An Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017

A product-specific cradle-to-gate EPD for

Reinforced Concrete Round Pipe (UNCPC: 37550)

CLARKSON CONSTRUCTION COMPANY

Rinker MATERIALS® A QUIKRETE® COMPANY

ASTM International Certified Environmental Product Declaration

This document is a Type III environmental product declaration (EPD) for reinforced concrete round pipe, as manufactured at the Rinker Materials Bonner Springs, Kansas facility for the reference year 2022.

This declaration has been prepared according to the requirements of ASTM PCR for Precast Concrete (1), ISO 21930 (2), ISO 14025 (3), ISO 14040/44 (4), (5), and ASTM General Program Instructions for Type III EPD (6).

The intent of this document is to further the development of environmentally compatible and more sustainable construction methods by providing comprehensive environmental information related to potential impacts of reinforced concrete round pipe in accordance with international standards.

Environmental Product Declaration Summary

General Information	
EPD Commissioner	**Clarkson Construction Company** Headquarters: 4133 Gardner Ave Kansas City, MO 64120 USA https://clarksonconstruction.com/ Clarkson Construction Company is a leader in delivering innovative solutions to some of the biggest infrastructure projects in the Midwest. Now in its sixth generation, family-owned Clarkson continues to set the standard using 21st Century technology to connect our communities and move them closer to the future.
Manufacturer and production facility	**Rinker Materials** Bonner Springs Facility 23600 W 40th St Shawnee, KS 66226 USA https://www.rinkerpipe.com/ *The manufacturer of the declared products is liable for the underlying information and evidence.*
Product Group and Name	Reinforced concrete round pipe- UNCPC: 37550
Product Definition	Precast concrete round pipe conveys wastewater and stormwater through complex underground infrastructure systems, preserving groundwater quality and ensuring a sanitary environment.
Product Category Rule (PCR)	ASTM International and NSF International, Product Category Rule for Environmental Product Declarations, PCR for Precast Concrete – UNCPC: 37550, 05/30/2021. (1)
Certification Period	05/07/2024 – 5-year validity
Declared Unit	1 metric tonne (1,000 kg) of reinforced concrete round pipe
ASTM Declaration Number	EPD – 737

EPD Information	
Program Operator	ASTM International 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428-2959 USA https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr.html

Declaration Type

A "cradle-to-gate" production stage EPD for reinforced concrete round pipe. Production stage activities covered include the raw material supply, transport, and manufacturing (modules A1 to A3). The declaration is intended for Business-to-Business (B-to-B) communication.

Applicable Countries

United States and Canada

Product Applicability

Reinforced concrete round pipe products satisfy a wide array of wastewater and stormwater infrastructure applications.

This EPD was independently verified by ASTM in accordance with ISO 14025 and the ISO 21930:	
Internal	**External**
	X

Tim Brooke
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959 USA
https://www.astm.org/

EPD Project Report Information	
EPD Project Report	A Cradle-to-Gate Life Cycle Assessment of N-12 Dual Wall HDPE pipe, reinforced concrete round pipe, and precast concrete catch basin, Prepared for: Clarkson Construction Company, July 2024.
Prepared by	Athena Sustainable Materials Institute 280 Albert St, Suite 404 Ottawa, ON K1P 5G8 Canada info@athenasmi.org; www.athenasmi.org
This EPD project report was independently verified by and in accordance with ISO 14025, ISO 14040/44, and ISO 21930:	Thomas P. Gloria, Ph.D. Industrial Ecology Consultants 35 Bracebridge Rd Newton, MA 02459-1728 USA
EPD explanatory material	For any explanatory material, regarding this EPD, please contact the program operator: ASTM International Environmental Product Declarations 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 USA http://www.astm.org

1 PRODUCT IDENTIFICATION

1.1 PRODUCT DEFINITION AND SPECIFICATIONS

Precast concrete is a construction product produced by casting concrete in a reusable mold or "form" which is then cured in a controlled environment, transported to the construction site, and lifted into place. In contrast, standard concrete is placed into site-specific forms and cured on site. Precast concrete is primarily composed of Portland cement, aggregates, and steel reinforcement materials.

