ViroDecs™ Special

Holcim Australia Ready-Mix Concrete

Western Australia - Perth Metropolitan Region - ECOPact Range

Environmental Product Declaration

In accordance with ISO 14025 and EN15804+A1
Programme: The International EPD® System | www.environdec.com
Programme Operator: EPD Australasia Limited | www.epd-australasia.com
Managed by: Holcim Certified EPD Process
EPD Process Certificate No. 04
Verified Accreditation Body: Epsten Group, Inc.
EPD Registration No. S-P-03716
Valid from 25 November 2021 | 25 November 2026
Revision Date: 25 November 2021
Revision Number: 1.0
Geographical Scope: Australia

Table of Contents

Version Number	Version Date	Description of Changes
v1.0	19/11/2021	n/a

Introduction

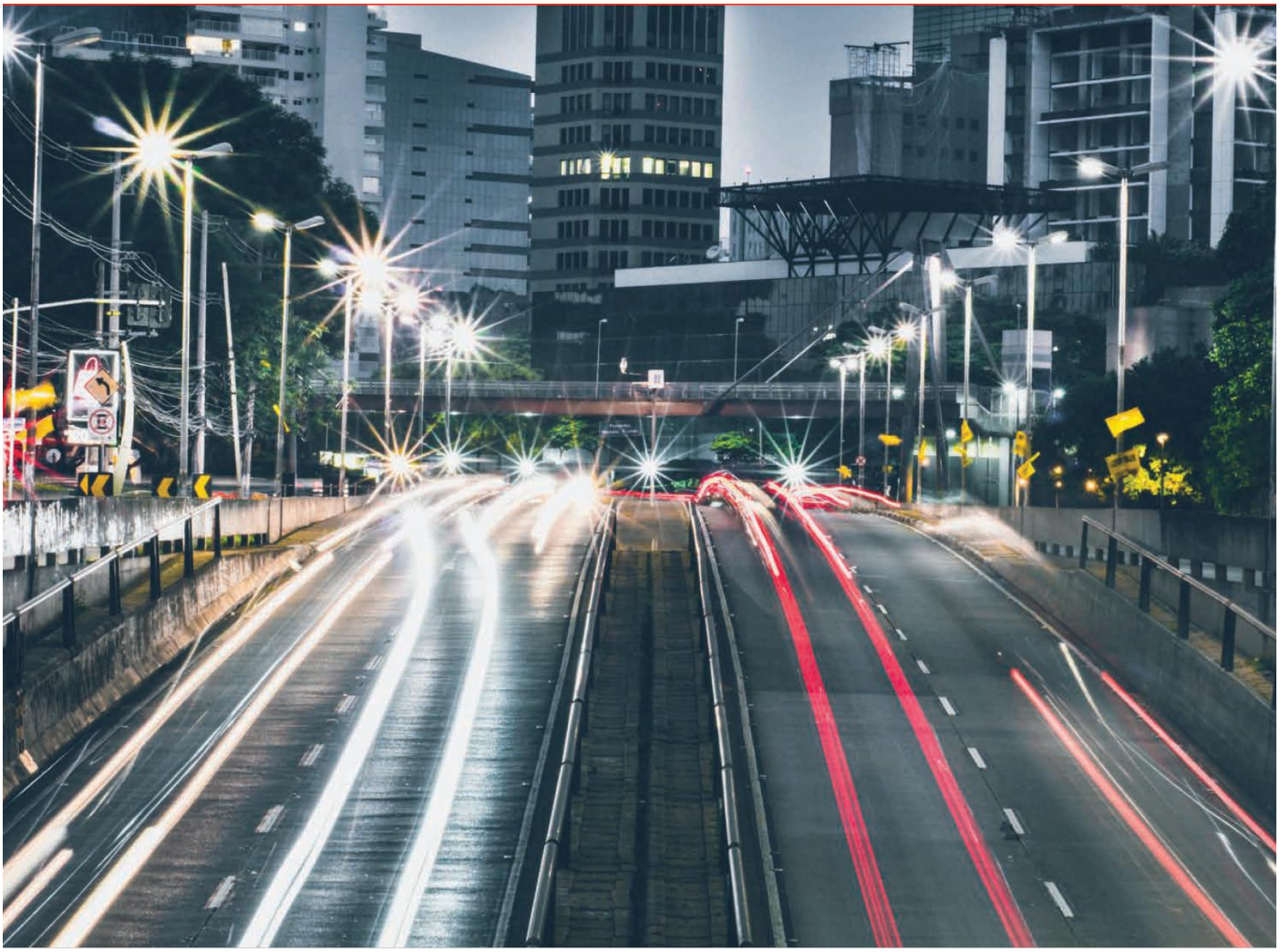
All around the world, the expectation for Governments and organisations to provide enhanced transparency and disclosure of environmental impacts, such as greenhouse gas (GHG) emissions, has been growing. This follows the landmark COP 21 Paris Agreement in 2015 in which all nations agreed to ambitiously pursue efforts to combat climate change and its effects.

At the same time, the global demand for construction materials is also growing due to worldwide population growth and an increase in urbanisation. In fact, concrete is the second most used commodity in the world behind water, and typically a major contributor to the embodied GHG emissions of an infrastructure or property asset.

