Environmental Product Declaration

"N-340 road"

EN 15804 and ISO 14025:2010 compliant

Reg. no. S-P-00516 **UN CPC 53211** **PCR 2013:20 Highways, streets and roads v 2.11**

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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.

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1. INTRODUCTION

This environmental product declaration (EPD®) describes, from a lifecycle perspective, the total environmental impact of a Spanish road, N -340 in Sector E -40, Elche (Alicante).

Within the International EPD® system based on ISO standard 14025, this EPD® was drawn up in accordance with Product Category Rules (PCR) 2013:20 Highways, streets and roads (except elevated highways) version 2.11 and with CEN standard 15804 (Sustainability of construction works).

The aim of this EPD® is that it will provide to experts and scientists (in the construction and infrastructure sectors) objective and reliable information regarding the environmental impact of constructing a road.

This EPD® has been developed by ACCIONA CONSTRUCTION. It has been verified by Marcel Gómez Ferrer, individual verifier, and the verification is valid internationally for five years.

As this EPD® is based on data relating N-340 road from 2019, the results might not be representative of other roads. In order to decide if the results can be representative for other road, the most important areas that should be checked to be comparable with other roads are:

- Topography.
- Type of road.
- Origin of materials
- Road functionality

2. DESCRIPTION OF THE COMPANY

ACCIONA is a global group that develops and manages sustainable infrastructure solutions. It business spans the entire value chain, from design and construction through to operation and maintenance. ACCIONA's goal is to lead the transition towards a low-carbon economy, bringing technical excellence and innovation to all of its projects to design a better planet. With a presence in more than 60 countries and sales of €7.191 billion in 2019, the company is committed to contributing to the economic and social development of the communities in which it operates.

Through the evolution of its positioning, ACCIONA shows that the smartest choice for achieving sustainable development is to invest in the planet through renewable energies, resilient infrastructures, and water management and treatment. This is a different way of doing business, one it considers to be essential in the bid for sustainability in response to major global challenges, such as the consequences of climate change and the transition toward a decarbonised economy.

This commitment is underscored by the fact that the Company is a component of several highly reputed sustainability indices, such as the Dow Jones Sustainability World Index (DJSI World) and the Dow Jones Stoxx Sustainability Index (DJSI Stoxx), in which ACCIONA obtained the highest score in its sector. ACCIONA's has consolidated its bet on innovation by stepping up investment and coming up with more and more projects, programmes and resources. Its intention is clear: ACCIONA aims to continue to lead the field in more sustainable solutions and alternatives.

ACCIONA Construction is at the forefront of R&D and Innovation and is one of the world's leading construction companies. The Company has the ability to put into practice the most highly advanced and innovative techniques, always choosing the most appropriate technologies for each project. This is down to an intense and uninterrupted research activity that has made ACCIONA Europe's leading company in terms of application of technology; also has the EU's largest R&D and Innovation division in terms of resources and projects all of which have been approved in a number of EU, American and Spanish programs.

ACCIONA Construction takes part in projects that share a number of common denominators, namely, social value, applied technical excellence and razor-sharp management. No construction project is beyond its capabilities. Its work on highways, ports, railways, airports, water treatment plants, hydro works-urban

infrastructure, buildings, industrial and energy production facilities and a long list of others, is all helping to improve the quality of life not only for end-users but also for the environment and the local community overall.

3. DESCRIPTION OF THE ROAD

This road is intended to meet the requirements of the resolution of the Demarcation of State Highways in the Valencian Community, the adequacy of the guidelines for energy efficiency and upgrade prices, of the Original Project drafted, aimed at defining the necessary works for the cleavage of the N -340 in Sector E -40.

The main goals are:

a) Improving the road network taking advantage of existing infrastructure.
b) Improve access to the industrial park "Parque Industrial Elche " from the national road network.
c) To maintain and where necessary improve the quality of the affected space or minimizing offsetting the negative impacts caused by road infrastructure.
d) Improving the efficiency of the road network maximizing economic resources available.