Reinforced concrete round pipe (UNCPC 3755) conveys wastewater and stormwater through complex underground infrastructure systems, preserving groundwater quality and ensuring a sanitary environment. Reinforced concrete round pipe is available in various sizes and strength classes to meet any need. Reinforced concrete round pipe products satisfy a wide array of wastewater and stormwater infrastructure applications. *More specifically, applications include* (7)*:*

- *Jacked or tunneled systems*
- *Low head pressure water transmission*
- *Culverts*
- *Sanitary sewers*
- *Storm drains*

For further product details and installation instructions, see the Rinker Materials website: https://www.rinkerpipe.com/products/reinforced-concrete-round-pipe-2/.

1.2 PRODUCT SPECIFICATIONS

Table 1 shows the product specifications for the declared products.

Table 1. Reinforced concrete round pipe specifications

Specifications
ASTM C361 - Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C443/AASHTO M198 — Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets
ASTM C655 — Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe

2 DECLARED UNIT

The declared unit is defined as the quantity of a construction product for use as a reference unit in an EPD based on LCA for the expression of environmental information in information modules (2). The declared unit for Reinforced concrete round pipe as manufactured at the Rinker Materials Bonner Springs, Kansas facility is defined as 1 metric tonne (1,000 kg) of reinforced concrete round pipe (1).

3 MATERIAL COMPOSITION

Table 2 provides the material composition by input material (in %) for reinforced concrete round pipe.

Table 2. Material composition per reinforced concrete round pipe (in %)

Material Composition	Reinforced concrete round pipe
Portland Limestone Cement (PLC)	11%
Aggregates (fine and coarse)	77%
SCMs	4%
Form Release Agent	0.003%
Steel Reinforcement (rebar, WWR) and Spacers	3%
Batch Water	5%
Total	100%

4 LIFE CYCLE STAGES

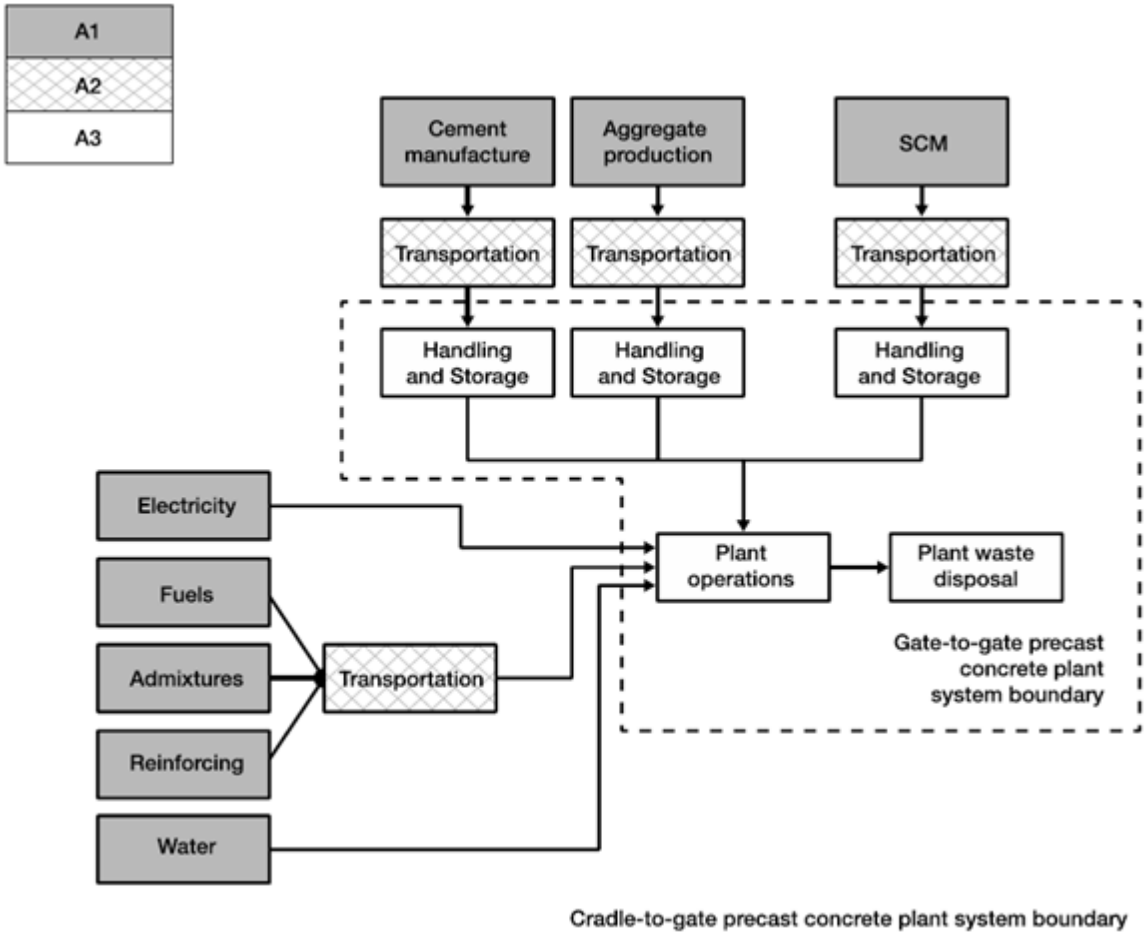
Figure 1 shows the life cycle stages and information modules that are included within the cradle-to-gate LCA system boundary of this EPD. The boundary is "cradle-to-gate," which includes the *Production stage* (A1 to A3 modules). *Construction, Use, and End-of-Life stages* are excluded from the system boundary. The *Production stage* system boundary is shown in Figure 2. Per ISO 21930, 7.1.7.2.1 (2), *the system boundary with nature (natural environment) includes those technical processes that provide the material and energy inputs into the system and the subsequent manufacturing and transport processes up to the to the factory gate, as well as the processing of any waste arising from those processes.*

