ENVIRONMENTAL IMPACT STUDY FOR THE RUMICHACA – PASTO DIVIDED HIGHWAY PROJECT PEDREGAL-CATAMBUCO SEGMENT, CONCESSION CONTRACT UNDER SCHEME PP NO. 15 OF 2015

CONCESIONARIA VIAL UNIÓN DEL SUR

Geminis Consultores SAS

CHAPTER 11.2.2 Compensation Plan for Biodiversity Loss

San Juan de Pasto, December, 2016

CONTENTS

11.2.2. COMPENSATION PLAN FOR BIODIVERSITY LOSS

This project framework is provided within the environmental impact study for the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment, as per the parameters stated in the terms of reference for highway construction projects approved under Resolution 0751 of 2015 (MADS, 2015) and in accordance to the Manual for the Allocation of Compensations for Biodiversity Loss, issued under Resolution 1517 of August, 2012 (MADS, 2012).

These actions are aimed at compensating the biodiversity that has been affected by negative impacts or effects which cannot be avoided, corrected, mitigated or replaced and that lead to biodiversity losses in natural terrestrial ecosystems and secondary vegetation; in such a way, that it ensures effective conservation of an ecologically equivalent area where a permanent conservation and/or ecological restoration is achieved so that when compared to a baseline, it guarantees a no net loss of biodiversity.

Compensation measures for biodiversity loss were stated to assure that residual impacts of development projects such as the environmental impact study for the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment, can be remedied by means of implementing restoration actions, enhancement or conservation of ecosystems which are equivalent to those that were intervened (Sarmiento , y otros, 2015). In this context, the characterization of the project´s area of influence as well as the assessment of the potential impacts that the project could have over biodiversity were taken into account.

The established strategies aim for the no net loss of biodiversity present within the area of influence. In other words, due to biodiversity´s compensation, conservation and/or sustainable use actions, no net reduction is produced in biodiversity. This occurs because said actions are equivalent to biodiversity losses that are generated by the project´s impacts. As a result, there is no total reduction on the type, amount and conditions (or quality) of biodiversity on a scale of ecosystems and habitats of species in space and time.
(BBOP, 2012).

11.2.2.1 Regulatory Framework

Political Constitution of Colombia

Article 8 of the Political Constitution of Colombia states that: "*It is the State´s and people´s obligation to protect the cultural and natural wealth of the Nation*," as per subparagraph 8 of Article 95 thereof. On the other hand, Article 79 states that: "…*It is the duty of the State to protect the diversity and integrity of the environment, preserve areas of special ecological importance and foster education to achieve these goals.*" Likewise, Article 80 indicates that: *"The State will plan the management and use of natural resources, to guarantee its sustainable development, conservation, restoration or substitution. Moreover, it must prevent and control environmental degradation factors, impose legal sanctions and demand the reparations of caused damages…*"

Law 23 of 1973

Article 12 of Law 23 of 1973 indicates that: "*The National Government will create technical evaluation systems that will enable it to engage users, of environmental resources, to participate in the protection and renovation of its expenses, when these are used for the benefit of profit-generating activities.*"

Law 99 of 1993

Article 1 of Law 99 of 1993 points out the general environmental principles including: *"2. The country´s biodiversity by being a national patrimony and in the interest of mankind, must be protected first and foremost and used sustainably."*

Article 50 defines an environmental license as: *"… the authorization granted by the competent environmental authority to execute a work or activity, subject to the beneficiary´s compliance of said license and its established requirements related to the prevention, mitigation, correction, compensation and management of the environmental effects of the work or activity that was authorized.*"

Law 165 of 1994

This Law, whereby the "Convention on Biological Diversity" is approved," in Rio de Janeiro, on June 5, 1992, establishes in Article 6, the general measures regarding the effects of conservation and sustainable use. This Article emphasizes the mandate for each Contracting Party, in accordance with its particular conditions and capabilities, the design of national strategies, plans or programs to preserve and use biological diversity in a sustainable way or the adoption for said purpose, of current strategies, plans or programs, which must reflect, among other things, the established measures in this Convention, that are relevant for the interested Contracting Party; and the integration as far as possible and as appropriate, the conservation and sustainable use of biological diversity, in the sectoral or inter-sectoral plans, programs and policies.

Ninth meeting of the Conference of the Parties to the Biological Diversity Convention

Decision IX/26 was adopted during the Ninth meeting of the Conference of the Parties to the Biological Diversity Convention. *Promotion of the Intervention of the Business Sector*, whose annex includes the *FRAMEWORK OF PRIORITY ACTIONS ABOUT THE BUSINESS SECTOR, 2008 – 2010, which considers* the priority actions to be undertaken by the Secretariat, among which we find: "*To disseminate tools and best practices*," as the Business and Biodiversity Offsets Program (BBOP). This was the base to elaborate some practical guidelines to design and apply compensations of high quality biological diversity.

Tenth meeting of the Conference of the Parties to the Biological Diversity Convention.

Decision X/21 Intervention of the Business Sector was adopted within the framework of the Tenth meeting of the Conference of the Parties to the Biological Diversity Convention. In its annex, the Executive Secretary is asked for, subject to the availability of resources, and together with organizations and relevant initiatives, to encourage progress and the application of tools and mechanisms that enables a business sector to intervene, even more, to integrate biological diversity considerations in its task, for example: Certifying, verifying, assessing biological diversity and the ecosystems´ services, incentives, offsets of biological diversity, etc. All the aforementioned

accordingly and in harmony with the Convention and other relevant international obligations, among other requests included in the annex of said Decision.

Decree 2820 of 2010

Decree 2820 of 2010, defines compensation measures as "*…actions aimed at compensating and giving back to the communities, regions, localities and natural environment for the impacts or negative effects generated by a project, work or activity, that cannot be avoided, corrected, mitigated or replaced*."

Decree 1791 of 1996

Subparagraph a), Article 5 of Decree 1791 of 1996 defines unique forest usages as: "*Those that are performed for just one time, in areas where based upon technical studies, it is demonstrated an improved suitability of the use of land, other than for forest purposes or when there are reasons related to public use and social interest. Unique forest usages could include the obligation to leave the area clean at the end of its use, but not an obligation to renew or preserve the forest."*

Paragraph 1, Article 12 of the aforementioned Decree, states that: "… *If in a forest reserve or special management area, and due to public use or social interest reasons defined by the legislator, it becomes necessary to perform activities that involve deforestation or change in land use, the affected zone must be previously removed from the reserve or from the special management area to that matter."* Likewise, paragraph 2 states that: "*If there exists public usage reasons and it is necessary to remove forests to make use of unique forests and these are located in publicly owned land, the affected area must be compensated, at the very least, by another one having the same coverage and extension, in the place determined by the entity that manages the resource."*

Resolution 1503 of 2010

The Methodology to Submit Environmental Studies adopted by Resolution 1503 de 2010, points out the compensation measures due to biodiversity loss These must be outlined according to the methodology, criteria and procedures to determine and calculate the compensation measures developed by the Ministry of Environment – MAD,

The Nature Conservancy – TNC, World Wildlife Fund – WWF and *Conservacion Internacional – CI.*

CONPES 3680 of 2010 Guidelines for the Consolidation of the National System of Protected Areas.

This CONPES is a strategic tool in the processes of the country´s land use planning and it facilitates the compliance of national objectives around the conservation in situ of strategic biological diversity as the natural base for social and economic development. It also facilitates the generation of environmental benefits and the protection of natural spaces that allow to determine the conservation of tangible and intangible culture, by prioritizing the inclusion of the administration funding and management of protected areas that belong to SINAP, in the regulations issued regarding compensations derived from environmental licenses.

11.2.2.2 Objective

To formulate a compensation plan due to the biodiversity loss for the environmental impact study of the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment and to follow established parameters in the Manual for the Allocation of Compensations for Biodiversity Loss of the Ministry of Environment and Sustainable Development.

11.2.2.3. Characterization of the area baseline that will be affected

Hereafter, there will be an area of characterization that will affect the environmental impact study of the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment; however, in Chapter 3: Project Description and Chapter 5: Characterization of the area of influence of this study, you will find detailed information about the project.

Baseline of the affected area

Hereunder you will find the project´s location and description, as well as some general aspects of the characterization of the biotic, abiotic and socioeconomic factors;

however, detailed information can be found in Chapter 3: Project Description and Chapter 5: Characterization of the area of influence of this study.

ü Location

The highway project "Rumichaca – Pasto" runs through the central-eastern and central southern zone of the Department of Nariño. The corridor is conceived as an international hub that connects Colombia with Ecuador, by linking the main cities of southern Colombia.

This highway has an estimated origin - destination length of eighty three point five kilometers (83.50). The main purpose of the project is to turn the current infrastructure into a high specification divided highway and improve the communications of the southwestern part of the country between Cali, Popayan, Pasto and the border with Ecuador; whose objective is to double the current lane.

The segment between Pedregal and the entrance to the urban zone of Pasto has thirty eight road kilometers (38.00 km) approximately, divided in two Functional Units named Functional Unit FU-4 Pedregal - Tangua and Functional Unit FU-5 Tangua-Pasto. An overview of the division of functional units FU4 and FU5 are presented on Chart 11.2.2.1.

Chart 11.2.2.1 Division of Functional Units

FU	Beginning			End			Total Length	Sector
	PK	Coordinate		PK	Coordinate			
		N	E		N	E		
FU4	PK 00+000	606679.90	957013.40	PK 15+750	613384.73	966117.87	15.75 km	Pedregal-Tangua
FU5	PK 15+750	613384.73	966117.87	PK 32+700	619975.18	975562.48	16.95 km	Tangua-Catambuco
	PK 32+700	619975.18	975562.48	PK 37+934	623684.62	977560.70	5.23 km	Catambuco-Pasto

FU	Beginning			End			Total Length	Sector
	PK	Coordinate		PK	Coordinate			
		N	E		N	E		
Total length of the divided highway construction							32.70 km	
Total length							37.93 km	

Note: The submitted information corresponds to designs during the feasibility stage, therefore the information is subject to modifications.
Source: Consorcio SH

The second subsector of the Functional Unit 5 is located between the south interchanger of the eastern variant of Pasto (Catambuco) and the entry to the urban zone of Pasto, were the rehabilitation of the current road is being contemplated. Rehabilitation means: "Reconstruction of a transportation infrastructure to return it back to its initial state for which it was built." For this reason, sub-sector 2 of FU5 is not part of this Environmental Impact Study, except for its first 60 meters in the township of Catambuco, given that the adaptation of an access to this town is being projected, which implies considerable impacts.

Functional Unit FU-4 Pedregal –Tangua

The Corridor of FU4 Pedregal – Tangua comprises from PK 43+150 until PK 60+020 of the national route 2501 in a total of approximately 15.75 Km of the road which run through a topography with high longitudinal and transverse slopes. The K0+000 of this functional Unit is located approximately 1.6Km before passing by the population center of Pedregal, Municipality of Imues and ends up in K15+750 (abscissa by definition), in the Municipality of Tangua. In its layout there are works such as:

- Variant in the Pedregal town between Abscissas (K1+750 a K2+300).
- Grade-separated intersection of a roundabout type (K2+150) to access Pedregal town and surrounding municipalities.
- Bridge over the Guaitara River between abscissa K2+780 and K3+075.
- *Placer* toll between abscissa K6+200.
- Connection with overpass in abscissa K8+600.
- Turnarounds in abscissas K12+700 and K14+400 at the entry and exit points of the town of Tangua.

The divided highway construction project of Ipiales - Catambuco in the segment Pedregal-Tangua, runs through 10 towns of the Municipalities of Imues, Yacuanquer and Tangua, which are described in the following Chart 11.2.2.2

Chart 11.2.2.2 Town of Segment Pedregal-Tangua

Functional Unit	Municipality	Town
FU4	Imues	El Pedregal
	Yacuanquer	Inantas Bajo
		Inantas Alto
	Tangua	El Tablón
		Cocha Verde
		San Pedro Obraje
		Casco Urbano
		El Vergel
		El Cebadal

Source: Géminis Consultores SAS

Functional Unit FU-5 Sub-sector 1 Tangua-Catambuco

The corridor of FU-5 Sub-sector 1 Tangua-Catambuco, is comprised between PK 60+020 and the PK 77+620 of national route 2501 in a total of approximately 16.95 Km of road that runs through a topography with high longitudinal slopes; however, the transverse development becomes slighter achieving more adequate planimetric zones. The abscission of the design for this Functional Unit is subject to the final abscissa of FU-4, for which it currently begins at K15+750 and ends at K32+700 in the township of Catambuco, in the Municipality of Pasto.

In the layout of functional unit 5 sub-sector 1, the following works are projected among others:

• Variant Alberto Quijano between K22+800 and K24+200
• Footbridge at K31+330
• Four (4) operational turnarounds

The divided highway construction project Ipiales-Catambuco in the segment Tangua-Catambuco, covers 12 towns of the Municipalites of Tangua and Pasto, which are described in the following Chart 11.2.2.3:

C 11.2.2.3 Towns' segment Tangua-Catambuco

Functional Unit	Municipality	Town
FU5	Tangua	El Cebadal
		Chávez
		El Tambor
		Los Ajos
		El Páramo
		La Palizada
	Pasto	Gualmatan Alto
		Vocacional
		La Merced
		Huertecillas
		Catambuco
		San José de Catambuco

Source: Geminis Consultores SAS

Chart 11.2.2.1 shows the general location of segment Pedregal-Catambuco that is part of this study. Also see Annex 1.

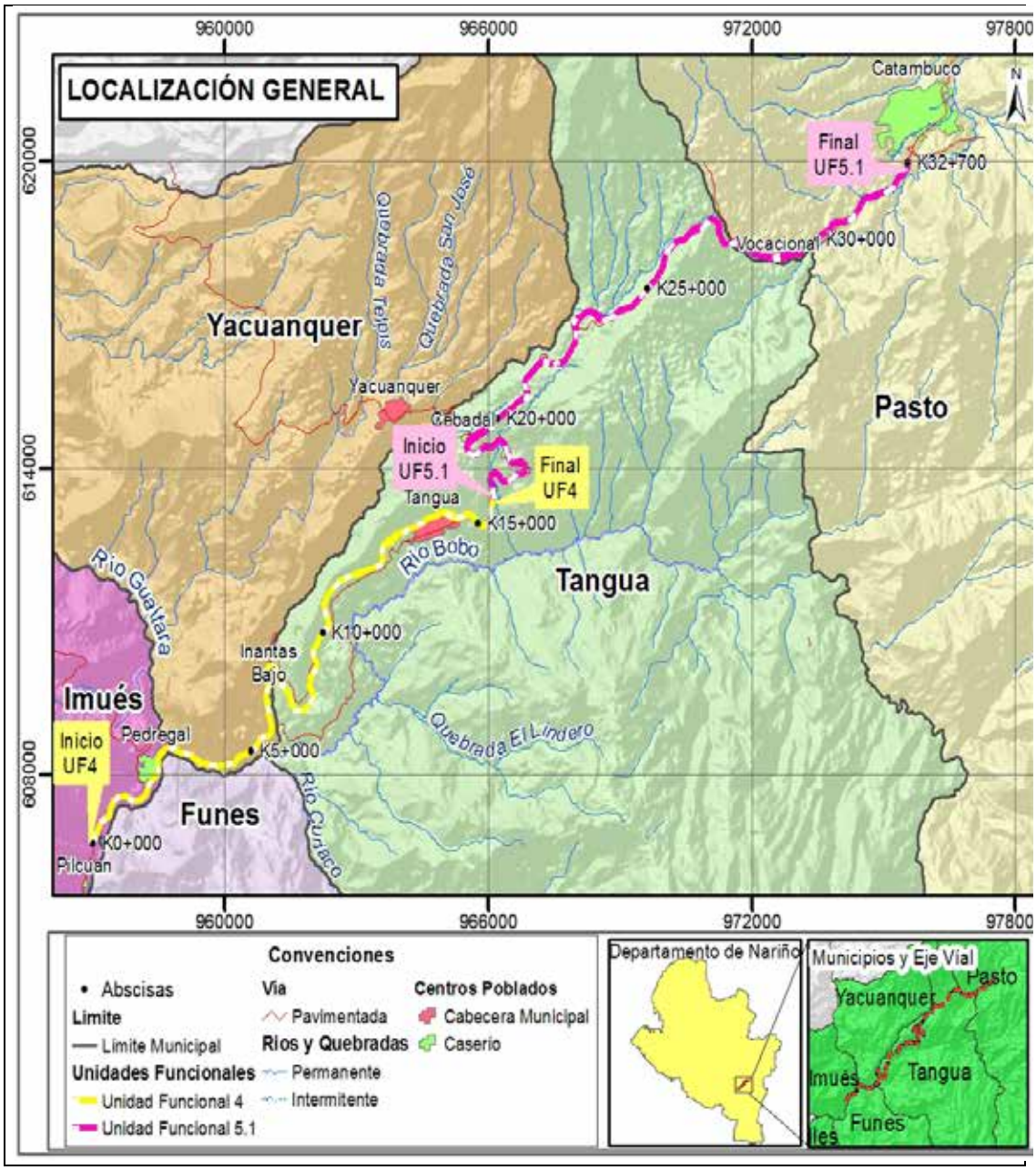

Chart 11.2.2.1 General location map for highway project Rumichaca-Pasto

Source: Geminis Consultores S.A.S., 2016

ü Characteristics of the project

The project´s characteristics of the divided highway project Ipiales- Catambuco in the segment Pedregal-Catambuco are described below including: Current infrastructure, project´s stages and activities, design characteristics including layout, infrastructure associated to the project and infrastructure of intercepted services. Also included: Main inputs to use for execution purposes and their approximate amounts, disposal and management of excess material from excavation, construction and demolition, and volumes and classification of wastes. It finally ends with a timetable for the project and the company´s organizational chart that is in charge of the project´s execution and an estimated economic assessment.

Ø Current Infrastructure

Road Infrastructure

There is a current main road for this Project, which is described as follows according to Technical appendix 1:

Chart 11.2.2.4 Description of current roads included in the Project

Road Code	COMPETENT AGENCY	ORIGIN (Name-PR)	DESTINATION (Name-PR)	Estimated LENGTH (Km)	CURRENT STATUS
National Route 25 Segment 2501 and Segment 25NRC	INVIAS	Eastern abutment of the International Bridge of Rumichaca PR 0+040 Does not include the international bridge	Pasto (Calle 12 with Carrera 4) PR 83+000 Catambuco interchanger in its links to the Eastern Variant of Pasto: PR0+440 of the Eastern Variant	83	Two-way national road which includes the segment between the Eastern abutment of the Rumichaca bridge PR 0+040 and the interchanger South of Ipiales PR 0+940, in a double road of three one way lanes and feeder links to CEBAF, to be built by INVIAS. (Does not include the international bridge). Includes the Ipiales variant, the urban crossing of Ipiales or urban crossings by populated centers.

Source: Technical Appendix 1 page 04,

Within the Pedregal - Catambuco segment, which this study refers to, there in a segment between PK43+150 and PK77+620 of the current national road 25.

Ø Grids and assets of public utilities

Public utilities companies are located in the project´s intervention area. Said companies are: Water and sewage, power and telecommunications. In the following Chart 11.2.2.5 you will find the name of the companies that provide different services:

Chart 11.2.2.5 Public utilities companies, segment Pedregal - Catambuco

PUBLIC SERVICE	COMPANY
Sewage	ASOASPIM
	EMPOTANGUA
	EMPAAAYAC SAS ESP
	EMPOPASTO
Water	ASOASPIM
	EMPOTANGUA
	EMPAAAYAC SAS ESP
	EMPOPASTO
Electric power	CEDENAR
Telecommunications	TELECOM
	CLARO
	MOVISTAR
	DIGITEL
	TV AZTECA
	TV CABLE PEDREGAL

Source: GEMINIS CONSULTORES AMBIENTALES, 2016.

The Project's intersection, together with different public utilities services is described in detail in Chapter 3 of this study: Infrastructure and intercepted services by the project.

