BRICKWORKS

Explorer Concrete Sleepers from Austral Masonry Yatala, Queensland

Environmental Product Declaration
In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021

Programme: The International EPD® System www.environdec.com
Programme operator: EPD International AB
Regional Programme: EPD Australasia www.epd-australasia.com
EPD Registration no. EPD-IES-0024421:001 | **Version 1.0**
Date of issue 2025-06-19 **| Valid until** 2030-06-19
Geographical scope: Australia

EPD of multiple concrete masonry products from a single manufacturing facility, based on average results.
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.environdec.com

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EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Program Information and Verification

An Environmental Product Declaration (EPD) is a standardised way of quantifying the potential environmental impacts of a product or system. EPDs are produced according to a consistent set of rules – Product Category Rules (PCR) – that define the requirements within a given product category. These rules are a key part of ISO 14025 as they enable transparency and comparability between EPDs.

This EPD is a "cradle-to-gate plus modules C1-C4, D" declaration covering production and end-of-life life cycle stages.

Brickworks Ltd, as the EPD owner, has the sole ownership, liability, and responsibility for the EPD.

Declaration Owner	Address: 738-780 Wallgrove Road, Horsley Park, NSW, 2175 Web: www.australmasonry.com.au Phone: 1300 627 667 Email: sales@australmasonry.com.au	
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CEN standard EN 15804 serves as the Core Product Category Rules (PCR)

PCR:	PCR 2019:14 Construction Products, Version 1.3.4, 2024-04-30 (valid until 2025-06-20) C-PCR-003 (to 2019:14) Concrete and concrete elements, version 2024-04-30
PCR review was conducted by:	The Technical Committee of the International EPD® System. See www.environdec.com for a list of members. Most recent review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Independent verification of the declaration and data, according to ISO 14025:	■ EPD verification by individual verifier
Third party verifier: Approved by EPD Australasia Ltd	Sazal Kundu, Edge Impact Address: Greenhouse, Level 3, 180 George Street Sydney NSW 2000, Australia Web: https://www.edgeimpact.global/ Phone: +61 2 9438 0100 Email: sazal.kundu@edgeimpact.global
Procedure for follow-up of data during EPD validity involves third party verifier	☐ Yes ■ No

About Us

Brickworks is one of Australia's largest and most diverse building material manufacturers.

Brickworks has been transformed from originally a NSW state-based operation to an International organisation with manufacturing operations in New South Wales, Victoria, Tasmania, South Australia, Queensland and North America.

Austral Masonry is a subsidiary of Brickworks that manufactures and sells Australian made concrete blocks, retaining wall blocks, concrete sleepers and concrete pavers.

Concrete blocks are used in residential and commercial construction. By mixing sands, aggregate and cement we produce grey blocks in a vast range of sizes and formats.

Concrete retaining wall blocks, concrete sleepers and concrete pavers are used in DIY and professionally installed applications to create landscape designs.

This EPD covers all Explorer concrete sleepers produced at our Yatala Queensland location which manufactures under the Austral Masonry brand.

