ENVIRONMENTAL IMPACT STUDY FOR THERUMICHACA - PASTO DUAL CARRIAGEWAY PROJECT, PEDREGAL – CATAMBUCO SPAN, UF. 4 AND 5.1., CONCESSION CONTRACT UNDER SCHEME APP N°. 15 OF 2015

Géminis Consultores Ambientales SAS

CHAPTER 8. ENVIRONMENTAL EVALUATION

San Juan de Pasto, March 2017

TABLE OF CONTENTS

INDEX OF TABLES

8. ENVIRONMENTAL EVALUATION

The environmental assessment was prepared based on characterization of the area of influence of the Rumichaca - Pasto Dual Carriageway Road Project, Pedregal – Catambuco Span, Concession Contract under Scheme APP N°15 of 2015, which allowed identifying and evaluating existing impacts (without project) and potential (with project), according to provisions in the terms of reference for the construction of roads and/or tunnels, under Resolution 0751 of 2015, whose chapter 8 reads:

- Project environmental impacts resulting from area developed activities
- Environmental impacts with project resulting from project execution activities in its three stages: pre-construction, construction, abandonment and final restoration

Methodology

Through an interdisciplinary group of professionals from the different socio-environmental areas, the anthropogenic activities were identified that are developed in the area of influence of the project and intended activities in development of the project. Subsequently, the impacts from each anthropic activity existing in the area, as well as the potential impacts resulting from different project activities, and based on the aforesaid the environmental importance of identified impacts for each presented scenarios were identified.

According to the aforesaid, to evaluate the environmental impacts the CONESA (2010) methodology was used, which is based on valuation of several impact attributes, with the aim of establishing the Environmental impact importance (IA).

Identification of interactions and nature of the impact

Having defined the impact generating actions using a matrix where the activities developed in the EIA are assessed and defining if of a positive and negative nature. (See Table 8.1)

Table 8.1. Identification of impact effects

Once impacts generating actions defined by a matrix in which the activities were evaluated in the EIA, indicating if its nature is positive and negative. (See Table 8.1)

Table 8.2. Identification of impact effects

Impact effects	Color identification
Positive effect	
Negative effect	

Attributes used and rating scale

- Nature

It is the qualitative condition that determines the direction of change brought about by an action of the project on the environment. (See Table 8.2.)

Table 8.3 Nature of the impact

RANGE OF THE NATURE (Qualitative condition)		
DEGREE OF IMPORTANCE	**DEGREE OF IMPORTANCE**	**DEGREE OF IMPORTANCE**
POSITIVE	**(+)**	When the impact produces a beneficial effect for the component.
NEGATIVE	**(-)**	When the impact produces a detrimental effect on the component.

Source: Conesa, 2010.

- Intensity (I)

This refers to the degree of incidence of the action on the factor, in the specific area in which it operates.

The seriousness of the consequences of the disturbance produced in the environmental or social area components is rated on a scale of 1 to 12. In the case of impacts classified

with a positive nature, the severity of the impact is inversely proportional to the described relationship. (See Table 8.3.)

Table 8.4. Intensity ranges

INTENSITY RANGES (Modification degree)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
LOW	**1**	No significant environmental effects, ie, when the consequences of the impact generates minimal modifications on the environment or the community.
HALF	**2**	The effect is not sufficient to seriously jeopardize natural resources or the community, therefore affectations or moderate alterations in the environment analyzed are analyzed.
HIGH	**4**	The effect alters or generates deterioration or alteration of the ecosystem and / or community.
VERY HIGH	**8**	The impact significantly or severely affects ecosystems or sociocultural environment.
TOTAL	**12**	The impact generates total destruction in the ecosystem and / or the sociocultural environment.

Source: Conesa, 2010.

- Extension (EX)

This refers to the area of influence of the impact in relation to the project's environment, i.e. the area or sector showing the consequences of the activity. It is measured on a scale from 1 to 8, where 1 is the lowest and 8 the greatest extent. (See Table 8.4.)

Table 8.5. Extension ranges

EXTENSION RANGES		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
PUNCTUAL	**1**	The impact has a very localized effect.
PARTIAL	**2**	The impact is within the area of influence of the project, but without being extensive or widespread.
EXTENSIVE	**4**	The effect of the impact is widespread within the area of direct influence of the project, but without transcend it.
TOTAL	**8**	The effect has a pervasive influence throughout the area of the project environment exceeding the area of direct influence.
CRITICAL	**+4**	If the effect occurs in a critical location, a value of 4 units is assigned above its corresponding one based on the extension percentage in which it manifests itself and if considered dangerous and without the possibility of corrective measures, another alternative for the project must be found.

Source: Conesa, 2010.

- Moment (MO)

Is the manifestation term of the impact where time *(tm)* refers to the time that elapses between the date the action appeared (t0) and the beginning of the effect (tj) on the environmental factor considered, being *tm = ti - to*.

When elapsed time is zero and / or less than one year, the moment is considered immediately. When it is a period of time exceeding 10 years, the time will be long term. (See Table 8.5.)

Table 8.6. Moment ranges

MOMENT RANGES (Manifestation term)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
LONG TERM	**1**	If the effect takes more than ten years to manifest.
MEDIUM TERM	**2**	If the time period goes from 1 to 10 years.
SHORT TERM	**3**	If the period is less than one year.
RIGHT NOW	**4**	When elapsed time is zero.
CRITICAL	**+4**	If any circumstances occur that would make the impact moment critical, a value of four units is assigned as specified above.

Source: Conesa, 2010.

- Persistence (PE)

This refers to the time the alteration produced by the impact remains. It is measured on a scale of 1 to 4, where one (1) is fleeting and four (4) permanent. (See Table 8.6.)

Table 8.7. Persistence ranges

PERSISTENCE RANGES (Permanence of effect)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
FLEETING OR MOMENTARILY	**1**	Duration between one (1) and twelve (12) months.
TEMPORARY	**2**	Duration between one (1) and ten (10) years.
PERSISTENT	**3**	Duration between ten (10) and fifteen (15) years.
PERMANENT	**4**	Duration exceeding fifteen (15) years.

Source: Conesa, 2010.

- Reversibility (RV)

This refers to the possibility of rebuilding the factor affected by the project, i.e. the possibility of returning to initial conditions prior to the action, by natural means, once same stops acting on the environment. (See Table 8.7.)
In the case of impacts classified as with a positive nature, the "reversibility" of the impact refers to said impact being reduced or that the effect expires with time.

Table 8.8. Reversibility ranges

RANGES REVERSIBILITY		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
SHORT TERM	**1**	Duration between one (1) and twelve (12) months.
MEDIUM TERM	**2**	Duration between one (1) fifteen (15) years.
LONG TERM	**3**	Duration exceeding fifteen (15) years.
IRREVERSIBLE	**4**	The consequences remain

Source: Conesa, 2010.

- Synergy (SI)

This attribute provides for the strengthening of two or more simple effects caused by actions acting simultaneously, its effect is greater than that expected from waiting for the manifestation of effects when their provoking actions act independently and not simultaneously. (See Table 8.8.)

Table 8.9. Synergy ranges

SYNERGY RANGES		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
WITHOUT SYNERGISM	**1**	When an action acts on the same factor, the attribute
SYNERGETIC	**2**	Presents moderate synergism
VERY SYNERGETIC	**4**	Highly synergistic

Source: Conesa, 2010.

· Accumulation (AC)

This attribute gives an idea of the progressive increase of the effect manifestation, when the generating action persists continuously or repeatedly. (See Table 8.9.)

Table 8.10. Accumulation ranges

ACCUMULATION RANGES		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
SIMPLE	**1**	When the action does not produce cumulative effects.
CUMULATIVE	**4**	When the action produces cumulative effects.

Source: Conesa, 2010.

· Effect (EF)

This attribute refers to the causal relationship, or the form of manifestation of the effect on a factor, as a result of an action. (See Table 8.10.)

Table 8.11. Effect ranges

EFFECT RANGES (Cause-effect ratio)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
INDIRECT (Secondary)	**1**	In the event that its manifestation is not a direct consequence of the action, but occurs from a primary effect, acting as a second order action.
DIRECT	**4**	The effect may be direct or primary, and in this case the impact of the direct result of this action.

Source: Conesa, 2010.

· Frequency (PR)

This refers to regularity of the manifestation of the effect (See Table 8.11.).

Table 8.11. Frequency ranges

EFFECT RANGES (Cause-effect ratio)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
DISCONTINUOUS IRREGULAR O PERIODIC	**1**	The manifestations occur unpredictably in time.
PERIODIC	**2**	The manifestation effect occurs cyclically or recurrently.
CONTINUOUS	**4**	The manifestations remain constant over time.

Source: Conesa, 2010.

- Recoverability (MC)

Lapse of time required for the ecosystem to return to their original condition with regard the alterations caused by an impact, with the use of technology and by introducing corrective and restorative measures.

It is measured on a scale of 1 to 8, where 1 is the most resilient and 8 is no possibility of recovery. (See Table 8.12.)

Table 8.12. Recoverability ranges

IMPACT RECOVERABILITY RANGES (Reconstruction by human means)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
IMMEDIATE RECOVERY	**1**	Immediate
SHORT-TERM RECOVERABLE	**2**	Duration of one (1) and twelve (12) months.
MEDIUM TERM RECOVERABLE	**3**	Duration between one (1) and ten (10) years.

IMPACT RECOVERABILITY RANGES (Reconstruction by human means)		
QUALIFICATION	**IMPORTANCE DEGREE**	**IMPORTANCE**
LONG TERM RECOVERABLE OR MITIGABLE	**4**	The consequences remain for more than ten (10) years.
IRRECOVERABLE	**8**	Alteration impossible to repair both by natural action or by human action.

Source: Conesa, 2010.

Environmental impact importance (IA)

The importance of an impact is determined by the sum of the rating criteria described above, that is, it depends on Intensity (I), Extension (EX), Moment (MO), Persistence (PE) Reversibility (RV), Synergy (SI), Accumulation (AC) Effect (EF), Periodicity (PR) and Recoverability (MC), whereby the environmental importance is defined as the result of the sum of all criteria except for Intensity that is multiplied by three (3) and Extension by two (2); because these two criteria are considered very important in determining the importance of an impact.

The importance of the impact allows prioritizing and determining required environmental management actions.

The Importance of the Environmental Impact is determined by the formula:

$$\mathbf{IA = (3I + 2EX + MO + PE + RV + SI + AC + EF + PR + MC)}$$

Where:
I = Impact Importance
EX = Extension (area of influence)
MO = Moment (manifestation term)
PE = Persistence (permanence of effect)
RV = Reversibility
SI = Synergy (Regularity of the manifestation)
AC = Accumulation (Gradual increase)

EF = Effect (Cause-effect ratio)
PR = Frequency (Regularity of the manifestation)
MC = Recoverability (Human means resources)

Impact rankings

The result of each impact is located according to established ranges for each attribute, then, the scale of consequences corresponding to the selected range is identified.

The level of importance of the impact ranges between 13 and 88. (See Table 8.13.)

Table 8.13. Level of environmental impact importance

ENVIRONMENTAL IMPACT IMPORTANCE	LEVEL OF IMPORTANCE NEGATIVE IMPACTS	LEVEL OF IMPORTANCE POSITIVE IMPACTS
13 A 38	Compatible	Favorable
39 A 51	Moderate	Favorable high
52 A 64	Severe	Beneficial
65 A 88	Critical	Beneficial high

Source: Conesa, 2010.

Considering the values assigned to each range within each evaluation criteria and the formula presented for the Impact Importance Value, the smallest possible value is 13, which corresponds to a minimal impact and the highest value is 88, which corresponds the maximum impact.

Identifying impacts without project

To identify the environmental impacts of the scenario without project, a checklist was developed from secondary information with the main human activities currently being conducted in the Area of Influence (AI).

The checklist was validated in the field to establish which activities are generating impacts on abiotic, biotic and socio-economic environments. Subsequently, they were

valued to determine the environmental importance of the impact, according to proposed methodology.

Identifying project impacts

For the scenario with project, the project implementation activities in its pre-construction, construction, abandonment and final restoration stages were identified, which will generate impacts on the components of the abiotic, biotic and socioeconomic environment that could be affected. They were then valuated to determine the Environmental Importance of the impact, according to proposed methodology.

8.1. Identification and Evaluation of impacts for the scenario without project

Anthropic activities identified are the result of the characterization of the current conditions of the surrounding area.

It should be noted that agriculture and livestock have been the economic base of the Department of Nariño, with predominantly smallholder production since 80% of holdings are less than 5 hectares in size, according to records of the regional economy for Pasto document, Banco de la República, 2007.

Table 8.14 lists human activities generating impacts, according to the productive sector in which they are listed.

Table 8.14 Anthropogenic impact generating activities, identified in the area of influence-without-project scenario

Anthropogenic activities	
Sector	**Activity**
FARMING	Temporary and permanent crops
CATTLE RAISING	Cattle raising
MANUFACTURING INDUSTRY	Brickworks
MINING	Underground mining

Anthropogenic activities	
Sector	**Activity**
TRANSPORT	Existing road
COMMERCE	Service Stations (EDS)
	Repair and maintenance of vehicles
	Restaurants and cafes
	Accommodation
	Informal sale in mobile stands
	Car wash
	Crematorium
FORESTRY	Plantations
OTHERS	Timber extraction
	Fires
	Human settlements

Source: Gemini Environmental Consultants SAS, 2016

Follows a description of AI anthropic activities and their generated impacts:

Farming

This refers to the different of small-scale crops (transient, annual and /or permanent crops), which help the economic development of the region. The activity is considered from preparing the soil for planting to harvesting the product.

- Temporary and permanent crops

Agricultural crops identified along the Pedregal – Catambuco Span Functional Units UF4 UF5 subsector 1, mainly those in the Tangua area and the Catambuco county are cold climate nature.

These crops are grown in an area less than ¼ hectare or home gardens, so production is small scale, whose products are in many cases subsistence plantations. (See Photo 8-1).

Photograph 8-1. Crops in the Area of Influence (AI)
Source: Gemini Environmental Consultants SAS, 2016

The production cycle of transitory crops is usually less than one year.

The production cycle of permanent crops is greater than one and usually several harvests are done per cycle.

The following types of crop were identified in the Area of Influence (AI):

- Semi-intensive: Correspond to barley, wheat, quinoa and vegetables crops.
- Intensive: Corresponds to potatoes
- Semi-permanent and permanent intensive: Correspond to pea and bean crops

Despite the presence of vegetation cover, as a mosaic of crops and agroforestry systems, the landscape presents fragmentations in plots, allowing classifying this landscape as smallholder agriculture.

The AI shows other traditional farming activities such as crops planted on land with more than 50% slopes and according to the contour lines where non-sustainable farming practices are applied.

Although agriculture is an important sector of the area economy, it is an activity that generates significant environmental changes since in most cases good agricultural practices are not apply, such as proper use of phytosanitary, fertilizers, handling and disposal of phytosanitary waste, organic fertilizers, inert, affecting several components of the abiotic, biotic and socioeconomic environment.

The negative impacts associated with this activity are:

- Slope instability
- Landscape modification
- Change in soil structure
- Modifying the current land use
- Changes in the physicochemical characteristics of surface water
- Obstructing or altering riverbeds, margins and water rounds
- Changes in water resources supply
- Changes in the surface cover of forests and semi-natural areas
- Modifying the composition and structure of natural and semi-natural ecosystems
- Fragmentation and changes in habitat connectivity
- Changes in the wildlife composition and structure
- Altering the physicochemical properties of freshwater habitats
- Changes in employment dynamics
- Impairment of social and economic infrastructure
- Generating employment expectations

Cattle raising

This is a set of economic activities associated with the primary sector of the economy in relation to handling cattle for production with one or more purposes (meat, milk, breeding and / or growing), it also includes grazing areas where cattle can moved and feed; and all the necessary infrastructure such as fences or corrals for development of the activity.

In the AI, one of the predominant covers is weedy pastures and woodlands, most of which are used by the livestock associated activities, such as cattle grazing, which is dual purpose, i.e. produces meat and milk.