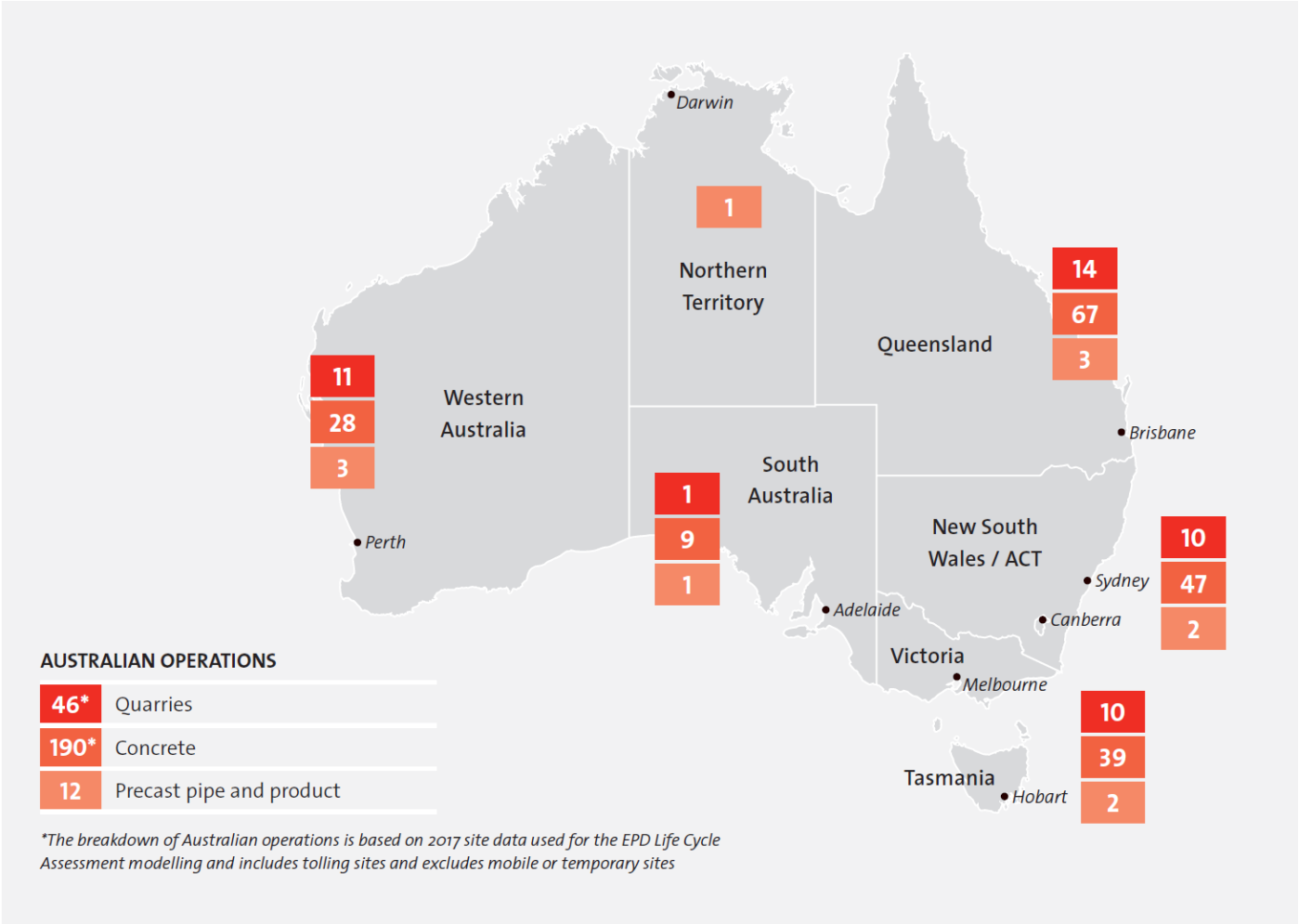
This clearly demonstrates both the essential need for construction materials now and in the future, as well as the necessity for the construction materials industry to be a leading part of the solution addressing climate change.

At Holcim, we recognise our responsibility to contribute to global emissions reduction targets and we have developed a roadmap with a number of actions to direct our efforts.

Our ViroDecs™ range of ready-mix concrete represented by an Environmental Product Declaration (EPD) is one such initiative for Holcim in Australia.



About Holcim



About Holcim

Holcim is a leading supplier of construction materials in Australia, originally serving the industry under the well-known Readymix and Humes brands dating back to 1901. Today Holcim continues to supply essential construction materials including aggregates, sand, ready-mix concrete, engineered precast concrete and prestressed concrete solutions to a range of customers and projects throughout Australia.

Holcim operates right across the Australian continent supplying concrete from a network of concrete plants, quarries, precast and concrete pipe places, and mobile and on-site project facilities.

As part of LafargeHolcim, Holcim Australia can be counted on for state-of-the-art product development, reliable service, and advanced technical expertise for your next project.

About LafargeHolcim

LafargeHolcim is the global leader in building materials and solutions and active in four business segments: Cement, Aggregates, Ready-mix Concrete and Solutions & Products.
With leading positions in all regions of the world and a balanced portfolio between developing and mature markets, LafargeHolcim offers a broad range of high-quality building materials and solutions.

LafargeHolcim experts solve the challenges that customers face around the world, whether they are building individual homes or major infrastructure projects.

Demand for LafargeHolcim materials and solutions is driven by global population growth, urbanisation, improved living standards and sustainable construction. Around 75,000 people work for the company in around 80 countries.

ViroDecs™ Special – a first for ready-mix concrete in Australia

ViroDecs™ Special at a glance

The Holcim ViroDecs™ Special provides project-specific, on-demand Environmental Product Declarations (EPDs) to Holcim's customers. This capability represents a significant step in Holcim's sustainability journey and embodies our multi-disciplinary approach to embedding sustainability into our organisation and operations. With the introduction of our ViroDecs™ Special, third-party verified data will underpin our capability to work with our customers from tender through to design and construction to optimise ready-mix concrete mix designs and report on sustainability performance.

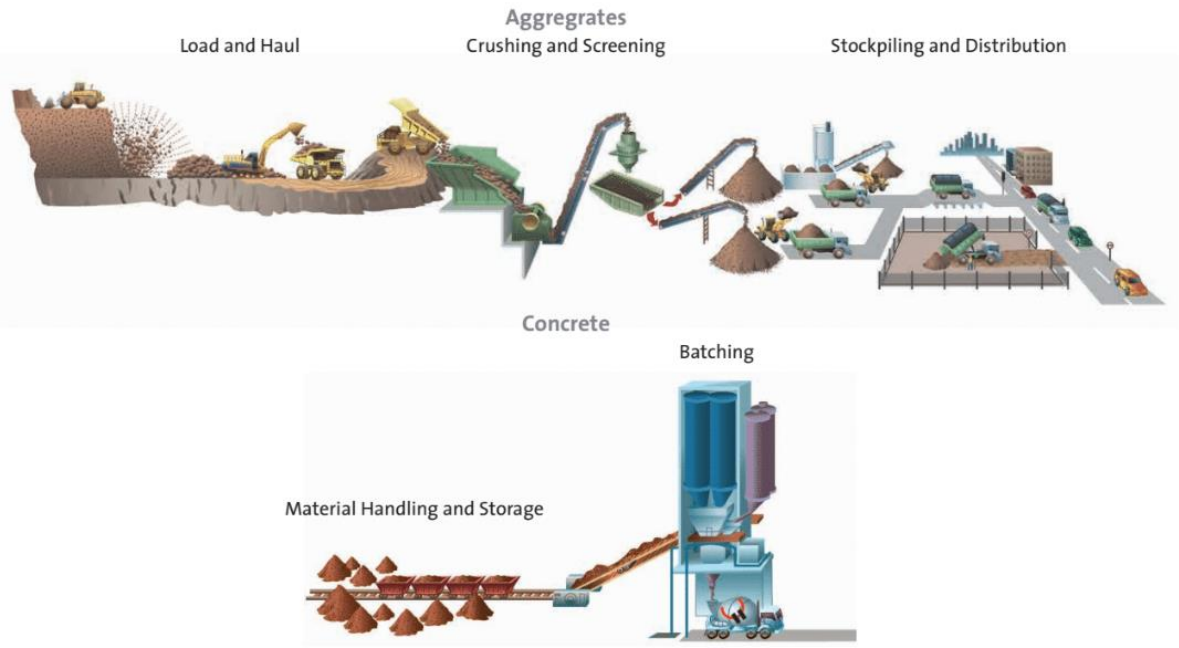
The publication of the original ViroDecs™ EPD in 2019 introduced quality, third-party verified embodied life cycle impact data for ready-mix concrete into the Australian market for the first time. Holcim has been pleased by the positive response from the industry. The message was loud and clear: "we want transparency and we want a evidence-based approach to specification, procurement and reporting". With the introduction of our ViroDecs™ Special, Holcim's customers can specify concrete sustainability performance in terms of CO_2-e, with the confidence that our claims are backed by our third-party verified EPD Process Certification.