Owner of the EPD: Brickworks Limited
Contact: info@brickworks.com.au

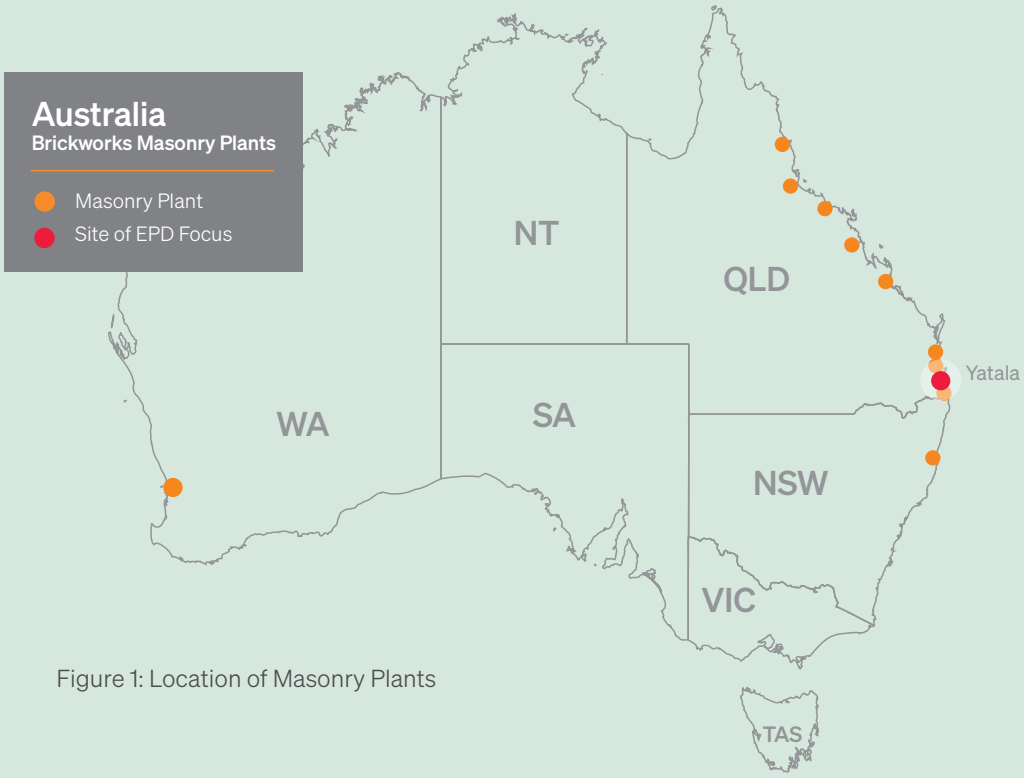

Figure 1: Location of Masonry Plants

Our Products

The life cycle of concrete sleepers starts with extraction of sand, gravel and cement from quarries and mines. The processed materials are then mixed and moulded into the desired sleeper size and finish in our manufacturing plant.

Concrete sleepers are typically used in residential and commercial retaining wall applications.

This EPD covers the Explorer range of concrete sleepers produced at our Yatala, Queensland plant under the Austral Masonry brand.

Figure 2 - Typical sleeper sizing and available ranges (Source: Brickworks)

1530L x200H x 75T mm
1580L x 200H x 75T mm
2000L x 200H x 75T mm
2400L x 200H x 75T mm
2000L x 400H x 75T mm
2000L x 600H x 75T mm
2000L x 1000H x 75T mm

Finish: Smooth
Available Ranges:
Austral Masony:
Explorer Concrete Sleepers

1530L x200H x 75T mm
1580L x 200H x 75T mm
2000L x 200H x 75T mm
2400L x 200H x 75T mm
2000L x 400H x 75T mm
2000L x 600H x 75T mm
2000L x 1000H x 75T mm

Finish: Timberlook
Available Ranges:
Austral Masony:
Explorer Concrete Sleepers

1530L x200H x 75T mm
1580L x 200H x 75T mm
2000L x 200H x 75T mm
2400L x 200H x 75T mm
2000L x 400H x 75T mm
2000L x 600H x 75T mm
2000L x 1000H x 75T mm

Finish: Sandstone
Available Ranges:
Austral Masony:
Explorer Concrete Sleepers

1530L x200H x 75T mm
1580L x 200H x 75T mm
2000L x 200H x 75T mm
2400L x 200H x 75T mm

Finish: Slate
Available Ranges:
Austral Masony:
Explorer Concrete Sleepers

Content Declaration

The concrete sleepers may have unique characteristics such as shape, colour and dimensions, but in essence, these concrete products are made with the same set of ingredients. The concrete constituents that are used (in various combinations) are shown in the table below:

The products included in this EPD do not contain any substances that are listed in the "Candidate List of Substances of Very High Concern (SVHC) for authorisation" (ECHA 2024) in concentrations exceeding 0.1% of the weight of the product.

Table 1: Product content declaration for Explorer concrete sleepers produced at Yatala

Product component	Weight (kg/t of sleeper)	Post-consumer recycled material, weight % of product	Biogenic material, weight % of product	Biogenic material (kgC/t of sleeper)
GP CEMENT	200-210	0%	0%	0
NATURAL SAND	180-200	0%	0%	0
MANUFACTURED SAND	590-600	0%	0%	0
ADMIXTURES	0-1	0%	0%	0
OXIDES	0-18	0%	0%	0
REINFORCEMENT STEEL	2-12	1.5-9.0%	0%	0
PP BAR CHAIRS	<0.1	0%	0%	0
TOTAL	1000	1.5-9.0%	0%	0

Our products contain recycled content, however, in line with reporting requirements outlined in the PCR, the above table will indicate 0% post-consumer recycled material where we cannot guarantee whether the origin of recycled material is pre-consumer or post-consumer.

Packaging materials

Concrete sleepers are stacked and held together using plastic (polyester or polypropylene) strapping bands. The amount of strapping is estimated to be less than 0.05% of total product mass and have been excluded from the results of this EPD.

Technical Compliance

Austral Masonry concrete sleeper products are manufactured to Australian Standard AS3600: 2018 Concrete Structures.

Product quality testing is performed in accordance with AS 1379:2007 Specification and Supply of concrete and AS1012:2014 Methods of Testing Concrete.

Further details on product use and design for different applications can be found on Austral Masonry's website and more specifically their concrete sleeper product page and product information page[1].