The performance criteria are the following:

a) Improve the local road connection to the national grid through intersections with roundabouts
b) Improving road safety through the introduction of central reservation to avoid indiscriminate turns, intersections management and establishment of branches access and service roads.

Figure 1. Location of the studied road

The road is located entirely in the town of Elche, affecting the stretch of the N -340 which is the southern boundary of the E -40 Sector.

Appropriate connecting branches to the existing road are established. The intersections are resolved through roundabouts with priority to the ring, connecting redrawing the existing road. The section developed for the main road has 4 lanes, divided into two roadways, separated by central reservation. Total length of the axes is 943 m 625 m on service roads, executing 2 new roundabouts.

For the definition of the layout have been geometrized 4 axis and the outer edge of the 2 existing roundabouts.

N340 - Stretch 1: It has a length of 225 m. Starts in 1 and ends, connecting with the existing N340.

N340 - Stretch 2: Plotting 537 m in length located between 1 and 2 roundabouts. The slope is conditioned by existing one which is parallel to this axis.

N340 - stretch 3: Plotting 181 m in length. Starts at the N340 and ends at the roundabout 2.

Via service: With a parallel path to the N340, it got its start at the roundabout 2 and ends at the roundabout 1. It has a length of 625 m.

Roundabouts: The axis of the roundabouts coincides with their outer edge, being its exterior radius of 40 m and the interior of 31 m. Its slope has been studied for the drainage system implemented.

