



Building something great

Pre-mix concrete EPD

Environmental Product Declaration

Perth (WA) region



In accordance with ISO 14025 and EN 15804

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 epd-australasia.com

Program: The international EPD® System, environdec.com

Program Operator: EPD International AB | **Regional Program:** EPD Australasia
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Geographical Scope: Perth (WA) region





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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, ISO 14040 and ISO 14044 as they enable transparency and comparability between EPDs. This EPD provides environmental indicators for Boral ENVISIA® ENVIROCRETE®, ENVIROCRETE® PLUS, products for special applications and our normal class of pre-mix concrete products manufactured in Australia. This EPD is a 'cradle-to-gate' declaration covering production of the concrete and its supply chain.

This EPD is verified to be compliant with EN 15804. EPD of construction products may not be comparable if they do not comply with EN 15804. EPDs within the same product category but from different programs or utilising different PCRs may not be comparable. Boral, as the EPD owner, has the sole ownership, liability and responsibility for the EPD.

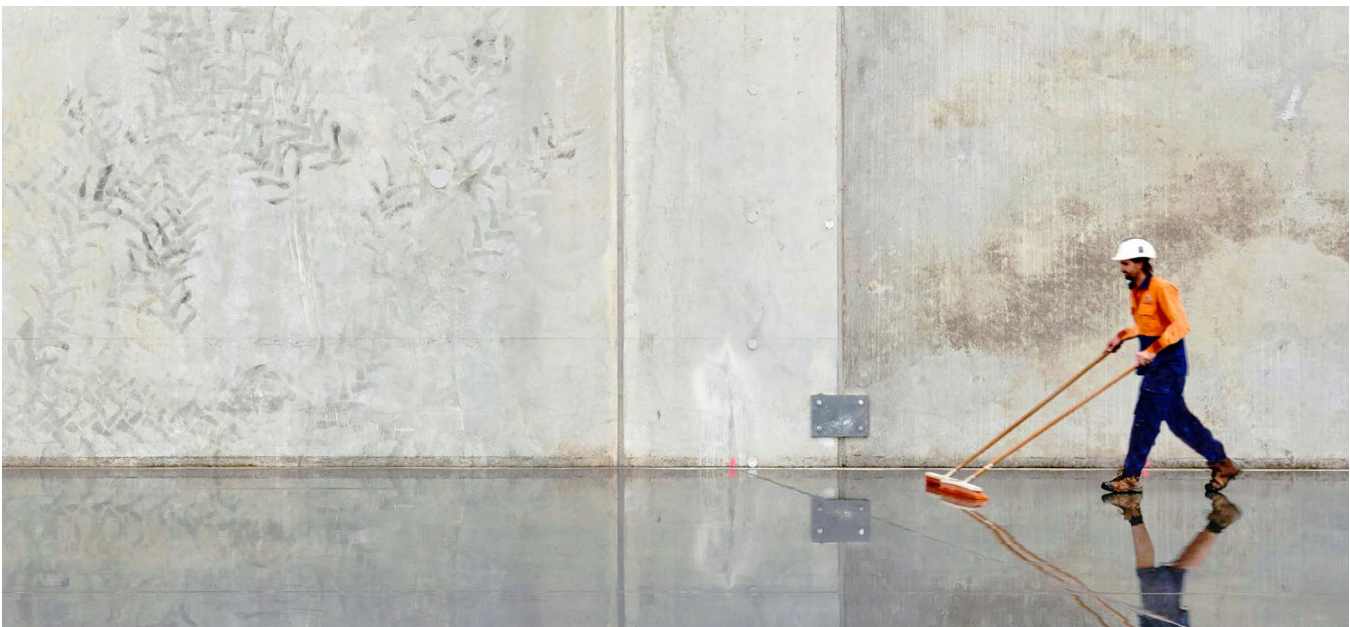
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Program information and verification

EPD version:	Description of the changes
Version 1	The EPD was updated in line with Boral's new branding.
Version 2	<p>The following edits were made as part of the first annual review.</p> <ul style="list-style-type: none"> • The branding was updated. • The address for Boral was updated. • The number of operating sites given under the section called "About Boral" was updated. • Products were added. • Organisations acronyms changed. • Updated the impact tables due to the publication of the cement supplier's EPD.
Reference year for data:	2018-01-01/2018-12-31

CEN standard EN 15804 served as the core PCR

PCR	<p>PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18</p> <p>PCR 2012:01-SUB-PCR-G Concrete and concrete elements, 2020-09-18</p>
PCR review was conducted by	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025	<input type="checkbox"/> EPD process certification (Internal) <input checked="" type="checkbox"/> EPD verification (External)
Procedure for follow-up of data during EPD validity involved third-party verifier	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes



About Boral

Boral is the largest integrated construction materials company in Australia, with a leading position underpinned by strategically located quarry reserves and an extensive network of operating sites. We also manufacture and supply a range of building products.

Boral Concrete has over 200 pre-mix concrete plants around Australia producing a wide range of concrete mixes in metropolitan and country areas.

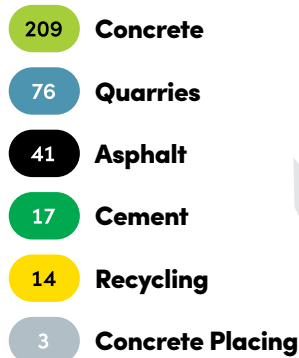
In Western Australia, Boral Concrete supplies pre-mix concrete to all segments of the construction industry including infrastructure, social, commercial, and residential construction.

This EPD covers the majority of the concrete products supplied from Boral plants in Perth.

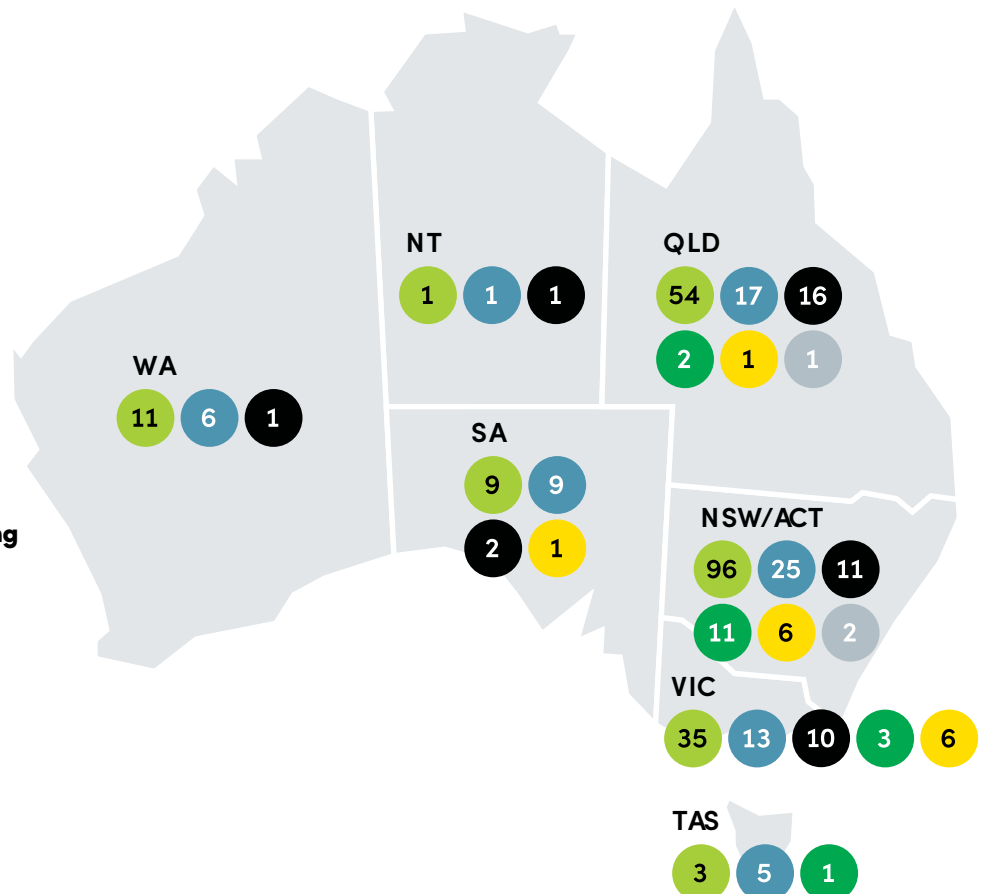
Construction materials Leading integrated network

360

Operating sites*



* Includes transport, fly ash and research and development sites.



About Boral

ZERO HARM TODAY

How we work

At Boral, we have a culture of 'working together' with a focus on Zero Harm Today.

This ensures all of our employees, contractors, partners and communities in which we operate are free from harm, injury and illnesses.

Boral has a team of full-time Health, Safety, Environment and Quality specialists who operate across our integrated business, offering a single interface for safety communications and innovation across raw materials, logistics, operations and placement.

Innovation and technical capability

The Innovation Factory is Boral's in-house centre of excellence responsible for developing advanced cement and concrete solutions for our customers.

Through consultation with our customers, the Innovation Factory is central to enabling transformation through innovative products at Boral.

Our focus on engagement and action is backed by intensive research and development through our dedicated and talented team who work in collaboration with many sections of the company to create a world of future generations will be proud of.



About Boral

Technical services

As one of Australia's largest construction materials companies, Boral is committed to excellence, providing customers with quality products and reliable service.

"Boral Materials Technical Services is also the largest facility of its kind in the country."

Our aim is to provide products backed up by specialised testing as well as extensive quality control testing and technical support.

To ensure we remain at the forefront, we constantly improve, develop and refine our products to maintain the high standards customers have come to expect.

Our production, technical and quality managers are committed to quality excellence in our manufacturing process. We have committed additional resources to research and we strive to develop whole-of-life solutions that offer a sustainable future. Our innovative products are designed in collaboration with our clients.

Not only are we the only Australian construction materials company to maintain a full-service construction materials laboratory in Australia, **Boral Materials Technical Services is also the largest facility of its kind in the country**, providing special and standard testing and product development services to Boral and our customers.

Boral maintains an ISO 9001-certified Quality System to ensure we conduct a regular regime of physical properties testing on all materials to certify they:

- meet Australian Standards in the civil and structural construction industry
- comply with applicable legislation, regulations and industry standards
- meet project specifications
- allow for continuous improvement.

Boral laboratory facilities have a quality management system that meets international standards and they are NATA-accredited for construction materials testing and chemical testing. These customer-focused services have earned Boral the reputation of a market leader in its approach.



About Boral

Sustainability at Boral

We recognise that our commitment and progress in managing sustainability outcomes is vital to our business and meeting the expectations of our customers.

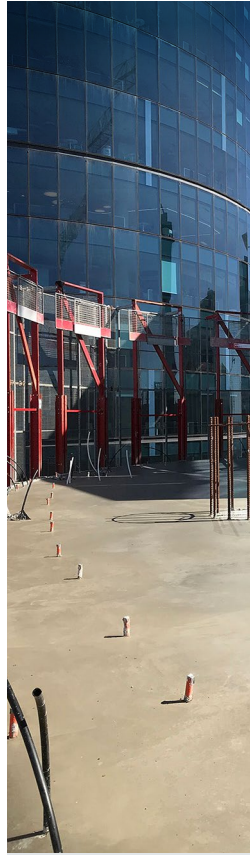
We strive to:

- **Deliver** innovative, superior performing and more sustainable products and solutions that respond to a changing world and better meet our customers' needs
- **Drive** safety performance towards world's best practice and invest in our people to enable them to deliver on our strategy
- **Reduce** our environmental footprint and build our resilience to climate impacts
- **Be** a socially responsible member of the communities in which we operate.