Additionally, livestock in the region is an important sector of the economy however, it is an activity that generates significant alterations in the socio-environmental, since in most cases good farming practices are not applied, as the disposal of organic waste, affecting several components of the abiotic, biotic and socioeconomic environment.

The negative impacts associated with this activity, are:

- Slope instability
- Erosion phenomena
- Changes in soil structure
- Effects on quality and quantity of groundwater
- Changes in the physicochemical characteristics of surface water
- Obstruction or alteration of riverbeds, margins and water rounds
- Changes in water resources supply
- Change in air quality
- Changes in the surface cover of forests and semi-natural areas
- Changes in the composition and structure of natural and semi-natural ecosystems
- Fragmentation and changes in habitat connectivity
- Changes in wildlife composition and structure
- Altering the physicochemical properties of freshwater habitats

Manufacturing industry

Manufacturing in the region is mainly represented by processing of building materials, which is an important source of employment and development, improving the conditions of the communities because this is associated to other activities such as provision of goods and services.

· Brickworks

The brick manufacturing activity is mainly concentrated in the Cebadal sector, municipality of Tangua. (See Photo 8-2)

Photograph 8-2. Brickworks - Tangua sector
Source: Environmental Consultants SAS Gemini 2016

All identified brickworks have similar infrastructure, they are small and they use traditional techniques for making bricks, they have a fixed direct fire kiln, which in most cases does not have emissions control, an open roof infrastructure and a farm area or yard.

The fuels used in the activity are highly toxic and they are not correctly managed, usually wood, tires plastics or textiles among others are used for baking bricks,.

The negative impacts associated with this activity are:

- Mass removal Phenomena
- Slope instability
- Erosion phenomena
- Landscape modification
- Affecting groundwater quality and quantity
- Changes in the physicochemical characteristics of surface water
- Obstruction or alteration of riverbeds, margins and water rounds

- Changes in water resources supply
- Changes in air quality
- Changes in sound pressure levels
- Change in the surface cover of forests and semi-natural areas
- Changes in the composition and structure of natural semi-natural ecosystems
- Fragmentation and changes in habitat connectivity
- Changes in wildlife composition and structure
- Altering the physicochemical properties of freshwater habitats
- Generating employment expectations
- Generating community discomfort
- Changes to everyday life, customs and lifestyles

Mining

· Underground mining

There is evidence of sinkhole material extraction, this activity is important in the economy of the area, generating direct and indirect employment; also it produces supplies for development of construction activities in the surrounding area.

Despite the socio-economic benefits, this is an activity that generates environmental impacts associated with poor mining planning; inadequate management of generated waste and altering stability properties and soil structure.

Transport

· Existing

The current Pan American or National Route 25 road is located in the project area. This road connects Colombia with Ecuador, so that a high flow of vehicles is presented with the impacts that it entails.

Commerce

Trade in the region is mainly represented by the provision of services and sale of formal products, reason why they become an alternative of employment and development by improving the conditions of the communities, since this is associated to other activities such as the provision of goods and services.

- Service stations

There are Service Stations (EDS) supplying liquid fuel along the Pedregal – Catambuco span, Functional Units UF4 UF5 subsector 1. (See Photo 8-3).

Photograph 8-3. Service Station (EDS) in the area of influence
Source: Environmental Consultants SAS Gemini 2016

Although the EDS are an important part of area economy and a key service provided to road users, IT is an activity that generates significant socio-environmental alterations, and solid and liquid waste are not correctly managed.

The main operational activities of service stations, generating negative impact are:

- Entering fuel tanker trucks
- Downloading and storing fuel
- Tank cleaning and equipment maintenance
- Solid and liquid waste management

- Supplying fuel to motor vehicles
- Other services such as preventive maintenance and oil changes

· Repair and maintenance of vehicles

Repair and maintenance of vehicles is an activity observed along the Pedregal - Catambuco span, Functional Units UF4 and UF5 subsector 1, especially in the municipalities of Tangua and the county of Catambuco. (See Photo 8-4.).

Photograph 8-4. Repair and maintenance of vehicles in the area of Influence of the project

Source: Environmental Consultants SAS Gemini 2016

This activity dedicated to repairing engines, electrical issues, painting and welding is important in the economy of the area, generating direct and indirect employment associated with trading in auto parts, painting and other supplies. It also provides a vital service to the local fleet and road users.

Despite the socio-economic benefit it is an activity that generates environmental impacts due to improper treatment of liquids and solids waste and gases.

· Restaurants and cafes

This activity takes place along the Pedregal – Catambuco span, and Functional Units UF4 and UF5subsector 1.

This activity is an important item of the economy of the area, because several families make a living from this. It also generates direct and indirect employment related to the supply of food, goods and services.

The Pedregal sector is known for the proving restaurant and cafeterias services, and is a landmark for travelers in southern Nariño because of its strategic location. (See photo 8-5)

Photograph 8-5. Restaurants and cafeterias, Pedregal area
Source: Environmental Consultants SAS Gemini 2016

Since there is a socioeconomic benefit, this is an activity that generates some negative environmental impacts by mainly improperly handling solid waste.

- Accommodation

In the Pedregal – Catambuco span, the infrastructure that provides accommodation in the towns around the Panamerican highway near human settlements is identified.

This activity is an important sector of the economy of the area, generating direct and indirect employment related to the supply of food, goods and services.

However, these establishments generate a large amount of solid waste, among which paper, plastics, organic waste, among others, are identified.

There is also a large consumption of power and water, which increases where there are pools and laundry service.

Although this activity is of economic importance, it generates negative environmental impacts by mainly improper treatment of solid waste.

- Informal sale in mobile stands

The Pedregal – Catambuco span, Functional Units UF4 and UF5 subsector 1 is characterized by informal sale stands such as fruits, prepared meals, beverages and flowers.

This activity is characterized by retail sales in groups of mobile stands and especially in the Pedregal Catambuco span.

This activity has become a economical alternative feature in the area, which seeks to improve the income of the population of human settlements located along the Pedregal – Catambuco span, Functional Units UF4 and UF5 subsector 1, taking advantage of the vehicular influx on the road.

- Car wash

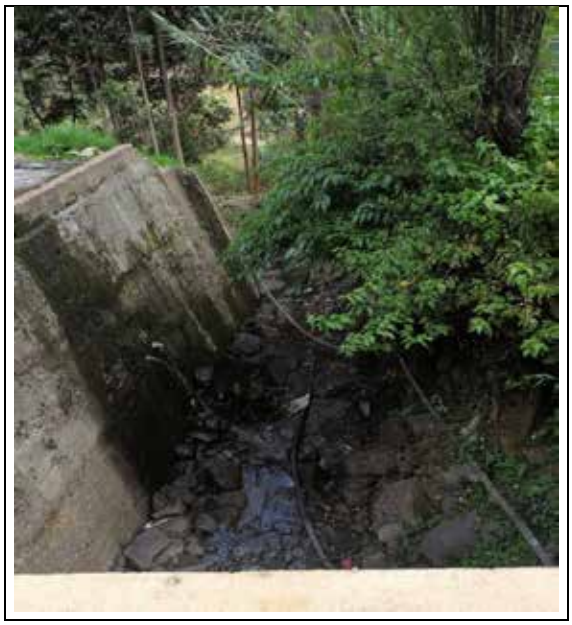
There are car washes along the Pedregal – Catambuco span, Functional Units UF4 and UF5 1 subsector.

This informal economic activity represents a way of life and livelihood for several families.

However, the authority does not exert any control in regard the use of water resources of small streams, creeks or small waterfalls.

This is a forbidden activity although it is a service provided to road users.

Given the inadequate liquid waste management conditions of this activity, effluents go directly to nearby water sources. (See Photo 8-6.)



Photograph 8-6. Disposal of contaminating substances from carwash substances in waterways

Source: Environmental Consultants SAS Gemini 2016

- Crematorium

There is a crematorium in the Pedregal – Catambuco Span, Functional Units UF4 and UF5 subsector 1 in the Catambuco county, owned by Jardines Cristo Rey. (See Photo 8-7).

Photograph 8-7. Crematorium in the Chapalito sector
Source: Environmental Consultants SAS Gemini 2016

This funeral service is provided with industrial furnaces, which reach temperatures between 870 and 980 ° C.

Natural gas and propane are used for furnace operation.

Forestry

- Plantations

Forest plantations identified in the Pedregal – Catambuco span, Functional Units UF4 and UF5 subsector 1, are part of the vegetal cover of the Area of Influence (AI) being part of the landscape, primarily consisting of the *Eucalyptus globulus* species, whose survival is due to natural regrowth.

Plantations correspond to forest stands that were established without any forestry management, with tree species being planted for reforestation, timber production purposes and / or environmental goods or services.

Others

- Timber extraction

Consists of harvesting timber of vegetal species from natural or planted forests; those used as fuel, mainly for cooking food, are included. Logging is identified as a practical domestic use for construction or maintenance of fences; such activities generate an impact on natural ecosystems, climate change, temperature changes in the soil, causing drought and of soil layer changes a determining factor in erosion processes, reducing flows. (See Photo 8-8).

Photograph 8-8. Logging activity Pedregal Pasto
Source: Environmental Consultants SAS Gemini 2016

Extraction of forest products is usually done to produce handicrafts, farm buildings and a significant percentage to supply energy resources.

- Fires

In the Pedregal – Catambuco span, Functional Units UF4 and UF5 subsector 1, areas that have been burned or affected by fires are observed (see photograph).

Such fires spread over large areas and are considered the main generators of impacts on the water, vegetal cover, and vegetation epiphyte and wooded areas. This situation is caused by human action since these burned areas are commonly seen close to homes considered sources of ignition.

This activity occurs in areas with slopes above 60% with poor and shallow soils, which have no productive or economic uses, so this action is considered as a traditional practice of preparing or clearing land for planting or to establish paddocks.

Photograph 8-9. Vegetation cover in Area of Influence
Source: Environmental Consultants SAS Gemini 2016

- Human settlements

This is understood as a non-productive activity, corresponding to community settlements the project associated territories, which are characterized at the municipal level (higher territorial units) and county level (lower territorial units) based on their spacial components, demographic, cultural, economic in chapter 5.3 of this study.

Generally, settlement patterns for the road corridor are variable and range from type nucleated in areas such as Catambuco or Pedregal, dispersed in areas such as Inantas and hamlets in the Pilcuán area.

This activity represents the presence of human action in the area of influence generating various types of impacts on natural elements.

8.1.1. No impact assessment project

From the identifying the activities carried out in the area of influence of the project, the environmental impacts they generate on the abiotic, biotic and socio-economic environment, its components and elements were identified. (See Table 8.15).

The result of the Environmental Impact Evaluation, without project, used 3 matrixes: Identification, Nature, Valuation and Qualification.

The Identification and Nature matrix determined whether the impact produced by the activity has a negative or positive effect. (See Annex 8.1.1.)

Table 8.15. Identification of environmental impacts generated by human activities in the area of influence of the project

MEDIUM	COMPONENT	ELEMENT	ENVIRONMENTAL IMPACT
ABIOTIC	GEOSPHERIC	GEOFORMS	Mass removal Phenomena
			Slope instability
			Erosion phenomena
		LANDSCAPE	Landscape modification
		SOIL	Change in soil structure
			Modification of current land use
		HYDROGEOLOGY	Effect on quality and quantity of groundwater
	HYDRIC	SUPERFICIAL WATER	Changes in the physicochemical

MEDIUM	COMPONENT	ELEMENT	ENVIRONMENTAL IMPACT
			characteristics of surface water
			Obstruction or alteration of riverbeds, margins and water rounds
			Change in supply of water resources
	ATMOSPHERIC	AIR QUALITY	Change in air quality
			Change in sound pressure levels
BIOTIC	TERRESTRIAL ECOSYSTEM	FLORA	Change in cover area of forests and semi-natural areas
			Changes in the composition and structure of natural and semi-natural ecosystems
		FLORA AND FAUNA	Fragmentation and changes in habitat connectivity
		FAUNA	Changes in wildlife composition and structure
	AQUATIC ECOSYSTEM	HIDROBIOLOGICAL COMMUNITIES	Altering the physicochemical properties of freshwater habitats
SOCIOECONOMIC	SOCIO-ECONOMIC AND CULTURAL	POPULATION ISSUES	Change in employment dynamics
		ECONOMY	Change in supply and demand for goods and services
			Modification of the economic activities of AID families
			Change in employment dynamics
		INFRASTRUCTURE OF GOODS AND	Impairment of social and economic infrastructure

MEDIUM	COMPONENT	ELEMENT	ENVIRONMENTAL IMPACT
		UTILITIES AND SOCIAL SERVICES	Change in the existing road infrastructure
			Change in mobility conditions
		ADAPTIVE AND CULTURAL STRATEGIES	Generating employment expectations
			Change in quality of life
			Changing expectations on the value of land
			Changing expectations om revenues from sales of goods and services
			Change in relations: community-community, community-authorities, community-authorities-business
			Community discomfort generation
			Change in organizational capacity and management of social, union, community civic organizations; public or private
			Changes on everyday life, customs and lifestyles

Source: Gemini Environmental Consultants SAS, 2016

The Valuation Matrix determined impact attributes: Intensity (I), Extension (EX), Moment (MO), Persistence (PE) Reversibility (RV), Synergy (SI), Accumulation (AC) Effect (EF), Periodicity (PR) and Recoverability (MC). (See Annex 8.1.b).

The Qualification matrix determined the Environmental Importance (IA) of the impacts according to valuation of the attributes, whereby the environmental impact over the impact elements is determined. (See Annex 8.1.1).

Impacts generated by human activities in the area of influence on abiotic, biotic and socioeconomic environments are established, based on their environmental importance (IA).

8.1.1.1. Abiotic environment

- *Geosphere component*

The geosphere component gather those elements related to the dynamics of landforms and the soil in the area of influence. This group of impact component under a scenario without project highlights generated livestock activities due to the topsoil removal that occurs with this activity. Although they have a direct impact on major elements such as Landforms, it represents a significant landscape impact, giving the area a general characterization of mosaics mainly associated to livestock activity.

o Landforms

Currently in the area of influence impacts of severe and critical nature are identified in terms of Landforms mainly due to mining, brickworks and livestock; the first seriously affects stability, producing slope instability, mass removal and erosion. Brickworks in turn, tend to produce landslides and slope instability phenomena, mainly due to improper handling of liquid and solid waste; and finally livestock affects the presence of erosive phenomena due to soil compaction from livestock treads.

ü Mass removal phenomena

The impact is generated by activating the removal processes in the AI due to human activities.

The presence of brickworks and underground mining are activities that have greater negative affect on this impact.

Table 8.16. shows IA impact

Table 8.15 Environmental impact importance from mass removal phenomena

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDFORMS	Brickworks	SEVERE = -60
	Underground mining	CRITIC = -74
	Existing road	MODERATE = -39
	Timber extraction	COMPATIBLE = -32
	Plantations	FAVORABLE = 36

Source: Gemini Environmental Consultants SAS, 2016

The only activity with a negative positive impact on landslides phenomena are plantations, as they help to compact the soil.

ü Slope instability

The impact generated by the loss of vegetation decreases soil compaction and causes displacement of material and landslides.

Soil cuts and excavations to obtain raw material for brick production, generate imbalance in soil compaction.

Table 8.17. shows impact AI.

Table 8.16 Environmental impact importance from slope instability

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDFORMS	Transient and permanent crops	COMPATIBLE = -24
	Cattle raising	MODERATE = -43
	Brickworks	SEVERE = -61
	Underground mining	CRITICAL= -70
	Existing road	COMPATIBLE = -37
	Informal sale in mobile stands	COMPATIBLE = -27
	Timber extraction	MODERATE = -44
	Plantations	FAVORABLE = 35
	Human settlements	COMPATIBLE = -29

Source: Gemini Environmental Consultants SAS, 2016

The activity generating the greatest negative effect on slope stability are those from brickworks and underground mining. Likewise, plantations present the most positive effects.