Ø Urban, architectural, cultural or archaeological heritage

Within the divided highway project Ipiales-Catambuco, an Andean road system or Qhapaq Ñan was found. It was named segment Rumichaca-Pasto and was declared as a Nationwide Site of Cultural Interest – BIC-Nal, by Resolution 3317 of October 25, 2013. This system is present in nine (9) sections of the municipalities of Ipiales, Potosí, Gualmatan, El Contadero, Funes, Yacuanquer and Tangua (see Chart 3.6). The Qhapaq Ñan or Inca Trail is an extensive network of paths improved by the Incas and whose main purpose was to connect diverse villages along the Andean territory. Thanks to this path, Incas were able to communicate, temporarily and spatially, the great historic, natural and cultural diversity of the territory that currently comprises countries such as Argentina, Chile, Bolivia, Peru, Ecuador and Colombia.

Chart 11.2.2.6 Sections of Qhapaq Ñan in the segment Rumichaca-Pasto

FILE CODE SENT TO UNESCO	SEGMENT	LOCATION
CO-RP-01-C-2011	Rumichaca	Municipality of Ipiales
CO-RP-02-C-2011	San Pedro	Municipality of Potosí
CO-RP-03-C-2011	La Cofradía	Municipality of Gualmatán
CO-RP-04-C-2011	La Paz	Municipality of Contadero
CO-RP-05-C-2011	Chitarran	Municipality of Funes
CO-RP-06-C-2011	Rosal de Chapal	Municipality of Funes
CO-RP-07-C-2011	Guapuscal Bajo	Municipality of Funes
CO-RP-08-C-2011	Inantas	Municipality of Yacuanquer
CO-RP-09-C-2011	Los Ajos	Municipality of Tangua and Pasto

Source: Resolution 3317 of October 25, 2013

A verification of the BIC was performed based on the information provided by the Ministry of Culture with respect to the project´s intervention. Finally it was identified

that the BIC-Nal reported for the Municipalities of Yacuanquer, Tangua and Pasto are not present in the area of intervention. Chart 11.2.2.2 and Annex 2 shows the general location of the Inca Trail with respect to the project´s layout which is found close to the project; however, it does not intercept the road´s layout.

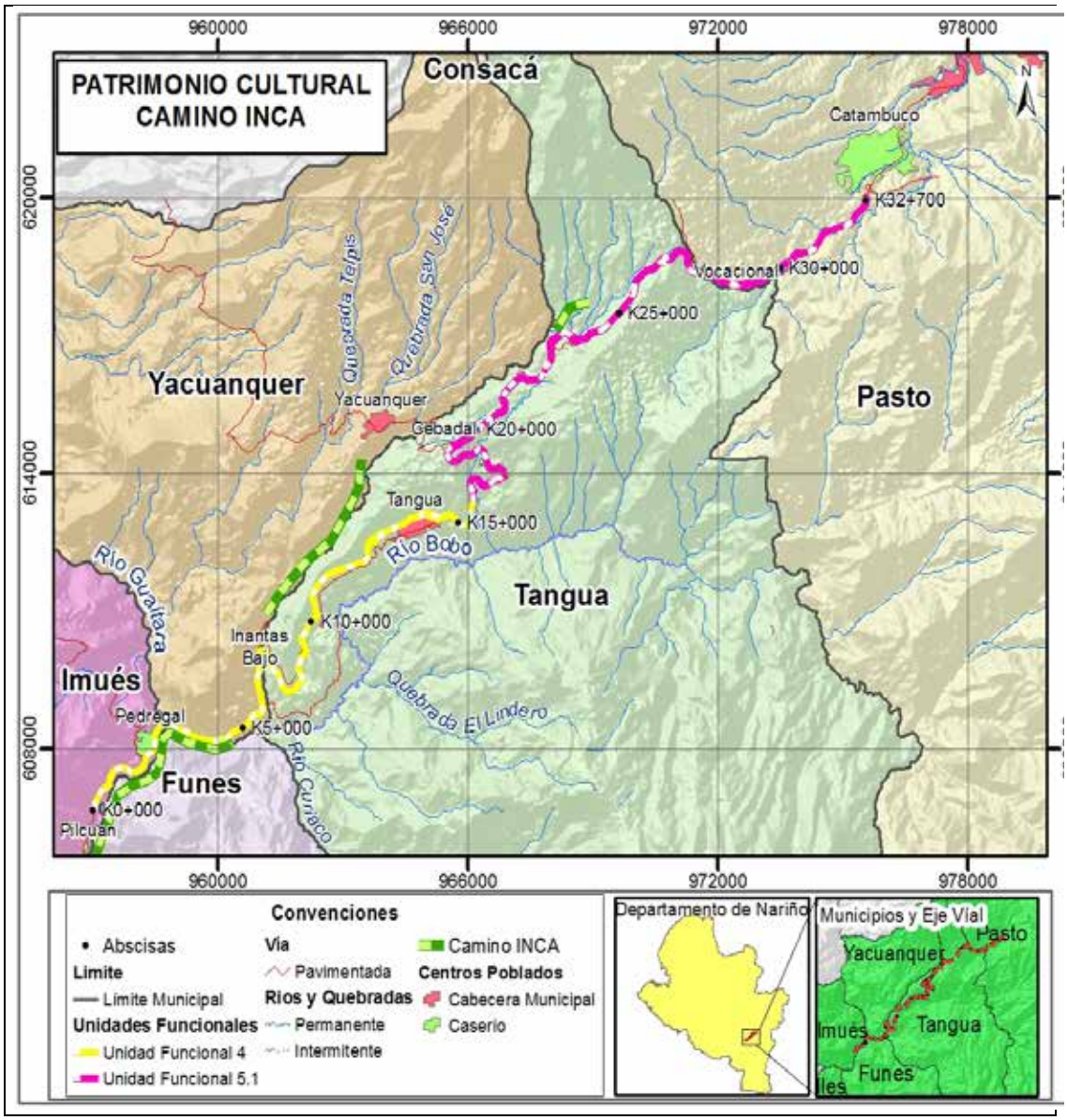

Chart 11.2.2.2 Inca Trail

Source GEMINIS CONSULTORES AMBIENTALES, 2016.

ü Project Design

The Project has been designed in compliance with the requirements of the concession contract under the PPP scheme 15 of September 11 of 2015, taking into account the two-way road that currently exists. Furthermore, the project´s design is submitted as well as its associated infrastructure. The information provided corresponds to the designs in the feasibility stage, therefore the information is subject to modifications. (See Annex 3, floor and profile plans of the layouts).

Ø Layout and geometrical characteristics of the roads to build which are the purpose of the Project.

ü Road classification

· **By its functionality**: According to the criteria defined by INVIAS, due to its functionality, the highway project Ipiales-Catambuco in the segment Pedregal-Catambuco is classified as a primary road, which will be part of Corridor 3 Santander de Quilichao - Chachagui- Pasto - Rumichaca, which is considered as an international hub that connects Colombia with Ecuador.

· **By its topography:** According to the criteria defined by INVIAS and due to its functionality, the highway project Ipiales-Catambuco in the segment Pedregal-Catambuco, corresponds to a road with topographic conditions which are characteristic of a mountainous land.

Elements

o Width of zone or right of way

According to Law 1228 of 2008 the exclusion zone corresponds to twenty meters (20m) on each side of the road which is measured from the axis of the outside roadway, including a minimum strip of 60m for primary roads.

- Crown

The crown is the set made up by the roadway and berms and its width is the horizontal distance usually measured to the axis between the interior borders of the roadside ditches.

- Roadway

The roadway is the part of the crown designed for the circulation of vehicles and it is made in accordance with the Technical Appendix of the contract. There will be two lanes of 3.65 m wide each. By lane we mean the strip width sufficient enough for one line vehicle circulation.

- Berms

Berm is the strip between the roadway and the ditch which provides protection to the pavement, it allows for occasional detentions, it ensures a free sidelight that acts psychologically on drivers by increasing the road´s capacity and it offers an additional space for emergency maneuvers, thus increasing safety. For functional Unit FU-4 and Functional Unit FU-5, subsector 1 and according to the contract´s Technical Appendix, an external berm´s width of 1.8m and an internal berm of 0.5m are established in divided highway sectors. (See Chart 11.2.2.3)

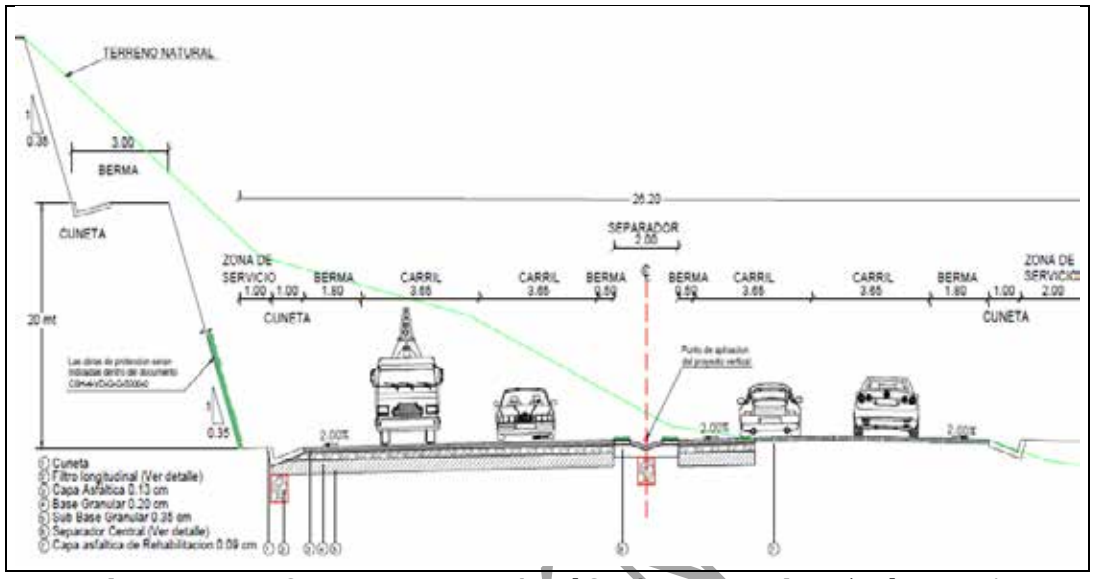

Chart 11.2.2.3 Common cross-sectional Section FU-4 and FU-5 subsector 1

Source: Consorcio SH 2016

o Ditches

These are open trenches in the land, lined or not, that collect and channel longitudinally, surface and infiltration waters. Its dimensions are deducted from hydraulic calculations, bearing in mind the foreseen rainfall intensity, nature of the land, slope of ditch and drained area.

In functional units FU-4 and FU5 subsector 1, there will be type 1 ditches measuring 1 m wide and 0.2 m tall for expansion sectors and new way and the type 2 ditch measuring 0.8m wide and 0.23 m tall, for zones that intend to replace the current ditch.

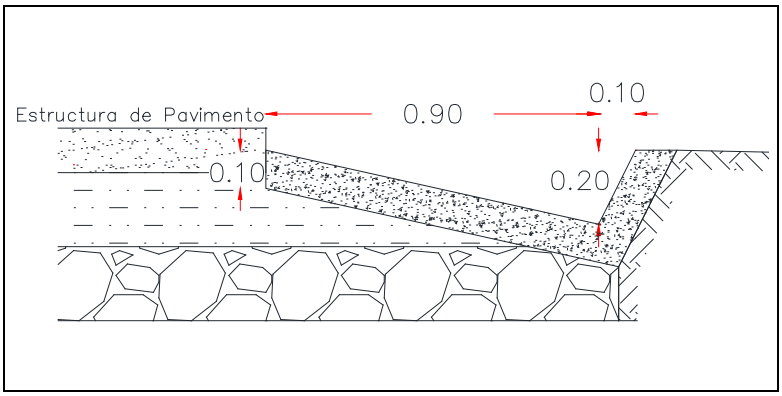

Chart 11.2.2.4 Ditch scheme type 1 FU4 and FU5 Subsector 1

Source GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

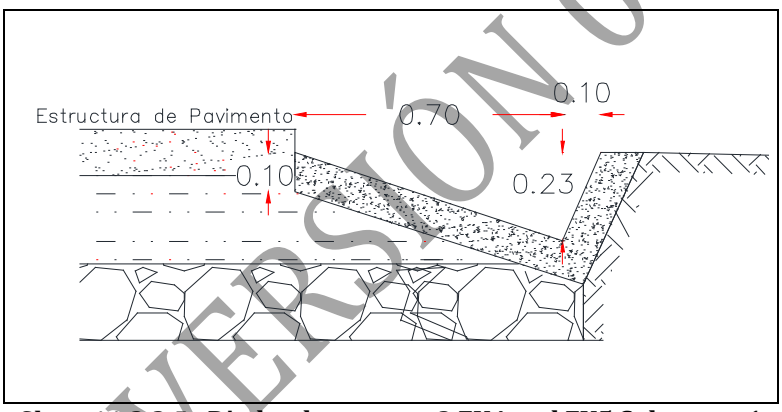

Chart 11.2.2.5 Ditch scheme type 2 FU4 and FU5 Subsector 1

Source GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

- Slopes estimated in cuttings and embankments

Slopes are the lateral planes that limit grading. Its tilting is measured by the angle´s tangent that forms such planes with the vertical in each segment of the road. The tilt of cutting slopes is variable along the road in the different functional units, according to quality and stratification of encountered soils. Slopes and embankments must be designed according to the guidelines that were presented in the "Embankments Stability Manual" of the National Roads Institute, considering the specific conditions of the site.

- For FU-4 and according to the preliminary analysis of slopes based on existing information and the geometry of current slopes on the field, the preliminary inclination cuts and fills were defined. It used the following slopes: cutting slope with a tilt of 0.35H:1V between the K0+000 up to K12+500 and thereafter a cutting slope of 0.5H:1.0V with a maximum cutting height of 20m and a berm of 3m wide. Additionally, slopes of 1.5H:1V were used for filling purposes.
- For FU-5 and according to the stability analyses carried out for static and pseudo- static conditions, and based upon geological, geomorphological and geotechnical information of the corridor, a geotechnical zoning was conducted to define the road´s cutting and embankment tilts, as shown in Chart 11.2.2.7

Chart 11.2.2.7 UF-5 Slopes

Initial Abscissa	Final Abscissa	Cutting slope	Embankment Slope
K15+750	K15+900	0.70H:1V With 3m wide berms each 20 m	1.5H:1V
K15+900	K16+100	0.75H:1V With 5m wide berms each 20 m	1.5H:1V
K16+100	K18+976	0.70H:1V With 3m wide berms each 20 m	1.5H:1V
K18+976	K24+018	0.70H:1V With 3m wide berms each 20 m	1.5H:1V
K24+018	K26+130	0.70H:1V With 3m wide berms each 20 m	1.5H:1V
K26+130	K29+500	0.75H:1V With 3m wide berms each 10 m	1.5H:1V
K29+500	K30+030	0.70H:1V With 3m wide berms each 20 m	1.5H:1V

Initial Abscissa	Final Abscissa	Cutting slope	Embankment Slope
K30+030	K32+700	0.70H:1V With 3m wide berms each 20 m	1.5H:1V

Note: The submitted information corresponds to the designs during the feasibility stage, therefore the information is subject to modifications.
Source: Consorcio SH 2016

Slopes with a tilt of 1.5H:1V with 3 m wide berms each being 10 m high were projected in the following high embankments sectors:

K22+380-K22+600
K22+800-K22+900
K23+800-K24+250
K27+800-K27+900

- Sidewalks and Pedestrian trails

Based upon the concession contract (technical Appendix), the construction of sidewalks in the following zone (see Chart 11.2.2.8 and 11.2.2.6) must be built.

Chart 11.2.2.8 Location of Sidewalks

Origin (name-abscissa)	Destination (Name-Abscissa	Type of Work	Conditions and Requirements of work execution	Estimated Length (Km)	Location of coordinates

Beginning of Urban Zone PR31.7	End of Urban Zone PR31.7	Sidewalks	Urban Zone Sidewalks pr31.7	0,08km (left side) 0,27Km (Right side)	E:974620 N:619298 E:974895 N:619354

Source: Technical Appendix 1 page 15

- Pedestrian Bridge Bavaria

Based upon technical appendix 1 a pedestrian bridge must be installed in the functional unit 5, sub-sector 1. The pedestrian bridge is projected in abscissa K31+330 between the towns of *La Merced* and *Vocacional* of the township of Catambuco in the Municipality of Pasto. The location of the bridge is close to *Merced* School.

Figure 11.2.2.7 Pedestrian Bridge Bavaria K31+330
Source: Consorcio SH 2016

- Center Divider

The provided center divider is made of a triangular ditch, measuring one meter (1m) wide
accompanied of green zones on each side achieving a total of 2m, as shown in figure 11.2.2.7

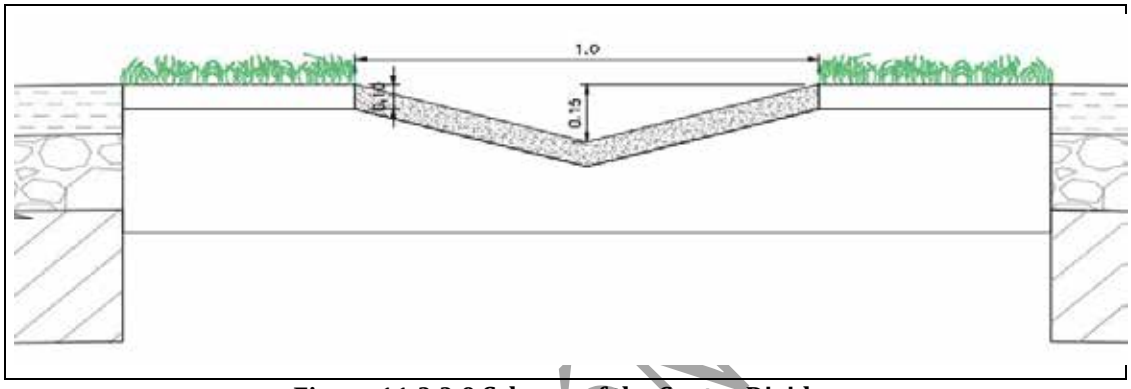

Figure 11.2.2.8 Scheme of the Center Divider
Source Consorcio SH 2016

o Chamfer lines

Corresponds to a floor representation of the levelling sides or lines that connect consecutive chamfer stakes. These lines indicate how far does the earth movement extends itself sideways due to cuts of embankments. For the divided highway construction project Ipiales-Catambuco in segment Pedregal-Catambuco, it can be observed the chamfers in Annex 4 and the floor-profile plans of said segment.

- *Transportation infrastructure of the project*

Transportation infrastructure corresponds to the components of works whose purpose is to enable vehicle circulation under conditions of continuity in the space, which must have proper levels of safety and convenience. Following, there is a description of the different project components related to transportation infrastructure in the segment Pedregal-Catambuco.

o Description of roads

Based on the project´s technical specifications, the design characteristics gathered in the Technical Appendix and as per the manual of Geometric designs of roads, down below you will see a set of design parameters that must be taken into account when designing a section geometrically.

Chart 11.2.2.9 General aspects of FU-4 and FU-5 Design

Parameter	Functional Unit 4	Functional Unit 5
	Pedregal-Tangua	Subsector 1 Tangua-Southeastern Interchanger Pasto Variant
Speed Design	60 Km/h	60 Km/h
Design vehicle	C3S2	C3S2
Minimum radius of curvature	113 m	113 m
Maximum Cant	8%	8%
Relative gradient of the cant ramps	0.60%	0.60%
Minimum length of spiral	49 m	49 m
Maximum longitudinal gradient	7%	7%
Minimum longitudinal gradient	0.30%	0.30%
Length percentage of the segment except to maximum gradient	19.67%	9.76%
Minimum length of the vertical curvature	36 m	36 m
Number of lanes per roadway	2	2
Width of lane	3,65 m	3,65 m
Width of internal berm	0,50 m	0,50 m
Width of external berm	1,80 m	1,80 m
Length of acceleration lane (30 Km/h to 60Km/h)	105	105
Length of decelaration lane 60 Km/h to 30Km/h)	70	70

Source Consorcio SH 2016

ü Speed Design

Speed design is the most relevant parameter for the geometrical design of roads. This design provides the characteristics of the road in its design stage which must guarantee the user´s safety and convenience. Consequently, for the Pedregal – Catambuco corridor, in Functional Unit 4 Pedregal – Tangua and for Functional Unit 5 subsector 1 Tangua- south Interchanger Eastern Variant of Pasto, which corresponds to a two lane primary national road having mountainous to steep type topographic conditions and according to the contract´s Technical Appendix, a design speed of 60 km/h will be used.

