

ENVIRONMENTAL PRODUCT DECLARATION



CalPortland Company
Front Avenue, Hillsboro and
West Vancouver Plants
Ready Mixed Concrete



NRMCA Certified Environmental Product Declaration

This environmental product declaration was conducted in accordance with ISO 14025:2006

Internal Verification

External Verification

Declared Product:	This Environmental Product Declaration (EPD) covers 50 concrete mixes produced at 3 concrete plants owned and operated by CalPortland in Portland Oregon, Hillsboro Oregon and Vancouver Washington	
Declaration Owner:	<p><i>Glacier NW Inc. dba CalPortland</i> 1050 N. River Street Portland, Oregon 97227 503-335-2600 www.calportland.com</p>	
Program Operator:	<p><i>National Ready-Mix Concrete Association</i> 900 Spring St. Silver Spring MD 20910 301-587-1400 www.nrmca.org/sustainability</p>	
LCA and EPD Developer	<p><i>Glacier NW Inc. dba CalPortland</i> 1050 N. River Street Portland, Oregon 97227 503-335-2600 www.calportland.com Utilizing WBCSD CSI-PCA EPD tool for concrete and cement. https://concrete-epd-tool.org</p>	
Independent LCA Reviewer and EPD verifier:	<p><i>Athena Sustainable Materials Institute.</i> Jamie Meil, Research Principal 119 Ross Avenue, Suite 100 Ottawa, Ontario Canada K1Y0N6 info@athenami.org</p>	
Product Category Rule	<p>Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete meeting the requirements of one of the following: ASTM C94, CSA A23.1/A23.2, UNSPSC code 30111500, Version 1.1 dated December 4, 2013 and Clarifications 1, 2, and 3 dated June 1, 2015; The Carbon Leadership Forum. www.carbonleadershipforum.org.</p> <p>PCR Reviewed By: Nicholas Santero, PE International; Holly Lahd, El Analytics; and Medgar Marceau, Morrison Hershfield</p>	
Date of Issue:	May 3, 2018	
Period of Validity:	May 3, 2023	
EPD Number:	NRMCAEPD:10019	

Description of Company

CalPortland Company is a major diversified building materials and construction solutions provider to the Western United States and Canada. Since 1891, we have reliably provided quality innovative and efficient solutions to your greatest construction challenges with our expertise in cement production and distribution, ready mixed concrete, construction aggregates, asphalt, construction services and other building materials. Our products provide solutions everywhere; in buildings for shelter; roads and bridges that transport and link us; systems that provide electricity, water, gas and waste treatment; and other necessary infrastructure like hospitals, schools, railways and airports. We are creating solid foundations using sustainable materials and renewable technologies.

CalPortland Company is the industry leader for energy conservation and environmental quality. Our commitment to continuously improve our environmental performance and provide positive contributions to our company and to society is a product of not just our words but also our actions. Sustainable development is defined as a society meeting the needs of the present without compromising the ability of future generations to meet their own needs. CalPortland is committed to solving tomorrow’s challenges today through the advancement of sustainable materials and renewable technologies

Location of Facilities

This EPD covers ready-mixed concrete produced at three facilities owned and operated by CalPortland.

Front Avenue Facility

5034 NW Front Ave
Portland, OR 97210

Hillsboro Facility

21480 NW Amberwood Dr.
Hillsboro, Oregon 97123

West Vancouver Facility

2327 West Mill Plain Blvd.
Vancouver, WA 98660

Description of Product

Products covered by this EPD satisfy general purpose concrete as used in residential, commercial and public works applications in the US and Canada. This EPD reports the impacts for 50 different ready- mixed concrete products (listed in Tables 1a - 1c on the following page) in accordance with the following:

- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- ACI 318: Building Code Requirements for Structural Concrete
- ASTM C94: Standard Specification for Ready-Mixed Concrete
- CSI Master Format Division 03-30-00: Cast-in-Place Concrete
- UNSPSC Code 30111500: Ready Mix Concrete

Declared Unit

The declared unit is one cubic yard (1yd³)

Product Components

- Compressive Strength- Compressive strengths are represented in the various mix designs and include the number of days after pouring as part of the reference value: i.e. 4,000 PSI @28 days; 5000 psi @ 56 days; etc.
- Water to cementitious ratio(w/cm)- Varies, but generally the lower the w/cm ratio the higher the strength.
- Admixtures use-Admixture use was specified for the different mixes that were modeled and the list contains air and non-air entrained mixes. Most commonly used mixes with water reducer, high range water reducers and air entrained mixes were modeled.
- SCM use-Various mix designs call for replacement of the Portland Cement with slag cement or fly ash at a 1:1 ratio.