ü Erosion phenomena

The impact is generated by wear or denudation of soils and rocks that produce different processes on the surface of the earth, and human activities altering the balance in soil compaction.

Cuts and soil excavation to obtain raw materials and livestock generate imbalance in soil compaction.

Table 8.18. shows AI impacts

Table 8.17 Environmental impact importance from erosion phenomena

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDFORMS	Transient and permanent crops	FAVORABLE = 38
	Cattle raising	SEVERE = -56
	Brickworks	MODERATE = -39
	Underground mining	-70
	Existing road	COMPATIBLE = -33
	Informal sale in mobile stands	COMPATIBLE = -27
	Service Stations (EDS), car washes and vehicle repair and maintenance	COMPATIBLE = -25
	Restaurants and cafes	COMPATIBLE = -26
	Timber extraction	MODERATE = -45
	Fires	COMPATIBLE = -34
	Plantations	FAVORABLE = 42
	Human settlements	COMPATIBLE = -28

Source: Gemini Environmental Consultants SAS, 2016

The activity that generates the most negative effect on erosive phenomena is livestock and underground mining. Likewise, plantations present the most positive effects.

- Landscape

  - Landscape modification

The impact is generated by modifying plant cover from dedicated land for agricultural activities.

Plantations improve the visual landscape environment, but its purpose is to meet timber requirements for various human activities.

Table 8.19. shows AI impact.

Table 8.18. Environmental impact importance from landscape changes

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDSCAPE	Transient and permanent crops	COMPATIBLE = -29
	Brickworks	COMPATIBLE = -25
	Timber extraction	COMPATIBLE = -33
	Fires	COMPATIBLE = -33
	Plantations	FAVORABLE = 33

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the most negative effect on the landscape are timber extraction and fires, even if moderate. Also, the most positive effects are plantations, mainly because they represent a wooded vegetation cover. This was identified by the various landscape workshops held, where the community associates the forest vegetation cover as a quality in the landscape, even if from exotic origin species such as eucalyptus or pine.

- Soil

  - Changes in soil structure

The impact is generated by impairment of use as a result of human activities.

Table 8-20, shows AI impacts

Table 8.20 Environmental impact importance from changes in soil structure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SOIL	Transient and permanent crops	**COMPATIBLE = -21**
	Cattle raising	**SEVERE = -61**
	Underground mining	**SEVERE = -53**
	Informal sale in mobile stands	**COMPATIBLE = -19**
	Service Stations (EDS), car washes and vehicle repair and maintenance	**COMPATIBLE = -30**
	Restaurants and cafes	**COMPATIBLE = -27**
	Accommodation	**COMPATIBLE = -25**
	Timber Extraction	**COMPATIBLE = -24**
	Fires	**COMPATIBLE = -24**
	Plantations	**COMPATIBLE = -24**
	Human settlements	**COMPATIBLE = -36**

Source: Gemini Environmental Consultants SAS, 2016

The activities generating the greatest negative effect on soil structure are livestock and underground mining as the most severe. The first due to soil compaction by cattle tread and the second for land use.

ü Modification of the current land use

The impact is generated by activities not in accordance with the uses established in municipal planning documents or potential land uses.

According to land use established by each municipality, it is evident that the following activities are those more likely to generate conflict over land use.

Table 8.21. show AI impacts

Table 8.21. Environmental impact importance from changing the current land use

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SOIL	Transient and permanent crops	COMPATIBLE = -25
	Brickworks	COMPATIBLE = -35
	Informal sale in mobile stands	COMPATIBLE = -19
	Service Stations (EDS), car washes and vehicle repair and maintenance	COMPATIBLE = -33
	Timber extraction	COMPATIBLE = -24
	Fires	COMPATIBLE = -24
	Human settlements	COMPATIBLE = -23

Source: Gemini Environmental Consultants SAS, 2016

Negative impacts generated on the current land use are not relevant given the identified importance.

- Hydrogeology

  - Affecting groundwater quality and quantity

The impact is generated by input of pollutants and impairment of the hydrogeological cycle of ground water bodies.

Table 8.23. shows AI impact

Table 8.19 Environmental impact importance: changes in physicochemical and biological characteristics of surface water

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
HYDROGEOLOGY	Cattle raising	MODERATE = -51
	Brickworks	SEVERE = -54
	Underground mining	SEVERE = -58
	Existing road	SEVERE = -60
	Informal sale in mobile stands	COMPATIBLE = -26
	Service Stations (EDS), car washes and vehicle repair and maintenance	MODERATE = -40
	Restaurants and cafes	MODERATE = -47
	Accommodation	COMPATIBLE = -37
	Timber extraction	COMPATIBLE = -21
	Plantations	MODERATE = -41
	Human settlements	COMPATIBLE = -26

Source: Gemini Environmental Consultants SAS, 2016

The activities with the most negative impairment on the quality and quantity of groundwater are underground mining, the existing road and brickworks. Even if these activities and do not use groundwater they have a high impact on this component as they change the hydrogeological cycle affecting availability and physicochemical characteristics of underground water.

- Surface water

ü Change in the physicochemical characteristics of surface water.

The impact is generated by the input of pollutants to local water bodies.

Table 8.23 shows AI impact

Table 8.20 Environmental impact importance: changes in the physicochemical and biological characteristics of surface water

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SUPERFICIAL WATER	Transient and permanent crops	COMPATIBLE = -37
	Cattle raising	MODERATE = -51
	Brickworks	COMPATIBLE = -26
	Underground mining	SEVERE = -53
	existing road	MODERATE = -40
	Informal sale in mobile stands	COMPATIBLE = -26
	Service Stations (EDS), car washes and vehicle repair and maintenance	COMPATIBLE = -29
	Restaurants and cafes	MODERATE = -40
	Accommodation	COMPATIBLE = -35
	Timber extraction	COMPATIBLE = -32
	Plantations	FAVORABLE = 24
	Human settlements	COMPATIBLE = -32

Source: Gemini Environmental Consultants SAS, 2016

The activity with that greatest negative effect on surface water physicochemical and bacteriological characteristics is underground mining, severe, since this activity produces industrial discharges with contents of suspended and sedimentary material; directly affecting the characteristics of the receiving body. Moreover, plantations have a favorable impact because they act as scavengers and retain some of the pollutants from water runoff.

ü Obstruction or alteration of riverbeds, margins and water rounds

The impact is generated by contribution of solid waste discharged to water sources, occupation of channels and water areas.

Table 8.24. shows AI impact

Table 8.21. Environmental Impact importance: Obstruction or alteration of riverbeds, margins and water rounds

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SUPERFICIAL WATER	Transient and permanent crops	COMPATIBLE = 32
	Cattle raising	COMPATIBLE = -32
	Brickworks	COMPATIBLE = -21
	Underground mining	COMPATIBLE = -17
	Existing road	COMPATIBLE = -16
	Service Stations (EDS), car washes and vehicle repair and maintenance	COMPATIBLE = -16
	Timber extraction	COMPATIBLE = -13
	Fires	COMPATIBLE = -13

Source: Gemini Environmental Consultants SAS, 2016

The impact generated by obstruction or alteration of riverbeds, margins and water rounds, is not relevant.

ü Change in water resource supply

This impact refers to the use of surface water previously identified in various human activities.

Table 8.25 shows AI impact

Table 8.22 Environmental impact importance: change in water resources supply

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SUPERFICIAL WATER	Transient and permanent crops	COMPATIBLE = -37
	Cattle raising	SEVERE = -62

	Brickworks	**COMPATIBLE = -26**
	Underground mining	**MODERATE = -39**
	Service Stations (EDS), car washes and vehicle repair and maintenance	**COMPATIBLE = -23**
	Timber extraction	**SEVERE = -57**
	Fires	**SEVERE = -54**
	Plantations	**MODERATE = -40**
	Human settlements	**COMPATIBLE = -32**

Source: Gemini Environmental Consultants SAS, 2016

The activities that generate the greatest negative impact on the supply of water resources are livestock, timber extraction resources and fires.

- *Atmospheric component*

o Air quality

ü Changes in air quality

The impact refers to the impact on air quality due to emissions resulting from human activities.

Table 8.26. shows AI impacts

Table 8.23 Environmental impact importance from Changes in air quality

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
AIR QUALITY	Cattle raising	**COMPATIBLE = -25**
	Brickworks	**MODERATE = -51**
	Underground mining	**SEVERE = -60**
	Crematorium	**MODERATE = -51**
	Existing road	**SEVERE = -57**

	Service Stations (EDS), car washes and vehicle repair and maintenance	**COMPATIBLE = -24**
	Fires	**SEVERE = -64**
	Plantations	**FAVORABLE = 24**
	Human settlements	COMPATIBLE = -37

Source: Gemini Environmental Consultants SAS, 2016

The activities with that greatest negative impact are: underground mining, the existing road and fires, the first from the extraction process and transport of benefit materials; the second due to high traffic flow and the third from combustion of organic material.

ü Change in sound pressure levels

The impact refers to the variation of sound pressure levels in the AI.

Table 8.27. shows AI impacts

Table 8.24 Environmental impact importance from Changes in sound pressure levels

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LEVELS OF SOUND PRESSURE	Brickworks	**COMPATIBLE = -28**
	Underground mining	**MODERATE = -42**
	Crematorium	**MODERATE = -42**
	Existing road	**MODERATE = -46**
	Human settlements	**COMPATIBLE = -35**

Source: Gemini Environmental Consultants SAS, 2016

Underground mining activities, the crematorium and the existing road produce a moderate impact on variation of noise levels.

8.1.1.2. Biotic Environment

- *Land and aquatic ecosystems component*

o Flora

ü Changes in surface cover of forests and semi-natural areas

The impact is generated by loss of plant cover because of the expansion of the frontier of agricultural activities and infrastructure, leading to reduced forest and semi-natural areas.

Table 8,28 shows AI impacts.

Table 8.25 Environmental impact importance from changes in surface cover of forests and semi-natural areas

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Flora	Transient and permanent crops	CRITIC = -68
	Cattle raising	CRITIC = -68
	Brickworks	COMPATIBLE = -34
	* Tree felling or timber extraction	SEVERE = -44
	Fires	SEVERE = -64
	Plantations	BENEFICIAL HIGH = 67

Source: Gemini Environmental Consultants SAS, 2016

Activities with that greatest negative effect on vegetation cover are transitory and permanent crops and livestock, critical, followed by fires and timber extraction. Likewise, plantations are considered as positive impacts because they counterbalance shortage of timber resources and the strong pressure applied on them.

ü Changes in composition and structure of natural and semi-natural ecosystems

The impact is generated by the loss and transformation of natural and semi-natural ecosystems because of the change of land use and timber extraction that are currently being replaced by the introduction of foreign species that have been drastically changing the composition and structure of forested areas because of the homogeneity in planting these species.

Table 8.29 shows AI impact

Table 8.26 Environmental impact importance from changing the composition and structure of natural ecosystems

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Vegetal cover	Transient and permanent crops	CRITIC = -68
	Cattle raising	CRITIC = -68
	Brickworks	COMPATIBLE = -34
	* Tree felling or timber extraction	MODERATE = -44
	Burning or fires	SEVERE = -64
	Plantations	SEVERE = -56

Source: Gemini Environmental Consultants SAS, 2016

The activity with that greatest negative effect on the composition and structure of natural and semi-natural ecosystems corresponds to the expansion of agricultural and livestock borders, with impacts recognized as critical.

- Flora, fauna and hydro-biological communities

ü Fragmentation and changes in habitat connectivity

The impact is generated by human activities giving rise to loss of continuity of the natural landscape that has progressively generated increasingly isolated fragments.

Habitat fragmentation poses a serious threat to biodiversity, largely by deforestation, since the loss of natural hedging implies that both plant species and wildlife communities lose their habitat and diversity, therefore their area of influence or living area is drastically reduced or fragmented, in many cases there is no possibility of connecting the fragments, and therefore the chances of survival of animal species are diminished. In addition, habitat fragmentation affects the continuity of natural vegetation cover and thus the composition of populations, leading to an alteration of ecological processes that also directly affects the richness and abundance of species.

The existing road infrastructure has two habitat fragmentation effects:

1. The barrier effect, consisting of the physical space occupied by the road, preventing colonization of the habitats that could be used by wildlife without physical abilities to cross the obstacle (barrier); for some groups of wildlife such as amphibians, reptiles or mammals the barrier represented by the road prevents them from traveling, who then use fragments of natural hedges looking for resources whether food or shelter areas. Displacement also occurs for reproductive reasons where species seek other populations to ensure their gene pool.

2. The edge effect is related to the change of natural, physical and biological conditions associated with artificial and sharp boundaries, disorders such as temperature changes, humidity, higher radiation exposure to wind and modification of different biological interactions such as dispersion, pollination and transfer of energy and nutrients through trophic interactions. For wildlife this effect has an incidence for example in their areas of refuge; having their nests or burrows close to the road changes the environmental variables such as sound interfering with the species own ethology and affecting their biological reproduction processes, locomotion, etc. (See photograph.)

Photograph 8-10. Overview of a landscape where fragmentation on one side of the current road is evident. Coordinates (01 ° 4'58.62 "N; 77 ° 24'59.03" O)

Source: Gemini Environmental Consultants SAS, 2016

Table 8.30. Shows AI impacts.

Table 8.27 Environmental impact importance from of changes in habitat connectivity

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Flora, fauna and hydro-biological communities	Transient and permanent crops	CRITIC = -66
	Cattle raising	CRITIC = -68
	Brickworks or Brickworks	COMPATIBLE = -34
	Existing road	CRITIC = -69
	* Tree felling or timber extraction	MODERATE = -44
	* Burning or fires	SEVERE = -64
	Plantations	FAVORABLE = 67

Source: Gemini Environmental Consultants SAS, 2016

Activities with that greatest negative effect on fragmentation of wildlife habitats, with a severe rating, are permanent and transitory crops, livestock, *three felling, *burning and human settlements**. Also, most positive effects are plantations, plantations understood as forest stands that were established without any forestry management bur were planted for reforestation, timber production and / or environmental goods or services; these forest areas with high grasses can help in successional processes and to reduce fragmentation of wildlife habitat generating forms of connectivity between fragments of natural hedges, corridors where wildlife can make their ecological processes such as locomotion.

- Fauna

ü Changes in wildlife composition and structure

The impact is associated to habitat loss, shelter sites, food and biological corridors, which has caudated the disappearance of species and reduced faunal communities due to lack of supply of resources and niches.

Table 8.31 shows IA impacts.

Table 8.28 Environmental impact importance from modifying fauna composition and structure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Fauna	Transient and permanent crops	CRITIC = -66
	Cattle raising	CRITIC = -68
	Brickworks	COMPATIBLE = -34
	Existing road	CRITIC = -69
	* Tree felling or timber extraction	MODERATE = -44
	* Burning or fires	SEVERE = -64
	Plantations	FAVORABLE = 67

Source: Gemini Environmental Consultants SAS, 2016

The activities that mostly affect the wildlife are related to transformation of natural hedging for agricultural and livestock uses, and construction of longitudinal, such as the existing road infrastructure.

- Hydro-biological communities

  - Changes in hydro-biological composition and structure of communities

The impact generated by runoff of physical, chemical and biological contaminating agents to the different water sources influencing the dynamics of the flow, the level of natural sediment, the physical properties of light and heat, the chemical properties as nutrients and biological properties as populations of flora and fauna.

Alteration of freshwater habitats affects the provision of ecosystem services providing food and clean water for wildlife.

The modification degree of these communities is inherent to human population growth in the region, using agricultural materials in crops and using the water for irrigation and livestock water holes, and industrial activities (factories and existing warehouses along the corridor).