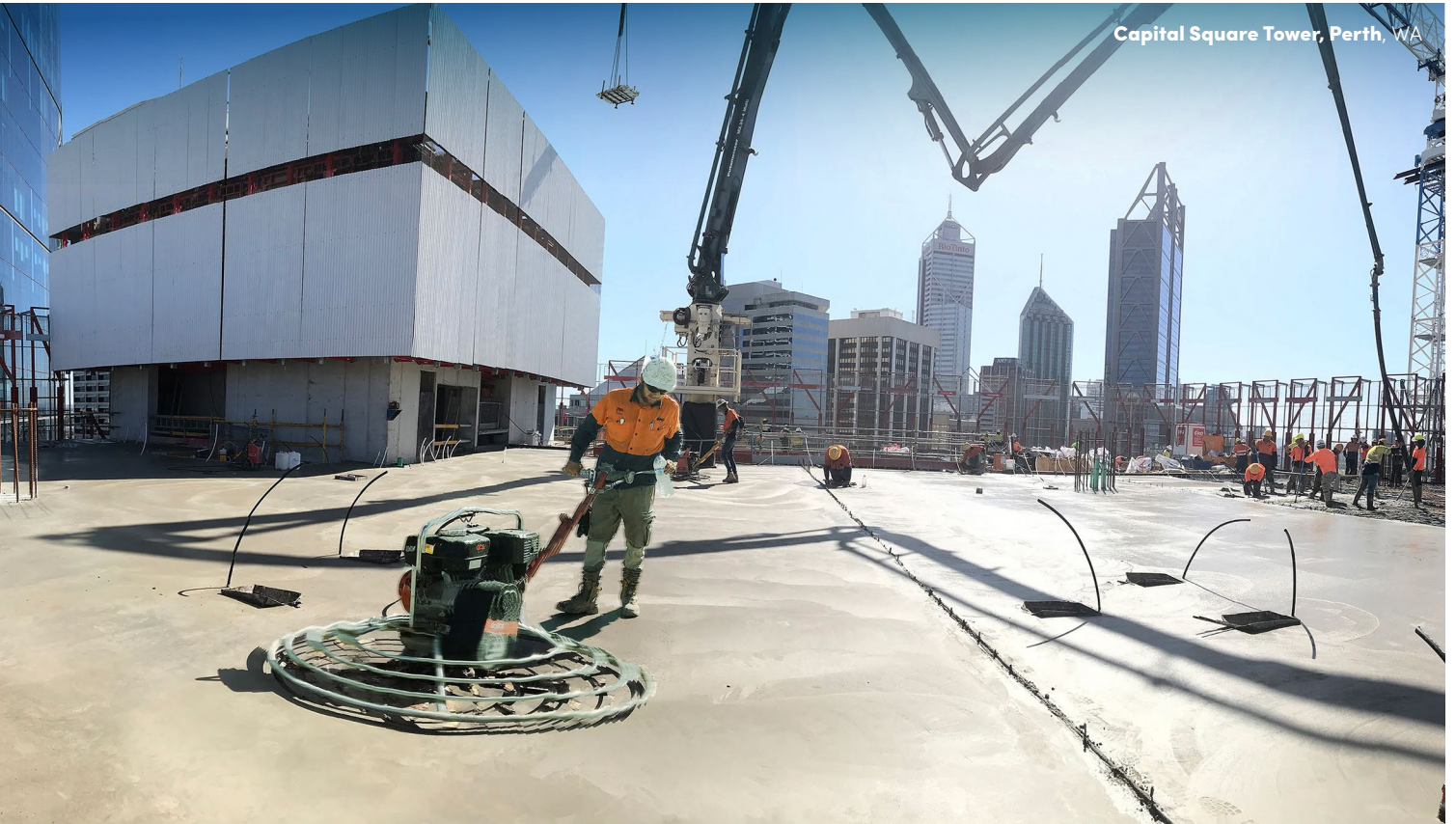
In recent years, we have substantially reshaped our business to respond and adapt to changing commercial, technological, and environmental factors. We have invested in growing our lower carbon concrete products.

We are increasing our investment in innovation to enable us to expand our products and solutions that have a lower carbon footprint and thereby positively contribute to an effective transition to a lower carbon economy.

Boral's ENVISIA® and ENVIROCRETE®/ PLUS products underpin this improved sustainable concrete range. We monitor and report on our sustainability performance to drive progress and continuous improvement and are responding to increasing expectations of our customers on the disclosure of our sustainability risks and opportunities.



About Boral



"We target zero injuries to our people and seek to eliminate adverse environmental impacts."

ZERO HARM TODAY

Our commitment

Our overarching goal is to deliver Zero Harm Today. This means we target zero injuries to our people and seek to eliminate adverse environmental impacts.

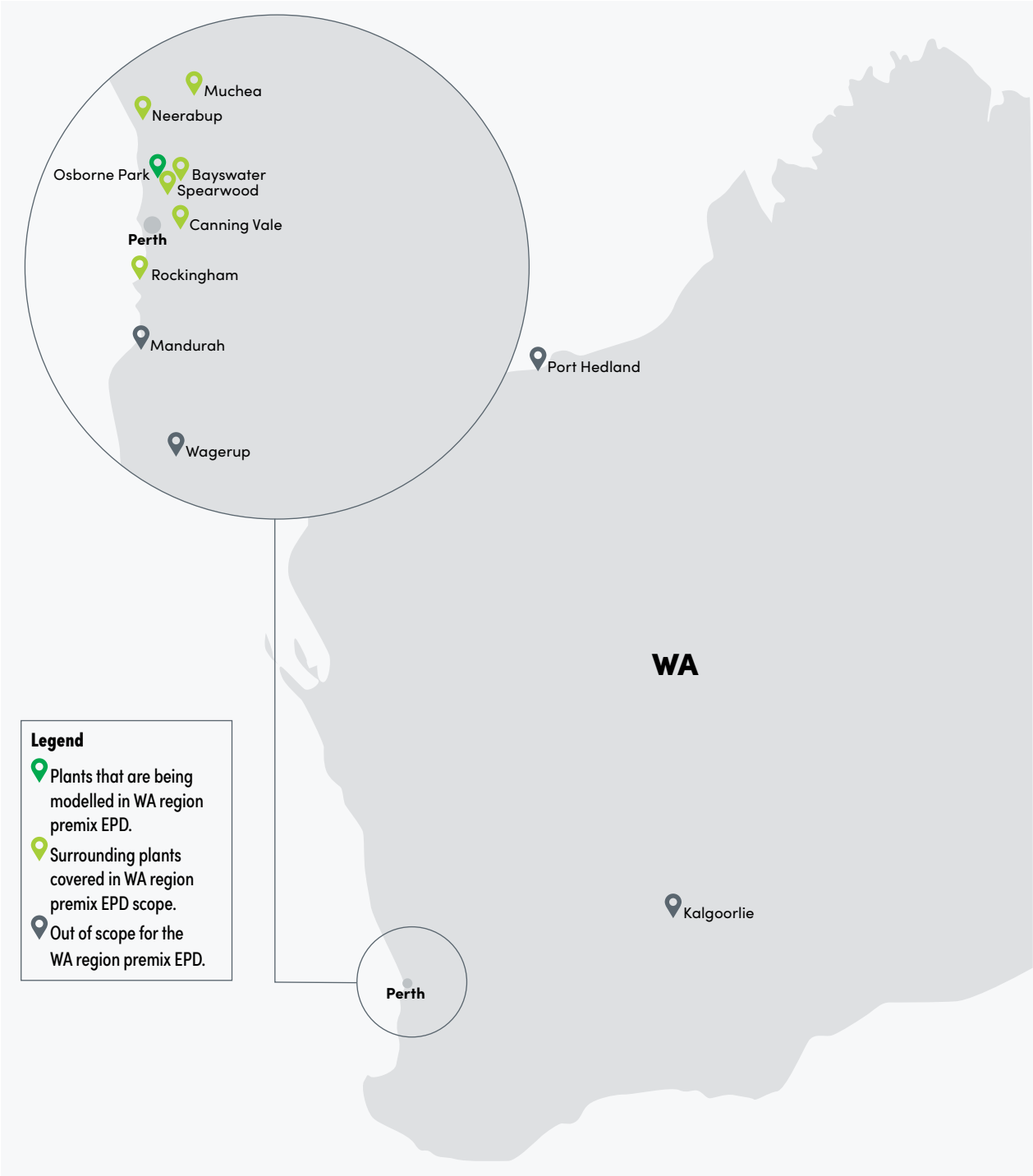
Where elimination is not possible, we seek to minimise any harmful effects from our operations. At an absolute minimum, this means complying with environmental legislation, regulations, standards and codes of practice.

- **Reducing greenhouse gas** emissions from our processes, operations and facilities.
- **Reducing waste** in all forms including through the efficient use of energy, conservation of water, minimising and recycling waste materials and energy, prevention of pollution, and effective use of virgin and recovered resources and supplemental materials.
- **Protecting biodiversity** values at and around our facilities.
- **Openly and constructively engaging** with communities surrounding our operations.

Geographical scope

Western Australia (Perth region)

The concrete plants considered for this Environmental Product Declaration comprise of those in the Perth Region, WA. Boral Concrete Osborne Park was assessed for life cycle assessment, and local surrounding similar raw material sources were included in the datasets.



Declared products

Products considered for the Perth (WA) region environmental product declaration

The products considered for the EPD fall into three broad categories: **normal class products, lower carbon concrete products and special concrete products.**

A brief description of each category is given below, followed by a full list of the products.

1) Normal class concrete products

Normal class concrete products are suitable for general applications and designed to meet the requirements of AS 1379 (Specification and supply of concrete). The normal class concrete products have been grouped according to the cement blend they contain as follows.

Normal class concrete category	Cementitious type
NORMAL CLASS GP BLEND	General Purpose (GP) cement
NORMAL CLASS GP/GGBFS BLEND	General Purpose (GP) cement and ground granulated blast furnace slag (GGBFS)

2) Lower carbon concrete products

Lower carbon concrete products have been designed to have lower portland cement contents and lower embodied carbon contents. The lower carbon concrete products have been further categorised according to their portland cement reduction and their performance, as per the sub categories below.

Lower carbon concrete product	Portland cement reduction*	Typical properties
ENVIROCRETE®	≥40%	<ul style="list-style-type: none"> Complies with AS 1379. Applicable for Green Star projects to ENVIROCRETE®.
ENVIROCRETE® PLUS	≥45%	<ul style="list-style-type: none"> Complies with AS 1379. Applicable for Green Star projects. Improved early age strength and drying shrinkage compared to the ENVIROCRETE® products.
ENVISIA®	≥50%	<ul style="list-style-type: none"> Complies with AS 1379. Applicable for Green Star projects. Improved early age strength and drying shrinkage compared to the ENVIROCRETE® and ENVIROCRETE® PLUS products.

* The percentages indicate the typical portland cement reduction against default concrete mixes as defined in the Green Star and IS Rating tools by the Green Building Council of Australia (GBCA) and the Infrastructure Sustainability Council (ISC) respectively.

Declared products

ENVIROCRETE® concrete

Boral's ENVIROCRETE® concrete is a lower carbon concrete product which complies with AS 1379.

It contains supplementary cementitious materials to reduce the portland cement content and the embodied carbon content of the concrete and is suitable for projects targeting a lower carbon footprint.

ENVIROCRETE® has a minimum portland cement reduction of 40% when compared to the GBCA reference case and is suitable for projects targeting a Green Star rating and where good early age strength or low drying shrinkage are not required.

ENVIROCRETE® PLUS CONCRETE

Boral's ENVIROCRETE® PLUS concrete is a lower carbon concrete product which complies with AS 1379.

It contains supplementary cementitious materials to reduce the portland cement and the minimum reduction in portland cement compared to the GBCA and ISC reference case is 45%. ENVIROCRETE® PLUS also has enhanced engineering properties compared to the Envirocrete® range. The early age strength and drying shrinkage are superior to ENVIROCRETE®.



Declared products

ENVISIA® concrete

Boral's ENVISIA® concrete is a lower carbon concrete product which complies with AS 1379 and has excellent engineering properties. It contains supplementary cementitious materials to reduce the portland cement and the minimum portland cement reduction compared to the GBCA and ISC reference case is 50%. ENVISIA® combines a proprietary cement technology (ZEP®) which gives it good early age strength, low shrinkage characteristics and excellent durability characteristics. An overview of the sustainability, durability, engineering and architectural properties are given below.

Lower carbon

- ENVISIA® has a low portland cement content and is suitable for projects seeking to maximise the number of green star points from concrete.
- ENVISIA® has a lower carbon content and is suitable for projects seeking a rating with the Green Building Council of Australia (GBCA) or the Infrastructure Sustainability Council (ISC).

Workability

- ENVISIA® can be placed, pumped and finished like conventional concrete.

Superior engineering properties

- ENVISIA® will achieve early-age strength equivalent to conventional concrete mixes with higher portland cement content (e.g. post-tensioned and precast concrete.)
- ENVISIA® has 20 percent greater flexural strength compared to conventional concrete of the same grade.
- ENVISIA® achieves up to 50 percent reduction in shrinkage when compared to conventional sustainable concrete mixes. The low shrinkage of ENVISIA® will allow for more engineering options such as the design of larger slabs with fewer joints.

