Environmental Product Declaration (EPD) for Concrete

NEVADA READY MIX

Nevada Ready Mix
151 Cassia Way
Henderson, Nevada 89014
www.nevadareadymix.com

Environmental Product Declaration

Ready-Mix Concrete

(per ISO 14025 and EN 15804)

Nevada Ready Mix

Founded in 1959, NRM has been the supplier of choice for over 90% of the Hotel/Casino projects on the Las Vegas Strip, Downtown, and throughout the Valley. NRM is the only fully vertically integrated concrete supplier in the Las Vegas Market. Our parent company, Mitsubishi Cement, supplies 100% of our cement, and we mine and utilize 100% of our own concrete aggregate. Today, the NRM team has supplied over 40 Million cubic yards of concrete under the management of the same individuals. Consistent in-house control of all ingredients combined with consistent and experienced management, place NRM as the unchallenged leader. We are currently approved by Clark County IQAC, NDOT, NRMCA, CCRL and AMRL.

Authors of the Life Cycle Assessment:

A. Grosse-Sommer and D. Green BASF

BASF
We create chemistry

NSF SUSTAINABILITY CERTIFIED Environmental Product Declaration

EPD Information			
Program Operator		NSF International	
Declaration Holder		Nevada Ready Mix	
Product: 4512F	Date of Issue January 30, 2019	Period of Validity 5 Years	Declaration Number EPD10160
This EPD was independently verified by NSF International in accordance with ISO 14025, ISO 21930 and EN 15804: ☐ Internal X External		 Jenny Oorbeck joorbeck@nsf.org	
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR.		 Jack Geibig jgeibig@ecoform.com	
LCA Information			
Basis LCA		Life Cycle Assessment Manager for Concrete Environmental Product Declaration June 2017	
LCA Preparers		David Green/Anahi Grosse-Sommer BASF Corporation/BASF SE david.r.green@basf.com anahi.grosse-sommer@basf.com	
This life cycle assessment was critically reviewed in accordance with ISO 14044 by:		Jack Geibig - Ecoform jgeibig@ecoform.com	

North America PCR Information	
Program Operator	Carbon Leadership Forum
Reference PCR	North American Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) version 1.1
Date of Issue	November 30, 2012, Revised December 4, 2013
PCR review was conducted by:	Nick Santero PE International
IBU PCR Information	
Program Operator	IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1, 10178 Berlin Germany
Reference PCR	Concrete components made of in-situ or ready-mixed concrete, version 1.5
Date of Issue	April 10, 2017
PCR review was conducted by:	Institut Bauen und Umwelt www.ibu-epd.de

ENVIRONMENTAL PRODUCT DECLARATION: DETAILED VERSION

Product Scope

This declaration and its LCA study are relevant to concrete and concrete products manufactured by Nevada Ready Mix in Henderson, Nevada. As the owner of the declaration, Nevada Ready Mix shall be liable for the underlying information and evidence; the program operator shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Product Description

Products covered by this Environmental Product Declaration (EPD) are for specific concrete applications for commercial and/or residential construction developed and produced by Nevada Ready Mix for markets in the Las Vegas metropolitan area. The design compressive strength is 31 MPA (4500 psi) at 28 days with a 2.5 – 10.2 cm (1 - 4 in) slump.

Concrete is batched and delivered in accordance with local standards. The producer provides product that meets or exceeds the standards based on standard operating procedures. Warranties and additional information are determined by the producer's terms and conditions.

During normal use, hardened concrete is stable and inert and does not pose a significant health or environmental hazard.

Fresh, plastic concrete must be managed in accordance with local regulations. Hardened concrete is an inert product and can be recycled subject to local regulations.

This EPD reports the impacts for the concrete components made of in-situ or ready- mixed concrete. The life cycle phases covered are A1 (Raw Material Supply: Upstream Processes), A2 (Transportation from Supplier to Gate of Producer) and A3 (Concrete Production Core Process). This EPD is based on a cradle-to-gate system boundary deemed appropriate as concrete mixtures are supplied to a variety of products and the function of the final product is not specifically determined. Reference service life is not relevant due to the cradle-to-gate boundary conditions.