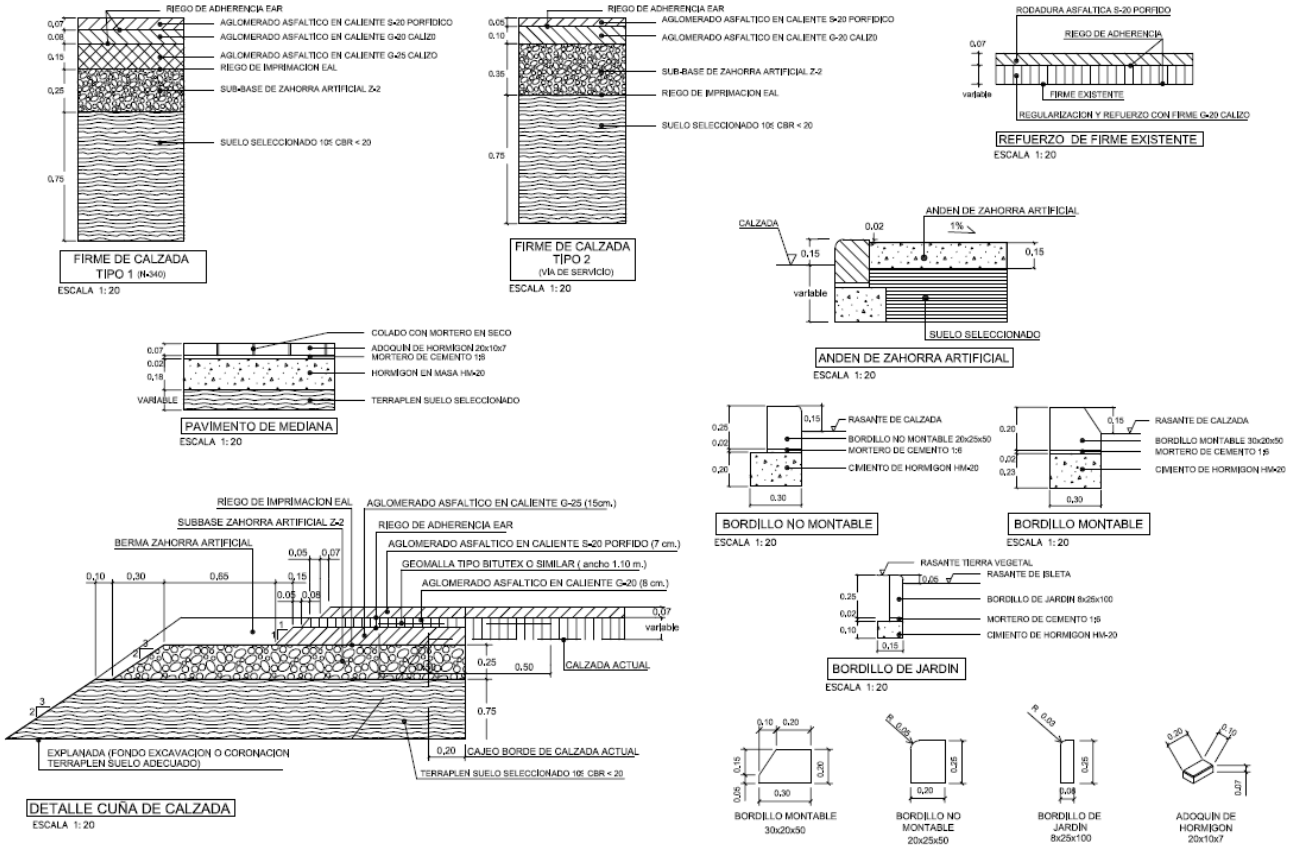

Figure 2. Standard sections. Pavement details.

4. FUNCTIONAL UNIT

The functional unit for N-340 road is defined as 1 m^2 of national road with an Annual average daily traffic (AADT) of 1.116 for freight transport and 20.356 for passenger transport. It is assumed that the lifespan of this road is 20 years and maintenance of the top layer of the road is required at half of the lifespan.

The allocation of environmental impact from road infrastructure could be made according to the following procedure: the environmental impact from road infrastructure (per m^2) is allocated to freight and passenger transports relative to the transport work, measured as Annual average daily traffic (AADT), that is performed on the infrastructure for freight and passenger transports respectively. According to the project, AADT for freight transport is estimated as 1.116 and AADT for passenger transport is 20.356. Freight transports then get the share ADDT (freight)/AADDT (total) and the passenger transports get the share AADDT (passenger)/AADT (total).

5. SYSTEM BOUNDARIES AND DATA QUALITY

This is a cradle to grave EPD® (Upstream, Core, Downstream and Module D). Upstream module considers all raw materials required for the construction of the road. Core module includes the transport of materials to work site, installation and construction itself. Operation, maintenance and end of life represent the downstream module. The operation activities are associated with the energy consumption of the lamp posts distributed along the road length. Maintenance activities are related to the repair of the top layer and the cleaning of the road. The potential environmental savings due to recycling at the end of life have been included (Module D), being the result of the recycling process (avoided product) crashed gravel, bitumen seal and soil.
Upstream module is composed by A1-A3 Product stage, which includes mainly the production of the raw materials.

Core module is composed by:

- A4 Raw materials transport to manufacturing site
- A5 Construction: it includes mainly the use of energy and waste production during the construction of the road.

Downstream module is composed by:

- B1 Use: in this case the impact is 0.
- B2 Maintenance: it includes the maintenance of the road (every 10 years) as well as annual cleaning activities.
- B3 Repair: in this case the impact is 0 (maintenance activities allocated to B2)
- B4 Replacement: in this case the impact is 0
- B5 Refurbishment: in this case the impact is 0
- B6 Operational energy use: it includes energy use in lighting.
- B7 Operational water use: in this case the impact is 0
- C1 Deconstruction/demolition: the impact is considered negligible.
- C2 Transport: 25 km to waste manager.
- C3 Waste processing: the impact of this phase is considered negligible.
- C4 Disposal: it includes the impact of landfill.