Superior durability

- ENVISIA® provides improved durability, through greater protection to steel reinforcement against chloride induced corrosion.
- ENVISIA® has improved sulphate and acid resistance properties.
- ENVISIA® mitigates the potential expansion due to alkali aggregate reactivity.

Architectural presence

- ENVISIA® can achieve a range of architectural benefits because of its off-form finish and lighter colour.
- ENVISIA®'s lighter colour will enhance the use of coloured oxides.



Declared products

3) Lower carbon concrete products for special applications

Boral's lower carbon special concrete products have been designed to meet specific project requirements in addition to the requirements of AS 1379. They include products that have been designed for infrastructure projects, multi-residential buildings, commercial buildings and civil works.

4) Concrete products for special applications

Boral's special concrete products have been designed to meet specific project requirements in addition to the requirements of AS 1379. They include products that have been designed for infrastructure projects, multi-residential buildings, commercial buildings and civil works.

Products covered by this Environmental Product Declaration (EPD)

The products covered in the EPD are listed below. The environmental impacts of products not referenced in the EPD can be provided on request. Boral is developing an environmental impact calculator allowing us to provide environmental profiles for virtually any mix design from any of our concrete plants in Australia. We intend to have the calculator independently verified in line with the same standards this EPD is based on, so that the results are of similar standing.

1) Normal class concrete products

- NORMAL CLASS GP BLEND 20 MPa
- NORMAL CLASS GP BLEND 25 MPa
- NORMAL CLASS GP BLEND 32 MPa
- NORMAL CLASS GP BLEND 40 MPa
- NORMAL CLASS GP BLEND 50 MPa
- NORMAL CLASS GP/GGBFS BLEND 20 MPa
- NORMAL CLASS GP/GGBFS BLEND 25 MPa
- NORMAL CLASS GP/GGBFS BLEND 32 MPa
- NORMAL CLASS GP/GGBFS BLEND 40 MPa
- NORMAL CLASS GP/GGBFS BLEND 50 MPa

2) Lower carbon concrete products

- ENVIROCRETE® 20 MPa
- ENVIROCRETE® 25 MPa
- ENVIROCRETE® 32 MPa
- ENVIROCRETE® 40 MPa
- ENVIROCRETE® 50 MPa
- ENVIROCRETE® 65 MPa
- ENVIROCRETE® PLUS 20 MPa
- ENVIROCRETE® PLUS 25 MPa
- ENVIROCRETE® PLUS 32 MPa
- ENVIROCRETE® PLUS 40 MPa
- ENVIROCRETE® PLUS 50 MPa
- ENVIROCRETE® PLUS 65 MPa
- ENVISIA® 20 MPa
- ENVISIA® 25 MPa
- ENVISIA® 32 MPa
- ENVISIA® 40 MPa
- ENVISIA® 50 MPa
- ENVISIA® 65 MPa

3) Lower carbon concrete products for special applications

- ENVIROCRETE® 50 MPa GB
- ENVIROCRETE® PT 50 MPa 22 MPa@4DAYS
- ENVIROCRETE® 65 MPa LH
- ENVIROCRETE® 65 MPa GB
- ENVIROCRETE® 65 MPa MCC:460
- ENVIROCRETE® 65 MPa MCC:350
- ENVIROCRETE® 80 MPa
- ENVIROCRETE® 80 MPa SWC
- ENVIROCRETE® 100 MPa
- ENVIROCRETE® 40 MPa 10mm TREMIE LH
- ENVIROCRETE® 40 MPa 10mm TREMIE GB
- ENVIROCRETE® CEMENT SLURRY@1100kg/m³
- MRWA ENVIROCRETE® 40 MPa LH MCC:400
- MRWA ENVIROCRETE® 50 MPa LH MCC:420
- ENVIROCRETE® 3% STABILISED SAND
- ENVIROCRETE® 4% STABILISED SAND
- ENVIROCRETE® 6% STABILISED SAND
- ENVIROCRETE® 8% STABILISED SAND
- ENVIROCRETE® 10% STABILISED SAND
- ENVIROCRETE® 12% STABILISED SAND
- ENVIROCRETE® 15% STABILISED SAND
- ENVIROCRETE® 20% STABILISED SAND
- ENVIROCRETE® 25% STABILISED SAND
- ENVIROCRETE® PLUS PT 40 MPa 22 MPa@3 DAYS
- ENVIROCRETE® PLUS 50MPa LH 50 MPa@90 DAYS

- ENVIROCRETE® PLUS HIGH SLUMP 50 MPa
- ENVIROCRETE® PLUS 40 MPa DIAPHRAGM WALL
- ENVIROCRETE® PLUS 40 MPa GB PTA TRACK SLAB
- ENVISIA® 80 MPa
- ENVISIA® 32 MPa PTA TRACK SLAB
- ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE
- MRWA ENVISIA® SLIPFORM 32 MPa

4) Concrete products for special applications

- MRWA 40 MPa GB MCC:400
- MRWA SLIPFORM 32 MPa
- PT S40 MPa GP 22 MPa@3DAYS
- S40 MPa GP MCC:380
- STABILISED SAND 6%
- KERB MACHINE 25 MPa
- KERB MACHINE 32 MPa
- SHOTCRETE 40 MPa
- NO FINES 6:1

Pre-mix concrete production

Concrete production is the process of combining water, aggregates, cementitious binders and additives. These different 'ingredients' are mixed at a specialised facility known as a 'batching' plant.

A batching plant stores the ingredients in cement silos, aggregate bins and admixture tanks. The plants use calibrated weigh scales and flow meters to accurately weigh the ingredients which are then mixed in a mixer compliant with item C3 of AS 1379. Most concrete plants mix the concrete in a transit mixer (concrete truck) which then delivers the concrete to the project. However, some plants use a stationary mixer before discharging the mixed concrete into a concrete truck which then delivers the concrete to the project.

Depending on the proposed application of the final product, the concrete may contain other ingredients such as colour oxides and fibres and the production process may include heaters or chillers. Concrete production is time-sensitive, once the ingredients are mixed, workers must put the concrete in place before it loses workability.



ENVISIA® case study



Building something great

Case study

ENVISIA® Concrete



Forrestfield Airport Link, Perth

Overview

Construction company
Webuild SpA (formerly Salini Impreglio) NRW JV

Project name
Forrestfield Airport Link

Owner
Public Transport Authority (PTA)

Location
Perth, WA

Concrete / Volume
ENVISIA® 32 MPa+
Synthetic macro fibre
5kg / m³

Project

The Forrestfield-Airport Link is a new rail service to the eastern suburbs of Perth, WA through twin-bored tunnels. Three train stations will also be built. Webuild SpA (formerly Salini Impreglio) NRW JV (SINRW) was awarded the design and construct contract by the WA Government in 2016.

Boral commenced concrete supply to the project in late 2016, including tunnel segment concrete. In collaboration with SINRW Boral commenced track slab concrete trials in late 2019, this was before SINRW had established the placement methodology and appointed a subcontractor (subsequently Martinus Rail was appointed).

What was the customer looking for

- The specification required **low shrinkage and high durability concrete** to meet the 120-year design life.
- The client specification called for **strict maximum crack width** requirements.
- Placement methodology** played a significant role and changed during the trial period from underground transit vehicles to pumping the concrete (>1km).

Project outcomes

- ENVISIA® met the project specified performance requirements.
- At 1.5km the ENVISIA® concrete pumped at **40 bar lower** than the alternative option. The lower pressure greatly reduced the risk of a blockage in the steel pipe line in the tunnel. Thus ENVISIA® became the preferred option.

Concrete performance*

ENVISIA® 32 MPa	
Portland cement reduction**	50%
1-day strength	13 MPa
2-day strength	22 MPa
3-day strength	29 MPa
4-day strength	35 MPa
7-day strength	38 MPa
28-day strength	46 MPa
56-day strength	49 MPa
Drying shrinkage at 56 days	320 microstrain

* Mean results.

** cf Green Building Council of Australia Mat 4 reference case.

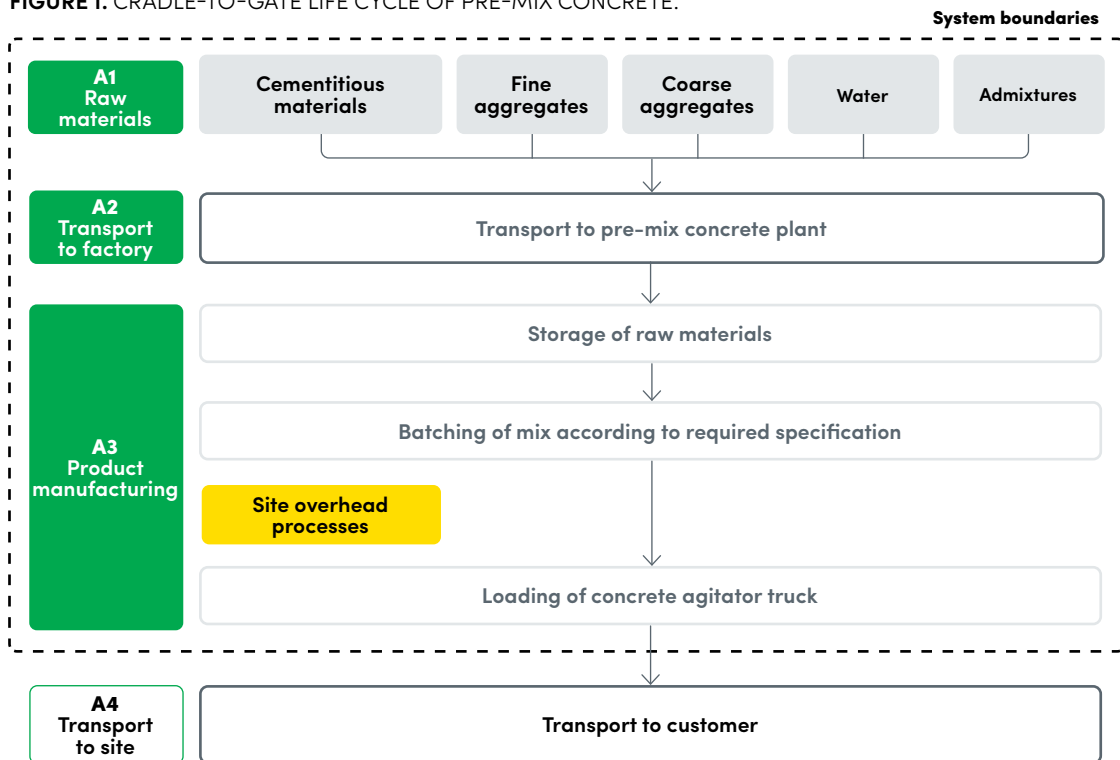
For more information please visit boral.com.au/lcc

Boral, the Boral logo and ENVISIA® are trade marks or registered trade marks of Boral Limited or one of its subsidiaries. 17658 01/24

Cradle-to-gate life cycle

This EPD covers the cradle-to-gate life cycle stages (A1-A3), as per diagram below. Downstream stages have not been included.

FIGURE 1. CRADLE-TO-GATE LIFE CYCLE OF PRE-MIX CONCRETE.



Raw material stage (A1)

All raw materials used in the production of Boral's normal class concrete, lower carbon concrete and special concrete products comply with the following standards as required by AS 3600 Concrete Structures (SA 2018) and AS 1379 Specification and Supply of Concrete (SA 2007/R2017):

- **AS3972:** General purpose and blended cements.
- **AS 3582.2** Supplementary cementitious materials Part 2: Slag—Ground granulated blast furnace.
- **AS 2758.1** Aggregates and rock for engineering purposes Part 1: Concrete Aggregates.
- **AS 1478.1** Chemical admixtures for concrete, mortar and grout.

Cradle-to-gate life cycle

Transportation stage (A2)

Raw materials are typically transported to our sites via rigid trucks. Coarse aggregates, manufactured sands and natural sands are sourced from our network of quarries, as well as third-party quarries. General Purpose Cement (GP) and Ground Granulated Blast Furnace Slag (GGBFS) are the two main cementitious materials used in the Western Australian market. They are supplied by a local supplier in West Australian market using local or imported ingredients and delivered to our sites in rigid trucks.

ZEP® additive is transported by rigid truck from Sydney; other admixtures are sourced from locally based suppliers and transported using rigid trucks.