Holcim ViroDecs™ Special is backed by an EPD Process Certification. It's not only a first for concrete but a first for any product in Australia. Our EPD Process Certification is a stamp of approval to produce compliant EPDs in-house, opening up significant capability and flexibility in producing and using life cycle impact data to inform our operations and our customers.

To gain our EPD Process Certification, Holcim invested in embedding Life Cycle Assessment (LCA) into our systems and processes. We have satisfied a rigorous, third-party evaluation in accordance with the relevant ISO standards and guidelines of the International EPD Programme and EPD Australasia.

This EPD has been developed using our EPD Process Certification for the project ECOPact – Perth Metropolitan Region with production occurring at Perth Metropolitan concrete plants.

Ready-mix concrete



Summary of properties and classes

Concrete is prepared by mixing cement, coarse and fine aggregates, and water, with or without the addition of auxiliary agents and additives. The fresh concrete is placed on the building site or prefabricated in factory moulds, compacted and hardened in the desired shape by the hydration of cement to form concrete.

General Australian Standard AS 1379 sets down a number of different ways of specifying and ordering concrete to promote uniformity, efficiency and economy in production and delivery. It refers to two classes of concrete: normal-class and special-class.

- **Normal-class –** designed for residential applications, low rise buildings, paving and driveways etc. Its specification and ordering have been simplified as far as practicable.
- **Special-class –** allows the purchaser to incorporate into the project specification any special requirements for the project. Special-class concrete is typically supplied to major and high-end construction projects from high rise buildings, dams and spillways, roads and bridges to public works infrastructure etc. Special-class concrete is typically specified in accordance with the technical parameters and performance requirements, which can include high-strength/high-performances concrete, high durability or marine application, post-tensioned, high-pumpability, super workable, piling concrete, architectural off-form finishes and other decorative applications.

LCA Information

Declared Unit

1 m^3 of ready-mix concrete.

Reference Service Life (RSL)

The RSL is not specified as the scope is from cradle to gate.

Time Representativeness

The plant data for the LCA is based on 2017 calendar year production data. The mix data for the LCA is based on 2021 calendar year production data.

Databases and LCA Software Used

SimaPro (v8.4) was used for the LCA modelling which developed the LCA Calculator, used as per the certified EPD Process. It uses background data from:

1. The Australian National Life Cycle Inventory Database (AusLCI) (2017)
2. Ecoinvent 3.4 (2017)
3. World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative (CSI) Tool Project Database (International Version) (2018); and
4. Product specific EPDs for admixtures and fibres.

The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories included in the environmental impact tables. The following impact categories were calculated manually for the foreground data:

- Use of renewable primary energy resources used as raw materials
- Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
- Use of secondary material
- Use of renewable secondary fuels
- Use of non-renewable secondary fuels

Allocation

Allocation was necessary to proportion inputs and outputs to intermediate flows at the quarry and processes at the batching plant level.
As much as possible, intermediate flows were allocated physically based on weight (quarries) or based on m^2 of concrete (at the batching plant). At the quarry level, whenever physical allocation was not possible, economic allocation was carried out based on Holcim's internal cost system.
Regarding inputs, it was assumed that fly ash and silica fumes are waste products and therefore burden-free. Ground granulated blast furnace slag from steel blast furnace production was allocated economically. Please refer to the "Recycled Material" section for further detail.

Cut-Off Criteria

No flows were excluded on the basis of cut-off criteria.

Address and Contact Information

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Data Quality

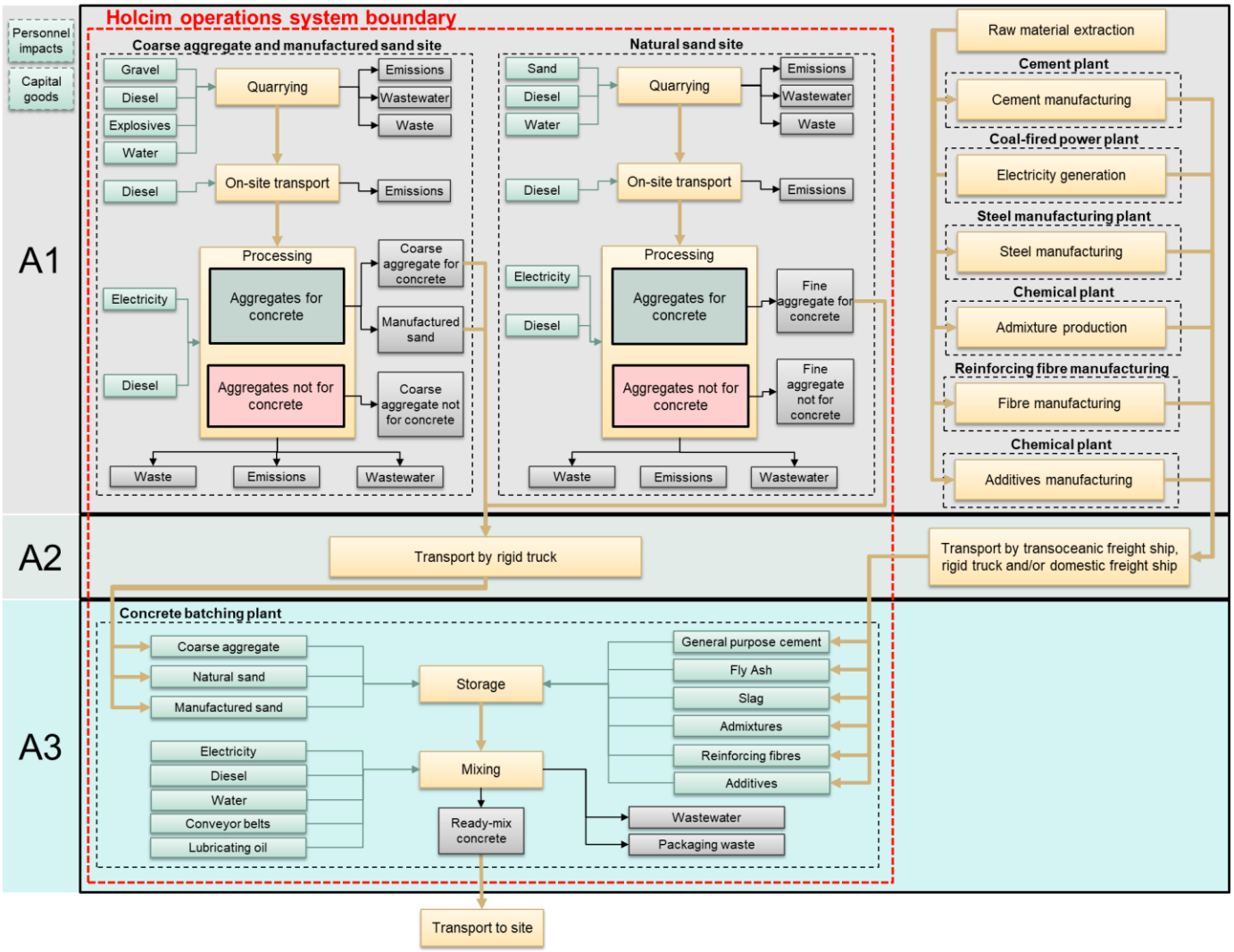
Data quality for the foreground data was assessed in terms of geographic and temporal representativeness. All data sources were scored medium or higher.

