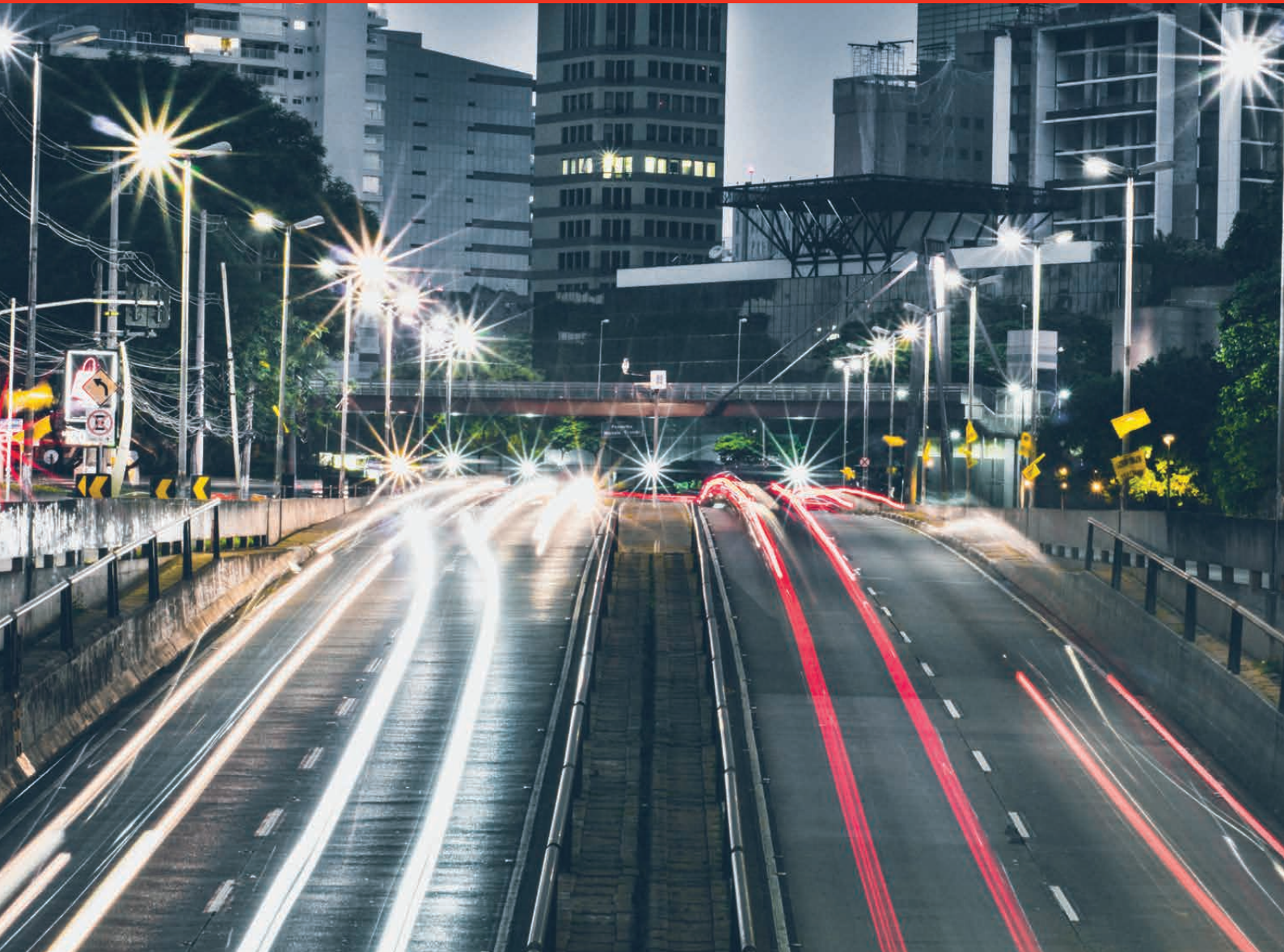


# ViroDecs<sup>™</sup>

## *Environmental Product Declaration*

Holcim Australia Ready-mix Concrete  
In accordance with ISO 14025 and EN 15804+A1  
Programme: The International EPD<sup>®</sup> System | [www.environdec.com](http://www.environdec.com)  
Programme operator: EPD Australasia Limited  
EPD registration no. S-P-01165  
Valid from 30 June 2019 | Valid until 30 June 2024  
Geographical scope: Australia



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# Introduction

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

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

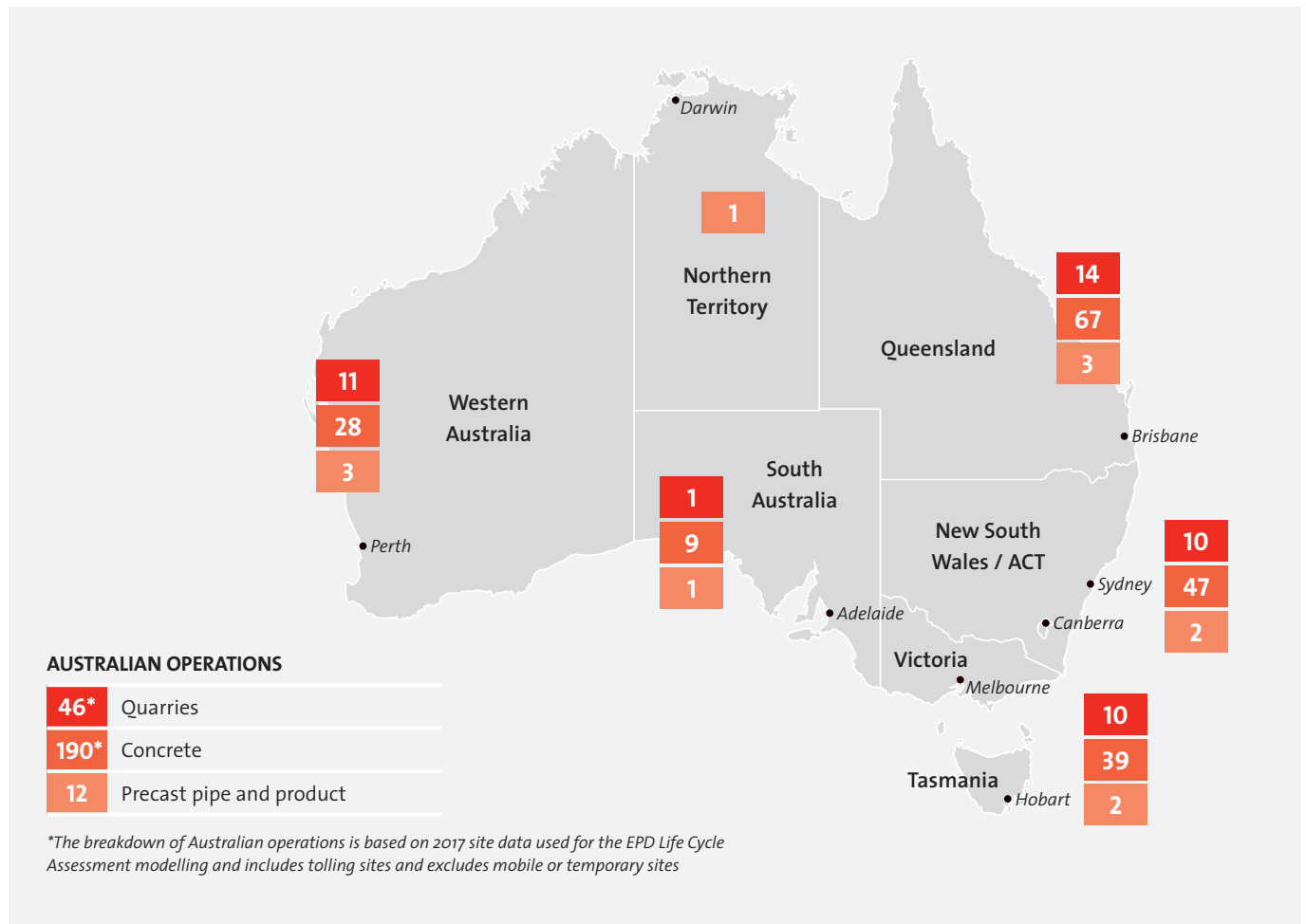
This clearly demonstrates both the essential need for construction materials now and in the future, as well as the necessity for the construction materials industry to be a leading part of the solution addressing climate change.

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

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



# About Holcim



## About Holcim

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

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

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

## About LafargeHolcim

LafargeHolcim is the global leader in building materials and solutions and active in four business segments: Cement, Aggregates, Ready-mix Concrete and Solutions & Products.

With leading positions in all regions of the world and a balanced portfolio between developing and mature markets, LafargeHolcim offers a broad range of high-quality building materials and solutions. LafargeHolcim experts solve the challenges that customers face around the world, whether they are building individual homes or major infrastructure projects. Demand for LafargeHolcim materials and solutions is driven by global population growth, urbanisation, improved living standards and sustainable construction. Around 75,000 people work for the company in around 80 countries.

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

## ViroDecs™ at a glance

The ViroDecs™ initiative for Environmental Product Declarations (EPDs) constitutes a major investment in comprehensively analysing and communicating to customers the embodied environmental impacts of Holcim's ready-mix concrete.

Data collected from across Holcim's Australian operations, including over 190 concrete batching plant sites and 46 quarries was fed into an ISO14044-compliant Life Cycle Assessment (LCA) model by specialist practitioners to generate an Environmental Product Declaration (EPD) to ISO 14025 and EN 15804, which have been independently reviewed by an approved, third-party verifier.

The development of a concrete EPD is a critical "missing" piece to having all key infrastructure and building products represented by an EPD in Australia. Its publication will support designers and developers to drive improved sustainable procurement and materials selection. Holcim's ViroDecs™ also have the potential to challenge common beliefs of environmental sustainability, by supporting the standardisation and transparency of environmental claims.

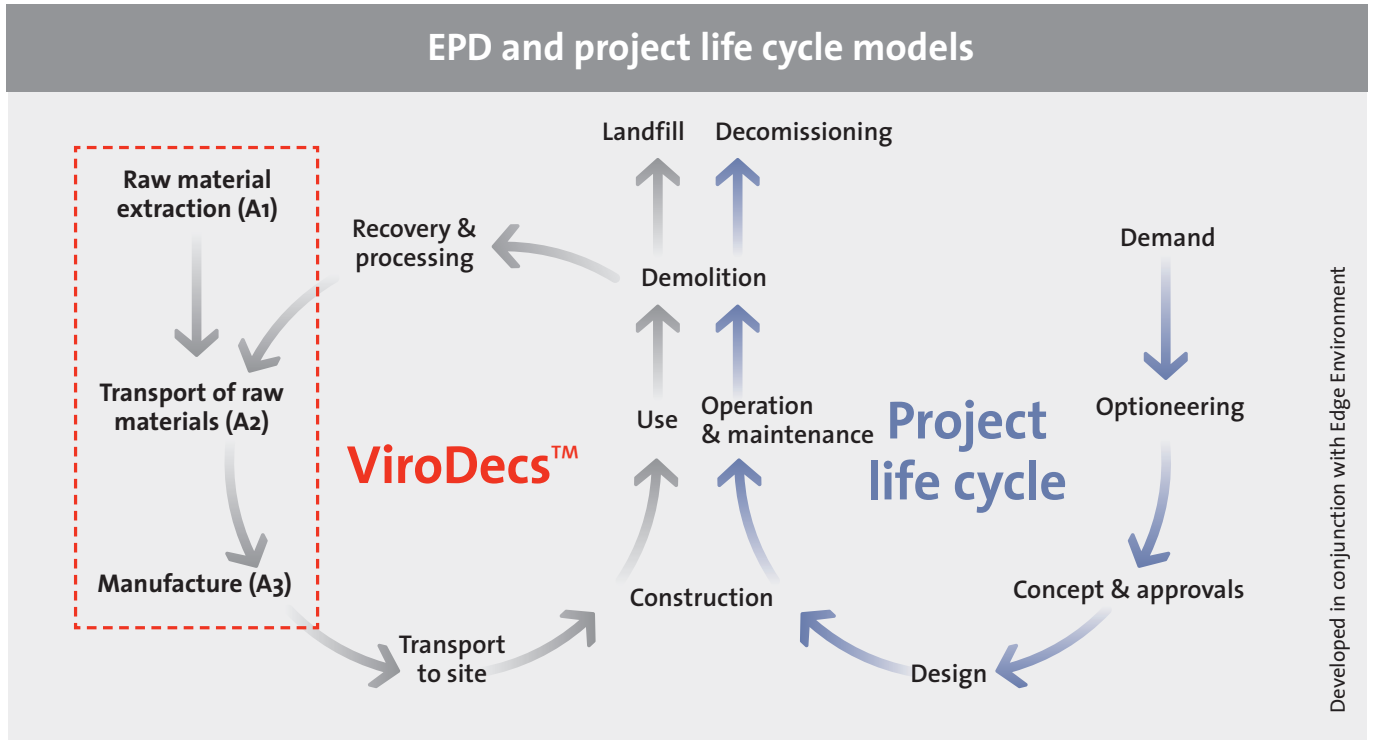
Holcim's ViroDecs™ will help shape the way the construction industry analyses the environmental impact of buildings and infrastructure now and in the future. Advancing from generic environmental information to product, company and geographically-specific information will allow for deeper, broader and more customised analysis with greater confidence in the results.

Beyond providing greater transparency, Holcim's ViroDecs™ also provide a rigorous, science-based framework for driving environmental improvement throughout Holcim's sites and supply chains.

As a result, Holcim's ViroDecs™ will offer an advantage to customers wanting to be leaders in the sustainable infrastructure and building industry. Holcim hopes it will lead the way for other concrete providers to follow suit, fostering a whole-of-life approach in the Australian construction materials industry.



# Why have we developed this EPD?



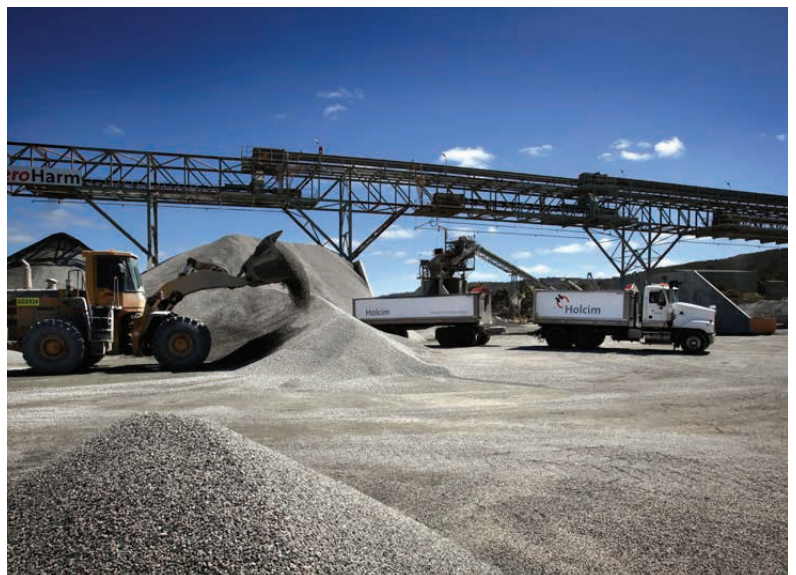
Developed in conjunction with Edge Environment

Note: ViroDecs™ EPD only covers EPD lifecycle stages A1 to A3

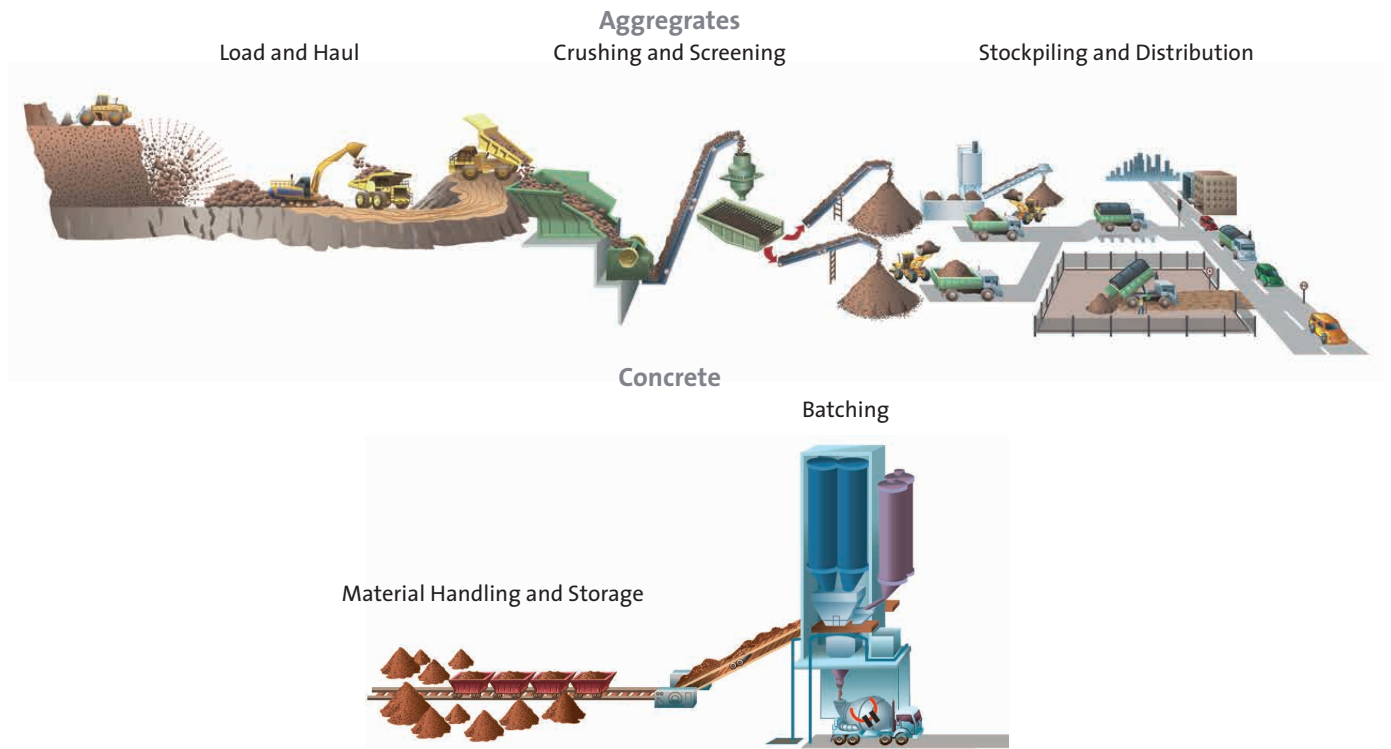
One significant means of providing transparency at the product level is the publication of Environmental Product Declarations.