TABLE 1. SCOPE OF EPD

Product stage			Construction stage		Use stage							End-of-life stage				Benefits beyond system boundary
RAW MATERIAL SUPPLY	TRANSPORT	MANUFACTURING	TRANSPORT	CONSTRUCTION-INSTALLATION PROCESS	USE	MAINTENANCE	REPAIR	REPLACEMENT	REFURBISHMENT	OPERATIONAL ENERGY USE	OPERATIONAL WATER USE	DECONSTRUCTION DEMOLITION	TRANSPORT	WASTE PROCESSING	DISPOSAL	REUSE, RECOVERY, RECYCLING POTENTIAL
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Scenario			Scenario							Scenario						
✓	✓	✓	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

✓ = module is included in this study MND = module is not declared*

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



Cradle-to-gate life cycle

Manufacturing stage (A3)

The typical manufacturing process of Boral's normal class concrete, lower carbon concrete and special concrete products is by mixing concrete constituents comprising of cement and supplementary cementitious materials (SCM) (AS 3972/AS 3582.1,2), and fine/coarse aggregates (AS 2758.1), plus admixtures/additives (AS 1478.1) and water (AS 1379) directly in the truck referred to as the dry batch method, or in selected locations pre-mixing in a wet mix fashion, before delivery by agitator truck.

The entire process is covered under AS 1379 Specification and Supply of concrete and verified by third party under ISO9001. This manufacturing stage (A3) includes activities associated with sourcing and delivery of individual concrete constituents, up to the point of mixing at the batch plant, but not including delivery and placement of concrete at the project location. This is typically described as the Cradle (A1) to Gate (A3) life cycle.



Life Cycle Assessment (LCA) methodology

Background data

Boral has supplied primary data from our Orange Grove and Gaskell Avenue quarries, and Osborne Park (Perth) concrete production site. The LCA shows that this site is representative for the Perth region.

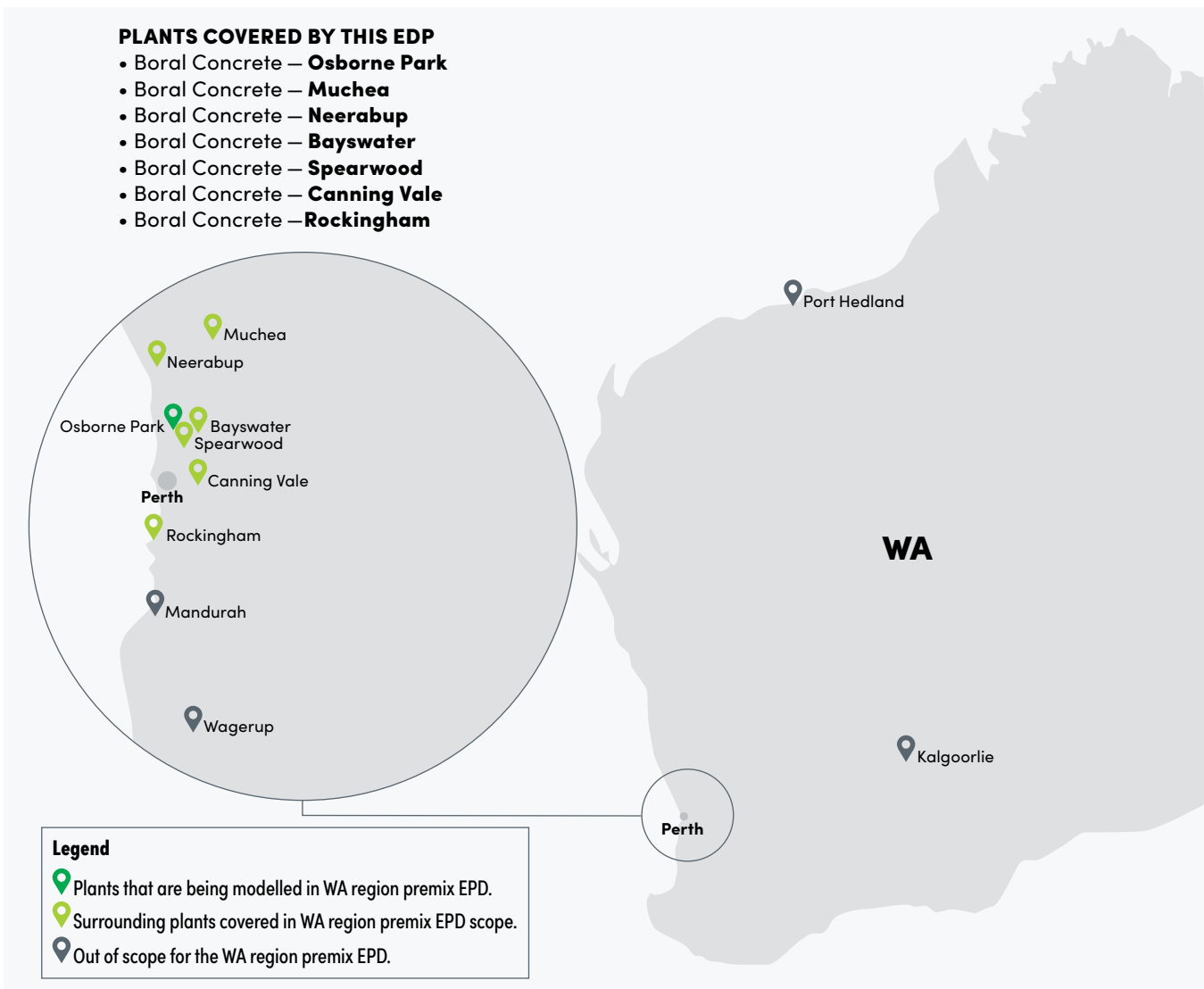
Where aggregates are sourced from other quarries, we use the unweighted average for those materials across all the Boral quarries that have provided data nationally. Data for admixtures have been sourced from EPDs published in December 2015 by EFCA (European Federation of Concrete Admixtures Associations) (EFCA 2015a-c). Background data (e.g. for energy and transport processes, cement and blast furnace slag) have predominantly been sourced from AusLCI and the AusLCI shadow database (v1.40).

The quarry data, cement production data and concrete production data have been collected for calendar year 2018. The vast majority of the environmental profiles of our products are based on life cycle data that are less than five years old. Background data used is less than 10 years old.

Methodological choices have been applied in line with EN 15804 (CEN 2013); deviations have been recorded.

Representative plants in each region

Boral operates 11 concrete plants in Western Australia. This EPD covers a sub-section of our plants in the Perth region. Our background LCA report shows that the Boral Concrete Osborne Park plant is representative for surrounding Perth plants that have similar supply chains and mix designs.



Life Cycle Assessment (LCA) methodology

Allocation

The key material production processes that require allocation are:

- **Pre-mix concrete:** Boral manufactures a range of pre-mix concrete products at its sites. At each manufacturing site, energy use for concrete production has been allocated to the products based on a volume basis (total m³ of pre-mix concrete products).
- **Aggregates:** aggregates are produced through crushing of rock, which is graded in different sizes. The energy required for the crushing and screening does not differentiate between products. Therefore, aggregate production (including manufactured sand) has been allocated based on the mass of product.
- **Cementitious binders:** Boral manufactures concrete using type GP cement inclusive of limestone mineral addition and slag cement sourced from third-party suppliers. The cement production data is taken from the AusLCI data set.
- **Silica fume (micro-silica):** is a by-product of silicon metal or ferrosilicon alloys production.
- **Blast Furnace Slag (BFS):** is a by-product from steel-making. We have used the AusLCI data for BFS ('blast furnace slag allocation, at steel plant/AU U'), which contain impacts from pig iron production allocated to blast furnace slag.

Cut-off criteria

- The contribution of capital goods (production equipment and infrastructure) and personnel is outside the scope of the LCA, in line with the PCR (Environdec 2020a).
- The amount of packaging used for admixtures is well below the materiality cut-off. Nonetheless, packaging materials and quantities are included in the admixture EPD data.

Key assumptions

- **Admixture data:** are based on generic EPDs that are valid for a range of different chemicals, including the admixtures used by Boral. No EPD has been published for Viscosity Modifying Admixtures (VMA); we have used an average of the five admixture EPDs published by EFCA as a proxy.
- **Water consumption:** is not measured consistently across quarries. We have used **AusLCI water consumption data per tonne of coarse and fine aggregates instead.**
- **Blast Furnace Slag (BFS):** receives some environmental impacts from pig iron production. This allocation decision has an effect on the environmental profile of products that use Ground-Granulated Blast Furnace Slag (GGBFS).
- **Cement data:** are based on generic AusLCI data for cement produced from imported clinker, where possible corrected with data from the *Adbri Cement Products EPD* (EPD Australasia; registration number: S-P-05516, issued 10 November 2023).
- **Silica fume data:** Silica fume receives some environmental impacts from ferrosilicon production as per the AusLCI database. This allocation decision has an effect on the environmental profile of products that use Silica Fume.
- **Steel fibre data:** are based on the EPD for *Dramix® Steel fibers for Concrete Reinforcement*, manufactured in Karawang, Indonesia from Bekaert NV (Instytut Techniki Budowlanej (ITB) Poland; registration number ITB No. 311/2022, issued 1 April 2022).
- **Synthetic fibre data:** are based on the EPD for *BarChip 48, BarChip 54 and BarChip 60 Macro Synthetic Fibre Concrete Reinforcement* from BarChip Inc. (EPD Australasia; registration number: S-P-02054, issued 1 December 2020).

Product composition

Content declaration (% by weight)

TABLE 2. PERTH REGION (WA) PRODUCT COMPOSITIONS

Constituent	NORMAL CLASS CONCRETE PRODUCTS	LOWER CARBON CONCRETE PRODUCTS
General purpose cement	6-20%	4-15%
Ground granulated blast furnace slag	2-6%	4-13%
Silica fume	0%	0%
Coarse aggregate	41-46%	38-46%
Manufactured sand	11-18%	7-13%
Natural sand	19-27%	0-32%
Admixtures	<0.1%	<0.7%
Steel fibre	0%	0%
Synthetic fibre	0%	0%
Water	7-8%	7-8%

TABLE 3. PERTH REGION (WA) PRODUCT COMPOSITION (CONTINUED)

Constituent	LOWER CARBON CONCRETE PRODUCTS FOR SPECIAL APPLICATIONS	CONCRETE PRODUCTS FOR SPECIAL APPLICATIONS
General purpose cement	1-40%	2-17%
Ground granulated blast furnace slag	0-27%	1-12%
Silica fume	<3%	<1%
Coarse aggregate	0-46%	0-82%
Manufactured sand	4-53%	5-52%
Natural sand	7-37%	18-44%
Admixtures	<0.7%	<0.1%
Steel fibre	0%	0%
Synthetic fibre	0%	0%
Water	6-35%	4-15%

The products as supplied are 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).

* May include Zep® technology.

Declared unit

The background LCA serves as the foundation for this EPD. An LCA analyses the environmental processes in the value chain of a product. It provides a comprehensive evaluation of all upstream (and sometimes downstream) material and energy inputs and outputs. The results are provided for a range of environmental impact categories, in line with EN 15804 (CEN 2013).

Pre-mix concrete is available in various strength grades and with characteristics that are specifically designed for each application. The declared unit that covers all of the products is: 1 cubic metre (m³) of pre-mix concrete (as ordered by client) with a given strength grade and identifying characteristics. This declared unit has been adapted from the sub-PCR (Environdec 2020b).

All results are presented per declared unit and cover the A1-A3 life cycle stages (cradle-to-gate).

The product code for pre-mix concrete is UN CPC 375 (Articles of concrete, cement and plaster) and ANZSIC 20330 (Concrete—ready mixed—except dry mix).



Environmental indicators

TABLE 4. IMPACT CATEGORIES INCLUDED IN THIS ASSESSMENT

Impact category	Acronym	Unit
Global warming potential	GWP	kg CO ₂ equivalents
Ozone depletion potential	ODP	kg CFC-11 equivalents
Acidification potential of soil and water	AP	kg SO ₂ equivalents
Eutrophication potential	EP	kg PO ₄ ³⁻ equivalents
Photochemical ozone creation potential	POCP	kg C ₂ H ₄ equivalents
Abiotic depletion potential for mineral elements	ADPE	kg Sb equivalents
Abiotic depletion potential for fossil fuels	ADPF	MJ

TABLE 5. PARAMETERS DESCRIBING RESOURCE USE, WASTE AND OUTPUT FLOWS

Resource use	Acronym	Unit
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

Environmental profiles

The cradle-to-gate (module A1-A3) environmental profiles and environmental parameters of each product group are expressed per m³ of pre-mix concrete (volume as ordered by the client).