Following are the concrete components used and their corresponding ASTM designations:

- Cement- ASTM C150
- Coarse Aggregate-ASTM C33
- Fine Aggregate- ASTM C33
- Slag Cement-ASTM C989
- Admixtures-ASTM C494
- Water-ASTM C1602
- Fly Ash-ASTM C618

Product (mix design) are specific by product number and may contain cement, fly ash, slag, natural or crushed aggregate, admixtures, and water.

Table 1a. Declared Product Range Classification, Front Avenue Plant

PRODUCT	DESCRIPTION	STRENGTH	AIR
570	2 SACK CEMENT CDF CHUTE ONLY	200 PSI @ 28 Days	Yes
0225FS	3000 PSI 1" W/GGBFS	3000 PSI @ 28 Days	No
0223FS	3000 PSI W/ 20 % GGBFS	3000 PSI @ 28 Days	No
0226FS	3000 PSI W/GGBFS/AEA	3000 PSI @ 28 Days	Yes
5471FS	3000/3DAY/5000 1" /GGBFS/WRA/ADVA/SRA	5000 PSI @ 28 Days	No
5473FS	3000/3DAY/5000 1" /GGBFS/WRA/ADVA/SRA	5000 PSI @ 28 Days	No
5233fs	3500 PSI 1"/GGBFS/WRA/ADVA	3500 PSI @ 28 Days	No
0595PFS	3500 PSI 50/50 W/ADVA/GGBFS	3500 PSI @ 28 Days	No
741	4000 PSI 1" /WRA	4000 PSI @ 28 Days	No
0241FS	4000 PSI 1" W/GGBFS	4000 PSI @ 28 Days	No
0242FS	4000 PSI 1" W/GGBFS/AEA	4000 PSI @ 28 Days	Yes
1241FS	4000 PSI 1"/GGBFS/MRWR	4000 PSI @ 28 Days	No
5241FS	4000 PSI 1"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
742	4000 PSI 1"/WRA/AEA	4000 PSI @ 28 Days	Yes
5643FS	4000 PSI 1.5" /GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
5645FS	4000 PSI 1.5" /GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
1859FS	4000 PSI 3/8"/GGBFS/MRWR	4000 PSI @ 28 Days	No
0859FS	4000 PSI 3/8"/GGBFS/WRA	4000 PSI @ 28 Days	No
0859PFS	4000 PSI 3/8"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
0597PFS	4000 PSI 50/50 W/ADVA/GGBFS	4000 PSI @ 28 Days	No
0446FS	4000 PSI W 25% GGBFS/AEA	4000 PSI @ 28 Days	Yes
5443FS	4000/4500 1"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days/5000 PSI @ 56 Days	No
0443FS	4000/4500 PSI 1"/GGBFS	4000/4500 PSI @ 28 Days	No
0445FS	4000/4500 PSI 1"/GGBFS	4000/4500 PSI @ 28 Days	No
0444FS	4000/4500 PSI 1"/GGBFS/AEA	4000/4500 PSI @ 28 Days	Yes
0329FS	4000/5000 PSI 1"/40% GGBFS	4000/5000 PSI @ 28 Days	No
0003FS	4000P/5000P W/GGBFS	4000/5000 PSI @ 28 Days	No
0467FS	5000 1" W GGBFS	5000 PSI @ 28 Days	No
0467PFS	5000 1" W GGBFS/ADVA IN TANK	5000 PSI @ 28 Days	No
5229FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5469FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5475FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
765	5000 PSI 1" AGG/WRA	5000 PSI @ 28 Days	No
766	5000 PSI 1" AGG/WRA/AEA	5000 PSI @ 28 Days	Yes
5411FS	5000 PSI 1"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days/6000 PSI @ 56 Days	No
5468FS	5000 PSI 1"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	Yes
0867PFS	5000 PSI 3/8"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5867FS	5000 PSI 3/8"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
0599PFS	5000 PSI 50/50 GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
994	5000 PSI SAND GROUT	5000 PSI @ 28 Days	No
5351	6000 PSI 1" /WRA/ADVA	6000 PSI @ 28 Days	No
0545P	6000 PSI 1" ADVA	6000 PSI @ 28 Days	No
5545	6000 PSI 1"/WRA/ADVA	6000 PSI @ 28 Days	No
0861PFS	6000 PSI 3/8"/GGBFS/WRA/ADVA	6000 PSI @ 28 Days	No
0476FS	6000 PSI PT DECK W/ADVA/AEA	6000 PSI @ 28 Days	Yes
2867PFS	8000 PSI 3/8"/30% GGBFS/WRA/ADVA	8000 PSI @ 56 Days	No
2869PFS	8000 PSI 3/8"/50% GGBFS/WRA/ADVA	8000 PSI @56 Days	No
0869PFS	8000 PSI 3/8"/GGBFS/WRA/ADVA	8000 PSI @ 28 DAYS	No
996	8000 PSI SAND GROUT	8000 PSI @ 28 DAYS	No
0989P	PUMP PRIME MIX	PUMP SLURRY	No