Life cycle stages that are not included in this EPD are A4 (Transportation to the Construction Site), A5 (Construction and Installation Process), B1-7 (Use Phase) and C1-4 (End of Life Stage).

Technical Data (* These characteristics are not relevant for ready-mix concrete)

Name	Value	Unit
Density	1,750 - 2,400	kg/m³
Thermal conductivity	*	W/(mK)
Water vapor diffusion resistance factor	*	-
Sound absorption coefficient	*	%
Compressive strength	17 - 110	N/mm²
Tensile strength	*	N/mm²
Flexural strength	*	N/mm²
Modulus of elasticity	*	N/mm²
Equilibrium moisture content	*	%

Product Components

The ready-mix concrete and its upstream materials covered by this Environmental Product Declaration conform to the appropriate ASTM standards as described in the Carbon Leadership Forum PCR, UNSPSC code 30111500, CSI Specification Section 03 30 00 or the requirements of European standard EN 206:2013, BS 8500-1:2015 and BS 8500-2:2015 based on the IBU PCR. Ready-mix concrete is generally batched at a plant, centrally mixed and then discharged into a truck mixer for delivery (central mixed) or dry- batched into the truck for mixing in the production yard, in transit or at the job site (truck mixed). Ready-mix concrete does not require packaging. The base material ranges for the defined ready-mix concrete are:

Material	***Amount***
Binders	5 - 15 %
Sands	30 - 45 %
Aggregates	25 - 40 %
Admixtures	< 1 %
Water	1 - 15 %

The product does not contain materials that are listed in the REACH “Candidate List of Substances of Very High Concern for Authorization”.

Production

Health and safety measures with potential impact to human health during manufacturing are to be consistently adhered to per regional regulatory requirements. Initiatives must be undertaken to minimize or eliminate potential impacts to the environment based on the use of best practices including engineered controls. Fresh, plastic concrete must be managed in accordance with local regulations. Hardened concrete is an inert product and can be recycled subject to local regulations. If disposed under the European waste catalogue, the waste code 17-01-01 for non-hazardous concrete and 17-01-06 for concrete containing hazardous substances is applicable.

Declared Unit

The declared unit is 1 m^3 of Nevada Ready Mix concrete produced for commercial applications with a specified compressive strength of 31 MPa (4500 psi) at 28 days, a design slump of 2.5 – 10.2 cm (1 - 4 in.) and a density of approximately 2400 kg/m3 (4050 lbs/yd3).

Cut-off Criteria

The cut-off criteria for raw material/energy consumption and environmental impacts for inclusion is less than 1% however for the Carbon Leadership Forum PCR all inputs and outputs for which data is available shall be included. The total of the estimated neglected input flows does not exceed 5% for the total impacts from energy, mass or climate change.

Life Cycle Assessment (LCA)

The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

A summary of the life cycle stages ***included*** in the EPD are as follows:

I. 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.

II. Transportation: Transportation of these materials from supplier to the 'gate' of the concrete producer.

III. Manufacturing (core processes): The core process results from the energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant).

IV. Water use in mixing and distributing concrete.

The processes ***excluded*** from the EPD are as follows:

I. Production, manufacture and construction of buildings, capital goods and infrastructure with an expected lifespan of over 5 years.

II. Production and manufacture of concrete production equipment, concrete delivery vehicles, earth-moving equipment and laboratory equipment with an expected lifespan of over 5 years.

III. Personnel-related activities (travel, furniture, office supplies) as well as energy and water use related to company management and sales activities.

A summary of the limitations of this EPD include:

This EPD does not report all environmental impacts due to manufacturing of the product, but rather reports the environmental impacts for those categories with established life cycle assessment-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change and habitat destruction.

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.

To assess the local impacts of product manufacturing, additional analysis is required.