In simple terms, an EPD is a comprehensive disclosure of a product's environmental impacts. An EPD can cover the different stages of a product's life cycle, from its creation and use to disposal, as well as other relevant information in accordance with recognised international standards. The ViroDecs™ EPD covers EPD lifecycle stages from raw material extraction (Stage A1), through to manufacturing of the ready-mix concrete (Stage A3).

EPDs provide credible transparency because they rely on an objective, scientifically accepted approach, defined in international and European standards, and are third party verified and publicly available.



# Ready-mix concrete



## Summary of properties and classes

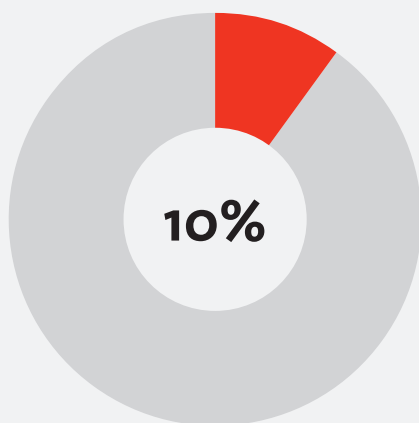
Concrete is prepared by mixing cement, coarse and fine aggregates, and water, with or without the addition of auxiliary agents and additives. The fresh concrete is placed on the building site or prefabricated in factory moulds, compacted, and hardened in the desired shape by the hydration of cement to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

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

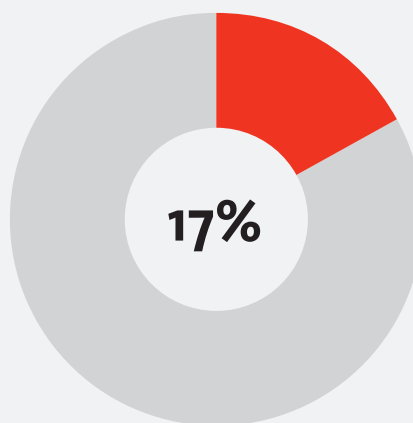
- **Normal-class** - designed for residential applications, low rise buildings, paving and driveways etc. Its specification and ordering have been simplified as far as practicable.
- **Special-class** - allows the purchaser to incorporate into the project specification any special requirements for the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

# Concrete and Life Cycle Assessment

## Construction materials: a major contributor to carbon footprint<sup>1</sup>



National carbon footprint in 2013 from road, bridge and heavy construction



Infrastructure sector footprint from the embodied GHG emissions of materials

### Impacts of materials occur before it arrives at construction site

Construction materials are a significant element of the Australian economy's total greenhouse gas (GHG) emissions. 10% of Australia's national carbon footprint in 2013 was from road, bridge and heavy construction. Of the infrastructure sector's footprint, 17% was from the embodied GHG emissions of materials<sup>1</sup>. While materials selection has lasting impacts on the sector's and Australia's carbon footprint, the majority of GHG impacts occur before the material arrives at the construction site. The provision of accurate and transparent life cycle environmental data is thus critical to lowering the embodied impact of infrastructure and property assets.

Concrete is typically a major contributor to the embodied GHG emissions of an infrastructure or property asset. The development of a concrete EPD is a critical 'missing' piece to having all key infrastructure and building products represented by an EPD.





By bringing concrete products on board to the EPD program in Australia, Holcim's ViroDecs™ will vastly increase the accessibility of life cycle data for construction materials. This will support designers and developers to drive improved sustainable procurement and materials.

To build infrastructure and buildings that have a lower environmental impact requires smarter design, informed by accurate and relevant environmental data. Holcim's ViroDecs™ set a very clear commitment to providing accurate and transparent environmental data for our customers and a framework for continued improvement on Holcim's part.

<sup>1</sup> Man Yu, Thomas Wiedmann, Robert Crawford, Catriona Tait, 'The Carbon Footprint of Australia's Construction Sector', *Procedia Engineering*, Volume 180, 2017, Pages 211-220, ISSN 1877-7058, (<http://www.sciencedirect.com/science/article/pii/S1877705817316879>)



# Sustainability at Holcim

Sustainability pillars	<p>CLIMATE AND ENERGY</p> 	<p>CIRCULAR ECONOMY</p> 	<p>ENVIRONMENT</p> 	<p>COMMUNITY</p> 
Objective	Reduction of CO <sub>2</sub> emissions	Increased reuse of waste-derived resources	Reduction of freshwater withdrawal	Creation of shared value
Lead metric	CO <sub>2</sub> emitted (kg CO <sub>2</sub> /t cementitious)	Quantity of waste reused (M tonnes)	Freshwater withdrawn (liters freshwater/tonne cementitious)	Number of new beneficiaries per year (M new beneficiaries)

Sustainability is not new to Holcim. For decades, Holcim has embedded the triple bottom line approach to sustainability with a focus on responsible utilisation of our planet’s natural resources, safety and environmental performance, and social responsibility.

Today, as a member of LafargeHolcim, Holcim is part of a global response to these challenges through the LafargeHolcim 2030 Sustainable Development Plan (2030 Plan). The 2030 Plan aims to generate one third of net sales from sustainable products and solutions, supported by four fields of action – climate, circular economy, water, and nature – in order to improve quality of life for communities and employees.

In conjunction with the Paris Agreement’s call to minimise the impact of climate change, LafargeHolcim has set targets to reduce net specific carbon dioxide equivalent (CO<sub>2</sub>-e) emissions per tonne of cementitious materials and to help customers avoid 10 million tonnes of CO<sub>2</sub>-e release from buildings and infrastructure each year. Supply of low-carbon materials and solutions is the key to reduce the carbon intensity of the ready-mix concrete.

The 2030 Plan goes beyond simply mitigating our impacts – it also addresses the positive impacts our operations can have beyond the boundaries of our plants.

# Supporting sustainable construction



## Supporting sustainable construction

The LafargeHolcim Foundation for Sustainable Construction was created in 2003 to raise awareness of the important role that architecture, engineering, urban planning and the building industry have in achieving a more sustainable future. It is the mission of the Foundation to select and support initiatives that combine sustainable construction solutions with architectural excellence and enhanced quality of life beyond technical solutions.

Through the non-commercial promotion and development of sustainable construction at national, regional, and global levels, the LafargeHolcim Foundation encourages sustainable responses to the technological, environmental, socioeconomic, and cultural issues affecting building and construction.

The Foundation is an independent legal entity that is supported by LafargeHolcim.

## LafargeHolcim Awards for Sustainable Construction

The Flagship of the Foundation is the LafargeHolcim Awards for Sustainable Construction. It is a significant worldwide competition for sustainable design. It rewards projects and visionary concepts that go beyond balancing environmental performance, social responsibility, and economic growth, thereby exemplifying architectural excellence and a high degree of transferability.

A total of USD 2 million in prize money is awarded and projects and visionary concepts in the fields of architecture, engineering, urban planning, material and construction technology and related fields are eligible for entry.

The next competition – the 6th LafargeHolcim Awards for Sustainable Construction – is open for entries from June 4, 2019 until February 25, 2020.

## LafargeHolcim Forum

The LafargeHolcim Forum is a tri-annual series of conferences on the topic of sustainable construction conducted by the Foundation. The multi-day Forum, including workshops and site visits, is an academic platform for architects, engineers, construction professionals and specialists of all generations to exchange information on creating a sustainable built environment and thus advancing sustainable development.

The Forum supports sustainable construction in the scientific field, among experts in the construction sector, business and society, and promotes interdisciplinary dialogue, brings forward new ideas, and examines potential solutions.

# Peak sustainability bodies

Holcim's ViroDecs™ will offer an advantage to customers wanting to be leaders in the sustainable infrastructure and building industry, currently led by the Infrastructure Sustainability Council of Australia and the Green Building Council of Australia. The Infrastructure Sustainability Council of Australia (ISCA) is the peak industry body for advancing sustainability in Australia's infrastructure. Holcim Australia is a founding member of ISCA and takes an interest and role in developing sustainable practices across the design, construction and operation of infrastructure.

ViroDecs™ was launched at the Infrastructure Sustainability Council of Australia's annual conference in September 2018 and rapidly generated a high level of interest and praise from customers, government departments and sustainability practitioners. As a member of ISCA, Holcim supported the conference with a trade table, interactive innovation workshops on ViroDecs™ as well as sponsorship of the Holcim and Edge Practitioners' Day.

The Green Building Council of Australia (GBCA) is the peak industry body for advancing sustainability in Australia's built environment. The GBCA is committed to developing buildings, cities, and communities that are healthy, liveable, productive, resilient, and sustainable. Holcim is a member of the GBCA and was also a key sponsor of their first 'TRANSFORM' conference in March 2019; at which we presented a session on the importance of collaboration for companies focused on reducing their carbon footprint and shared the Holcim plan for delivering low-carbon concrete.



## Infrastructure Sustainability Council of Australia

*"ViroDecs™, Holcim Australia's range of ready-mix concrete covered by an Environmental Product Declaration, is a step forward for the construction industry. For the first time, stakeholders will have access to third-party verified life cycle data for CO<sub>2</sub>-e emissions in one of Australia's essential construction materials.*

*Holcim's ViroDecs™ will help shape the way the construction industry analyses the environmental impact of infrastructure, and enable projects to achieve positive outcomes and score points using the IS rating scheme."*

**Ainsley Simpson**  
CEO, Infrastructure Sustainability Council of Australia



green  
building  
council  
australia

## Green Building Council of Australia

*"Environmental Product Declarations play an important role in achieving the GBCA's vision to create healthy, resilient and positive places for people. We support the development of EPDs in the market as they represent verified, transparent environmental impact data, and have a transformational impact by enabling the built environment to understand its impact on a deeper level. We commend our member Holcim for demonstrating leadership in trying to achieve these outcomes."*

**Davina Rooney**  
CEO, Green Building Council of Australia



## Beyond Zero Emissions

*"Holcim should be commended on developing their ViroDecs™ EPD for ready-mix concrete. As a first for Australia, the timing could not be better for the Australian construction and infrastructure industry as it faces a new era of transparency and sustainable development. Holcim's ViroDecs™ will provide their customers with the information required to make better decisions and create more sustainable solutions.*

*This increased transparency is aligned with our internationally recognised Rethinking Cement report, which advocated for higher standards to be recognised and achieved for low-carbon cement mixes as a move towards decarbonising cement. Beyond Zero Emissions is one of Australia's most respected climate change think tanks. We produce independent research demonstrating that zero emissions is achievable and affordable now. Our small team with extensive experience in climate change, climate solutions, sustainability research, engineering, policy development and stakeholder engagement are committed to our vision of a zero carbon Australia."*

**Vanessa Petrie**  
CEO, Beyond Zero Emissions

# Key Green Star and ISCA Projects

For more than 100 years Holcim has worked on the construction of iconic projects in Australia. We have accumulated a wealth of experience supplying products and services to some of our country's largest and most technically demanding projects.

Holcim excels in supplying concrete to bridges, dams, major roadway, water treatment and other infrastructure projects. These projects often require significant planning, co-ordination and development work. At Holcim we can meet the challenges of technically and logistically difficult projects.

The following sections provide examples of some of the recent Green Star and IS (Infrastructure Sustainability) rated projects that Holcim has supplied ready-mix concrete.

## Metro Tunnel Project

The Metro Tunnel Project in Melbourne will deliver twin nine-kilometre rail tunnels from Kensington to South Yarra and five new underground stations. Holcim has been contracted by CYP Design & Construction - a consortium led by John Holland, Lendlease and Bouygues Construction designing and building the Tunnels and Stations - to supply the project with concrete.

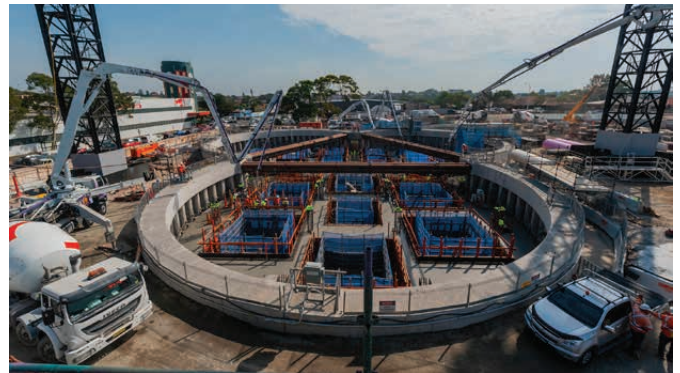
- The Tunnels and Stations package is seeking a 'Leading' Design and As Built rating using the IS Rating Scheme administered by the Infrastructure Sustainability Council of Australia
- Tunnels and Stations Contract Value: \$6 billion
- Practical Completion: 2025



## WestConnex M4 East

The WestConnex M4 East in Sydney will extend the existing M4 Motorway in Sydney with two new 5.5-kilometre tunnels.

- Achieved a 'Leading' Design v1.1 IS Rating
- Capital Value: \$3.8 billion



## Sydney CBD and South East Light Rail

A new light rail line in Sydney extending 12 kilometres from Circular Quay to Moore Park via Central Station, then to Randwick and Kingsford.

- Registered for a IS Design and As Built rating v1.2
- Capital Value: \$2.1 billion
- Practical Completion: March 2020



Images of Sydney Light Rail are reproduced with permission of Transport for NSW.

## Stage 1B Basement Barangaroo South

Holcim has been successful in securing the Stage 1B Basement works.

- Targeting a 6 Star Green Star Design and As-built v1.1 certification
- Targeting 20% embodied carbon reduction commitment



## Sunshine Coast University Hospital

The Queensland Government's Sunshine Coast University Hospital surpassed its four-star Green Star target, using innovative design and construction techniques.

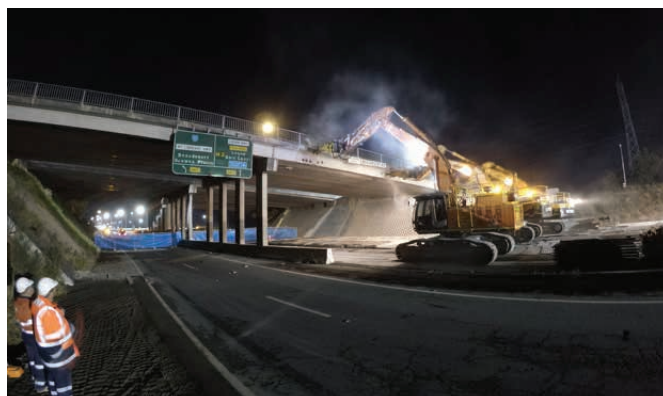
- The largest public healthcare facility in Australia to achieve a 6 Star Green Star v1.0 Design and As-Built rating
- Total Project Cost: \$1.8 billion



## Logan Enhancement Project

The Logan Enhancement Project (LEP) in Queensland includes widening sections of the Logan and Gateway Extension motorways, including improving key congestion hot spots and constructing new south-facing on and off-ramps on the Gateway Extension Motorway at Compton Road.

- Achieved an 'Excellent' Design v1.2 IS Rating
- Capital Value: \$512 million



## Sydney Metro Northwest – Tunnel, Stations and Civil Works

The project is part of the first stage of the Sydney Metro program of works, Australia's biggest public transport project. The Tunnel, Stations and Civil works contract, delivered by CPB John Holland Dragados (CPBJHD) were awarded a 'Leading' rating for sustainability by the Infrastructure Sustainability Council of Australia (ISCA), the highest rating awarded at that point in time.

- As Built v1.2 IS Rating of 92
- Capital Value: \$1.15 billion
- Completed: Mid-2016



## NorthConnex

Due for completion in 2019, the \$2.6 billion NorthConnex Project is a nine kilometre, twin-tunnel, motorway linking the M1 Pacific Motorway to the Hills M2 Motorway. NorthConnex will be the longest road tunnel project in Australia.

- Achieved a 'Leading' Design v1.0 IS Rating
- Capital Value: \$2.65 billion



## WestConnex M5

The WestConnex M5 East in Sydney will duplicate the existing M5 Motorway in Sydney with two new 9 kilometre tunnels.

- Achieved a 'Leading' Design v1.1 IS Rating
- Capital Value: \$3.8 billion



## Sydney Metro City & Southwest - Tunnel and Station Excavation Works

Sydney Metro City & Southwest extends metro rail from the north west, under Sydney Harbour, through the CBD and south west to Bankstown. It is due to open in 2024. The Tunnel and Station Excavation Works contract commenced in June 2017.

- Registered for a Design v1.2 IS Rating.
- Capital Value: \$2.81 billion
- Practical Completion: Mid-2021



# How the EPD can be used in the IS and Green Star rating schemes

The Infrastructure Sustainability (IS) and Green Star rating schemes are the most commonly applied sustainability rating schemes for infrastructure and property assets in Australia, respectively. Both schemes are run by industry bodies the Infrastructure Sustainability Council of Australia and the Green Building Council of Australia with strong support from the built environment sector, government and academia.

## The IS rating scheme

The IS rating scheme scores infrastructure assets on a broad range of sustainability areas, from greenhouse gas (GHG) emissions to community health and well-being, for the three major project stages: design, construction and operation. Holcim’s ViroDecs™ may help IS registered projects gain points in three key credits:

Credit topic	IS rating v1.1 and 1.2	IS rating v2.0	Purpose
Materials environmental impacts	Mat-1	Rso-6	To reward the reduction of embodied environmental impacts associated with materials
Environmental labels	Mat-2	Rso-7	To reward the use of materials with environmental labels
High clinker substitution: innovation challenge	IC-5	IC-2	To reward the significant substitution of clinker with lower carbon emission alternatives

## Green Star

The Green Star rating scheme provides a framework for understanding and communicating the sustainability performance of a property, masterplan or building re-fit.

Holcim’s ViroDecs™ may help Green Star registered projects gain points in three key credits:

Credit topic	Green Star v1.1 and v1.2	Purpose
Life Cycle Assessment	19A	To reward the reduction of life cycle environmental impact
Environmental labels	21C	To reward the use of products with environmental labels
Responsible carbon impacts	Innovation challenge	To reward the reduction of embodied carbon in a building, with any remaining emissions offset

## ViroDecs™ benefits for rating schemes

For concrete-intensive projects our products can contribute to achieving points in the IS materials environmental impacts and Green Star life cycle assessment credits, and relevant innovation credits and challenges. To address the requirements of these credits, the environmental impact data contained in ViroDecs™ can be used by projects to inform the procurement of lower-impact concrete and better target embodied impact reductions for materials. Holcim’s technical team are available to work with customers to develop mixes that meet both technical and sustainability requirements specified by customers. Holcim is also able to provide monthly sustainability reports with the necessary data for projects to monitor their performance under these credits.

Holcim’s ViroDecs™ range of concrete can be used to achieve points allocated to environmental labels, recognised under Green Star credit 21C and IS credits Mat-2 (v1.1 and v1.2) and Rso-7 (v2.0). For concrete-intensive projects, higher levels may be achievable, dependent on the relative value of concrete within the project’s total materials budget. Tailored EPD solutions for specific projects, incorporating normal and special class concrete, can also be developed.