· Infrastructure associated to the project

o ZODMES associated to the project

For the execution project of the divided highway Ipiales-Catambuco construction segment Pedregal-Catambuco, the disposal of excess material for the excavation in 33 Zones of Debris and Excavation Material Management (ZODME). Eleven (11) of these zones are locate in FU-4 and 24 of them in FU-5. You can see these zones accordingly in Chart 11.2.2.10 and Chart 11.2.2.11. The location of ZODMES by segment is shown in Figure 11.2.2.8 and Figure 11.2.2.9.

Chart 11.2.2.10 General Description of FU-4 ZODMES

FU	IDENTIFICATION	LOCATION	SIDE OF THE ROAD	AREA (M2)	CAPACITY (M3)
FU-4	Z4-1	K 0+000	Right	20,473	311,253
	Z4-2	K 0+400	Right	3,950	
	Z4-3	K 2+000	Right	13,321	29,415
	Z4-4	K 5+200	Right	62,865	757,346
	Z4-5	K 5+200	Right	36,798	694,854
	Z4-6	K 8+600	Right	135,188	737,886
	Z4-7	K 10+400	Right	116,241	1,221,882

	Z4-8	K 12+680	Right	29,570	216,794
	Z4-9	K 14+560	Right	45,619	465,186
	ZR4-1	K 2+100	Right	11,419	52,164
	ZR4-2	K 8+600	Right	36,771	93,158

Source Consorcio SH 2016

Chart 11.2.2.11 General Description of FU-5 ZODMES

FU	IDENTIFICATION	LOCATION	SIDE OF THE ROAD	AREA (M2)	CAPACITY (M3)
FU-5	Z5-1A	K 17+200	Right	32,986	200,622
	Z5-1B	K 17+350	Right	24,445	76,935
	Z5-2	K 17+600	Right	23,363	140,646
	Z5-3	K 18+900	Right	330,045	3,246,017
	Z5-4	K 19+300	Left	6,117	9,400
	Z5-5	K 19+600	Left	19,732	127,177
	Z5-6	K 20+900	Right	38,056	181,432
	Z5-7	K 24+500	Left	9,983	32,345
	Z5-8	K 25+000	Left	120,099	815,711
	Z5-9	K 26+280	Left	110,293	229,773
	Z5-10	K 26+900	Left	5,826	14,368
	Z5-11	K 30+730	Right	20,702	19,575
	Z5-12	K 30+780	Right	27,670	133,001
	Z5-13	K 31+600	Right	100,722	813,426
	ZR5-1	20+100	Left	51,561	537,224
	ZR5-2	20+520	Left	71,110	794,203
	ZR5-3	22+450	Left	43,640	425,701
	ZR5-4	30+950	Right	42,817	509,423

FU	IDENTIFICATION	LOCATION	SIDE OF THE ROAD	AREA (M2)	CAPACITY (M3)
	ZR5-5	31+840	Left	7,202	25,759

Source Consorcio SH 2016

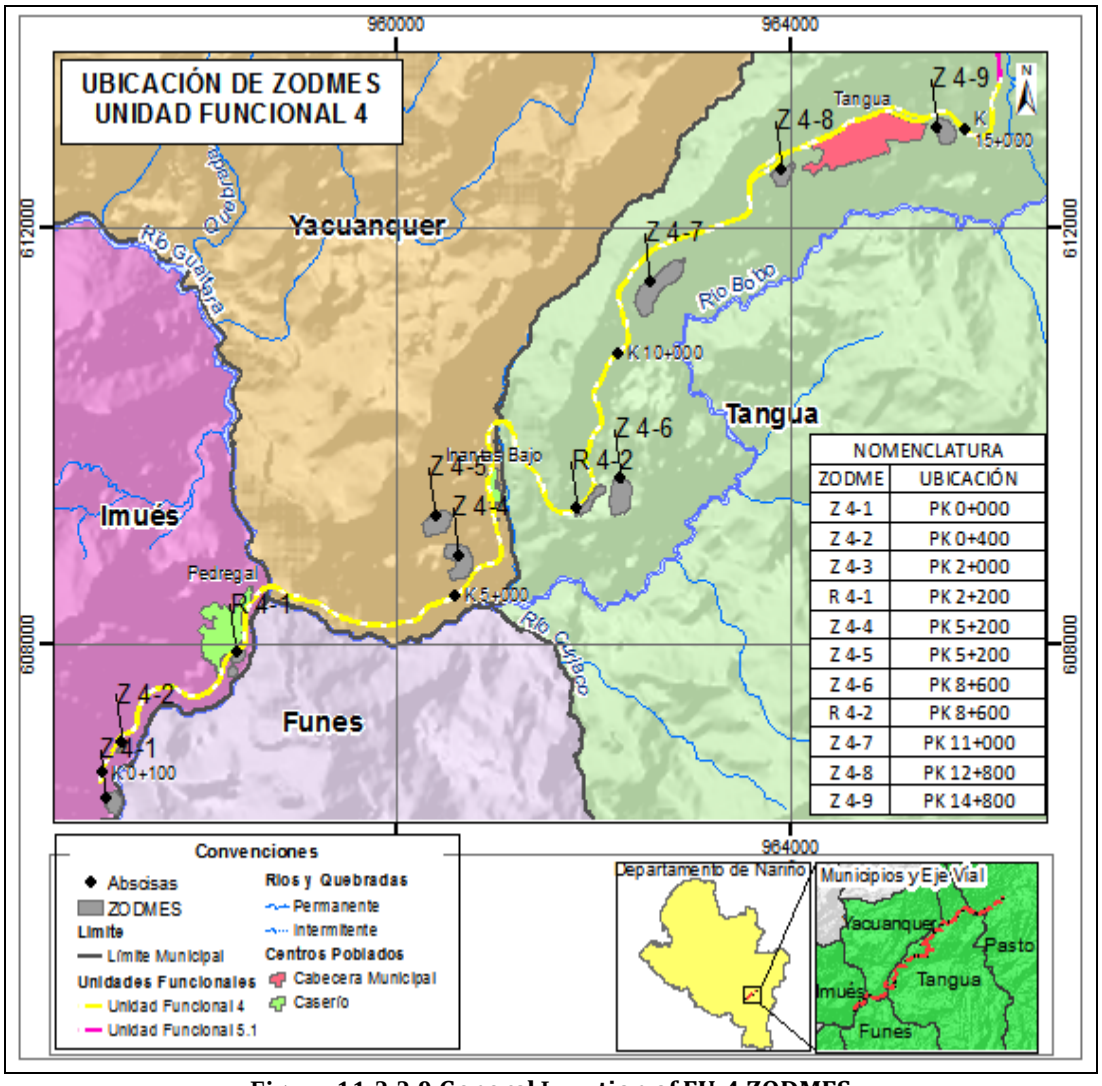

Figure 11.2.2.9 General Location of FU-4 ZODMES

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

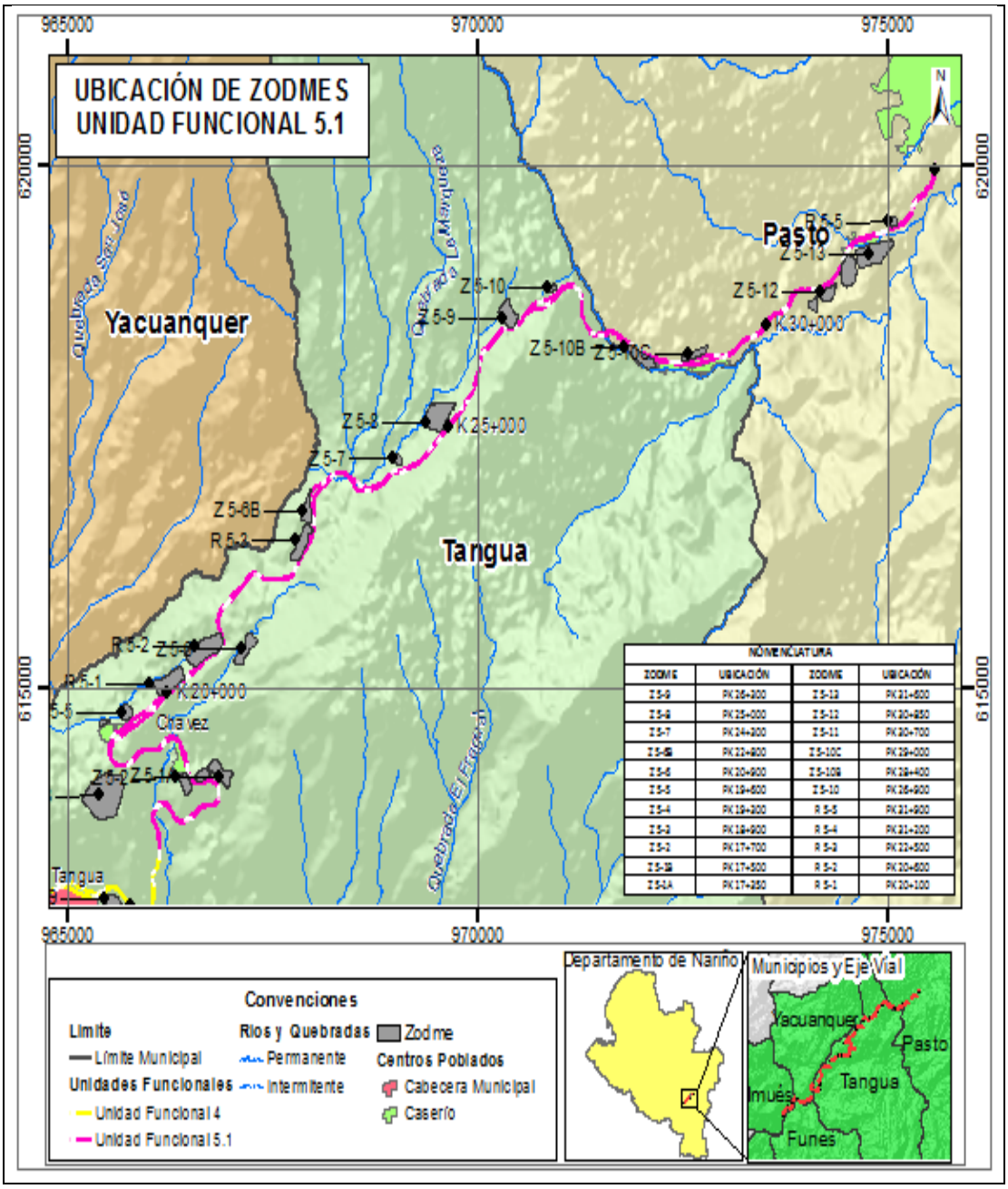

Figure 11.2.2.10 General Location of FU-5 ZODME Subsector 1

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

- Permanent Camps

The divided highway construction project Ipiales – Catambuco in functional units 4 and 5 subsector 1, will have two (2) camps; one for each functional unit. Chart 11.2.2.12 shows the location of these camps and its estimated occupation area.

Chart 11.2.2.12 Permanent Camps FU4 and FU5

OBSERVATION	TANGUA CAMP	CEBADAL CAMP
Municipality	Tangua	Tangua
Village	El Vergel	El Tambor
Township	Porvenir	Nuevo Horizonte
Initial Abscissa	K 14+200	K 21+500
Final Abscissa	K 14+600	K 21+800
East Coordinate reference	965316	967283
North Coordinate reference	613251	616084
Estimated area	3.25 Ha	3.51 Ha
Functional Unit	UF4	UF5

Note: The submitted information corresponds to designs during the feasibility stage, therefore the information is subject to modifications.

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

- Sources of materials

Chart 11.2.2.13 shows some extraction and commercialization sites of construction material, close to the project´s development area. Required materials can be purchased there for project execution purposes.

Chart 11.2.2.13 Sites for extraction and commercialization of authorized material.

LOCATION*		NAME	MINING CODE	FILE No. CORPONARIÑO	APPROVAL RESOLUTION – ENVIRONMENTAL LICENSE
EAST	NORTH				
975244	621115	El Hueco	GLC – 111	2442	Res. No. 934 of December 4, 2008
974261	628415	Victoria	GDFN – 04	163	Res. No. 226 of July 2, 1996
955500	604825	Capulí	EIM-142	LSC -013-10	Res. No. 964 of November 23, 2009
955823	602093	Capulí - Panavias	Res. No. 4059 of September 29, 2014.	2201	Res. No. 273 of July 23, 2002
957092	605368	Tellez - PANAVIAS	FG6-161	2403	Res. No. 981 of December 28, 2006
957080	605372	YANDAR	GGLE-01	621	Res. No. 217 of June 25, 1995
972886	629680	Cantera Javier	IFK – 08251 July 6, 2009	LSC-004-12	Res. No. 584 of September 18, 2012
979478	628478	Cantera Las Delicias	License No. 00270 - 52	941	Res. 862 of July 14,1997
943149	624620	La Concepción	JB7-14351X	Lsc-009-10	Res. 662 of August 19, 2010

* Magna Sirgas flat coordinates West origin

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Temporary Camps

There will be temporary camps at the work fronts to store temporary material necessary to execute the project. This stockpiling will be made in the right of way of the proposed layout and will act as a temporary storage for machinery and tools that are being used at the construction site and that due to logistic reasons cannot be moved to permanent camps

- Processing Plants

For the execution of the divided highway project Ipiales-Catambuco, Pedregal – Catambuco Segment, two (2) concrete plants, two (2) asphalt plants, and two (2) crushers and projected in order to provide the necessary material to execute the project. These plants are planned within the area of Tangua and Cebadal camps.

- Industrial Roads

Chart 11.2.2.14 shows a list of roads that will be used to transport materials and machinery. It also shows a description of the road´s main use even though it is not the only use it will have.

Chart 11.2.2.14 Industrial roads Pedregal-Catambuco

NAME	DESCRIPTION	LENGTH(m)
Industrial Road PEPA 01	Access 1 for construction of Guaitara Bridge	286
Industrial Road PEPA 02	Access 2 for construction of Guaitara Bridge	89
Industrial Road PEPA 03	Access 3 for construction of Guaitara Bridge	198
Industrial Road PEPA 04	Access to ZODMEs Z4-4 and Z4-5	1289
Industrial Road PEPA 05	Access to ZODME Z4-6	167
Industrial Road PEPA 06	Access to ZODMEs Z4-7 Y Z4-8	4517

NAME	DESCRIPTION	LENGTH(m)
Industrial Road PEPA 07	Access to Tangua Camp	311
Industrial Road PEPA 08	Access to ZODMEs Z5-1A and Z5-1B and catchment point La Chaquita	786
Industrial Road PEPA 09	Access to ZODME Z5-3	251
Industrial Road PEPA 10	Access to Cebadal Camp and ZODME Z5-6	805
Industrial Road PEPA 11	Access to ZODME Z5-10	57
Industrial Road PEPA 12	Access to ZODME Z5-11	286
Industrial Road PEPA 13	Access to ZODMES ZR5-4 and Z5-13	390
Industrial Road PEPA 14	Access to water catchment points Río Bobo	1270
Industrial Road PEPA 15	Access to Catchment Points, ZODMES Z5-4, Z5-5	2073
Industrial Road PEPA 16	Access to ZODMEs Z4-1, Z4-2, Z4-3, ZR4-1, Z5-2, ZR5-1, ZR5-2, and Cebadal camps, ZR5-3, Z5-7, Z5-8, Z5-9, Z5-12, ZR5-5.	34609

Source: CONSORCIO SH 2016

· Biogeographic provinces of the intervention area of the highway project

The multiple levels of the hierarchical organization included in a particular biological element, operate from the level of genes, populations, species, communities, ecosystems,
landscape, and biogeographical provinces of biomes up to the biosphere. Each of these levels is characterized by having a structural, functional and composition diversity which are contained simultaneously when we observe a biotic component to establish the classification. All of these contained levels are the ones that move through space and time.

In the case of the biogeographic provinces based on the classification proposed by Hernandez Camacho in 1992, there are 9 for Colombia which come close to the country´s biota complexity. This work is still pending due to the diversity found throughout the national territory.

According to the classification conducted by Hernandez, province 9 is found specifically in the zone that corresponds to the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment -IX. North Andean biogeographical province in which one (1) of its forty five (45) districts, represents the biogeographical characteristics of the ecosystems related to the project, namely District (17): Andean Forests West Nariño District (Hernandez, *et al.* 1992).

Particularly, the North Andean province includes *Sierra Nevada de Santa Marta*, the *Serrania del Perija*, the Eastern, Central and Western mountain range, the valleys of rivers *Magdalena and Cauca*, the Colombian Massif and *Nudo de los Pastos*; in the Department it is represented by the Andean Massif «formed by the eastern and western slopes of the mountain ranges, the inter Andean basins, highlands and volcanos, as well as canyons and valleys located between the 2 mountain ranges» (Hernandez, *et al.* 1992; Ramirez and Churchill, 2002) (See figure 5.2).

The Andean Forests West Nariño District comprises the Municipalities of Yacuanquer, Tangua and Pasto (Delgado *et al.* 2008).

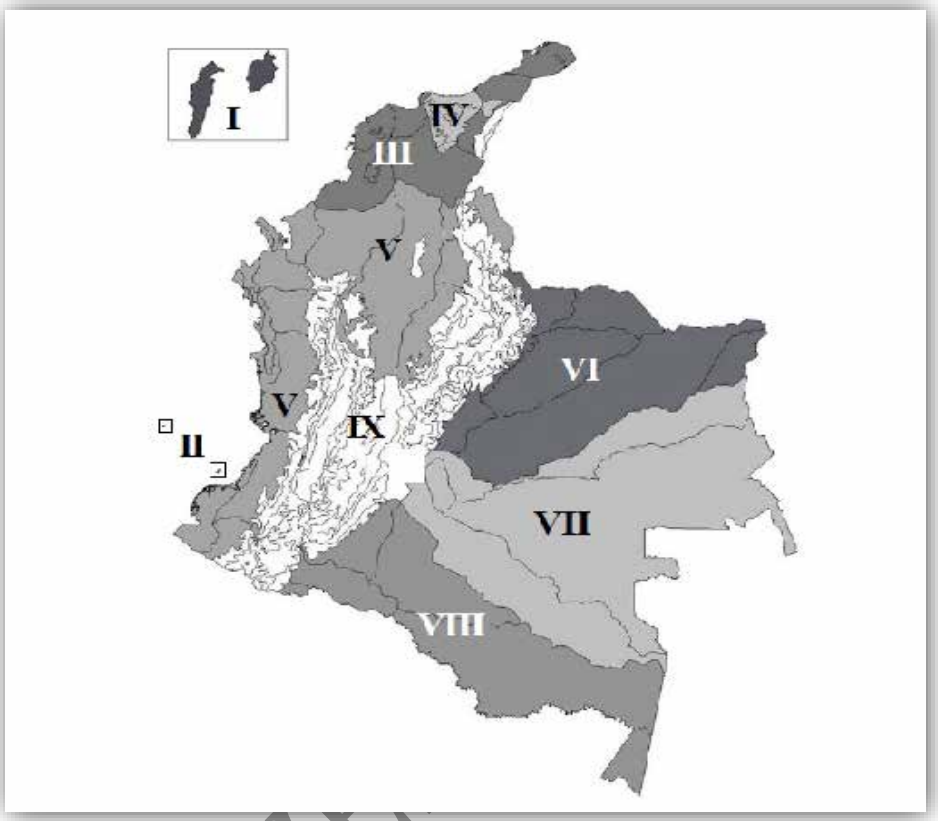

Figure 11.2.2.11 Biogeographical Provinces of Colombia
Source: http://www.redalyc.org/pdf/491/49150103.pdf.