Life cycle impact assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Comparability:
EPD of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. While an EPD can be used to compare concrete mixtures, the data cannot be used to compare between construction products or concrete mixtures 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 mixtures used in these different products unless all life cycle phases are included.

Allocation:
During the production of ready-mix concrete, co-products are not introduced into the mixture designs. Source-specific allocations are assigned to supplementary cementitious materials as these are considered secondary materials rather than co-products. For these secondary materials, all processing and transportation required to transform these materials to SCMs are included.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbuishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycleing potential
A1	A2	A3	A4	A%	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

LCA: Interpretation and Results

The following tables provide the environmental impacts for one (1) cubic meter of ready-mix concrete. The first table shows the environmental impacts expressed in each of the designated categories based on the CML method and the IBU PCR. The second table shows the environmental impacts based on the TRACI v2.1 characterization factors and CLF PCR.

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ READY-MIX CONCRETE - CML 2001

	A1	A2	A3
Global warming potential (GWP) [kg CO2 eq.]	3.07E02	5.63E00	6.77E00
Ozone Depletion Potential (ODP) [kg R11 eq.]	8.46E-07	2.34E-13	5.92E-12
Acidification potential (AP) [kg SO2 eq.]	1.72E00	1.31E-02	2.41E-02
Eutrophication potential (EP) [kg Phosphate eq.]	1.04E-01	3.14E-03	2.97E-03
Photochemical Ozone Creation Potential (POCP) [kg Ethene eq.]	1.03E-01	-4.31E-03	3.07E-03
Abiotic depletion potential for non fossil resources (ADPE) [kg Sb eq.]	9.23E-07	4.60E-07	5.02E-06
Abiotic depletion potential for fossil resources (ADPF) [MJ]	1.35E03	7.67E01	3.83E02
Renewable primary energy as energy carrier (PERE) [MJ]	7.75E00	4.03E00	1.55E01
Total use of renewable primary energy resources (PERT) [MJ]	7.75E00	4.03E00	1.55E01
Non-renewable primary energy as energy carrier (PENRE) [MJ]	1.43E03	7.71E01	3.97E02
Total use of non-renewable primary energy resources (PENRT) [MJ]	1.43E03	7.71E01	3.97E02
Use of renewable secondary fuels [MJ]	1.47E-22	3.80E-28	2.35E-28
Use of non-renewable secondary fuels [MJ]	1.73E-21	5.77E-27	3.75E-27
Use of net fresh water (FW) [m3]	3.20E-01	7.41E-03	6.10E-02
Hazardous waste disposed (HWD) [kg]	5.58E-07	4.07E-06	2.68E-06
Non-hazardous waste disposed (NHWD) [kg]	4.50E01	6.19E-03	3.09E-02
Radioactive waste disposed (RWD) [kg]	1.90E-03	1.61E-04	5.48E-03

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ READY-MIX CONCRETE - TRACI v2.1

	A1	A2	A3
Global warming potential [kg CO2 eq.]	3.07E02	5.63E00	6.77E00
Ozone depletion potential [kg CFC 11 eq.]	1.08E-06	2.34E-13	5.92E-12
Acidification potential [kg SO2 eq.]	1.69E00	1.71E-02	2.46E-02
Eutrophication potential [kg N eq.]	3.67E-02	1.66E-03	3.34E-03
Formation potential of tropospheric ozone photochemical oxidants [kg O3 eq.]	1.99E01	3.63E-01	3.27E-01

ADDITIONAL LIFE CYCLE INVENTORY DATA RESULTS per 1m³ READY-MIX CONCRETE

Concrete batching water [m3]	0.132
Concrete washing water [m3]	0.01

For the specific system boundaries identified for this EPD, the raw material supply (phase A1) is the primary driver for all environmental impact categories with this phase accounting for over 80% of the total results for GWP, ODP, AP, EP and POCP.