# Case study projects

Holcim have supplied concrete to a range of Green Star and ISCA projects, several of which were profiled in an earlier section.

## WestConnex M4 East

The WestConnex M4 East project in Sydney is one package within the NSW Government's WestConnex program of tunnels and motorway upgrades which aim to reduce congestion and increase accessibility and connections to western Sydney and key employment hubs across the city. The M4 East project's capital value exceeds Transport for NSW's (TfNSW) \$50 million threshold and is thus required to pursue an IS rating.

Holcim developed a range of special-class and normal-class ready-mix concrete for the project to meet specific technical and sustainability requirements. The average supplementary cementitious material (SCM) content of the supplied concrete was over 30% (as a proportion of total cementitious material). The high SCM rate for the concrete supplied assisted the head construction contractor, a CPB John Holland Samsung Joint Venture, to achieve a 'Leading' IS design rating.

The project's top 25 concrete mixes (by volume) were included in this EPD, thus enabling them to achieve points under the Mat-2 IS credit as well.

## Barangaroo South

The Barangaroo precinct in Sydney, major urban redevelopment overseen by the Barangaroo Delivery Authority and developed by Lendlease, is one of only 19 projects around the world participating in the C40 Cities Climate Positive Development Program. The precinct has ambitious sustainability targets, including the goal of being carbon neutral in operations.

Holcim were approached to develop concrete mixes to meet the specifications for the Stage 1B Basement works which will underpin the future residential development. While meeting the rigorous technical requirements and meeting Green Star concrete specifications, Holcim is also targeting a 20% reduction in embodied greenhouse gas emissions as part of the Barangaroo South overall sustainable procurement agenda.

Holcim is able to offer a high level of transparency and certainty regarding the environmental impacts of our concrete, by including the ready-mix concrete mixes for Stage 1B Basement works in the EPD. This environmental data can be input directly into a whole of life building LCA, as required under the Green Star LCA credit, can translate to direct points under the environmental labels Green Star credit and can be used to benchmark the embodied impacts of the building, to help achieve Barangaroo South's overall embodied emissions targets.



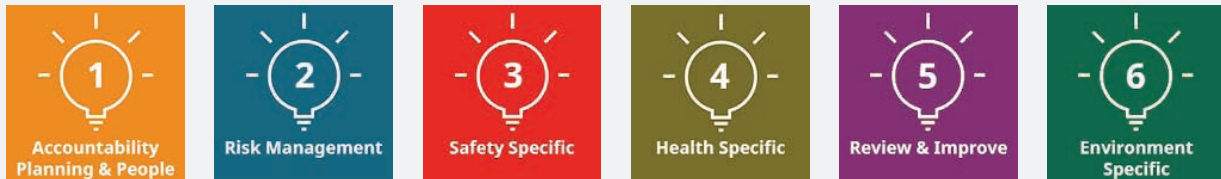
WestConnex M4 East



# Holcim's management systems

## Safety, Health & Environment Management System

### Introduction to the SHEMS



Holcim Australia is committed to providing positive contributions to the community, the environment, and our business by continuously improving environmental performance and focusing on sustainable development. Holcim's Safety, Health and Environment Management System (SHEM) has been developed in alignment with the fundamental management principles as set out in the following International Standards:

- **AS/NZS 4801:** Occupational Health and Safety Management Systems - Specification with guidance for use
- **AS/NZS 4804:** Occupational Health and Safety Management Systems - General Guidelines on principles, systems and supporting techniques
- **AS/NZS ISO 14001:** Environmental Management Systems - Requirements with guidance for use\*
- **AS/NZS ISO 14004:** Environmental Management Systems - General Guidelines on principles, systems and support techniques.
- **AS/NZS ISO 31000:** Risk management – Principles and guidelines\*

Holcim's SHEM is used to support sites and areas across Holcim Australia and New Zealand to implement, maintain and continually improve an effective Safety, Health and Environment program. The SHEM is an interrelated collection of policies, processes, programs, procedures, accountabilities and activities designed to provide the foundation for successful safety, health and environment management. Holcim sets corporate objectives and targets and undertake regular audits of environmental performance to monitor progress.

\*Note: Holcim's Safety, Health and Environment Management System (SHEM) is not certified to ISO 14001 or ISO 31000 etc.

# LCA information

## Declared unit

1 m<sup>3</sup> of ready-mix concrete

## Reference service life (RSL)

The RSL is not specified as the scope is from cradle to gate, and there is a variety of applications of ready-mix concrete with different anticipated RSLs.

## Time representativeness

The primary data for the LCA is based on 2017 calendar year production data.

## Databases and LCA software used

SimaPro (v8.4) was used for the LCA modelling, using background data from:

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

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

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

## Allocation

Allocation was necessary to proportion inputs and outputs to intermediate flows at the quarry and processes at the batching plant level.

As much as possible, intermediate flows were allocated physically based on weight (quarries) or based on m<sup>3</sup> of concrete (at the batching plant). At the quarry level, whenever physical allocation was not possible, economic allocation was carried out based on Holcim's internal cost system.

Regarding inputs, it was assumed that fly ash and silica fumes are waste products and therefore burden-free. Ground granulated blast furnace slag from steel blast furnace production was allocated economically. Please refer to the "Recycled Material" section for further detail.

## Cut-off criteria

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

## Data quality

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

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

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

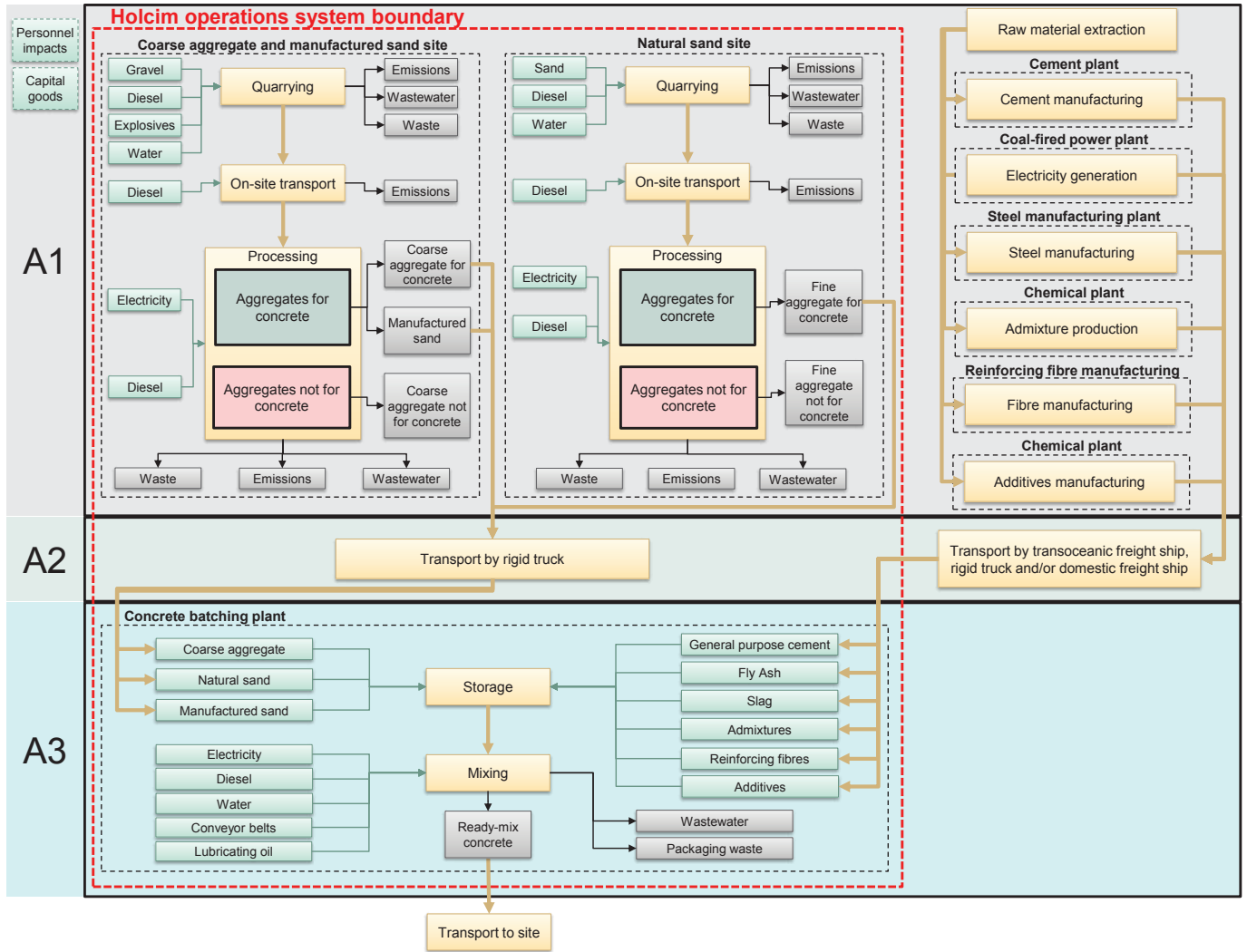
## Assumptions and limitations

The key assumptions and limitations of the LCA are outlined and assessed in the following table.

Assumption or limitation	Potential impact on LCA results	Discussion	Adjusted impact on LCA results
Raw material data for most of the materials in concrete production is based on generic information.	Significant	The EN 15804 standard permits generic data for upstream processes, however, this is where the main impacts are for products across the life cycle.	Medium
Transport distances assumed for all raw materials barring quarry products	Medium	Conservative assumptions regarding transport distance were made based on country of origin and transport mode information.	Low
It was assumed that all concrete mixes require or result in an equal amount of site resources or discharges.	Medium	The uncertainty analysis undertaken to understand the potential likely impact of this assumption on the LCA results demonstrates that it has a minimal impact on most impact categories.	Low
National average values for site resource use and discharge (quarries and concrete batching plants)	Significant	The uncertainty analysis undertaken to understand the potential likely impact of this assumption on the LCA results demonstrates that it has a minimal impact on most impact categories.	Low
Tolling plants are assumed to have a similar site resource use profile as Holcim operated concrete batching plants.	Low	Concrete batching plant resource use constitute less than 1% of environmental impact in each impact category. Tolling plants (i.e. third part plants toll manufacturing for Holcim) have the same site resource use profile as Holcim branded sites.	Low

### System diagram

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



### Description of system boundaries and excluded lifecycle stages

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

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

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

\*Module not declared (MND)

# EPD product description

This EPD covers Holcim's range of ViroDecs™ normal-class ready-mix concrete sold in Australia, as well as select ViroDecs™ special-class ready-mix concrete that Holcim is currently supplying to high-profile infrastructure and property projects in Australia. The following table outlines the features of the normal-class and select special-class mixes covered by this EPD.

Feature	Holcim ViroDecs™ EPD	
	Normal-class mixes	Select special-class mixes
<b>Specification</b>	Specified by: <ul style="list-style-type: none"> <li>• State</li> <li>• Strength grade</li> <li>• Blend</li> </ul> Developed for residential applications, low rise buildings, paving and driveways etc. Its specification and ordering have been simplified as far as practicable.	Specified by: <ul style="list-style-type: none"> <li>• Project</li> <li>• Strength grade OR prescription mix</li> </ul> Prescription mixes are based on aggregate to cement ratios (with no set water to cement ratios). There is no strength guarantee for some prescription mixes. High strength designations above 50 MPa are also class as special class concrete, e.g. 65 MPa, 80 MPa and 100 MPa.
<b>Slump class</b>	A single slump category (80mm) was adopted as an overarching parameter for the normal-class mixes included in the EPD. Please note: the WA-50-B product group consists of mixes at 120 slump	Mix specific
<b>Cement content ranges</b>	Fixed – outlined in environmental impact tables	N/A - Mix specific cement content
<b>Geographic scope</b>	Australia-wide	Australia-wide / Project site-specific
<b>Included plants</b>	Fixed or permanent plants (excludes temporary or project-specific plants)	All plants producing for the selected projects
<b>Tolling plants?</b>	Yes – includes mixes which were produced at Holcim's tolling sites	No
<b>Typical function</b>	Developed for residential applications, low rise buildings, paving and driveways etc. Its specification and ordering have been simplified as far as practicable.	High strength or high-performance concrete, architectural off-form finishes and other decorative applications. Special-class concrete is developed and specified based on a wide range of technical and other requirements.
<b>Example of uses</b>	Developed for residential applications, low rise buildings, paving and driveways etc.	Specified for non-conventional concrete applications, for example: high rise buildings, dams and spillways, and roads, bridges and other civil infrastructure.

## Content declaration

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

Materials	% (by weight)
General purpose cement	5 - 21%
Aggregate	67 - 84%
Supplementary cementitious materials	0 - 11%
Water	11.6 - 12%
Admixtures	0.01 - 0.02%

## Packaging

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

## Recycled material

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

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

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

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

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

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



# Environmental performance

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

Impact Category	Abbreviation	Measurement Unit
<b>Potential Environmental Impacts</b>		
Global warming potential	GWP	kg CO <sub>2</sub> equivalents (GWP100)
Ozone depletion potential	ODP	kg CFC 11 equivalents
Acidification potential	AP	kg SO <sub>2</sub> equivalents
Eutrophication Potential	EP	kg PO <sub>4</sub> <sup>3-</sup> equivalents
Photochemical ozone creation potential	POCP	kg C <sub>2</sub> H <sub>2</sub> equivalents
Abiotic depletion potential (elements)	ADPE	kg Sb equivalents
Abiotic depletion potential (fossil fuels)	ADPF	MJ net calorific value
<b>Resource use</b>		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ, net calorific value
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value
Use of net fresh water	FW	m <sup>3</sup>
<b>Output categories</b>		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed/stored	RWD	kg
Components for reuse	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ per energy carrier
<b>Optional Green Star (v1.2) indicators</b>		
Human Toxicity	HT	CTUh
Land use	LU	m <sup>2</sup>
Water stress indicator	WSI	m <sup>3</sup>
Ionising radiation	IR	kBq U235 eq
Particulate matter	PM	kg PM2.5 eq

## ViroDecs™ normal-class concrete

The Holcim normal-class concrete products included in this EPD have been grouped according to a set of key properties outlined in the following table.

Property	Explanation	Application in product grouping
Strength	Concrete strength is measured in units of pressure (MPa) and refer to the load bearing properties of the material.	There are 5 normal-class strength categories in the EPD: 20, 25, 32, 40 and 50 MPa
Blend	The blend refers to the type and number of supplementary cementitious materials (SCMs) included in the mix design.	The 4 normal-class blend categories in the EPD: G - general mix (no SCM) F - fly ash included B - ground granulated blast furnace slag included T - triple blend (includes slag & fly ash)
Slump	A measure of the consistency of fresh concrete, based on the measured reduction in mm of the height of a pile of concrete, as recorded via the 'slump test' method.	A single slump category (80mm) was adopted as an overarching parameter for the normal-class mixes included in the EPD.  Please note: the WA-50-B product group consists of mixes at 120 slump
Cement content range	The amount of general purpose cement in 1 m <sup>3</sup> of concrete	Each normal-class product group in the EPD has a defined cement content range for which the EPD results are considered 'representative' (as defined in Section 2.5 of the PCR 2012:01).

The following table provides a snapshot of the Holcim normal-class concrete mixes included in this EPD.

MPa	ViroDecs™ General Blend (G)					ViroDecs™ Fly Ash Blend (F)					ViroDecs™ Slag Blend (B)					ViroDecs™ Triple Blend (T)					
	20	25	32	40	50	20	25	32	40	50	20	25	32	40	50	20	25	32	40	50	
NSW ACT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
QLD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
VIC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓
SA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
WA	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓						

## New South Wales (NSW) and the Australian Capital Territory (ACT)

NSW/ACT: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS			GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
20	G	245 - 280	2.73E+02	3.05E-06	6.08E-01	1.28E-01	1.87E-02	1.25E-04	1.84E+03
	F	180 - 224	2.20E+02	2.97E-06	5.04E-01	1.07E-01	1.64E-02	1.14E-04	1.55E+03
	B	118 - 145	1.71E+02	2.70E-06	3.89E-01	8.31E-02	1.52E-02	1.04E-04	1.41E+03
	T	100 - 123	1.52E+02	2.84E-06	3.54E-01	7.59E-02	1.43E-02	1.04E-04	1.30E+03
25	G	255 - 315	2.97E+02	3.21E-06	6.55E-01	1.38E-01	1.99E-02	1.32E-04	1.97E+03
	F	200 - 249	2.41E+02	3.09E-06	5.45E-01	1.16E-01	1.75E-02	1.19E-04	1.67E+03
	B	130 - 159	1.85E+02	2.85E-06	4.17E-01	8.88E-02	1.61E-02	1.10E-04	1.51E+03
	T	106 - 124	1.54E+02	2.87E-06	3.61E-01	7.74E-02	1.46E-02	1.05E-04	1.32E+03
32	G	298 - 355	3.43E+02	3.53E-06	7.50E-01	1.58E-01	2.23E-02	1.48E-04	2.24E+03
	F	227 - 285	2.73E+02	3.40E-06	6.07E-01	1.28E-01	1.89E-02	1.34E-04	1.86E+03
	B	138 - 170	1.96E+02	2.95E-06	4.36E-01	9.29E-02	1.67E-02	1.15E-04	1.58E+03
	T	122 - 147	1.76E+02	3.01E-06	3.99E-01	8.53E-02	1.56E-02	1.13E-04	1.46E+03
40	G	380 - 430	4.05E+02	3.97E-06	8.73E-01	1.83E-01	2.55E-02	1.69E-04	2.61E+03
	F	279 - 347	3.28E+02	3.85E-06	7.17E-01	1.51E-01	2.19E-02	1.54E-04	2.19E+03
	B	177 - 216	2.43E+02	3.38E-06	5.25E-01	1.11E-01	1.96E-02	1.35E-04	1.91E+03
	T	156 - 189	2.19E+02	3.51E-06	4.85E-01	1.03E-01	1.87E-02	1.33E-04	1.78E+03
50	G	500 - 515	5.14E+02	4.74E-06	1.09E+00	2.28E-01	3.10E-02	2.05E-04	3.25E+03
	F	371 - 436	4.14E+02	4.58E-06	8.91E-01	1.87E-01	2.63E-02	1.84E-04	2.71E+03
	B	233 - 285	3.03E+02	3.92E-06	6.44E-01	1.36E-01	2.32E-02	1.57E-04	2.31E+03
	T	241 - 255	2.84E+02	3.99E-06	6.13E-01	1.30E-01	2.16E-02	1.55E-04	2.13E+03