Unidades Biogeográficas / *Biogeographic Units*

Territorios Insulares Oceánicos Caribeños / *Caribbean Oceanic Insular Territories*	**I**
Territorios Insulares Oceánicos del Pacífico / *Pacific Oceanic Insular Territories*	**II**
Cinturón Arido Pericaribeño / *Arid Peri-Caribbean Belt*	**III**
Macizo de la Sierra Nevada de Santa Marta / *Massif of the Sierra Nevada de Santa Marta*	**IV**
Provincia del Chocó-Magdalena / *Choco-Magdalena Province*	**V**
Provincia de la Orinoquia / *Orinoquia Province*	**VI**
Provincia de la Guyana / *Guyana Province*	**VII**
Provincia de la Amazonia / *Amazonian Province*	**VIII**
Provincia Norandina / *North-Andean Province*	**IX**

Tomado de: Hernández J., A. Hurtado, R. Ortiz, T. Walschburger 1991 Unidades Biogeográficas de Colombia En: Hernández J., R. Ortiz, T. Walshburger, A. Hurtado (Eds.) Estado de la Biodiversidad en Colombia Informe Final Santafé de Bogotá, Instituto Colombiano para el Desarrollo de la Ciencia y la Tecnología "Francisco José de Caldas" – Colciencias

· Ecosystems identified in the intervention area

The biotic intervention area was defined once works in the area of intervention were developed by the Construction project.

Said process was established taking into account the agreement on continental, coastal and marine ecosystems of Colombia (IDEAM, et al., 2007), with a scale of 1:25.000 for the study area.

Accordingly, 38 ecosystems were identified in the area of influence distributed in 1933.63 hectares, where the grass mosaics and crops of high Orobiome of the Andes and grass Mosaics and crops of mid Orobiome of the Andes with 254. 56 and 226.51 hectares stand out. Followed by the crops, grasses and natural spaces of mid Orobiome of the Andes and the open and rocky grasslands of mid Orobiome of the Andes with 114.71 and 112.19 hectares were identified respectively. This information is further detailed in chapter 5.2 of this study.

The ecosystems found in the area of influence are presented down below:

Chart 11.2.2.15. Ecosystems identified in the area of influence of the highway project, segment Pedregal - Catambuco

RAN BIOMA	BIOME	NAME	Nomenclature*	AREA	%
Great Biome of the rainforest	High orobiome of the Andes	Dense shrubland of high orobiome of the Andes	213221	7,70	0,40
	Mid orobiome of the Andes	Dense shrubland of mid orobiome of the Andes	203221	15,03	0,78
	High orobiome of the Andes	Gallery forest and/or Riparian of high orobiome of the Andes	21314	8,01	0,41
	Mid orobiome of the Andes	Gallery forest and/or Riparian of mid orobiome of the Andes	20314	21,32	1,10

	Mid orobiome of the Andes	Coffee of mid orobiome of the Andes	202222	8,36	0,43
	Mid orobiome of the Andes	Crops and tree planted of mid orobiome of the Andes	202242	33,87	1,75
	Mid orobiome of the Andes	Open and rocky grassland of mid orobiome of the Andes	2032122	112,19	5,80
	High orobiome of the Andes	Crop mosaic of high orobiome of the Andes	21241	68,01	3,52
	Mid orobiome of the Andes	Crop mosaic of mid orobiome of the Andes	20241	134,06	6,93
	High orobiome of the Andes	Crop mosaic and natural spaces of high orobiome of the Andes	21245	10,97	0,57
	Mid orobiome of the Andes	Crop mosaic and natural spaces of mid orobiome of the Andes	20245	21,02	1,09
	High orobiome of the Andes	Mosaic of crops, grasses and natural spaces of high orobiome of the Andes	21243	77,98	4,03
	Mid orobiome of the Andes	Mosaic of crops, grasses and natural spaces of mid orobiome of the Andes	20243	146,70	7,59
	High orobiome of the Andes	Mosaic of grasses with natural spaces of high orobiome of the Andes	21244	82,35	4,26
	Mid orobiome of the Andes	Mosaic of grasses with natural spaces of mid orobiome of the Andes	20244	114,71	5,93
	High orobiome of the Andes	Mosaic of grasses and crops of high orobiome of the Andes	21242	254,69	13,17
	Mid orobiome of the Andes	Mosaic of grasses and crops of mid orobiome of the Andes	20242	226,91	11,73
	High orobiome of the Andes	Other temporary crops of the high orobiome of the Andes	21211	10,58	0,55
	Mid orobiome of the Andes	Other temporary crops of the mid orobiome of the Andes	20211	4,53	0,23
	High orobiome of the Andes	Potato from high orobiome of the Andes	212151	6,85	0,35
	Mid orobiome of the Andes	Potato from mid orobiome of the Andes	202151	5,18	0,27
	Mid orobiome of the Andes	Wooded pastures of mid orobiome of the Andes	20232	3,15	0,16
	High orobiome of the Andes	Weedy grasses of high orobiome of the Andes	21233	24,53	1,27
	Mid orobiome of the Andes	Weedy grasses of mid orobiome of the Andes	20233	56,37	2,92
	High orobiome of the Andes	Clean grasses of high orobiome of the Andes	21231	84,07	4,35
	Mid orobiome of the Andes	Clean grasses of mid orobiome of the Andes	20231	67,96	3,51
	High orobiome of the Andes	Grasses and trees planted of high orobiome of the Andes	212241	64,34	3,33
	Mid orobiome of the Andes	Grasses and trees planted from mid orobiome of the Andes	202241	58,52	3,03
	High orobiome of the Andes	Forest plantation of high orobiome of the Andes	21315	10,32	0,53

	Mid orobiome of the Andes	Forest plantation of mid orobiome of the Andes	20315	14,97	0,77
	High orobiome of the Andes	Road and railway network and associated terrains from high orobiome of the Andes	21122	13,99	0,72
	Mid orobiome of the Andes	Road and railway network and associated terrains from mid orobiome of the Andes	20122	34,55	1,79
	Mid orobiome of the Andes	Rivers (50 m) of mid orobiome of the Andes	20511	20,89	1,08
	Mid orobiome of the Andes	Continuous urban fabric of mid orobiome of the Andes	20111	55,36	2,86
	High orobiome of the Andes	Discontinuous urban fabric of high orobiome of the Andes	21112	8,10	0,42
	Mid orobiome of the Andes	Discontinuous urban fabric of mid orobiome of the Andes	20112	40,77	2,11
	High orobiome of the Andes	Industrial or commercial zones of high orobiome of the Andes	21121	4,62	0,24
	Mid orobiome of the Andes	Industrial or commercial zones of mid orobiome of the Andes	20121	0,06	0,00
TOTAL				**1933,62**	**100,00**

*Nomenclature obtained from the continental ecosystems map of Colombia
Source: GEMINIS ENVIRONMENTAL CONSULTANTS 2016

Thirty-six (36) types of ecosystems have been identified for the intervention area. They are distributed in 482.49 hectares, where the grass mosaics and crops of high orobiome of the Andes stand out with 66.26 and 61.97 hectares respectively. Followed by open and rocky grassland of mid orobiome of the Andes and the mosaics of crops, grasses and natural spaces of mid orobiome of the Andes with 32.26 and 34.30 hectares respectively.

Chart 11.2.2.16 down below shows the ecosystems that were identified in the highway project´s intervention area:

Chart 11.2.2.16. Ecosystems identified in the highway project´s area of influence, segment Pedregal - Catambuco

GREAT BIOME	BIOME	NAME	NOMENCLATURE *	TOTAL AREA	%
	Mid orobiome of the Andes	Dense shrubland of Mid orobiome of the Andes	203221	2,00	0,42

GREAT BIOME	BIOME	NAME	NOMEN CLATURE *	TOTAL AREA	%
Great Biome of the tropical rainforest	High orobiome of the Andes	Gallery forest and/or riparian of high orobiome of the Andes	21314	0,11	0,02
	Mid orobiome of the Andes	Gallery forest and/or riparian of mid orobiome of the Andes	20314	2,07	0,43
	Mid orobiome of the Andes	Coffee of mid orobiome of the Andes	202222	0,51	0,11
	Mid orobiome of the Andes	Crops and trees planted from mid orobiome of the Andes	202242	2,99	0,62
	Mid orobiome of the Andes	Open and rocky grassland of mid orobiome of the Andes	2032122	32,26	6,69
	High orobiome of the Andes	Crop mosaic of high orobiome of the Andes	21241	12,50	2,59
	Mid orobiome of the Andes	Crop mosaic of mid orobiome of the Andes	20241	29,16	6,04
	High orobiome of the Andes	Crop mosaic and natural spaces of high orobiome of the Andes	21245	1,26	0,26
	Mid orobiome of the Andes	Crop mosaic and natural spaces of mid orobiome of the Andes	20245	10,84	2,25
	High orobiome of the Andes	Mosaic of crops, grasses and natural spaces of high orobiome of the Andes	21243	14,29	2,96
	Mid orobiome of the Andes	Mosaic of crops, grasses and natural spaces of mid orobiome of the Andes	20243	34,30	7,11
	High orobiome of the Andes	Crop mosaic and natural spaces of high orobiome of the Andes	21244	14,05	2,91
	Mid orobiome of the Andes	Crop mosaic with natural spaces of mid orobiome of the Andes	20244	31,30	6,49
	High orobiome of the Andes	Mosaic of grasses and crops of high orobiome of the Andes	21242	66,26	13,73
	Mid orobiome of the Andes	Mosaic of grasses and crops of mid orobiome of the Andes	20242	61,97	12,84
	High orobiome of the Andes	Other temporary crops of the high orobiome of the Andes	21211	4,18	0,87
	Mid orobiome of the Andes	Other temporary crops of the mid orobiome of the Andes	20211	2,50	0,52
	High orobiome of the Andes	Potato from high orobiome of the Andes	212151	1,34	0,28
	Mid orobiome of the Andes	Potato from mid orobiome of the Andes	20232	2,79	0,58
	High orobiome of the Andes	Weedy grasses of high orobiome of the Andes	21233	6,91	1,43
	Mid orobiome of the Andes	Weedy grasses of mid orobiome of the Andes	20233	16,89	3,50
	High orobiome of the Andes	Clean grasses of high orobiome of the Andes	21231	17,18	3,56
	Mid orobiome of the Andes	Clean grasses of mid orobiome of the Andes	20231	11,12	2,31
	High orobiome of the Andes	Grasses and trees planted of high orobiome of the Andes	212241	15,13	3,14

GREAT BIOME	BIOME	NAME	NOMENCLATURE *	TOTAL AREA	%
	Mid orobiome of the Andes	Grasses and trees planted of mid orobiome of the Andes	202241	19,73	4,09
	High orobiome of the Andes	Forest plantation of high orobiome of the Andes	21315	0,34	0,07
	Mid orobiome of the Andes	Forest plantation of mid orobiome of the Andes	20315	2,54	0,53
	High orobiome of the Andes	Road and railway network and associated terrains from high orobiome of the Andes	21122	13,77	2,85
	Mid orobiome of the Andes	Road and railway network and associated terrains from mid orobiome of the Andes	20122	28,20	5,85
	Mid orobiome of the Andes	Rivers (50 m) of mid orobiome of the Andes	20511	0,16	0,03
	Mid orobiome of the Andes	Continuous urban fabric of mid orobiome of the Andes	20111	12,81	2,65
	High orobiome of the Andes	Discontinuous urban fabric of high orobiome of the Andes	21112	5,36	1,11
	Mid orobiome of the Andes	Discontinuous urban fabric of mid orobiome of the Andes	20112	4,57	0,95
	High orobiome of the Andes	Industrial or commercial zones of high orobiome of the Andes	21121	1,08	0,22
	Mid orobiome of the Andes	Industrial or commercial zones of mid orobiome of the Andes	20121	0,02	0,00
		Total		**482,49**	**100, 00**

* Nomenclature obtained from the continental ecosystems map of Colombia
Source GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Figures 11.2.2.1 and 11.2.2.2, show the ecosystems identified by functional unit, which makes part of the highway project Rumichaca-Pasto, for segment Pedregal-Catambuco.

· Natural ecosystems identified in the area of influence

Natural ecosystems identified in the area of influence of the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment, are outlined as follows:

Chart 11.2.2.17 Natural ecosystems present in the area of influence

GREAT BIOME	BIOME	NAME	NOMENCLATURE	TOTAL AREA	%
Great Biome of the tropical rainforest	High orobiome of the Andes	Dense shrubland of high orobiome of the Andes	213221	7,70	4,69
	Mid orobiome of the Andes	Dense shrubland of mid orobiome of the Andes	203221	15,03	9,15

	High orobiome of the Andes	Gallery forest and/or riparian of high orobiome of the Andes	21314	8,01	4,88
	Mid orobiome of the Andes	Gallery forest and/or riparian of mid orobiome of the Andes	20314	21,32	12,98
	Mid orobiome of the Andes	Open and rocky grassland of mid orobiome of the Andes	2032122	112,19	68,31
		Total		**164,25**	**100,00**

* Nomenclature obtained from the continental ecosystems map of Colombia
Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

· Natural ecosystems identified in the area of intervention

Natural ecosystems identified in the area of intervention of the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment, are outlined as follows:

Chart 11.2.2.18 Natural ecosystems present in the area of intervention

GREAT BIOME	BIOME	NAME	NOMENCLATURE*	TOTAL AREA	%
Great Biome of the tropical rainforest	Mid orobiome of the Andes	Dense shrubland of mid orobiome of the Andes	203221	2,00	5,50
	High orobiome of the Andes	Gallery forest and/or riparian of high orobiome of the Andes	21314	0,11	0,31
	Mid orobiome of the Andes	Gallery forest and/or riparian of mid orobiome of the Andes	20314	2,07	5,67
	Mid orobiome of the Andes	Open and rocky grassland of mid orobiome of the Andes	2032122	32,26	88,52
		Total		**36,44**	**100,00**

* Nomenclature obtained from the continental ecosystems map of Colombia
Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Natural ecosystems found in the area of intervention are described as follows:

Dense shrubland of mid orobiome of the Andes

This ecosystem is comprised of a plant community dominated by typically shrubby elements, which form an irregular canopy, but that it can present disperse arboreal

elements. Species such as: *Miconia versicolor Naudin* (Munchiro), *Miconia theaezans (Bonpl.) Cogn* (Morochillo), prevail.

Photograph 11.2.2.1 Dense shrubland of mid oriobome of the Andes
Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Open and rocky grassland of mid orobiome of the Andes

In these types of ecosystems the natural, open herbaceous vegetation prevails without having arboreal elements. Its development occurs over areas of predominant rocky and stony substrates that do not retain moisture.

Species such as: Cylindrical cactus, flat cactus, old man cactus and bromeliads.

Photograph 11.2.2.1. Open and rocky grassland of high orobiome of the Andes
Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Riparian forest of mid orobiome of the Andes

The arboreal type of species prevails in this type of ecosystem. It is found along water courses and it is limited by its breadth. The most representative species are: *Miconia theaezans (Bonpl.) Cogn*. (Morochillo), *Lafoensia acuminata (Ruiz & Pav.) DC*. (Guayacan), *Tecoma stans (L.) Juss. ex Kunth* (Quillotocto), *Senna spectabilis (DC.) H.S.Irwin & Barneby* (Pichuelo) and *Myrsine guianensis (Aubl.) Kuntze* (cucharo) among others.

Photograph 11.2.2.2. Riparian forest of mid orobiome of the Andes
Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

· Protected areas

Through secondary information analysis the presence of forest reserve areas is discarded of Law 2ª of 1959, areas of the national system of Protected Areas, strategic, sensitive zones or ecosystems and protected areas in the area of influence of the divided highway project, segment Pedregal-Catambuco, that could be affected directly with the divided highway road construction.

The preliminary verification was made with the Tremactos Colombia tool and the overlap of influence areas of the highway project with the information of the National, Natural Parks System, the Local System of Protected Areas and Civil Society Reserves of Galeras, National Protective Forest Reserves and Regional Protected Areas (see description Chapter 5 Characterization of the area of influence, subparagraph 5.2.1.3 Sensitive, Strategic Ecosystems and/or protected areas).

Accordingly, and in order to validate the data obtained, some information was requested to the Ministry of Environment and Sustainable Development-MADS, National Parks of Colombia, as well as to the regional environmental authorities such as CORPONARIÑO,
the Municipal City Hall of Pasto and the Department´s Governorship, regarding whether or not there are protected areas or strategic ecosystems in the area of influence the Rumichaca – Pasto divided highway project. The results were that the area of interest does NOT overlap with any category recognized by environmental authorities in the National Registry of Protected Areas (RUNAP), regulated by Decree 1076 of 2015, in its Article 2.2.2.1.3.3 “National System of Protected Areas-SINAP”. See annexes 5.2.1.4-a, 5.2.1.4-b, 5.2.1.4-c and 5.2.1.4-d).

Within the surrounding area of the project´s impact the following are identified: Reserve of river Bobo-Buesaquillo, Reserve of Civil Society of Galeras, Flora and Fauna Sanctuary *Galeras*, Protected Area *Ovejas-Tauso*, Protected Area *Tabano-Campanero*, Protected Area *Divina Pastora*, Protected Area *Morasuro*.

However and even though there are no strategic ecosystems or protected areas per se in the area of influence of the highway project, natural ecosystems corresponding to Riparian forest and open and rocky grassland are identified. (See Chart 11.2.2.19).
The location of the identified protected areas in the area of indirect influence of the highway project is graphically displayed as follows:

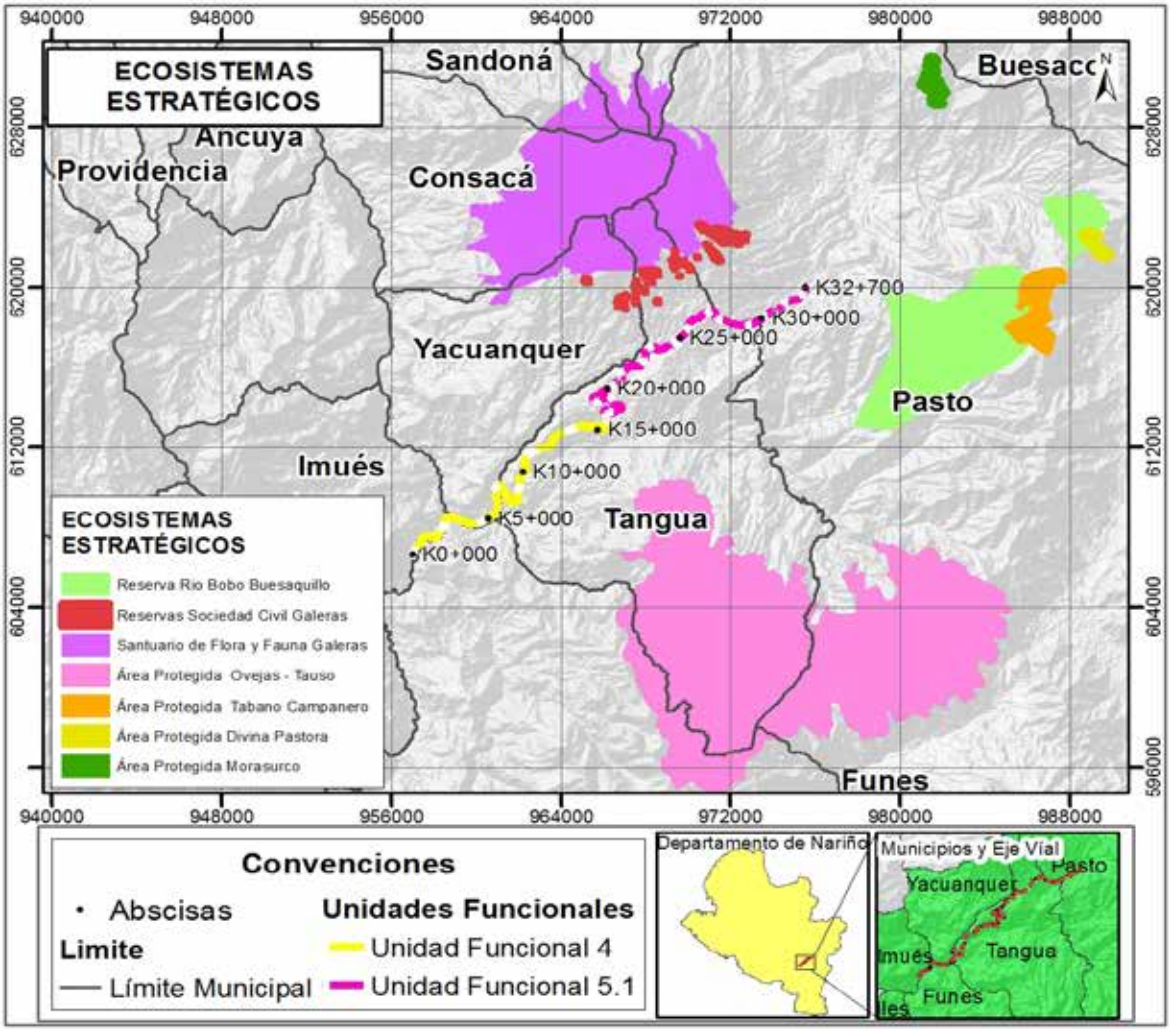

Figure 11.2.2.12. Protected areas at a local and regional scale vs the road corridor Rumichaca-Pasto, segment Pedregal-Catambuco.