Module	Input/outputs	Sub-processes	Data source	Temporal scope	Geographic scope	Quality
A1	Coarse aggregate Manufactured sand Fine aggregate	Electricity	Electricity provider invoices	2017	All states	High
		Diesel	Supplier invoices	2017	All states	High
		Pollutants	National Pollution Inventory (NPI) data	2017	All states	High
		Mains water	Water utility invoices	2017	All states barring NSW	Medium
		Water – other sources (lakes, groundwater, rainwater)	Metered withdrawal data	2017	All states barring NSW	Medium
		Water discharge from site	Measured site data	2017	All states barring NSW	Medium
		Explosives (Manufactured sand and Coarse aggregate only)	Invoices	2017	All states (excluding the Kalgoorlie Quarry in WA which purchases raw feed from an external source)	High
		Gravel	Calculated – spoil + production amount	2017	All states	High
		Spoil	Holcim waste records	2017	All states	High
A2	Aggregate transport	Background data used to model	Actual transport distances and loads per trip	2017	All states (excluding Lynwood Quarry which transports by freight rail)	High
A3	Concrete batching plant	Electricity	Electricity provider invoices	2017	All states	High
		Diesel	Supplier invoices	2017	All states	High
		Mains water	Water metres, with utility invoices as a back-up	2017	All states	High
		Water – other sources (lakes, groundwater, rainwater)	Estimate based on water balance	2017	All states	Medium
		Water discharge from site	Estimate based on Holcim site performance metrics	2017	All states	Medium
		Lubricating oil	AusLCI concrete process	2015	National	Medium
		Conveyor belt				
	Concrete mix designs	Background data used to model	Holcim internal technical database containing mix designs	2017	All states	High
	Packaging waste	Background data used to model	Estimate based on researched packaging material and sizes	N/A	N/A	Medium

Background data sources were also assessed with respect to their timeliness, with all data sources being updated within the 10 years required under PCR 2012:01.

System Diagram

The processes included in the LCA are presented in a process diagram in the figure below.



Description of System Boundaries and Excluded Lifecycle Stages

The scope of the LCA and EPD is from cradle to gate. Life cycle stages beyond Holcim's gate are excluded from the LCA (see figure below).

Environmental impacts relating to personnel, infrastructure and production equipment not directly consumed in the process are excluded from the system boundary as per the Product Category Rules (2012:01 Construction Production and Construction Services).

Product Stage			Construction Stage		Use Stage							End of Life Stage				Benefits & loads for the next product system
Raw Material Supply	Transport	Manufacturing	Transport	Construction/installation process	Use	Maintenance incl. transport	Repair incl. transport	Replacement incl. transport	Refurbishment incl. transport	Operational Energy Use	Operational Water Use	De-construction & demolition	Transport	Re-use recycling	Final Disposal	Reuse, Recovery Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

*Module not declared (MND)

EPD Product Description and Use

ViroDecs™ Ready-mix concrete - Western Australia - Perth Metropolitan Region - ECOPact Range

A detailed breakdown of the functional properties of the ready-mix concrete included in this EPD are provided below. Product environmental information should only be compared with consideration of the product's requisite function.

MIX DESCRIPTIONS	Western Australia - Perth Metropolitan Region - ECOPact Range		MIX DESCRIPTIONS	Western Australia - Perth Metropolitan Region - ECOPact Range	
Strength (MPa)	Mix code	Description of use	Strength (MPa)	Mix code	Description of use
20	WE202E1	S20 20mm ECOPACT 100mm SLUMP CONCRETE	40	WE404E4	S40 14mm ECOPACT 180mm SLUMP CONCRETE
20	WE204E1	S20 14mm ECOPACT 100mm SLUMP CONCRETE	40	WE401E4	S40 10mm ECOPACT 180mm SLUMP CONCRETE
20	WE201E1	S20 10mm ECOPACT 100mm SLUMP CONCRETE	50	WE502E4	S50 20mm ECOPACT 180mm SLUMP CONCRETE
25	WE252E1	S25 20mm ECOPACT 100mm SLUMP CONCRETE	50	WE504E4	S50 14mm ECOPACT 180mm SLUMP CONCRETE
25	WE254E1	S25 14mm ECOPACT 100mm SLUMP CONCRETE	50	WE501E4	S50 10mm ECOPACT 180mm SLUMP CONCRETE
25	WE251E1	S25 10mm ECOPACT 100mm SLUMP CONCRETE	20	WE201EBMX	S20 10mm ECOPACT BLOCKMIX CONCRETE
32	WE322E1	S32 20mm ECOPACT 100mm SLUMP CONCRETE	25	WE251EBMX	S25 10mm ECOPACT BLOCKMIX CONCRETE
32	WE324E1	S32 14mm ECOPACT 100mm SLUMP CONCRETE	32	WE321EBMX	S32 10mm ECOPACT BLOCKMIX CONCRETE
32	WE321E1	S32 10mm ECOPACT 100mm SLUMP CONCRETE	25	WE254EKC	S25 14mm ECOPACT KERB AND CHANNEL CONC
40	WE402E1	S40 20mm ECOPACT 100mm SLUMP CONCRETE	25	WE251EKC	S25 10mm ECOPACT KERB AND CHANNEL CONC
40	WE404E1	S40 14mm ECOPACT 100mm SLUMP CONCRETE	32	WE324EKC	S32 14mm ECOPACT KERB AND CHANNEL CONC
40	WE401E1	S40 10mm ECOPACT 100mm SLUMP CONCRETE	32	WE321EKC	S32 10mm ECOPACT KERB AND CHANNEL CONC
32	WE322E2	S32 20mm ECOPACT 120mm SLUMP CONCRETE	20	WE202EP1	N20 20mm ECOPACT PLUS CONCRETE
32	WE324E2	S32 14mm ECOPACT 120mm SLUMP CONCRETE	25	WE252EP1	N25 20mm ECOPACT PLUS CONCRETE
32	WE321E2	S32 10mm ECOPACT 120mm SLUMP CONCRETE	25	WE254EP1	N25 14mm ECOPACT PLUS CONCRETE
40	WE402E2	S40 20mm ECOPACT 120mm SLUMP CONCRETE	32	WE324EP1	N32 14mm ECOPACT PLUS CONCRETE
40	WE404E2	S40 14mm ECOPACT 120mm SLUMP CONCRETE	50	WE504EQ01	S50 14mm ECOPACT SWC CONCRETE
40	WE401E2	S40 10mm ECOPACT 120mm SLUMP CONCRETE			
50	WE502E2	S50 20mm ECOPACT 120mm SLUMP CONCRETE			
50	WE504E2	S50 14mm ECOPACT 120mm SLUMP CONCRETE			
50	WE501E2	S50 10mm ECOPACT 120mm SLUMP CONCRETE			
32	WE322E4	S32 20mm ECOPACT 180mm SLUMP CONCRETE			
32	WE324E4	S32 14mm ECOPACT 180mm SLUMP CONCRETE			
32	WE321E4	S32 10mm ECOPACT 180mm SLUMP CONCRETE			
40	WE402E4	S40 20mm ECOPACT 180mm SLUMP CONCRETE			

Content Declaration

The following table provides a summary of the materials included in Holcim ready-mix concrete and their relative composition by weight.