NSW/ACT: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	MJ <sub>Ncv</sub>	MJ <sub>Ncv</sub>	MJ <sub>Ncv</sub>	MJ <sub>Ncv</sub>	MJ <sub>Ncv</sub>	MJ <sub>Ncv</sub>	kg	MJ <sub>Ncv</sub>	MJ <sub>Ncv</sub>	m <sup>3</sup>
20	G	245 - 280	2.03E+01	0.00E+00	2.03E+01	1.10E+03	1.38E+02	1.23E+03	0.00E+00	0.00E+00	0.00E+00	6.76E-01
	F	180 - 224	1.65E+01	0.00E+00	1.65E+01	9.78E+02	1.44E+02	1.12E+03	7.50E+01	0.00E+00	0.00E+00	6.11E-01
	B	118 - 145	1.59E+01	0.00E+00	1.59E+01	9.76E+02	1.38E+02	1.11E+03	1.29E+02	0.00E+00	0.00E+00	5.69E-01
	T	100 - 123	1.43E+01	0.00E+00	1.43E+01	9.34E+02	1.33E+02	1.07E+03	1.89E+02	0.00E+00	0.00E+00	5.50E-01
25	G	255 - 315	2.19E+01	0.00E+00	2.19E+01	1.16E+03	1.38E+02	1.30E+03	0.00E+00	0.00E+00	0.00E+00	7.07E-01
	F	200 - 249	1.79E+01	0.00E+00	1.79E+01	1.03E+03	1.48E+02	1.18E+03	6.70E+01	0.00E+00	0.00E+00	6.38E-01
	B	130 - 159	1.72E+01	0.00E+00	1.72E+01	1.04E+03	1.34E+02	1.17E+03	1.43E+02	0.00E+00	0.00E+00	5.93E-01
	T	106 - 124	1.42E+01	0.00E+00	1.42E+01	9.48E+02	1.43E+02	1.09E+03	1.92E+02	0.00E+00	0.00E+00	5.51E-01
32	G	298 - 355	2.50E+01	0.00E+00	2.50E+01	1.29E+03	1.33E+02	1.42E+03	0.00E+00	0.00E+00	0.00E+00	7.70E-01
	F	227 - 285	2.05E+01	0.00E+00	2.05E+01	1.13E+03	1.25E+02	1.26E+03	8.90E+01	0.00E+00	0.00E+00	6.89E-01
	B	138 - 170	1.83E+01	0.00E+00	1.83E+01	1.08E+03	1.27E+02	1.20E+03	1.53E+02	0.00E+00	0.00E+00	6.12E-01
	T	122 - 147	1.66E+01	0.00E+00	1.66E+01	1.02E+03	1.23E+02	1.15E+03	1.98E+02	0.00E+00	0.00E+00	5.88E-01
40	G	380 - 430	2.95E+01	0.00E+00	2.95E+01	1.48E+03	1.25E+02	1.60E+03	0.00E+00	0.00E+00	0.00E+00	8.57E-01
	F	279 - 347	2.44E+01	0.00E+00	2.44E+01	1.30E+03	1.18E+02	1.42E+03	1.02E+02	0.00E+00	0.00E+00	7.68E-01
	B	177 - 216	2.23E+01	0.00E+00	2.23E+01	1.27E+03	1.21E+02	1.39E+03	1.95E+02	0.00E+00	0.00E+00	6.86E-01
	T	156 - 189	2.00E+01	0.00E+00	2.00E+01	1.21E+03	1.26E+02	1.34E+03	2.55E+02	0.00E+00	0.00E+00	6.57E-01
50	G	500 - 515	3.71E+01	0.00E+00	3.71E+01	1.78E+03	1.07E+02	1.89E+03	0.00E+00	0.00E+00	0.00E+00	1.01E+00
	F	371 - 436	3.04E+01	0.00E+00	3.04E+01	1.55E+03	1.05E+02	1.66E+03	1.35E+02	0.00E+00	0.00E+00	8.91E-01
	B	233 - 285	2.72E+01	0.00E+00	2.72E+01	1.49E+03	1.11E+02	1.60E+03	2.32E+02	0.00E+00	0.00E+00	7.79E-01
	T	241 - 255	2.45E+01	0.00E+00	2.45E+01	1.38E+03	1.03E+02	1.48E+03	2.64E+02	0.00E+00	0.00E+00	7.48E-01

<sup>†</sup>Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

NSW/ACT: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS			HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	kg	kg	kg	kg	kg	kg	MJ
20	G	245 - 280	8.03E-04	7.63E+00	1.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	180 - 224	7.11E-04	6.90E+00	1.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	118 - 145	9.71E-04	6.43E+00	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	100 - 123	9.30E-04	6.34E+00	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	G	255 - 315	8.30E-04	8.10E+00	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	200 - 249	7.36E-04	7.04E+00	8.72E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	130 - 159	1.03E-03	6.77E+00	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	106 - 124	9.04E-04	6.33E+00	1.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	G	298 - 355	8.89E-04	8.86E+00	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	227 - 285	8.52E-04	8.02E+00	1.09E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	138 - 170	1.09E-03	7.06E+00	1.09E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	122 - 147	1.04E-03	6.87E+00	1.09E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	G	380 - 430	1.02E-03	1.01E+01	1.19E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	279 - 347	9.68E-04	9.14E+00	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	177 - 216	1.28E-03	8.11E+00	1.09E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	156 - 189	1.18E-03	7.87E+00	1.09E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	G	500 - 515	1.21E-03	1.21E+01	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	371 - 436	1.11E-03	1.01E+01	3.48E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	233 - 285	1.45E-03	8.68E+00	3.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	241 - 255	1.29E-03	8.95E+00	7.98E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00

NSW/ACT: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS*			HT	LU	WSI	IR	PM
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	CTUh	m <sup>2</sup>	m <sup>3</sup>	kBq U235 eq	kg PM2.5 eq
20	G	245 - 280	1.84E+03	5.03E-10	1.15E-02	8.81E-01	1.51E-02
	F	180 - 224	1.55E+03	4.19E-10	1.09E-02	7.24E-01	1.36E-02
	B	118 - 145	1.41E+03	3.53E-10	9.71E-03	5.75E-01	1.33E-02
	T	100 - 123	1.30E+03	3.30E-10	1.00E-02	5.20E-01	1.32E-02
25	G	255 - 315	1.97E+03	5.38E-10	1.21E-02	9.54E-01	1.55E-02
	F	200 - 249	1.67E+03	4.51E-10	1.14E-02	7.88E-01	1.41E-02
	B	130 - 159	1.51E+03	3.78E-10	1.03E-02	6.21E-01	1.37E-02
	T	106 - 124	1.32E+03	3.27E-10	1.01E-02	5.30E-01	1.28E-02
32	G	298 - 355	2.24E+03	6.08E-10	1.35E-02	1.10E+00	1.63E-02
	F	227 - 285	1.86E+03	5.13E-10	1.26E-02	8.84E-01	1.56E-02
	B	138 - 170	1.58E+03	3.99E-10	1.07E-02	6.55E-01	1.43E-02
	T	122 - 147	1.46E+03	3.72E-10	1.07E-02	5.96E-01	1.40E-02
40	G	380 - 430	2.61E+03	7.10E-10	1.53E-02	1.29E+00	1.82E-02
	F	279 - 347	2.19E+03	6.04E-10	1.44E-02	1.05E+00	1.73E-02
	B	177 - 216	1.91E+03	4.75E-10	1.24E-02	8.01E-01	1.55E-02
	T	156 - 189	1.78E+03	4.38E-10	1.26E-02	7.34E-01	1.48E-02
50	G	500 - 515	3.25E+03	8.84E-10	1.84E-02	1.62E+00	2.10E-02
	F	371 - 436	2.71E+03	7.42E-10	1.73E-02	1.33E+00	1.93E-02
	B	233 - 285	2.31E+03	5.73E-10	1.45E-02	9.94E-01	1.70E-02
	T	241 - 255	2.13E+03	5.48E-10	1.46E-02	9.31E-01	1.69E-02

\*The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories.

†Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

## Queensland (QLD)

QLD: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS			GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
20	G	220 - 247	2.42E+02	3.52E-06	5.55E-01	1.17E-01	1.82E-02	1.30E-04	1.71E+03
	F	165 - 203	2.03E+02	3.44E-06	4.76E-01	1.01E-01	1.62E-02	1.20E-04	1.49E+03
	B	Unspecified‡	1.63E+02	3.78E-06	5.63E-01	9.53E-02	2.09E-02	1.05E-04	1.44E+03
	T	110 - 122	1.54E+02	3.44E-06	4.65E-01	8.68E-02	1.73E-02	1.04E-04	1.31E+03
25	G	230 - 261	2.57E+02	3.61E-06	5.88E-01	1.24E-01	1.91E-02	1.34E-04	1.80E+03
	F	177 - 218	2.19E+02	3.46E-06	5.07E-01	1.08E-01	1.69E-02	1.23E-04	1.58E+03
	B	Unspecified‡	1.72E+02	3.95E-06	5.95E-01	1.00E-01	2.19E-02	1.09E-04	1.51E+03
	T	115 - 139	1.67E+02	3.60E-06	4.98E-01	9.25E-02	1.83E-02	1.10E-04	1.39E+03
32	G	270 - 314	3.03E+02	4.00E-06	6.81E-01	1.44E-01	2.16E-02	1.52E-04	2.08E+03
	F	202 - 251	2.47E+02	3.72E-06	5.66E-01	1.20E-01	1.85E-02	1.34E-04	1.75E+03
	T	135 - 154	1.86E+02	3.93E-06	5.52E-01	1.02E-01	2.01E-02	1.20E-04	1.54E+03
40	G	340 - 367	3.55E+02	4.32E-06	7.85E-01	1.65E-01	2.42E-02	1.68E-04	2.38E+03
	F	252 - 299	2.97E+02	4.31E-06	6.68E-01	1.41E-01	2.15E-02	1.58E-04	2.07E+03
	T	170 - 191	2.18E+02	4.35E-06	6.38E-01	1.16E-01	2.26E-02	1.32E-04	1.75E+03
50	F	329 - 387	3.63E+02	4.30E-06	7.94E-01	1.67E-01	2.41E-02	1.68E-04	2.42E+03
	T	237 - 258	2.96E+02	5.65E-06	8.52E-01	1.53E-01	2.94E-02	1.71E-04	2.31E+03

QLD: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
20	G	220 - 247	1.85E+01	0.00E+00	1.85E+01	1.05E+03	1.44E+02	1.19E+03	0.00E+00	0.00E+00	0.00E+00	6.65E-01
	F	165 - 203	1.55E+01	0.00E+00	1.55E+01	9.48E+02	1.44E+02	1.09E+03	7.65E+01	0.00E+00	0.00E+00	6.12E-01
	B	Unspecified‡	1.59E+01	0.00E+00	1.59E+01	1.02E+03	1.42E+02	1.17E+03	1.10E+02	0.00E+00	0.00E+00	5.80E-01
	T	110 - 122	1.39E+01	0.00E+00	1.39E+01	9.19E+02	1.48E+02	1.07E+03	1.13E+02	0.00E+00	0.00E+00	5.61E-01
25	G	230 - 261	1.91E+01	0.00E+00	1.91E+01	1.10E+03	1.55E+02	1.25E+03	0.00E+00	0.00E+00	0.00E+00	6.78E-01
	F	177 - 218	1.67E+01	0.00E+00	1.67E+01	9.83E+02	1.42E+02	1.12E+03	6.50E+01	0.00E+00	0.00E+00	6.34E-01
	B	Unspecified‡	1.67E+01	0.00E+00	1.67E+01	1.07E+03	1.41E+02	1.21E+03	1.18E+02	0.00E+00	0.00E+00	5.97E-01
	T	115 - 139	1.49E+01	0.00E+00	1.49E+01	9.67E+02	1.44E+02	1.11E+03	1.24E+02	0.00E+00	0.00E+00	5.81E-01
32	G	270 - 314	2.28E+01	0.00E+00	2.28E+01	1.24E+03	1.46E+02	1.38E+03	0.00E+00	0.00E+00	0.00E+00	7.53E-01
	F	202 - 251	1.87E+01	0.00E+00	1.87E+01	1.07E+03	1.42E+02	1.22E+03	7.50E+01	0.00E+00	0.00E+00	6.76E-01
	T	135 - 154	1.65E+01	0.00E+00	1.65E+01	1.06E+03	1.45E+02	1.20E+03	1.40E+02	0.00E+00	0.00E+00	6.15E-01
40	G	340 - 367	2.60E+01	0.00E+00	2.60E+01	1.38E+03	1.45E+02	1.53E+03	0.00E+00	0.00E+00	0.00E+00	8.14E-01
	F	252 - 299	2.21E+01	0.00E+00	2.21E+01	1.25E+03	1.36E+02	1.39E+03	1.18E+02	0.00E+00	0.00E+00	7.50E-01
	T	170 - 191	1.92E+01	0.00E+00	1.92E+01	1.18E+03	1.31E+02	1.31E+03	1.70E+02	0.00E+00	0.00E+00	6.64E-01
50	F	329 - 387	2.66E+01	0.00E+00	2.66E+01	1.40E+03	1.24E+02	1.52E+03	1.50E+02	0.00E+00	0.00E+00	8.24E-01
	T	237 - 258	2.57E+01	0.00E+00	2.57E+01	1.53E+03	1.12E+02	1.64E+03	2.40E+02	0.00E+00	0.00E+00	7.97E-01

†Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

‡This product group had uniform cement content in 2017, the date range used to create the ViroDecs™ EPD.

QLD: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS			HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	kg	kg	kg	kg	kg	kg	MJ
20	G	220 - 247	8.69E-04	7.62E+00	1.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	165 - 203	7.51E-04	6.53E+00	5.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	Unspecified <sup>‡</sup>	1.01E-03	6.24E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	110 - 122	8.78E-04	6.15E+00	1.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	G	230 - 261	8.15E-04	7.76E+00	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	177 - 218	7.98E-04	6.76E+00	4.88E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	Unspecified <sup>‡</sup>	1.05E-03	6.48E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	115 - 139	9.16E-04	6.43E+00	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	G	270 - 314	9.91E-04	8.84E+00	1.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	202 - 251	8.57E-04	7.36E+00	4.72E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	135 - 154	9.96E-04	6.97E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	G	340 - 367	9.97E-04	9.63E+00	1.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	252 - 299	9.49E-04	8.65E+00	6.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	170 - 191	1.09E-03	7.66E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	F	329 - 387	9.98E-04	9.09E+00	3.38E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	237 - 258	1.37E-03	9.77E+00	1.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

QLD: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS*			HT	LU	WSI	IR	PM
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	CTUh	m <sup>2</sup>	m <sup>3</sup>	kBq U235 eq	kg PM2.5 eq
20	G	220 - 247	1.71E+03	5.68E-10	1.28E-02	7.99E-01	1.58E-02
	F	165 - 203	1.49E+03	4.69E-10	1.23E-02	6.84E-01	1.41E-02
	B	Unspecified <sup>‡</sup>	1.44E+03	4.42E-10	1.42E-02	5.39E-01	1.43E-02
	T	110 - 122	1.31E+03	4.35E-10	1.25E-02	5.23E-01	1.42E-02
25	G	230 - 261	1.80E+03	5.45E-10	1.32E-02	8.48E-01	1.51E-02
	F	177 - 218	1.58E+03	5.11E-10	1.25E-02	7.32E-01	1.48E-02
	B	Unspecified <sup>‡</sup>	1.51E+03	4.61E-10	1.49E-02	5.67E-01	1.48E-02
	T	115 - 139	1.39E+03	4.55E-10	1.32E-02	5.62E-01	1.46E-02
32	G	270 - 314	2.08E+03	6.71E-10	1.48E-02	9.90E-01	1.77E-02
	F	202 - 251	1.75E+03	5.59E-10	1.35E-02	8.21E-01	1.57E-02
	T	135 - 154	1.54E+03	4.92E-10	1.45E-02	6.21E-01	1.54E-02
40	G	340 - 367	2.38E+03	7.05E-10	1.61E-02	1.15E+00	1.78E-02
	F	252 - 299	2.07E+03	6.26E-10	1.57E-02	9.77E-01	1.69E-02
	T	170 - 191	1.75E+03	5.41E-10	1.61E-02	7.17E-01	1.63E-02
50	F	329 - 387	2.42E+03	7.19E-10	1.61E-02	1.17E+00	1.78E-02
	T	237 - 258	2.31E+03	6.73E-10	2.12E-02	9.61E-01	1.90E-02

\* The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories.

<sup>†</sup>Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

<sup>‡</sup>This product group had uniform cement content in 2017, the date range used to create the ViroDecs™ EPD.