Concrete sleeper products are classified under:

• UN CPC 37550 - Prefabricated structural components for building or civil engineering, of cement, concrete or artificial stone

• ANZSIC 2034 - Concrete product manufacturing.

Declared Unit

Concrete sleepers are available in various shapes and sizes that are specifically designed for different styles and applications. The declared unit that covers all the permutations within the scope of the products included in this EPD is:

1 tonne (1,000 kg) of concrete sleeper products.

A reference service life (RSL) is not declared, as the EPD does not cover the full life cycle.

https://australmasonry.com.au/sqld/product-information/

Product Life Cycle

Overview

The EPD covers the cradle-to-gate with modules C1–C4 and module D (A1–A3, C and D) life cycle stages. Intermediate life cycle stages (Modules A4, A5 and B1-B7) have not been included as these are better defined at building or structure level.

Table 2: Scope of the EPD

Stages	Product stage			Construction stage		Use stage							End-of-life stage				Benefits beyond system boundary
	Raw Materials	Transport	Production	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/Demolition	Transport	Waste Processing	Disposal	Reuse, recovery, recycling potential
Modules	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
				SCENARIO					SCENARIO					SCENARIO			SCENARIO
Modules Declared	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	✓	✓	✓	ND	ND	ND	ND	ND	ND	ND	ND	ND	✓	✓	✓	✓	✓
Geography	AU, VN	AU	AU										AU	AU	AU	AU	AU
Share of specific data		31%															
Variation products		<10%															
Variation sites		0%															

✓ = module is included in this study

ND = module is not declared. When a module is not accounted for, the stage is marked with "ND" (Not Declared). ND is used when we cannot define a typical scenario.

Product Stages (A1-A3)

Stage A1 – raw material extraction

Concrete sleeper products are typically made using cement, fine and coarse aggregates, reinforcing steel and water. Admixtures and oxides may be used to achieve desired material properties and colours. Reinforcing steel mesh is sourced locally.

Stage A2 – transportation

Raw materials are typically transported to Austral Masonry facilities via articulated trucks (with distances varying for each facility). Cement is sourced from overseas and transported by transoceanic freight ship as well as articulated trucks.

The impact of transportation is determined from the specific supply sources to Austral Masonry's plants. It is noted that for admixtures, the supplier location which is known is the location that is used in the analysis.

Internal transport occurring within Austral Masonry's core process is included in stage A3, as fuel use cannot always be separated from other core processes.

Stage A3 – manufacturing

The manufacturing process of Austral Masonry's concrete sleepers starts by batching and mixing the concrete constituents in exact formulations (concrete mix designs). Steel reinforcement bars/mesh are inserted into the mould before pouring the concrete. The wet concrete mix is poured into moulds and vibrated. The concrete sleepers are cured in curing chambers for a minimum of 12 hours prior to demoulding and recovery. Our facilities use electricity, diesel and LPG in this process. When the concrete has developed enough strength, the mould is removed, cleaned and reused. Finally, the products are tested and stockpiled.

End-of-life stage (C1-C4)

The end-of-life modules for concrete sleepers are based on a generic scenario. The scenario included is currently in use and is representative for one of the most probable alternatives.

Module C1 covers demolition of the concrete retaining walls at the end of its service life. We have used the Australian average end-of-life scenario representative for building & demolition materials products based on the National Waste Report 2022 (NWR 2022). This scenario implies that 79.8% of the concrete is recycled and the remaining 20.2% of the concrete is sent to landfill.

Module C2 comprises the transport from the demolition site to a recycling centre or landfill site (50km). Module C3 encompasses the recycling process (i.e. crushing of concrete), while Module C4 represents disposal of concrete in a landfill site.

The concrete reaches end-of-waste status when it is crushed and stockpiled as "recycled crushed concrete" (RCC) aggregates.

Details for the end-of-life scenario have been captured in table 3 below.

Due to high uncertainty in the parameters and lack of data, CO_2-uptake (carbonation) has not been included in end-of-life.

Resource recovery stage (D)

Net benefits and loads from net flows leaving the product system beyond the system boundary that have passed the end-of-waste state (except those which have been allocated as co-products). This stage is modelled based on assumptions to represent the most likely scenario for steel-reinforced sleepers produced in Yatala.

Impacts and benefits associated with recycling of steel scrap that has come out of module C3 for steel-reinforced sleepers produced in Yatala:

- A typical steel reinforcement content is assumed for all reinforced sleepers (of 5% by mass) to calculate module D benefits.
- InfraBuild has disclosed the recycled content of its steel. For the net flow calculation, the (post-consumer) recycled content of incoming steel is 73.5%. The net flow for each tonne of reinforcement steel used is calculated ('79.6% - 73.5%) as a small (6.1%) flow of scrap leaving the product system into module D, , resulting in a credit associated with steel in module D.
- Module D credits/debits are calculated as the difference between secondary steelmaking and primary steel making using AusLCI data.

