

Example Calculation

Product	**Papakura 80074191 Concrete Titan Pipe VT 675.2500mm Class 2 RRJ**
Product group	**VT Class 2 (Group 13)**
Mass per effective linear metre	**0.560 t/eff m**
Site (for transportation)	**Papakura**
Diameter (for installation)	**675mm (from specification)**
End-of-life scenario	**Exhumed and Recycled**

Table 21 – Example, calculation of GWP-GHG per effective metre of pipe

MODULE	GWP-GHG [KG CO2E-EQ.]	UNIT	CONVERSION FACTOR (TO EFFECTIVE LINEAR METRE)	RESULT PER EFFECTIVE LINEAR METRE OF PIPE
A1-A3	184	per tonne	0.560	103
A4	9.21	per tonne	0.560	5.16
A5	22.3	per metre	1	22.3
C1	1.15	per tonne	0.560	0.64
C2	8.78	per tonne	0.560	4.92
C3	2.93	per tonne	0.560	1.64
C4	0.0301	per tonne	0.560	0.0169
D	-32.0	per tonne	0.560	-17.9
Total (A-C)		per metre		138

Module D declares the potential impacts or benefits of recycling or reuse of the product in the next life cycle. These impacts are beyond the scope of the current life cycle of the product, and so should not be included when calculating life cycle impacts. The life cycle impact of a product are the impacts related to modules A, B, and C.

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Humes pipes are manufactured to AS/NZS 4058 under an AS/NZS ISO9001:2016 Certified Quality Management System, and are designed to be installed according to AS/NZS 3725:2007

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