## Victoria (VIC)

VIC: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS			GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
20	G	220 - 258	2.57E+02	3.42E-06	5.87E-01	1.24E-01	1.98E-02	1.40E-04	1.85E+03
	F	179 - 198	2.21E+02	3.18E-06	5.10E-01	1.08E-01	1.78E-02	1.28E-04	1.64E+03
	T	170 - 179	2.09E+02	3.19E-06	4.86E-01	1.03E-01	1.75E-02	1.27E-04	1.60E+03
25	G	240 - 292	2.86E+02	3.61E-06	6.43E-01	1.36E-01	2.12E-02	1.49E-04	2.02E+03
	F	193 - 228	2.40E+02	3.33E-06	5.48E-01	1.16E-01	1.88E-02	1.35E-04	1.75E+03
	T	180 - 204	2.15E+02	3.21E-06	4.93E-01	1.05E-01	1.74E-02	1.23E-04	1.62E+03
32	G	279 - 338	3.28E+02	3.92E-06	7.29E-01	1.54E-01	2.34E-02	1.64E-04	2.27E+03
	F	219 - 259	2.65E+02	3.60E-06	6.02E-01	1.27E-01	2.02E-02	1.46E-04	1.91E+03
	T	203 - 223	2.52E+02	3.56E-06	5.62E-01	1.19E-01	1.95E-02	1.39E-04	1.87E+03
40	G	335 - 395	3.86E+02	4.28E-06	8.41E-01	1.77E-01	2.58E-02	1.77E-04	2.58E+03
	F	252 - 290	3.02E+02	3.96E-06	6.73E-01	1.42E-01	2.18E-02	1.56E-04	2.11E+03
	T	230 - 238	2.72E+02	3.84E-06	6.11E-01	1.29E-01	2.13E-02	1.55E-04	2.02E+03
50	G	438 - 454	4.54E+02	4.93E-06	9.81E-01	2.06E-01	2.96E-02	2.04E-04	2.99E+03
	F	325 - 360	3.63E+02	4.64E-06	7.92E-01	1.67E-01	2.47E-02	1.82E-04	2.48E+03
	T	260 - 296	3.02E+02	4.33E-06	6.62E-01	1.40E-01	2.31E-02	1.68E-04	2.26E+03

VIC: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
20	G	220 - 258	1.92E+01	0.00E+00	1.92E+01	1.16E+03	1.68E+02	1.32E+03	0.00E+00	0.00E+00	0.00E+00	6.64E-01
	F	179 - 198	1.66E+01	0.00E+00	1.66E+01	1.05E+03	1.60E+02	1.21E+03	4.80E+01	0.00E+00	0.00E+00	6.14E-01
	T	170 - 179	1.63E+01	0.00E+00	1.63E+01	1.05E+03	1.62E+02	1.21E+03	4.40E+01	0.00E+00	0.00E+00	6.05E-01
25	G	240 - 292	2.11E+01	0.00E+00	2.11E+01	1.24E+03	1.63E+02	1.40E+03	0.00E+00	0.00E+00	0.00E+00	7.03E-01
	F	193 - 228	1.80E+01	0.00E+00	1.80E+01	1.11E+03	1.56E+02	1.26E+03	5.30E+01	0.00E+00	0.00E+00	6.42E-01
	T	180 - 204	1.71E+01	0.00E+00	1.71E+01	1.04E+03	1.58E+02	1.20E+03	7.80E+01	0.00E+00	0.00E+00	6.18E-01
32	G	279 - 338	2.42E+01	0.00E+00	2.42E+01	1.36E+03	1.55E+02	1.51E+03	0.00E+00	0.00E+00	0.00E+00	7.63E-01
	F	219 - 259	1.98E+01	0.00E+00	1.98E+01	1.19E+03	1.55E+02	1.35E+03	6.80E+01	0.00E+00	0.00E+00	6.81E-01
	T	203 - 223	2.02E+01	0.00E+00	2.02E+01	1.17E+03	1.42E+02	1.32E+03	1.15E+02	0.00E+00	0.00E+00	6.77E-01
40	G	335 - 395	2.82E+01	0.00E+00	2.82E+01	1.48E+03	1.41E+02	1.62E+03	0.00E+00	0.00E+00	0.00E+00	8.42E-01
	F	252 - 290	2.25E+01	0.00E+00	2.25E+01	1.28E+03	1.49E+02	1.43E+03	9.30E+01	0.00E+00	0.00E+00	7.37E-01
	T	230 - 238	2.14E+01	0.00E+00	2.14E+01	1.28E+03	1.45E+02	1.43E+03	9.80E+01	0.00E+00	0.00E+00	7.05E-01
50	G	438 - 454	3.30E+01	0.00E+00	3.30E+01	1.70E+03	1.39E+02	1.84E+03	0.00E+00	0.00E+00	0.00E+00	9.43E-01
	F	325 - 360	2.72E+01	0.00E+00	2.72E+01	1.46E+03	1.09E+02	1.56E+03	1.31E+02	0.00E+00	0.00E+00	8.35E-01
	T	260 - 296	2.50E+01	0.00E+00	2.50E+01	1.42E+03	1.28E+02	1.55E+03	1.90E+02	0.00E+00	0.00E+00	7.71E-01

†Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

VIC: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS			HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	kg	kg	kg	kg	kg	kg	MJ
20	G	220 - 258	8.27E-04	1.02E+01	5.27E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	179 - 198	7.68E-04	9.54E+00	5.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	170 - 179	8.07E-04	9.50E+00	5.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	G	240 - 292	8.74E-04	1.07E+01	5.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	193 - 228	8.07E-04	9.92E+00	5.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	180 - 204	8.33E-04	7.94E+00	2.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	G	279 - 338	9.58E-04	1.16E+01	5.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	219 - 259	8.68E-04	1.05E+01	5.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	203 - 223	9.71E-04	8.79E+00	2.76E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	G	335 - 395	1.03E-03	1.13E+01	3.46E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	252 - 290	9.28E-04	1.00E+01	3.37E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	230 - 238	1.02E-03	1.10E+01	5.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	G	438 - 454	1.18E-03	1.28E+01	3.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	325 - 360	1.11E-03	1.11E+01	2.95E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	T	260 - 296	1.25E-03	1.03E+01	2.84E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

VIC: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS*			HT	LU	WSI	IR	PM
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	CTUh	m <sup>2</sup>	m <sup>3</sup>	kBq U235 eq	kg PM2.5 eq
20	G	220 - 258	1.85E+03	4.29E-10	1.25E-02	8.26E-01	1.49E-02
	F	179 - 198	1.64E+03	3.72E-10	1.15E-02	7.12E-01	1.40E-02
	T	170 - 179	1.60E+03	3.56E-10	1.15E-02	6.79E-01	1.38E-02
25	G	240 - 292	2.02E+03	4.74E-10	1.33E-02	9.12E-01	1.56E-02
	F	193 - 228	1.75E+03	4.03E-10	1.22E-02	7.70E-01	1.45E-02
	T	180 - 204	1.62E+03	3.70E-10	1.16E-02	7.05E-01	1.40E-02
32	G	279 - 338	2.27E+03	5.42E-10	1.46E-02	1.04E+00	1.68E-02
	F	219 - 259	1.91E+03	4.47E-10	1.32E-02	8.51E-01	1.54E-02
	T	203 - 223	1.87E+03	4.33E-10	1.30E-02	8.20E-01	1.51E-02
40	G	335 - 395	2.58E+03	6.37E-10	1.61E-02	1.23E+00	1.80E-02
	F	252 - 290	2.11E+03	5.11E-10	1.46E-02	9.72E-01	1.65E-02
	T	230 - 238	2.02E+03	4.64E-10	1.40E-02	8.77E-01	1.59E-02
50	G	438 - 454	2.99E+03	7.48E-10	1.87E-02	1.44E+00	2.02E-02
	F	325 - 360	2.48E+03	6.18E-10	1.72E-02	1.16E+00	1.88E-02
	T	260 - 296	2.26E+03	5.26E-10	1.58E-02	9.83E-01	1.74E-02

\*The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories.

†Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.





## South Australia (SA)

SA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS			GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
20	G	Unspecified‡	2.65E+02	2.99E-06	5.88E-01	1.24E-01	1.80E-02	1.20E-04	1.77E+03
	F	180 - 188	1.98E+02	2.78E-06	4.57E-01	9.72E-02	1.52E-02	1.04E-04	1.41E+03
	B	155 - 210	2.00E+02	3.29E-06	4.63E-01	9.80E-02	1.74E-02	1.26E-04	1.57E+03
25	G	295 - 305	3.03E+02	3.26E-06	6.65E-01	1.40E-01	2.01E-02	1.33E-04	2.00E+03
	F	206 - 218	2.27E+02	3.03E-06	5.15E-01	1.09E-01	1.68E-02	1.15E-04	1.59E+03
	B	174 - 229	2.20E+02	3.47E-06	5.02E-01	1.06E-01	1.86E-02	1.34E-04	1.70E+03
32	G	345 - 355	3.51E+02	3.61E-06	7.62E-01	1.60E-01	2.26E-02	1.49E-04	2.28E+03
	F	238 - 255	2.63E+02	3.34E-06	5.88E-01	1.24E-01	1.86E-02	1.29E-04	1.80E+03
	B	197 - 217	2.38E+02	3.67E-06	5.38E-01	1.14E-01	1.96E-02	1.40E-04	1.82E+03
40	G	410 - 420	4.13E+02	4.04E-06	8.86E-01	1.86E-01	2.58E-02	1.70E-04	2.65E+03
	F	290 - 301	3.08E+02	3.78E-06	6.76E-01	1.43E-01	2.10E-02	1.47E-04	2.08E+03
	B	217 - 243	2.62E+02	3.93E-06	5.83E-01	1.23E-01	2.12E-02	1.52E-04	2.00E+03
50	B	250 - 260	3.03E+02	4.45E-06	6.57E-01	1.38E-01	2.43E-02	1.74E-04	2.35E+03

SA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
20	G	Unspecified‡	2.28E+01	0.00E+00	2.28E+01	1.03E+03	1.29E+02	1.16E+03	0.00E+00	0.00E+00	0.00E+00	6.63E-01
	F	180 - 188	1.79E+01	0.00E+00	1.79E+01	8.87E+02	1.51E+02	1.04E+03	6.00E+01	0.00E+00	0.00E+00	5.79E-01
	B	155 - 210	1.91E+01	0.00E+00	1.91E+01	1.06E+03	1.57E+02	1.22E+03	6.20E+01	0.00E+00	0.00E+00	6.04E-01
25	G	295 - 305	2.54E+01	0.00E+00	2.54E+01	1.15E+03	1.29E+02	1.27E+03	0.00E+00	0.00E+00	0.00E+00	7.15E-01
	F	206 - 218	1.99E+01	0.00E+00	1.99E+01	9.75E+02	1.46E+02	1.12E+03	7.00E+01	0.00E+00	0.00E+00	6.21E-01
	B	174 - 229	2.08E+01	0.00E+00	2.08E+01	1.14E+03	1.52E+02	1.29E+03	7.50E+01	0.00E+00	0.00E+00	6.36E-01
32	G	345 - 355	2.87E+01	0.00E+00	2.87E+01	1.29E+03	1.29E+02	1.41E+03	0.00E+00	0.00E+00	0.00E+00	7.82E-01
	F	238 - 255	2.26E+01	0.00E+00	2.26E+01	1.08E+03	1.39E+02	1.22E+03	8.20E+01	0.00E+00	0.00E+00	6.73E-01
	B	197 - 217	2.25E+01	0.00E+00	2.25E+01	1.20E+03	1.53E+02	1.35E+03	9.00E+01	0.00E+00	0.00E+00	6.68E-01
40	G	410 - 420	3.28E+01	0.00E+00	3.28E+01	1.47E+03	1.27E+02	1.60E+03	0.00E+00	0.00E+00	0.00E+00	8.66E-01
	F	290 - 301	2.55E+01	0.00E+00	2.55E+01	1.23E+03	1.24E+02	1.35E+03	1.26E+02	0.00E+00	0.00E+00	7.38E-01
	B	217 - 243	2.48E+01	0.00E+00	2.48E+01	1.31E+03	1.46E+02	1.45E+03	1.19E+02	0.00E+00	0.00E+00	7.09E-01
50	B	250 - 260	2.95E+01	0.00E+00	2.95E+01	1.53E+03	1.25E+02	1.66E+03	1.99E+02	0.00E+00	0.00E+00	7.88E-01

†Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

‡This product group had uniform cement content in 2017, the date range used to create the ViroDecs™ EPD.

SA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS			HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	kg	kg	kg	kg	kg	kg	MJ
20	G	Unspecified <sup>‡</sup>	7.67E-04	6.53E+00	3.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	180 - 188	6.66E-04	5.55E+00	4.66E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	155 - 210	8.87E-04	8.38E+00	3.53E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	G	295 - 305	8.30E-04	7.23E+00	3.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	206 - 218	7.25E-04	6.14E+00	4.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	174 - 229	9.60E-04	8.83E+00	3.53E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	G	345 - 355	9.11E-04	8.13E+00	2.90E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	238 - 255	8.01E-04	6.88E+00	3.37E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	197 - 217	1.03E-03	8.63E+00	2.49E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	G	410 - 420	1.01E-03	9.26E+00	3.86E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F	290 - 301	8.87E-04	7.85E+00	4.38E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	217 - 243	1.16E-03	9.25E+00	2.49E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	B	250 - 260	1.45E-03	1.05E+01	2.53E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS*			HT	LU	WSI	IR	PM
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	CTUh	m <sup>2</sup>	m <sup>3</sup>	kBq U235 eq	kg PM2.5 eq
20	G	Unspecified <sup>‡</sup>	1.77E+03	4.43E-10	1.12E-02	8.68E-01	1.46E-02
	F	180 - 188	1.41E+03	3.43E-10	1.01E-02	6.67E-01	1.32E-02
	B	155 - 210	1.57E+03	3.53E-10	1.18E-02	6.72E-01	1.39E-02
25	G	295 - 305	2.00E+03	5.04E-10	1.24E-02	9.86E-01	1.56E-02
	F	206 - 218	1.59E+03	3.90E-10	1.11E-02	7.56E-01	1.40E-02
	B	174 - 229	1.70E+03	3.86E-10	1.25E-02	7.34E-01	1.45E-02
32	G	345 - 355	2.28E+03	5.80E-10	1.38E-02	1.13E+00	1.68E-02
	F	238 - 255	1.80E+03	4.50E-10	1.23E-02	8.69E-01	1.51E-02
	B	197 - 217	1.82E+03	4.20E-10	1.33E-02	7.98E-01	1.52E-02
40	G	410 - 420	2.65E+03	6.78E-10	1.55E-02	1.32E+00	1.83E-02
	F	290 - 301	2.08E+03	5.25E-10	1.40E-02	1.01E+00	1.62E-02
	B	217 - 243	2.00E+03	4.61E-10	1.43E-02	8.73E-01	1.61E-02
50	B	250 - 260	2.35E+03	5.36E-10	1.62E-02	1.00E+00	1.77E-02

\* The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories.

<sup>†</sup> Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

<sup>‡</sup> This product group had uniform cement content in 2017, the date range used to create the ViroDecs™ EPD.



## Western Australia (WA)

WA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS			GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
20	G	235 - 273	2.65E+02	3.10E-06	6.24E-01	1.27E-01	1.93E-02	1.20E-04	1.80E+03
	B	156 - 204	2.07E+02	2.83E-06	4.73E-01	1.01E-01	1.62E-02	1.09E-04	1.53E+03
25	G	240 - 286	2.80E+02	3.84E-06	6.65E-01	1.35E-01	2.11E-02	1.40E-04	1.94E+03
	B	175 - 209	2.21E+02	3.43E-06	5.08E-01	1.08E-01	1.76E-02	1.26E-04	1.64E+03
32	G	275 - 337	3.21E+02	3.63E-06	7.82E-01	1.53E-01	2.37E-02	1.38E-04	2.14E+03
	B	185 - 211	2.37E+02	3.76E-06	5.35E-01	1.13E-01	1.92E-02	1.38E-04	1.81E+03
40	G	320 - 404	3.70E+02	3.92E-06	8.52E-01	1.72E-01	2.52E-02	1.57E-04	2.42E+03
	B	208 - 247	2.67E+02	4.00E-06	5.94E-01	1.25E-01	2.10E-02	1.50E-04	2.01E+03
50	B	292 - 299	3.34E+02	4.59E-06	7.27E-01	1.53E-01	2.50E-02	1.77E-04	2.46E+03

WA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Blend	Cement content† (kg/m <sup>3</sup> )	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
20	G	235 - 273	2.05E+01	0.00E+00	2.05E+01	1.04E+03	1.43E+02	1.19E+03	0.00E+00	0.00E+00	0.00E+00	7.05E-01
	B	156 - 204	1.72E+01	0.00E+00	1.72E+01	9.68E+02	1.51E+02	1.12E+03	6.00E+01	0.00E+00	0.00E+00	6.07E-01
25	G	240 - 286	2.17E+01	0.00E+00	2.17E+01	1.15E+03	1.46E+02	1.30E+03	0.00E+00	0.00E+00	0.00E+00	7.51E-01
	B	175 - 209	1.78E+01	0.00E+00	1.78E+01	1.05E+03	1.52E+02	1.20E+03	4.80E+01	0.00E+00	0.00E+00	6.39E-01
32	G	275 - 337	2.51E+01	0.00E+00	2.51E+01	1.20E+03	1.37E+02	1.34E+03	0.00E+00	0.00E+00	0.00E+00	8.33E-01
	B	185 - 211	2.03E+01	0.00E+00	2.03E+01	1.18E+03	1.44E+02	1.32E+03	1.07E+02	0.00E+00	0.00E+00	6.81E-01
40	G	320 - 404	2.81E+01	0.00E+00	2.81E+01	1.35E+03	1.32E+02	1.48E+03	0.00E+00	0.00E+00	0.00E+00	8.68E-01
	B	208 - 247	2.26E+01	0.00E+00	2.26E+01	1.29E+03	1.42E+02	1.43E+03	1.23E+02	0.00E+00	0.00E+00	7.25E-01
50	B	292 - 299	2.81E+01	0.00E+00	2.81E+01	1.54E+03	1.28E+02	1.67E+03	1.58E+02	0.00E+00	0.00E+00	8.28E-01

†Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

‡This product group had uniform cement content in 2017, the date range used to create the ViroDecs™ EPD.

WA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS			HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	kg	kg	kg	kg	kg	kg	MJ
20	G	235 - 273	7.89E-04	6.60E+00	4.33E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	156 - 204	8.52E-04	5.76E+00	2.89E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	G	240 - 286	8.90E-04	7.72E+00	4.89E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	175 - 209	8.79E-04	6.94E+00	6.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	G	275 - 337	8.77E-04	7.66E+00	4.39E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	185 - 211	1.09E-03	7.49E+00	4.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	G	320 - 404	9.74E-04	8.63E+00	3.99E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	B	208 - 247	1.17E-03	8.25E+00	6.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	B	292 - 299	1.40E-03	9.73E+00	9.31E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00

WA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS*			HT	LU	WSI	IR	PM
Strength (MPa)	Blend	Cement content <sup>†</sup> (kg/m <sup>3</sup> )	CTUh	m <sup>2</sup>	m <sup>3</sup>	kBq U235 eq	kg PM2.5 eq
20	G	235 - 273	1.80E+03	4.40E-10	1.18E-02	8.43E-01	1.64E-02
	B	156 - 204	1.53E+03	3.57E-10	1.04E-02	6.94E-01	1.35E-02
25	G	240 - 286	1.94E+03	4.79E-10	1.43E-02	9.00E-01	1.81E-02
	B	175 - 209	1.64E+03	3.90E-10	1.24E-02	7.44E-01	1.45E-02
32	G	275 - 337	2.14E+03	5.25E-10	1.41E-02	9.82E-01	2.12E-02
	B	185 - 211	1.81E+03	4.24E-10	1.36E-02	7.99E-01	1.55E-02
40	G	320 - 404	2.42E+03	6.08E-10	1.52E-02	1.16E+00	2.05E-02
	B	208 - 247	2.01E+03	4.73E-10	1.46E-02	8.92E-01	1.64E-02
50	B	292 - 299	2.46E+03	5.84E-10	1.69E-02	1.10E+00	1.84E-02

\* The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories.

<sup>†</sup>Results presented for medium mix designs using data from 2017. Cement content ranges are provided to assist customers in identifying whether the concrete purchased is covered by the ViroDecs™ EPD. Purchased concrete with a lower or higher cement content is not covered by the ViroDecs™ EPD.

