ENVIRONMENTAL PRODUCT DECLARATION

PRECAST CONCRETE PRODUCTS

Certified Environmental Product Declaration
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CONCRETE PRODUCTS, INC.

Program Operator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org
Manufacturer Name and Address	A.C. Miller Concrete Products, Inc. 31 E. Bridge Street, Spring City, PA 19475 9558 Route 22, Blairsville, PA 15717
Declaration Number	EPD10588
Declared Product and Declared Unit	Precast concrete manufactured in Spring City, PA and Blairsville, PA 1 metric tonne of precast concrete
Reference PCR and Version Number	ASTM International Precast Concrete (UN CPC 3755)
Product's intended Application and Use	The product has various applications including box culverts, manholes, train stations, tunnels, and water systems.
Product RSL	75 years
Markets of Applicability	North America
Date of Issue	07/09/2021
Period of Validity	5 years from date of issue
EPD Type	Product Specific
Range of Dataset Variability	N/A
EPD Scope	Cradle-to-Gate with Options (A4-A5. C1-C4)
Year of reported manufacturer primary data	2020
LCA Software and Version Number	GaBi 10.0.0.71
LCI Database and Version Number	GaBi Database 2021.1
LCIA Methodology and Version Number	TRACI 2.1
The sub-category PCR review was conducted by:	• Nicholas Santero, PE International (Chairperson) • Christine Subasic, Consulting Architectural Engineer • Juan Tejeda, ORCO Block Company
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Life Cycle Assessment Calculation Rules and Report Requirements" v3.2 (December 2018), based on CEN Norm EN 15804 (2012) and ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ Internal ☒ External	Tony Favilla afavilla@nsf.org
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Lindsay Bonney, WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig - EcoForm jgeibig@ecoform.com

Limitations:
Environmental declarations from different programs (ISO 14025) may not be comparable.
Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, reference service life, and quantified by the same functional unit, and meeting all the conditions in ISO 14025, Section 6.7.2, can be used to assist purchasers and users in making informed comparisons between products.
Full conformance with the PCR for Products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.
Additional information on the life cycle assessment can be found by contacting AC Miller directly.

DESCRIPTION OF COMPANY

A.C. Miller Concrete Products, Inc. provides a broad range of quality precast products including manholes, accelerated bridge systems, rail platforms, stormwater and sewerage systems, and firewalls. A.C. Miller is dedicated to supplying top quality precast products and accessories while providing excellent customer service.

PRODUCT DESCRIPTION

This EPD includes representative products derived from A.C. Miller's line of products produced at the facilities located in Blairsville, Pennsylvania and Spring City, Pennsylvania. Products reviewed in this study include precast concrete products reinforced with steel. The products under review are used for road, transportation, and underground utility projects. A.C. Miller's precast products consist primarily of cement, a coarse aggregate, and a fine aggregate. Additionally, admixtures are utilized to protect against freezing and to improve durability. All products in this review are considered precast concrete products. The UN CPC Class for this product is 3755 and the CSI code is 09 30 00.

The products included in this study fall under the following sub-categories as defined by the PCR: underground precast and architectural precast.

Results in this EPD are based on a weighted average of the impacts of the products manufactured in A.C. Miller's Blairsville, PA and Spring City, PA plants based on the mass of products sold in 2020.

PRODUCT SPECIFICATION AND APPLICATION RULES

The products considered in the EPD meet the following technical specifications:

- ASTM C-150: Standard Specification for Portland Cement
- ASTM C-33: Standard Specification for Concrete Aggregates
- ASTM C-94: Standard Specification for Ready-Mixed Concrete

APPLICATION

A.C. Miller products are used in a variety of utility, transportation, environmental, and heavy civil projects including but not limited to the construction of:

- Box Culverts;
- Manholes;
- Train stations;
- Tunnels;
- Stormwater systems;
- Wastewater systems and
- Freshwater systems

TECHNICAL DATA

Table 1 shows the technical specifications of the products, including any testing data as appropriate.

Table 1: Technical Details

Parameter	Precast Concrete
Compressive Strength, psi after 18 hours	6,239-6,462
Compressive Strength, psi after 7 days	7,823-8,022
Compressive Strength, psi after 14 days	7,926-8,189
Compressive Strength, psi after 28 days	8,571-8,626
Reinforcement	Rebar spaced based on job requirements
Additional Hardware	No additional hardware needed

FLOW DIAGRAM

This LCA is a Cradle-to-Gate with Options study. An overview of the system boundary is shown in Figure 1.