Figure 1 Life Cycle Stages and Modules

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
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X			MND												

X- module is included in system boundary; MND- module is not declared (excluded from system boundary)

Figure 2 Production stage (module A1 to A3) system boundary of reinforced concrete round pipe manufactured at a precast concrete plant (1)



Note 1: Life-cycle-stage modules are designated A1, A2, and A3 using shading in the figure (1).
Note 2: SCM is Supplementary Cementitious Materials and consists of materials such as fly ash, slag cement (ground, granulated blast-furnace slag), and silica fume (1).

5 LIFE CYCLE INVENTORY

5.1 DATA COLLECTION, SOURCES, AND CALCULATIONS

LCI data collection was based on one customized LCI survey. The LCI survey covered the primary data for the Rinker Materials Bonner Springs, Kansas facility for the 2022 reference year (12 consecutive months).

Data calculation procedures follow ISO 14044 (5), and ISO 21930 (2). The LCA model was developed using SimaPro v.9.5.0.2 2024 (8). SimaPro LCA software contains recognized databases (e.g., ecoinvent v3.9.1, 2023 database, Allocation, Cut-off by classification and U.S. LCI Database, 2015) that provide LCI datasets for upstream, core, and downstream material and processes. SimaPro 9.5.0.2 2024 also contains the U.S. EPA TRACI v2.1 2012 LCIA methodology, CML-baseline version 4.7 2016 LCIA methodology, and the Cumulative Energy Demand, LHV (NCV) version 1.0 November 2018 which are used for this LCA study. Per ISO 21930, 7.2.2 (2), when transforming the inputs and outputs of combustible material into inputs and outputs of energy, the net calorific value (lower heating value) of fuels is applied according to scientifically based and accepted values specific to the combustible material.

5.2 DATA QUALITY REQUIREMENTS AND ASSESSMENTS

A detailed description of collected data and the data quality assessment regarding the ISO 14044 (5) and ISO 21930 (2) is provided in the LCA report (9). Data quality is assessed based on its representativeness (technology coverage, geographic coverage, time coverage), completeness, consistency, reproducibility, transparency, and uncertainty (Table 3).