Limitations

The results of this study and the EPD are valid for Boral products only. Products from other manufacturers will likely have different impacts due to differences in mix designs, supply chains and manufacturing processes. The main limitations of the LCA results are found in the parameter results, which are highly dependent on background data.

The environmental parameters are based on the life cycle inventory. There is some ambiguity around their presentation, and issues to note include:

- hazardous waste disposal (HWD) is derived from background LCI data
- non-hazardous waste disposal (NHWD) is derived from background LCI data
- radioactive waste disposal (RWD) is derived from background LCI data. Radioactive waste is only coming through the EPD data for admixtures, unless the life cycle contains clinker manufactured overseas.

Variation (A1-A3) Per impact category

The results of the LCA are based on data from one representative plant for the Perth WA region (Osborne Park).

The environmental profiles of concrete manufactured at other plants in the Perth region are largely similar, with variations mainly due to differences in transport distances for raw materials supplied to the concrete plant. The largest variation is found in stabilised sand 6%, as this is the product with the smallest footprint and the largest contribution from transport. In Rockingham, the variations in stabilised sand are larger than 10% for global warming potential (11%), ozone layer depletion (44%), acidification (16%), eutrophication (18%), photochemical oxidant creation (38%) and abiotic depletion (fossil fuels) (18%), which are caused by differences in aggregates and cement transport.

The variation across included sites for other concrete products is considerably lower, and most mandatory indicators stay well within the $\pm 10\%$ range as required by the PCR (Envirodec 2020a). The variations do remain larger than $\pm 10\%$ for ozone depletion potential and photochemical ozone creation potential for plants that are located furthest from Osborne Park, which is caused by differences in (aggregates) transport.

We therefore believe it is reasonable to use Boral Concrete Osborne Park as representative for the wider Perth region.



Perth region

ENVIRONMENTAL PROFILES AND PARAMETERS

Product table list

Perth region

In the Perth region, we start with presenting a summary of the carbon footprint (GWP summary) of our concrete mixes.

Normal class concrete products

Table no. 6 and 728

- NORMAL CLASS GP BLEND 20 MPa
- NORMAL CLASS GP BLEND 25 MPa
- NORMAL CLASS GP BLEND 32 MPa
- NORMAL CLASS GP BLEND 40 MPa
- NORMAL CLASS GP BLEND 50 MPa

Table no. 8 and 929

- NORMAL CLASS GP/GGBFS BLEND 20 MPa
- NORMAL CLASS GP/GGBFS BLEND 25 MPa
- NORMAL CLASS GP/GGBFS BLEND 32 MPa
- NORMAL CLASS GP/GGBFS BLEND 40 MPa
- NORMAL CLASS GP/GGBFS BLEND 50 MPa

Lower carbon concrete products

Table no. 10 and 1130

- ENVIROCRETE® 20 MPa
- ENVIROCRETE® 25 MPa
- ENVIROCRETE® 32 MPa
- ENVIROCRETE® 40 MPa
- ENVIROCRETE® 50 MPa
- ENVIROCRETE® 65 MPa

Table no. 12 and 1331

- ENVIROCRETE® PLUS 20 MPa
- ENVIROCRETE® PLUS 25 MPa
- ENVIROCRETE® PLUS 32 MPa
- ENVIROCRETE® PLUS 40 MPa
- ENVIROCRETE® PLUS 50 MPa
- ENVIROCRETE® PLUS 65 MPa

Table no. 14 and 1532

- ENVISIA® 20 MPa
- ENVISIA® 25 MPa
- ENVISIA® 32 MPa
- ENVISIA® 40 MPa
- ENVISIA® 50 MPa
- ENVISIA® 65 MPa

Lower carbon concrete products for special applications

Table no. 16 and 1733

- ENVIROCRETE® 50 MPa GB
- ENVIROCRETE® POST TENSIONED 50 MPa 22 MPa@4DAYS
- ENVIROCRETE® 65 MPa LH
- ENVIROCRETE® 65 MPa GB

Table no. 18 and 1934

- ENVIROCRETE® 65 MPa MCC:460
- ENVIROCRETE® 65 MPa MCC:350
- ENVIROCRETE® 80 MPa
- ENVIROCRETE® 80 MPa SWC
- ENVIROCRETE® 100 MPa

Table no. 20 and 2135

- ENVIROCRETE® 40 MPa 10mm TREMIE LH
- ENVIROCRETE® 40 MPa 10mm TREMIE GB
- ENVIROCRETE® CEMENT SLURRY@1100kg/m³
- MRWA ENVIROCRETE® 40 MPa LH MCC:400
- MRWA ENVIROCRETE® 50 MPa LH MCC:420

Table no. 22 and 2336

- ENVIROCRETE® 3% STABILISED SAND
- ENVIROCRETE® 4% STABILISED SAND
- ENVIROCRETE® 6% STABILISED SAND
- ENVIROCRETE® 8% STABILISED SAND
- ENVIROCRETE® 10% STABILISED SAND

Table no. 24 and 2537

- ENVIROCRETE® 12% STABILISED SAND
- ENVIROCRETE® 15% STABILISED SAND
- ENVIROCRETE® 20% STABILISED SAND
- ENVIROCRETE® 25% STABILISED SAND

Table no. 26 and 2738

- ENVIROCRETE® PLUS PT 40 MPa 22 MPa@3DAYS
- ENVIROCRETE® PLUS 50 MPa LH 50MPa@90 DAYS
- ENVIROCRETE® PLUS HIGH SLUMP 50 MPa
- ENVIROCRETE® PLUS 40 MPa DIAPHRAGM WALL
- ENVIROCRETE® PLUS 40 MPa GB PTA TRACK SLAB

Table no. 28 and 2939

- ENVISIA® 80 MPa
- ENVISIA® 32 MPa PTA TRACK SLAB
- ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE
- MRWA ENVISIA® SLIPFORM 32 MPa

Concrete products for special applications

Table no. 30 and 3140

- MRWA 40 MPa GB MCC:400
- MRWA SLIPFORM 32 MPa
- PT S40 MPa GP 22 MPa@3DAYS
- S40 MPa GP MCC:380

Table no. 32 and 3341

- STABILISED SAND 6%
- KERB MACHINE 25 MPa
- KERB MACHINE 32 MPa
- SHOTCRETE 40 MPa
- NO FINES 6:1

Cradle-to-Gate

GWP summary (kg CO₂ eq/m³)

Perth region

NORMAL CLASS GP BLEND 20 MPa	NORMAL CLASS GP BLEND 25 MPa	NORMAL CLASS GP BLEND 32 MPa	NORMAL CLASS GP BLEND 40 MPa	NORMAL CLASS GP BLEND 50 MPa	
244	263	295	356	468	
NORMAL CLASS GP / GGBFS BLEND 20 MPa	NORMAL CLASS GP / GGBFS BLEND 25 MPa	NORMAL CLASS GP / GGBFS BLEND 32 MPa	NORMAL CLASS GP / GGBFS BLEND 40 MPa	NORMAL CLASS GP / GGBFS BLEND 50 MPa	
192	204	235	277	356	
ENVIROCRETE® 20 MPa	ENVIROCRETE® 25 MPa	ENVIROCRETE® 32 MPa	ENVIROCRETE® 40 MPa	ENVIROCRETE® 50 MPa	ENVIROCRETE® 65 MPa
179	195	220	272	335	386
ENVIROCRETE® PLUS 20 MPa	ENVIROCRETE® PLUS 25 MPa	ENVIROCRETE® PLUS 32 MPa	ENVIROCRETE® PLUS 40 MPa	ENVIROCRETE® PLUS 50 MPa	ENVIROCRETE® PLUS 65 MPa
171	188	212	258	311	362
ENVISIA® 20 MPa	ENVISIA® 25 MPa	ENVISIA® 32 MPa	ENVISIA® 40 MPa	ENVISIA® 50 MPa	ENVISIA® 65 MPa
163	175	205	239	298	363
ENVIROCRETE® 50 MPa GB	ENVIROCRETE® POST TENSIONED 50 MPa 22 MPa@4DAYS	ENVIROCRETE® 65 MPa LH	ENVIROCRETE® 65 MPa GB		
382	329	274	368		
ENVIROCRETE® 65 MPa MCC:460	ENVIROCRETE® 65 MPa MCC:350	ENVIROCRETE® 80 MPa	ENVIROCRETE® 80 MPa SWC	ENVIROCRETE® 100 MPa	
352	384	461	431	498	
ENVIROCRETE® 40 MPa 10mm TREMIE LH	ENVIROCRETE® 40 MPa 10mm TREMIE GB	ENVIROCRETE® CEMENT SLURRY @1100kg / m ³	MRWA ENVIROCRETE® 40 MPa LH MCC:400	MRWA ENVIROCRETE® 50 MPa LH MCC:420	
226	292	709	222	220	
ENVIROCRETE® 3% STABILISED SAND	ENVIROCRETE® 4% STABILISED SAND	ENVIROCRETE® 6% STABILISED SAND	ENVIROCRETE® 8% STABILISED SAND	ENVIROCRETE® 10% STABILISED SAND	
55	64	80	106	118	
ENVIROCRETE® 12% STABILISED SAND	ENVIROCRETE® 15% STABILISED SAND	ENVIROCRETE® 20% STABILISED SAND	ENVIROCRETE® 25% STABILISED SAND		
150	182	246	290		

Cradle-to-Gate GWP summary (kg CO₂ eq/m³)

Perth region

ENVIROCRETE® PLUS PT 40 MPa 22 MPa@3DAYS	ENVIROCRETE® PLUS 50 MPa LH 50MPa @90 DAYS	ENVIROCRETE® PLUS HIGH SLUMP 50 MPa	ENVIROCRETE® PLUS 40 MPa DIAPHRAGM WALL	ENVIROCRETE® PLUS 40 MPa GB PTA TRACK SLAB
280	263	346	235	309
ENVISIA® 80 MPa	ENVISIA® 32 MPa PTA TRACK SLAB	ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE	MRWA ENVISIA® SLIPFORM 32 MPa	
386	271	268	225	
MRWA 40 MPa GB MCC:400	MRWA SLIPFORM 32 MPa	PT S40 MPa GP 22 MPa @3DAYS	S40 MPa GP MCC:380	
326	271	371	383	
STABILISED SAND 6%	KERB MACHINE 25 MPa	KERB MACHINE 32 MPa	SHOTCRETE 40 MPa	NO FINES 6:1
87	304	321	347	258

Perth region

TABLE 6. ENVIRONMENTAL PROFILES (A1-A3), NORMAL CLASS CONCRETE, PERTH (WA), PER M³

Indicator	Unit	NORMAL CLASS GP BLEND 20 MPa	NORMAL CLASS GP BLEND 25 MPa	NORMAL CLASS GP BLEND 32 MPa	NORMAL CLASS GP BLEND 40 MPa	NORMAL CLASS GP BLEND 50 MPa
GWP	kg CO₂ eq	244	263	295	356	468
ODP	kg CFC11 eq	1.10E-05	1.17E-05	1.29E-05	1.52E-05	1.95E-05
AP	kg SO ₂ eq	1.08	1.16	1.30	1.57	2.06
EP	kg PO ₄ ³⁻ eq	0.149	0.160	0.178	0.212	0.275
POCP	kg C ₂ H ₄ eq	0.0376	0.0400	0.0439	0.0515	0.0655
ADPE	kg Sb eq	1.54E-05	1.67E-05	1.89E-05	2.32E-05	3.09E-05
ADPF	Mj _{NCV}	1350	1440	1570	1840	2340