Material	Content
General purpose cement	5-21%
Aggregate	67-84%
Supplementary cementitious materials	0-11%
Water	11.6-12%
Admixtures	0.01-0.02%

Holcim Ready-mix concrete is classified as Non-Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. The safety data sheet for pre-mixed concrete lists all associated hazard phrases.

The gross weight of this declared material makes up a minimum of 99% of the products covered by this EPD.

Packaging

Holcim ready-mix concrete is delivered in bulk with no packaging.

Recycled Material

BS EN 16757:2017 specifically lists the following materials relevant to the study as co-products:

- Fly ash;
- Ground granulated blast furnace slag; and
- Silica fume

As such, the above materials are considered as co-products of their production process and the impacts for their production process are allocated according to PCR 2012:01 Construction Products and Construction Services (co-produced goods, multi-output allocation).

Default background data from LCA databases was used to model the above co-products:

- Fly ash: AusLCI process for fly ash treats it as a waste material and only includes transport impacts.
- Ground granulated blast furnace slag: the AusLCI process for slag is allocated based on economic value, as the product has a significant economic value at the point of collection.
- Silica fume: the ecoinvent process for silica fume treat it as a waste material and only includes transport impacts.

The allocation approach of the AusLCI LCA database was adopted as a default for secondary data and processes (e.g. secondary fuel in cement production). The AusLCI dataset conforms to EN 15804 when applying allocation to its various processes and sub-processes.

Environmental Performance

The environmental impacts considered in this EPD are listed in the table below. All further tables from this point will contain abbreviation only.

Impact Category	Abbreviation	Measurement Unit
Potential Environmental Impacts		
Global warming potential	GWP	kg CO_2 equivalents (GWP100)
Ozone depletion potential	ODP	kg CFC 11 equivalents
Acidification potential	AP	kg SO_2 equivalents
Eutrophication Potential	EP	kg PO_4^{3-} equivalents
Photochemical ozone creation potential	POCP	kg C_2H_2 equivalents
Abiotic depletion potential (elements)	ADPE	kg Sb equivalents
Abiotic depletion potential (fossil fuels)	ADPF	MJ net calorific value
Resource use		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value
Use of non- renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value
Total use of non- renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ, net calorific value
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value
Use of net fresh water	FW	m^3
Output categories		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed/stored	RWD	kg
Components for reuse	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ per energy carrier
Optional Green Star (v1.2) indicators		
Human Toxicity	HT	CTUh
Land use	LU	m^2
Water stress indicator	WSI	m^3
Ionising radiation	IR	kBq U235 eq
Particulate matter	PM	kg PM2.5 eq

Western Australia - Perth Metropolitan Region - ECOPact Range

Western Australia - Perth Metropolitan Region - ECOPact Range: 1m^3 of ViroDecs™ ready-mix concrete – Primary indicators

PRIMARY INDICATORS		GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Mix Code	kg CO_2 eq	kg CFC-11 eq	kg SO_2 eq	kg PO_4^{3-} eq	kg C_2H_4 eq	kg Sb eq	MJ
20	WE202E1	193.25	3.08E-06	4.75E-01	1.01E-01	1.76E-02	1.18E-04	1.56E+03
20	WE204E1	201.92	3.19E-06	4.96E-01	1.05E-01	1.85E-02	1.23E-04	1.63E+03
20	WE201E1	203.23	3.16E-06	4.95E-01	1.05E-01	1.85E-02	1.23E-04	1.64E+03
25	WE252E1	209.47	3.24E-06	5.10E-01	1.08E-01	1.88E-02	1.26E-04	1.67E+03
25	WE254E1	218.26	3.36E-06	5.32E-01	1.13E-01	1.97E-02	1.30E-04	1.75E+03
25	WE251E1	218.67	3.32E-06	5.29E-01	1.12E-01	1.96E-02	1.30E-04	1.75E+03
32	WE322E1	232.49	3.48E-06	5.61E-01	1.18E-01	2.04E-02	1.36E-04	1.83E+03
32	WE324E1	239.25	3.52E-06	5.75E-01	1.21E-01	2.09E-02	1.38E-04	1.88E+03
32	WE321E1	241.71	3.56E-06	5.80E-01	1.22E-01	2.13E-02	1.41E-04	1.91E+03
40	WE402E1	268.94	3.84E-06	6.41E-01	1.35E-01	2.30E-02	1.53E-04	2.09E+03
40	WE404E1	276.53	3.90E-06	6.58E-01	1.38E-01	2.37E-02	1.56E-04	2.15E+03
40	WE401E1	276.37	3.93E-06	6.56E-01	1.38E-01	2.38E-02	1.57E-04	2.16E+03
32	WE322E2	234.49	3.48E-06	5.64E-01	1.19E-01	2.08E-02	1.37E-04	1.86E+03
32	WE324E2	241.31	3.52E-06	5.78E-01	1.22E-01	2.13E-02	1.40E-04	1.91E+03
32	WE321E2	243.83	3.57E-06	5.83E-01	1.24E-01	2.16E-02	1.42E-04	1.95E+03
40	WE402E2	271.29	3.85E-06	6.45E-01	1.36E-01	2.34E-02	1.54E-04	2.12E+03
40	WE404E2	278.94	3.91E-06	6.62E-01	1.40E-01	2.41E-02	1.57E-04	2.18E+03
40	WE401E2	278.84	3.94E-06	6.60E-01	1.39E-01	2.42E-02	1.59E-04	2.20E+03
50	WE502E2	327.64	4.42E-06	7.69E-01	1.61E-01	2.75E-02	1.80E-04	2.52E+03
50	WE504E2	328.39	4.41E-06	7.70E-01	1.62E-01	2.77E-02	1.80E-04	2.53E+03
50	WE501E2	321.08	4.37E-06	7.53E-01	1.58E-01	2.73E-02	1.78E-04	2.50E+03
32	WE322E4	234.49	3.48E-06	5.64E-01	1.19E-01	2.08E-02	1.37E-04	1.86E+03
32	WE324E4	241.31	3.52E-06	5.78E-01	1.22E-01	2.13E-02	1.40E-04	1.91E+03
32	WE321E4	243.83	3.57E-06	5.83E-01	1.24E-01	2.16E-02	1.42E-04	1.95E+03
40	WE402E4	271.29	3.85E-06	6.45E-01	1.36E-01	2.34E-02	1.54E-04	2.12E+03
40	WE404E4	278.94	3.91E-06	6.62E-01	1.40E-01	2.41E-02	1.57E-04	2.18E+03
40	WE401E4	278.84	3.94E-06	6.60E-01	1.39E-01	2.42E-02	1.59E-04	2.20E+03
50	WE502E4	327.64	4.42E-06	7.69E-01	1.61E-01	2.75E-02	1.80E-04	2.52E+03
50	WE504E4	328.39	4.41E-06	7.70E-01	1.62E-01	2.77E-02	1.80E-04	2.53E+03
50	WE501E4	321.08	4.37E-06	7.53E-01	1.58E-01	2.73E-02	1.78E-04	2.50E+03
20	WE201EBMX	203.91	3.16E-06	4.95E-01	1.06E-01	1.87E-02	1.20E-04	1.67E+03
25	WE251EBMX	222.85	3.35E-06	5.36E-01	1.15E-01	2.00E-02	1.28E-04	1.81E+03
32	WE321EBMX	248.83	3.62E-06	5.93E-01	1.26E-01	2.20E-02	1.39E-04	2.00E+03
25	WE254EKC	213.59	3.26E-06	5.26E-01	1.10E-01	1.98E-02	1.27E-04	1.72E+03
25	WE251EKC	226.36	3.36E-06	5.54E-01	1.15E-01	2.07E-02	1.32E-04	1.81E+03
32	WE324EKC	256.98	3.70E-06	6.22E-01	1.29E-01	2.28E-02	1.46E-04	2.02E+03
32	WE321EKC	269.51	3.79E-06	6.50E-01	1.34E-01	2.38E-02	1.51E-04	2.11E+03
20	WE202EP1	195.65	3.11E-06	4.81E-01	1.02E-01	1.74E-02	1.15E-04	1.55E+03
25	WE252EP1	211.66	3.28E-06	5.16E-01	1.09E-01	1.85E-02	1.22E-04	1.66E+03
25	WE254EP1	215.67	3.32E-06	5.25E-01	1.11E-01	1.89E-02	1.23E-04	1.70E+03
32	WE324EP1	234.45	3.50E-06	5.66E-01	1.19E-01	2.01E-02	1.31E-04	1.82E+03
50	WE504EQ01	396.06	4.77E-06	9.19E-01	1.92E-01	3.31E-02	2.10E-04	3.00E+03