The next end of life scenario has been assumed:

- Soil used in road substructure: 100% landfill
- Concrete: 100% recycling. Crashed round gravel is produced as avoided product.
- Soil and artificial graded used in pavement: 50% landfill and 50% recycling. The avoided product due to recycling is soil extraction.
- Asphalt and bitumen: 100% recycling. The avoided product due to recycling is bitumen.
- Soil used in drainage system: 30% recycled and 70% landfill. The avoided products due to recycling are crashed round gravel and soil extraction.

According to PCR indications the next processes have been excluded:

- Manufacturing of production equipment, buildings and other capital goods.
- Business travel of personnel.
- Travel to and from work by personnel.
- Research and development activities.

The impact method CML IA v 3.05 has been used, together with AWARE 1.2 for water footprint calculation and GHG Protocol v 1.02 for carbon footprint calculation.

The process of construction considered consists of many different operations, which are listed below:

1. Production of road substructure
2. Production of road pavement
3. Production of road equipment
4. Production of road informatics devices

The production of N-340 substructure includes the demolition of the previous pavement and fence as well as soil excavation/movement. The production of road pavement includes the construction of different pavement layers. The production of road equipment includes the drainage system.

Neither bridges nor tunnels are part of this road and road informatics services are not included in the analysis due to its negligible contribution.
At least 99% of the total materials and energy consumption, and 95% of the materials and energy consumption by module have been included. The modularity principle, as well as the polluter payer principle have been followed. Where necessary, an allocation based on mass or labor hours has been performed.

An overview of system boundaries and included processes is given in the Figure 3.

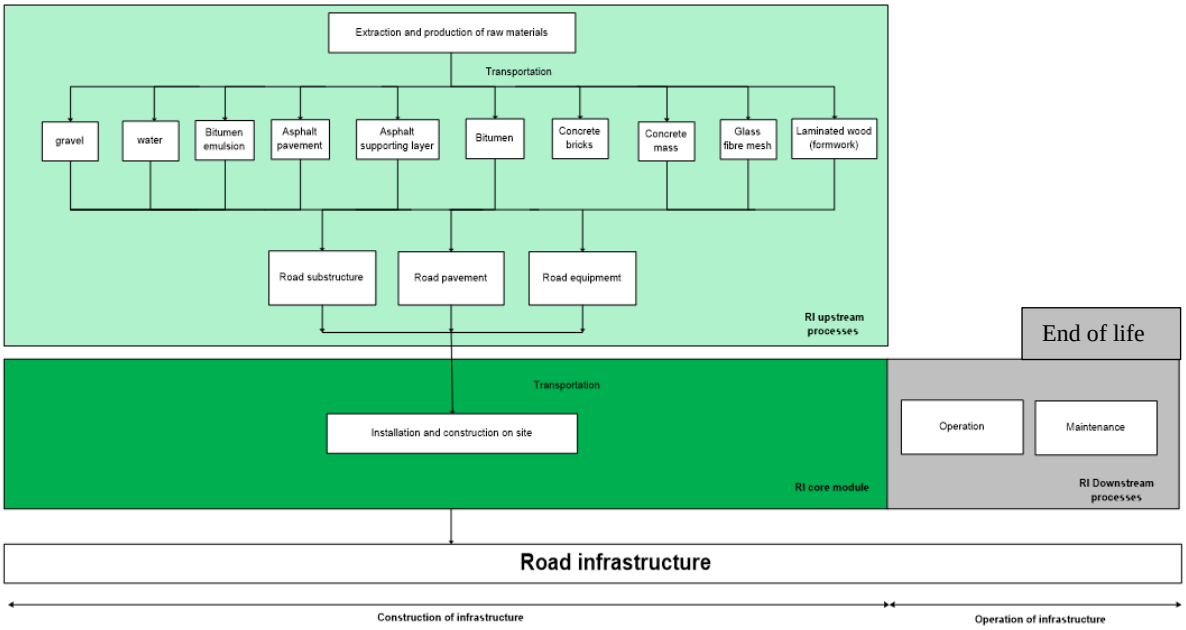

Figure 3: Flow chart of the product system for Road Infrastructure

6. CONTENT DECLARATION

Specific data regarding construction, operation and maintenance processes (raw materials and energy requirements) was collected from the work site as well as manufactures and design project and draws (year 2019).
During the life cycle of the product any hazardous substance listed in the "Candidate List of Substances of Very High Concern (SVHC) for authorization[1]" has been used in a percentage higher than 0.1% of the weight of the product. The verifier and the program operator do not make any claim nor have any responsibility of the legality of the product

Table 1. Required materials for construction of 1m² of "N-340" road.