Source: Géminis Consultores S.A.S 2016

As shown in the previous figure the Reserve of river *Bobo-Buesaquillo*, the Reserve of Civil Society of Galeras, the Flora and Fauna Sanctuary *Galeras*, the Protected Area *Ovejas-Tauso*, the Protected Area *Tabano-Campanero*, Protected Area *Divina Pastora* and the Protected Area *Morasuro* do not have a direct relationship or make part of the area of influence of the highway project.

- Evaluation of associated impacts

The environmental evaluation of the impacts generated by the project´s development is presented in Chapter 8 of this study. There, each of the environmental components is related through the qualitative estimate of the environmental importance of the impacts.

According to the results of the environmental evaluation in the Scenario with Project, the most affected means are identified in descending order through the different activities of the project which are abiotic, biotic and socioeconomic.

The next figure broadly shows the activities that generate the most negative impacts over the abiotic, biotic and socioeconomic components.

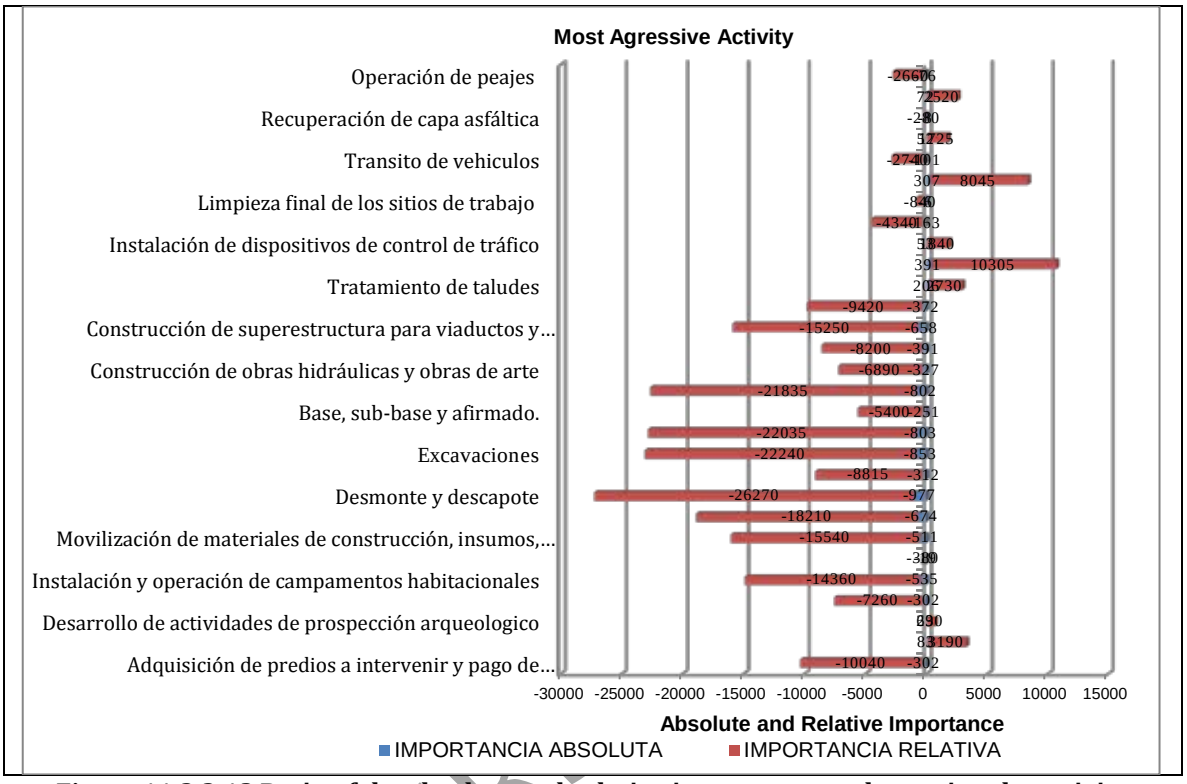

Figure 11.2.2.13 Ratio of the absolute and relative importance, to determine the activity that has the greatest negative effect on the means.

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

The activities of dismounting and stripping, excavations, installation and operation of processing plants generate a significant impact on the environment, however there are also non aggressive activities such as restoring the terrain into grasslands and revegetating, conducting landscape management and doing embankment treatments, among others.

On the other hand and according to the analysis developed in the impact evaluation matrix, it was established that the abiotic environment is the most adversely affected and the least affected is the socioeconomic environment as shown in the following figure:

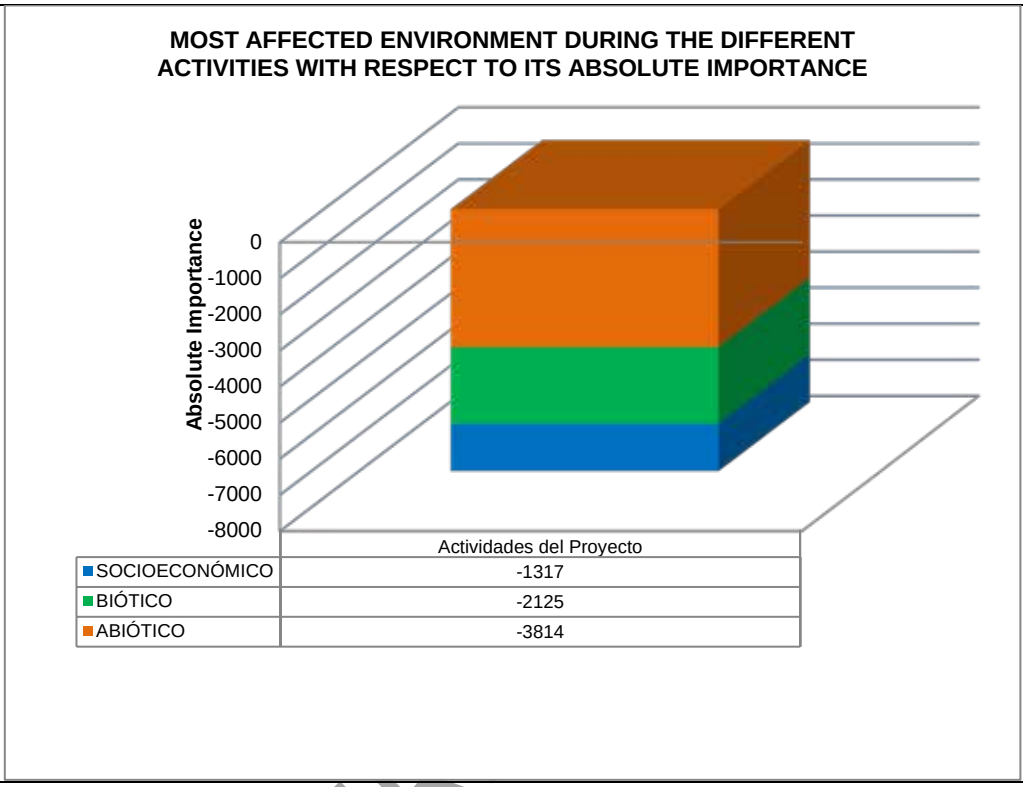

Figure 11.2.2.14 Most affected environment during the different activities with respect to its absolute importance

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

The impacts of the biotic environment that will be taken into account in the following segment are considered relevant for environmental purposes as described down below:

- *Modification of the plant cover*

The zones to handle debris and excavation materials is one of the activities that has the greatest effect on the change in the vertical and horizontal structure of herbaceous, shrub and arboreal vegetation, which means that for management purposes, it requires the adaption of specific sites, thus directly modifying the types of vegetation cover.

Building structures such as bridges and viaducts has a severe level of importance, given that removing the vegetation cover affects the vertical and horizontal structure of the herbaceous, shrub and arboreal vegetation, which leads to the loss of different plant species.

In view of the above it is important to bear in mind that the structure and flora composition of a cover is given by the presence of plant individuals that, according to its species, structure (herbaceous, shrub, arboreal), abundance (number of individuals), distribution, development (diameter and height) among other variables that determine the type or coverage unit. The alteration of the structure and flora composition refers to the partial or total modification of the previously mentioned variables, affecting the ecosystem´s functionality.

This impact is mainly generated during dismounting, stripping and/or vegetation removal, since the current vegetation must be removed for its development, due to the fact that there are woodland areas and it is considered significant for the loss of the protective cover of the soil and the connectivity of ecosystems. However, in the case of forests and secondary vegetation, this activity causes an impact of great magnitude, because when taking advantage of the species in the track gauge, the forest is divided and this generates more "edge" area which considerably alters the structure and composition of current vegetation having very complex plant succession processes and dynamics.

- Change of the vegetation cover in waterbodies
- Change in the abundance of species in closed season
- Wild fauna habitat fragmentation

The removal of plant cover and stripping could completely modify current habitats in the selected areas; mainly in the woodland ecosystems where fauna seeks for shelter and finds a greater resource. The coverages that are intervened by the project´s activities are an essential part of ecosystems. The activity produces a decrease of the micro-habitat available for species that usually occupy the area and its facilities as well as mobility, trophic relationships and social behaviors of species.

The impact will occur in the road corridor and in the neighboring zones where construction works will take place over the secondary vegetation patches and minor lotic waterbodies, as surplus residues of land movements; discharges of hydrophobic liquids (oils, fuels, lubricants) and/or residual waters from temporary camps

- *Change in the abundance of species in closed season, threatened and/or in danger*

One of the activities that generates the greatest impact on the change in abundance of species is the dismounting and strapping, as well as demolition and excavation activities which directly alters the coverages and as a result the current forest and epiphytic species.

Fragmentation of habitats of wild fauna

The construction phase encompasses the largest part of the activities that generate fragmentation processes of wild fauna habitats is mainly due to the elimination of plant covers that are used by wild fauna as feeding or passage sites, resting places, burrows, etc. Photograph 8.18 shows the typical fragmented covers of the study area.

One of the most relevant factors that lead to the deterioration of the habitats is its fragmentation. The loss of continuity of natural resources and conditions in an area, directly and specially affects reproduction, eating habits and as a result the survival of species.

The physical and biological characteristics of an habitat allow its occupation by different species depending on the degree of relationship these have with their environment and this leads us to the specificity of the habitat. Habitat disruptions might be considered discreet or indiscreet in time, capable of transforming the structures of animal populations, generating changes in the composition of communities and an overall change of the natural dynamic of animal species.

Habitat fragmentation and the number of resulting fragments will reduce the size of populations thus affecting its density since it reduces the capacity to maintain the species
due to the loss of the dynamics and complexity of the habitat leading to a threshold of population unfeasibility.

Photograph 11.2.2.3 Fragmentation of wild fauna habitats
Source: GÉMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Activities pertaining to construction works tend to generate changes in naturales spaces in the habitat and local fauna populations thereby, varying its composition and structure as well as their behavior. In a matrix as the one shown in Photograph 11.2.2.4, there are structural changes in fauna as a result of fragmentation, with the activities that pertain to the construction. Said changes increase and now there are different structures and compositions in wild fauna.

Photograph 11.2.2.4 Changes in the composition of wild fauna/habitat alteration
Source: GÉMINIS ENVIRONMENTAL CONSULTANTS, 2016.

- *Alteration of the fresh water habitat*

Hydrobiological communities such as phytoplankton, zooplankton, periphyton and benthos associated with the substrate and the macrophytes, are related to the quality of water and for having bio-indication properties. Any alteration in its habitat, which could be a ravine, a well or a spring it's directly related with the composition and structure of the communities of each group. Each species has certain tolerance ranges towards a specific alteration factor and their adaption thereto. Changes in the structure of communities mainly occur through actions that directly affect the waterbodies where said communities live. It is well known that excavations alter the flow of water supply systems as well as their physicochemical characteristics besides modifying the communities that inhabit them.

All of the activities of the construction process that imply the movement of materials will affect the surrounding waterbodies. The affectation of water supply systems s starts with the most sensitive communities represented by primary producers and the modifications of the physicochemical characteristics of water.

The dismounting and stripping of plant covers implies a direct impact over surrounding water supply systems. First of all the plant cover is, which acts as a protection and as a filter of natural sediments, is lost. Secondly, the micro climate of the waterbody and the physicochemical parameters also change and by doing so the structure and composition of the hydro-biological communities is modified. An example of this situation is seen in Photograph 11.2.2.5. Here you can see an almost non-existence of riparian cover plus erosive processes of the surrounding terrain. This affects the water of river *Guaitara*, with a higher incidence of sediments, changes in the physicochemical parameters as well as in the hydrobiological communities that inhabit the system.

Photograph 11.2.2.5 Loss of riparian cover and erosive processes over river Guaitara
Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Changes in the freshwater habitat are related to a larger extent, with the construction phase. Activities during said phase such as demolition, dismounting and stripping and mobilization of construction materials, inputs, machinery, equipment, wastes and vehicles, generate erosive and removal processes that directly impact the surrounding waterbodies, which in turn are largely used in the road layout as sumps where all types of factors or physical, chemical and biological characters are drained. This generates an alteration of the requirements of aquatic habitats, the dynamic of the flow, the natural levels of sediments, the physical properties of light and heat, chemical such as nutrients and biological such as flora and fauna populations that have a dynamic and natural fluctuation, and losing these requirements, will cause an alteration of the freshwater

habitats that will directly affect their quality because the provision of ecosystem services will become more difficult as well as the intervention in each and every one of the vital processes of all living creatures as food provision and clean water. They also represent the habitat for nearly 25% of all vertebrates described in the world.

Photograph11.2.2.6 shows an example of the environmental damage in the zone of the road corridor that it is being studied. Here you can see the poor waste disposal management that will affect water supply systems as well as the communities that inhabit the area.

Photograph 11.2.2.6 Poor disposition of wastes near river Guaitara
Source: GÉMINIS ENVIRONMENTAL CONSULTANTS, 2016.

· Residual Impacts

Compensations for the biodiversity loss are a set of actions that aim to compensation the biodiversity due to the impacts and negative effects that cannot be avoided, corrected, mitigated or replaced and that lead to the loss of biodiversity in natural, land and secondary vegetation ecosystems. These are applied in ways that guarantee the effective conservation of an ecologically equivalent area where a new management category or a permanent conservation area is achieved. Before any compensation it is necessary to demonstrate that those actions to avoid, minimize and repair or restore residual impacts generated by the project, were executed.

Following, there are a series of actions carried out within the Hierarchy of mitigation: Avoid, minimize and repair or restore the impacts generated by the project.

Taking into account the impact evaluation, possible impacts over the biotic environment were identified for each of the stages of the project. These were the findings:

Chart 11.2.2.20. Environmental impacts identified in the project

IDENTIFIED IMPACT	ENVIRONMENTAL EVALUATION
Modification of the plant cover	Negative Impact, Severe Importance
Change of the protective vegetation of waterbodies	Negative Impact, Severe Importance
Change in the abundance of closed season species, threatened and/or in danger	Negative Impact, Severe Importance
Habitat fragmentation of wild fauna	Negative Impact, Severe Importance
Alteration of the freshwater habitat	Negative Impact, Severe Importance

Source: GÉMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Broadly, you will see down below some of the proposed measures to develop according to the generated impacts.

Chart 11.2.2.21. Proposed measures to develop according to the generated impacts.

IMPACT	IMPACT MANAGEMENT			
	PREVENTION	MITIGATION	CORRECTION	COMPENSATION
	ZONING	MANAGEMENT PLAN	MANAGEMENT PLAN	
Modification of the plant cover	Excluded areas	Planning and execution of activities stated in PMA.	Recovery of areas intervened due to the development of activities	Long term occupation of the land surface with the developed structures along the project.
Change of the protective vegetation of waterbodies				
Change in the abundance of closed season species, threatened and/or in danger				
Habitat fragmentation of wild fauna				
Alteration of the freshwater habitat				

Source: GÉMINIS ENVIRONMENTAL CONSULTANTS, 2016.

Environmental management zooning: Establishes or defines the management to conduct during the different activities and enables planning and distribution of the infrastructure considering the environmental sensitiveness, which is drawn from abiotic, biotic and socioeconomic considerations. In this way, several sensitivity categories and intervention areas are established. Natural plant covers offer a high degree of sensitiveness and therefore present a restriction for their intervention.

Down below there is a defined methodological outline to carry out the environmental zooning of the divided highway project Rumichaca - Pasto, segment Pedregal – Catambuco.

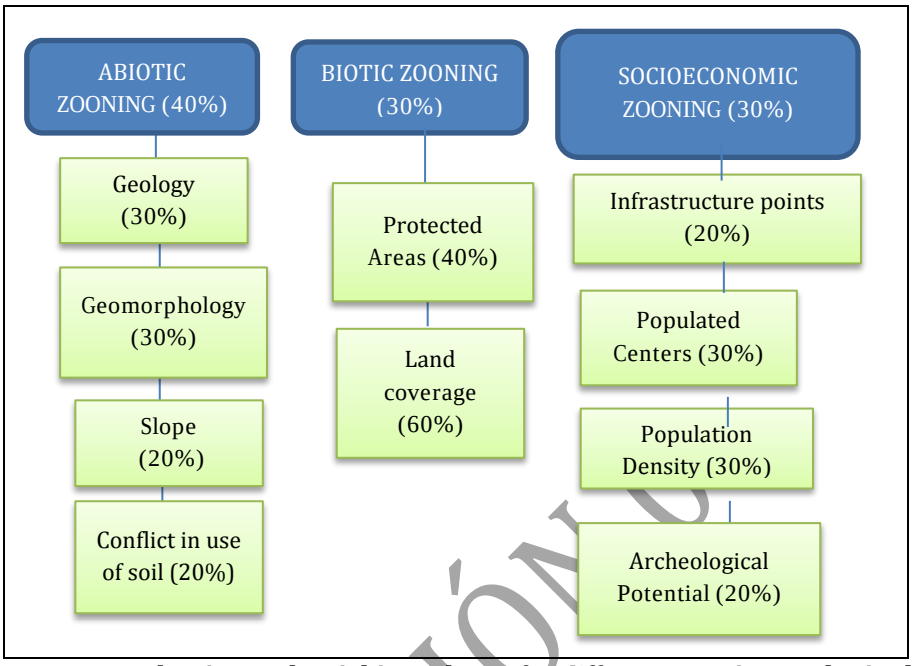

Figure 11.2.2-15 Evaluation and weighing scheme for different zooning to obtain the Total environmental zooning.

The identification of zones for abiotic, biotic and socioeconomic components reflect the degree of potentiality or fragility within a given zone. This identification enabled to determine the environmental sensitiveness of the area without the project (Chart 11.2.2.22), where the areas with High, Medium and Low environmental sensitiveness are classified.