Western Australia - Perth Metropolitan Region - ECOPact Range: 1m^3 of ViroDecs™ ready-mix concrete – Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE		PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Mix Code	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	kg	MJ_{NCV}	MJ_{NCV}	m^3
20	WE202E1	2.85E+01	0.00E+00	2.85E+01	8.51E+02	1.41E+02	9.93E+02	1.00E+02	0.00E+00	0.00E+00	8.40E-01
20	WE204E1	3.00E+01	0.00E+00	3.00E+01	8.88E+02	1.57E+02	1.04E+03	1.04E+02	0.00E+00	0.00E+00	8.66E-01
20	WE201E1	3.02E+01	0.00E+00	3.02E+01	8.98E+02	1.49E+02	1.05E+03	1.13E+02	0.00E+00	0.00E+00	8.50E-01
25	WE252E1	3.03E+01	0.00E+00	3.03E+01	9.14E+02	1.37E+02	1.05E+03	1.10E+02	0.00E+00	0.00E+00	8.67E-01
25	WE254E1	3.19E+01	0.00E+00	3.19E+01	9.51E+02	1.54E+02	1.10E+03	1.14E+02	0.00E+00	0.00E+00	8.93E-01
25	WE251E1	3.21E+01	0.00E+00	3.21E+01	9.60E+02	1.45E+02	1.10E+03	1.24E+02	0.00E+00	0.00E+00	8.71E-01
32	WE322E1	3.30E+01	0.00E+00	3.30E+01	1.00E+03	1.35E+02	1.14E+03	1.24E+02	0.00E+00	0.00E+00	9.05E-01
32	WE324E1	3.39E+01	0.00E+00	3.39E+01	1.03E+03	1.37E+02	1.16E+03	1.28E+02	0.00E+00	0.00E+00	9.12E-01
32	WE321E1	3.48E+01	0.00E+00	3.48E+01	1.05E+03	1.42E+02	1.19E+03	1.38E+02	0.00E+00	0.00E+00	9.10E-01
40	WE402E1	3.76E+01	0.00E+00	3.76E+01	1.15E+03	1.30E+02	1.28E+03	1.46E+02	0.00E+00	0.00E+00	9.45E-01
40	WE404E1	3.88E+01	0.00E+00	3.88E+01	1.17E+03	1.39E+02	1.31E+03	1.50E+02	0.00E+00	0.00E+00	9.58E-01
40	WE401E1	3.90E+01	0.00E+00	3.90E+01	1.19E+03	1.36E+02	1.33E+03	1.62E+02	0.00E+00	0.00E+00	9.58E-01
32	WE322E2	3.31E+01	0.00E+00	3.31E+01	1.04E+03	1.35E+02	1.17E+03	1.24E+02	0.00E+00	0.00E+00	9.05E-01
32	WE324E2	3.40E+01	0.00E+00	3.40E+01	1.06E+03	1.37E+02	1.20E+03	1.28E+02	0.00E+00	0.00E+00	9.12E-01
32	WE321E2	3.48E+01	0.00E+00	3.48E+01	1.09E+03	1.42E+02	1.23E+03	1.38E+02	0.00E+00	0.00E+00	9.10E-01
40	WE402E2	3.77E+01	0.00E+00	3.77E+01	1.19E+03	1.30E+02	1.32E+03	1.46E+02	0.00E+00	0.00E+00	9.46E-01
40	WE404E2	3.89E+01	0.00E+00	3.89E+01	1.21E+03	1.39E+02	1.35E+03	1.50E+02	0.00E+00	0.00E+00	9.58E-01
40	WE401E2	3.91E+01	0.00E+00	3.91E+01	1.23E+03	1.36E+02	1.37E+03	1.62E+02	0.00E+00	0.00E+00	9.58E-01
50	WE502E2	4.42E+01	0.00E+00	4.42E+01	1.41E+03	1.23E+02	1.53E+03	1.80E+02	0.00E+00	0.00E+00	1.04E+00
50	WE504E2	4.45E+01	0.00E+00	4.45E+01	1.41E+03	1.31E+02	1.54E+03	1.80E+02	0.00E+00	0.00E+00	1.04E+00
50	WE501E2	4.40E+01	0.00E+00	4.40E+01	1.40E+03	1.30E+02	1.53E+03	1.89E+02	0.00E+00	0.00E+00	1.03E+00
32	WE322E4	3.31E+01	0.00E+00	3.31E+01	1.04E+03	1.35E+02	1.17E+03	1.24E+02	0.00E+00	0.00E+00	9.05E-01
32	WE324E4	3.40E+01	0.00E+00	3.40E+01	1.06E+03	1.37E+02	1.20E+03	1.28E+02	0.00E+00	0.00E+00	9.12E-01
32	WE321E4	3.48E+01	0.00E+00	3.48E+01	1.09E+03	1.42E+02	1.23E+03	1.38E+02	0.00E+00	0.00E+00	9.10E-01
40	WE402E4	3.77E+01	0.00E+00	3.77E+01	1.19E+03	1.30E+02	1.32E+03	1.46E+02	0.00E+00	0.00E+00	9.46E-01
40	WE404E4	3.89E+01	0.00E+00	3.89E+01	1.21E+03	1.39E+02	1.35E+03	1.50E+02	0.00E+00	0.00E+00	9.58E-01
40	WE401E4	3.91E+01	0.00E+00	3.91E+01	1.23E+03	1.36E+02	1.37E+03	1.62E+02	0.00E+00	0.00E+00	9.58E-01
50	WE502E4	4.42E+01	0.00E+00	4.42E+01	1.41E+03	1.23E+02	1.53E+03	1.80E+02	0.00E+00	0.00E+00	1.04E+00
50	WE504E4	4.45E+01	0.00E+00	4.45E+01	1.41E+03	1.31E+02	1.54E+03	1.80E+02	0.00E+00	0.00E+00	1.04E+00
50	WE501E4	4.40E+01	0.00E+00	4.40E+01	1.40E+03	1.30E+02	1.53E+03	1.89E+02	0.00E+00	0.00E+00	1.03E+00
20	WE201EBMX	3.01E+01	0.00E+00	3.01E+01	9.30E+02	1.48E+02	1.08E+03	1.13E+02	0.00E+00	0.00E+00	8.56E-01
25	WE251EBMX	3.23E+01	0.00E+00	3.23E+01	1.01E+03	1.44E+02	1.15E+03	1.26E+02	0.00E+00	0.00E+00	8.84E-01
32	WE321EBMX	3.55E+01	0.00E+00	3.55E+01	1.12E+03	1.43E+02	1.26E+03	1.43E+02	0.00E+00	0.00E+00	9.22E-01
25	WE254EKC	3.17E+01	0.00E+00	3.17E+01	9.19E+02	1.67E+02	1.09E+03	1.22E+02	0.00E+00	0.00E+00	9.11E-01
25	WE251EKC	3.32E+01	0.00E+00	3.32E+01	9.64E+02	1.67E+02	1.13E+03	1.30E+02	0.00E+00	0.00E+00	9.32E-01
32	WE324EKC	3.66E+01	0.00E+00	3.66E+01	1.08E+03	1.54E+02	1.24E+03	1.51E+02	0.00E+00	0.00E+00	9.80E-01
32	WE321EKC	3.83E+01	0.00E+00	3.83E+01	1.13E+03	1.59E+02	1.29E+03	1.60E+02	0.00E+00	0.00E+00	1.00E+00
20	WE202EP1	2.92E+01	0.00E+00	2.92E+01	8.24E+02	1.38E+02	9.62E+02	1.04E+02	0.00E+00	0.00E+00	8.34E-01
25	WE252EP1	3.11E+01	0.00E+00	3.11E+01	8.82E+02	1.36E+02	1.02E+03	1.14E+02	0.00E+00	0.00E+00	8.62E-01
25	WE254EP1	3.18E+01	0.00E+00	3.18E+01	8.96E+02	1.43E+02	1.04E+03	1.16E+02	0.00E+00	0.00E+00	8.70E-01
32	WE324EP1	3.40E+01	0.00E+00	3.40E+01	9.64E+02	1.37E+02	1.10E+03	1.28E+02	0.00E+00	0.00E+00	8.95E-01
50	WE504EQ01	4.95E+01	0.00E+00	4.95E+01	1.72E+03	1.45E+02	1.86E+03	1.60E+02	0.00E+00	0.00E+00	1.15E+00