Table 3. Data Quality Requirements and Assessments

Data Quality Requirements	Description
Technology Coverage	The data represents the prevailing technology at Rinker Materials' Bonner Springs, Kansas, manufacturing facility. Whenever available, technological-specific, or average industry LCI datasets were utilized for all upstream and core materials and processes. *Technological representativeness is characterized as "high."*
Geographic Coverage	The geographic region considered is the U.S. Whenever available, for all upstream and core material and processes, geographic specific LCI datasets were utilized. *Geographical representativeness is characterized as "high."*

Data Quality Requirements	Description
Time Coverage	Activity data are representative. - Reinforced concrete round pipe- primary data collected for reference year 2022 (12 months) - In-bound/ out-bound transportation data- primary data collected for reference year 2022 (12 months) - Generic data: the most appropriate LCI datasets were used as found in the ecoinvent v.3.9.1 database for US and global and US LCI Database, and modeled in SimaPro LCA software v.9.5.0.2, 2024 (8). PCA EPD data, 2023 were used for the PLC. *Temporal representativeness is characterized as "medium" to "high."*
Completeness	All relevant, specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled. The relevant background materials and processes were taken from the ecoinvent v 3.9.1 LCI database for US and global and US LCI Database and modeled in SimaPro LCA software v.9.5.0.2, 2024 (8). The completeness of the cradle-to-gate process chain in terms of process steps is rigorously assessed for all products and documented in the LCA report.
Consistency	To ensure consistency, the input/output LCI modeling of the concrete pipes used the same LCI modeling structure, which consisted of input raw, secondary (if applicable), ancillary and packaging materials (if applicable), intermediate products (if applicable), energy flows, water resource inputs, product outputs, co-products, emissions to air, water and soil, and solid and liquid waste disposal (if applicable). Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the facility level to maintain a high-level of consistency.
Reproducibility	Internal reproducibility is possible since the data and the models are stored and available in Athena Clarkson LCI database developed in SimaPro, 2024. A high level of transparency is provided throughout the reviewed LCA report as the LCI profile is presented for the declared products. Key primary (manufacturer specific) and secondary (generic) LCI data sources are summarized in the supporting LCA report.
Transparency	Activity and LCI datasets are transparently disclosed in the LCA report, including data sources.
Uncertainty	A *sensitivity check* was conducted to assess the reliability of the EPD results and conclusions by determining how they are affected by uncertainties in the data or assumptions on calculation of LCIA and energy indicator results. The LCA report includes the results of a *sensitivity analysis* and *Monte Carlo uncertainty analysis of background data sets.*

5.3 ALLOCATION RULES

The Rinker Materials Bonner Springs, Kansas manufacturing facility produces various products and as such, allocation was necessary. "Mass" based, plant-specific data for 1,000 kg of declared reinforced concrete round pipe were used to calculate the input raw materials, secondary materials and semi-finished products consumed. "Mass" was used as the physical parameter for allocating flows between the products of interest and other co-products to calculate the input energy flows (electricity, natural gas, and other fossil fuels), ancillary materials used at the

facility, total water consumption, process emissions to air and water and waste flows (as applicable). The LCI modeling accounts for the manufacturing yield (production loss) of all upstream and on-site processes. In addition, allocation related to transport is based on the mass of transported inputs and outputs. *This sub-category PCR recognizes fly ash, silica fume, and granulated blast furnace slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a precast concrete material input* (1).

5.4 CUT OFF RULES

The cut-off criteria as per PCR (1) and ISO 21930, 7.1.8 (2) were followed.
In cases of insufficient input data or data gaps for a unit process, the cut-off criteria shall be 1% of renewable primary resource (energy), 1% nonrenewable primary resource (energy) usage, 1% of the total mass input of that unit process and 1% of environmental impacts. The total of neglected input flows per module shall be a maximum of 5% of energy usage, mass, and environmental impacts. When assumptions are used in combination with plausibility considerations and expert judgement to demonstrate compliance with these criteria, the assumptions shall be conservative.