Table 8.32 shows AI impacts

Table 8.29 Environmental impact importance from Alterations in the composition and structure of hydro-biological communities

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Hydro-biological communities	Transient and permanent crops	SEVERE = -72
	Cattle raising	SEVERE = -66
	Brickworks	COMPATIBLE = -37
	Existing road	MODERATE = -44
	Service Stations (EDS) and car washes	COMPATIBLE = -33
	Restaurants and cafes	COMPATIBLE = -30
	accommodation	COMPATIBLE = -30
	* Tree felling or timber extraction	MODERATE = -48
	Burnings or fires	CRITIC = -65
	Plantations	FAVORABLE = 37
	**Human settlements	COMPATIBLE = -30

Source: Gemini Environmental Consultants SAS, 2016

Activities with that greatest negative effect on freshwater aquaculture habitat, considered critical, are permanent and temporary crops, livestock and *burning or fires. The latter being a determining factor in the deterioration of the quality of freshwater habitats in the dry season.

8.1.1.3. Socioeconomic environment

- *Socioeconomic component and cultural aspects*

o Population aspects

ü Change in population dynamics

The impact is generated by the existence of human settlements**, potentiated by the development of economic activities that generate in people from other regions of the country expectations regarding employment contracting, considered as a negative

impact given the pressure exerted on utilities and social services, as well as the impact on the practices and customs of the region.

Table 8.33 shows AI impacts

Table 8.30 Environmental impact importance from change in population dynamics

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Population issues	Transient and permanent crops	COMPATIBLE = -30
	Intensive livestock	FAVORABLE = 29
	Underground mining	COMPATIBLE = -31
	Informal sale in mobile stands	COMPATIBLE = -38
	**Human settlements	COMPATIBLE = -36

Source: Gemini Environmental Consultants SAS, 2016

The activity with the greatest effect on population dynamics are informal sales in mobile stands and human settlements.

- Economy

ü Change in supply and demand of goods and services

The impact is generated by productive and human activities taking place in the area, generating economic income to the population, which influences the ability to access more and better goods and services.

Table 8.34 shows AI impacts.

Table 8.31 Environmental impact importance of change in supply and demand for goods and services

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Economy	Transient and permanent crops	PRO = 32
	Cattle raising	FAVORABLE = 27
	Brickworks	FAVORABLE _ = 21

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Underground mining	FAVORABLE = 25
	Informal sale in mobile stands	FAVORABLE HIGH = 45
	Service Stations (EDS), car washes and vehicle maintenance	PRO = 15
	Accommodation	PRO = 35
	Restaurants and cafes	PRO = 30

Source: Gemini Environmental Consultants SAS, 2016

The activity generating the most positive effect on the demand and supply of goods and services is the informal sale in mobile stands.

ü Modification of the economic activities of AID families

The impact is generated by incursion of new income-generating activities in the communities in the area of influence, leaving aside traditional economic activities that involve working the land.

Table 8.35 shows AI impacts

Table 8.32 Environmental impact importance from Modification of the economic activities of AID families

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
ECONOMY	Underground mining	COMPATIBLE = -25
	Informal sale in mobile stands	COMPATIBLE = -23
	Service stations (EDS), car washes and vehicle repair and maintenance	COMPATIBLE = -27
	Restaurants and cafes	COMPATIBLE = -33
	Accommodation	COMPATIBLE = -28

Source Gemini Environmental Consultants SAS, 2016

The activity generating the most effect the economic activities of AID families is the amount of restaurants and cafés.

ü Change in employment dynamics

The impact is generated because productive activities developed in the area of influence, require goods and services offering the opportunity of direct and indirect jobs for the people living there.

Table 8.36 shows AI impacts.

Table 8.33 Environmental impact importance from changes in employment dynamics

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Economy	Transient and permanent crops	FAVORABLE = 37
	Cattle raising	FAVORABLE = 37
	Brickworks	FAVORABLE = 37
	Underground mining	FAVORABLE = 37
	Informal sale in mobile stands	FAVORABLE = 37
	Service Stations (EDS), car washes and vehicle maintenance	FAVORABLE = 37
	Accommodation	FAVORABLE = 37
	Restaurants and cafes	FAVORABLE = 37
	Plantations	FAVORABLE = 37

Source: Gemini Environmental Consultants SAS, 2016

Activities involving generation of employment contracts are considered as a favorable impact.

o Infrastructure of Goods and Social Services and Utilities

ü Impairment of social and economic infrastructure

The impact is generated by the presence of ** Human Settlements in the area, which influences the number, quality and form of housing and community facilities; which in turn is crucial in the community organization and quality of life of the community.

Table 8.37 shows AI impacts

Table 8.34 Environmental impact importance from impairment in social and economic infrastructure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Infrastructure of Goods and Social Services and Utilities	Transient and permanent crops	COMPATIBLE = -18
	Underground mining	COMPATIBLE = -24
	Informal sale in mobile stands	COMPATIBLE = -19
	**Human settlements	COMPATIBLE = -32

Source: Gemini Environmental Consultants SAS, 2016

The activity generating the most positive affect on housing and community facilities are human settlements.

ü Change in the existing road infrastructure

The impact is generated as a result of agricultural activities, especially those associated with mining and transport of products derived therefrom, which contribute to the deterioration undergoing by the existing primary road, specially county roads connecting to the national highway, adding to the deterioration caused by the fleet of cargo flowing through the road.

Table 8.38 shows AI impacts

Table 8.35 Environmental impact importance from changes in existing road infrastructure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Infrastructure of Goods and Social Services and Utilities	Underground mining	COMPATIBLE = -36

Source: Gemini Environmental Consultants SAS, 2016

ü Change in mobility conditions

Continuous changes to the existing road infrastructure synergistically act with changes in mobility conditions given that this change renders traveling conditions by road users difficult.

Table 8.36 Environmental impact importance from Change in mobility conditions

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Infrastructure of Goods and Social Services and Utilities	Underground mining	COMPATIBLE = -36

Source: Gemini Environmental Consultants SAS, 2016

ü Generating employment expectations

The negative impact is mainly generated by the expectations generated by incursion of new economic activities, which in many cases leads to the presence of migratory processes from people from nearby communities or from other regions of the country.

Table 8.40 shows AI impacts.

Table 8.37 Environmental impact importance from generating labor expectations

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Transient and permanent crops	COMPATIBLE_ = -18
	Brickworks	COMPATIBLE = -36
	Underground mining	COMPATIBLE = -31
	Informal sale in mobile stands	COMPATIBLE = -37

Source: Gemini Environmental Consultants SAS, 2016

The activity generating the greatest negative affect on community expectations is the informal sale in mobile stands.

ü Change in quality of life

The impact is considered positive and acts as a synergist with the impact of change in employment dynamics, since contracting community people improves their economic conditions, allowing and facilitating the satisfaction of basic needs.

Table 8.41 shows AI impacts

Table 8.38 Activities affecting the impact from changse in quality of life

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Transient and permanent crops	FAVORABLE HIGH = 29
	Cattle raising	FAVORABLE HIGH = 29
	Brickworks	FAVORABLE = 19
	Existing road	FAVORABLE HIGH = 29
	Restaurants and cafes	FAVORABLE HIGH = 29
	Accommodation	FAVORABLE HIGH = 29

Source: Gemini Environmental Consultants SAS, 2016

ü Changing expectations on land value

The incursion of exogenous activities in the area of influence and development thereof, leads to speculation by owners about a possible increase in the value of the land.

Table 8.42 show AI impacts

Table 8.39 Activities affecting the impact of changing expectations on the value of the land

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Underground mining	COMPATIBLE = -29

Source: Gemini Environmental Consultants SAS, 2016

ü Changing expectations of revenues from sales of goods and services

The incursion of exogenous activities in the area of influence and subsequent arrival of people from other regions of the country, lead to speculation and generating expectations from the sale of goods and services and the income derived therefrom.

Table 8.43 shows AI impacts

Table 8.40 Activities affecting the impact from changing expectations of income from sales of goods and services

Source: Gemini Environmental Consultants SAS, 2016

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Underground mining	COMPATIBLE = -29
	Informal sale in mobile stands	COMPATIBLE = -37
	Accommodation	COMPATIBLE = -30
	Restaurants and cafes	COMPATIBLE = -30

Source: Gemini Environmental Consultants SAS, 2016

ü Change in community-community, community-authorities, community-authorities-business relations

Different social and economic processes taking place in every community lead to strengthening social relations between the actors that are found there, as long as they are correctly and timely developed.

Table 8.44 show AI impacts

Table 8.41 Activities affecting the impact of change in community-community, community-authorities, community-authorities-business relations

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Transient and permanent crops	FAVORABLE HIGH = 18
	Cattle raising	FAVORABLE HIGH = 18
	Brickworks	FAVORABLE HIGH = 18
	Human settlements	FAVORABLE HIGH = 18

Source: Gemini Environmental Consultants SAS, 2016

ü Community discomfort generation

The negative impact is mainly generated by those activities that produce some discomfort in communities, either by the environmental impacts derived therefrom, impairment in health and living conditions thereof.

Table 8.45 shows AI impacts

Table 8.45 Activities affecting the impact of Community discomfort generation

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
ADAPTIVE AND CULTURAL STRATEGIES	Brickworks	MODERATE = -51
	Informal sale in mobile stands	COMPATIBLE = -30
	EDS service stations and car wash and vehicle maintenance	COMPATIBLE = -16
	Timber extraction	COMPATIBLE = -26
	Fires	COMPATIBLE = -26
	**Human settlements	COMPATIBLE = -25

Source: Gemini Environmental Consultants SAS, 2016

The activity generating the most negative effects in conflict generating are still brickworks, although moderate.

ü Changes in organizational capacity and management of social organizations, unions, civic community; public or private

The difficulties arising within the communities and with external agents motivate and have a positive effect in strengthening relations and in turn on the organizational capacity thereof, reason why this impact is considered positive and presents a synergy with the impacts described above.

Table 8.46 show AI impacts

Table 8.42 Environmental impact importance from changes in organizational and management capacity social organizations, unions, civic communities; public or private

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Cattle raising	PRO = 18
	Brickworks	PRO = 18
	Informal sale in mobile stands	PRO = 18
	Restaurants and cafes	PRO = 18
	Accommodation	PRO = 18

Source: Gemini Environmental Consultants SAS, 2016

ü Changes of everyday life, customs and lifestyles

Community lifestyles may be affected by incursion of foreign activities.

Table 8.47 shows AI impacts

Table 8.43 Environmental Impact importance from Changes of everyday life, customs and lifestyles

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Brickworks	COMPATIBLE = -39
	Underground mining	COMPATIBLE = -39
	Informal sale in mobile stands	COMPATIBLE = -32

Source: Gemini Environmental Consultants SAS, 2016

8.1.2. Analysis of impairment and environmental trends in the area of influence

The environmental evaluation of the scenario without project, allows analyzing human activities generating the most negative affect on the abiotic, biotic and socioeconomic environment and environmental elements.

· Impairment on the abiotic environment

ü Livestock activity has a negative effect and severe environmental importance on:

- Presence of erosive phenomena.
- Soil structure.
- Availability of water resources.

This impact is generated as a result of the presence of cattle, which due to their weight and loss of vegetation cover from the activity generate effects such as loss of stability in the land and changes in the physical and chemical characteristics of the soil. The severe impact on water resources is reflected in the down-regulation of this resource in the ecosystem, which is relative to the presence of vegetation on the ground, i.e. the less vegetal cover the lower the regulatory processes. This activity requires further development for water resources for both fodder production and pasture management for the cattle, reason why in some areas associated with livestock may present water catchment points.

ü The activities carried out in brickworks generate considerable negative involvement, the presence of landslides and slope instability phenomena and on the quality and quantity of groundwater resulting in severe environmental importance.

This activity occurs mainly in the municipality of Tangua and generates significant impacts on the geosphere component, by using extracted stone material as raw material by removing cover and topsoil to finally remove the rock used for this activity removing supporting and stability members, especially in areas with steep slopes and generating mass removal processes, loss of water table and significant landscape change and the visual quality of the intervened area.

ü Activities related to underground mining significantly affect the abiotic environment because they cause critical impacts to landslides, slope instability and erosion phenomena.

This activity severely impacts the geospheric component, given that it is underground affecting soil stability, favoring removal and slope instability phenomena, in addition to changing the soil compaction balance which leads to erosion.

It also provides pollutant loadings in local water bodies, changing their physicochemical characteristics, likewise it tends to affect the quality and quantity of groundwater, because it alters the water table and thus its availability.

Also, it significantly affects air quality, since the extraction, transport and processing of these materials generates pollutant emissions and noise.

ü Livestock activities, timber resources extraction and fires generate the most negative affect on availability of water resources, with a severe impact.

One of the most environmentally sensitive resources given its need in company conducted activities, as well as being central to their livelihood, is water. Beyond its social importance, it is also important given the implications of any intervention on its cycle or regulating elements and are directly associated with the ability to produce and deliver it.

Therefore, and since activities previously set forth affect these elements, the impact generated on water availability can be severe.

ü Fire activities, underground mining and the existing road are those that generate the greatest negative affect on air quality with a severe impact.

The pollution generated in air quality by fire, underground mining and the existing road is multiple since it involves the production of particulate material, the destruction of carbon dioxide scavengers and thus releasing them, by the implications for recycling oxygen and generating gases affecting the health of those who come into contact with them when burning. Therefore, a severe impact is not only generated but a synergistic one.

According to the aforesaid, it can be deduced that the most significant trend of environmental impacts on abiotic environment elements by human action are:

- Increased erosion as a result of agricultural activities and use of stone materials.

- Change in soil structure for possible landslides events and development activities involving topsoil removal and vegetation cover stripping.
- Increased demand for wood energy of a dendronergetic use as a result of the increase in population and human settlements.
- Increased demand of water resources by increasing the number of users of water sources because of increase in population or expansion of the production frontier.
- Greater impairment in environmental quality, water resources, soil and landscape by increasing the amount of liquid and solid waste and probable improper disposal.
- Change in soil quality per share of agricultural and productive activities not developing good practice.
- Land use change by the expansion of productive activities and urban development likely.
- Altered natural drainage and runoff as a result of increased housing infrastructure in areas of slopes or increased productive activities infrastructure.
- Increased air pollution and noise as a result of increased demand from a fleet of vehicles associated with the use of the existing road.

· Impairment on biota environment

ü Agricultural, livestock, logging or timber extraction resources, burning or fires activities generate the most negative affect on the vegetation cover and natural ecosystems, with a critical impact.

This because of the need to increase the agricultural frontier for obtaining higher rates of productivity per area, as well as the absence of measures to make use of soil resources without involving the removal of vegetation cover.

Its impact is rated critical, according to the assessment and the criteria used by Connesa, by the size and extent of previously identified human activities, which currently have a very significant scale over the resilient capacity of the biotic systems.

ü Agricultural, livestock and the existing road, create the largest negative affect on fragmentation and changes in habitat connectivity, with a critical impact. It also generates a moderate impact on protective vegetation of water bodies.

In accordance with the above analysis, human activities involving change in land use and destruction and removal of vegetal cover, inexorably adversely affect the ecosystems and therefore the habitats of multiple species, which are displaced or reduced in number of individuals, bringing their chances of existence to critical thresholds.

ü Agricultural and livestock activities and the existing road, create the largest negative affect on wildlife, with a critical impact.

A significant effect of the development of human activities is breaking food chains and thus the balance achieved by various communities, both terrestrial and aquatic, which are connected to affected systems.

ü Agricultural and livestock activities as well as fires generate the greatest impacts on the composition and structure of hydro-biological communities, with a critical impact.

Generated changes in freshwater aquaculture habitats associated to the contribution of sediments and chemical substances to water bodies are primarily responsible for reducing abundance of aquatic communities and their diversity.

According to the environmental impacts on elements of the biota, by human action, the following trend is anticipated:

- Change in vegetation cover due to likely increase in population and number of agricultural plots and development of other productive activities, increased logging activities and fires,
- Deterioration in ecosystem dynamics permanently affecting faunal communities by anthropic pressure on natural resources,
- Reducing populations of land fauna as a result of increased production frontier, because of decline in natural areas,
- Decrease in diversity of aquatic species by altering the physicochemical and biological characteristics of water resources as a result of polluting processes, inappropriate use and likely increase in users of water sources and change in the supply of the resource from natural processes.

· Impairment on the socioeconomic environment

ü Brickworks activities generate the most negative affect on generation of expectations and conflicts, with a moderate impact.