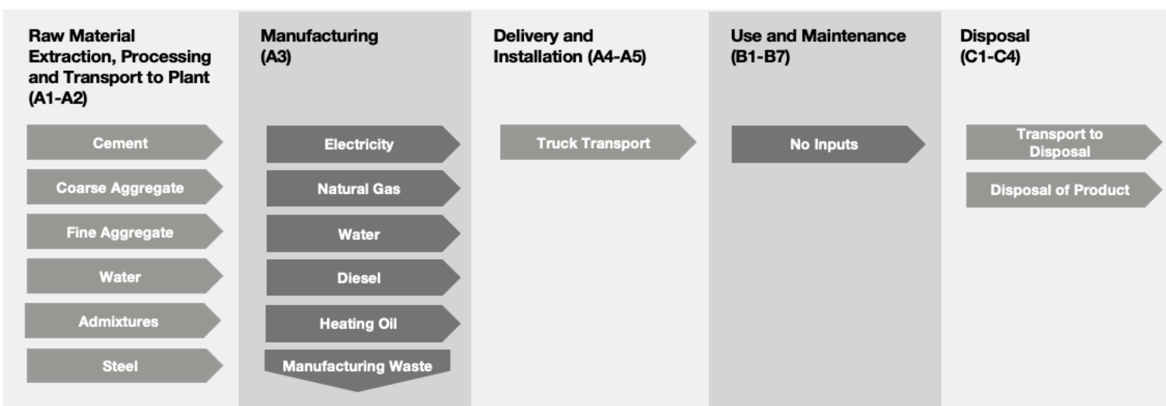

Figure 1: System Boundary

MANUFACTURING

A.C. Miller precast concrete products are manufactured utilizing molds with natural gas as the main energy source. Cement is delivered to the manufacturing site via bulk containers and is poured into the molds. Sand and stone aggregates are then added to the cement. To keep materials at the proper suspension, to protect against freezing, and to improve durability, admixtures are combined along with water. Then, rebar is placed into the mold for reinforcement. The concrete rests and hardens before it is transported to customers. Excess concrete is shaped into blocks and reused by neighboring organizations for various purposes. The product does not require any packaging materials.

MATERIAL COMPOSITION

The raw materials for the product were obtained from various suppliers across North America. The general composition is represented in the table below.

Table 2: Material Composition

	Composition
Cement	10% - 20%
Fly Ash	0% - 5%
Coarse Aggregate	30% - 40%
Fine Aggregate	30% - 40%
Water	0% - 10%
Admixtures	1% - 2%
Steel	1% - 5%

PRODUCT INSTALLATION

The product is delivered to the customer via a flatbed truck that houses a crane. The crane removes the product from the truck bed and places it into the appropriate place of installation. The fuel used during transportation and installation are both included in the study. Although the vehicle used for transporting the product to the customer site is the same vehicle used to install the product, impacts from transportation and installation were measured separately.

USE CONDITIONS

This study does not include the impacts associated with use, maintenance, repair, operational energy and water use, replacement, and refurbishment (B1-B7) as minimal resources are used in the rare occasion that maintenance, repair, operational energy and water use, replacement, or refurbishment is necessary.

DISPOSAL

All concrete is assumed to be disposed at end-of-life in a construction landfill.

LIFE CYCLE ASSESSMENT BACKGROUND INFORMATION

DECLARED UNIT

The declared unit is 1 metric tonne of precast concrete

Table 3: Declared Unit

	Precast Concrete
Mass per declared unit [kg]	1,000
Density [lbs/cu ft]	130 -150

SYSTEM BOUNDARY

This EPD is considered a Cradle-to-Gate with Options study. A summary of the life cycle modules included in this EPD is presented in Table 4. Infrastructure flows have been excluded.

Table 4: Summary of Included Life Cycle Modules

Module Name	Description	Analysis Period	Summary of Included Elements
A1-A3	Product Stage: Raw Material Supply, Transport, Manufacturing	2020	Raw Material sourcing and processing as defined by secondary data. Shipping from supplier to manufacturing site including fuel. Energy, water and material inputs required for manufacturing products from raw materials. Manufacturing waste. No packaging materials are utilized.
A4	Construction Process Stage: Transport	2020	Shipping from manufacturing site to project site. Fuel use requirements estimated based on sales records.
A5	Construction Process Stage: Installation	2020	Includes installation materials. No installation waste or packaging material waste was generated.
B1-B7	Use Stage	MND	Modules not declared
C1	EOL: Deconstruction	2020	No inputs required for deconstruction.
C2	EOL: Transport	2020	Shipping from site to landfill. Fuel use requirements estimated based on product weight and assumed distance of 100 miles.
C3	EOL: Waste Processing	2020	Waste processing not required. All waste can be processed as is.
C4	EOL: Disposal	2020	Assumes all products are sent to landfill. Landfill impacts modeled based on secondary data.
D	Benefits beyond system	MND	Module not declared

