Richmond Cement Plant

Environmental Product Declaration (EPD)

This document constitutes a Type III Product Specific Environmental Product Declaration (EPD) for cement produced at the Lafarge Canada Inc. Richmond cement plant. This EPD was developed in compliance with ISO 14025:2006a and ISO 21930:2007.

This EPD includes Life Cycle Assessment (LCA) results computed with the US version of the WBCSD-CSI tool for EPDs of concrete and cement for the calculation of impacts conforming to the requirements of ISO 14040:2006b. The scope of this EPD is for the product stage (Modules A1 to A3), commonly referred to as Cradle-to-Gate, manufacture of General Use, GU (Type I), portland cement and General Use Limestone, GUL (Type IL), portland-limestone cement at the Richmond cement plant in 2018 and is intended for business-to-business (BtoB) communication.

For more information about Lafarge Canada Inc., please go to www.lafarge.ca.

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements

For more information visit csaregistries.ca/epd

#9798-5018

August 2019 - 2024

EPD Information

Declared Product	General Use (CSA A3001 GU, ASTM C150/C150M Type I, ASTM C1157/C1157M GU, AASHTO M85 Type I) portland cement and General Use Limestone (CSA A3001 GUL, ASTM C595/C595M Type IL, ASTM C1157/C1157M GU, AASHTO M240M/M240 Type IL) portland-limestone cement
Declaration Holder	Lafarge Canada Inc 300 – 115 Quarry Park Rd SE Calgary AB T2C 5G9
Manufacturing Site	Richmond Cement Plant 7611 #9 Rd Richmond BC V6W 1H4
Program Operator	CSA Group 178 Rexdale Blvd Toronto ON M9W 1R3
Date of Issue	August 28, 2019
Period of Validity	August 28, 2019 – August 27, 2024
EPD Registration No	9798-5018
Notes	The LCA results were calculated using the US version of the WBCSD-CSI tool for EPDs of concrete and cement, v1.5, April 2018 (https://concrete-epd-tool.org). Further information and explanatory material regarding this EPD may be obtained by contacting matt.dalkie@lafargeholcim.com.

EPD Verification

This EPD and related data has been independently verified by an external verifier in accordance with ISO 14025:2006a.

Verifier	Lindita Bushi, Ph.D. Athena Sustainable Materials Institute lindita.bushi@athenasmi.org
Verifier Signature	
Date Verified	August 21, 2019

PCR Information

Reference PCR	Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements (UN CPC 3744)
Program Operator	ASTM International 100 Barr Harbor Dr PO Box C700 West Conshohocken PA 19428-2959
Date of Issue	September 2, 2014
PCR Review	Nicolas Santero, Chairperson, PE International (now thinkstep), cert@astm.org Hamid Farzam, CEMEX Anthony Fiorato, Consultant

Description of Lafarge Canada Inc.

Lafarge Canada Inc. is a proud member of LafargeHolcim, the global leader in building materials and solutions. We are 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, urbanization, improved living standards and sustainable construction. Around 75,000 people work for the company in around 80 countries.

LafargeHolcim is committed to providing products using sustainable manufacturing practices and improving the environment in and around its plants. Through a myriad projects at locations around the world, LafargeHolcim has worked to reduce carbon dioxide emissions, restore wetlands for native plants and animals, and identify waste materials that can be recycled and used at LafargeHolcim plants. Further sustainability information can be found on our websites:

www.lafargeholcim.com/lafargeholcim-sustainability

www.lafarge.ca/en/sustainability

Description of Richmond Cement Plant

In 1956, Paris-based Lafarge expanded its worldwide operations to North America by opening the Richmond Cement Plant in British Columbia with production starting on February 17, 1958. Since that time, Lafarge continued to expanded its role in cement as well as developed operations in aggregates, concrete, and asphalt. The Richmond Cement Plant underwent a major capital investment and upgraded the facility to a modern, state of the art pre-calciner kiln line technology bringing capacity to over one million tonnes. The modern kiln line began operation in May 1999 and remains in operation today.

Description of Products

Figure 1

Cement, shown in Figure 1, is the essential binding ingredient in concrete, one of the most durable construction materials known to humankind. A paste of cement and water is the glue that binds sand and gravel together to form the rock like substance, concrete, that is used to build the structures in which we live and work, and the infrastructure that supports modern living. Both General Use, GU, portland cement and General Use Limestone, GUL, portland-limestone cement represented by this EPD are considered General Use hydraulic cements.

Table 1 below describes the two cement products detailed in this EPD.