TABLE 7. ENVIRONMENTAL PARAMETERS (A1-A3), NORMAL CLASS CONCRETE, PERTH (WA), PER M³

Parameter	Unit	NORMAL CLASS GP BLEND 20 MPa	NORMAL CLASS GP BLEND 25 MPa	NORMAL CLASS GP BLEND 32 MPa	NORMAL CLASS GP BLEND 40 MPa	NORMAL CLASS GP BLEND 50 MPa
PERE	Mj _{NCV}	1.90E+01	1.98E+01	2.12E+01	2.40E+01	2.90E+01
PERM	Mj _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	Mj _{NCV}	1.90E+01	1.98E+01	2.12E+01	2.40E+01	2.90E+01
PENRE	Mj _{NCV}	1.27E+03	1.35E+03	1.48E+03	1.73E+03	2.18E+03
PENRM	Mj _{NCV}	4.84E+00	5.26E+00	5.99E+00	7.56E+00	9.89E+00
PENRT	Mj _{NCV}	1.28E+03	1.36E+03	1.48E+03	1.73E+03	2.19E+03
SM	kg	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
NRSF	Mj _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.15E+00	3.14E+00	3.06E+00	3.03E+00	2.95E+00
HWD	kg	2.83E-04	3.07E-04	3.50E-04	4.30E-04	5.78E-04
NHWD	kg	9.24E-01	1.00E+00	1.14E+00	1.40E+00	1.88E+00
RWD	kg	9.42E-04	1.02E-03	1.17E-03	1.47E-03	1.92E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 8. ENVIRONMENTAL PROFILES (A1-A3), NORMAL CLASS CONCRETE, PERTH (WA), PER M³

Indicator	Unit	NORMAL CLASS GP / GGBFS BLEND 20 MPa	NORMAL CLASS GP / GGBFS BLEND 25 MPa	NORMAL CLASS GP / GGBFS BLEND 32 MPa	NORMAL CLASS GP / GGBFS BLEND 40 MPa	NORMAL CLASS GP / GGBFS BLEND 50 MPa
GWP	kg CO₂ eq	192	204	235	277	356
ODP	kg CFC11 eq	9.10E-06	9.59E-06	1.08E-05	1.24E-05	1.55E-05
AP	kg SO ₂ eq	0.938	1.00	1.15	1.36	1.74
EP	kg PO ₄ ³⁻ eq	0.125	0.132	0.150	0.176	0.222
POCP	kg C ₂ H ₄ eq	0.0346	0.0364	0.0409	0.0472	0.0588
ADPE	kg Sb eq	1.12E-05	1.20E-05	1.40E-05	1.68E-05	2.19E-05
ADPF	MJ _{NCV}	1260	1330	1480	1710	2120

TABLE 9. ENVIRONMENTAL PARAMETERS (A1-A3), NORMAL CLASS CONCRETE, PERTH (WA), PER M³

Parameter	Unit	NORMAL CLASS GP / GGBFS BLEND 20 MPa	NORMAL CLASS GP / GGBFS BLEND 25 MPa	NORMAL CLASS GP / GGBFS BLEND 32 MPa	NORMAL CLASS GP / GGBFS BLEND 40 MPa	NORMAL CLASS GP / GGBFS BLEND 50 MPa
PERE	MJ _{NCV}	1.96E+01	2.03E+01	2.22E+01	2.50E+01	2.99E+01
PERM	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ _{NCV}	1.96E+01	2.03E+01	2.22E+01	2.50E+01	2.99E+01
PENRE	MJ _{NCV}	1.21E+03	1.27E+03	1.41E+03	1.63E+03	2.01E+03
PENRM	MJ _{NCV}	4.40E+00	4.69E+00	5.55E+00	6.69E+00	8.80E+00
PENRT	MJ _{NCV}	1.21E+03	1.27E+03	1.42E+03	1.63E+03	2.02E+03
SM	kg	7.18E+01	7.70E+01	9.05E+01	1.09E+02	1.44E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.08E+00	3.12E+00	3.04E+00	3.02E+00	2.96E+00
HWD	kg	1.99E-04	2.13E-04	2.51E-04	3.03E-04	3.98E-04
NHWD	kg	6.64E-01	7.09E-01	8.36E-01	1.01E+00	1.32E+00
RWD	kg	8.48E-04	9.04E-04	1.07E-03	1.29E-03	1.70E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 10. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® 20 MPa	ENVIROCRETE® 25 MPa	ENVIROCRETE® 32 MPa	ENVIROCRETE® 40 MPa	ENVIROCRETE® 50 MPa	ENVIROCRETE® 65 MPa
GWP	kg CO₂ eq	179	195	220	272	335	386
ODP	kg CFC11 eq	8.73E-06	9.33E-06	1.03E-05	1.24E-05	1.48E-05	1.66E-05
AP	kg SO ₂ eq	0.913	0.995	1.13	1.39	1.72	1.97
EP	kg PO ₄ ³⁻ eq	0.119	0.129	0.145	0.176	0.214	0.245
POCP	kg C ₂ H ₄ eq	0.0345	0.0370	0.0410	0.0491	0.0589	0.0678
ADPE	kg Sb eq	1.01E-05	1.12E-05	1.28E-05	1.61E-05	2.04E-05	3.48E-05
ADPF	MJ _{NCV}	1260	1350	1500	1790	2150	2510

TABLE 11. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® 20 MPa	ENVIROCRETE® 25 MPa	ENVIROCRETE® 32 MPa	ENVIROCRETE® 40 MPa	ENVIROCRETE® 50 MPa	ENVIROCRETE® 65 MPa
PERE	MJ _{NCV}	1.99E+01	2.13E+01	2.31E+01	2.68E+01	3.18E+01	4.56E+01
PERM	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-01
PERT	MJ _{NCV}	1.99E+01	2.13E+01	2.31E+01	2.68E+01	3.18E+01	4.58E+01
PENRE	MJ _{NCV}	1.21E+03	1.30E+03	1.44E+03	1.71E+03	2.05E+03	2.39E+03
PENRM	MJ _{NCV}	4.50E+00	5.47E+00	6.31E+00	7.99E+00	1.10E+01	2.50E+01
PENRT	MJ _{NCV}	1.22E+03	1.30E+03	1.44E+03	1.72E+03	2.06E+03	2.42E+03
SM	kg	9.78E+01	1.08E+02	1.25E+02	1.58E+02	2.00E+02	2.29E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.10E+00	3.09E+00	3.05E+00	3.01E+00	2.88E+00	2.89E+00
HWD	kg	1.75E-04	1.94E-04	2.24E-04	2.84E-04	3.59E-04	4.51E-04
NHWD	kg	5.91E-01	6.56E-01	7.55E-01	9.55E-01	1.21E+00	3.39E+00
RWD	kg	8.63E-04	1.05E-03	1.21E-03	1.53E-03	2.10E-03	6.27E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	0.00E+00	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

Perth region

TABLE 12. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® PLUS 20 MPa	ENVIROCRETE® PLUS 25 MPa	ENVIROCRETE® PLUS 32 MPa	ENVIROCRETE® PLUS 40 MPa	ENVIROCRETE® PLUS 50 MPa	ENVIROCRETE® PLUS 65 MPa
GWP	kg CO₂ eq	171	188	212	258	311	362
ODP	kg CFC11 eq	8.53E-06	9.23E-06	1.02E-05	1.21E-05	1.41E-05	1.59E-05
AP	kg SO ₂ eq	0.905	0.998	1.14	1.40	1.66	1.95
EP	kg PO ₄ ³⁻ eq	0.117	0.127	0.143	0.172	0.204	0.236
POCP	kg C ₂ H ₄ eq	0.0348	0.0379	0.0425	0.0505	0.0585	0.0688
ADPE	kg Sb eq	9.23E-06	1.01E-05	1.17E-05	1.44E-05	1.78E-05	3.36E-05
ADPF	MJ _{NCV}	1290	1400	1570	1870	2160	2590

TABLE 13. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® PLUS 20 MPa	ENVIROCRETE® PLUS 25 MPa	ENVIROCRETE® PLUS 32 MPa	ENVIROCRETE® PLUS 40 MPa	ENVIROCRETE® PLUS 50 MPa	ENVIROCRETE® PLUS 65 MPa
PERE	MJ _{NCV}	2.12E+01	2.26E+01	2.54E+01	2.95E+01	3.34E+01	5.02E+01
PERM	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-01
PERT	MJ _{NCV}	2.12E+01	2.26E+01	2.54E+01	2.95E+01	3.34E+01	5.04E+01
PENRE	MJ _{NCV}	1.25E+03	1.35E+03	1.52E+03	1.80E+03	2.07E+03	2.49E+03
PENRM	MJ _{NCV}	4.59E+00	4.59E+00	6.12E+00	7.65E+00	9.18E+00	2.63E+01
PENRT	MJ _{NCV}	1.25E+03	1.36E+03	1.53E+03	1.81E+03	2.08E+03	2.51E+03
SM	kg	1.19E+02	1.35E+02	1.66E+02	2.08E+02	2.39E+02	2.96E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.12E+00	3.13E+00	3.06E+00	3.02E+00	2.93E+00	2.90E+00
HWD	kg	1.57E-04	1.74E-04	2.00E-04	2.49E-04	3.11E-04	4.01E-04
NHWD	kg	5.39E-01	5.96E-01	6.86E-01	8.56E-01	1.06E+00	3.47E+00
RWD	kg	8.78E-04	8.80E-04	1.17E-03	1.46E-03	1.76E-03	6.70E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	0.00E+00	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

Perth region

TABLE 14. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE, PERTH (WA), PER M³

Indicator	Unit	ENVISIA® 20MPa	ENVISIA® 25MPa	ENVISIA® 32 MPa	ENVISIA® 40MPa	ENVISIA® 50MPa	ENVISIA® 65MPa
GWP	kg CO₂ eq	163	175	205	239	298	363
ODP	kg CFC11 eq	8.22E-06	8.70E-06	9.91E-06	1.13E-05	1.37E-05	1.61E-05
AP	kg SO ₂ eq	0.871	0.935	1.10	1.28	1.61	1.96
EP	kg PO ₄ ³⁻ eq	0.112	0.119	0.138	0.160	0.197	0.237
POCP	kg C ₂ H ₄ eq	0.0342	0.0362	0.0414	0.0474	0.0578	0.0691
ADPE	kg Sb eq	9.80E-06	1.08E-05	1.29E-05	1.53E-05	1.94E-05	2.91E-05
ADPF	MJ _{NCV}	1290	1360	1560	1770	2170	2600

TABLE 15. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE, PERTH (WA), PER M³

Parameter	Unit	ENVISIA® 20MPa	ENVISIA® 25MPa	ENVISIA® 32 MPa	ENVISIA® 40MPa	ENVISIA® 50MPa	ENVISIA® 65MPa
PERE	MJ _{NCV}	2.28E+01	2.42E+01	2.72E+01	3.04E+01	3.69E+01	4.70E+01
PERM	MJ _{NCV}	1.92E-02	2.40E-02	2.89E-02	3.46E-02	4.42E-02	1.37E-01
PERT	MJ _{NCV}	2.28E+01	2.42E+01	2.73E+01	3.04E+01	3.70E+01	4.72E+01
PENRE	MJ _{NCV}	1.25E+03	1.32E+03	1.51E+03	1.71E+03	2.09E+03	2.50E+03
PENRM	MJ _{NCV}	5.82E+00	6.56E+00	7.88E+00	9.45E+00	1.21E+01	2.11E+01
PENRT	MJ _{NCV}	1.25E+03	1.33E+03	1.52E+03	1.72E+03	2.11E+03	2.52E+03
SM	kg	1.20E+02	1.30E+02	1.56E+02	1.87E+02	2.39E+02	2.96E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.11E+00	3.10E+00	3.10E+00	3.06E+00	3.01E+00	2.92E+00
HWD	kg	1.48E-04	1.61E-04	1.93E-04	2.32E-04	2.97E-04	3.86E-04
NHWD	kg	7.06E-01	8.01E-01	9.60E-01	1.15E+00	1.47E+00	2.71E+00
RWD	kg	1.27E-03	1.45E-03	1.74E-03	2.08E-03	2.66E-03	5.13E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	0.00E+00	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

Perth region

TABLE 16. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® 50 MPa GB	ENVIROCRETE® POST TENSIONED 50 MPa 22 MPa@4DAYS	ENVIROCRETE® 65 MPa LH	ENVIROCRETE® 65 MPa GB
GWP	kg CO₂ eq	382	329	274	368
ODP	kg CFC11 eq	1.66E-05	1.43E-05	1.27E-05	1.61E-05
AP	kg SO ₂ eq	1.96	1.67	1.60	1.89
EP	kg PO ₄ ³⁻ eq	0.243	0.209	0.188	0.234
POCP	kg C ₂ H ₄ eq	0.0666	0.0589	0.0577	0.0647
ADPE	kg Sb eq	2.66E-05	2.67E-05	2.12E-05	2.86E-05
ADPF	MJ _{NCV}	2440	2210	2120	2350