Figure 3: Life cycle stages of Austral Masonry concrete sleepers

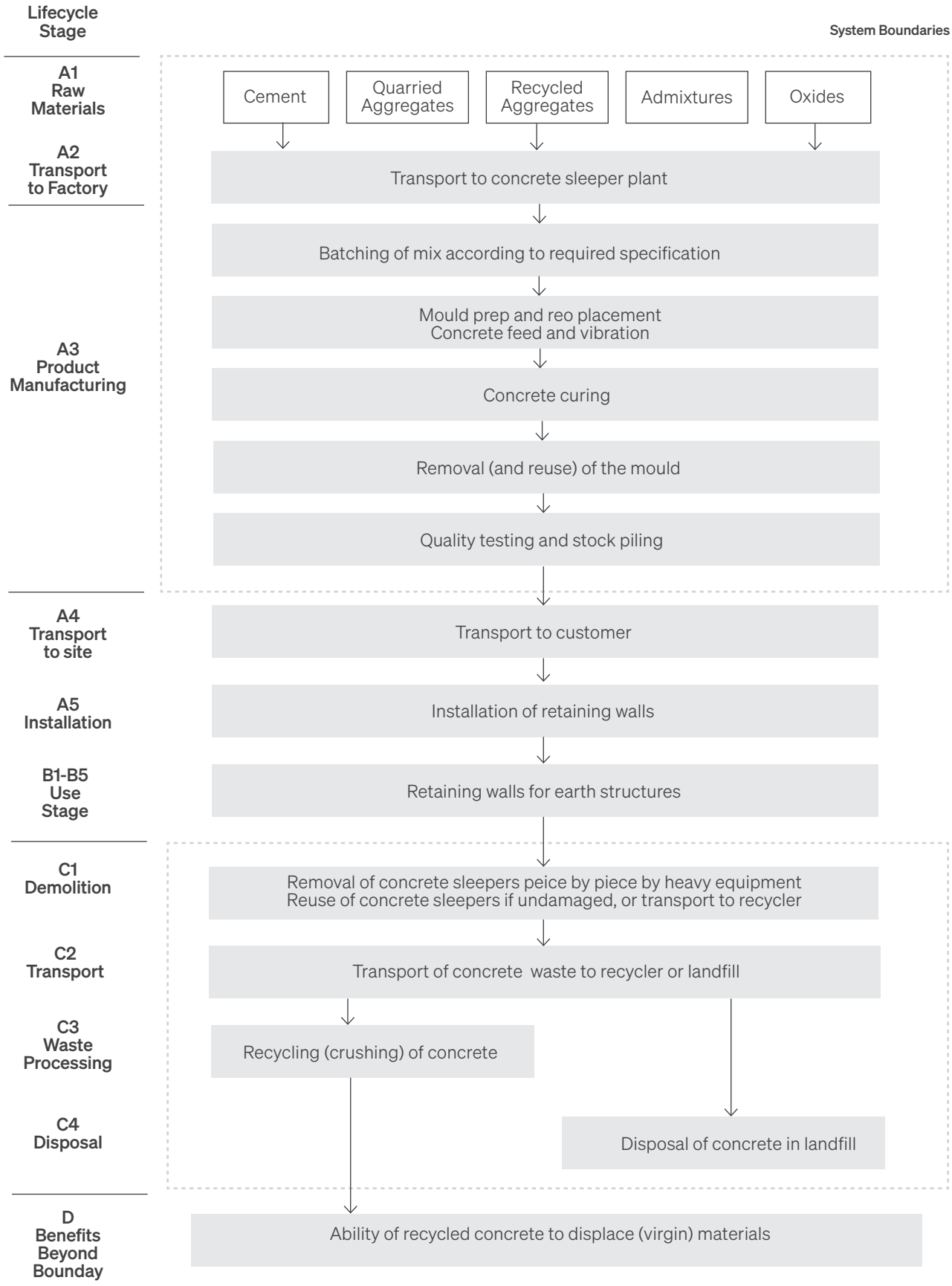

Table 3: End-of-life scenario of concrete sleepers, per tonne

Processes	Quantity	Unit
Collection process specified by type	1,000	kg collected separately
	0	kg collected with mixed construction waste
Transport from demolition site to recovery/ disposal sites	50	km transport (transport, truck, 16-28t, fleet average/AU U)
Recovery system specified by type	0	kg for re-use
	798	kg for recycling (recycling brick rubble and concrete, at plant/AU U)
	0	kg for energy recovery
Disposal to landfill	202	kg product or material for final deposition (disposal, concrete, 5% to inert material landfill/CH U/ AusSD U)
Assumptions for scenario development	61.7	MJ for demolition (diesel, burned in building machine/GLO U/AusSD U)
		The end-of-life scenario is based on the National Waste Report 2022 (NWR 2022); table 37 building & demolition materials, Australian av-erage