Product Type	Applicable Standard	Standard Designation
General Use (Portland) Cement	CSA A3001, ASTM C1157/C1157M	Type GU
	ASTM C150/C150M, AASHTO M85	Type I
General Use Limestone (Portland-Limestone) Cement	CSA A3001	Type GUL
	ASTM C595/C595M, AASHTO M240M/M240	Type IL
	ASTM C1157/C1157M	Type GU

Table 1

Table 2 below details the material content, in absolute and percentage basis, of GU and GUL cements presented in this EPD for the declared unit of one metric tonne (1 t, 1000 kg).

Material	GU		GUL	
	kg	%	kg	%
Clinker	900.2	90	833.0	83
Limestone	43.2	4	117.8	12
Gypsum	56.6	6	49.2	5
Total	**1000**	**100**	**1000**	**100**

Table 2

Definitions

Portland Cement, n – a product obtained by pulverizing clinker consisting essentially of hydraulic calcium silicates, to which the various forms of calcium sulphate, limestone, water, and processing additions may be added at the option of the manufacturer (*CSA A3001-18*).

Portland-Limestone Cement, n – a product obtained by intergrinding portland cement clinker and limestone, to which the various forms of calcium sulphate, water, and processing additions may be added at the option of the manufacturer (*CSA A3001-18*).

CSA recognizes that up to 5% limestone may be added to any cement type including GU (*see CSA A3001-18 clause 4.4.3*), and that Portland-Limestone Cement shall have a limestone content greater than 5% and less than or equal to 15% (*see CSA A3001-18 clause 4.3.1*)

ASTM C150/C150M-19a and AASHTO M85 also permit up to 5% limestone to be used in Portland cement, including Type I, and ASTM C595/C595M-19 and AASHTO M240M/M240 permit between 5% and 15% limestone in Portland-Limestone Cement, including Type IL.

For the purposes of this document, an occurrence of "GU" cement implies cement compliant with CSA A3001-18 GU, ASTM C150/C150M-19a Type I, AASHTO M85 Type I, and ASTM C1157/C1157M-17 Type GU cement. Likewise, an occurrence of "GUL" cement implies cement compliant with CSA A3001-18 GUL, ASTM C595/C595M-19 Type IL, AASHTO M240M/M240 Type IL, and ASTM C1157/C1157M-17 Type GU cement.

Product Standards

Applicable standards for General Use, GU, Portland Cement and General Use Limestone, GUL, Portland-Limestone Cement, UN CPC3744, include:

- General Use, GU, Portland Cement
  - AASHTO M85 – Standard Specification for Portland Cement (Chemical and Physical)
  - ASTM C150/C150M-19a – Standard Specifications for Portland Cement
  - ASTM C1157/C1157M-17 – Standard Performance Specifications for Hydraulic Cement
  - CSA A3001-18 – Cementitious materials for use in concrete
- General Use Limestone, GUL, Portland-Limestone Cement
  - AASHTO M240M/M240 – Standard Specification for Blended Hydraulic Cement
  - ASTM C595/C595M-19 – Standard Specification for Blended Hydraulic Cements
  - ASTM C1157/C1157M-17 – Standard Performance Specifications for Hydraulic Cement
  - CSA A3001-18 – Cementitious materials for use in concrete

System Boundaries

Scope of EPD

The scope of this EPD is for the product stage (Modules A1 to A3), commonly referred to as Cradle-to-Gate, manufacture of GU and GUL cements at the Richmond cement plant and is intended for business-to-business communication (BtoB EPD). The declared functional unit for this EPD is the production of one metric tonne (1 t, 1000 kg) of GU or GUL cement in storage silos ready for delivery to customers in bulk. Figure 2 represents the Life-Cycle Stages and Modules, highlighting Modules A1 to A3 as the scope of this EPD.

Production Stage			Construction Stage		Use Stage							End of Life Stage				
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste	Optional information beyond system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D

Figure 2

Modules A1 to A3 include:

- Extraction and processing of raw materials, including fuels used in extraction and transport within the process;
- Transportation of raw materials from extraction site or source to manufacturing site (including any recovered materials from source to be recycled in the process), including empty backhauls and transportation to interim distribution centers or terminals;
- Manufacturing including all energy and materials required, and all emissions and wastes produced;
- Packaging, including transportation and waste disposal, to make product ready for shipment;
- Transportation from manufacturing site to recycling/reuse/landfill for pre-consumer wastes and unutilized by-products from manufacturing, including empty backhauls; and
- Recycling/recovery/reuse/energy recovery of pre-consumer wastes and by-products from production.

System Boundary Exclusions

The following are excluded in the LCA system boundary:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure;
- Production and manufacture of production equipment, delivery vehicles, site mobile equipment, and laboratory equipment;
- Personnel-related activities such as travel, office furniture, office supplies, etc; and
- Energy and water use related to company management and sales activities.