This is generally the result of the cement content in the concrete mixture as cement production requires high levels of energy for the calcining process while at the same time emitting CO_2 as part of the reaction from converting limestone ($CaCO_3$) to lime (CaO). Transportation may have a larger percentage of the total impact when raw materials are transported from long distances such as trans-oceanic locations.

Data Quality and Variability

The requirements for data quality and background data correspond with the requirements of the IBU PCR part A, Carbon Leadership PCR for Concrete or other Product Category Rules publicly available and identified in the EPD Information section of this declaration. The calculated data in this report is based on actual ready-mix concrete compositions with data collected for review in 2018.

The time over which inputs to and outputs from the system are accounted for is 100 years from the year for which the data is deemed representative.

The technology coverage reflects the physical reality for the declared ready-mix concrete product.

Used datasets are complete according to the system boundary within the limits set by the criteria for the exclusion of inputs and outputs.

To calculate the life cycle of the declared ready-mix concrete products, the software solution GaBi ts 8.5 from thinkstep AG was used. Background datasets were extracted from the GaBi database. The last revision of the GaBi data is less than 3 years ago according to thinkstep AG. Altogether, the data quality is considered high.

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.

The following table summarizes the overall quality assessments for the main inputs for ready-mix concrete.

Inputs	Data Quality					
	Technology	*Time*	*Geography*	*Completeness*	*Reliability*	*Source*
Binders						
Cement (CEM I)	good	2018	Europe	good	good	Gabi 8.5
Portland cement	good	2016	US	good	good	Gabi 8.5
Fly ash	good	2018	Regional	good	good	Gabi 8.5
Blast furnace slag	good	2018	Germany	fair	good	Gabi 8.5
Granite	good	2016	US	good	good	Gabi 8.5
Limestone	good	2017	Europe	good	good	Gabi 8.5
Glass	good	2016	Europe	good	good	Gabi 8.5
Natural pozzolan	good	2016	Global	good	good	Gabi 8.5
Lime	good	2016	US	good	good	Gabi 8.5
Kaolin	good	2016	Germany	good	good	Gabi 8.5
Silica fume	good	2017	US	fair	good	Gabi 8.5
Titanium dioxide	good	2016	US	good	good	Gabi 8.5

Iron oxide	good	2018	Germany	good	good	Gabi 8.5
Rice husk ash	fair	2017	US	fair	good	Gabi 8.5
Sands						
Natural sand	good	2016	Europe	good	good	Gabi 8.5
Natural sand, washed	good	2016	Europe	good	good	Gabi 8.5
Manufactured sand	good	2016	China	good	good	Gabi 8.5
Limestone powder	good	2017	Europe	good	good	Gabi 8.5
River dredge sand	fair	2016	Global	fair	good	Gabi 8.5
Aggregates						
Natural aggregate	good	2016	China	good	good	Gabi 8.5
Recycled aggregate	good	2016	US	good	good	Gabi 8.5
Recycled glass	fair	2016	Europe	fair	good	Gabi 8.5
Lightweight aggregate/expanded clay	good	2016	Europe	good	good	Gabi 8.5
Recycled concrete	good	2016	US	good	good	Gabi 8.5
Recycled tires	fair	2018	US	fair	good	Gabi 8.5
Limestone	good	2017	Europe	good	good	Gabi 8.5
Admixtures						
MasterPozzolith 322 N	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterPozzolith 210	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterPolyheed N	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterPolyheed 997	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterRheobuild	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterGlenium	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterSet AC 534	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterPozzolith 122HE	good	2018	US/Europe	good	good	GaBi 8.5/BASF
Master X-Seed 100	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterSet R 300	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterSet DELVO	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterLife 300D	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterMatrix VMA 358	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterLife SRA 035	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterLife AMA 100	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterAir AE 90	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterSure Z 60	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterColor	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterKure ER 50	good	2018	US/Europe	good	good	GaBi 8.5/BASF
MasterLife CI 30	good	2018	US/Europe	good	good	GaBi 8.5/BASF
Water						
Water	good	2018	US/Germany	good	good	Gabi 8.5
Desalinated water	fair	2018	Middle East	fair	good	Gabi 8.5
Reinforcement						
Steel sections	good	2016	Global	good	good	Gabi 8.5
Reinforced steel	good	2016	Europe	good	good	Gabi 8.5
Polypropylene	good	2016	Europe	good	good	Gabi 8.5
MasterFiber MAC 2200 CB	good	2018	US	good	good	Gabi 8.5
Recycled PET	fair	2016	Europe	fair	good	Gabi 8.5
Recycled PP	fair	2016	Europe	fair	good	Gabi 8.5
Energy						
US Electricity grid mix	good	2016	US	good	good	Gabi 8.5
EU-27 Electricity grid mix	good	2016	Europe	good	good	Gabi 8.5
US Natural gas	good	2016	US	good	good	Gabi 8.5
EU-27 Natural gas	good	2016	Europe	good	good	Gabi 8.5
Packaging						
Pallet	good	2016	Europe	good	good	Gabi 8.5
Steel	good	2016	Global	fair	good	Gabi 8.5
Plastic	good	2016	Europe	fair	good	Gabi 8.5