Table 4: Assumptions relating to Module D of reinforced concrete sleeper products

Parameter	Unit / effect
$M_{MR\ out}$ = 79.8%	Amount of concrete and steel exiting the system that will be recycled in a subsequent system
$M_{MR\ in}$ = 0% (conrete) M_{MR} in = 73.5% (steel)	Amount of recycled input material in the concrete and steel components
Y = 100%	The material yield, between point of end-of-waste (M-EoW) in modules A4-C4 and point of substitution (M-DoS) in module D (when the material has been upgraded).
$E_{MR\ after\ EoW\ out}$ = transport + recycling recycling of the steel component	Specific emissions and resources consumed per unit of analysis arising from material recovery processes of a subsequent system after the end-of-waste state. Transport = 50 km transport, truck, 28t, fleet average/AU U Recycling process: Steel, electric, un- and low-alloyed, at plant/RER U/AusSD U
$E_{VMSub\ out}$ = virgin materials	Specific emissions and resources consumed per unit of analysis arising from acquisition and pre-processing of the primary material, or average input material if primary material is not used, from the cradle to the point of functional equivalence where it would substitute secondary material that would be used in a subsequent system Virgin materials (concrete): coarse aggregates Virgin materials (steel): Steel, converter, unalloyed, at plant/RER U/AusSD U
$Q_{R\ out}$ / Q_{Sub} = 1	Quality ratio between outgoing recovered material and the substituted material is assumed to be 1 (equal quality)

Life Cycle Assessment Methodology

LCA methodology

A background LCA for Austral Masonry's concrete sleeper products was conducted by ERM and serves as the foundation for this EPD. The methodology for the LCA is detailed below.

Primary and Background Data

Austral Masonry supplied primary data for the FY22 (1 July 2021 – 30 June 2022) period. Primary data include production volumes at each Austral Masonry plant, product compositions for all concrete mixes, type and quantity of concrete used for each product group, energy and water consumption and waste data. Austral Masonry also provided information regarding its upstream value chain (raw materials and supply chain logistics data). Data sets used for calculations have been reviewed and where relevant updated within the last 10 years for generic data and within the last 5 years for producer-specific data.

Background data have predominantly been sourced from AusLCI (v1.42) and the AusLCI shadow database (based on ecoinvent v2):

- Cement is known to be the key contributor to environmental impacts of most concrete products. GP cement used at the Yatala facility has been adjusted to reflect EPD data published by their supplier, for GP cement manufactured in Vietnam.
- Aggregate data are based on natural sand production or crushed rock production (for manufactured sand). Some of the sands we use are double-washed or triple-washed. Energetics doubled or tripled electricity use in the sand production process to account for the additional handling of the material. The effect on the LCA results is minimal.
- Data for admixtures have been sourced from EPDs published by EFCA in 2021 and 2023 (European Federation of Concrete Admixtures Associations Ltd.)
- We use various types of iron oxides to colour our products. AusLCI data for iron ore production have been used to model the impacts of the oxides.
- Data for steel reinforcements used in the sleeper production at Yatala have been sourced from EPDs published by InfraBuild Reinforcing in May 2022. The EPDs are compliant with EN15804+A1. Non-verified EN15804+A2 have also been used since it was considered the best data available.

Methodological choices have been applied in line with EN 15804 and any deviations have been recorded.

Allocation

The allocation hierarchy outlined in ISO 14044 and joint co-product allocation rules from EN 15804 have been followed.

The materials, products, and processes in the life cycle of concrete sleeper products that require allocation are:

- Coarse aggregates: coarse aggregates (and manufactured sand) are produced through crushing of rock, which is graded in different sizes. The process cannot be subdivided and energy required for the crushing and screening does not differentiate between products. Therefore, the background data used show aggregates (including manufactured sand) have been allocated based on the mass of product.

- Production of various concrete products: Austral Masonry manufactures a range of concrete sleepers. Energy use for concrete production has been allocated to the products based on their share in the total mass of products.
- Landfill: landfill is a multi-input process. Physical causality has been used to allocate emissions in landfill.

Cut-off Criteria

All inputs and outputs to a process have been included where possible. The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of a process.