Chart 11.2.2.23. Environmental sensitiveness categories identified for segment Pedregal - Catambuco

SENSITIVENESS	AREA (HA)	PERCENTAGE %
Low	1397,9	72,30
Medium	288,8	14,94
High	246,9	12,77
TOTAL	**1933,6**	100,00

Source: (Géminis Consultores Ambientales, 2016)

This is how for the project's area of influence there are 1397,9 hectares with *low sensitiveness* representing 72,30%, while *medium sensitiveness* represents 14,94% and *high* 12,77% equivalent to 246,9 ha. Spatial distribution of the different identified categories, with regard to the project´s layout, can be seen in Figure 11.2.2-16 and Figure 11.2.2-17.

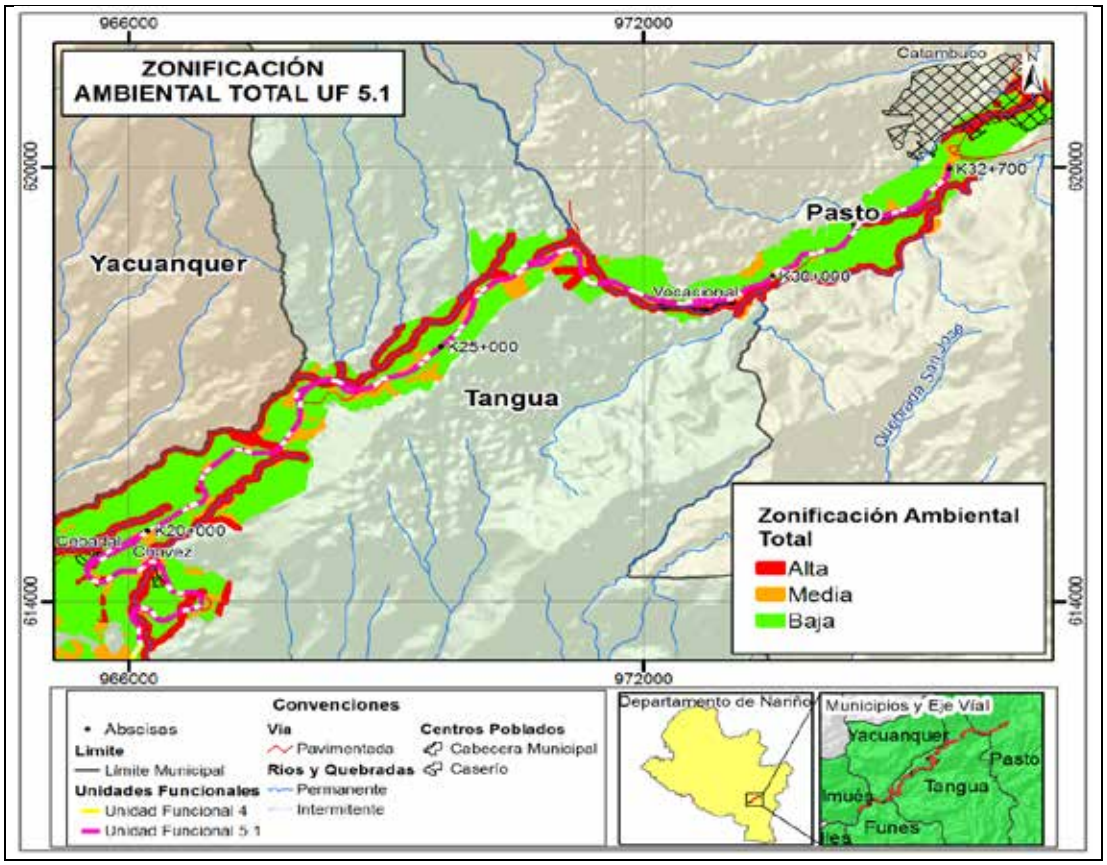

Figure 11.2.2-16 Total environmental zooning FU 5.1

Source: (Géminis Consultores Ambientales, 2016)

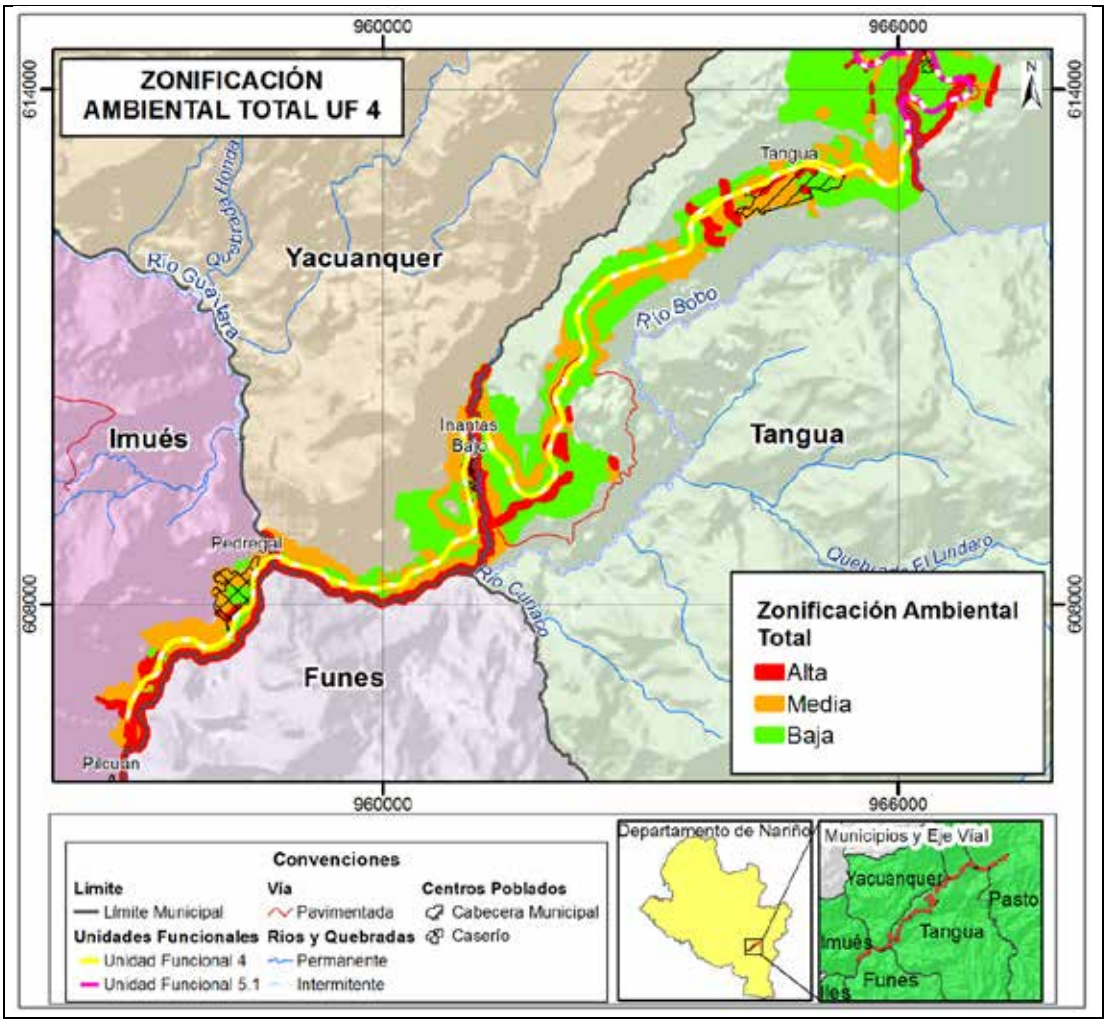

Figure 11.2.2-17 Total environmental zooning FU 4

Source: (Géminis Consultores Ambientales, 2016)

Environmental Management Plan: Environmental management programs presented in Chapter 11.1.1, comprise the set of measures aimed at preventing (avoid), mitigating and correcting (repair or restore) the impacts generated by the project.

Following you will see the Environmental Management Programs (PMA) for the biotic area, which would be implemented for the development of the divided highway project

Rumichaca – Pasto segment Pedregal – Catambuco. The outlined programs and projects were formulated based on the biotic conditions of the area of influence, as well as from the evaluation of impacts made for the project´s development

Chart 11.2.2.24 Program structure for the Biotic environment

COMPONENT	PROGRAM	CODE	PROJECTS
BIOTIC	SOIL RESOURCE MANAGEMENT	MRS-1	Plant cover removal and stripping management
	FLORA AND FAUNA RESOURCE MANAGEMENT	MRFF-1	Flora management
		MRFF-2	Fauna management
		MRFF - 3	Habitat management and conservation
		MRV-2	Cover impact compensation management

Source:Géminis Consultores S.A.S. 2015

1.2.2.4 Definition of compensations

The definition of the areas to compensate within the framework of the Rumichaca – Pasto divided highway project Pedregal – Catambuco segment, was determined taking into account the guidelines established in the Manual for the Allocation of Compensations for Biodiversity Loss, covered under Resolution 1517 of 2012.

For that matter, the existence of those natural ecosystems identified in the intervention area were checked with the help of the Ma.F.E v 2.0 tool, to determine its equivalent in the area of influence of the highway project. This meant that there are equivalent areas to compensate for ecosystems represented by dense shrub of high orobiome of the Andes, gallery forest and/or riparian of high orobiome of the Andes and, gallery forest and/or riparian of mid orobiome of the Andes. However, for the open and rocky grasslands of mid orobiome of the Andes, there are no compact areas, meaning that very scattered zones were identified, which might hinder its compensation.

Accordingly, and in compliance with subparagraph 4.1 Criteria for the selection of the area ecologically equivalent if the Compensation Manual, which establishes that:

If it is not possible to locate an equivalent area to compensate the area of influence, neither in the hydrological subzone where the project is located, nor in the surrounding zones of the area then, ecological restoration activities can be conducted which might include landscape management tools (silvopasture, agroforestry, silviculture types of activities, etc.) and/or where the protected areas of the National System of Protected Areas-SINAP, participate in sanitation or expansion activities.

In that matter and bearing in mind that this type of cover does not exist within the hydrological subzones and surrounding areas where the project is located, it was determined to carry out landscape management activities in surrounding areas of the impacted area and property sanitation activities in areas protected by SINAP.

11.2.2.1. Calculations of the area to affect

The intervention area for the construction of the second lane Rumichaca-Pasto, segment Pedregal-Catambuco, a project that corresponds to areas that will be stripped or that require cleaning (of plant cover) for the transit of machinery and equipment, as well as the ZODME areas and camps.

In order to calculate the compensation, the areas of intervention were grouped in three categories. These categories correspond to the type of infrastructure that will be conducted in each one of them: Roads, infrastructure associated to the project and ZODME. The definition of the areas comprised the following stages:

- *Area Definition*

Together with the designs of the highway project, the areas of intervention were calculated by grouping the infrastructure in three categories:

- Roads: Where the roadway´s width is and the berms, chamfers and current roads,
- Infrastructure associated to the project: Where plants were grouped, camp area

- Zone for disposal of excavation material-ZODME

- *Calculation of the area undergoing intervention, per ecosystem*

Once the ecosystems are defined and the area´s biogeographical districts of the intervention area of the highway project are identified, thirty six (36) ecosystems were classified within which, four (4) correspond to naturals. See Chart 11.2.2.25.

Such natural ecosystems were overlapped with biogeographical districts, identifying that the highway project´s intervention area is part of the *Andean Forests of West Nariño District*, including the Municipalities of Yacuanquer, Tangua and Pasto (Delgado *et al.* 2008).

Based on this information, the National List of Compensation Factors for Terrestrial Natural Ecosystems for the Allocation of compensations due to Biodiversity Loss was consulted, to determine its representativeness, rarity, loss potential, remanence and its corresponding compensation factor through the use of the following formulas:

Total compensation factor for natural ecosystems (MADS, 2012)

$$Ac = Ai \times SFc$$

Where:
Ac: Area to compensate due to biodiversity loss
Ai: Area of the natural ecosystem to be affected by the development of the project, works or activity.
Fc: Total compensation factor, which is equal to the sum of the following individual factors: Representativeness, Rarity, Remanence and loss potential or transformation.

For that matter, a compensation value of 7.75 and 5.75 was assigned to the natural ecosystems that were identified in the highway project´s intervention area, as seen in the following charts 11.2.2.26 and 11.2.2.27:

Chart 11.2.2.28 Natural ecosystems of the intervention area

ECOSYSTEM IDENTIFIED IN THE INTERVENTION AREA	BIOGEOGRAPHICAL DISTRICT ECOSYSTEM	INTERVENED AREA (ha)
Dense shrubland of mid orobiome of the Andes	*Andean Forests of West Nariño* District	2,00
Gallery forest and/or Riparian of high orobiome of the Andes		0,11
Gallery forest and/or Riparian of mid orobiome of the Andes		2,07
Open and rocky grassland of mid orobiome of the Andes		32,26
TOTAL		**36,44**

Source GEMINIS ENVIRONMENTAL CONSULTANTS. 2016

Chart 11.2.2.29 Compensation factors for natural ecosystems identified in the intervention area

ECOSYSTEM IDENTIFIED IN THE INTERVENTION AREA	BIOGEOGRAPHICAL DISTRICT ECOSYSTEM	Representativeness	Rarity	Loss potential	Remanence	Compensation Factor	AFFECTED AREA
Dense shrubland of mid orobiome of the Andes	*Andean Forests of West Nariño District*	2	2	1,75	2	7,75	2
Gallery forest and/or Riparian of high orobiome of the Andes		2	2	1,75	2	7,75	0,11
Gallery forest and/or Riparian of mid orobiome of the Andes		2	2	1,75	2	7,75	2,07
Open and rocky grassland of mid orobiome of the Andes		1	1	1,75	2	5,75	32,26
TOTAL							**36,44**

Source GEMINIS ENVIRONMENTAL CONSULTANTS. 2016

According to the previous chart, the compensation factor is equal for the dense shrubland of mid orobiome of the Andes, the gallery forest and/or riparian of high orobiome of the Andes and the gallery forest and/or riparian of mid orobiome of the Andes ecosystems.

The ecosystem that has the lowest compensation factor value is represented by the open and rocky grassland of mid orobiome of the Andes and this is mainly due to the fact that rarity and representativeness are differential regarding other ecosystems.

Based upon the equivalency of these ecosystems and according to the guidelines established in the Manual for the Allocation of Compensations for Biodiversity Loss, the total area to compensate was calculated as follows:

Chart 11.2.2.30 Area of intervention of ecosystems and compensations per ecosystems

Ecosystem	Ecosystem Biogeographical District	Road Corridor (ha)	Infrastructure associated to the project (ha)	ZODME (ha)	Total	Compensation factor per Ecosystem	Area to compensate (ha)
Dense shrubland of mid orobiome of the Andes	*Andean Forests of West Nariño District*	0,9	0	1,1	2	7,75	15,5
Gallery forest and/or Riparian of high orobiome of the Andes	*Andean Forests of West Nariño District*	0,11	0	0	0,11	7,75	0,8525
Gallery forest and/or Riparian of mid orobiome of the Andes	*Andean Forests of West Nariño District*	2,07	0	0	2,07	7,75	16,0425
Open and rocky grassland of mid orobiome of the Andes	*Andean Forests of West Nariño District*	32,25	0	0,01	32,26	5,75	185,495
TOTAL		**35,33**	**0**	**1,11**	**36,44**		**217,89**

Source GÉMINIS CONSULTORES S.A.S. 2015

According to the previous chart, the natural ecosystem areas to intervene correspond to 36.44 hectares. However, considering the compensation factor obtained per ecosystem, the environmental compensation will be applied to a total of 217.89 has, among which, 15.5 corresponds to dense shrubland of mid orobiome of the Andes, 0.8525 corresponds to gallery forest and/or Riparian of high orobiome, 16.0425 corresponds to

gallery forest and/or riparian of mid orobiome of the Andes and 185,495 corresponds to open and rocky grassland of mid orobiome of the Andes.

· Description of the ecologically equivalent areas to compensate

According to the guidelines stated in the Manual for the Allocation of Compensations for Biodiversity Loss, "compensations must be directed preferably towards the conservation of areas that are ecologically equivalent," which could be determined based upon the following criteria:

- Be the same type of affected natural ecosystem
- Be equivalent to the size and area to compensate and to the fragment of affected ecosystem
- Having equal or better landscape condition and context than the fragment of impacted ecosystem
- Having equal or more richness of species than the fragment of impacted ecosystem
- Located in the project´s area of influence
- In case there are not enough ecologically equivalent areas to compensate, then ecological restoration activities should be conducted. These could include landscape/silvopasture and agroforestry management measures, until complying with the area to compensate, and/or activities in the current protected areas of SINAP.

For the case of the divided highway project Rumichaca-Pasto, compensations will be carried out in the area of influence and surroundings of the area affected by the highway project´s development. This is due to the fact that the compensation for the open and rocky grassland of mid orobiome of the Andes cannot be made in the area of influence because only scattered areas were identified and this hinders the development of activities.

Accordingly, the compensation for this type of ecosystem will be performed in surrounding areas of the area affected by the highway project´s development with landscaping management activities and within SINAP areas.

The following chart shows the areas of the natural ecosystems that were identified both in the intervention area and in the highway project´s area of influence. (see Chart 11.2.2.31).

Chart 11.2.2.31 Natural ecosystems in the area of influence and in the area of intervention

NAME OF ECOSYSTEM	INTERVENTION AREA (has)	AREA OF INFLUENCE (has)	PERCENTAGE OF THE AFFECTED COVERAGE WITHIN THE INTERVENTION AREA (%)
Dense shrubland of mid orobiome of the Andes	2	15,03	13,307
Gallery forest and/or Riparian of high orobiome of the Andes	0,11	8,01	1,373
Gallery forest and/or Riparian of mid orobiome of the Andes	2,07	21,32	9,709
Open and rocky grassland of mid orobiome of the Andes	32,26	112,19	28,755
	4,75	52,2	

Source GEMINIS ENVIRONMENTAL CONSULTANTS. 2016

As seen in the previous chart, in all the cases, the area of intervened ecosystems is less than the total area of the natural ecosystems represented in the project´s area of influence.

Determination of the areas to compensate

The equivalent formulas mapping tool was used (M.a.f.e. V 2.0) to determine the areas to compensate. The RapidEye satellite imaging of year 2016, was used which superimposes ecosystems and the project´s area to locate equivalent areas subject of compensation, at the physico-biotic influence area level; however only a few zones, not to broad and slightly representative were established. As a result, the search area at the micro-basins levels was extended; however, this was not fully successful, given that the open and rocky grasslands can only be identified in the area of influence and not in compact areas. Said information can be verified in Annex GDB 2.inputs/raster/rapideye_2015_2016.

In compliance to subparagraph 4.1 of the compensation manual referring to the selection of an ecologically equivalent area, where it states that:

If it is impossible to locate an equivalent area to compensate in the area of influence, or in the hydrological subzone where the project is located, or in the surrounding zones of the affected area, then there can be ecological restoration activities, that might include landscape management tools (silvopasture, agroforestry, silviculture types of activities, etc.) and/or in the current protected areas of the National System of Protected Areas-SINAP, and in property sanitation or expansion activities. The idea is to conduct landscaping management activities in surrounding areas to the affected area and property sanitation activities in protected areas of SINAP, as a compensation to the open and rocky grassland of mid orobiome of the Andes

Compensations of the ecosystems represented by the dense shrubland of mid orobiome of the Andes, and the Gallery Forest and/or Riparian of high and mid orobiome of the Andes, will be carried out in the area of influence of the highway project.

Following you will find some ecologically equivalent consideration that were taken into account to select the areas to compensate.

The organisms that occupy the same ecological niche or similar niches in different geographical regions, are known as ecological equivalents. Said species are likely to be taxonomically closely related in regions that are adjacent, but not in regions that are very distant or isolated with respect to one another.

The composition of the communities' species broadly differs in different geographical regions, even though they develop in similar ecosystems. This is what precisely occurs in the zone of influence of the project where a set of geomorphological, weather and composition characteristics of species, foster the establishment of species that are ecologically equivalent.