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Table 1b. Declared Product Range Classification, Hillsboro Plant.

PRODUCT	DESCRIPTION	STRENGTH	AIR
570	2 SACK CEMENT CDF CHUTE ONLY	200 PSI @ 28 Days	Yes
0225FS	3000 PSI 1" W/GGBFS	3000 PSI @ 28 Days	No
0223FS	3000 PSI W/ 20% GGBFS	3000 PSI @ 28 Days	No
0226FS	3000 PSI W/GGBFS/AEA	3000 PSI @ 28 Days	Yes
5471FS	3000/3DAY/5000 1" /GGBFS/WRA/ADVA/SRA	5000 PSI @ 28 Days	No
5473FS	3000/3DAY/5000 1" /GGBFS/WRA/ADVA/SRA	5000 PSI @ 28 Days	No
5233fs	3500 PSI 1"/GGBFS/WRA/ADVA	3500 PSI @ 28 Days	No
0595PFS	3500 PSI 50/50 W/ADVA/GGBFS	3500 PSI @ 28 Days	No
741	4000 PSI 1" /WRA	4000 PSI @ 28 Days	No
0241FS	4000 PSI 1" W/GGBFS	4000 PSI @ 28 Days	No
0242FS	4000 PSI 1" W/GGBFS/AEA	4000 PSI @ 28 Days	Yes
1241FS	4000 PSI 1"/GGBFS/MRWR	4000 PSI @ 28 Days	No
5241FS	4000 PSI 1"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
742	4000 PSI 1" /WRA/AEA	4000 PSI @ 28 Days	Yes
5643FS	4000 PSI 1.5" /GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
5645FS	4000 PSI 1.5" /GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
1859FS	4000 PSI 3/8"/GGBFS/MRWR	4000 PSI @ 28 Days	No
0859FS	4000 PSI 3/8"/GGBFS/WRA	4000 PSI @ 28 Days	No
0859PFS	4000 PSI 3/8"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
0597PFS	4000 PSI 50/50 W/ADVA/GGBFS	4000 PSI @ 28 Days	No
0446FS	4000 PSI W 25% GGBFS/AEA	4000 PSI @ 28 Days	Yes
5443FS	4000/4500 1"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days/5000 PSI @ 56 Days	No
0443FS	4000/4500 PSI 1"/GGBFS	4000/4500 PSI @ 28 Days	No
0445FS	4000/4500 PSI 1"/GGBFS	4000/4500 PSI @ 28 Days	No
0444FS	4000/4500 PSI 1"/GGBFS/AEA	4000/4500 PSI @ 28 Days	Yes
0329FS	4000/5000 PSI 1"/40% GGBFS	4000/5000 PSI @ 28 Days	No
0003FS	4000P/5000P W/GGBFS	4000/5000 PSI @ 28 Days	No
0467FS	5000 1" W GGBFS	5000 PSI @ 28 Days	No
0467PFS	5000 1" W GGBFS/ADVA IN TANK	5000 PSI @ 28 Days	No
5229FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5469FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5475FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
765	5000 PSI 1" AGG/WRA	5000 PSI @ 28 Days	No
766	5000 PSI 1" AGG/WRA/AEA	5000 PSI @ 28 Days	Yes
5411FS	5000 PSI 1"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days/6000 PSI @ 56 Days	No
5468FS	5000 PSI 1"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	Yes
0867PFS	5000 PSI 3/8"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5867FS	5000 PSI 3/8"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
0599PFS	5000 PSI 50/50 GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
994	5000 PSI SAND GROUT	5000 PSI @ 28 Days	No
5351	6000 PSI 1" /WRA/ADVA	6000 PSI @ 28 Days	No
0545P	6000 PSI 1" ADVA	6000 PSI @ 28 Days	No
5545	6000 PSI 1"/WRA/ADVA	6000 PSI @ 28 Days	No
0861PFS	6000 PSI 3/8"/GGBFS/WRA/ADVA	6000 PSI @ 28 Days	No
0476FS	6000 PSI PT DECK W/ADVA/AEA	6000 PSI @ 28 Days	Yes
2867PFS	8000 PSI 3/8"/30% GGBFS/WRA/ADVA	8000 PSI @ 56 Days	No
2869PFS	8000 PSI 3/8"/50% GGBFS/WRA/ADVA	8000 PSI @56 Days	No
0869PFS	8000 PSI 3/8"/GGBFS/WRA/ADVA	8000 PSI @ 28 DAYS	No
996	8000 PSI SAND GROUT	8000 PSI @ 28 DAYS	No
0989P	PUMP PRIME MIX	PUMP SLURRY	No