## ViroDecs™ select special-class mixes

Select special mixes were modelled for three high-profile infrastructure projects registered for ISCA or Green Star ratings:

- **WestConnex M4 East (NSW)**
- **Stage 1B Basement Barangaroo South (NSW)**
- **Metro Tunnel Project (VIC)**

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

Strength	WestConnex M4 East		Stage 1B Basement Barangaroo South		Metro Tunnel Project	
	Mix code	Description of use	Mix code	Description of use	Mix code	Description of use
10			NS102T	Blinding		
20	NN202TR53	General RMS concrete				
	NS201T230	Blockfill				
25	NN251TR53	General RMS concrete				
	NN252TR53	General RMS concrete				
32	NS322FJKH	Barrier Kerb	NS322EC2	General		
	NS322FRT1	B80 Bridge				
	NS322FJKL	Barrier Kerb				
	NN322TR53	R83 Road Concrete				
35	NS352FRTW	R83 Road Concrete				
	NS352FRT7	R83 Road Concrete				
40	NS401P3R1*	Shotcrete	NS222E2V4	Post-tensioned Concrete	VS402MTT	Concrete Slabs
	NS401P1R1*	Shotcrete	NS402EC2	General	VS402MTD	Concrete Slabs
	NS401X1R1	Shotcrete			VS401MTW	Piling and Diaphragm walls
	NS402FBX1	B80 Bridge				
	NS401MSRP	Shotcrete				
	NS402TBS2	B80 Bridge				
	NS402FBS1	B80 Bridge				
	NN402TR53	General RMS concrete				
50	NS402TRT2	B80 Bridge				
	NS502TBS2	B80 Bridge	NS501THM	Columns and walls		
	NS502TBX2	B80 Bridge	NS502EC2	General		
65						
80			NS651THM	Columns and walls		
100			NS801THM	Columns and walls		
Prescription mix			NS1001THM	Columns and walls		
	NP6:12GNF	No Fines (Permeable Pavement)				
	NP8:1GSS	No Fines (Permeable Pavement)				
	NP3FFFHS	Flowable fill				
	NS52FRT7	Road Sub Base				
	NP3FFFMD	Flowable Fill				

\*NS401P3R1 and NS401P1R1 on WestConnex M4 East include steel or polypropylene fibres for reinforcement – the inclusion of fibres increases the GWP results of the mix.

## WestConnex M4 East (NSW)

WestConnex M4 East: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS		GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength	Mix code	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
20	NN202TR53	2.34E+02	9.72E-06	5.99E-01	1.22E-01	2.68E-02	2.79E-04	2.21E+03
	NS201T230	2.23E+02	7.63E-06	5.47E-01	1.13E-01	2.52E-02	2.38E-04	2.13E+03
25	NN251TR53	2.61E+02	1.09E-05	6.64E-01	1.35E-01	2.98E-02	3.13E-04	2.46E+03
	NN252TR53	2.51E+02	1.06E-05	6.43E-01	1.31E-01	2.89E-02	3.04E-04	2.38E+03
32	NS322FJKH	3.33E+02	1.05E-05	8.07E-01	1.65E-01	3.17E-02	3.12E-04	2.74E+03
	NS322FRT1	3.26E+02	8.93E-06	7.77E-01	1.60E-01	2.95E-02	2.78E-04	2.60E+03
	NS322FJKL	3.32E+02	1.05E-05	8.06E-01	1.65E-01	3.15E-02	3.12E-04	2.73E+03
	NN322TR53	2.83E+02	1.25E-05	7.24E-01	1.47E-01	3.29E-02	3.54E-04	2.71E+03
35	NS352FRTW	3.35E+02	5.15E-06	7.35E-01	1.55E-01	2.51E-02	1.81E-04	2.47E+03
	NS352FRT7	3.17E+02	3.76E-06	6.91E-01	1.46E-01	2.13E-02	1.49E-04	2.15E+03
40	NS401P3R1*	4.32E+02	4.51E-03	1.00E+00	2.11E-01	5.46E-02	5.39E-03	3.93E+03
	NS401P1R1*	4.27E+02	4.51E-03	9.94E-01	2.09E-01	5.35E-02	5.39E-03	3.82E+03
	NS401X1R1	3.91E+02	1.34E-05	9.55E-01	1.94E-01	3.99E-02	4.04E-04	3.36E+03
	NS402FBX1	3.67E+02	8.94E-06	8.56E-01	1.77E-01	3.14E-02	2.87E-04	2.83E+03
	NS401MSRP	3.48E+02	1.08E-04	8.10E-01	1.68E-01	3.03E-02	3.80E-04	2.70E+03
	NS402TBS2	3.41E+02	1.44E-05	8.51E-01	1.72E-01	3.85E-02	4.13E-04	3.22E+03
	NS402FBS1	3.25E+02	3.82E-06	7.07E-01	1.50E-01	2.17E-02	1.52E-04	2.20E+03
	NN402TR53	3.20E+02	1.29E-05	7.99E-01	1.62E-01	3.52E-02	3.72E-04	2.96E+03
50	NS402TRT2	3.12E+02	1.04E-05	7.51E-01	1.54E-01	3.23E-02	3.17E-04	2.79E+03
	NS502TBS2	4.31E+02	2.12E-05	1.10E+00	2.19E-01	5.21E-02	5.93E-04	4.26E+03
	NS502TBX2	3.45E+02	1.03E-05	8.08E-01	1.66E-01	3.36E-02	3.20E-04	2.98E+03
Prescription mix	NS502TBSP	3.03E+02	4.10E-06	6.47E-01	1.38E-01	2.27E-02	1.61E-04	2.28E+03
	NP6:12GNF	2.50E+02	4.69E-06	5.68E-01	1.18E-01	1.84E-02	1.58E-04	1.78E+03
	NP8:1GSS	2.14E+02	2.44E-06	4.88E-01	1.03E-01	1.58E-02	9.54E-05	1.48E+03
	NP3FFFHS	2.05E+02	3.14E-06	4.56E-01	9.67E-02	1.83E-02	1.18E-04	1.67E+03
	NS52FRT7	1.68E+02	8.82E-06	4.63E-01	9.45E-02	2.19E-02	2.45E-04	1.72E+03
	NP3FFFM	1.64E+02	2.99E-06	3.81E-01	8.16E-02	1.38E-02	1.03E-04	1.26E+03

\*NS401P3R1 and NS401P1R1 on WestConnex M4 East include steel or polypropylene fibres for reinforcement – the inclusion of fibres increases the GWP results of the mix.



WestConnex M4 East: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE		PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength	Mix code	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
20	NN202TR53	3.19E+01	0.00E+00	3.19E+01	1.75E+03	1.38E+02	1.89E+03	1.39E+02	0.00E+00	0.00E+00	8.89E-01
	NS201T230	3.18E+01	0.00E+00	3.18E+01	1.67E+03	1.43E+02	1.81E+03	2.23E+02	0.00E+00	0.00E+00	8.05E-01
25	NN251TR53	3.56E+01	0.00E+00	3.56E+01	1.95E+03	1.39E+02	2.09E+03	1.51E+02	0.00E+00	0.00E+00	9.64E-01
	NN252TR53	3.46E+01	0.00E+00	3.46E+01	1.89E+03	1.36E+02	2.03E+03	1.48E+02	0.00E+00	0.00E+00	9.43E-01
32	NS322FJKH	3.78E+01	0.00E+00	3.78E+01	1.99E+03	1.29E+02	2.12E+03	1.11E+02	0.00E+00	0.00E+00	1.02E+00
	NS322FRT1	3.62E+01	0.00E+00	3.62E+01	1.85E+03	1.33E+02	1.98E+03	8.70E+01	0.00E+00	0.00E+00	9.50E-01
	NS322FJKL	3.77E+01	0.00E+00	3.77E+01	1.99E+03	1.29E+02	2.12E+03	1.11E+02	0.00E+00	0.00E+00	1.02E+00
	NN322TR53	3.97E+01	0.00E+00	3.97E+01	2.16E+03	1.28E+02	2.29E+03	1.55E+02	0.00E+00	0.00E+00	1.05E+00
35	NS352FRTW	3.10E+01	0.00E+00	3.10E+01	1.63E+03	1.01E+02	1.73E+03	1.00E+02	0.00E+00	0.00E+00	8.12E-01
	NS352FRT7	2.64E+01	0.00E+00	2.64E+01	1.30E+03	9.93E+01	1.40E+03	1.00E+02	0.00E+00	0.00E+00	7.53E-01
40	NS401P3R1*	9.42E+01	0.00E+00	9.42E+01	3.16E+03	1.17E+02	3.28E+03	1.48E+02	0.00E+00	0.00E+00	1.19E+00
	NS401P1R1*	9.29E+01	0.00E+00	9.29E+01	3.03E+03	1.17E+02	3.15E+03	1.48E+02	0.00E+00	0.00E+00	1.19E+00
	NS401X1R1	4.92E+01	0.00E+00	4.92E+01	2.53E+03	1.37E+02	2.67E+03	1.48E+02	0.00E+00	0.00E+00	1.18E+00
	NS402FBX1	3.92E+01	0.00E+00	3.92E+01	1.95E+03	1.28E+02	2.08E+03	1.02E+02	0.00E+00	0.00E+00	9.94E-01
	NS401MSRP	3.90E+01	0.00E+00	3.90E+01	1.88E+03	1.37E+02	2.02E+03	1.48E+02	0.00E+00	0.00E+00	9.40E-01
	NS402TBS2	4.74E+01	0.00E+00	4.74E+01	2.54E+03	1.14E+02	2.65E+03	2.15E+02	0.00E+00	0.00E+00	1.19E+00
	NS402FBS1	2.69E+01	0.00E+00	2.69E+01	1.32E+03	1.02E+02	1.43E+03	1.02E+02	0.00E+00	0.00E+00	7.65E-01
	NN402TR53	4.30E+01	0.00E+00	4.30E+01	2.30E+03	1.22E+02	2.42E+03	1.70E+02	0.00E+00	0.00E+00	1.11E+00
50	NS402TRT2	4.09E+01	0.00E+00	4.09E+01	2.11E+03	1.22E+02	2.24E+03	2.15E+02	0.00E+00	0.00E+00	1.01E+00
	NS502TBS2	6.41E+01	0.00E+00	6.41E+01	3.46E+03	1.03E+02	3.56E+03	2.50E+02	0.00E+00	0.00E+00	1.55E+00
	NS502TBX2	4.30E+01	0.00E+00	4.30E+01	2.19E+03	1.10E+02	2.30E+03	2.50E+02	0.00E+00	0.00E+00	1.04E+00
Prescription mix	NS502TBSP	2.93E+01	0.00E+00	2.93E+01	1.47E+03	9.02E+01	1.56E+03	2.57E+02	0.00E+00	0.00E+00	7.73E-01
	NP6:12GNF	2.39E+01	0.00E+00	2.39E+01	1.13E+03	5.37E+01	1.18E+03	0.00E+00	0.00E+00	0.00E+00	7.11E-01
	NP8:1GSS	1.72E+01	0.00E+00	1.72E+01	9.04E+02	1.92E+02	1.10E+03	0.00E+00	0.00E+00	0.00E+00	5.80E-01
	NP3FFFHS	2.10E+01	0.00E+00	2.10E+01	1.15E+03	1.70E+02	1.32E+03	2.30E+02	0.00E+00	0.00E+00	6.20E-01
	NS52FRT7	2.52E+01	0.00E+00	2.52E+01	1.44E+03	1.24E+02	1.57E+03	1.60E+02	0.00E+00	0.00E+00	7.72E-01
NP3FFFMD	1.59E+01	0.00E+00	1.59E+01	8.69E+02	1.48E+02	1.02E+03	2.15E+02	0.00E+00	0.00E+00	5.57E-01	

\*NS401P3R1 and NS401P1R1 on WestConnex M4 East include steel or polypropylene fibres for reinforcement – the inclusion of fibres increases the GWP results of the mix.

WestConnex M4 East: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS		HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength	Mix code	kg	kg	kg	kg	kg	kg	MJ
20	NN202TR53	1.77E-03	1.55E+01	1.64E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS201T230	1.66E-03	1.51E+01	4.65E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	NN251TR53	1.96E-03	1.74E+01	1.89E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NN252TR53	1.92E-03	1.69E+01	1.83E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	NS322FJKH	1.81E-03	1.73E+01	1.94E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS322FRT1	1.61E-03	1.66E+01	3.39E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS322FJKL	1.81E-03	1.73E+01	1.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NN322TR53	2.21E-03	1.97E+01	2.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	NS352FRTW	1.17E-03	1.01E+01	1.82E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS352FRT7	9.92E-04	8.29E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	NS401P3R1*	8.62E-01	3.29E+01	8.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS401P1R1*	8.62E-01	3.29E+01	8.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS401X1R1	2.24E-03	2.53E+01	7.63E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS402FBX1	1.64E-03	1.75E+01	4.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS401MSRP	2.06E-02	1.78E+01	5.44E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS402TBS2	2.62E-03	2.29E+01	2.58E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS402FBS1	1.01E-03	8.44E+00	1.95E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NN402TR53	2.34E-03	2.07E+01	2.28E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	NS402TRT2	2.09E-03	1.89E+01	4.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS502TBS2	3.63E-03	3.29E+01	4.12E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS502TBX2	2.14E-03	1.91E+01	4.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Prescription mix	NS502TBSP	1.37E-03	8.83E+00	1.96E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NP6:12GNF	1.00E-03	8.95E+00	5.15E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NP8:1GSS	5.51E-04	5.36E+00	4.66E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NP3FFFHS	9.93E-04	6.42E+00	5.86E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS52FRT7	1.46E-03	1.36E+01	1.54E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NP3FFFMD	7.47E-04	5.76E+00	5.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

\*NS401P3R1 and NS401P1R1 on WestConnex M4 East include steel or polypropylene fibres for reinforcement – the inclusion of fibres increases the GWP results of the mix.



## Stage 1B Basement Barangaroo South (NSW)

Stage 1B Basement Barangaroo South: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS		GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength	Mix code	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
10	NS102T	1.36E+02	2.55E-06	3.20E-01	6.91E-02	1.30E-02	9.15E-05	1.17E+03
32	NS322EC2	2.08E+02	3.20E-06	4.66E-01	9.96E-02	1.72E-02	1.20E-04	1.64E+03
40	NS222E2V4	3.19E+02	3.67E-06	7.00E-01	1.48E-01	2.15E-02	1.46E-04	2.15E+03
	NS402EC2	2.49E+02	3.62E-06	5.45E-01	1.16E-01	1.97E-02	1.38E-04	1.92E+03
50	NS501THM	3.38E+02	4.24E-06	7.18E-01	1.53E-01	2.54E-02	1.72E-04	2.54E+03
	NS502EC2	2.86E+02	3.97E-06	6.15E-01	1.31E-01	2.20E-02	1.54E-04	2.18E+03
65	NS651THM	3.82E+02	4.56E-06	8.07E-01	1.74E-01	2.85E-02	1.89E-04	2.84E+03
80	NS801THM	4.65E+02	5.35E-06	9.71E-01	2.07E-01	3.31E-02	2.22E-04	3.36E+03
100	NS1001THM	4.65E+02	5.35E-06	9.71E-01	2.07E-01	3.31E-02	2.22E-04	3.36E+03

Stage 1B Basement Barangaroo South: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE		PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength	Mix code	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
10	NS102T	1.54E+01	0.00E+00	1.54E+01	8.51E+02	1.34E+02	9.85E+02	1.44E+02	0.00E+00	0.00E+00	5.20E-01
32	NS322EC2	2.09E+01	0.00E+00	2.09E+01	1.11E+03	1.31E+02	1.24E+03	1.82E+02	0.00E+00	0.00E+00	6.25E-01
40	NS222E2V4	2.60E+01	0.00E+00	2.60E+01	1.29E+03	1.27E+02	1.41E+03	7.60E+01	0.00E+00	0.00E+00	7.48E-01
	NS402EC2	2.46E+01	0.00E+00	2.46E+01	1.27E+03	1.19E+02	1.39E+03	2.24E+02	0.00E+00	0.00E+00	6.90E-01
50	NS501THM	3.14E+01	0.00E+00	3.14E+01	1.65E+03	1.14E+02	1.77E+03	2.36E+02	0.00E+00	0.00E+00	8.10E-01
	NS502EC2	2.78E+01	0.00E+00	2.78E+01	1.43E+03	1.05E+02	1.53E+03	2.60E+02	0.00E+00	0.00E+00	7.46E-01
65	NS651THM	3.46E+01	0.00E+00	3.46E+01	1.86E+03	1.14E+02	1.98E+03	2.69E+02	0.00E+00	0.00E+00	8.56E-01
80	NS801THM	4.20E+01	0.00E+00	4.20E+01	2.13E+03	9.64E+01	2.23E+03	3.36E+02	0.00E+00	0.00E+00	9.84E-01
100	NS1001THM	4.20E+01	0.00E+00	4.20E+01	2.13E+03	9.64E+01	2.23E+03	3.36E+02	0.00E+00	0.00E+00	9.84E-01

Stage 1B Basement Barangaroo South: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS		HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength	Mix code	kg	kg	kg	kg	kg	kg	MJ
10	NS102T	8.58E-04	5.11E+00	7.75E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	NS322EC2	1.01E-03	6.60E+00	1.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	NS222E2V4	9.10E-04	8.08E+00	1.44E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS402EC2	1.16E-03	7.57E+00	1.31E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	NS501THM	1.39E-03	9.32E+00	4.45E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NS502EC2	1.29E-03	8.40E+00	1.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	NS651THM	1.40E-03	1.10E+01	8.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	NS801THM	1.63E-03	1.31E+01	7.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	NS1001THM	1.63E-03	1.31E+01	7.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Stage 1B Basement Barangaroo South: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Green Star As Built v1.2 optional indicators

GREEN STAR INDICATORS*		HT	LU	WSI	IR	PM
Strength	Mix code	CTUh	m <sup>2</sup>	m <sup>3</sup>	kBq U235 eq	kg PM2.5 eq
10	NS102T	6.73E-09	8.99E-03	4.67E-01	1.27E-02	2.57E-01
32	NS322EC2	1.01E-08	1.15E-02	6.92E-01	1.44E-02	2.83E-01
40	NS222E2V4	1.43E-08	1.38E-02	1.02E+00	1.65E-02	3.35E-01
	NS402EC2	1.22E-08	1.32E-02	8.19E-01	1.57E-02	2.91E-01
50	NS501THM	1.61E-08	1.57E-02	1.07E+00	1.82E-02	3.33E-01
	NS502EC2	1.40E-08	1.45E-02	9.30E-01	1.67E-02	2.94E-01
65	NS651THM	1.75E-08	1.69E-02	1.19E+00	1.87E-02	3.44E-01
80	NS801THM	2.16E-08	2.00E-02	1.45E+00	2.11E-02	3.66E-01
100	NS1001THM	2.16E-08	2.00E-02	1.45E+00	2.11E-02	3.66E-01

### Metro Tunnel Project (VIC)

Metro Tunnel Project: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Primary indicators

PRIMARY INDICATORS		GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength	Mix code	kg CO <sub>2</sub> eq	kg CFC-11 eq	kg SO <sub>2</sub> eq	kg PO <sub>4</sub> <sup>3-</sup> eq	kg C <sub>2</sub> H <sub>4</sub> eq	kg Sb eq	MJ
40	VS402MTT	2.56E+02	4.77E-06	5.73E-01	1.22E-01	2.21E-02	1.72E-04	2.08E+03
	VS402MTD	2.54E+02	5.17E-06	5.51E-01	1.17E-01	2.46E-02	1.88E-04	2.31E+03
	VS401MTW	2.38E+02	4.93E-06	5.17E-01	1.11E-01	2.41E-02	1.77E-04	2.24E+03

Metro Tunnel Project: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Resource use parameters

PARAMETERS DESCRIBING RESOURCE USE		PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength	Mix code	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	kg	MJ <sub>NCV</sub>	MJ <sub>NCV</sub>	m <sup>3</sup>
40	VS402MTT	2.75E+01	0.00E+00	2.75E+01	1.42E+03	1.21E+02	1.54E+03	2.00E+02	0.00E+00	0.00E+00	7.29E-01
	VS402MTD	3.25E+01	0.00E+00	3.25E+01	1.66E+03	1.16E+02	1.78E+03	3.05E+02	0.00E+00	0.00E+00	7.75E-01
	VS401MTW	2.96E+01	0.00E+00	2.96E+01	1.65E+03	1.37E+02	1.79E+03	3.03E+02	0.00E+00	0.00E+00	7.41E-01

Metro Tunnel Project: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Waste categories and output flows

WASTE CATEGORIES AND OUTPUT FLOWS		HWD	NHWD	RWD	CRU	MFR	MER	EE
Strength	Mix code	kg	kg	kg	kg	kg	kg	MJ
40	VS402MTT	1.26E-03	1.02E+01	5.46E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	VS402MTD	1.78E-03	1.11E+01	5.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	VS401MTW	1.68E-03	9.54E+00	5.96E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

\*The environmental impacts modelled from the CSI tool and existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories.