Soil?En la version interior no se incluía	99.99%
Gravel	0,0004217%
Asphalt (G25, G20, S20)	0,0000868%
Others (concrete, wood, glass fibres, bituminous mixture)	0,0000353%

[1] https://echa.europa.eu/web/guest/candidate-list-table. Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

7. ENVIRONMENTAL PERFORMANCE

The environmental performance section of the declaration is based on a life cycle assessment (LCA) carried out by ACCIONA Construction in 2020.

A full set of impact categories as well as the use of resources and energy are calculated, and the results are presented in Table 2. The results are given per 1m^2 of road and the life cycle is separated in upstream, core and downstream modules, as well as Module D, detailing each contribution to the global environmental performance over a calculation period of 20 years.

Table 2. Results on impact categories of the life cycle of 1m² of "N-340" road. Life cycle stages not included in the table have no impact.

Impact categories	Unit	UPSTREAM	CORE			DOWNSTREAM					Total life cycle	Module D
		A1-A3	A4	A5	Total Core	B2	B6	C2	C4	Total Downstream		
Global warming (GWP)-fossil	kg $CO_{2\ eq.}$	7,92E+01	6,22E+01	1,16E+01	7,38E+01	7,63E+00	1,75E-01	5,98E+01	5,03E-02	6,77E+01	2,21E+02	-2,71E+00
Global warming (GWP)-biogenic	kg $CO_{2\ eq.}$	3,98E+00	2,83E-01	2,08E-02	3,04E-01	3,30E-01	1,16E-01	2,85E-01	7,55E-04	7,32E-01	5,02E+00	-2,33E-01
Global warming (GWP)-land use and land transformation	kg $CO_{2\ eq.}$	4,02E-02	1,63E-02	9,92E-04	1,73E-02	2,08E-03	1,86E-03	1,76E-02	8,21E-06	2,15E-02	7,91E-02	-1,55E-03
Global warming (GWP)-total	kg $CO_{2\ eq.}$	8,32E+01	6,25E+01	1,16E+01	7,41E+01	7,96E+00	2,93E-01	6,01E+01	5,11E-02	6,85E+01	2,26E+02	-2,94E+00
Acidification potential (AP)	kg $SO_{2\ eq.}$	4,49E-01	1,65E-01	8,80E-02	2,53E-01	4,27E-02	1,75E-03	1,43E-01	3,73E-04	1,88E-01	8,89E-01	-1,88E-02
Eutrophication potential (EP)	Kg PO_4^{2-} eq.	6,34E-02	2,25E-02	1,90E-02	4,15E-02	6,65E-03	2,03E-04	1,89E-02	7,19E-05	2,58E-02	1,31E-01	-3,95E-03
Formation potential of tropospheric ozone (POCP)	Kg $C_2H_{4\ eq.}$	2,18E-02	9,77E-03	2,31E-03	1,21E-02	2,35E-03	5,60E-05	9,10E-03	1,41E-05	1,15E-02	4,54E-02	-7,12E-04
Abiotic depletion potential-elements	Kg Sb-eq	4,79E-04	1,22E-04	3,91E-06	1,26E-04	3,67E-05	1,02E-08	1,83E-04	5,46E-08	2,20E-04	8,24E-04	-3,24E-05
Abiotic depletion potential-fossil fuels	MJ	1,91E+03	1,02E+03	1,68E+02	1,19E+03	2,52E+02	2,02E+00	9,08E+02	1,65E+00	1,16E+03	4,27E+03	-3,90E+01
Water scarcity potential	m^3	4,10E+01	6,06E+00	7,72E-01	6,83E+00	3,47E+00	1,06E-01	4,70E+00	6,52E-03	8,28E+00	5,61E+01	-3,23E+00

Table 3. Results on resource use categories of the life cycle of 1m² of "N-340" road. Life cycle stages not included in the table have no impact.