The materials and processes that have been excluded are:

- Greases and lubricants, other minor ancillary materials used during precast concrete products production
- Packaging of admixtures and oxides are also well below the cut-off:
    - Admixtures make up less than 1% of the mass of the concrete sleepers. Packaging of admixtures (IBCs) is estimated to make up less than 0.01% of total mass inputs and can be reused.
    - Oxides make up less than 0.6% of the mass of the concrete sleepers. Packaging of oxides (20 kg lined paper bags) is estimated to make up less than 0.01% of total mass inputs.
- Packaging of concrete sleepers. Sleepers are stacked and held together using plastic (polyester or polypropylene) strapping bands. The amount of strapping is estimated to be less than 0.05% of total product mass

The total (cumulative) of neglected input flows for the cradle-to-gate stages is well below 5% of energy usage and mass (the exact percentage has not been determined).

The environmental impacts incorporated in the infrastructure (buildings, plant, equipment, roads, vehicles, etc.) associated with manufacturing products is excluded from the product system. Other capital goods (e.g. transport equipment, power lines, etc.)

Key assumptions

The following key assumptions have been made:

- Concrete composition: concrete composition of each product is taken from Austral Masonry's internal operating systems and is considered of high quality.
- Production waste: production waste tonnage is measured at the plant and an average production waste percentage has been incorporated across all products into the environmental profiles.
- Transport of raw materials to the plant: transport modes for raw materials where data was not provided has been estimated. This has no material impact on the LCA results.
- Cement data: the cement data have been taken from our supplier's EPD (S-P-07448, EPD International).
- Admixtures: Austral Masonry has provided information on which admixtures they use for their concrete products. Due to lack of detail regarding admixture constituents and production data, European EPDs for admixtures (EFCA 2021, EFCA 2023) have been used.
- Oxides: Austral Masonry uses various iron oxides to colour concrete blocks. We have modelled these using iron ore production.
- Washed sand: Some of the sand supplied to Austral Masonry is double washed or triple washed sand. AusLCI data for natural sand production has been used and it has been assumed that the electricity used in the sand production process doubles or triples for double washed sand and triple washed sand, respectively. We assumed that washing water is recycled and have not adjusted water use data.

Electricity

Electricity in core processes has been modelled using adjusted AusLCI data to represent the estimated residual electricity grid mix in Queensland.

The GWP-GHG of the electricity is 0.92 kg CO_2e/ kWh. The residual grid mix is made up of Black coal (68.0%), natural gas (9.4%), solar (14.5%), wind (3.4%), hydro (1.9%), other (2.7%), based on Brown & Grant 2025.

Electricity used in upstream and downstream processes is typically modelled following a location-based approach.

LCA Indicators

An LCA serves as the foundation for this EPD. An LCA analyses the production systems of a product. It provides comprehensive evaluations of all upstream and downstream energy inputs and outputs. The results are provided in a form which covers a range of environmental impact categories.

Table 5: Environmental indicators legend (EN 15804+A2)

Core indicators	Acronym	Unit
Climate change – total	GWP-total	kg CO_2 equivalent
Climate change – fossil	GWP-fossil	kg CO_2 equivalent
Climate change – biogenic	GWP-biogenic	kg CO_2 equivalent
Climate change – land use and land use change	GWP-luluc	kg CO_2 equivalent
Ozone layer depletion	ODP	kg CFC-11 equivalent
Acidification	AP	mol H^+ equivalent
Eutrophication aquatic freshwater	EP-freshwater	kg P equivalent
Eutrophication aquatic marine	EP-marine	kg N equivalent
Eutrophication terrestrial	EP-terrestrial	mol N equivalent
Photochemical ozone formation	POCP	kg NMVOC equivalent
Abiotic depletion potential – minerals and metals[2]	ADP minerals & metals	kg Sb equivalent
Abiotic depletion potential – fossil fuels[2]	ADP fossil	MJ, net calorific value
Water use[2]	WDP	m^3 world equivalent deprived

Table 5: Environmental indicators legend (EN 15804+A2) - continued

Additional indicators	Acronym	Unit
Global Warming Potential – Greenhouse gases	GWP-GHG	kg CO_2 equivalent
Particulate matter emissions	PM	disease incidence
Ionising radiation, human health[1]	IRP	kBq U235 equivalent
Ecotoxicity (freshwater)[2]	ETP-fw	CTUe
Human toxicity, cancer effects[2]	HTP-c	CTUh
Human toxicity, non-cancer effects[2]	HTP-nc	CTUh
Land use related impacts / soil quality[2]	SQP	- (dimensionless)
Additional GHG indicator	**Acronym**	**Unit**
Carbon footprint in line with IPCC AR5	GWP-GHG (IPCC AR5)	kg CO_2 equivalent
Carbon footprint in line with IPCC AR5 – location-based electricity	GWP-GHG (IPCC AR5) (location-based electricity)	kg CO_2 equivalent

1 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.

2 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.