For this particular case, the impact is mainly generated by being a capital intensive and low labor demand activity, in contrast to the impact dimensions on abiotic and biotic environment, radically changing life conditions of the populations in adjacent areas, who also perceives the territory as a unit and on a cost-benefit analysis perceived as much higher that the positive negative impacts.

For the socioeconomic environment, environmental impacts from human action, allows establishing the following trend:

- Change in type and number of community and housing infrastructures, because of population growth and expansion of the production frontier. Likewise, the increase in number of vehicles associated with productive activities and households.
- Increased demand for provision of goods and services.
- Increase in formal and informal employment offer.
- Increased need for road infrastructure improvement, as well as public services, health, education and community in general.
- Increased migration and cultural changes.
- Changes in institutional presence, social and political management as a result of population growth, expansion of the production frontier in the region and generation of social projects.

8.1.3. Conclusion of the environmental assessment stage without project

The conclusion from characterization of the area of influence is that there is a significant environmental damage on the biota, with severe impairment on plant cover, wildlife and hydro-biological communities, because of the pressure on terrestrial ecosystems and water sources exerted by human activities.

The negative effect on the biota, as a result of logging and forest plantations with alien species, contribute to the decline of floristic diversity in vegetation cover, which

consequently leads to a loss of wildlife biodiversity and in altering terrestrial and freshwater habitats.

Agricultural activities have gained ground causing changes in vegetation cover, modifying social patterns and contaminating the different environments.

At a biotic level, the greatest impairment is on water resources, which in time, will not only increase changes in the dynamics and quality of the resource, but may lead to loss processes in water sources connection, their fountainheads to the lower parts of the land, disrupting natural ecosystems.

Soil and landscape are strongly influenced by the communities that use natural resources, who gradually modify it.

Socioeconomically and culturally there is a social dynamic that despite the development of the area in terms of expanding production frontiers, tourism and the provision of goods and services, has a strong and visible roots tradition.

The population hoards tangible and intangible cultural and heritage assets, observed in the organization and social, cultural and ethnic manifestations

8.2. Identification and impact evaluation for the scenario with project

The Rumichaca - Pasto Road Project, Pedregal – Catambuco span, Concession Contract under Scheme APP No. 15, 2015, is developed in three stages: Pre-construction, Construction, Abandonment and Final Restoration.

Table 8.48, lists project activities that will generate impacts

Table 8.44. Project activities generating impacts

Project stages	Activities
PRE-CONSTRUCTION	Community information processes and participation
	Land acquisition and easement
	Contract labor

Project stages	Activities
	Purchase and / or rent goods and services
BUILDING	Install and operate camps
	Install and operate process plants (asphalt, concrete, crushing)
	Mobilize construction materials, supplies, machinery, equipment, waste and vehicles.
	Operation and maintenance of machinery and / or equipment
	Top soil removal
	Vegetal cover removal
	Demolition
	Excavations and / or earthworks
	Operation of debris and excavation material Management Zone (ZODME).
	Install base, sub-base and pave
	Construction of hydraulic works and artworks
	Foundations and piloting
	Building superstructure for bridges and viaducts
	Installing and rolling asphalt layer
	Install pedestrian bridges
	Slope Treatment
	Revegetation
	Toll facility
ABANDONMENT AND FINAL RESTORATION	Dismantling of temporary facilities and camps
	Final cleaning of workstations
	Landscape management

Source: Gemini Environmental Consultants SAS, 2016

The project activities are described in Chapter 3, numeral 3.2.2. of this Environmental Impact Study.

8.2.1. Impact evaluation with project

Based on identification of activities to be carried out during project implementation, environmental impacts generate thereby on abiotic, biotic and socio-economic environment, their components and elements were identified. (See Table 8.49)

The result of the Environmental Impact Evaluation with project, used 3 matrixes: Identification, Nature, Valuation and Qualification.

The Identification and Nature matrix determined whether the impact produce by the activity has a negative or positive effect. (See Annex 8.2.1).

Table 8.45. Identification of environmental impacts generated by project activities

MEDIUM	COMPONENT	ELEMENT	ENVIRONMENTAL IMPACT
ABIOTIC	Geospheric	LANDFORMS	Mass removal phenomena
			Slope instability
			Erosion phenomena
		LANDSCAPE	landscape modification
		SOIL	Change in soil structure
			Modification of the current land use
		Hydrogeology	Impairment on quality and quantity of groundwater
	HYDRIC	SUPERFICIAL WATER	Changes in the physicochemical characteristics of surface water
			Obstruction or alteration of riverbeds, margins and water rounds
			Change in supply of water resources

MEDIUM	COMPONENT	ELEMENT	ENVIRONMENTAL IMPACT
	ATMOSPHERIC	AIR QUALITY	Change in air quality
			Change in sound pressure levels
BIOTIC	LAND AND WATER ECOSYSTEMS	FLORA	Change in surface cover of forests and semi-natural areas
			Changes in the composition and structure of natural and semi-natural ecosystems
		FLORA, FAUNA AND HYDROBIOLOGICAL C.	Fragmentation and changes in habitat connectivity
		FAUNA	Changes in wildlife composition and structure
		HYDRO-BIOLOGICAL COMMUNITIES	Alteration in composition and structure of hydro-biological communities
SOCIOECONOMIC	SOCIO-ECONOMIC AND CULTURAL	POPULATION ISSUES	Changes in population dynamics
		ECONOMY	Change in supply and demand for goods and services
			Modification of the economic activities of AID families
			Change in employment dynamics
		INFRASTRUCTURE OF GOODS AND SERVICES AND PUBLIC SOCIAL	Impairment of social and economic infrastructure
			Change in existing road infrastructure

MEDIUM	COMPONENT	ELEMENT	ENVIRONMENTAL IMPACT
			Change in mobility conditions
		ADAPTIVE AND CULTURAL STRATEGIES	Generating employment expectations
			Change in quality of life
			Changing expectations on land value
			Changing expectations on revenues from sales of goods and services
			Change in relations: community-community, community-authorities, community-authorities-business
			Generating community discomfort
			Change in organizational capacity and management of social organizations , unions, civic, public or private communities
			Changes of everyday life, customs and lifestyles
		POLITICAL	Change in the dynamics of institutional management

Source: Gemini Environmental Consultants SAS, 2016

The valuation matrix determined the attributes of the impacts: Intensity (I), Extension (EX), Moment (MO), Persistence (PE) Reversibility (RV), Synergy (SI), Accumulation (AC) Effect (EF), Periodicity (PR) and Recoverability (MC). (See Annex 8.2.1).

Follows the impacts generated by project activities during execution thereof on the abiotic, biotic and socio-economic environment, based on its environmental importance (IA).

8.2.1.1. Abiotic environment

- *Geospheric component*

o Landforms

ü Mass removal phenomena

The impact is generated by activating the removal processes in the AI due to project activities.

This type of phenomenon can occur by making cuts, excavations, fillings and other project activities requiring AI landforms.

Table 8.50. shows AI impacts

Table 8.50 Environmental impact importance from landslides phenomena

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDFORMS	Installation and operation of camps	COMPATIBLE = -25
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -25
	Operation and maintenance of machinery and / or equipment	COMPATIBLE = -27
	Soil stripping	COMPATIBLE = -38
	Top soil removal	COMPATIBLE = -32

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Excavations and / or earthworks	COMPATIBLE = -34
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -48
	Construction of hydraulic works and artworks	COMPATIBLE = -38
	Foundations and piloting	MODERATE = -40
	Building superstructure for bridges and viaducts	MODERATE = -40
	Slope Treatment	PRO HEIGHT = 41
	Plant grass and revegetate	BENEFICIAL = 53
	Landscape management	PRO = 30

Source: Gemini Environmental Consultants SAS, 2016

The activities with the greatest negative effect of landslides phenomena will be the ZODMES operation, foundation and piloting and construction of the superstructure for bridges and viaducts in the construction stage. Also, the positive effect will by the revegetation processes. However, the negative impacts identified can be easily handled because its importance is moderate.

ü Slope instability

The impact may be generated by cave ins, landslides, flows and complex movements due to cuts and earthworks that will cause alteration of the initial conditions and terrain features.

Table 8.51 shows AI impacts

Table 8.46 importance Ambiental impact slope instability

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDFORMS	Installation and operation of camps	COMPATIBLE = -24
	Removal vegetal cover	COMPATIBLE = -38
	Stripping	COMPATIBLE = -38
	Excavations and / or earthworks	COMPATIBLE = -38

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -45
	Base installation, sub-base and paving	COMPATIBLE = -35
	Construction of hydraulic works and artworks	FAVORABLE HIGH = 50
	Slope Treatment	PRO HEIGHT = 44
	Grassing and revegetation	BENEFICIAL = 52
	Dismantling of temporary facilities and camps	COMPATIBLE = -21

Source: Gemini Environmental Consultants SAS, 2016

The activity with greatest negative affect negative on slope stability will be the ZODME operation. Also, most positive affect will be the revegetation processes. However, negative impacts identified can be easily handled because their importance is moderate.

ü Erosion phenomena

The impact is generated by wear or denudation of soils and rocks that produce different processes on the surface of the earth; human activities alter soil compaction balance.

Cuts and soil excavation to obtain raw materials and livestock generate imbalance in soil compaction.

Table 8.52. shows AI impacts

Table 8.47 Environmental importance of erosion phenomena impacts

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDFORMS	Installation and operation of camps	COMPATIBLE = -38
	Top soil removal	MODERATE = -42
	Stripping	COMPATIBLE = -38
	Excavations and / or earthworks	COMPATIBLE = -34
	Construction of hydraulic works and artworks	FAVORABLE HIGH = 45
	Foundations and piloting	MODERATE = -43

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Building superstructure for bridges and viaducts	MODERATE = -45
	Slope Treatment	FAVORABLE HIGH = 44
	Landscape management	FAVORABLE = 37

Source: Gemini Environmental Consultants SAS, 2016

The activities with greatest negative affect in triggering landslides phenomena will be removing the top soil, the foundation and piloting and construction of the superstructure for bridges and viaducts in the construction stage. However, these impacts can be easily managed because its importance is moderate.

- Landscape

ü Landscape modification

The impact may be generated mainly by intervention of the vegetal cover, earthworks, construction and modification of infrastructure. However, all surface activities alter in one way or another current landscape conditions.

Table 8.53 show AI impacts

Table 8.48 Environmental impact importance of landscape modification

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
LANDSCAPE	Installation and operation of camps	MODERATE = -51
	Installation and operation of process plants (asphalt, concrete, crushing)	MODERATE = -51
	Operation and maintenance of machinery and / or equipment	COMPATIBLE =-37
	Topsoil removal	COMPATIBLE =-35
	Stripping	MODERATE = -46
	Demolition	MODERATE = -fifty
	Excavations and / or earthworks	MODERATE = -fifty

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -40
	Construction of hydraulic works and artworks	COMPATIBLE =-25
	Foundations and piloting	COMPATIBLE =-31
	Building superstructure for bridges and viaducts	COMPATIBLE =-32
	Installing and rolling asphalt layer	MODERATE = -47
	Installation of pedestrian bridges	COMPATIBLE =-31
	Slope Treatment	MODERATE = -43
	Grassing and revegetation	FAVORABLE HIGH =51
	Toll facility	COMPATIBLE =-28
	Dismantling of temporary facilities and camps	FAVORABLE =27
	Final cleaning of workstations	FAVORABLE =26

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative effect on the landscape will be the installation and operation of process plants (asphalt, concrete, grinding), stripping, top soil removal, ZODMES operation, and laying and rolling the asphalt layer among others. Also, the most positive effects will be revegetation, dismantling of temporary installations, camps and final cleaning of the workstations in the abandonment stage and final restoration. However, the negative impacts identified can be easily handled because they have a moderate importance.

- Soil

ü Changes in soil structure

The impact can be generated by removal and compaction, earth moving, construction and installation of infrastructure, changing the initial soil characteristics.

Table 8.54. shows AI impacts

Table 8.49 Environmental impact importance of Changes in soil structure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
FLOOR	Installation and operation of camps	COMPATIBLE = -30
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -32
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	- COMPATIBLE = 38
	Operation and maintenance of machinery and / or equipment	MODERATE = -42
	Topsoil removal	COMPATIBLE = -36
	Stripping	-75
	Demolition	COMPATIBLE = -28
	Excavations and / or earthworks	MODERATE = -47
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -50
	Installation base, sub-base and paving	COMPATIBLE = -33
	Foundations and piloting	MODERATE = -40
	Building superstructure for bridges and viaducts	COMPATIBLE = -22
	Slope Treatment	MODERATE = -40
	Grassing and revegetation	ENEFICIOSO = 58
	Dismantling of temporary facilities and camps	FAVORABLE = 36
	Final cleaning of workstations	FAVORABLE = 29
	Landscape management	FAVORABLE HIGH = 45

Source: Gemini Environmental Consultants SAS, 2016

The activity that will significantly affect the soil is stripping, because all the soil is removed to develop other project activities, although this impact cannot be avoided, the management plan will include all necessary measures to ensure this impact is managed. Moreover, grassing and revegetation help restore affected soils, so it has a positive impact.

ü Modification of current land use

The impact may be generated by changes on land use vocation most of which are used for agriculture, livestock and / or residential, by intervention of road infrastructure, which can also generate changes in other productive activities.

Table 8.55. shows IA impacts

Table 8.50 Environmental impact importance from modifying current land use

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SOIL	Installation and operation of camps	COMPATIBLE = -33
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -33
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	COMPATIBLE = -36
	Operation and maintenance of machinery and / or equipment	MODERATE = -42
	Topsoil removal	SEVERE = -62
	Demolition	COMPATIBLE = -28
	Operation Management Zone debris and excavation material (ZODME)	MODERATE = -48
	Foundations and piloting	COMPATIBLE = -32
	Slope Treatment	FAVORABLE HIGH = 43
	Grassing and revegetation	BENEFICIAL = 58
	Dismantling of temporary facilities and camps	FAVORABLE = 36
	Final cleaning of workstations	FAVORABLE = 28
	Landscape management	FAVORABLE HIGH = 45

Source: Gemini Environmental Consultants SAS, 2016

The activity generating the most negative effect on the current land use, being severe, they will be the removal of vegetation cover. Also, the most positive effect will be the revegetation.

o Hdrogeology

ü Impairment of groundwater quality and quantity

The impact may be generated by surface activities that could produce a spill or leak of toxic substances on the surface that may infiltrate (oils and greases, waste water, waste, chemical, etc.).

Table 8.56. shows AI impacts

Table 8.51 Environmental impact importance from impairing groundwater quality and quantity

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Hydrogeology	Operation and maintenance of machinery and / or equipment	MODERATE = -39
	Topsoil removal	COMPATIBLE =-25
	Stripping	COMPATIBLE =-37
	Excavations and / or earthworks	MODERATE = -40
	Construction of hydraulic works and artworks	COMPATIBLE =-26
	Foundations and piloting	MODERATE = -40
	Building superstructure for bridges and viaducts	COMPATIBLE =-38
	Slope Treatment	MODERATE = -40

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on the physical-chemical composition of groundwater, being moderate, will be excavations and / or earthworks and foundations and piloting.

- *Water component*

o Surface water

ü Change in physicochemical characteristics of surface water.

The impact may be generated mainly by sediments to water sources, during construction or assembly of infrastructure and generation of waste water.

Table 8.57. shows AI impacts

Table 8.52 Environmental impact importance of changes in the physicochemical characteristics of surface water

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SURFACE WATER	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	COMPATIBLE = -33
	Topsoil removal	COMPATIBLE = -30
	Stripping	COMPATIBLE = -36
	Excavations and / or earthworks	COMPATIBLE = -38
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -43
	Construction of hydraulic works and artworks	COMPATIBLE = -26
	Foundations and piloting	COMPATIBLE = -35
	Building superstructure for bridges and viaducts	MODERATE = -40
	Installing and rolling asphalt layer	MODERATE = -49
	Slope Treatment	COMPATIBLE = -27
	Dismantling of temporary facilities and camps	FAVORABLE HIGH = 45

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on the physicochemical characteristics of surface water, although with a moderate impact, are ZODMES operation, laying and rolling asphalt layer. Also, the most positive effect will dismantling.