Table 1c. Declared Product Range Classification, West Vancouver Plant

PRODUCT	DESCRIPTION	STRENGTH	AIR
570	2 SACK CEMENT CDF CHUTE ONLY	200 PSI @ 28 Days	Yes
0225FS	3000 PSI 1" W/GGBFS	3000 PSI @ 28 Days	No
0223FS	3000 PSI W/ 20% GGBFS	3000 PSI @ 28 Days	No
0226FS	3000 PSI W/GGBFS/AEA	3000 PSI @ 28 Days	Yes
5471FS	3000/3DAY/5000 1" /GGBFS/WRA/ADVA/SRA	5000 PSI @ 28 Days	No
5473FS	3000/3DAY/5000 1" /GGBFS/WRA/ADVA/SRA	5000 PSI @ 28 Days	No
5233fs	3500 PSI 1"/GGBFS/WRA/ADVA	3500 PSI @ 28 Days	No
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741	4000 PSI 1" /WRA	4000 PSI @ 28 Days	No
0241FS	4000 PSI 1" W/GGBFS	4000 PSI @ 28 Days	No
0242FS	4000 PSI 1" W/GGBFS/AEA	4000 PSI @ 28 Days	Yes
1241FS	4000 PSI 1"/GGBFS/MRWR	4000 PSI @ 28 Days	No
5241FS	4000 PSI 1"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
742	4000 PSI 1"/WRA/AEA	4000 PSI @ 28 Days	Yes
5643FS	4000 PSI 1.5" /GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
5645FS	4000 PSI 1.5" /GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
1859FS	4000 PSI 3/8"/GGBFS/MRWR	4000 PSI @ 28 Days	No
0859FS	4000 PSI 3/8"/GGBFS/WRA	4000 PSI @ 28 Days	No
0859PFS	4000 PSI 3/8"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days	No
0597PFS	4000 PSI 50/50 W/ADVA/GGBFS	4000 PSI @ 28 Days	No
0446FS	4000 PSI W 25% GGBFS/AEA	4000 PSI @ 28 Days	Yes
5443FS	4000/4500 1"/GGBFS/WRA/ADVA	4000 PSI @ 28 Days/5000 PSI @ 56 Days	No
0443FS	4000/4500 PSI 1"/GGBFS	4000/4500 PSI @ 28 Days	No
0445FS	4000/4500 PSI 1"/GGBFS	4000/4500 PSI @ 28 Days	No
0444FS	4000/4500 PSI 1"/GGBFS/AEA	4000/4500 PSI @ 28 Days	Yes
0329FS	4000/5000 PSI 1"/40% GGBFS	4000/5000 PSI @ 28 Days	No
0003FS	4000P/5000P W/GGBFS	4000/5000 PSI @ 28 Days	No
0467FS	5000 1" W GGBFS	5000 PSI @ 28 Days	No
0467PFS	5000 1" W GGBFS/ADVA IN TANK	5000 PSI @ 28 Days	No
5229FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5469FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5475FS	5000 PSI 1" /GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
765	5000 PSI 1" AGG/WRA	5000 PSI @ 28 Days	No
766	5000 PSI 1" AGG/WRA/AEA	5000 PSI @ 28 Days	Yes
5411FS	5000 PSI 1"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days/6000 PSI @ 56 Days	No
5468FS	5000 PSI 1"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	Yes
0867PFS	5000 PSI 3/8"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
5867FS	5000 PSI 3/8"/GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
0599PFS	5000 PSI 50/50 GGBFS/WRA/ADVA	5000 PSI @ 28 Days	No
994	5000 PSI SAND GROUT	5000 PSI @ 28 Days	No
5351	6000 PSI 1" /WRA/ADVA	6000 PSI @ 28 Days	No
0545P	6000 PSI 1" ADVA	6000 PSI @ 28 Days	No
5545	6000 PSI 1"/WRA/ADVA	6000 PSI @ 28 Days	No
0861PFS	6000 PSI 3/8"/GGBFS/WRA/ADVA	6000 PSI @ 28 Days	No
0476FS	6000 PSI PT DECK W/ADVA/AEA	6000 PSI @ 28 Days	Yes
2867PFS	8000 PSI 3/8"/30% GGBFS/WRA/ADVA	8000 PSI @ 56 Days	No
2869PFS	8000 PSI 3/8"/50% GGBFS/WRA/ADVA	8000 PSI @56 Days	No
0869PFS	8000 PSI 3/8"/GGBFS/WRA/ADVA	8000 PSI @ 28 DAYS	No
996	8000 PSI SAND GROUT	8000 PSI @ 28 DAYS	No
0989P	PUMP PRIME MIX	PUMP SLURRY	No