LIFE CYCLE ASSESSMENT SCENARIOS

Table 5: Transport to building site (A4)

	Precast Concrete
Vehicle Type	U.S. Flatbed truck, platform / 49,000 payload
Fuel Efficiency [L/100km]	1,308
Fuel Type	Diesel
Distance (average from sales records) [km]	216
Capacity Utilization [%]	98
Weight of Products Transported [kg]	1,000

Table 6: Installation into the building (A5)

Name	Value
Diesel Usage [kg]	0.0392

Table 7: End-of-Life Parameters (C1-C4)

Parameter	Precast Concrete
Collected as mixed construction waste [kg]	1,000
Waste to Landfill [kg]	1,000
Distance to Landfill [km]	161

LIFE CYCLE ASSESSMENT RESULTS

All results are given per declared unit, which is 1 metric tonne of precast concrete. Environmental impacts were calculated using the GaBi software platform. Impact results have been calculated using TRACI 2.1 characterization factors. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
Cradle to Gate with Options	X			X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND
An X in the table above signifies that a module was included in the life cycle assessment. MND stands for Module Not Declared and signifies that a life cycle stage was not evaluated in the life cycle assessment.																	

Figure 2: Description of the system boundary modules

Table 8: Acronym Key

Acronym	Text	Acronym	Text
Impact Categories			
AP	Acidification potential of soil and water	**ODP**	Depletion of stratospheric ozone layer
EP	Eutrophication potential	**POCP**	Photochemical ozone creation potential
GWP	Global warming potential	**Resources**	Depletion of non-renewable fossil fuels
LCI Indicators			
RPR_E	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	**SM**	Use of secondary materials
RPR_M	Use of renewable primary energy resources used as raw materials	**RSF**	Use of renewable secondary fuels
$NRPR_E$	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	**NRSF**	Use of non-renewable secondary fuels
$NRPR_M$	Use of non-renewable primary energy resources used as raw materials	**FW**	Net use of fresh water
HWD	Disposed-of-hazardous waste	**MR**	Materials for recycling
NHWD	Disposed-of non-hazardous waste	**MER**	Materials for energy recovery
HLRW	High-level radioactive waste, conditioned, to final repository	**EE**	Exported energy
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	**CRU**	Components for reuse
RE	Recovered energy		

The user of the EPD should take care when comparing EPDs from different companies. Assumptions, data sources, and assessment tools may all impact the variability of the final results and make comparisons misleading. Without understanding the specific variability, the user is therefore, not encouraged to compare EPDs. Even for similar products, differences in use and end-of-life stage assumptions, and data quality may produce incomparable results.

A.C. MILLER PRECAST CONCRETE RESULTS

The results presented below are for 1 metric tonne of precast concrete.

Impact Category	A1-A3	A4	A5	C1	C2	C3	C4
TRACI 2.1 LCIA Impacts							
AP [kg SO2 eq]	3.11E-01	2.24E-02	2.24E-04	0.00E+00	3.66E-02	0.00E+00	1.87E-01
EP [kg N eq]	1.90E-02	3.56E-03	3.56E-05	0.00E+00	4.22E-03	0.00E+00	1.04E-02
GWP [kg CO2 eq]	1.83E+02	1.45E+01	1.45E-01	0.00E+00	1.28E+01	0.00E+00	4.24E+01
ODP [kg CFC 11 eq]	3.93E-13	2.90E-15	2.90E-17	0.00E+00	2.57E-15	0.00E+00	1.47E-13
Resources [MJ]	1.53E+02	2.73E+01	2.73E-01	0.00E+00	2.41E+01	0.00E+00	8.56E+01
POCP [kg O3 eq]	7.13E+00	5.02E-01	5.02E-03	0.00E+00	8.34E-01	0.00E+00	3.33E+00
Resource Use Indicators							
RPR_E [MJ]	1.21E+02	8.48E+00	8.48E-02	0.00E+00	7.49E+00	0.00E+00	5.59E+01
RPR_M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_T [MJ]	1.21E+02	8.48E+00	8.48E-02	0.00E+00	7.49E+00	0.00E+00	5.59E+01
$NRPR_E$ [MJ]	1.53E+03	2.06E+02	2.06E+00	0.00E+00	1.82E+02	0.00E+00	6.73E+02
$NRPR_M$ [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_T$ [MJ]	1.53E+03	2.06E+02	2.06E+00	0.00E+00	1.82E+02	0.00E+00	6.73E+02
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	3.44E-01	3.62E-02	3.62E-04	0.00E+00	3.20E-02	0.00E+00	9.24E-02
Output Flows and Waste Categories							
HWD [kg]	1.93E-05	1.72E-08	1.72E-10	0.00E+00	1.52E-08	0.00E+00	6.36E-08
NHWD [kg]	1.22E+00	1.89E-02	1.89E-04	0.00E+00	1.67E-02	0.00E+00	1.00E+03
HLRW [kg]	7.87E-05	6.94E-07	6.94E-09	0.00E+00	6.13E-07	0.00E+00	6.49E-06
ILLRW [kg]	7.55E-02	5.84E-04	5.84E-06	0.00E+00	5.16E-04	0.00E+00	5.60E-03
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