Note regarding various GWP indicators:

GWP-total is calculated using the European Union's Joint Research Centre's characterisation factors (CFs) based on the "EF 3.1 package" for CFs to be used in the EU's Product Environmental Footprint (PEF) framework. CFs listed by JRC are based on the IPCC AR6 method (IPCC 2021) and include indirect radiative forcing, which results in higher numerical Global Warming Potential (GWP) values than the CFs in the internationally accepted (IPCC 2013). The GWP-GHG indicator is identical to GWP-total except that the CFs for biogenic CO2 are set to zero. The GWP-GHG indicator in PCR 2019:14 v1.3.4 (based on EF 3.1) differs from the GWP-GHG in earlier PCR 2019:14 versions (if based on EF 3.0). The "GWP-GHG (IPCC AR5)" indicator is determined using the IPCC AR5 GWPs with a 100-year time horizon (IPCC 2013). This indicator is aligned with Australia's greenhouse gas reporting frameworks, using a market-based electricity accounting approach. The "GWP-GHG (IPCC AR5) (location-based electricity)" indicator is aligned with Australia's greenhouse gas reporting frameworks, using a location-based electricity accounting approach.

Table 6: Legend for parameters describing resource use, waste and output flows

Parameter	Acronym	Unit
Parameters describing resource use		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ_{NCV}
Use of renewable primary energy resources used as raw materials	PERM	MJ_{NCV}
Total use of renewable primary energy resources	PERT	MJ_{NCV}
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ_{NCV}
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ_{NCV}
Total use of non-renewable primary energy resources	PENRT	MJ_{NCV}
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ_{NCV}
Use of non-renewable secondary fuels	NRSF	MJ_{NCV}
Use of net fresh water	FW	m^3
Waste categories		
Hazardous waste disposed	HWD	kg
Non-Hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Output flows		
Components for re-use	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ

Table 7: Legend for EN 15804+A1 indicators

Indicator	Acronym	Unit
Global warming potential	GWP	kg CO_2 equivalent
Ozone layer depletion potential	ODP	kg CFC-11 equivalent
Acidification potential	AP	kg SO_2 equivalent
Eutrophication potential	EP	kg PO_4^{3-} equivalent
Photochemical oxidation (Photochemical ozone creation) potential	POCP	kg ethylene equivalent
Abiotic depletion potential - elements	ADPE	kg Sb equivalent
Abiotic depletion potential – fossil fuels	ADPF	MJ_{NCV}

Life Cycle Assessment
Results

The results in the following tables are provided by life cycle module, per declared unit (one tonne of concrete sleeper products).

The results have been calculated with SimaPro software v9.6.0.1.

Water flows have been disaggregated using the 36 ALCAS water catchments for which characterisation factors are available for both Pfister WSI and the AWARE method.

To separate the use of primary energy into energy used as raw material and energy used as energy carrier, Option B from Annex 3 of PCR 2019:14 has been applied. In option B, the energy used as raw material is declared as an input to the module where it enters the product system (often in module A1) and as an output from the product system if it exits the product system as useful energy (often from modules A5 or C3).

(Note: As module A5 is not declared, balancing has occurred in modules A1-A3.) Energy content that is wasted (e.g. in landfill), remains as part of the indicator for energy used for raw materials, and is not reported as an input of energy used for energy carriers.

Please consider the following mandatory statements when interpreting the results:

- The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.
- The use of the results of modules A1-A3 (A1-A5 for services) without considering the results of module C is discouraged.

Table 8: Environmental indicators EN 15804+A2, Explorer concrete sleepers produced at Yatala (QLD), per tonne