Life Cycle Assessment

This EPD is based on a 'cradle-to-gate' life cycle assessment (LCA) of various ready mixed concrete. A summary of the life cycle stages included in the EPD are as follows:

1. Raw material supply (upstream processes): Extraction, handling, and processing of the raw materials used in production of concrete: cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
2. Transportation: Transportation of these materials from supplier to the gate of the concrete producer.
3. Manufacturing (core processes): Energy used to store, batch, mix, and distribute the concrete and operate the facility (concrete plant).
4. Water use in mixing and distributing concrete.

A summary of life cycle stages excluded from the EPD is as follows:

1. Production, manufacture, and construction of buildings, capital goods, and infrastructure.
2. Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment, and laboratory equipment.
3. Personnel-related activities (travel, furniture, office supplies).
4. Energy and water use related to company management and sales activities.

A summary of the limitations of this EPD include the following:

1. This EPD does not report all the environmental impacts due to manufacturing of the product, but rather environmental impacts for categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, water use in the upstream manufacturing process, and habitat destruction.
2. This EPD reports the results of an LCA for 'cradle-to-gate' analysis. Thus, declarations themselves are not comparative assertions, defined as an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.
3. To assess the local impacts of product manufacturing, additional analysis is required.
4. Life cycle impact assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

Building Life Cycle Information Modules															
Product Stage			Construction Process Stage		Use Stage							End-Of-Life-Stage			
Raw Material Supply	Transport	Manufacturing	Transport	Construction/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/Demolition	Transport	Waste Processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4

Figure 1. Life Cycle Stage Schematic-alpha-numeric designations as per CLF PCR 2013(adapted from CEN 15978:2011)

This EPD has been developed using the Quantis 2016 (WBCSD-CSI tool for EPD of concrete and cement v1.4 - U.S. version, concrete-epd-tool.org).