A1-A3: Raw Material Production and Transportation, Manufacturing, A4: Transport to Customer, A5: Installation, C1: Deconstruction, C2: Waste Transport, C3: Waste Processing, C4: Disposal

Modules B1-B7 and D are not declared for this cradle-to-gate with options study.

LIFE CYCLE ASSESSMENT INTERPRETATION

A dominance analysis was performed for the products in the LCA to show which of the life cycle modules contributes to the majority of the impacts. Due to the relevance of these impact categories to the product type and the manufacturer's interests, this dominance analysis will be provided for CML Global Warming Potential (GWP) results. The dominance analysis shows that the raw material sourcing and manufacturing activities are the most impactful. This is primarily a result of the choice of materials used in the product formula. The materials with the largest A1-A3 impacts are cement (65% of A1-A3 emissions) and sand (7% of A1-A3 impacts). As such, it is recommended A.C. Miller that considers reducing the amount of these materials utilized in the product or replace these substances with less carbon intensive materials.

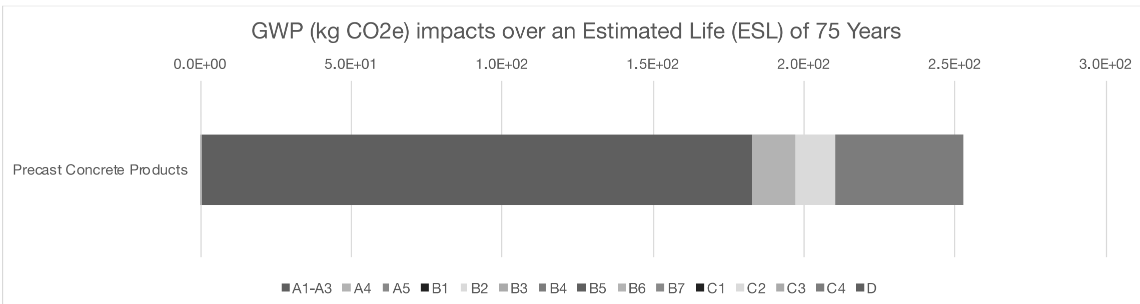

Figure 2: Dominance Analysis for GWP

Some limitations to the study have been identified as follows:

- Only facility-level data was provided for manufacturing processes. Sub-metering of manufacturing lines would allow for more accurate manufacturing impacts to be modeled.
- Only known and quantifiable environmental impacts are considered.
- Due to the assumptions and value choices listed above, these do not reflect real-life scenarios and hence they cannot assess actual and exact impacts, but only potential environmental impacts.

ADDITIONAL ENVIRONMENTAL INFORMATION

ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

There is no additional environmental information to be included in this EPD.

REFERENCES

1. Life Cycle Assessment, LCA Report for A.C. Miller Precast Concrete. WAP Sustainability Consulting. May 2021.
2. Product Category Rule (PCR) for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL 10010. Version 3.2, December 12, 2018.
3. ASTM International Precast Concrete (UN CPC 3755)
4. ISO 14044: 2006 Environmental Management – Life cycle assessment – Requirements and Guidelines.
5. ISO 14044: 2006/ Amd 1:2017 Environmental Management – Life cycle assessment – Requirements and Guidelines – Amendment 1.
6. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
7. ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
8. European Standard DIN EN 15804: 2012.04+A1 2013. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products (includes Amendment A1:2013)
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10. Bare, J.C., G.A. Norris, D.W. Pennington, and T. McKone (2003). TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Journal of Industrial Ecology 6(3), pp. 49-78.