ü Obstruction or alteration of riverbeds, margins and water rounds.

The impact can be generated by earthworks, which can disrupt and alter the level of water sources; likewise, sediments may affect the natural pattern of the channels.

Table 8.58. shows AI impacts

Table 8.53 Environmental impact importance from obstructing or altering riverbeds, margins and water rounds.

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SUPERFICIAL WATER	Installation and operation of camps	COMPATIBLE = -25
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -25
	Operation and maintenance of machinery and / or equipment	MODERATE = -50
	Topsoil removal	MODERATE = -40
	Stripping	MODERATE = -45
	Excavations and / or earthworks	MODERATE = -50
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -46
	Construction of hydraulic works and artworks	MODERATE = -50
	Foundations and piloting	MODERATE = -40
	Building superstructure for bridges and viaducts	MODERATE = -40
	Slope Treatment	FAVORABLE HIGH = 50
	Grassing and revegetation	BENEFICIAL HIGH = 75
	Dismantling of temporary facilities and camps	COMPATIBLE = -18
	Landscape management	BENEFICIAL = 55

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on carrying capacity of water resources, even though their impact is moderate, will be the operation of machinery and / or equipment, stripping, removal of vegetation, excavation and / or earthworks, foundation, piling and construction of viaducts and bridges superstructure. Also, the most positive involvement will by revegetation.

ü Change in supply of water resources

The impact can be generated by improper consumption use required for the project and resource demand for the activities carried out in the area and an increase in the number of users of water sources and temporal variability.

Table 8.59. show AI impacts

Table 8.54 Environmental impact importance of changes in water resources supply

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
SUPERFICIAL WATER	Installation and operation of process plants (asphalt, concrete, crushing)	MODERATE = -40
	Installation base, sub-base and paving	COMPATIBLE = -33
	Foundations and piloting	COMPATIBLE = -19
	Installing and rolling asphalt layer	MODERATE = -43
	Slope Treatment	MODERATE = -40

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on the supply of water resources, although moderate, will be laying the asphalt layer and rolling, treatment of the slopes and installation and operation of process plants.

- *Atmospheric component*

o Air quality

ü Change in air quality

The impact can be generated by emission of gases and particulate material, which may have an effect on vegetation, animals and people in the area of influence.

Table 8.60. shows AI impacts

Table 8.55 Environmental impact importance of Changes in air quality

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
AIR QUALITY	Installation and operation of camps	COMPATIBLE = -22
	Installation and operation of process plants (asphalt, concrete, crushing)	MODERATE = -44
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	COMPATIBLE = -38
	Operation and maintenance of machinery and / or equipment	MODERATE = -45
	Topsoil removal	COMPATIBLE = -19
	Stripping	COMPATIBLE = -32
	Demolition	MODERATE = -50
	Excavations and / or earthworks	MODERATE = -43
	Debris and Excavation Material Operation Management Zone (ZODME)	MODERATE = -49
	Installing base, sub-base and paving	MODERATE = -40
	Foundations and piloting	COMPATIBLE = -24
	Building superstructure for bridges and viaducts	COMPATIBLE = -34
	Installing layer asphaltic and rolling	COMPATIBLE = -24
	Grassing and revegetation	FAVORABLE HIGH = 42
	Landscape management	FAVORABLE HIGH = 39

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on air quality, being moderate, will be installation and operation of process plants (asphalt, concrete, crushing), as the operation and maintenance of equipment and machinery, demolition, excavations, ZODMEs, laying the base and subbase and paving. Also, the most positive effects will be by revegetation and landscape management during the abandonment stage and final restoration.

ü Change in sound pressure levels.

The impact can be generated from noise from the operation and heavy machinery concentrated in the area during simultaneous activities.

Table 8.61. shows AI impacts

Table 8.56 Environmental impact importance from changes in sound pressure levels

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Sound pressure levels	Installation and operation of camps	COMPATIBLE = -20
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -20
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	COMPATIBLE = -38
	Operation and maintenance of machinery and / or equipment	MODERATE = -44
	Topsoil removal	COMPATIBLE = -33
	Stripping	COMPATIBLE =
	Demolition	MODERATE = -48
	Excavations and / or earthworks	MODERATE = -44
	Operation Management Zone debris and excavation material (ZODME)	MODERATE = -48
	Base installation, sub-base and affirmed	MODERATE = -51
	Construction of hydraulic works and artworks	MODERATE = -48
	Foundations and piloting	COMPATIBLE = -29
	Building superstructure for bridges and viaducts	COMPATIBLE = -26
	Installing layer asphaltic and rolling	MODERATE = -42
	Dismantling of temporary facilities and camps	MODERATE = -50

Activities generating the greatest negative impact on sound pressure levels, although moderate, will be demolition, excavation and / or earthworks, ZODME operations, laying base, subbase, and paving, construction of hydraulic structures and artworks, foundations and piling, building superstructure for bridges and viaducts; laying asphalt layer, rolling, dismantling temporary installations and camps during abandonment and

final restoration stage. Also, the most positive effect will be from operation and maintenance of machinery and / or equipment.

8.2.1.2. Biotic Environment

- *Land and water ecosystems component*

o Flora

ü Change in surface cover of forests and semi-natural areas

The impact will be generated by effects on herbaceous, shrubs and trees which directly modify the cover, which can cause the loss of many of plant species.

Table 8.62. show AI impacts

Table 8.57 Environmental importance of the impact surface modification hedge forests and semi-natural areas

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
FLORA	Stripping	MODERATE = -43
	Topsoil removal	SEVERE = -56
	revegetation	BENEFICIAL HIGH = 66
	Landscape management	BENEFICIAL = 43

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on the vegetation cover, being severe, will be stripping and removal of vegetation cover. Likewise, the positive impacts will be revegetation activities and landscape management (during the abandonment and final restoration stage).

ü Changes in of natural ecosystems composition and structure

Table 8.63 shows AI impacts

Table 8.58 Environmental impact importance modifications in the composition and structure of natural and semi-natural ecosystems

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
FLORA	Stripping	MODERATE = -43
	Topsoil removal	SEVERE = -42
	Revegetation	BENEFICIAL HIGH = 36
	Landscape management	BENEFICIAL = 37

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on the composition and structure of natural and semi-natural ecosystems corresponds to topsoil removal with a severe impact, followed by stripping with a moderate impact.

- Flora, fauna and hydro-biological communities

ü Fragmentation and changes in habitat connectivity

The impact will be generated primarily by eliminating vegetable cover used by wildlife as feeding sites or for crossing, roosting, burrows, etc. Thus, fragmentation will occur from loss of continuity of natural resources and especially for reproduction, maintenance of the eating habits, the survival of the species.

Table 8.64. shows AI impacts

Table 8.59 Environmental impact importance from fragmentation and changes in habitat connectivity

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Topsoil removal	SEVERE = -58
	Excavations and / or earthworks	SEVERE = -57
	Water construction works	MODERATE = -49
	Foundations and piloting	MODERATE = -39
	Revegetation	PRO = 36
	Landscape management	PRO = 34

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on habitat fragmentation, being severe, will be vegetation cover removal and excavations and / or gradings. The latter are highlighted, since construction of the second carriageway requires large cuts that will synergistically cause effects together with the damages caused by the existing road, mobility and movement of land fauna.

Likewise, severe impacts on freshwater habitats are expected during the construction of water works and foundation and piloting activities.

o Fauna

ü Changes in wildlife composition and structure

Table 8.65. shows AI impacts

Table 8.60 Environmental impact importance of modifications in wildlife composition and structure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Fauna	Installation and operation of camps	COMPATIBLE = -27
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	COMPATIBLE = -28
	Operation and maintenance of machinery and / or equipment	COMPATIBLE = -34
	Stripping	MODERATE = -53
	Topsoil removal	SEVERE = -54
	Excavations and / or earthworks	SEVERE = -47
	Debris and Excavation Material Operation Management Zone (ZODME).	SEVERE = -39
	Construction of waterworks	SEVERE = -42
	Foundations and piloting	COMPATIBLE = -32

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Revegetation	FAVORABLE = 33
	Dismantling of temporary facilities and camps	COMPATIBLE = -37
	Landscape management	FAVORABLE = 34

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on wildlife composition and structure, being severe, will be excavations, ZODME operation, and water works construction. These impacts are mainly associated with the operation of machinery, travel of vehicles and dump trucks, and direct intervention on water bodies in places where riverbed occupation for water works construction permit is granted. The moderate and less important impacts are those related to removal of vegetation cover and stripping.

- Hydro-biological communities

ü Alteration in the composition and structure of hydro-biological communities

The impact is mainly generated by intervention of the areas adjacent to the water sources, which affected the hydro-biological communities such as phytoplankton, zooplankton, periphyton, benthos and macrophytes will initially obey to changes in the physiochemical characteristics of the water, due to intervention of vegetal cover that that act as protection.

In the particular case of the Guáitara River, whose low riparian cover and erosion of the surrounding terrain, requires strict implementation of management measures for their protection and conservation, without denying that today there is already a significant environmental damage in the study area due to poor disposal of solid and liquid waste discharging into this body of water.

Table 8.66 shows AI impacts

Table 8.61 Environmental impact importance from Alteration in composition and structure of hydro-biological communities

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Hydro-biological communities	Installation and operation of camps	COMPATIBLE = -26
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles	COMPATIBLE = -29
	Stripping	MODERATE = -42
	Topsoil removal	COMPATIBLE = -34
	Demolition	MODERATE = -41
	Excavations and / or earthworks	MODERATE = -44
	Debris and Excavation Material Operation Management Zone (ZODME).	MODERATE = -44
	Installation base, subbase and paving	COMPATIBLE = -38
	Construction of hydraulic works and artworks	MODERATE = -41
	Foundations and piloting	COMPATIBLE = -34
	Building superstructure for bridges and viaducts	COMPATIBLE = -20
	Installing and rolling asphalt layer	COMPATIBLE = -32
	Installation of pedestrian bridges	COMPATIBLE = -19
	Slope Treatment	COMPATIBLE = -36
	Revegetation	FAVORABLE HIGH = 51
	Toll facility	MODERATE = -39
	Dismantling of temporary facilities and camps	COMPATIBLE = -36
	Final cleaning of workstations	FAVORABLE HIGH = 43
	Landscape management	PRO = 32

Source: (Gemini SAS Consultants, 2016)

Activities generating the greatest negative impact on the composition and structure of hydro-biological communities, even if moderate, will be stripping, demolition, excavation, operation of machinery and equipment, water works construction and toll installation.

8.2.1.3. Socioeconomic environment

- *Component socioeconomic and cultural aspects*

o Population issues

ü Change in population dynamics

The arrival at the area of a new road infrastructure project and therefore the expectations of hiring labor expected during development thereof can generate speculation on the demand for unskilled labor and therefore strong population mobility offering their labor.

Thus, it is considered that population mobility may modify the population dynamics by generating employment expectations in populations around the AI municipalities. Similarly, the arrival of personnel hired as skilled labor from other regions of the country will undoubtedly increase population size and thus an alteration in population structure.

Table 8.67. shows AI impacts

Table 8.62 Environmental impact importance from Changes in population dynamics

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
POPULATION ISSUES	Information processes and community participation	COMPATIBLE = -23
	Land acquisition and easement	COMPATIBLE = -28
	Labor contracting	COMPATIBLE = -27
	Installation and operation of camps	MODERATE = -44
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	COMPATIBLE = -35

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Building superstructure for bridges and viaducts	MODERATE = -50

Source: Gemini Environmental Consultants SAS, 2016

Activities generating the greatest negative impact on population dynamics and employment, being severe, are installation and operation of camps and construction of superstructures for viaducts and bridges due to the high labor demand implied by this activity.

o Economy

ü Change in supply and demand for goods and services

The impact is particularly generated by the provision of goods and services from the community to the work according to its needs during the construction phase and the abandonment and final restoration stage, considered as a positive impact, since it will promote income for the communities in the area of influence.

Table 8.68. shows AI impacts.

Table 8.63 Environmental impact importance of changes in supply and demand for goods and services.

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Economy	Labor contracting	FAVORABLE = 26
	Purchase and / or rental of goods and services	FAVORABLE = 33
	Installation and operation of camps	FAVORABLE = 26
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	FAVORABLE = 26
	Operation and maintenance of machinery and / or equipment	FAVORABLE = 29

Source: Gemini Environmental Consultants SAS, 2016

There is no negative effect activity on the supply and demand of goods and services. Also, most positive effects will by the purchase and / or rental of goods and services.

ü Modification of economic activities of AID families

A new infrastructure project in the area and with it the creation of employment expectations generating additional revenues may lead villagers to discontinue their traditional economic activities and focus on achieving labor places or sale of goods and services increasing the location of informal trading stands.

Table 8.69. shows AI impacts

Table 8.64 Environmental impact importance from modifying the economic activities of AID families

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Economy	Land acquisition and easement	COMPATIBLE = -37
	Labor contracting	COMPATIBLE = -35
	Purchase and / or rental of goods and services	COMPATIBLE = -29

Source: Gemini Environmental Consultants SAS, 2016

Activities adversely affected even if this impact is compatible will be the property purchase and easement and contracting labor. Also, the most positive effects will be landscape management during abandonment and final restoration stage.

ü Change in employment dynamics

The impact will be generated by changes in the direct or indirect employment processes from hiring skilled and unskilled labor during project implementation and from acquiring goods and services from the community as an alternative of opportunities.

Table 8.70 shows AI impacts

Table 8.65 Environmental impact importance from changes in the dynamics of employment

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Economy	Labor contracting	FAVORABLE HIGH = 44
	Purchase and / or rental of goods and services	FAVORABLE HIGH = 40

Source: Gemini Environmental Consultants SAS, 2016

o Infrastructure of Goods and Social Services and Utilities

ü Impairment of social and economic infrastructure

The impact will be generated by changes in the housing infrastructure and community infrastructure, given by their modification, relocation or change needed for project development.

Table 8.71. shows AI impacts

Table 8.66 Environmental impact importance due to impairment in social and economic infrastructure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Infrastructure of Goods and Social Services and Utilities	Land acquisition and easement	MODERATE = -41
	Installation and operation of camps	MODERATE = 42
	Installation and operation of process plants	MODERATE = -42

	Mobilization of construction materials, supplies and machinery	MODERATE = -43
	Operation management zones of debris and excavation material	MODERATE = -40

Source: Gemini Environmental Consultants SAS, 2016

The negative affect activity on alteration of the social and economic infrastructure is considered as a moderate space with similar qualification in activities involving the need to acquire land or intervene any area of social and / or community interest.

ü Change in the existing road infrastructure

The impact will be generated because the area where the project is proposed there is a settled population that has housing infrastructure and community infrastructure, which in some cases will be required for the project, which implies a necessary modification thereto, and where not, activities such as mobilizing construction materials activities can structurally affect them which in turn may result in a modification thereof. On the other hand, it is considered as positive for those activities that involve improving existing road where the project is expected to develop.

Table 8.72. shows AI impacts

Table 8.67 Environmental impact importance of changes in existing road infrastructure

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Infrastructure of Goods and Social Services and Utilities	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	MODERATE = -43
	Building superstructure for bridges and viaducts	BENEFICIAL = 54
	Installation of pedestrian bridges	PRO = 33
	Toll facility	COMPATIBLE = -21

Source: Gemini Environmental Consultants SAS, 2016

ü Change in mobility

The impact will be generated by interrupting mobility and restricted passage of the population living in the area of influence as a result of possible closures during the course of construction or the increase in number of vehicles traveling on the roads of the area of influence of the project.