Allocation

The applied allocation procedures conform with ISO 14044:2006 clause 4.3.4

Cut-off Rules

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO14044:2006 and section 3.3 of the CLF PCR 2013. Specifically, the cut-off criterial were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., Portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows-all of which are included in the life cycle inventory.

Data Comparability

EPDs of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. While EPDs can be used to compare concrete mixes, the data cannot be used to compare between construction products or concrete mixes used in different concrete products unless the data is integrated into a comprehensive LCA. For example, precast concrete, concrete masonry units, and site-cast concrete all have different manufacturing processes whose impacts are attributed to different LCA stages. This precludes direct comparison between mixes used in these different products until all life cycle phases are included.

Data Sources and Data Quality Assessment

This EPD is based on foreground LCI data collected from Glacier Northwest dba CalPortland production facilities. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the CLF PCR. Tables 2 to 4 describe each LCI data source for raw materials (A1), transportation by mode (A2), the RMC core manufacture process (A3), and descriptions of data quality for each data source. This EPD was created using industry-average data for upstream materials. Variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel type used.

This section provides the sources of data used to compute the upstream material life-cycle inventory (LCI) in this study accompanied by qualitative data quality assessments using the five indicators outlined in the “Product Life Cycle Accounting and Reporting Standard” [GHG Protocol 2011]. Data quality is rated “very good”, “good”, “fair”, or “poor” for each indicator.

Table 2: A1 – Raw Material Supply				
Material\Unit	LCI data source	Geography	Year	Data Quality Assessment
Cement (lbs)	WBCSD-CSI tool for EPDs of concrete and cement - Background Report. Korean-specific clinker factors and kiln fuels assumed.*	South Korea	2014-2015	<ul style="list-style-type: none"> • Technology: good, Process represents average cement production in Korea. • Time: very good, Data is within 5 years. • Geography: very good • Completeness: good, Data is based on an average of regional production. • Reliability: very good
Slag Cement (lbs)	Slag Cement Association N. American EPD of Slag Cement, 2015	N. America	2013-2014	<ul style="list-style-type: none"> • Technology: good, Process models ground granulated blast furnace slag. • Time: good, Data is within 5 years. • Geography: Fair, material is sourced from China but data used represents N. American Slag, which includes 5% imports of finished product and 30% imports of slag that needs further grinding. • Completeness: good • Reliability: very good
Fly Ash (lbs)	None, no incoming burden. Only inbound transport was considered	N/A	N/A	N/A
Crushed Aggregates (lbs.) coarse and fine	ecoinvent 3.1 process: “Gravel, crushed, production, CA-QC”	Quebec, Canada	2001	<ul style="list-style-type: none"> • technology: fair; process represents current technology for gravel and sand quarry operations in Switzerland • time: poor; data is older than ten years • geography: fair; Process model’s production based on

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				<p>Swiss data and is adjusted for the rest of the world</p> <ul style="list-style-type: none"> • completeness: very good; process is 100% representative of Swiss production • reliability: fair; Data is verified by ecoinvent with the following caveat: "This is a dataset automatically generated based on a dataset transferred from ecoSpold v1 / ecoinvent database version 2. It may not in all aspects fulfill the requirements of the ecoinvent data quality guideline for version 3."
Natural Aggregates (lbs.) coarse and fine	ecoinvent 3.1 process: "Gravel, round, market for, GLO"	Global	2011	<ul style="list-style-type: none"> • Technology: good • Time: fair • Geography: fair • Completeness: fair • Reliability: fair
Sand (lbs)	Ecoinvent 3.1 process: "Sand, market for, GLO"	Global	2011	<ul style="list-style-type: none"> • Technology: good • Time: fair • Geography: fair • Completeness: fair • Reliability: fair
Admixtures (lbs): Accelerator, Air Entrainer, Plasticizer, Retarder, SuperPlasticizer, Waterproofing	EFCA EcoProfiles (301, 324 and 325) http://www.efca.info/efca-publications/environmental/	EU	2005-2006	<ul style="list-style-type: none"> • Technology: very good, Processes represents admixture production for use in concrete • Time: fair, Data is within ten years • Geography: fair • Completeness: good, Data from a federation of European admixture producers • Reliability: good, Profiles have undergone an independent review process. Compliance with ISO standards (unknown)