Environmental Indicator	Unit	Module A1-A3	Module C1	Module C2	Module C3	Module C4	Module D
			Core Indicators				
GWP-total	kg CO_2 eq.	3.26E+02	5.30E+00	6.40E+00	3.28E+00	4.79E-01	-7.04E+00
GWP-fossil	kg CO_2 eq.	3.26E+02	5.30E+00	6.40E+00	3.27E+00	4.79E-01	-7.02E+00
GWP-BIOGENIC	kg CO_2 eq.	2.28E-01	3.51E-04	3.96E-04	3.12E-03	3.86E-05	-1.38E-02
GWP-luluc	kg CO_2 eq.	2.68E-02	2.54E-06	3.02E-06	1.52E-06	2.32E-07	-1.08E-06
ODP	kg CFC-11 eq.	4.13E-06	8.47E-07	1.01E-06	4.14E-07	7.83E-08	-2.40E-07
AP	mol H+ eq.	1.30E+00	5.82E-02	5.62E-02	9.01E-03	1.14E-03	-2.57E-02
EP-freshwater	kg P eq.	3.31E-02	7.05E-07	3.85E-07	2.43E-06	6.53E-08	-5.06E-06
EP-marine	kg N eq.	1.37E-01	2.53E-02	1.77E-02	1.60E-03	2.06E-04	-4.30E-03
EP-terrestrial	mol N eq.	2.84E+00	2.78E-01	1.94E-01	1.75E-02	2.25E-03	-4.66E-02
POCP	kg NMVOC eq.	8.04E-01	7.42E-02	4.73E-02	4.68E-03	6.05E-04	-1.22E-02
ADP minerals & metals[2]	kg Sb eq.	7.71E-05	6.25E-09	7.43E-09	8.13E-07	5.63E-10	-1.03E-06
ADP fossil[2]	MJ_{NCV}	2.47E+03	7.39E+01	8.79E+01	4.67E+01	6.82E+00	-1.01E+02
WDP	m^3 world eq. deprived	8.53E+01	4.67E-01	5.56E-01	4.79E-01	4.30E-02	-4.69E+01
			Additional Indicators				
GWP-GHG	kg CO_2 eq.	3.18E+02	5.30E+00	6.40E+00	3.28E+00	4.79E-01	-7.04E+00
PM	Disease incidence	1.63E-05	1.54E-06	3.16E-07	6.00E-08	6.05E-09	-2.15E-07
IRP[1]	kBq U235 eq.	1.25E+03	1.08E-04	1.28E-04	6.60E-04	9.91E-06	-6.39E-04
ETP-fw[2]	CTUe	2.66E+02	1.64E+01	1.94E+01	8.06E+00	1.49E+00	-4.82E+00
HTP-c[2]	CTUh	3.90E-07	2.05E-10	2.75E-11	6.86E-11	3.79E-12	-3.06E-10
HTP-nc[2]	CTUh	1.15E-05	1.09E-09	5.24E-10	4.47E-10	4.58E-11	-1.93E-09
SQP[2]	-	7.10E+02	3.55E-01	3.95E-01	8.88E+03	1.13E+01	-1.44E+02
			Carbon footprint				
GWP-GHG (IPCC AR5)	**kg CO_2 eq.**	**318**	**5.30**	**6.40**	**3.28**	**0.479**	**-7.04**

1 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.

2 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.

Table 9: Parameters, Explorer concrete sleepers produced at Yatala (QLD), per tonne

Environmental Indicator	Unit	Module A1-A3	Module C1	Module C2	Module C3	Module C4	Module D
PERE	MJ_{NCV}	1.20E+02	1.14E-01	1.26E-01	8.08E-01	1.33E-02	-5.74E+00
PERM	MJ_{NCV}	2.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	1.20E+02	1.14E-01	1.26E-01	8.08E-01	1.33E-02	-5.74E+00
PENRE	MJ_{NCV}	2.45E+03	7.39E+01	8.79E+01	4.67E+01	6.82E+00	-1.01E+02
PENRM	MJ_{NCV}	1.43E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ_{NCV}	2.47E+03	7.39E+01	8.79E+01	4.67E+01	6.82E+00	-1.01E+02
SM	kg	3.71E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	2.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.17E+00	1.07E-02	1.27E-02	1.66E-02	9.88E-04	-1.10E+00
HWD	kg	3.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	2.28E+01	3.39E-04	3.73E-04	2.28E-03	2.02E+02	-1.69E-02
RWD	kg	3.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	2.03E+01	0.00E+00	0.00E+00	7.98E+02	0.00E+00	0.00E+00
MER	kg	2.58E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 10: EN 15804+A1 indicators, Explorer concrete sleepers produced at Yatala (QLD), per tonne

Environmental Indicator	Unit	Module A1-A3	Module C1	Module C2	Module C3	Module C4	Module D
GWP	kg CO_2 eq	3.26E+02	5.28E+00	6.39E+00	3.27E+00	4.78E-01	-7.00E+00
ODP	kg CFC11 eq	4.14E-06	6.69E-07	7.97E-07	3.27E-07	6.18E-08	-1.90E-07
AP	kg SO_2 eq	1.20E+00	4.14E-02	3.12E-02	5.69E-03	9.20E-04	-8.08E-03
EP	kg PO_4^{3-} eq	1.58E-01	8.50E-03	5.97E-03	5.58E-04	7.09E-05	-1.49E-03
POCP	kg C_2H_4 eq	1.09E-01	4.06E-03	2.01E-03	3.18E-04	4.58E-05	-5.57E-04
ADPE	kg Sb eq	8.25E-05	6.33E-09	7.52E-09	8.13E-07	5.72E-10	-1.04E-06
ADPF	MJ_{NCV}	2.51E+03	7.39E+01	8.79E+01	4.67E+01	6.82E+00	-1.01E+02

Variation (A1-A3) per impact category

The variation in the GWP-GHG indicator (as well as other core indicators) is less than ±10%.

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