Table 8.73. shows AI impacts

Table 8.68 Environmental impact importance of changes in mobility

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	MODERATE = -50
	Debris and Excavation Material Operation Management Zone (ZODME).	MODERATE = -40
	Landscape management	FAVORABLE HIGH = 50

Source: Gemini Environmental Consultants SAS, 2016

The negative affect activity on change in mobility, being moderate, will be mobilization of building materials, supplies, machinery, equipment, waste and vehicles.

o Adaptive and cultural strategies

ü Generating employment expectations

The impact will be generated by the perception by the population regarding the benefits brought by the road, to generate employment for the inhabitants of the region, both skilled and unskilled labor, the opportunity to other business activities and the provision of goods and services; and the creation of infrastructure to meet the cultural, educational and sporting needs.

Table 8.74. shows AI impacts

Table 8.69 Environmental impact importance of labor generation expectations

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Information processes and community participation	COMPATIBLE = -23
	Labor contracting	MODERATE = -39
	Purchase and / or rental of goods and services	COMPATIBLE = -36
	Installation and operation of camps	MODERATE = -45
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -35
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	MODERATE = -48
	Operation and maintenance of machinery and / or equipment	COMPATIBLE = -29
	Debris and excavation material operation management zone	COMPATIBLE = -36

Source: Gemini Environmental Consultants SAS, 2016

Negative affect activities on generation of expectations, even if moderate, will be labor contracting, installation and operation of camps, installation and mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.

ü Change in quality of life

The quality of life in a population is measured by the satisfaction of their basic needs, thus labor contracting in the area of influence of the project and the purchase of goods and services in the area, increase the possibility of its people to meet their immediate basic needs through increased purchasing power in an area where employment opportunities are restricted, reason why this is considered a positive impact. On the other hand,

activities that could potentially affect the tranquility of the population and in that sense their quality of life is classified as a negative impact.
Table 8.75. shows AI impacts

Table 8.70 Environmental impact importance from changes in quality of life

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Labor contracting	PRO = 24
	Purchase and / or rental of goods and services	PRO = 24
	Installation and operation of process plants (asphalt, concrete, crushing)	MODERATE = -44
	Demolition	COMPATIBLE = -34
	Excavations and / or earthworks	COMPATIBLE = -34
	Debris and excavation material operation management zone	COMPATIBLE = -36

Source: Gemini Environmental Consultants SAS, 2016

ü Changing expectations on land value

Speculation generated by the project in relation to land acquisition begins to generate a strong expectation that has been reverberating in an accelerated increase in the value of the land and consequent speculation. Additionally, considering that these are productive social units the values are subject to considerable increases and must be evaluated in the light of Resolution 545 of 2008 when carrying out the applicable socioeconomic compensation process. In that sense, it is defined as a negative impact.

Table 8.76. shows AI impacts

Table 8.71 Environmental impact importance of changing expectations on land value

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Information processes and community participation	COMPATIBLE = -23

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
ADAPTIVE AND CULTURAL STRATEGIES	Installation and operation of camps	COMPATIBLE = -26

Source: Gemini Environmental Consultants SAS, 2016

ü Changing expectations of revenues from sales of goods and services

Higher income of population contracted in project implementation and the arrival of professional staff accruing higher salaries can change expectations in revenues by selling goods and services in the municipalities in the area of influence from the supply side. This situation is occurring because traders, for example, expect higher revenues for their products on the premise that those working in this type of projects receive higher incomes and therefore have greater payment capacity.

This situation in turn may interfere with the cost of living of the population as speculation can influence prices of goods and services offered by merchants and population of the area of influence. The presence of foreign personnel will undoubtedly lead to a higher demand for goods and services without project incursion leading to price speculation, increasing the cost of the family basket for those who are not hired or negotiated lands or are traders, with negative effects because their ability to meet their basic needs (utilities, education, health, food), becomes more difficult.

Table 8.77. shows AI impacts

Table 8.72 Environmental impact importance of changing revenues expectations from sales of goods and services

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
ADAPTIVE AND CULTURAL STRATEGIES	Information processes and community participation	COMPATIBLE = -23
	Labor contracting	COMPATIBLE = -32
	Purchase and / or rental of goods and services	COMPATIBLE = -24

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Installation and operation of camps	MODERATE = -41
	Mobilization of construction materials, supplies machinery	MODERATE = -40

Source: Gemini Environmental Consultants SAS, 2016

ü Changing expectations of revenues from sales of goods and services

Higher income for population contracted in project implementation and the arrival of professional staff accruing higher salaries can change revenue expectations by selling goods and services in the municipalities in the area of influence from the supply side. This situation is occurring because traders, for example, expect higher revenues for their products on the premise that those working in this type of projects receive higher incomes and therefore have greater payment capacity.

This situation in turn may interfere with the cost of living of the population as speculation can influence prices of goods and services offered by merchants and population of the area of influence. The presence of foreign personnel will undoubtedly lead to demand for goods and services exceeds the lawsuit filed without the incursion of the project in the area which makes speculation in prices, increasing the cost of the basket for those who are not or negotiation related land held or traders, affecting them negatively because their ability to meet their basic needs (public services, education, health, food), become more difficult.

Table 8.78. shows AI impacts

Table 8.73 Environmental impact importance of changing revenues expectations from sales of goods and services

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
ADAPTIVE AND CULTURAL STRATEGIES	Information processes and community participation	COMPATIBLE = -23
	Labor contracting	COMPATIBLE = -32

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Purchase and / or rental of goods and services	COMPATIBLE = -24
	Installation and operation of camps	MODERATE = -41
	Mobilization of construction materials, supplies, machinery	MODERATE = -40

Source: Gemini Environmental Consultants SAS, 2016

ü Change in community-community, community-authorities, community-authorities-business relations

The project with its actions seeks to consolidate good relations between each actor involved in the process (community- company - authorities) expecting thereby that those relations that are broken today, by project development are strengthened and have the same goal, which will be a constant goal from social management area of the concession and is considered strategic to the development of some activities that will allow their consolidation provided they are executed in the framework of respect and strengthening of the trust and credibility processes.

Table 8.79 shows AI impacts

Table 8.74 Environmental impact importance of changes in community-community, community-authorities, community-authorities-business relations

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Land acquisition and easement	PRO = 18
	Labor contracting	PRO = 18
	Purchase and / or rental of goods and services	PRO = 24

Source: Gemini Environmental Consultants SAS, 2016

ü Generating community discomforts

During the development of related activities the communities may be inconvenienced which could undoubtedly be an obstacle when creating good relations and bonds of trust with the community.

Discomfort may be twofold with regard to hiring labor: first, in agreeing payments and working conditions, and two, in the number of contingent job opportunities. Conflicts can arise between community members, JAC representatives and contractor company members.

Machinery and equipment mobilization activities, machinery operation, ZODMES, among others are actions that include traffic of foreign elements during the term to develop these activities, as well as installation of foreign elements such as generators and other machinery necessary for the development thereof; the aforesaid can cause discomfort in the community by activities they are not used to.

Table 8.80 shows AI impacts.

Table 8.75 Environmental impact importance from generation community discomfort

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Land acquisition and easement	MODERATE = -48
	Labor contracting	COMPATIBLE = -28
	Purchase and / or rental of goods and services	COMPATIBLE = -36
	Installation and operation of camps	MODERATE = -48
	Installation and operation of process plants (asphalt, concrete, crushing)	MODERATE = -40
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	MODERATE = -45
	Operation and maintenance of machinery and / or equipment	MODERATE = -50

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Stripping	COMPATIBLE = -36
	Demolition	MODERATE = -50
	Excavations and / or earthworks	MODERATE = -42
	Debris and excavation material Operation Management Zone (ZODME).	MODERATE = -45
	Toll facility	MODERATE = -50

Source: Gemini Environmental Consultants SAS, 2016

ü Change in organizational capacity and management of social organizations, unions, civic, public or private communities

Community Action Boards are identified as grassroots organizations in the AI counties who play a fundamental role and are mediators from recruitment processes to project activities that generate impacts on the environment.

The pre-construction stage of the project and the structuring process has generated a change in organizational processes allowing communities to not only seek support in the JAC but also spaces, to organize themselves and be an active part forming today organizations seeking to ensure the best interests of their communities

Table 8.8.1. shows AI impacts

Table 8.76Environmental impact importance of change in organizational capacity and management of social, professional, civic community organizations; public or private

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Information processes and community participation	FAVORABLE = 25
	Land acquisition and easement	FAVORABLE = 18

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Labor contracting	FAVORABLE = 24
	Purchase and / or rental of goods and services	FAVORABLE = 24

Source: Gemini Environmental Consultants SAS, 2016

ü Changes in everyday life, customs and lifestyles

The impact is mainly generated by intervened land acquisition processes and payment of easements, among others, generating changes in everyday life, customs and lifestyles, productive and commercial activities as it will change the social fabric.

Likewise, upon arrival in the area of foreign staff as part of skilled labor contracts for project implementation, it is possible that a change in the cultural patterns of the area may occur, considering that hired staff comes from other regions which can lead to a clash in cultural practices, permeating the culture and idiosyncrasy of regional population and partially change the values and cultural practices in the area.

As a matter of grave concern, the population state contingent raises in rates of prostitution and single mothers in the AI, where very young women focus their interests in the pursuit of economic resources and prostitution is an alternative.

Table 8.82. shows AI impacts

Table 8.77 Environmental impact importance from Changes in everyday life, customs and lifestyles

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Adaptive and Cultural Strategies	Land acquisition and easement	COMPATIBLE = -27
	Labor contracting	MODERATE = -42
	Purchase and / or rental of goods and services	COMPATIBLE = -31
	Installation and operation of camps	MODERATE = -40

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
	Installation and operation of process plants (asphalt, concrete, crushing)	COMPATIBLE = -31
	Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.	MODERATE = -40
	Operation and maintenance of machinery and / or equipment	MODERATE = -44
	Debris and excavation material Operation Management Zone (ZODME).	MODERATE = -47
	Toll facility	COMPATIBLE = -38

Source: Gemini Environmental Consultants SAS, 2016

- Political

ü Change in the dynamics of institutional management

The impact will be generated by the likely cultural and archaeological excavation intervention processes, which will be additional to the social one.

Table 8.83. shows AI impacts

Table 8.78 Environmental impact importance from changes in the dynamics of institutional management

ENVIRONMENTAL ELEMENT	ACTIVITY	IMPORTANCE
Political	Information processes and community participation	FAVORABLE = 25
	Labor contracting	FAVORABLE = 18
	Purchase and / or rental of goods and services	FAVORABLE = 24
	Toll facility	FAVORABLE = 28

Source: Gemini Environmental Consultants SAS, 2016

Impairment of the dynamics in institutional management will be positive by the purchase and / or rental of goods and services and toll facility

8.2.2. Analysis of environmental impairment in the area of influence

The environmental evaluation of scenario with project allows analyzing project activities that affect the abiotic, biotic and socioeconomic resources and environmental elements.

· Impairment of the geosphere component

- *Soil*

Excavations and / or leveling, cuts and access conditioning will change land shapes according to the technical specifications of the works to be built in the project. Construction of the ZODMES will also change land shapes, both by landfill and for lifting when shaping terraces.

Impairment occurs along the road corridor and the ZODMES; especially where there are cuts and fills for slope stabilization. That is, impairment to the soil component occurs on what has been called the project intervention area, so that for this component, as previously explained in Chapter 4, said area is established as that where the environmental impacts are evidenced and therefore its area of influence.

Impacts on land shapes may potentiate morphodynamic processes and generate instability in specific sectors of the section under construction. However, all second road designs have necessary support geotechnical studies to ensure stability of the works and the ground in each of the construction activities.

Impairment of this component is residual, in terms of changes in land shapes, since construction of the road and the ZODMES are permanent.

- *Morphodynamic processes*

Opencast activities increase the erosive processes because of extensive modifications from linearity slope cuts, especially due to ground vibrations, which must withstand the

carried load. Likewise, there will be increased exposure of land without vegetation cover and material breakout.

Impairment will be present along the road corridor, especially in areas with stripping and vegetation cover removal activities, although management measures for overlay and / or slope stability are considered.

Impairment will be limited to the construction stage since the fine material will be exposed and affected by weather conditions such as rain and wind and mechanical conditions resulting from vehicular traffic, mainly.

Revegetation of some spans will allow restoring vegetation cover, protecting the soil and minimizing the effect of morphodynamic processes.

- *Soil use*

Project implementation involves changes in land use due to permanent impairment of mulches, such as livestock pasture, agricultural mosaics, among others. Likewise, the associated temporary infrastructure during construction will influence the change of use.

Stripping and removal of vegetation cover activities as part of road assurance to improve, among others, corridor visibility will alter the soil protection use provided by tree cover, which will be compensated according to plan environmental management.

In areas where industrial plants and the ZODMES will be installed, production activities will be reorganized according to capacity and land use, taking into account generated changes.

Impairment occurs along the corridor where the road corridor, the ZODMES areas and industrial plants are built.

§ Impairment of this component, as to land-use change is Residual because this will be permanent after completion of the construction stage

- *Physicochemical soil conditions*

Removal of the vegetation cover in the area of influence of the project will cause changes in the physicochemical properties of the soil because of stripping, causing soil exposure to weather conditions, sun, wind, rain, temperature, among others, as well as pollution caused by accidental or anthropic action.

Impairment will occur along the road corridor and ZODMES, drainage works where slopes are shaped or specific areas with medium to low slope.

- *Landscape*

The scenery along the road corridor and the area of influence will be significantly affected because of the activities of the construction phase of the project, such as removing vegetation cover and stripping, demolishing existing infrastructure and housing, relocation of infrastructure and interrupted utilities, intervention of artificial water bodies, excavations and cuts, construction of artworks, horizontal and vertical signage, installation and operation of temporary infrastructure, shaping slopes and use of explosives (if required), construction of special works, adapting accesses, building drainage and underdrain, disposal of scrap material excavation, morphological shaping of the intervention area, and other road related activities.

Implementation of the activities implies the presence of infrastructure and personnel, mobilization of specialized machinery and vehicle fleet associated with the project to transport light and heavy load, which will have a significant effect on the quality of the landscape in the area of influence.

Positive affect on this component is primarily related to revegetation, signs during construction, maintenance of artworks, infrastructure and vegetation on the right of way, recovery of road signs, and finally decommissioning, closure and abandonment of temporary infrastructure that will allow reshaping the landscape units in scenarios recovered under a plan of environmental management and ecological restoration.

Like all road corridors, the Rumichaca - Pasto Dual Carriageway Road Project, Pedregal – Catambuco Span, Concession Contract under scheme APP No. 15 of 2015, becomes an alien element to the natural landscape, favoring fragmentation of natural hedges, deteriorating visual quality, so that road construction will increase the fragility of the

surrounding vegetation cover, causing an impact that is not only of a visual nature but functional and structural on the component.

The project implies greater environmental impairment in the construction stage since there will be spillover effects that act in synergy with the biotic and social components. As such, the restoration and recovery of intervened area will have a positive involvement, since once the natural vegetation cover is established, soil protection and reduced erosion processes will be achieved, enabling the structural and functional reconfiguration of these spaces at the landscape level, adjusted to the specific management plan implemented.

Human activities have influenced the landscape where the impairment synergy has determined the gradual transformation of the landscape of the surrounding area.

§ Landscape impairment on this component increases the synergy, is cumulative and residual; nevertheless, the magnitude of the impact does not differ from current scenario (without project), although management will be done through prevention, mitigation, control and compensation, structured in the Environmental Management Plan.

· Impairment on the water component

- *Drainage system*

The natural drainage system will be replaced by canals, ditches, drains, sumps, sink, sewers, among others, affecting the natural flow of water bodies and, temporarily, the physical, biological and chemical balance.

In addition, construction activities will produce particulate material and debris that affect the transport capacity of nearby water bodies, due to accident from transported elements or blockage of drainage systems (sewers, box culvert) and / or runoff.
Impairment can occur at points of interference with the surface drainage network with the road network, on water currents in the ZODMES area and the drainage construction points.

With direct impairment on water bodies in the area of influence for water works construction, due to the existence of the roadway surface water drainage, the water works construction will be subject to the current system, in order to avoid greater impairment on the dynamics of the drains.

- *Availability of water resources*

The different project activities will require surface water use, trying not to exceed the minimum flow rates for different return periods, avoiding conflicts from surface water availability with the communities in the area of influence.