Western Australia - Perth Metropolitan Region - ECOPact Range: 1m^3 of ViroDecs™ ready-mix concrete – Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS		HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength (MPa)	Mix Code	kg	kg	kg	kg	kg	kg	MJ
20	WE202E1	9.76E-04	5.62E+00	9.58E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	WE204E1	1.00E-03	5.84E+00	9.94E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	WE201E1	1.00E-03	5.82E+00	9.88E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE252E1	1.03E-03	5.97E+00	1.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE254E1	1.06E-03	6.19E+00	1.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE251E1	1.06E-03	6.16E+00	1.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE322E1	1.12E-03	6.47E+00	1.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE324E1	1.13E-03	6.58E+00	1.12E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE321E1	1.14E-03	6.67E+00	1.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE402E1	1.23E-03	7.25E+00	1.25E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE404E1	1.24E-03	7.39E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE401E1	1.27E-03	7.44E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE322E2	1.12E-03	6.47E+00	1.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE324E2	1.13E-03	6.58E+00	1.12E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE321E2	1.15E-03	6.68E+00	1.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE402E2	1.23E-03	7.26E+00	1.25E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE404E2	1.24E-03	7.40E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE401E2	1.27E-03	7.45E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE502E2	1.43E-03	8.46E+00	1.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE504E2	1.42E-03	8.45E+00	1.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE501E2	1.43E-03	8.36E+00	1.41E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE322E4	1.12E-03	6.47E+00	1.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE324E4	1.13E-03	6.58E+00	1.12E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE321E4	1.15E-03	6.68E+00	1.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE402E4	1.23E-03	7.26E+00	1.25E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE404E4	1.24E-03	7.40E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	WE401E4	1.27E-03	7.45E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE502E4	1.43E-03	8.46E+00	1.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE504E4	1.42E-03	8.45E+00	1.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE501E4	1.43E-03	8.36E+00	1.41E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	WE201EBMX	1.01E-03	5.81E+00	9.80E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE251EBMX	1.08E-03	6.22E+00	1.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE321EBMX	1.16E-03	6.78E+00	1.15E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE254EKC	1.05E-03	6.04E+00	9.98E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE251EKC	1.08E-03	6.28E+00	1.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE324EKC	1.21E-03	6.98E+00	1.16E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE321EKC	1.24E-03	7.21E+00	1.19E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	WE202EP1	9.84E-04	5.73E+00	9.86E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE252EP1	1.04E-03	6.08E+00	1.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	WE254EP1	1.05E-03	6.16E+00	1.06E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	WE324EP1	1.11E-03	6.56E+00	1.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	WE504EQ01	1.43E-03	9.47E+00	1.63E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Western Australia - Perth Metropolitan Region - ECOPact Range: 1m^3 of ViroDecs™ ready-mix concrete – Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS		HT	LU	WSI	IR	PM
Strength (MPa)	Mix Code	CTUh	m^2	m^3	kBq U235 eq	kg PM2.5 eq
20	WE202E1	6.14E-09	1.14E-02	6.01E-01	7.18E-02	2.93E-01
20	WE204E1	6.39E-09	1.18E-02	6.28E-01	7.45E-02	3.11E-01
20	WE201E1	6.45E-09	1.17E-02	6.29E-01	7.41E-02	3.00E-01
25	WE252E1	6.70E-09	1.21E-02	6.47E-01	7.62E-02	2.98E-01
25	WE254E1	6.95E-09	1.25E-02	6.74E-01	7.89E-02	3.17E-01
25	WE251E1	6.98E-09	1.24E-02	6.73E-01	7.85E-02	3.03E-01
32	WE322E1	7.47E-09	1.30E-02	7.14E-01	8.26E-02	3.06E-01
32	WE324E1	7.69E-09	1.32E-02	7.32E-01	8.42E-02	3.10E-01
32	WE321E1	7.76E-09	1.34E-02	7.40E-01	8.50E-02	3.12E-01
40	WE402E1	8.69E-09	1.45E-02	8.18E-01	9.37E-02	3.16E-01
40	WE404E1	8.92E-09	1.47E-02	8.39E-01	9.55E-02	3.26E-01
40	WE401E1	8.93E-09	1.48E-02	8.39E-01	9.52E-02	3.22E-01
32	WE322E2	7.47E-09	1.30E-02	7.14E-01	8.26E-02	3.07E-01
32	WE324E2	7.69E-09	1.32E-02	7.32E-01	8.42E-02	3.10E-01
32	WE321E2	7.76E-09	1.34E-02	7.40E-01	8.50E-02	3.12E-01
40	WE402E2	8.69E-09	1.45E-02	8.18E-01	9.37E-02	3.16E-01
40	WE404E2	8.92E-09	1.47E-02	8.40E-01	9.56E-02	3.26E-01
40	WE401E2	8.93E-09	1.48E-02	8.40E-01	9.52E-02	3.23E-01
50	WE502E2	1.06E-08	1.68E-02	9.78E-01	1.09E-01	3.39E-01
50	WE504E2	1.06E-08	1.67E-02	9.80E-01	1.09E-01	3.44E-01
50	WE501E2	1.03E-08	1.66E-02	9.60E-01	1.07E-01	3.39E-01
32	WE322E4	7.47E-09	1.30E-02	7.14E-01	8.26E-02	3.07E-01
32	WE324E4	7.69E-09	1.32E-02	7.32E-01	8.42E-02	3.10E-01
32	WE321E4	7.76E-09	1.34E-02	7.40E-01	8.50E-02	3.12E-01
40	WE402E4	8.69E-09	1.45E-02	8.18E-01	9.37E-02	3.16E-01
40	WE404E4	8.92E-09	1.47E-02	8.40E-01	9.56E-02	3.26E-01
40	WE401E4	8.93E-09	1.48E-02	8.40E-01	9.52E-02	3.23E-01
50	WE502E4	1.06E-08	1.68E-02	9.78E-01	1.09E-01	3.39E-01
50	WE504E4	1.06E-08	1.67E-02	9.80E-01	1.09E-01	3.44E-01
50	WE501E4	1.03E-08	1.66E-02	9.60E-01	1.07E-01	3.39E-01
20	WE201EBMX	6.45E-09	1.17E-02	6.28E-01	7.35E-02	3.00E-01
25	WE251EBMX	7.09E-09	1.25E-02	6.82E-01	7.87E-02	3.05E-01
32	WE321EBMX	7.95E-09	1.36E-02	7.56E-01	8.61E-02	3.15E-01
25	WE254EKC	6.88E-09	1.22E-02	6.67E-01	7.50E-02	3.24E-01
25	WE251EKC	7.32E-09	1.26E-02	7.03E-01	7.79E-02	3.29E-01
32	WE324EKC	8.40E-09	1.39E-02	7.93E-01	8.69E-02	3.34E-01
32	WE321EKC	8.81E-09	1.43E-02	8.29E-01	8.96E-02	3.43E-01
20	WE202EP1	6.35E-09	1.16E-02	6.18E-01	7.39E-02	2.89E-01
25	WE252EP1	6.91E-09	1.22E-02	6.65E-01	7.84E-02	2.95E-01
25	WE254EP1	7.03E-09	1.24E-02	6.77E-01	7.95E-02	3.02E-01
32	WE324EP1	7.68E-09	1.31E-02	7.31E-01	8.47E-02	3.05E-01
50	WE504EQ01	1.24E-08	1.83E-02	1.13E+00	1.23E-01	3.85E-01