TABLE 17. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® 50 MPa GB	ENVIROCRETE® POST TENSIONED 50 MPa 22 MPa@4DAYS	ENVIROCRETE® 65 MPa LH	ENVIROCRETE® 65 MPa GB
PERE	MJ _{NCV}	3.84E+01	3.90E+01	3.81E+01	3.86E+01
PERM	MJ _{NCV}	4.81E-02	8.85E-02	1.32E-01	1.40E-01
PERT	MJ _{NCV}	3.84E+01	3.91E+01	3.83E+01	3.88E+01
PENRE	MJ _{NCV}	2.32E+03	2.10E+03	2.05E+03	2.24E+03
PENRM	MJ _{NCV}	1.72E+01	3.99E+01	9.80E+00	1.04E+01
PENRT	MJ _{NCV}	2.34E+03	2.13E+03	2.06E+03	2.25E+03
SM	kg	2.29E+02	1.91E+02	3.12E+02	2.20E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	2.88E+00	2.95E+00	2.93E+00	2.90E+00
HWD	kg	4.23E-04	4.39E-04	2.70E-04	4.14E-04
NHWD	kg	1.91E+00	2.18E+00	2.26E+00	2.79E+00
RWD	kg	3.67E-03	5.88E-03	2.97E-03	3.16E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 18. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® 65 MPa MCC:460	ENVIROCRETE® 65 MPa MCC:350	ENVIROCRETE® 80 MPa	ENVIROCRETE® 80 MPa SWC	ENVIROCRETE® 100 MPa
GWP	kg CO₂ eq	352	384	461	431	498
ODP	kg CFC11 eq	1.54E-05	1.66E-05	1.95E-05	1.86E-05	1.98E-05
AP	kg SO ₂ eq	1.80	1.96	2.36	2.22	2.42
EP	kg PO ₄ ³⁻ eq	0.225	0.244	0.291	0.273	0.300
POCP	kg C ₂ H ₄ eq	0.0623	0.0673	0.0794	0.0751	0.102
ADPE	kg Sb eq	2.91E-05	3.19E-05	3.89E-05	3.65E-05	4.40E-05
ADPF	MJ _{NCV}	2290	2470	2920	2740	3100

TABLE 19. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® 65 MPa MCC:460	ENVIROCRETE® 65 MPa MCC:350	ENVIROCRETE® 80 MPa	ENVIROCRETE® 80 MPa SWC	ENVIROCRETE® 100 MPa
PERE	MJ _{NCV}	3.96E+01	4.27E+01	5.03E+01	4.63E+01	1.42E+02
PERM	MJ _{NCV}	1.35E-01	1.48E-01	1.80E-01	2.10E-01	2.70E-01
PERT	MJ _{NCV}	3.98E+01	4.29E+01	5.05E+01	4.65E+01	1.42E+02
PENRE	MJ _{NCV}	2.19E+03	2.36E+03	2.78E+03	2.61E+03	3.01E+03
PENRM	MJ _{NCV}	1.82E+01	2.00E+01	2.51E+01	1.56E+01	2.00E+01
PENRT	MJ _{NCV}	2.21E+03	2.38E+03	2.80E+03	2.63E+03	3.03E+03
SM	kg	2.08E+02	2.29E+02	2.79E+02	2.60E+02	1.87E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	2.94E+00	2.88E+00	2.74E+00	2.83E+00	3.69E+01
HWD	kg	4.00E-04	4.40E-04	5.37E-04	4.99E-04	5.66E-04
NHWD	kg	2.70E+00	2.97E+00	3.62E+00	3.78E+00	4.59E+00
RWD	kg	4.57E-03	5.03E-03	6.26E-03	4.74E-03	6.06E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 20. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® 40 MPa 10mm TREMIE LH	ENVIROCRETE® 40 MPa 10mm TREMIE GB	ENVIROCRETE® CEMENT SLURRY @1100kg / m ³
GWP	kg CO₂ eq	226	292	709
ODP	kg CFC11 eq	1.06E-05	1.29E-05	2.90E-05
AP	kg SO ₂ eq	1.34	1.49	3.68
EP	kg PO ₄ ³⁻ eq	0.159	0.187	0.437
POCP	kg C ₂ H ₄ eq	0.0513	0.0531	0.115
ADPE	kg Sb eq	2.93E-05	3.02E-05	4.09E-05
ADPF	MJ _{NCV}	1940	1960	4100

TABLE 21. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® 40 MPa 10mm TREMIE LH	ENVIROCRETE® 40 MPa 10mm TREMIE GB	ENVIROCRETE® CEMENT SLURRY @1100kg / m ³
PERE	MJ _{NCV}	4.19E+01	3.64E+01	5.22E+01
PERM	MJ _{NCV}	1.80E-01	1.17E-01	0.00E+00
PERT	MJ _{NCV}	4.21E+01	3.65E+01	5.22E+01
PENRE	MJ _{NCV}	1.89E+03	1.88E+03	3.88E+03
PENRM	MJ _{NCV}	2.13E+01	1.64E+01	1.37E+00
PENRT	MJ _{NCV}	1.91E+03	1.89E+03	3.88E+03
SM	kg	2.81E+02	1.68E+02	4.58E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.02E+00	2.93E+00	9.89E-01
HWD	kg	2.29E-04	3.33E-04	8.02E-04
NHWD	kg	4.48E+00	3.93E+00	2.67E+00
RWD	kg	6.96E-03	5.37E-03	1.00E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

Perth region

TABLE 22. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® 3% STABILISED SAND	ENVIROCRETE® 4% STABILISED SAND	ENVIROCRETE® 6% STABILISED SAND	ENVIROCRETE® 8% STABILISED SAND	ENVIROCRETE® 10% STABILISED SAND
GWP	kg CO₂ eq	55	64	80	106	118
ODP	kg CFC11 eq	3.41E-06	3.78E-06	4.41E-06	5.42E-06	5.92E-06
AP	kg SO ₂ eq	0.271	0.320	0.402	0.534	0.600
EP	kg PO ₄ ³⁻ eq	0.0409	0.0468	0.0565	0.0720	0.0798
POCP	kg C ₂ H ₄ eq	0.0134	0.0149	0.0174	0.0214	0.0234
ADPE	kg Sb eq	2.48E-06	3.09E-06	4.14E-06	5.71E-06	6.52E-06
ADPF	MJ _{NCV}	510	560	650	800	870

TABLE 23. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® 3% STABILISED SAND	ENVIROCRETE® 4% STABILISED SAND	ENVIROCRETE® 6% STABILISED SAND	ENVIROCRETE® 8% STABILISED SAND	ENVIROCRETE® 10% STABILISED SAND
PERE	MJ _{NCV}	1.05E+01	1.12E+01	1.24E+01	1.41E+01	1.51E+01
PERM	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ _{NCV}	1.05E+01	1.12E+01	1.24E+01	1.41E+01	1.51E+01
PENRE	MJ _{NCV}	4.97E+02	5.48E+02	6.33E+02	7.70E+02	8.37E+02
PENRM	MJ _{NCV}	9.51E-01	1.23E+00	1.90E+00	2.47E+00	2.85E+00
PENRT	MJ _{NCV}	4.98E+02	5.49E+02	6.35E+02	7.72E+02	8.40E+02
SM	kg	2.08E+01	2.70E+01	3.74E+01	5.41E+01	6.24E+01
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	2.61E+00	2.60E+00	2.57E+00	2.54E+00	2.52E+00
HWD	kg	3.75E-05	4.86E-05	6.74E-05	9.70E-05	1.12E-04
NHWD	kg	1.32E-01	1.69E-01	2.33E-01	3.31E-01	3.81E-01
RWD	kg	2.21E-04	2.76E-04	4.03E-04	5.13E-04	5.86E-04
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 24. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® 12% STABILISED SAND	ENVIROCRETE® 15% STABILISED SAND	ENVIROCRETE® 20% STABILISED SAND	ENVIROCRETE® 25% STABILISED SAND
GWP	kg CO₂ eq	150	182	246	290
ODP	kg CFC11 eq	7.18E-06	8.43E-06	1.10E-05	1.27E-05
AP	kg SO ₂ eq	0.766	0.930	1.26	1.49
EP	kg PO ₄ ³⁻ eq	0.099	0.119	0.158	0.185
POCP	kg C ₂ H ₄ eq	0.0285	0.0335	0.0435	0.0505
ADPE	kg Sb eq	8.54E-06	1.06E-05	1.46E-05	1.74E-05
ADPF	MJ _{NCV}	1050	1230	1590	1840

TABLE 25. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® 12% STABILISED SAND	ENVIROCRETE® 15% STABILISED SAND	ENVIROCRETE® 20% STABILISED SAND	ENVIROCRETE® 25% STABILISED SAND
PERE	MJ _{NCV}	1.73E+01	1.96E+01	2.41E+01	2.73E+01
PERM	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ _{NCV}	1.73E+01	1.96E+01	2.41E+01	2.73E+01
PENRE	MJ _{NCV}	1.01E+03	1.18E+03	1.52E+03	1.76E+03
PENRM	MJ _{NCV}	3.80E+00	4.75E+00	6.66E+00	7.99E+00
PENRT	MJ _{NCV}	1.01E+03	1.18E+03	1.53E+03	1.77E+03
SM	kg	8.32E+01	1.04E+02	1.46E+02	1.75E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	2.48E+00	2.43E+00	2.35E+00	2.28E+00
HWD	kg	1.49E-04	1.86E-04	2.61E-04	3.13E-04
NHWD	kg	5.05E-01	6.29E-01	8.77E-01	1.05E+00
RWD	kg	7.69E-04	9.51E-04	1.32E-03	1.57E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 26. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVIROCRETE® PLUS POST TENSIONED 40 MPa 22 MPa@3DAYS	ENVIROCRETE® PLUS 50 MPa LH 50MPa @90 DAYS	ENVIROCRETE® PLUS HIGH SLUMP 50 MPa	ENVIROCRETE® PLUS 40 MPa DIAPHRAGM WALL	ENVIROCRETE® PLUS 40 MPa GB PTA TRACK SLAB
GWP	kg CO₂ eq	280	263	346	235	309
ODP	kg CFC11 eq	1.25E-05	1.23E-05	1.50E-05	1.08E-05	1.51E-05
AP	kg SO ₂ eq	1.42	1.51	1.75	1.36	1.68
EP	kg PO ₄ ³⁻ eq	0.180	0.181	0.220	0.161	0.247
POCP	kg C ₂ H ₄ eq	0.0514	0.0557	0.0619	0.0612	0.0696
ADPE	kg Sb eq	2.15E-05	1.94E-05	2.88E-05	2.60E-05	6.45E-02
ADPF	MJ _{NCV}	1950	2100	2340	2070	2570

TABLE 27. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVIROCRETE® PLUS POST TENSIONED 40 MPa 22 MPa@3DAYS	ENVIROCRETE® PLUS 50 MPa LH 50MPa @90 DAYS	ENVIROCRETE® PLUS HIGH SLUMP 50 MPa	ENVIROCRETE® PLUS 40 MPa DIAPHRAGM WALL	ENVIROCRETE® PLUS 40 MPa GB PTA TRACK SLAB
PERE	MJ _{NCV}	3.45E+01	3.88E+01	4.22E+01	7.92E+01	8.11E+01
PERM	MJ _{NCV}	6.21E-02	8.17E-02	1.15E-01	1.50E-01	5.85E-02
PERT	MJ _{NCV}	3.45E+01	3.89E+01	4.23E+01	7.94E+01	8.12E+01
PENRE	MJ _{NCV}	1.85E+03	2.04E+03	2.22E+03	2.04E+03	2.58E+03
PENRM	MJ _{NCV}	3.51E+01	1.66E+01	3.75E+01	1.90E+01	1.26E+01
PENRT	MJ _{NCV}	1.89E+03	2.05E+03	2.26E+03	2.06E+03	2.60E+03
SM	kg	1.58E+02	2.87E+02	2.00E+02	2.63E+02	2.28E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+01
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.29E+00
FW	m ³	3.06E+00	3.01E+00	2.97E+00	1.72E+01	3.89E+00
HWD	kg	3.72E-04	2.51E-04	4.46E-04	2.12E-04	2.77E-02
NHWD	kg	1.70E+00	1.71E+00	2.51E+00	3.76E+00	2.24E+01
RWD	kg	4.76E-03	3.82E-03	6.06E-03	6.01E-03	5.25E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 28. ENVIRONMENTAL PROFILES (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	ENVISIA® 80 MPa	ENVISIA® 32 MPa PTA TRACK SLAB	ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE	MRWA ENVISIA® SLIPFORM 32 MPa
GWP	kg CO₂ eq	386	271	268	225
ODP	kg CFC11 eq	1.70E-05	1.20E-05	1.22E-05	1.07E-05
AP	kg SO ₂ eq	2.08	1.44	1.45	1.22
EP	kg PO ₄ ³⁻ eq	0.252	0.177	0.178	0.151
POCP	kg C ₂ H ₄ eq	0.0730	0.0557	0.0520	0.0453
ADPE	kg Sb eq	3.11E-05	2.90E-05	2.55E-05	1.95E-05
ADPF	MJ _{NCV}	2750	2390	1910	1670