All input/output data collected at the Rinker Materials' Bonner Springs, Kansas, manufacturing facility were included in the LCI modelling developed using SimaPro v.9.5.0.2 2024 (8). None of the input/output data were excluded based on the cut-off criteria. Safety Data Sheet (SDS) was used for concrete release form. Any data gaps in the SDS are filled in with two (proxy) generic LCI datasets, as appropriate (conservative assumptions): Chemical, organic {GLO}| market for | Cut-off, U; Chemical, inorganic {GLO}| market for | Cut-off, U.

This EPD excludes the following processes:

- production, manufacture, and construction of manufacturing capital goods and infrastructure;
- production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- personnel-related activities (travel, furniture, and office supplies); and
- energy and water use related to company management and sales activities that may be located either within the factory site or at another location.

6 LIFE CYCLE ASSESSMENT RESULTS

Table 4 presents the "cradle-to-gate" LCA results for 1,000 kg of reinforced concrete round pipe.

As per the US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2012 (10) impact categories are used as they provide a North American context for the mandatory category indicators to be included in this EPD. *These are relative expressions only and do not predict category impact endpoints, the exceeding of thresholds, safety margins or risks* (5). Per ISO 21930, 7.1.7.1 (2), "individual indicators for information modules A1, A2 and A3 may be aggregated to a total for each indicator in the production stage."

Table 4. Production stage (Total A1-A3) EPD results for 1,000 kg of reinforced concrete round pipe

Impact category and inventory indicators	Unit	Total (A1 to A3)
		1000 kg
Global warming potential, GWP 100[1)]	kg CO_2 eq	**203.0**
Ozone depletion potential, ODP[1)]	kg CFC-11 eq	**2.6E-06**
Smog formation potential, SFP[1)]	kg O_3 eq	**7.8**
Acidification potential, AP[1)]	kg SO_2 eq	**0.5**
Eutrophication potential, EP[1)]	kg N eq	**0.2**
Fossil fuel depletion, FFD[1)]	MJ surplus	**1.4E-04**
Abiotic depletion potential, fossil ADPf[2)]	MJ	**1,775.5**
Renewable primary resources used as an energy carrier (fuel), RPR_E	MJ	**83.0**
Renewable primary resources with energy content used as material, RPR_M[3)]	MJ	**0.03**
Non-renewable primary resources used as an energy carrier (fuel), $NRPR_E$	MJ	**1,855.4**
Non-renewable primary resources with energy content used as material, $NRPR_M$[3)]	MJ	**0.4**
Secondary materials, SM[3)]	kg	**36.8**
Renewable secondary fuels, RSF[3)]	MJ	**5.5**
Non-renewable secondary fuels, NRSF[3)]	MJ	**53.2**
Recovered energy, RE[3)]	MJ	**0**
Consumption of freshwater, FW[3)]	m^3	**1.1**
Hazardous waste disposed, HWD[3)]	kg	**0.4**
Non-hazardous waste disposed, NHWD[3)]	kg	**3.7**
High-level radioactive waste, conditioned, to final repository, HLRW[3) 4)]	m^3	**1.6E-05**
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW[3) 4)]	m^3	**1.3E-02**
Components for re-use, CRU[3)]	kg	**0**
Materials for recycling, MR[3)]	kg	**10.1**
Materials for energy recovery, MER[3)]	kg	**0**
Recovered energy exported from the product system, EE[3)]	MJ	**0.2**
Additional Inventory Parameters for Transparency		
Emissions from calcination	kg CO_2 eq	**48.8**

Notes to Table 4:

[1)] Calculated as per U.S EPA TRACI 2.1, v1.08, SimaPro v 9.5.0.2 GWP-100, excludes biogenic CO_2 removals and emissions associated with any biobased products, including bio-based packaging (n/a). There is no biogenic content in the declared product. 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5), TRACI 2.1, v1.05 (10). FFD is required in LEED v4.1 MR Credit: Building Product Disclosure and Optimization – Environmental Product Declarations (11).

[2)] Calculated as per CML-IA Baseline (v3.09), SimaPro v 9.5.0.2. ADP_f is also required in LEED v4.1 MR2 Credit: Building Product Disclosure and Optimization – Environmental Product Declarations (11).