Other life cycle stages not included in this EPD

While the LCA study and EPD only consider the cradle to gate environmental impacts of Holcim's ready-mix concrete, practitioners using the EPD for the purpose of whole-of-life building studies or the functional comparison of different building products on a whole-of-life basis will consider concrete's other life cycle stages. Some of the environmental impacts of benefits associated with other life cycle stages not included in this EPD are described in the following sections.

Lifetime absorption of CO_2

Carbonation is a natural process whereby concrete absorbs carbon dioxide (CO_2) from the atmosphere through a chemical reaction between the CO_2 in the ambient air and hydration products within the concrete ($CaOH_2$). Ready-mix concrete can be subject to carbonation from the use stage onward (i.e. after construction and curing). From a life cycle impact accounting perspective, this process can also be referred to as 'reabsorption', since the CO_2 emitted during the cement manufacturing process can be partly offset by the lifetime absorption of CO_2, therefore reducing the net CO_2 emissions associated with concrete over its lifetime.

The carbonisation process is a commonly known process in building design and is typically taken into consideration by engineers when specifying special-class concrete.

The total amount of CO_2 absorption during the life cycle of concrete is subject to a range of factors and varies over time. The calculation has been standardised in the British and European Standard BS EN 16757:2017 *Sustainability of construction works – Environmental Product Declarations – Product Category Rules for concrete and concrete elements.* It is recommended that practitioners make use of this standard when conducting whole-of-life building studies and if the building materials include substantial amounts of concrete. Please note that CO_2 absorption has not been considered in this EPD and is not reflected in the EPD results tables.

End of life scenarios

BS EN 16757:2017 presents four end of life scenarios for concrete:

1. Disposal of concrete at a landfill site,
2. Reuse of recovered concrete elements in new construction works,
3. Use of concrete debris, e.g. In land restoration, or
4. Crushing/recycling of concrete:
    a. Crushed concrete substitutes primary material without further processing, or
    b. Substitution of natural aggregates in fresh concrete.

Scenarios 2, 3 and 4 can all result in benefits and loads outside the system boundary and thus should be considered in a whole-of-life building study or when comparing concrete products on a functional basis in line with BS EN 16757:2017.

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Programme-related information and verification

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EPD Produced by	Holcim (Australia) Pty Ltd Level 8, 799 Pacific Highway Chatswood NSW 2067, Australia Web: www.holcim.com.au Phone: +61 2 9412 6600	Holcim
EPD Process Certified by	Epsten Group Suite 2600, 101 Marietta St NW, Atlanta, Georgia 30303, USA Web: www.epstengroup.com	epstengroup
EPD Registration Number	S-P-03716	
Valid From	2021-11-25	
Version	1.0	
Valid Until	2026-11-25	
Product category rules	PCR 2012:01 Construction Products and Construction Services, Version 2.3, 2018-11-15	
Product group classification	UN CPC 54	
Geographical Scope	Australia	
Reference Year for Data	2017 Plant Data, 2021 Mix/Materials Data	

CEN standard EN 15804:2012+a1:2013 served as the core PCR

Product category rules	PCR 2012:01 Construction Products and Construction Services, Version 2.3, 2018-11-15
PCR review was conducted by	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent third-party verification of the declaration and data, according to ISO 14025:2006:	☒ EPD process certification ☐ EPD verification
Third Party Verifier	Epsten Group, Inc., Katherine McFeaters: Katherine McFeaters Accredited by: A2LA, Certificate #3142.03
Procedure for follow-up of data during EPD validity involves third party verifier:	☐ Yes ☒ No

Programme-related information and verification:

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.

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