Table 3: A2 – Transportation				
Process	LCI data source	Geography	Year	Data Quality Assessment
Truck, rail, and boat (lbs.*miles)	USLCI – combination truck for all materials except admixtures and packaging which are in single unit, diesel powered; rail transport, diesel powered; boat, adapted from barge, average fuel mix	USA	2008	<ul style="list-style-type: none"> • Technology: very good, Process represents U.S. average transportation profiles • Time: fair, Data is within 10 years • Geography: good • Completeness: good • Reliability: good

Table 4: A3 - Manufacturing				
Process	LCI data source	Geography	Year	Data Quality Assessment
Electricity (kWh)	ecoinvent 3.1, Sources of electricity for WECC grid mix modeled in ecoinvent 3.1 adapted to include the 2012 grid mix from USEPA eGRID, custom process: “Electricity, low voltage {WECC} market for (custom, 2012 USEPA eGRID data)”	USA/Oregon	2012	<ul style="list-style-type: none"> • Technology: very good • Time: fair, Data is within ten years. • Geography: very good • Completeness: good, Data is representative of Oregon production. • Reliability: good, Data has been verified by ecoinvent.
Natural Gas (cu. ft.)	ecoinvent 3.1 process: “natural gas, high pressure, market for, US,”	USA	2010	<ul style="list-style-type: none"> • Technology: very good • Time: fair, data is within 10 years • Geography: very good • Completeness: good • Reliability: good
Diesel (gallon)	ecoinvent 3.1 process: “Diesel, market for, RoW”	Global	2011	<ul style="list-style-type: none"> • Technology: very good • Time: fair, within 10 years • Geography: good • Completeness: good • Reliability: very good
Non-Hazardous Solid Waste (lbs.)	ecoinvent 3.1 process: “Inert waste, market for, (GLO)”	Global	2011	<ul style="list-style-type: none"> • Technology: good • Time: fair, within 10 years, • Geography: fair • Completeness: very good • Reliability: very good

LIFE CYCLE ASSESMENT RESULTS

Environmental Indicators and Inventory Metrics

This EPD covers the required set of environmental impact categories in accordance with the PCR, Section 3.2.

Life Cycle Category Indicators and Inventroy Metrics			
#	LCIA Indicators	Abbreviations	Units
1	Global Warming Potential(Climate Change)	GWP	kg CO2-eq
2	Acidification Potential	AP	kg SO2-eq
3	Eutrophication Potential	EP	kg N-eq
4	Photochemical Ozone Creation/Smog Potential	POCP	kg O3-eq
5	Ozone Depletion Potential	ODP	kg CFC-11-eq
6	Total Primary Energy Consumption	PEC	MJ (HHV)
7	Depletion of Non-Renewable Energy Resources	NRE	MJ (HHV)
8	Use of Renewable Primary Energy	RE	MJ (HHV)
9	Depletion of Non-Renewable Resources	NRM	kg
10	Use of Renewable Material Resources	RM	kg
11	Concrete Batching Water Consumption	CBW	m3
12	Concrete Washing Water Consumption	CWW	m3
13	Total Water Consumption	TW	m3
14	Concrete Hazardous Waste	CHW	kg
15	Concrete Non Hazardous Waste	CNHW	kg

References:

American Concrete Institute (ACI) 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

American Concrete Institute (ACI) 318: Building Code Requirements for Structural Concrete

ASTM International (ASTM) C94: Standard Specification for Ready-Mixed Concrete

Carbon Leadership Forum (December 4, 2013). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.1.

Carbon Leadership Forum (April 10, 2014). Clarification #1 to: PCR for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.1.

Construction Specifications Institute (CSI) Master Format Division 03-30-00 Cast-in-Place Concrete

EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

European Federation of Concrete Admixture Associations (2006). EFCA Environmental Declarations for Admixtures. <http://www.efca.info/publications.html>

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

ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.

ISO 14044: 2006 Environmental management - Life cycle assessment - Requirements and guidelines.

National Ready Mixed Concrete Association 2013. Program Operator Instructions for Environmental Product Declarations v1.2.

National Renewable Energy Laboratory 2014. U.S. Life Cycle Inventory Database. <https://www.lcacommons.gov/nrel/search>.