Within the framework of compensations as a result of biodiversity loss in ecologically equivalent areas, there is a reference to areas that are comparable. This might be in terms of diversity of species, functional diversity and composition, integrity or

ecological status, landscape context (for example connectivity, location, status or use of adjacent soil, fragment size, among others) and eco-systemic services (including human appropriation and cultural value) (BBOP, 2012).

For the specific case of the Manual of Compensations - MADS (2012), these areas correspond to "*areas of natural ecosystems and/or secondary vegetation that maintain species, communities and ecological processes similar to the ones present in the natural ecosystem or affected secondary vegetation and that have similar ecological feasibility by area and landscape context.*"

It is important to highlight that management for the development of compensation activities will be conducted with the local and regional environmental authorities, namely CORPONARIÑO, City Halls of the Municipalities that make part of the highway project´s surrounding zone, Governorship of Nariño and National Parks of Colombia, as well as local entities such as water supply systems´ committees, municipal water companies, and owners of natural reserves from civil society. It is important to also consider the following:

- Ecosystem types
- Size equivalency of affected fragment
- Condition and landscape context
- Ratio of the richness of species and the affected ecosystem
- Location of area to compensate
- Ratio of the ecosystem to compensate with the protected areas of SINAP(for the case of grasslands)
- Comply with the area to compensate

Accordingly and for the specific case of the dense shrubland of mid orobiome of the Andes, and the Gallery Forest and/or Riparian of high and mid orobiome of the Andes ecosystems, the equivalent areas to compensate (32,395 ha, Chart 11.2.2.32 Intervention area, ecosystems and compensation per ecosystem) are inside the project´s area of influence, as it is outlined in the cartographic annex, Map EIADCRP_PC_040 Compensation Areas.pdf., as well as in the figure and the next chart.

The compensation of 185,495 hectares of open and rocky grassland of mid orobiome of the Andes, will be made in the surrounding zones of the affected area through the development of activities related to landscape management and property sanitation of the areas protected by SINAP, as outlined in subparagraph 1.2.2.1 "Definition of compensation areas."

Chart 11.2.2.333 Natural ecosystems to compensate

NAME OF ECOSYSTEM	BASIN	LOCATION
Dense shrubland of mid orobiome of the Andes	River *Bobo*	*Cocha Verde* Village
Gallery forest and/or Riparian of high orobiome of the Andes	Ravine *La Magdalena*	*Buena Esperanza* Village
Gallery forest and/or Riparian of mid orobiome of the Andes	Ravine *La Magdalena*	*El Tablon* Village
Gallery forest and/or Riparian of high orobiome of the Andes	Ravine *La Magdalena*	*El Paramo* Village
Gallery forest and/or Riparian of mid orobiome of the Andes	Ravine *Aserradora*	*La Palizada* Village
Gallery forest and/or Riparian of high orobiome of the Andes	Ravine *La Magdalena*	*El Tablon* Village
Gallery forest and/or Riparian of mid orobiome of the Andes	River *Bobo*	*Chavez* Village
Open and rocky grassland of mid orobiome of the Andes	River reserve *Bobo-Buesaquillo*, Civil Society of *Galeras* Reserve, *Galeras* Flora and Fauna Sanctuary, *Ovejas-Tauso* Protected Area, *Tabano-Campanero* Protected Area, *Divina Pastora* Protected Area, *Morasuro* Protected Area	Municipality of Pasto

Source: Geminis Environmental Consultants, 2016

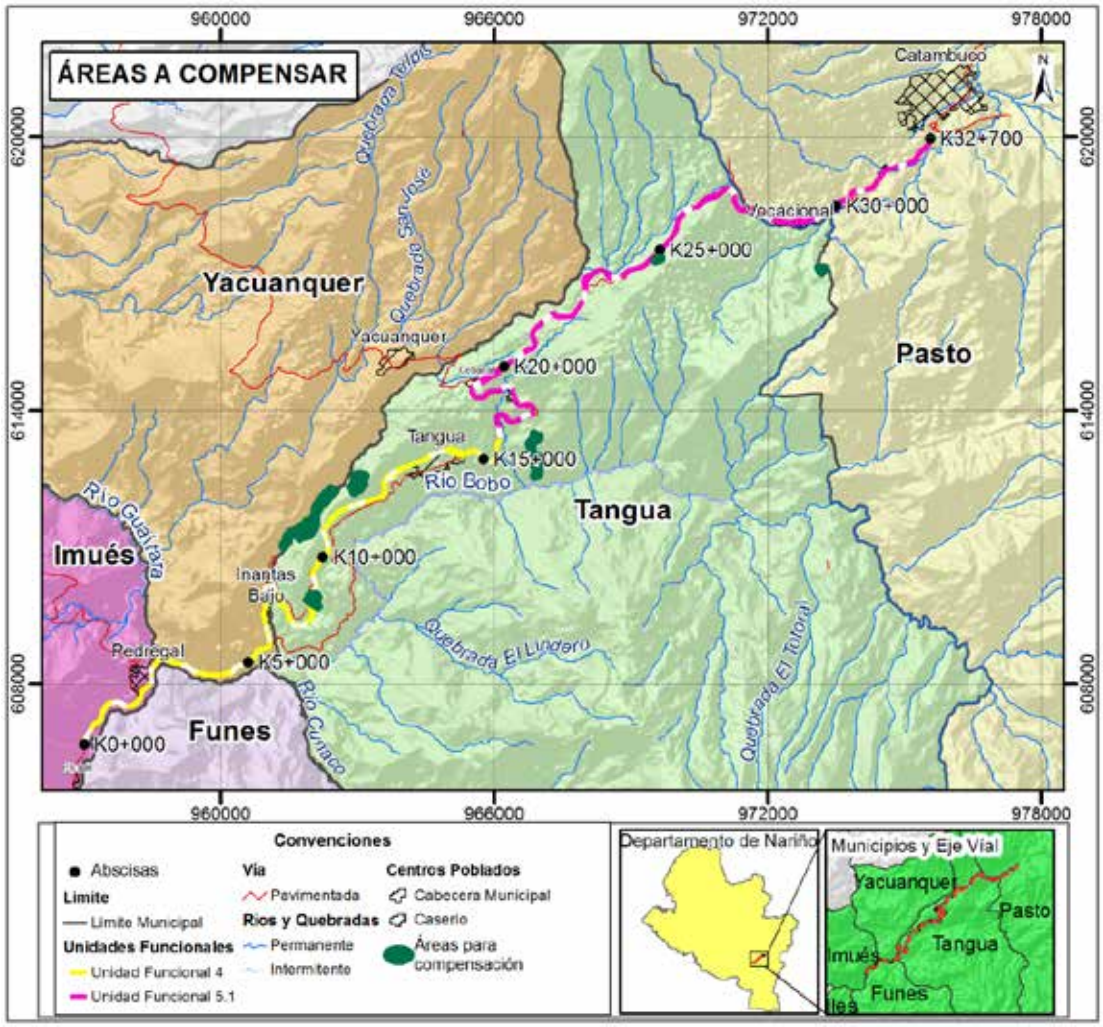

Figure 11.2.2-18 Equivalent areas to compensate
Source: Geminis Environmental Consultants, 2016

The compensations proposed for riparian forests are associated with waterbodies that have a significant ecological importance for the region, among which we find the *Guaitara* River, *Bobo* River and *La Magdalena* Ravine, which will positively contribute to the conservation and protection of the local and regional hydro-biological resources.

In case that for some reason the proposed areas do not comply with the conditions or if there are no lands available in these areas to execute the activities, then the compensation activities will be done based on landscaping management tools such as agroforestry silvopasture, silvicultural systems and other sustainable systems that promote the recovery and functionality of natural ecosystems. In case this possibility is not feasible either, other areas will be searched for by following the guidelines of the Compensation Manual, as performed with the grasslands.

11.2.2.2. Compensation Proposal

Considering the impacts that might be generated by the project as well as the characterized natural ecosystems of referral that will be compensated, the compensation alternatives established by the Compensation Manual were evaluated.

Compensation Actions

The compensation actions that are mentioned are established for their execution according to the management processes that derive from stakeholders involved, pertaining to public and private entities or who own private properties or reserves. For that matter, it is considered that the following compensation activities can be executed within the study area, both in public or private properties:

- Property purchase (property sanitation)
- Voluntary agreements with indigenous communities
- Enrichment of intervened ecosystems (landscape management)

- **<u>Property Purchase (property sanitation)</u>**

The purchase of properties will be done in areas equivalent to natural intervened ecosystems. The ownership and/or improvement thereof, will be handed to national or regional entities, as guarantors of the conservation of departmental and national biological resources.

When the process is carried out in protected areas of the National System of Protected Areas- SINAP, it is necessary to include ecological restoration and prevention of deforestation and degradation measures, always taking into account that with the purchase of properties as a conservation and protection activity of natural, regional ecosystems, there will be a plant enrichment and the natural succession of species of ecological relevance for the region.

This activity will be conducted in 10. 6 has., and there will be properties located in the Municipalities of the surrounding highway project´s development zone, namely the Municipalities of Imues, Tangua, Yacuanquer and Pasto.

The Road Concessionaire *Unión del Sur S.A.S*, acting as guarantor of the resources, will manage the process and will accompany the implementation of the activity´s development.

Activities to develop for property acquisition purposes:

ü Land Selection

The properties to acquire will be selected jointly with national environmental entities such as National Parks, for the areas of municipal influence of Tangua, Yacuanquer and Pasto. Once the properties are acquired, they will be donated to national environmental field entities who act as guarantors of the conservation of national and biological resources at a departmental and national level.

The purchasing process of the properties will be done as follows:

a) Property selection
b) Inspection visit of the property, environmental analysis and technical feasibility concept.
c) Analysis of the legal situation and study of the legal situation.
d) Plane table surveying
e) Appraisal
f) Purchase and Sales offer to the owner.

g) Receipt of the owner´s answer.
h) Purchase and Sales commitment contract.
i) Purchase and Sales draft.
j) Request for allocation in a Public Notary Office, when applicable
k) Purchase and Sales deed granting
l) Payment certification
m) Acquisition notification to the Administrative and Financial Deputy Directorate

ü Procurement and property classification

Once the property is acquired it will be isolated so its natural recovery can begin and/or to avoid the extraction of wood based or biological products.

ü Timetable of Activities

Following, you will find a detailed timetable that outlines the acquisition activities included in the Compensation Plan:

ACTIVITY	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Selection of property												
Inspection visit to the property, environmental analysis and technical feasibility concept.												
Analysis and study of the legal situation												
Plane table surveying												
Appraisal												
Purchase and sales offer to the owner												
Reception of the owner´s answer												
Purchase and sales commitment contract.												
Purchase and sales draft												
Request for allocation in a Public Notary Office, when applicable.												
Purchase and Sales deed granting												
Payment certification												
Acquisition notification to the Administrative and Financial Sub-directorate												
Acquisition and property classification												
Property handover												

Chart 11.2.2.21 Activity timetable for property acquisition activities

ü Isolation of acquired properties

The lands acquired will be isolated with barbed wire fences to avoid the entrance of humans and animals, particularly of the bovine and equine type, that could alter the biological community.

These are the steps to install the fence:

- Georeferencing and demarcation of the selected area with stakes.
- Hole excavation to plant the posts.
- Stacking, placing and affirming posts in a linear way
- Installation of containment or retaining posts
- Wire laying and tensing through the use of clamps
- Building a wicket gate, waterways, etc.

- **Richness of intervened ecosystems (landscape management)**

ü Recommended species

This project, proposes the enrichment of species that are present in the ecosystems to intervene. These species are outlined in the chart below and are characterized by presenting a very good response to the region´s conditions, besides offering an ecological and ecosystem value.

Chart 11.2.2.34 Species recommended for the ecosystems' richness

Nº	FAMILIA	*ESPECIE*	COMÚN	Hábito	Tipo de reproducción	
					Semilla	Estolon
1	Melastomataceae	*Miconia nodosa*	Amarillo	ar	x	
2	Ericaceae	*Cavedishia cordifolia*	Arnanulo	a	x	
3	Myrthaceae	*Myrcianthes rhopaloides*	Arrayán	ar	x	
4	Bombacaceae	*Ochroma pyramidale*	Balso	ar	x	
5	Rosaceae	*Hesperomeles obtusifolia*	Cerote	a	x	
6	Ericaceae	*Macleania rupestris*	Chaquilulo	a	x	
7	Euphorbiaceae	*Hyeronima macrocarpa*	Charmolan	ar	x	
8	Juglandaceae	*Piper bogotence*	Cordoncillo	ar	x	
9	Myrsinaceae	*Myrsine guianensis*	Cucharo	ar	x	
10	Cunoniaceae	*Weinmannia tomentosa*	Encino	ar	x	
11	Lythraceae	*Lafoensia speciosa*	Guayacan	ar	x	
12	Myricaceae	*Morella pubescens*	Laurel	ar	x	
13	Araliaceae	*Oreopanax bogotensis*	Mano de Oso	ar	x	
14	Melastomataceae	*Tibouchina lepidota*	Mayo	ar	x	
15	Actinidiaceae	*Saurauia bullosa*	Moquillo	ar	x	
16	Actinidiaceae	*Saurauia ursina*	Mote	ar	x	
17	Juglandaceae	*Juglans neotropica*	Nogal	ar	x	
18	Caprifoliaceae	*Viburnum triphyllum*	Pelotillo	ar	x	
19	Fabaceae	*Senna spectabilis*	Pichuelo	ar	x	
20	Araliaceae	*Oreopanax floribundum*	Pumamaque	ar	x	
21	Elaeocarpaceae	*Vallea stipularis*	Roso	ar	x	
22	Asteraceae	*Liabum igniarium*	Santa María	a	x	
23	Salicaceae	*Salix humboldtiana*	Sauce	ar		x
24	Caprifoliaceae	*Sambucus nigra*	Sauco	ar		x
25	Papaveraceae	*Bocconia frutescens*	Trompeto	ar	x	
26	Ericaceae	*Cavendishia bracteata*	Zarcillejo	a	x	

Source GEMINIS CONSULTANTS S.A.S 2016

* Ar: type arboreal, a: shrubby

Chart titles: FAMILY, SPECIES, COMMON, HABIT, TYPE OF REPRODUCTION, SEED, STOLON)

The species to implement must be obtained in nurseries from the region that are certified by ICA. Furthermore, endangered forest species such as Walnuts and Cedars can be included. This is a strategy to diversify and increase populations of endangered species, considering that individuals from these species will be affected due to the highway project´s development.

Chart 11.2.2.35. Classification of species according to their threat category at a regional or national level.

No.	Common Name	Scientific Name	Res. 0192/ 2014	CITES	UICN	RED BOOK OF TIMBER PLANTS OF COLOMBIA
1	Walnut	*Juglans neotropica*	*Endangered (EN)*	*III*	*Endangered (EN)**	*Endangered(EN)*
2	Cedar	*Cedrela odorata*	*Endangered (EN)*	*III*	*Vulnerable (VU)***	*Endangered(EN)*
	TOTAL					

*http://www.iucnredlist.org/details/32078/0 **http://www.iucnredlist.org/details/32292/0
Source: Géminis Consultores S.A.S, 2016.

ü Enclosure and isolation of areas

The areas to recover will be isolated by installing a barbed wire fence to prevent cattle or other type of animals to enter. These are the steps to follow to install said fence:

- Georeferencing and demarcation of the selected area with stakes.
- Excavation of holes to plant posts.
- Stacking, placing and affirming posts in a linear way
- Installation of containment or retaining posts
- Wire laying and tensing through the use of clamps
- Building a wicket gate, waterways, etc.

ü Setting out plant material

A forestry or agroforestry professional will be in charge of planning, coordinating and supervising the restoration model. This professional must have experience in ecological restoration projects and reforestation and will coordinate the following activities:

- Land cleaning
- Layout
- Weed control and planting out
- Hole digging
- Material planting
- Maintenance woks

Parallel to the maintenance works, there will be a 3 year period follow up and monitoring, with a quarterly maintenance during the first year and a biannual during years two and three; provided that the species used are from the region thereby having a good adaption process to the environmental and edaphic conditions of the zone.

Maintenance works will not exceed the three years, given that during that time, the individuals would have reached a growth and vegetative development that allows them to survive in such environment. This will also enable the regeneration of other species that appear naturally.

ü Technical characteristics of the project

The technical characteristics described down below are stated globally; however, those activities that are not outlined here will be stated in the project´s Environmental Management.

Land preparation: The space of land where the seedlings will be planted is prepared in such a way as to offer the best growth and development conditions for individuals. This activity comprises the following:

Land cleaning and weed control: Corresponds to the creeping vegetation on the land, with the idea of reducing or elimination the competition that would hinder the growth of individuals.

Elimination of physical obstacles: Obstacles that might stop the growth of trees and/or hinder weeding operations must be removed.

Layout: The planting distance between individuals is 4 x 4 meters, for a total of 625 individuals per hectare.

Hole digging: There will be land perforations of 40x40x40 cm deep.

Fertilization: Land fertilization processes will be conducted according to the results obtained from laboratory samples and the nutritional characteristics of species implement.

Seedlings selection: Individuals to be planted will have a size between 40 and 50 cm high, with a good stem lignification, without physiological malformations in the root such as pig tail, gooseneck and/or splitting. They will also be plague and disease free. Will have 5 foliage floors, with a good content of organic matter. Its acquisition will be made in certified nurseries by the Colombian Agricultural Institute ICA.

Planting: Planting will be carried out using protective and producing forestry species. The determination of species will be made according to soil and landscape characteristics of the zone. This activity will begin preferably during the rainy season to increase the probabilities of development of seedlings.

The planting density will comprise 625 trees per hectare, with a 4 meter distance between individuals.

Land isolation: The fence that encompasses the isolation of the areas will be done with immunized wood posts and/or wood plastic, obtained from authorized vendors. When looking for immunized wood, the vendors must guarantee that the product comes from sustainable forests.
Wooden stakes will have a 2 meter distance between them, each with (4) four barbed wired, 12 caliber lines, with a 20cm separation among them.

ü Project Delivery

1. After three (3) years, and once the maintenance program is finished, the plantation will be handed over to departmental and national environmental authorities, as guarantors of the conservation and protection of natural resources and the biodiversity of the country.

2. This handover will be conducted in agreement and by means of the signature of a Certificate of Practical Completion that specifies the project´s accountability terms.

Expected Results

ü Increase the speed of the succession process through ecological and eco-systemic restoration activities.

ü Ecosystems associated with waterbodies, expect to improve the capacity of regulation of the hydro-biological cycle through the recovery and/or improvement of the current protective vegetation, which will enable to increase the colonization capacity of native species

ü Reduce the sedimentation rate of the riversides of waterbodies which are present in the study zone.

o Implementation timetable

The implementation timetable will be established using the proposed activities, where there is a description of the general activities and certain aspects will be taken into account for the compliance thereof.

As per Resolution 1517 of 2012, issued by the Ministry of Environment and Sustainable Development, there will be an agreement and presentation of the final Compensation Plan during the first year, based on securing the project´s license.

Chart 11.2.2.36 Timetable of implementation actions in terms of ecological restoration

STAGE	Implementation program of ecological restoration actions in terms of Rehabilitation				
Activity/Year	Years				
	1	2	3	4	5
Project agreement with Regional Autonomous Corporation of Nariño-CORPONARIÑO	X				
Determination of the Project´s execution site	X				
Agreement and socialization of the project with the community	X				
Establishment and legalization of voluntary agreements in defined areas	X	X			
Planting design	X	X			
Selectito of species	X	X			
Acquisition of plant material		X	X		
Demarcation and enclosure of areas to recover		X	X		
Land preparation		X	X		
Planting inducing species.		X	X		
Maintenance of plantation			X	X	X
Follow up and monitoring of permanent plots			X	X	X
Project delivery					X

Source: GÉMINIS CONSULTORES S.A.S 2016

- **<u>Voluntary agreements with indigenous communities</u>**

The feasibility of this conservation action, mainly originates because there are remaining areas of natural ecosystems in the study area, that maintain ecological conditions that must be sustained in time and are subject to pressures that derive mostly from the change in soil use.