# Interpretation

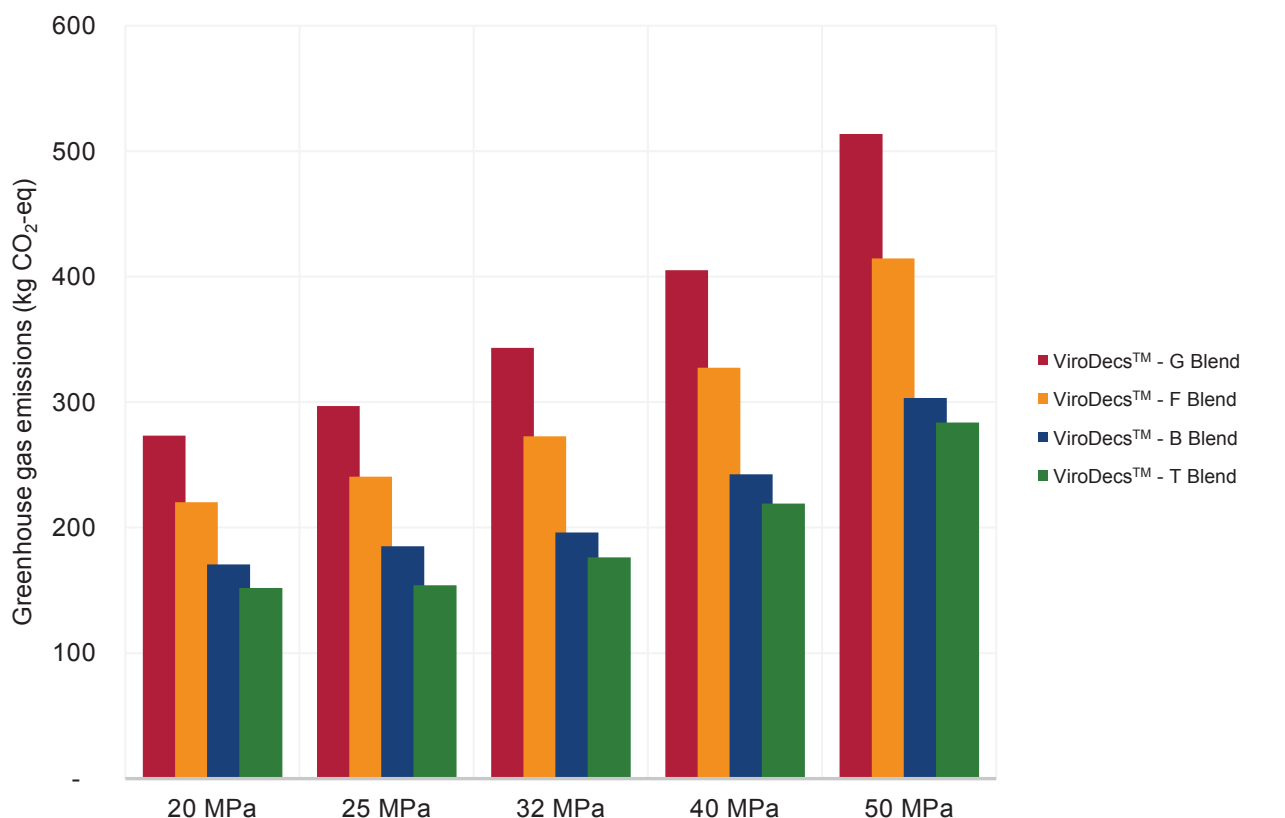
## ViroDecs™ normal-class ready-mix concrete

Care should be taken when comparing EPDs. The EPD of construction products may not be comparable if they do not comply with the requirements of comparability set in EN 15804. EPDs within the same product category but from different programmes may not be comparable.

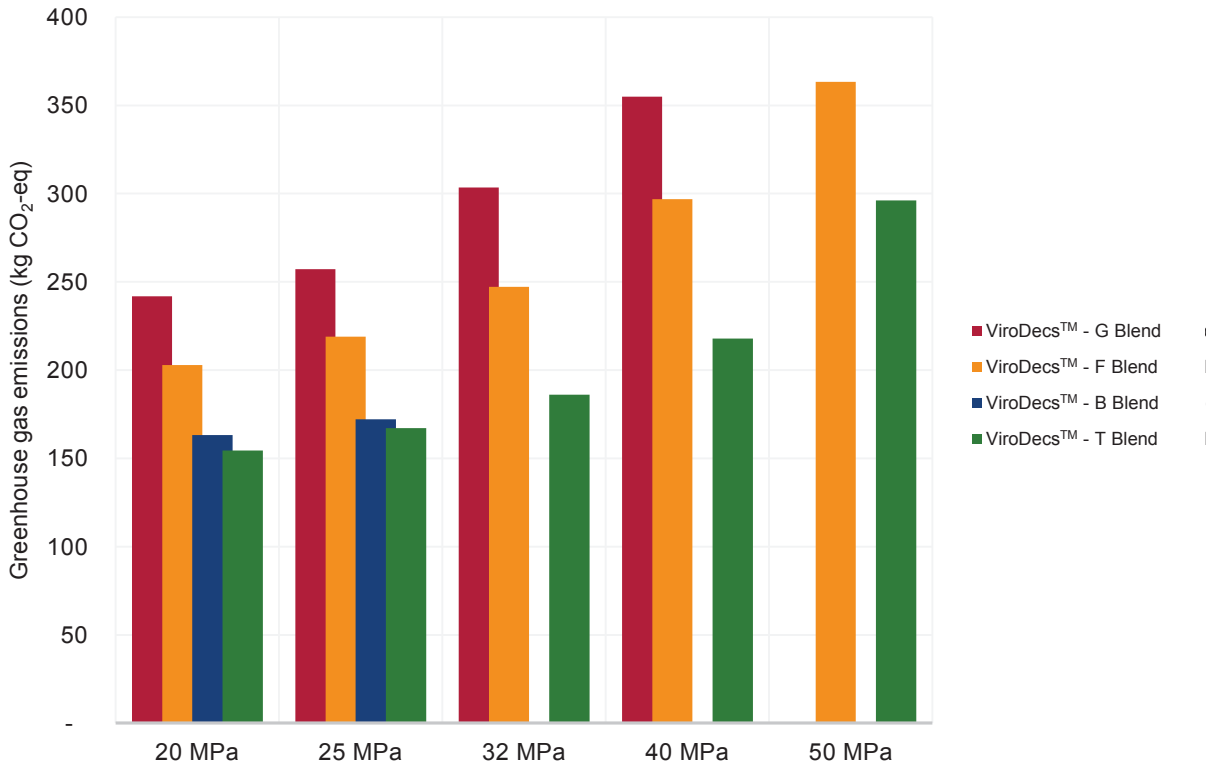
Holcim’s normal-class, ready-mix concrete has a range of greenhouse gas (GHG) emissions, across the different states, strengths and blends covered by the EPD. The following section presents the GHG emissions associated with 1 m<sup>3</sup> of Holcim normal-class ready-mix concrete in Australia for:

- **ViroDecs™ - General Blend**
- **ViroDecs™ - Fly Ash Blend**
- **ViroDecs™ - Blast Slag Blend**
- **ViroDecs™ - Triple Blend**

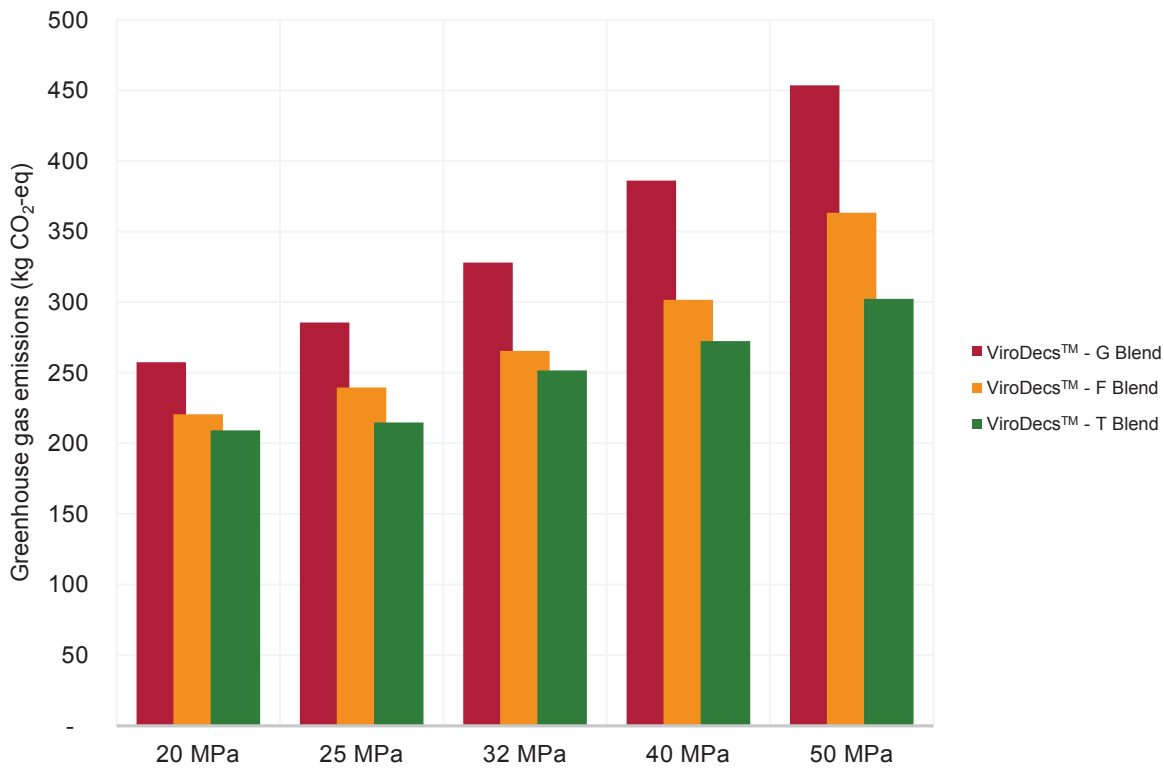
To evaluate the performance of Holcim’s ViroDecs™ normal-class ready-mix concrete range, the EPD results can be benchmarked against the Green Star concrete reference case, IS materials calculator default concrete mix and the Australian National Life Cycle Inventory Database (AusLCI).



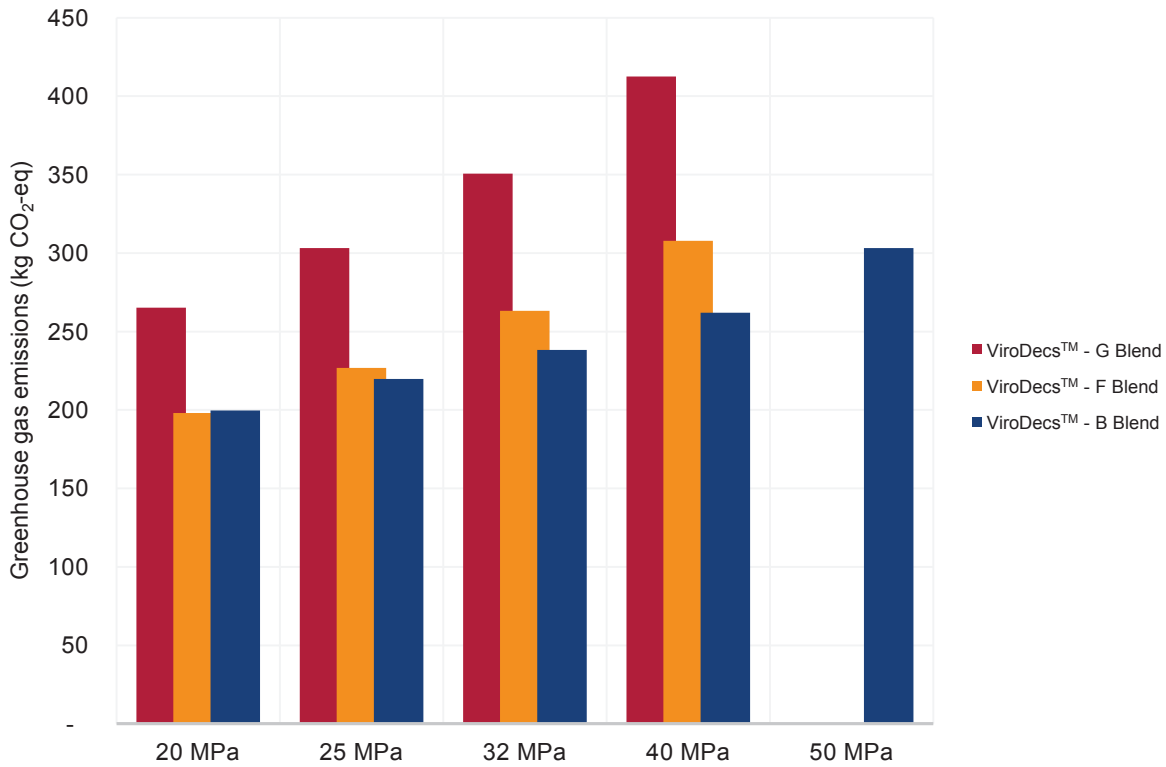
NSW/ACT: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)



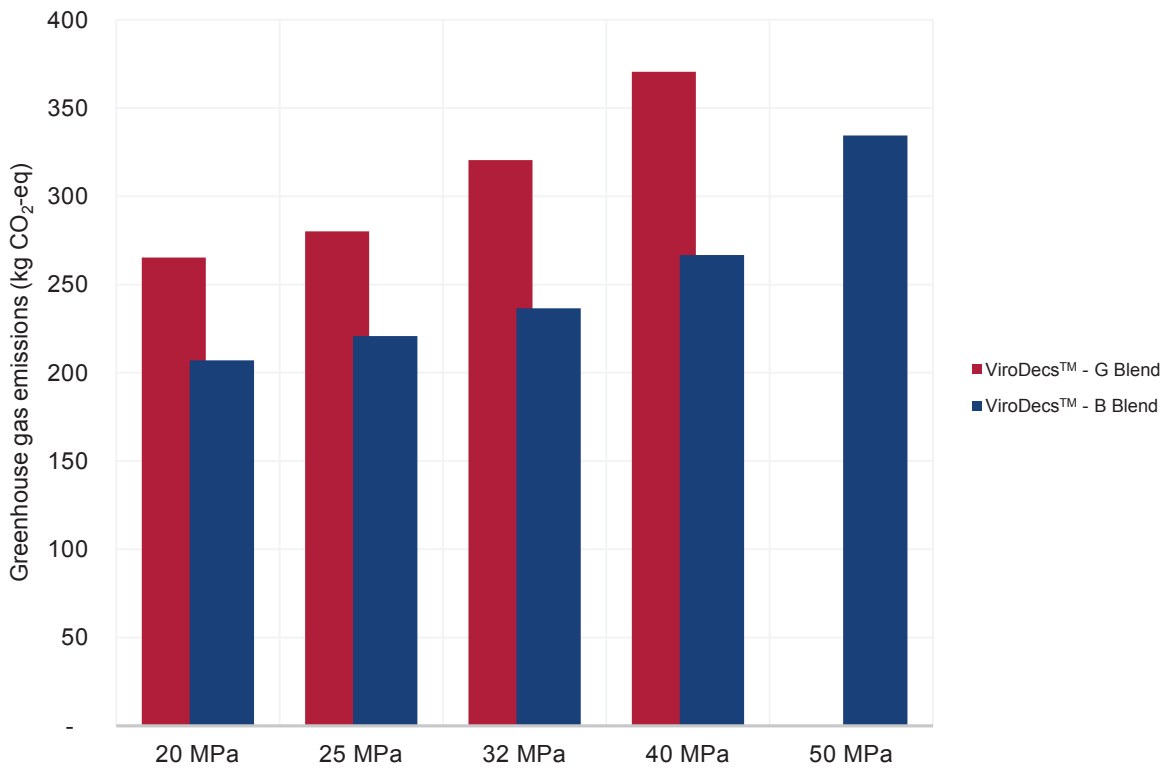
QLD: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)



VIC: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)



SA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)



WA: 1 m<sup>3</sup> of ViroDecs™ normal-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)