Cut-off Criteria

The cut-off criteria detailed in Section 7.2 of the ASTM PCR for cement were observed. All known and available input/output flow data were included in the LCI modeling. For flows where data was not available and the flow exists, the CAC Industry Average EPD (Program Operator CSA Group, EPD Registration Number 5357-9431, Version 1.1 published March 31, 2016) LCI flow was applied.

Data Collection

Temporal, Geographical and Technological Boundaries

- **Temporal** – Data collected represents all known and available inputs and outputs at the Richmond cement plant of Modules A1 to A3 for the 2018 calendar year. Electricity mix data for the 2018 calendar year was not available and the BC Hydro fiscal year data was used (April 2018 to March 2019) in conjunction with the latest available US EPA eGRID data (2016).
- **Geographical** – Data collected represents all raw material and fuel sources for the production of cement at the Richmond cement plant, BC, Canada.
- **Technological** – Data collected represents the production of cement at the Richmond cement plant using a pre-calciner kiln for clinker production and ball mills for cement milling.

Primary Data

The following primary data was obtained for the 2018 calendar year:

- All clinker and cement raw material input volumes;
- Clinker and cement production volumes;
- Inbound transportation distances and modes for raw materials and fuels;
- Fuel, electricity, and water consumption;
- Process and combustion emissions to air, including calcination CO_2 emissions; and
- Waste outputs and outbound transportation distances and modes.

Allocation

The allocation rules detailed in Section 7.5 of the ASTM PCR for cement in conformance with ISO 14044, clause 4.3 were observed. Recovered materials used as either material inputs or fuels were considered as raw materials with an origin point of the industrial process creating them. Any allocations of water, energy, emissions, and wastes during their creation were allocated to the original product.

In the case of flows where there is no distinction and measurement available to directly attribute the flow to the production of clinker or cement, the flow was attributed as 70% to clinker, and 30% to cement. Further allocations of flows, where applicable, were allocated on a mass basis.

Electricity Grid Mix

The electricity grid mix was determined from the mix reported by *BC Hydro in their 2018/19 Annual Service Plan Report*, published July 2019 for the 2018 fiscal year (April 2018 to March 2019). This report details the delivery and generating capacity of BC Hydro facilities as well as electricity purchase under short and long term commitments. Electricity purchases were taken as the NWPP (WECC Northwest) NERC sub region as reported in the US EPA's latest available *eGRID 2016*. The combination of BC Hydro generation and NWPP purchases results in the electricity grid mix indicated in Table 3 below and used in this EPD:

Generation Type	Portion of grid mix (%)
Coal and peat	9.58
Oil	0.08
Gas	6.73
Biomass	0.55
Waste	0.00
Nuclear	1.43
Hydro	77.52
Geothermal	0.29
Solar	0.21
Wind	3.61

Table 3

Environmental Impacts

The LCI data presented in this EPD was calculated using the *WBCSD-CSI tool for EPD of concrete and cement, US Version, v1.5, April 2018*. Further detailed information on the databases and methodologies used for conducting the LCA for this EPD can be found in the *LCA core model and database report*. Table 4 below presents the LCA results for modules A1 to A3, cradle to gate, to produce one metric tonne (1 t, 1000 kg) of GU or GUL cement.

Category/Indicator	Units	GU A1 to A3 Total	GUL A1 to A3 Total
Environmental Impacts			
Global warming potential, GWP	kg CO_2 equiv	808.5	746.3
Acidification potential, AP	kg SO_2 equiv	2.637	2.434
Eutrophication potential, EP	kg N equiv	0.3857	0.3496
Smog creation potential, POCP	kg O_3 equiv	51.33	47.46
Ozone depletion potential, ODP	kg CFC-11 equiv	4.015E-05	3.699E-05
Total Primary Energy Consumption			
Non-renewable (fossil), PENR-fossil	MJ (HHV)	4239	3900
Non-renewable (nuclear), PENR-nuclear	MJ (HHV)	60.46	53.30
Renewable (solar, wind, hydroelectric, and geothermal), PER-HWSG	MJ (HHV)	431.1	371.2
Renewable (biomass), PER-biomass	MJ (HHV)	16.75	14.75
Material Resources Consumption			
Non-renewable material resources, NRMR	kg	1507	1469
Renewable material resources, RMR	kg	0.6938	0.6102
Net fresh water, NFW	l	3076	2752
Waste Generated[1]			
Non-hazardous waste generated, NHW	kg	0.1693	0.1607
Hazardous waste generated, HW	kg	0.1105	0.1038

Table 4

Additional Environmental Information

The Richmond cement plant complies with the Canadian and BC environmental protection requirements and monitors and reports emissions to air and water resulting from the manufacturing process. The Richmond cement plant has an Environmental Management System in place which follows the ISO 14001 structure and plans to achieve certification in 2020.