This action encourages the region to create awareness about the elements and environmental services that these areas provide with respect to support, supply and regulation, which must be valued under this incentives scheme.

Voluntary agreements with indigenous communities are characterized by being "voluntary" actions, where the indigenous community, by their own accord, restricts the type or intensity of usage of resources in specific areas of their property, where the priority thereof will be to preserve the existing natural resources.

This activity represents a way of limiting the ownership rights (property) and the use of real estate.

- In Exchange, the owner receives an economic profitability of ($320.000 per hectare).
- The agreement is framed within Real Rights.
- The time considerations of the agreement will be of minimum three (3]) years.
- It will be formalized by means of civil contracts and a deed before a Notary Public for its registration in the Public Records Office.
- The objective must be focused on the conservation, protection, restoration, improvement and proper management of natural resources and environmental services that are provided by the property.
- The agreement´s objectives and activities are agreed between the parties and their scope depends upon the biological and geographical characteristics of the involved properties
- During this process there will be verification and follow up mechanisms, which should be agreed between the parties.
- *Concesionario vial Unión del Sur* will be in charge of monitoring the compliance of the agreement´s activities.

The agreement´s expiration could occur due to the following reasons:

- Expiration of the term agreed.
- Resolution of the right that has been agreed
- Inability to provide the service due to loss or decay of the property´s conditions.

In case there is no property ownership, a compliance contract must be entered into. In this case, the follow up is more rigorous. A contractual agreement document must be formalized before a Notary´s Office.

ü **Proposal to constitute a voluntary agreement**

The following procedure should be followed to constitute a voluntary agreement:

- Definition of objectives
- Definition of the figure´s usefulness to achieve objectives
- Establishment of a baseline (cartography, physical-biotic information)
- Negotiation of the agreement and contract preparation
- Signing the public deed and recording it

Once the effective compensation areas have been defined, the following agreement activities of the project will be carried out with the environmental authorities at the Municipal, Departmental and National levels, as guarantors of the conservation of natural resources and the regional and national biodiversity.

As a result of this activity, there will be a socialization with the actions and their location with the directly involved thereby generating commitments and accountabilities.

ü **Real estate management to establish a voluntary agreement**

The general steps that will apply to manage and establish the agreement with indigenous communities are outlined as follows:

1. Property identification
2. Property confirmation
3. Inform about economic payments per hectare, as an incentive to the voluntary agreement

4. Payment of notarial fees, recording fees and process expenses during the real estate management process.

ü **Execution Agreement**

If there is an agreement between the parties, then you enter into the agreement minute with the owners of the properties and then continue with the implementation of said agreement through a public deed or legal document that serves thereof, with its corresponding recording in the national real estate registry system.

ü **Preparation of the voluntary agreement contract**

The agreement contract, will be performed according to the conservation objectives and within the area to protect. This contract must include at least the following information:

- General legal information about the parties and their capacity.
- Background related to activities of the parties and the importance of the area to preserve.
- Identification of properties, their area and ownership.
- Objectives of the agreement
- Activities and allowed and prohibited uses within the area
- Duration of agreement
- Obligations and responsibilities of the parties
- Guidelines to public management and potential conflicts with third parties
- Mechanisms and parties to monitor the area under protection and follow up and verification of activities and agreed commitments.
- Procedures to solve the differences in the implementation of agreements

ü **Definition of restricted and allowed activities within the area of constitution of the voluntary agreement**

The following activities can be carried out in the voluntary agreement area but in case that the owner wants to perform another activity that encourages the site´s conservation, then it must communicate this with those who are responsible for conducting this plan´s follow up.

- Creating ecological trails and eco-touristic spaces
- Conduct conservation, environmental education, investigation and production activities aimed towards the search of sustainable development criteria.
- Avoid the entrance of livestock to the conservation area
- Prohibit hunting in the conservation area
- Avoid tree felling and extraction of genetic material
- Avoid the entrance of flora and fauna exotic species

ü **Defining boundaries and the enclosing area subject of the voluntary agreement**

Once the rights of the agreement have been awarded, and the activities, obligations and duties of each of the parties have been set, the following actions will be performed over the defined area:

1. The owner and professionals in charge of the compensation, will georeference the area subject of the agreement. The information will be recorded in a drawing plan at minimum scale of 1:10.000. This information will be forwarded to the environmental authorities that are involved with the area of constitution thereof, for their knowledge and relevant purposes.
2. Those boundaries that require enclosure will be revised. The Concession will bear the costs of isolation, required maintenance and the annual review of the fences.

ü **Arrangement of permanent plots to characterize the ecosystem and monitor indicators**

The characterization activities of the ecosystem within the final area will be carried out According to the terms of reference for the biotic component of the baseline, performed by this study.

The floristic characterization will be done through sampling of a minimum of three (3) plots per hectare, thereby determining the following aspects:

a) Floristic composition per type of cover with the identification of endemism, species in closed seasons, in critical danger, having economic and cultural importance.
b) Degree of sociability, spatial structure, mixing ratio and diversity index of different types of defined plant cover.
c) Importance Value Index (IVI), density and distribution per diametric and altimetric class of different types of species found.
d) Volume of property per hectare.
e) If a permit is required to collect plant material for identification purposes, then it is necessary to process a scientific investigation permit in advance, before the Ministry of Environment, Sustainable Development and Environmental Services (MADS)

In order to draft the report about characterization and monitoring of indicators, it is necessary to georeferenciate the plot´s location and define it with plastic stakes in each vertex as well as its subdivisions, thereby preventing the loss of the characterized unit during the time.

ü **Follow up and monitoring**

The follow up activities in the compensation area will be conducted through verification visits to see the conditions of the property and the compliance of commitments on a quarterly basis. There will be visits to the owners of the property and a photographic record of the area will be kept.

The owner will perform an ongoing follow up of the property and will inform about any anomaly, inconvenient or problem that might occur in the area.

ü **Payments of the voluntary agreement**

Payments related to property rights will be done according to the periods established in the negotiation. The value will be of $320.000 pesos, per hectare; however, this value

can be modified based on the agreed negotiation with the indigenous owner of the property involved.

ü **Expected results**

These are the expected results:

a) Promote connectivity of ecosystems.
b) Protect key objectives such as strategic and vulnerable ecosystems and endemic and/or endangered species.

c) Socialize with communities and with local, regional, departmental and national environmental authorities, the conservation initiative, within the framework of compensation due to biodiversity loss, taking into account the benefits that derive from conservation in terms of environmental services and ecosystems.

d) Reduce the pressure and fragmentation of natural ecosystems that exist in the zone.

e) Include society in planning and land-use planning activities and in managing natural resources, through voluntary actions that aim at the conservation of natural resources, biodiversity and eco-systemic services.

f) Mitigate the impacts that derive from mining activities, extensive livestock farming and illegal wood extraction.

ü **Implementation timetable**

An implementation timetable is established given the activities considered to implement this conservation action. This timetable outlines the processes to comply with the proposal´s implementation. It is important to highlight that, as per Resolution 1517 of 2012 issued by the Ministry of Environment and Sustainable Development, the agreement and presentation of the final Compensation Plan will take place starting the

first year of obtaining the project´s license. Therefore, areas and strategies are preliminary according to what it is actually affected by the project.

Chart 11.2.2.37 Timetable for the implementation of voluntary agreements

STAGE			
Activity/Year	**1**	**2**	**3**
Project agreement with CORPONARIÑO	X		
Determining the project´s execution site	X		
Management	X		
Implementation of Agreements	X		
Preparation of the contract of voluntary agreement	X		
Definition of restricted and allowed activities within the establishment area of the agreement.	X		
Boundary marking of the target area		X	X
Set up of permanent plots to characterize the ecosystem and monitor indicators		X	
Follow up and monitoring		X	X
Payment completion		X	X
Project delivery			

Source: GÉMINIS CONSULTORES S.A.S 2016

11.2.2.3 Investment plan

The investment of economic resources will be made in areas equivalent to the intervened natural ecosystems as set out in the guidelines of the Manual for the Allocation of Compensations for Biodiversity Loss, protected under Resolution 1517 of 2012. To this effect there will be property purchasing, voluntary agreements and activities pertaining to richness and landscape management. Said ecosystems will be represented by the dense shrubland of high orobiome of the Andes, Gallery forest and/or Riparian of high oriobiome of the Andes and Gallery forest and/or Riparian of mid oriobiome of the Andes and open and rocky grassland of mid orobiome of the Andes

The following chart shows the investment plan for environmental compensations, however, it will be subject to modifications.

Chart 11.2.2.38 Costs of the compensation program per activity due to biodiversity loss

ACTIVITY	UNIT	AMOUNT	VALUE PER UNIT	TOTAL VALUE
PROPERTY PURCHASING (property sanitation)				
Phase I Hiring a study to evaluate the properties to acquire				
Manpower				
Forestry or agroforestry engineer (1)	monthly	2	$2.800.000	$5.600.000
Agricultural engineer (1)	monthly	2	$2.800.000	$5.600.000
Social Professional (1)	monthly	2	$2.800.000	$5.600.000
SIG Professional (1)	monthly	2	$2.800.000	$5.600.000
Subtotal				**$22.400.000**
Phase II Purchase of properties				
Land plot and/or property (subject to changes according to the value defined with the owners)	ha	1	$90.000.000	$90.000.000
Subtotal per ha				**$112.400.000**
Subtotal per 10,5 has				**$1.180.200.000**

Phase III Enclosure of plots per ha				
Posts (of plastic wood)	Post	167	$13.500	$2.254.500
Barbed wire 12.5 caliber, rolls of 350 m (four stretching courses per wooden stake)	Roll	8	$130.000	1.040.00
Clamps	Boxes	10	$4.550	$45.500
Tools (CREW)	Kit	5	$790.000	$3.950.000
Manpower	Daily	12	$28.000	$336.000
Mayor Transportation	Trips	4	$450.000	$1.800.000
Minor Transportation	Trips	2	$120.000	$2.400.000
Subtotal per hectare				**10.786.000**
Subtotal for 10,5 has				**113.253.000**
Phase IV Monitoring and follow-up				
Forestry and agroforestry professional (Monitoring and follow up will be conducted during 5 years)	Monthly	60	$2.800.000	$168.000.000
Subtotal				**$168.000.000**
TOTAL PROPERTY PURCHASE				**$1.315.853.000**
VOLUNTARY AGREEMENTS WITH INDIGENOUS COMMUNITIES				
Phase I Selection of properties to benefit				
Manpower				
Forestry or agroforestry engineer (1)	Monthly	2	$2.800.000	$5.600.000
Agricultural engineer (1)	Monthly	2	$2.800.000	$5.600.000
Social Professional (1)	Monthly	2	$2.800.000	$5.600.000
SIG Professional (1)	Monthly	2	$2.800.000	$5.600.000
Field assistants (2)	Daily	120	$40.000	$4.800.000
Subtotal				**$27.200.000**
Phase II Payment of economic incentive per ha				
Payment of the economic incentive (subject to changes according to the value defined by the owners) (it is estimated in $320.000 per ha-per month)	ha	173,8	$1.328.640.000	$2.669.568.000
Subtotal for 2 years				**$2.669.568.000**
Phase III Follow up and monitoring				
Forestry and agroforestry professional (monitoring and follow up will be conducted during 2 years)	Monthly	24	$2.800.000	$67.200.000

Subtotal				**$67.200.000**
TOTAL VOLUNTARY AGREEMENTS				**$2.763.968.000**
ENRICHMENT OF INTERVENED ECOSYSTEMS				
Phase I Hiring a study to assess the selection of properties				
Manpower				
Forestry or agroforestry engineer (1)	Monthly	2	$2.800.000	$5.600.000
Agricultural Engineer (1)	Monthly	2	$2.800.000	$5.600.000
Social Professional (1)	Monthly	2	$2.800.000	$5.600.000
SIG Professional (1)	Monthly	2	$2.800.000	$5.600.000
Fiel assistants (2)	Daily	120	$40.000	$4.800.000
Subtotal				**$27.200.000**
Phase II Establishment of plant material per ha (enrichment)				
Posts (plastic wood)	Post	167	$13.500	$2.254.500
Barbed wire 12.5 caliber, 350 m rolls	Roll	8	$130.000	1.040.00
Clamps	Boxes	10	$4.550	$45.500
Tools (CREW)	Kit	1	$2.890.000	$2.890.000
Mayor Transportation	Trips	4	$450.000	$1.800.000
Minor Transportation	Trips	2	$120.000	$2.400.000
Purchase of seedlings (includes a 10% for loss)	Seedlings	690	$3.500	$2.415.000
Layout, hole digging, planting, irrigation, etc. (1 crews of 4 people, with a performance of 30 trees per day)	Daily	80	$40.000	$3.200.000
Subtotal per hectare				**15.005.000**
Subtotal for 32.7 has				**490.663.500**
Phase III Maintenance of enriched areas				
Operators. (The first maintenance will be performed after three months and subsequently every 6 months)(3 operators during 36 months)	Daily	3240	$40.000	$129.600.000
Subtotal				**$129.600.000**
Phase IV Monitoring and follow up				

Forestry or agroforestry professional (monitoring and follow up will be performed during 3 years)	Monthly	36	$2.800.000	$100.800.000
Subtotal				**$100.800.000**
TOTAL RICHNESS OF ECOSYSTEMS INTERVENED				**$748.263.500**
TOTAL VALUE OF COMPENSATION DUE TO BIODIVERSITY LOSS EIA 2				**$4.844.884.500**

Source: GEMINIS ENVIRONMENTAL CONSULTANTS 2016

Taking into account the 217 has to compensate (see Chart 11.2.2.30 Area of intervention of ecosystems and compensation per ecosystem) there will be distribution as follows:

- ***Purchase of properties:*** In 10.5 has, at a value of $1.332.63.000 which includes: Purchase of land, enclosing, monitoring and follow up during 6 months.
- ***Richness of intervened ecosystems***: In 32.7 has, at a value of $748.63.000, which includes maintenance, follow up and monitoring during 3 years.
- ***Voluntary agreements with ethnic communities***: It will encompass 173.8 has, paying $320.000 a month for a period of no less than 2 years.

Implementation and administration mechanisms

In this technical stage, the proposal about the compensation scheme, is considered to be more adequate to implement in the work area through the mechanism of *trust fund with a shared participation.* This proposal, should be based upon a basic principle: Environmental services are maintained or improved if key players voluntarily assign in exchange of a recognition, a part or all of their property unit for the development of new activities such as the conservation of a native forest and/or floristic restoration.

Broadly speaking, the basic structure will have four large components, which are: (1) Administrating Committee of the compensation plan, (2) Beneficiaries of environmental services, (3) Technical – financial Operator, and (4) Beneficiaries of the economic tool, which are represented in Figure 11.2.2.18.

Figure 11.2.2.19 Operating scheme of the trust fund with shared participation

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, Adapted from MADS, 2012. (2016)

This committee, is created to make joint decisions that allow the proper guidance for implementing this economic incentive, particularly, with respect to issues associated with the prioritization of strategic areas for the conservation and selection of properties. Even though the economic amount for the activities has been defined, it will be subject to changes by the Committee.

Specifically, the Committee will make decisions with respect to activities that have been established for compensation purposes, without implying the modification thereof.

The technical-financial operator of the compensation plan, will be responsible for making the decisions of all the activities that will be developed. Therefore, it can be guaranteed that the resources will properly managed.

These are some of its duties:

- ü Manage the collection of all the resources provided by the different committed funding sources.
- ü When necessary, enter into agreements with the owners of properties, prioritized in strategic areas for conservation and/or restoration purposes.
- ü According to the formulated activities, give the negotiated (money) economic recognition to the beneficiary that complies with the agreed commitments.

ü Monitor and follow up the good progress of the programmed activities.

The financial mechanism whereby resources are managed and their availability is guaranteed throughout all of the time in which this plan is in force, besides guaranteeing a greater transparency and optimization in the management and administration of resources for the implementation of proposed objectives, are among some of the advantages this mechanism provides. Others are:

1. Trust: It is the main characteristic. It is a double trust, both for the client towards the fiduciary as well as from the fiduciary towards the client. Additionally, the objective of implementing this mechanism is the shared participation of direct key players who are involved in commissioning this compensation plan.

2. Purpose: The importance of complying with all legal standards that regulate the contract as well as the powers and rights, obligations and attributions of surveillance and control authorities should be clear in the contracts that are executed.

3. Temporality: This mechanism is ideal due to the temporality of each of the actions to implement, since the validity of this mechanism depends directly upon the establishment and monitoring of different actions proposed in the plan.

4. Transparency: Common ordinary funds can be constituted when formalizing and executing businesses over which the trustee provides a collective administration; likewise, ensuring transparency when managing the resources.

Monitoring and follow up plan

Monitoring and doing a follow up of the compensation plan comprises a series of actions to guarantee the compliance and execution of the approaches and therefore its effectiveness. The following measures must be taken into account:

It is important to consider that this document is a proposal of the compensation plan due to loss of biodiversity, which takes into account a series of alternatives, already selected, as being the most feasible for its implementation.

Objective: To monitor and do follow up of the actions stated in the compensation plan due to biodiversity loss, in accordance to what is set forth in this plan's document.

The environmental coordination will conduct periodic reviews of the implementation of the measures, where it will verify the compliance of technical requirements thereof, for example, the distance between seedlings will be validated in the cases where plant species will be planted as well as the survival of individuals and maintenance, among other variables.

Chart 11.2.2.31 shows the indicators proposed for the final compensation plan due to biodiversity loss.

Chart 11.2.2.39 Follow up indicators of the compensation Plan due to biodiversity loss.

Indicator	Calculation Formula	Success value	Frequency	Verification means
Reduction of the affected area of natural and semi-natural ecosystems	(Area (ha) of natural and semi-natural ecosystems intervened by project/area)ha) of natural and semi-natural ecosystems identified in AI) x 100	<20% Excellent =20% Acceptable >20% Deficient	Monthly	Amount of works Recorded in minutes
Implementation of compensation strategy/ies proposed for each stage of the timetable	(Progress of the strategy implemented in the planted area (ha), voluntary agreements performed (ha) /Proposed progress of the planted area (ha), according to timetable) x 100	<100% Excellent =100% Acceptable >100% Deficient	Every six months according to timetable	Amounts of works, activity recording, photographic recording
Review of follow up and monitoring actions	(N° of action controls or reviews proposed /N° of controls or reviews proposed in plan) x 100	<100% Excellent =100% Acceptable >100% Deficient	Every six months according to timetable	Amounts of works, activity recording, photographic recording

Indicator	Calculation Formula	Success value	Frequency	Verification means
Implementation of compensation strategy/ies proposed for each stage of the timetable	(Progress of the strategy implemented in the planted area (ha), voluntary agreements performed (ha) /Proposed progress of the planted area (ha), according to timetable) x 100	<100% Excellent =100% Acceptable >100% Deficient	According to timetable proposed in the plan	Reviewing minutes, reports and photographic recording
Diversity Index – Shannon Index	$H = -\sum_{i=1}^{S} pi \log_2 pi$ S=*Number of species* *Pi= Proportion of individuals from species i with respect to the total number of individuals(relative abundance of each species i = ni/N where ni=number of individuals of each species I and N= Number of all the individuals of all the species)*	Compared with the baseline value: <100% Excellent =100% Acceptable >100% Deficient	According to timetable proposed in the plan	Reviewing minutes, reports and photographic recording
Margalef Index	Diversity = (S-1) /log N S = number of species N = total number of individuals	Compared with the baseline value: <100% Excellent =100% Acceptable >100% Deficient	According to timetable proposed in the plan	Reviewing minutes, reports and photographic recording
Simpson Index	$\lambda = \sum p_i^2$ ***pi*** = proportional abundance of species i, namely, the number of individuals of species i divided between the total number of individuals of the sample (Melo, et al. 1994.)	Compared with the baseline value: <100% Excellent =100% Acceptable >100% Deficient	According to timetable proposed in the plan	Reviewing minutes, reports and photographic recording

Source: GEMINIS ENVIRONMENTAL CONSULTANTS, 2016

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