Resource categories	Unit	UPSTREAM	CORE			DOWNSTREAM					Total life cycle	Module D
		A1-A3	A4	A5	Total Core	B2	B6	C2	C4	Total Downstream		
Use of primary renewable energy resources used as energy carrier	MJ.	1,13E+02	1,10E+01	9,82E-01	1,20E+01	7,71E+00	2,30E+00	9,82E+00	2,21E-02	1,98E+01	1,45E+02	-1,00E+01
Use of primary renewable energy resources used as raw materials	MJ.	9,38E+02	0	0	0	0	0	0	0	0	9,38E+02	0
Total use of primary renewable energy resources	MJ.	1,05E+03	1,10E+01	9,82E-01	1,20E+01	7,71E+00	2,30E+00	9,82E+00	2,21E-02	1,98E+01	1,45E+02	-1,00E+01
Use of primary non-renewable energy resources used as energy carrier	MJ.	2,12E+03	1,04E+03	1,69E+02	2,42E+03	2,61E+02	4,38E+00	9,22E+02	1,69E+00	2,38E+03	4,52E+03	-5,98E+01
Use of primary non-renewable energy resources used as raw materials	MJ.	0	0	0	0	0	0	0	0	0	0	0
Total use of primary non-renewable energy resources	MJ.	2,12E+03	1,04E+03	1,69E+02	2,42E+03	2,61E+02	4,38E+00	9,22E+02	1,69E+00	2,38E+03	4,52E+03	-5,98E+01
Secondary material	Kg	0	0	0	0	0	0	0	0	0	0	0
Renewable secondary fuels	MJ.	0	0	0	0	0	0	0	0	0	0	0
Non-renewable secondary fuels	MJ	0	0	0	0	0	0	0	0	0	0	0
Net use of fresh water[2]	m^3	4,16E+02	5,35E+01	5,40E+00	5,89E+01	1,86E+01	3,66E+00	4,36E+01	9,82E-02	6,60E+01	5,41E+02	-1,92E+02

[2] Water used for turbine and refrigeration use in electricity production have not been included, since it is considered that the quality of the water before and after use is the same.

Table 4. Results on waste production categories of the life cycle of 1m² of "N-340" road. Life cycle stages not included in the table have no impact.

Waste production	Unit	UPSTREAM	CORE			DOWNSTREAM					Total life cycle	Module D
		A1-A3	A4	A5	Total Core	B2	B6	C2	C4	Total Downstream		
Hazardous waste disposed	Kg	1,37E-03	6,02E-04	7,56E-05	6,78E-04	9,73E-05	4,34E-06	5,88E-04	5,76E-07	6,90E-04	2,74E-03	-6,62E-05
Non-hazardous waste disposed	Kg	7,98E+00	8,83E+01	1,81E-01	8,85E+01	8,93E-01	9,73E-08	4,41E+01	7,76E+03	5,68E+01	1,53E+02	-3,68E-01
Radioactive waste disposed	Kg	1,12E-02	7,07E-03	1,18E-03	8,24E-03	1,44E-03	3,37E-05	6,23E-03	1,15E-05	7,72E-03	2,72E-02	-5,11E-04

Table 5. Results on output flows categories of the life cycle of 1m² of "N-340" road. Life cycle stages not included in the table have no impact.