[3)] *Some LCA impact categories and inventory items are still under development and can have high levels of uncertainty. To promote uniform guidance on the data collection, calculation, and reporting of results, the ACLCA methodology (ACLCA 2019) was used* (1). Calculated as per ACLCA ISO 21930 Guidance (12), respective sections 6.2 to 10.8.

[4] It should be noted that the foreground system (A3 manufacturing process) does not generate any HLRW or ILLRW. High, intermediate, or low-level radioactive waste is generated by electricity production (spent fuel from reactors, routine facility maintenance and operations)" (ISO 21930:2017, clause 7.2.14). High-level radioactive waste, e.g., when generated by electricity production, consists mostly of spent fuel from reactors." (ISO 21930:2017, clause 7.2.14).

7 INTERPRETATION

The reinforced concrete round pipe EPD results represent a "cradle-to-gate" environmental profile for 1,000 kg of reinforced concrete round pipe manufactured at Rinker Materials' Bonner Springs, Kansas facility for the reference year 2022.

Module A1 Extraction and upstream production contributes the largest share of the LCIA category indicator results, accounting for between 54% and 93% of the Production stage (A1 to A3) potential environmental burdens. *Module A3 Manufacturing* is the second largest contributor to the overall potential impacts of the production stage, accounting for between 7% and 46%. *Module A2 Transportation* contributed less than 10% to the overall potential impacts of the production stage, except for SFP (13%).

8 ADDITIONAL ENVIRONMENTAL INFORMATION

The Rinker Materials Bonner Springs, Kansas, manufacturing facility uses low temperature baghouse and dry filter as pollution abatement equipment.

9 DECLARATION TYPE

This "cradle-to-gate" EPD applies to reinforced concrete round pipe. Production activities covered include *the extraction and upstream production, transport to factory, manufacturing* (modules A1 to A3). The declaration is intended for Business-to-Business (B-to-B) communication.

The EPD for reinforced concrete round pipe fall under the description:

- *A product-specific EPD, from one manufacturer's plant*.

10 EPD COMPARABILITY LIMITATION STATEMENT

The following ISO 14025 and ISO 21930 statements indicate the EPD comparability limitations and intent to avoid any market distortions or misinterpretation of EPDs.

- *Environmental declarations from different programs (ISO 14025) may not be comparable. EPDs are comparable only if they use the same PCR (or sub-category PCR where applicable), include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works. This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. However, variations and deviations are possible. Example of variations: different LCA software and background LCI datasets may lead to different results for the life cycle stages declared* (1).

11 REFERENCES

1. ASTM International and NSF International, Product Category Rule for Environmental Product Declarations, PCR for Precast Concrete – UNCPC: 37550, 05/30/2021. .

2. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

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

4. ISO 14040/Amd1:2020 Environmental Management – Life Cycle Assessment – Principles and Framework, International Organization for Standardization, 2006.

5. ISO 14044/Amd1:2017/Amd2:2020 Environmental Management – Life Cycle Assessment – Requirements and guidelines, International Organization for Standardization, 2006.

6. ASTM Program Operator for Product Category Rules (PCRs) and Environmental Product Declarations (EPDs), General Program Instructions, 04/29/20.

7. Rinker Materials 2024, Product Description, Reinforced Concrete Round Pipe, https://www.rinkerpipe.com/products/reinforced-concrete-round-pipe-2/ .

8. PRé 2024. SimaPro LCA Software v9.5.0.2, 2024., https://simapro.com/.

9. Athena Sustainable Materials Institute, A Cradle-to-Gate Life Cycle Assessment of N-12 Dual Wall HDPE Pipe, Reinforced Concrete Round Pipe, and Precast Concrete Catch Basin, Prepared for: Clarkson Construction Company, July 2024.

10. Bare, J., TRACI 2.0: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts 2.0. Clean Technologies and Environmental Policy 2011, 13, (5), https://link.springer.com/article/10.1007/s10098-010-0338-9#page-1.

11. LEED v4.1, MRc2: Building product disclosure and optimization, Environmental Product Declarations,. https://leeduser.buildinggreen.com/credit/NC-v4.1/MRc2#tab-credit-language .

12. ACLCA 2019, Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. The American Centre for Life Cycle Assessment. May, 2019.