Emissions from the manufacturing process are reported through the Canadian National Pollutant Release Inventory (NPRI). Further information on NPRI reporting and resulting data and reports may be found here: https://www.canada.ca/en/services/environment/pollution-waste-management/national-pollutant-release-inventory.html

CO_2 emissions are also reported to BC Ministry of Environment & Climate Change in accordance with the requirements of the Greenhouse Gas Industrial Reporting and Control Act. These emissions are

[1] Waste generation information was not available for modules A1 and A2. The waste generation information in the CAC industry average EPD (Program Operator CSA Group, EPD Registration Number 5357-9431, Version 1.1 published March 31, 2016) was used for module A1.

externally audited and verified by PricewaterhouseCoopers LLP. These verified emissions were used in the preparation of this EPD.

In addition to the information presented from the LCA, recovered materials are also used as raw materials (copper refining slag, jet grouting spoils, water treatment residues, and lime manufacturing residues) and alternative fuels (petcoke, construction and demolition materials, nylon fibres from recycled tires, woodfines, used wooden railties, plastics, and recycled carpet), offsetting the use of virgin materials and fuels. While the use of these recovered materials is included in the LCI data presented in Table 4 above, the WBCSD-CSI tool for EPD of concrete and cement, US Version does not separately calculate recovered materials. The use of these recovered materials has been calculated from the primary data and is presented in Table 5 below.

Category/Indicator	Units	GU A1 to A3 Total	GUL A1 to A3 Total
Recovered materials used as raw materials	kg	329	305
Recovered materials used as fuels	MJ (HHV)	1069	989

Table 5

Disclaimer

This EPD presents LCI data for the production of GU and GUL cements at the Richmond cement plant in 2018. It is solely intended for use in Business-to-Business (BtoB) communication and no claim of environmental superiority is inferred or implied.

This Cradle to Gate (Modules A1 to A3) EPD complies with the ASTM Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements. EPDs for cements that follow other PCRs may not be comparable.

This EPD is an indication of potential environmental impact and does not support or provide definitive comparisons of the environmental performance of specific products. Only EPDs prepared from Cradle to Grave (Modules A1 to C4) life cycle results which are based on the same function, reference service life, and quantified by the same functional unit, can be used to assist purchasers and users in making informed comparisons between products. The data presented in this EPD must be integrated into a comprehensive Cradle to Grave, ISO 14044 compliant LCA in order to compare between different products. The basis of a comparison, where applicable, shall include the product application in accordance with ISO 21930.

The LCI category results presented are relative expressions that do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks. The indicators reported comply with the PCR and is not a complete or exhaustive list of all possible environmental burdens.

In addition to the LCI category results, this EPD presents several metrics and other information related to resource consumption and waste generation. While these data may be informational, they do not provide a measure, implied or otherwise, of impact on the environment.

References

AASTHO M85, Standard Specification for Portland Cement, January 2019

AAHTO M240M/M240, Standard Specification for Blended Hydraulic Cement, January 2019

ASTM International, Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, September 2014.

ASTM C150/C150M-19a, Standard Specification for Portland Cement, April 2019

ASTM C595/C595M-19, Standard Specification for Blended Hydraulic Cements, April 2019

ASTM C1157/C1157M-17, Standard Performance Specification for Hydraulic Cement, June 2017

British Columbia Hydro and Power Authority, 2018/19 Annual Service Plan Report, July 2019

CAC Industry Average GU and GUL Cements EPD, Registration Number 5357-9431, Version 1.1, March 2016

CSA A3000-18 Cementitious materials compendium, November 2018.

CSA Group Environmental Product Declaration (EPD) Program, Program Requirements, November 2013.

Environment and Climate Change Canada, National Pollutant Release Inventory, 2018 submission, May 2019.

ISO 14001:2015 Environmental management systems – Requirements with guidance for use, September 2015

ISO 14021:2016 Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling), March 2016.

ISO 14025:2006a Environmental labels and declarations – Type III environmental declarations – Principles and procedures, July 2006

ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework, July 2006

ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines, July 2006.

ISO 21930:2007 Sustainability in building construction – Environmental declaration of building products, October 2007.

Lafarge Canada Inc. – Richmond Plant, 2018 Greenhouse Gas Verification Report, PricewaterhouseCoopers LLP, May 2019.

US EPA, eGRID 2016, Emissions & Generation Resource Integrated Database, February 2018 (www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid, accessed July 22, 2019)

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