Waste production	Unit	UPSTREAM	CORE			DOWNSTREAM					Total life cycle	Module D
		A1-A3	A4	A5	Total Core	B2	B6	C2	C4	Total Downstream		
Components for reuse	Kg	0	0	0	0	0	0	0	0	0	0	0
Material for recycling	Kg	0	0	0	0	0	0	0	6,80E+03	6,80E+03	6,80E+03	0
Materials for energy recovery	Kg	0	0	0	0	0	0	0	0	0	0	0
Exported energy-electricity	Kg	0	0	0	0	0	0	0	0	0	0	0
Exported energy-thermal	Kg	0	0	0	0	0	0	0	0	0	0	0

In general terms, as it is shown in the Table 2 (environmental performance of 1 m^2) and in Figure 4 (impact categories), Upstream Module has the biggest impact, representing at least 48% of the whole impact. Core Module has a moderate impact, representing at most 27% of the life cycle impact. Downstream Module has little impact, representing at most 25% of the whole impact. Module D represents savings between 1% and 5% of the total impact.

The life cycle of the road has an impact of 2,26E+02 kg of CO_2 equivalent per m^2 with an AADT of 1116 for freight transport and 20356 for passenger transport.

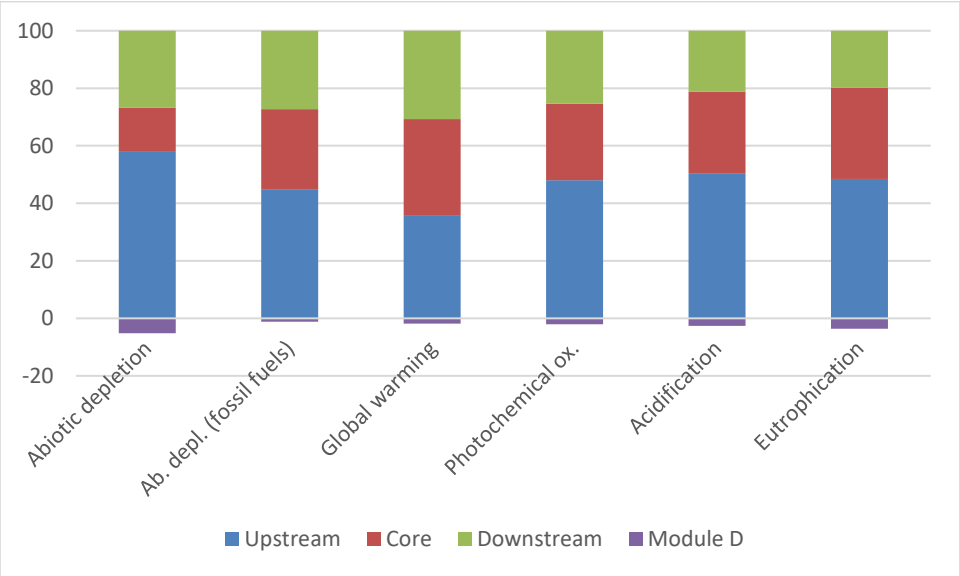

Figure 4. Results on impact categories of the life cycle of 1 m^2 of "N-340" road. Dominance analysis according to different modules (upstream, core and downstream).

8. ADDITIONAL ENVIRONMENTAL INFORMATION

- Protection and Conservation of soils and vegetation.

The following measures are proposed: delimitation of working area, definition of exclusion areas as well as restriction to the location of landfills and support facilities, reuse of topsoil, vegetation protection, priority habitat protection and protection of public utility.

- Protection of the hydrologic system and water quality.

The following measures or actions are taken: rectification and channeling banks are avoided, by not allowing the concentration of several ones in a single work of drainage and the remaining of isolated pools with fish are also avoided because of the mortality risk for them, hence applying, in this case, systems for the recovery of affected individuals.

In addition, during construction, there are barriers for sediment retention, settling ponds, infiltration trenches or other similar devices to avoid the removal of soil to the rivers, ensuring that the placement of these systems does not alter the environmental values to be protected, and their subsequent removal after their function.