EPD Program Operator
NSF International
789 N. Dixboro Road Ann Arbor, MI 48105
www.nsf.org

Date of Issue: January 30, 2019
Period of Validity: 5 years
Declaration: EPD10160

Transport						
Truck	good	2016	Global/regional	good	good	Gabi 8.5
Train	good	2018	Global/regional	good	good	Gabi 8.5
Ship - river	good	2016	Global/regional	good	good	Gabi 8.5
Ship - oceanic	good	2016	Global/regional	good	good	Gabi 8.5

Ratings: good, fair, poor

References

North American Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPD) Concrete version 1.1 December 4, 2013.

ISO, International Organization for Standardization, Environmental Management-Life Cycle Assessment-Principles and Framework; ISO 14040:2006; ISO 14044:2006. ISO, Geneva, Switzerland, www.iso.org (2006).

ISO, International Organization for Standardization. Environmental Management - Eco-efficiency assessment of product systems - Principles, requirements and guidelines; ISO 14045. ISO, Geneva, Switzerland, www.iso.org (2012)

ASTM C94 C94 M Standard Specification for Ready-mixed Concrete

BS 8500-1:2015, Concrete - Complementary British Standards to BS EN 206. Method of specifying and guidance for the specifier.

BS 8500-2:2015, Concrete - Complementary British Standards to BS EN 206. Specification for constituent materials and concrete.

CSI Specification Section 03 30 00 Cast-in-Place Concrete

DIN EN ISO 14025:2011: Environmental labels and declarations - Type III environmental declarations - Principles and procedures.

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

EN 206:2013, Beton - Festlegung, Eigneschaften, Herstellung und Konformität

GaBi ts 8.5: Software and GaBi database, LBP, University of Stuttgart and thinkstep AG, 2018

Product Category Rules for Building-Related Products and Services Part A - IBU calculation rules for the life cycle assessment and requirements on the project report.

PCR Guidance - Texts for Building-Related Products and Services Part B - IBU requirements on the EPD for Concrete components made of in-situ or ready-mixed concrete, version 1.5, 10.04.2017.

REACH Directive (EG) No. 1907/2006 of the European Parliament and of the Council dated 18 December 2006 on the registration, evaluation, approval and restriction of chemical substances (REACH), for establishing a European Agency for chemical substances, for amending Directive 1999/45/EC and for annulment of Directive (EEC) No. 793/93 of the Council, Directive (EC) No. 1488/94 of the Commission, Guideline 76/769/EEC of the Council and Guidelines 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC of the Commission.

UNSPSC Code 30111500 Concrete and Mortars

EPD Program Operator
NSF International
789 N. Dixboro Road Ann Arbor, MI 48105
www.nsf.org

Date of Issue: January 30, 2019
Period of Validity: 5 years
Declaration: EPD10160