TABLE 29. ENVIRONMENTAL PARAMETERS (A1-A3), LOWER CARBON CONCRETE FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	ENVISIA® 80 MPa	ENVISIA® 32 MPa PTA TRACK SLAB	ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE	MRWA ENVISIA® SLIPFORM 32 MPa
PERE	MJ _{NCV}	4.95E+01	5.26E+01	4.13E+01	2.86E+01
PERM	MJ _{NCV}	1.47E-01	1.81E-01	4.26E-01	0.00E+00
PERT	MJ _{NCV}	4.96E+01	5.27E+01	4.18E+01	2.86E+01
PENRE	MJ _{NCV}	2.64E+03	2.10E+03	1.84E+03	1.61E+03
PENRM	MJ _{NCV}	2.25E+01	2.40E+02	9.81E+00	3.70E+00
PENRT	MJ _{NCV}	2.66E+03	2.34E+03	1.85E+03	1.62E+03
SM	kg	3.17E+02	1.98E+02	2.18E+02	1.77E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	2.89E+00	3.10E+00	3.00E+00	3.02E+00
HWD	kg	4.13E-04	2.80E-04	3.00E-04	2.17E-04
NHWD	kg	2.89E+00	3.76E+00	2.48E+00	2.89E+00
RWD	kg	5.49E-03	6.46E-03	3.06E-03	2.51E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 30. ENVIRONMENTAL PROFILES (A1-A3), CONCRETE PRODUCTS FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	MRWA 40 MPa GB MCC:400	MRWA ENVIROCRETE® 40 MPa LH MCC:400	MRWA ENVIROCRETE® 50 MPa LH MCC:420	MRWA SLIPFORM 32 MPa
GWP	kg CO₂ eq	326	222	220	271
ODP	kg CFC11 eq	1.44E-05	1.08E-05	1.06E-05	1.22E-05
AP	kg SO ₂ eq	1.60	1.32	1.32	1.34
EP	kg PO ₄ ³⁻ eq	0.205	0.157	0.156	0.172
POCP	kg C ₂ H ₄ eq	0.0549	0.0492	0.0492	0.0470
ADPE	kg Sb eq	2.23E-05	1.26E-05	1.20E-05	2.34E-05
ADPF	MJ _{NCV}	2000	1820	1820	1690

TABLE 31. ENVIRONMENTAL PARAMETERS (A1-A3), CONCRETE PRODUCTS FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	MRWA 40 MPa GB MCC:400	MRWA ENVIROCRETE® 40 MPa LH MCC:400	MRWA ENVIROCRETE® 50 MPa LH MCC:420	MRWA SLIPFORM 32 MPa
PERE	MJ _{NCV}	2.99E+01	3.01E+01	3.05E+01	2.62E+01
PERM	MJ _{NCV}	3.99E-02	2.00E-02	0.00E+00	0.00E+00
PERT	MJ _{NCV}	2.99E+01	3.01E+01	3.05E+01	2.62E+01
PENRE	MJ _{NCV}	1.90E+03	1.76E+03	1.77E+03	1.62E+03
PENRM	MJ _{NCV}	1.09E+01	8.54E+00	1.07E+01	3.72E+00
PENRT	MJ _{NCV}	1.91E+03	1.77E+03	1.78E+03	1.62E+03
SM	kg	1.30E+02	2.76E+02	2.84E+02	1.06E+02
RSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	3.01E+00	3.03E+00	3.01E+00	2.98E+00
HWD	kg	3.67E-04	1.93E-04	1.89E-04	2.99E-04
NHWD	kg	1.62E+00	8.81E-01	6.72E-01	3.13E+00
RWD	kg	2.42E-03	1.79E-03	2.02E-03	2.51E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

Perth region

TABLE 32. ENVIRONMENTAL PROFILES (A1-A3), CONCRETE PRODUCTS FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Indicator	Unit	STABILISED SAND 6%	KERB MACHINE 25 MPa	KERB MACHINE 32 MPa	SHOTCRETE 40 MPa	NO FINES 6:1	PT S40 MPa GP 22 MPa @3DAYS	S40 MPa GP MCC:380
GWP	kg CO₂ eq	87	304	321	347	258	371	383
ODP	kg CFC11 eq	4.66E-06	1.35E-05	1.41E-05	1.47E-05	1.10E-05	1.58E-05	1.62E-05
AP	kg SO ₂ eq	0.421	1.43	1.49	1.65	1.14	1.63	1.69
EP	kg PO ₄ ³⁻ eq	0.0597	0.188	0.196	0.212	0.154	0.220	0.227
POCP	kg C ₂ H ₄ eq	0.0178	0.0487	0.0502	0.0623	0.0375	0.0535	0.0547
ADPE	kg Sb eq	4.63E-06	1.88E-05	1.99E-05	2.12E-05	1.74E-05	2.61E-05	2.50E-05
ADPF	MJ _{NCV}	6.63E+02	1770	1810	2050	1330	1920	1950

TABLE 33. ENVIRONMENTAL PARAMETERS (A1-A3), CONCRETE PRODUCTS FOR SPECIAL APPLICATIONS, PERTH (WA), PER M³

Parameter	Unit	STABILISED SAND 6%	KERB MACHINE 25 MPa	KERB MACHINE 32 MPa	SHOTCRETE 40 MPa	NO FINES 6:1	PT S40 MPa GP 22 MPa @3DAYS	S40 MPa GP MCC:380
PERE	MJ _{NCV}	1.23E+01	2.37E+01	2.38E+01	5.75E+01	1.94E+01	2.63E+01	2.51E+01
PERM	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-02	3.51E-02	0.00E+00
PERT	MJ _{NCV}	1.23E+01	2.37E+01	2.38E+01	5.75E+01	1.94E+01	2.63E+01	2.51E+01
PENRE	MJ _{NCV}	6.42E+02	1.67E+03	1.71E+03	1.97E+03	1.25E+03	1.80E+03	1.83E+03
PENRM	MJ _{NCV}	1.72E+00	7.27E+00	6.69E+00	8.03E+00	1.82E+00	9.48E+00	7.41E+00
PENRT	MJ _{NCV}	6.44E+02	1.68E+03	1.72E+03	1.97E+03	1.25E+03	1.81E+03	1.83E+03
SM	kg	2.81E+01	7.28E+01	6.24E+01	9.36E+01	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	0.00E+00
NRSF	MJ _{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	2.59E+00	2.82E+00	2.82E+00	1.41E+01	2.37E+00	3.00E+00	2.98E+00
HWD	kg	7.81E-05	3.46E-04	3.69E-04	3.83E-04	3.13E-04	4.55E-04	4.66E-04
NHWD	kg	2.65E-01	1.14E+00	1.21E+00	1.27E+00	1.26E+00	1.84E+00	1.52E+00
RWD	kg	3.70E-04	1.41E-03	1.30E-03	1.59E-03	5.87E-04	2.12E-03	1.45E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	0.00E+00	0.00E+00	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	0.00E+00

Other environmental information

Water management

Water is a valuable resource and good quality fresh water is essential to our concrete, construction material and plasterboard operations. We use water in manufacturing, and for dust suppression, cleaning and sanitation. Our quarry and asphalt operations are able to use recycled, brackish and/or process water.

At our larger sites, including quarries, we also capture rainfall or stream flow that is largely used for dust control purposes. We are developing systems that will enable us to collect data on captured rainfall and are developing plans that will underpin an overall improvement in water efficiency.

When developing or purchasing new facilities, our due diligence assessment includes scenario analysis of the quantity and quality of water, assessment of the risks of potential water discharges, and, where relevant, river catchment assessments to ensure sufficient water availability and supply.

Waste and recycling

Throughout Boral's operations, some materials are commonly re-used back into our production processes. Returned concrete is used to make concrete blocks at some plants. This beneficially uses materials that would otherwise require disposal. A large proportion of Boral's recycled and lower carbon products revenue, totalling nine per cent of Boral Limited revenue, is derived from external waste products.

This includes our fly ash and recycling businesses. Opportunities for the re-use of production by-products or waste material continues to grow and are actively being pursued.

Biodiversity management

Protecting the diversity of plant and animal species at and around our operational sites is a core component of our land management efforts. Some examples of the many initiatives to protect biodiversity at our own sites include:

- Boral in WA has completed a number of community projects at **Orange Grove Primary School** including a Heritage Garden space, installation of garden pathways and cockatoo nesting boxes.
- Collaborating with the **Royal Botanic Garden Sydney NSW** in research on the endangered Illawarra Socketwood population at our Dunmore Quarry in New South Wales.
- Partnering with **Sleepy Burrows Wombat Sanctuary** to capture and relocate wombats found at our Peppertree Quarry in New South Wales.
- Maintaining **koala fodder plantations** at Narangba and Petrie quarries in Queensland.
- Conservation work to provide habitat for the threatened **legless lizard** and **spiny rice-flower** at Deer Park Quarry in Victoria.
- Construction of a **bird island habitat** as part of our rehabilitation of wetlands at our Dunmore Quarry in New South Wales.
- Through our community partnership with **Conservation Volunteers Australia**, we support conservation and education initiatives in our local communities, including native vegetation initiatives in local reserves and schools.

Our approach to climate related risks

Our approach

Boral recognises that climate related physical risks and a global transition to a lower-carbon future are expected to impact our operations, customers and suppliers. We support the Paris Agreement and mechanisms to achieve its objective of limiting future average global temperature rises to well below 2°C, as well as Australia’s 2030 target of a 26–28% reduction in carbon emissions below 2005 levels.

Looking at how Boral’s carbon emissions are tracking relative to 2005 levels, in Australia we have reduced emissions by around 40% since FY2005. We achieved about half of this decrease largely by realigning our portfolio away from emissions-intensive businesses. The remainder of the decrease is due to reducing clinker manufacturing in Australia in favour of importing it from more efficient and larger scale operations in Asia. Including Boral North America, our Scope 1 and 2 emissions decreased by 43% since FY2005. We continue to progressively adopt the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). In FY2019, we enhanced our climate-related governance and risk management, completed scenario analysis of Boral Cement’s business and continued to strengthen our resilience to a 2°C scenario. We also broadened our reporting of physical climate-related risks and Scope 3 emissions.

We completed a Group-wide review of our climate-related risks and opportunities using the TCFD framework. This review informed a two-year roadmap to undertake further scenario analysis of key climate related business risks. We transparently and constructively engaged with Climate Action 100+ investor representatives and other stakeholders during the year, sharing our progress in aligning our efforts with the TCFD recommendations and building greater resilience to climate-related impacts.



Our approach to climate related risks

Energy and climate policy

Boral has not identified any major positions on energy and climate policy held by our industry associations that are materially inconsistent with Boral's position.

We support:

- **A national approach to climate and energy policy** to ensure that least-cost carbon emissions abatement is targeted while ensuring reliable and competitive energy can be delivered.
- **Climate and energy policies** that do not unduly erode the competitiveness of domestic based businesses.

Through our community partnership with Conservation Volunteers Australia, we support conservation and education initiatives in our local communities, including native vegetation initiatives in local reserves and schools.

In Australia, we are a member of the Cement Industry Federation (CIF). The CIF policy is to support the Federal Government's national target to reduce emissions by 26–28 percent by 2030, and the CIF has been working with the World Business Council for Sustainable Development and its current roadmap to reduce emissions.

Boral acknowledges the Paris Agreement and supports mechanisms to achieve its objectives, including a national approach to climate and energy policy. Boral's major industry associations are:

- Cement, Concrete and Aggregates Australia (CCAA).
- Green Building Council of Australia (GBCA)
- Infrastructure Sustainability Council (ISC)
- Concrete Institute of Australia (CIA)
- Australian Pozzolan Association (APozA)
- Business Council of Australia (BCA)
- Cement Industry Federation (CIF)

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