- Protection of wildlife

In order to protect the fauna around the new infrastructure and minimize the barrier effect, the following steps are taken: measures for correction of barrier effect for amphibians and reptiles, measures to protect fish fauna as well as birds, measures for correction the barrier effect for micro and meso-mammals, and establishment of wildlife crossings for vertebrates, being perfectly located, sized and integrated into the environment.

- Atmospheric protection.

To avoid the inconvenience of dust generated during construction of the road, regular irrigation is made to all access roads to work as well as auxiliary facilities areas and machinery parks. The frequency of watering is adapted to the characteristics of the soil and the weather, to keep the roads used permanently wet. The materials capable of emitting dust into the atmosphere are transported covered.

- Protection against noise and vibration.

The construction project includes an acoustic study to be completed with the prediction of the noise levels specified in the operational phase. In accordance with the quality objectives, this will be translated into the corresponding noise maps. Furthermore, the acoustic study determines the need to develop protective measures to achieve quality objectives identified in this condition. The design of these measures considers their aesthetics and landscaping, using shapes, materials, textures and colors design. Moreover, the materials and design are able to suffer the action of wind, road traffic and other mechanical actions that can act with lifetime spam of at least 20 years. Moreover, the use of transparent noise barriers in areas of interest fauna is avoided.

- Defense against erosion, environmental restoration and landscaping of the work.

Measures against erosion, environmental restoration and landscaping of the work are applied, consisting of the restoration of all items directly associated with the work, as abutments, mouths of the tunnels, etc. Additionally, measures for restoring other associated items indirectly are proposed, as loan and landfill areas, work roads and auxiliary facilities.

9. EPD MODIFICATIONS REGARDING PREVIOUS VERSION

- The present EPD has been adapted to the requirements established by PCR 2013:20 Highways, streets and roads (except elevated highways) version 2.11
- The functional unit of the LCA study has been modified to 1 m^2 of road.
- Some impact categories have been changed at section 7. Environmental performance according to the new PCR and programme instructions.
- The end of life of the products as well as Module D have been included in the limits of the system.
- The description of Company has been updated

10. VERIFICATION AND CONTACT

- Owner of the declaration: Acciona Contrucción SA. Avenida de Europa 18. 28108 Alcobendas, Madrid (Spain).www.acciona.com
- Programme used: The International EPD® System. More information at www.environdec.com
- EPD prepared by: Andrea Casas Ocampo and Edith Güedella Bustamante-Acciona Construcción LCA team
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"EPDs of construction products may be not comparable if they do not comply with EN 15804". "Environmental Product Declarations within the same product category from different programs may not be comparable".

Product category rules (PCR): 2013:20 Highways, streets and roads, version 2.11.

PCR review was conducted by: The Technical Committee of the International EPD® System.
Review chair: Andrew Norton Contact via info@environdec.com.
Independent third-party verification of the declaration and data, according to ISO14025:2010:

EPD process certification ***EPD verification : X***

Third party verifier:

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Accredited by: "The International EPD® System"

Procedure for follow-up of data during EPD validity involves third party verifier:

Yes: X ***No***

11. REFERENCES

- PCR 2013:20 Highways, streets and roads (except elevated highways) version 2.11
- ISO 14025: Environmental labels and declarations-Type III Environmental Declarations-Principles and procedures (2010)
- ISO 14040: Environmental management-Life Cycle Assessment-Principles and framework (2006)
- ISO 14044: Environmental management-Life Cycle Assessment-Requirements and guidelines (2006)
- EN 15804:2012+A1:2014 Sustainability of construction works – Environmental product declaration – Core rules of the product category of construction products
- EPD International (2017) General Programme Instructions for the International EPD® System. Version 3.0, dated 2017-12-11
- ISO 14046:2014, Environmental management – Water footprint – Principles, requirements and guidelines
- ISO 21930:2017, Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services