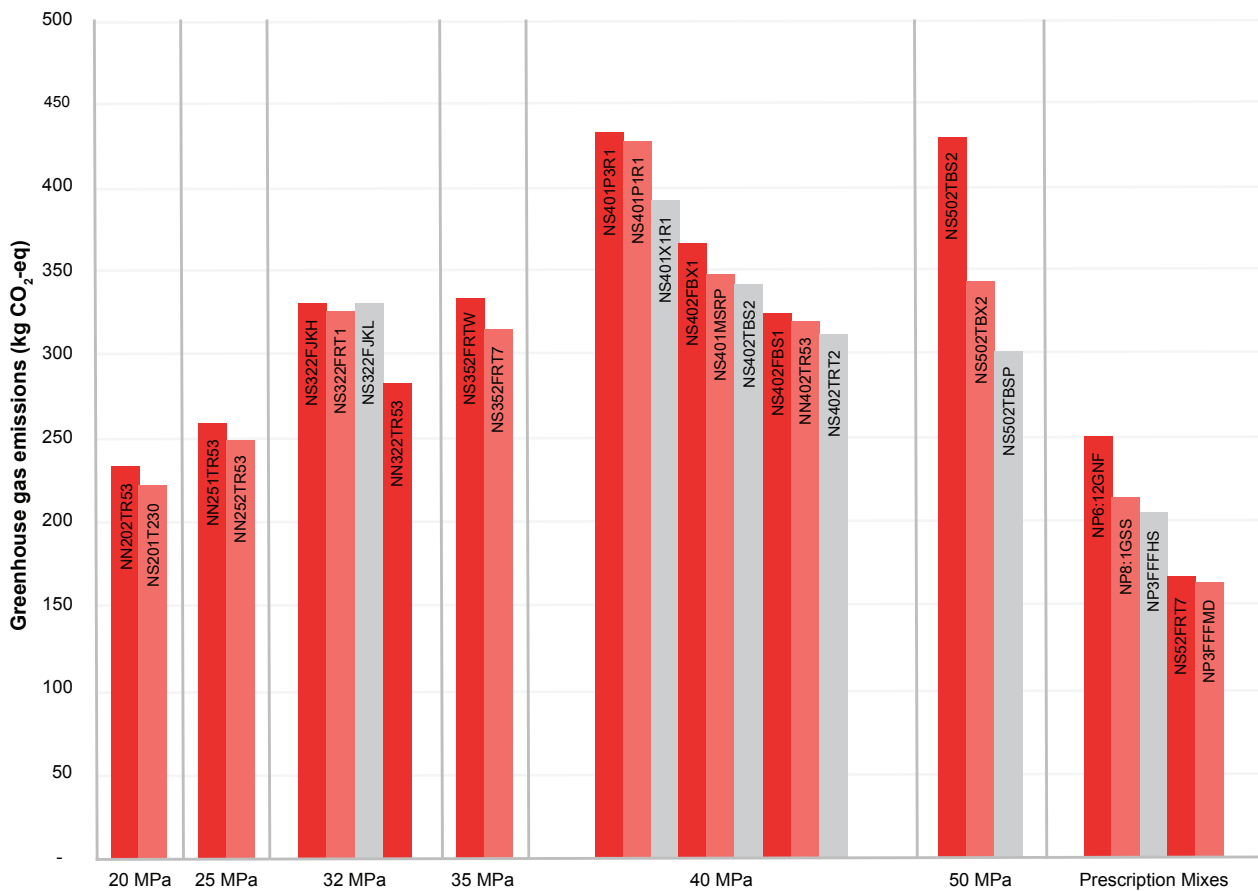


## ViroDecs™ special-class ready-mix concrete

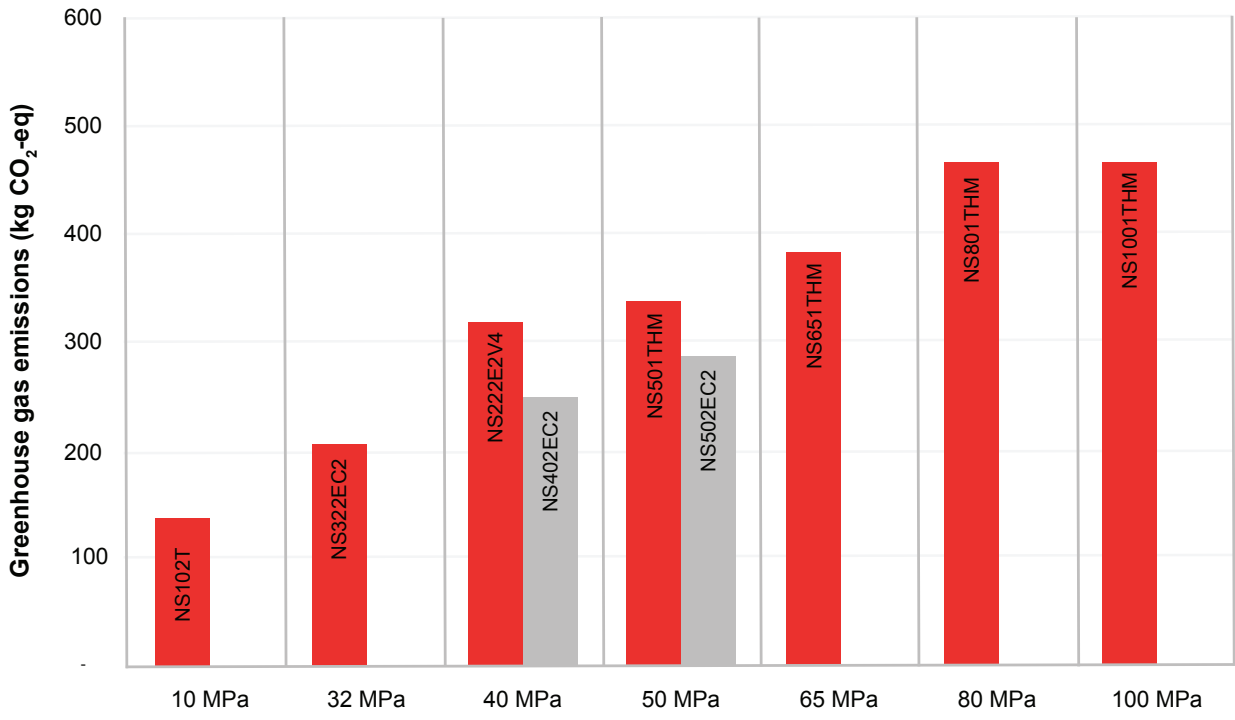
Special-class concretes allow the purchaser to incorporate into the project specification any special requirements for the project. Special-class concrete is typically supplied to major and high-end construction projects from high rise buildings, dams and spillways, roads and bridges to public works infrastructure etc. Special-class concrete is typically specified by the purchaser in accordance with technical parameters and performance requirements provided by the purchaser, which can include: high-strength/highperformance concrete, early strength, high durability or marine application, post-tensioned, high pumpability, super workable, piling concrete and architectural off-form finishes applications.

A special-class concrete is specifically developed for a project, use and application in accordance with defined performance properties or prescriptive requirements specified by the purchaser. Due to this specific use application, special class mixes cannot be directly compared to other special class mixes of similar strength, function or project. Nor can it be directly compared with normal class concrete blends.

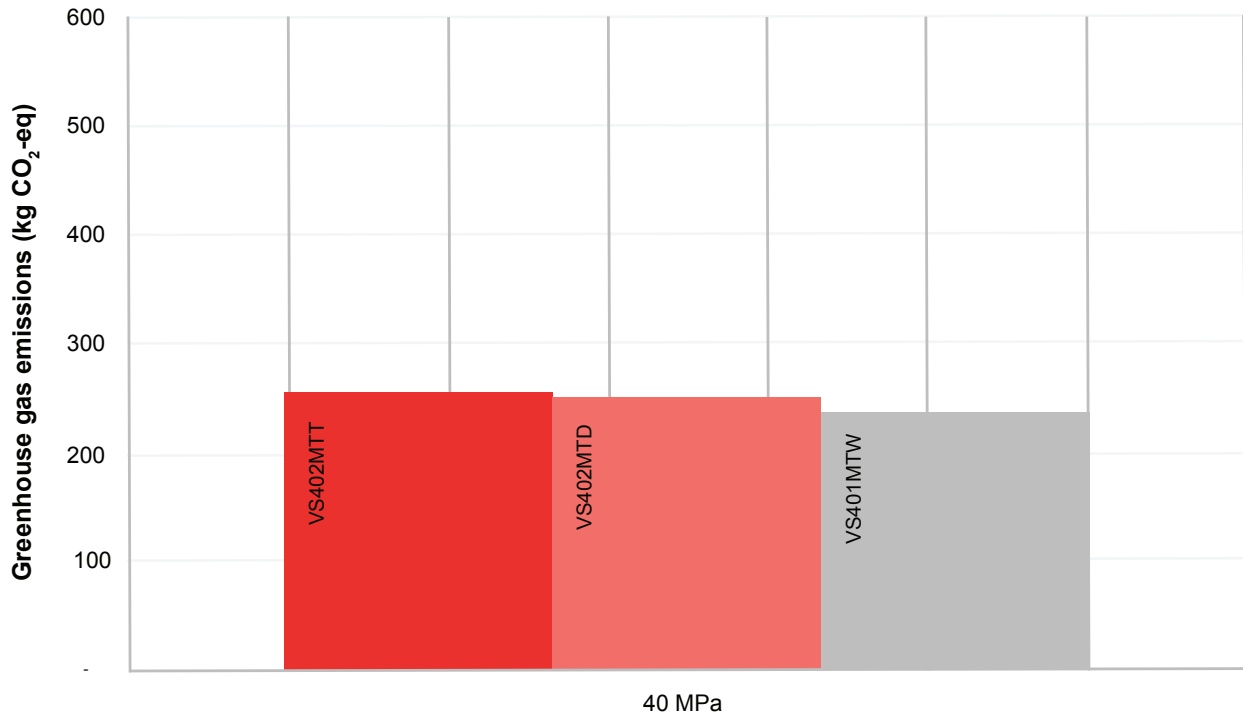
The following figures present the greenhouse gas impact of select ViroDecs™ special-class ready-mix concrete Holcim is currently supplying to high-profile infrastructure and property projects in Australia.



WestConnex M4 East: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)



Stage 1B Basement Barangaroo South: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)



Metro Tunnel Project: 1 m<sup>3</sup> of ViroDecs™ special-class ready-mix concrete - Cradle to gate GHG emissions (kg CO<sub>2</sub>-eq)

# Other life cycle stages not included in this EPD

While the LCA study and EPD only consider the cradle to gate environmental impacts of Holcim's ready-mix concrete, practitioners using the EPD for the purpose of whole of life building studies or the functional comparison of different building products on a whole-of-life basis will consider concrete's other life cycle stages.

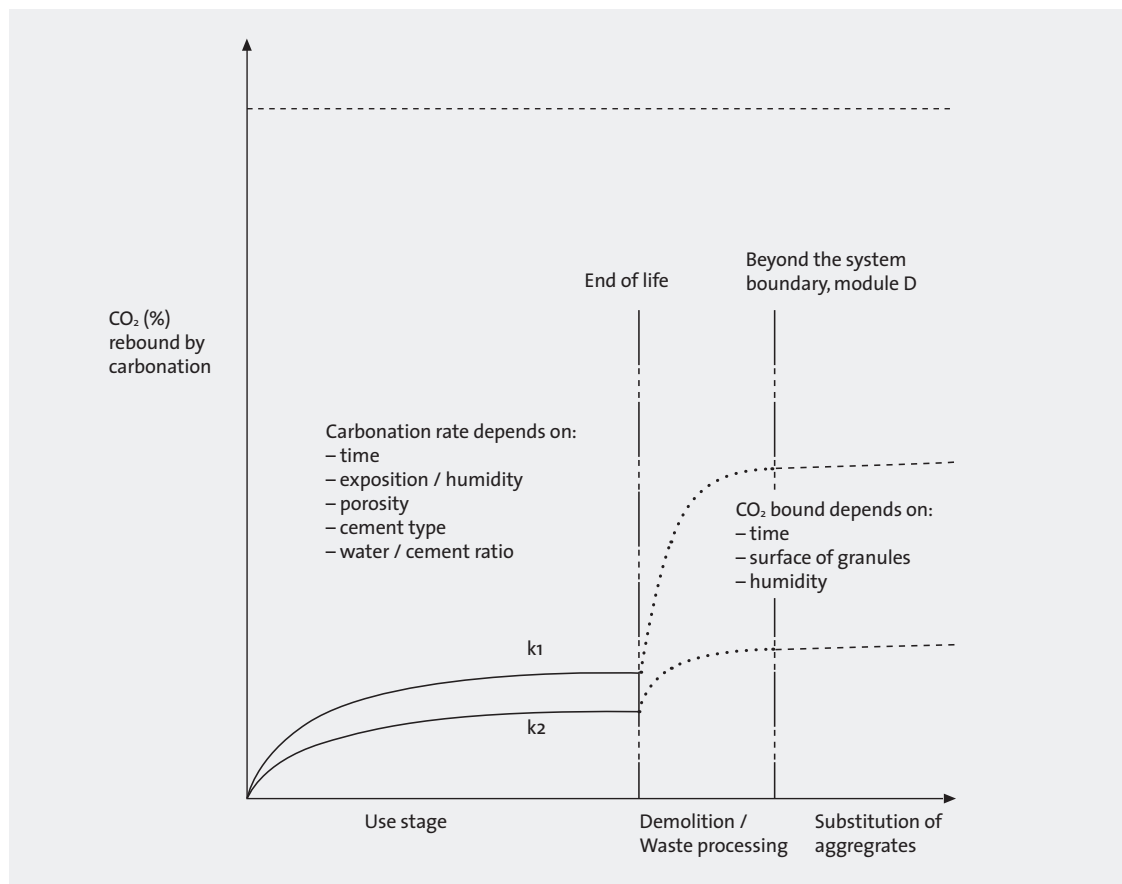
Some of the environmental impacts or benefits associated with other life cycle stages not included in this EPD are described in the following sections.

## Lifetime absorption of CO<sub>2</sub>

Carbonation is a natural process whereby concrete absorbs carbon dioxide (CO<sub>2</sub>) from the atmosphere through a chemical reaction between the CO<sub>2</sub> in the ambient air and hydration products within the concrete (CaOH<sub>2</sub>). Ready-mix concrete can be subject to carbonation from the use stage onward (i.e. after construction and curing). From a life cycle impact accounting perspective, this process can also be referred to as 'reabsorption', since the CO<sub>2</sub> emitted during the cement manufacturing process can be partly offset by the lifetime absorption of CO<sub>2</sub>, therefore reducing the net CO<sub>2</sub> emissions associated with the concrete over its lifetime.

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

The total amount of CO<sub>2</sub> absorption during the life cycle of concrete is subject to a range of factors and varies over time (see following figure). The calculation has been standardised in the British and European Standard BS EN 16757:2017 *Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements*. It is recommended that practitioners make use of this standard when conducting whole of life building studies and if the building materials include substantial amounts of concrete. Please note that CO<sub>2</sub> absorption has not been considered in this EPD and is not reflected in the EPD results tables.



General principle of rebinding of CO<sub>2</sub> by carbonation of concrete (Adapted from: BS EN 16757:2017)

The following table shows a worked example of the use phase and end of life phase CO<sub>2</sub> uptake associated with the 25 MPa normal-class Holcim ready-mix fly ash (F) blend from NSW, as used in a building and having the following characteristics:

- Exposed to the outdoors
- Sheltered from rain
- Building service life of 60 years

Uptake during use - exposed area - Module B				
Parameters	Symbol	Value	Unit	Source
k-factor	k	<b>4.4</b>	mm/year	Refer to Table BB.1 of BS EN 16757:2017
K Correction to k-factor	K <sub>k</sub>	<b>1.10</b>		Refer to Table BB.2 of BS EN 16757:2017
Service life	t	<b>60</b>	Years	Green Star typical lifetime of residential building
Maximum theoretical uptake	U <sub>tcc</sub>	<b>0.49</b>	kg CO <sub>2</sub> /kg cement	Refer to section BB.2 of BS EN 16757:2017. The value is 0.49 for Portland cement (CEM I), 0.41 for CEM II/A-cement, and 0.36 CEM II/B-cement.
Cement content	C	<b>223</b>	kg/m <sup>3</sup>	Concrete mix specification
Degree of carbonation	D <sub>C</sub>	<b>75%</b>		Refer to Table BB.1 of BS EN 16757:2017
<b>Calculation</b>	$CO_2 \text{ uptake} = k \times K_k \times \left( \frac{\sqrt{t}}{1000} \right) \times U_{tcc} \times C \times D_C$ $= 4.4 \times 1.1 \times \left( \frac{\sqrt{60}}{1000} \right) \times 0.49 \times 223 \times 0.75$ $= 3.07 \frac{kg \ CO_2}{m^2}$			
<b>CO<sub>2</sub> uptake</b>	<b>3.07</b>	<b>kg CO<sub>2</sub>/m<sup>2</sup></b>	<b>Refer to calculation above</b>	
Uptake end of life - theoretical max - Module C				
Conservative average value:	<b>5</b>	kg CO <sub>2</sub> /m <sup>3</sup>	According to: STRIPPLE H. Greenhouse gas strategies for cement containing products”, IVL Report B2024, 2013, as referenced in BS EN 16757:2017	
<b>Maximum long-term uptake of CO<sub>2</sub></b>	<b>81.95</b>	<b>kg CO<sub>2</sub>/m<sup>3</sup></b>	<b>Calculated according to BS EN 16757:2017</b>	

Note: When crushed concrete is used in a new application as a primary product and CO<sub>2</sub> uptake accordingly is reported in module B, for instance as road base, the need for more precise data is evident.

## End of life scenarios

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

1. Disposal of concrete at a landfill site;
2. Reuse of recovered concrete elements in new construction works;
3. Use of concrete debris, e.g. in land restoration; or
4. Crushing/recycling of concrete:

- Crushed concrete substitutes primary material without further processing; or
- Substitution of natural aggregates in fresh concrete.

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

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Man Yu, Thomas Wiedmann, Robert Crawford, Catriona Tait, 'The Carbon Footprint of Australia's Construction Sector', *Procedia Engineering*, Volume 180, 2017, Pages 211-220, ISSN 1877-7058, (<http://www.sciencedirect.com/science/article/pii/S1877705817316879>)

# Programme-related information and verification

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<b>EPD Programme Operator</b>	EPD Australasia Limited 315a Hardy Street Nelson 7010 New Zealand Web: <a href="http://www.epd-australasia.com">www.epd-australasia.com</a> Email: <a href="mailto:info@epd-australasia.com">info@epd-australasia.com</a> Phone: 02 8005 8206	
<b>EPD Produced by</b>	Charlotte Wang and Jonas Bengtsson Edge Environment Pty Ltd Web: <a href="http://www.edgeenvironment.com">www.edgeenvironment.com</a> Phone: +612 9438 0100 Email: <a href="mailto:info@edgeenvironment.com">info@edgeenvironment.com</a>	
<b>EPD Registration Number</b>	S-P-01165	
<b>Valid From</b>	2019-06-30	
<b>Version</b>	1.0	
<b>Valid Until</b>	2024-06-30	
<b>Product category rules</b>	PCR 2012:01 Construction Products and Construction Services, Version 2.3, 2018-11-15	
<b>Product group classification</b>	UN CPC 54	
<b>Geographical Scope</b>	Australia	
<b>Reference Year for Data</b>	2017	

## CEN standard EN 15804:2012+A1:2013 served as the core PCR

<b>Product category rules</b>	PCR 2012:01 Construction Products and Construction Services, Version 2.3, 2018-11-15	
<b>PCR review was conducted by</b>	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via <a href="mailto:info@environdec.com">info@environdec.com</a>	
<b>Independent third-party verification of the declaration and data, according to ISO 14025:2006:</b>	<input type="checkbox"/> EPD process certification <input checked="" type="checkbox"/> EPD verification	
<b>Third Party Verifier</b>	Jane Anderson ConstructionLCA Limited Approved by: EPD Australasia	
<b>Procedure for follow-up of data during EPD validity involves third party verifier:</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

## Programme-related information and verification:

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

Contact your Holcim representative today for more information.

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