Such impairment will occur with water sources used, which have been previously identified in the resource demand chapter (Chapter 7).

§ Availability impairment on this component is cumulative and is managed through prevention, mitigation, control and compensation, structured in the Environmental Management Plan.

Physicochemical and bacteriological characteristics of surface water

The various road construction activities can generate changes in water quality due to solid and / or other substances discharged or transported by runoff action, which can cause changes in turbidity, suspended solids, dissolved solids, conductivity, color and changes in pH, dissolved oxygen, presence of grease and oils.

This impairment may occur during operation of the ZODMES and industrial plants.

Impairment will be presented on the bodies of water within the project's area of influence and the basin drainage areas downstream.

The contribution of particulate material to water bodies will be reduced with environmental management plans.

- *Physical-chemical and bacteriological characteristics of groundwater*

The activities of the construction phase of the project, including excavation and / or flatwork for foundations, building brackets, the use of explosives (if necessary), the disposal of solid and liquid waste can generate discharge of fluids, potentially contaminating aquifers in area of influence, affecting the health of water intended for human consumption.

· Impairment on the atmospheric component

- *Air quality*

During the construction stage of road sections, drainage works and ZODMES, air quality can be altered because of particulate matter, especially due to handling of granular materials and other building materials, and by the use of equipment and machinery due to traveling on dirt roads and from combustion of vehicle fleet associated with road construction.

Impairment will be present along the road corridor of the projected areas of influence, especially by emission of pollutant gases and particulate material during road construction.

- *Noise decibels*

Noise levels will increase during the construction phase due to operation of the vehicle fleet associated with the construction, equipment and machinery in various activities on the road, drainage and disposal of waste material excavation in ZODMES.

Impairment will be along the corridor and the area of influence during the construction phase of the project focused on work fronts.

· Impairment on land and water ecosystems component

- *Forest vegetation cover, structure and composition of natural and semi-natural ecosystems*

Vegetation cover and stripping of the areas identified in the designs will be removed during the construction phase of the road, complementary civil works, adaptation of

ZODMES and temporary infrastructure, but these are specific areas not affecting the structure and floral composition.

Vegetation cover and stripping will be removed according to the specific management measures ensuring this is done only in the areas of design and that impairment is about the size of the cover and not on the composition and structure thereof.

§ Impairment occurs in the areas of project designs, corridors, civil works, and ZODMES infrastructure and will be of residual nature, especially in areas where land use changes are permanent and in forestry areas.

§ Impairment of this changes in plant cover component is not synergistic as it only happens once and not continuously, which will not cause accumulation effect on existing coverage. Likewise, the negative impacts will be positively offset by revegetation activities with biomantle, maintenance of vegetation on the right of way and compensation for loss of biodiversity.

- *Land and freshwater habitats*

Habitats will be punctually affected because of the activities associated with excavations and cuts, construction of artworks (walls, ditches, slope protection and / or banking) and removal of vegetation cover and stripping, which will enhance the negative effects, generating transformation and fragmentation.

Demolition and relocation of infrastructure activities will significantly impact the habitat modification of some wild species such as small flying and land rodents, which may be associated with this infrastructure, that, due to prior changes in their natural habitat and general habits have changed their behavior.

Although building walls, ditches, slope protection and / or banks are fundamental for the safety of the road, they will change the microclimate and runoff processes affecting the interaction between the populations on either side of the road due to the barrier and road edge effect.

Likewise, some of the negative impacts may be offset by revegetation activities with biomantles, maintenance of vegetation on the right of way and compensation for loss of

biodiversity, favoring the return of wildlife that will accelerate regeneration and natural vegetation succession and habitat restoration.

- *Fauna*

Demolition activities of existing infrastructure and housing, excavations and cuts, construction of artworks, installation and operation of temporary infrastructure, profiling for bank sloping, handling and use of explosives (if required), construction of special works, construction of drainage and sub-drainage, disposal of surplus excavation material, morphological conformation of intervened area, removal of vegetation cover and stripping, operation and mobilization of machinery and equipment produce a significant effect on wildlife, decreasing populations.

Wildlife populations that will be directly affected by construction activities may be ecologically important species because of habitats in the area of influence, which can severely affect the composition, structure and function of area ecosystems.

Another impact directly affecting wildlife of the area of influence is the noise generated by project activities since acoustic signals are perceived by the animals and have an effect on reproductive performance, density and structure in the community (Barber et al. 2010).

Particularly, the activities of the construction stage will collide during construction since changes in microclimate and food availability synergistically may make wildlife leave, a common event in species that do not react to danger and others who become disoriented or paralyzed even perceived danger.

Activities related to earthworks will generate changes in the relief, causing slope instability and particle entrainment into water bodies, modifying their conditions, which can cause wildlife migration.

Revegetation with biomantle activities and maintenance of vegetation in the right of way and on roadsides will be a positive effect, if they develop favorable microhabitats for generalist species. Similarly, the water collected and flows in gutters following the infrastructure layout, would lead to creating relatively moist habitats on the riverbanks where some generalist amphibian species may thrive (Delibes de Castro, 2002). However,

protection of existing natural areas in the area of influence, described in the baseline, must be ensured.

It is important to implement environmental management plan measures that allow, among others, to condition wildlife crossings and conservation of breeding areas. To also implement follow-up monitoring and control, enabling greater knowledge of of the biology and population dynamics of the species in the area of influence for decision-making on plans required to ensure the conservation and management of wildlife.

§ Wildlife impairment on this component, under important human pressure due to the expansion of agricultural borders expect synergy with the current activities in the area of influence and activities of the construction phase of the road.

Hydro-biological communities

Construction activities related to the invasion of water bodies of in contact with them, including profiling for slopes, casting concrete structures in situ, handling and use of explosives (if required) construction and operation of the leachate treatment system, building drainage and underdrain, disposal of excess excavation material, morphological conformation of the intervention area and surface water intakes are those that produce the greatest effect on aquatic ecosystems.

Contribution of building materials and particulate material to nearby waterways may alter water quality and affect water communities. Similarly, leachates of hydrocarbons, oils and organic waste among others, could go directly to the aquifer, contaminating the water.

Extracting materials can produce terrain depressions that will modify surface drainage and increase suspended solids entrained by runoff, that, once accumulated can prevent penetration of light and photosynthesis processes of some aquatic organisms, also altering chemical balance cycles, and generating a higher oxygen demand and consequently an increase in the eutrophication of water and / or death of organisms that inhabit them (Hernandez et al., 2001).

Dismantling activities and abandonment of temporary installations can affect water quality as well as stripping materials because of the contribution of excavation material and any waste or liquid.

The use of explosives (if required) will generate vibrations that can scare, disturb or cause the death of aquatic fauna.

Higher impairment on fish fauna and other aquatic communities will be during the construction phase of the road section and drainage works.

Impairment of this aquatic ecosystems and hydro-biological communities, projects foreseen a synergy with current human activities in the area of influence, who have these ecosystems exposed to contamination processes and wildlife alterations with the road construction stage activities. However, to reduce negative impacts on communities and hydro-biological ecosystem in the long term, environmental management plan measures must be complied with.

· Impairment on the socioeconomic and cultural component

- *Lands*

Activities generating impairment on lands will be the purchase of land and easements, demolition of homes and existing infrastructure.

Impairment is direct, demolition of properties currently located in the areas required for the new road, according to project designs. This will be measured in terms of the individuality of the owners of the land and the community, being important from the economic point of view and from the social and cultural roots.

§ Impairment of this component is residual in terms of the properties since construction of road and the current infrastructure change is permanent.

- *Mobility*

In addition to construction works, the activities affecting mobility will be signs and demarcation of road safety, as well as the conditioning of accesses. There will also be traumas and disruption of normal mobility development in the area of influence, impairment that in time will be positive.

§ Impairment of this component is residual in terms of mobility because safety and travel times would benefit road users.

- *Community facilities*

Activities affecting the premises will be the purchase of land, demolition of existing infrastructure, relocation of infrastructure and interrupted services.

§ Impairment of this component is residual since road construction and current community infrastructure change is permanent.

- *Labor, goods and services*

Construction activities will involve hiring labor, goods and services from the communities of the area of influence, ensuring participation in the project. Direct hiring of personnel for the activities of road construction is foreseen as well as generating other economic activities by providing services, even if they do not represent a permanent or significant socioeconomic and cultural change.

- *Expectations*

Community expectations relate to the purchase of land and easements and associated compensation processes, recruitment and procurement of goods and services as well as with information and socialization processes.

It is important to work with the communities in order to offer clarity on the project, its benefits, implications and negative effects, as well as aspects related to recruitment, relocation of infrastructure and compensation measures for the purchase of land, to avoid idealization of the project and the benefits they would receive.

The most important tool is citizen participation, in legal terms, the good will of the community to the project.

- *Conflicts*

The conflict with the community could be due to the purchase of land and easements, compensation for land purchase, labor contracts, procurement of goods and services as well as with the information and socialization processes.

It is important to work with the communities in order to offer clarity on the project, its benefits, implications and negative effects, as well as aspects related to recruitment, and the land acquisition process to avoid idealization of the project and the benefits they would receive.

The most important tool is citizen participation, in legal terms, the good will of the community to the project. In addition, the consultation processes with regard to sensitive issues can be developed in friendly conditions.

The most significant impacts on impairment of socioeconomic and environmental components according to above analysis have been defined by its residual aspect since they will remain in time; accumulation thereof and effect will be added to the impacts that occur in the area from human action.

Table 8.84 show the elements most affected by type of impact, according to the environmental evaluation analysis.

Table 8.79. Main impairment to environmental components according to impact type

COMPONENT	ELEMENT	IMPACT	TYPE OF IMPACT			IMPACT CHARACTERISTICS
			Residual	Cumulative	Synergistic	
Geospheric	SOIL	Changes in soil structure	X			The road and the ZODMES will be permanent, so that changes in land forms will also be permanent

COMPONENT	ELEMENT	IMPACT	TYPE OF IMPACT			IMPACT CHARACTERISTICS
			Residual	Cumulative	Synergistic	
		Modification of the current land use	X			Land use change is permanent
	LANDSCAPE	Landscape modification	X	X	X	Landscape transformation has been and will be gradual
WATER	SURFACE WATER	Change in supply of water resources		X		The use of this resource is affected and its demand will significantly increase
LAND ECOSYSTEM	VEGETATION COVER	Change in vegetation cover	X			Areas where land use change will be permanent and in the forestry areas
	WILDLIFE	Fragmentation of wildlife habitats		X	X	It has given and will decay processes and fragmentation of habitats
						Faunal communities have been and will be submitted to anthropic pressure
Economic and cultural	INFRASTRUCTURE OF GOODS AND SOCIAL SERVICES AND UTILITIES	Modification of housing and community facilities	X			The road and land infrastructure and community infrastructure changes will be permanent
		Change in mobility	X			The road will be permanent, as mobility conditions, travel times

Source: Gemini Environmental Consultants SAS, 2016

8.2.3. Completion of the environmental evaluation on the scenario with project

From the environmental evaluation of the project in terms of activities generating impact on the abiotic, biotic and socio-economic environment, the conclusions are:

- Geosphere component will be affected by increased erosion in construction zones, by destabilization of land devoid of vegetation, mainly due to the construction and excavation activities.

- The change in land use will contribute to socioeconomic and cultural changes in the region.

- The landscape will undergo significant changes associated with the construction of the second carriageway and changes in community infrastructure.

- Water resources present greater impairment to the current one due to anthropic action, by the resource demand in the various project activities as a result of uptake in the different fronts of work.

- The atmospheric component will be affected mainly from gas emissions, particulate matter and noise generation during the construction of the road. Thus, they must be implemented during project implementation to minimize impacts on this component, to reduce public health problems associated with air emissions.

- Forestry use has a significant effect on biota because of the start of work activities.

- Transfer activities and conservation of species under epiphytic and tree prohibition generate a positive impact by creating new habitats and protection of the diversity of flora and fauna.

- Impairment on land ecosystems directly affects habitats, vegetation cover and wildlife due to current changes.

- Impaired freshwater ecosystems will affect the composition and structure of hydro-biological communities. This item is being affected by human activities reason why protective measures will be established.

- The socioeconomic and cultural environment will be mainly affected by land acquisition, social displacement, disruption of cultural patterns and changing land use.

- Regarding the high density of small farms along the corridor, intervention is necessary of utility networks, access and rights of way that the project must restore or restitute, which will contribute to conflict resolutions with the community.

- The demand for unskilled and skilled labor will favor stable employment in the area during project implementation.

- Expectations of the population regarding changes in routines and lifestyles of communities should be mitigated through an effective social management plan.

8.3. Environmental impacts identified by the community

In fieldwork during socializations, with social and institutional actors, communities of 25 villages were identified, which, from their perception, considered the environmental impacts described in table 8.85.

Table 8.80. Categorization of impacts identified by area communities

Community identified impacts					
Higher Territorial Units					
Medium	**Component**	**Element**	**Environmental impact**	**Total counties**	**%**
Biotic	**Land ecosystem**	**Vegetal cover**	Forest harvesting	3	12
			Revegetation	2	8
			Increased knowledge of ecosystems areas	3	12
			Reforestation of native and introduced species	17	68
			Clearing of trees and native and introduced plants	19	76

Community identified impacts					
Higher Territorial Units					
Medium	**Component**	**Element**	**Environmental impact**	**Total counties**	**%**
			Lower availability of ecosystem services (impairment of medicinal plants, trees, crops affected)	7	28
			Loss of green areas	2	8
			Possible effect on protected areas	1	4
		Wildlife	Signs on wildlife crossings	4	16
			Migration of animals including native species	16	64
			Death of animals	2	8
			Stress affects livestock low milk production	1	4
Abiotic	**Geosphere**		Reduced soil for cultivation productivity (degradation)	2	8
			Soil erosion	9	36
			Landslides	5	twenty
			Improper handling of waste (pollution)	8	32
			Proper waste management	2	8
	Water	**Surface water**	Micro-basins study (area of influence)	1	4
			Channeling water	4	16
			Contamination	19	76
			Impairment and loss of water bodies	9	36
			Reduced water flow	5	twenty

Community identified impacts					
Higher Territorial Units					
Medium	**Component**	**Element**	**Environmental impact**	**Total counties**	**%**
	Atmospheric	**Air quality**	Air pollution	24	96
			Noise pollution	10	40
	Geosphere	**Landscape**	Relief impairment	2	8
			Landscape improvement	4	16
Socioeconomic	**Socio-economic and cultural aspects**	**Economy**	Employment generation	twenty-one	84
			Increased trade	eleven	44
			Ability to create commercial places.	2	8
			Tourism promotion	7	28
			Higher cost of living	3	12
			Shortage trading own products due to consumption in other regions.	1	4
			Implementation of toll increases travel costs	1	4
		Infrastructure goods and social services and utilities	Shortest travel time	11	44
			Easy to transport goods and people	15	60
			Increased transportation costs	1	4
			Longer trips due to remote turnarounds	1	4
			Difficult pedestrian traffic	25	20
			Impairment mobility in existing roads during construction time	3	12
			Affectation access	2	8
			improving roads used by project	2	8

Community identified impacts					
Higher Territorial Units					
Medium	**Component**	**Element**	**Environmental impact**	**Total counties**	**%**
			Easy to transport patients	1	4
			Health impairment from pollution	3	12
			Safer road	8	32
			Unsafe road for animals and people	6	24
			Theft insecurity in counties due to easy access by outsiders	6	24
			Training greater environmental awareness	7	28
			Sewerage maintenance	2	8
			Damage to water supply networks and infrastructure	4	16
			Impairment to housing due to vibration and use of explosives	6	24
			Mobilization of people due to intervention of their homes with the project	eleven	44
			Demolitions of housings	6	24
			Reduces land tenure	5	twenty
			Land assessment	4	16
		Adaptive and cultural strategies	Territorial Development Unit	10	40

Source: Gemini Environmental Consultants SAS, 2016

Chapter 5.3.1.4. of this environmental impact study develops the corresponding analysis of community perceptions of what they consider are the main environmental impacts analysis.