

ENVIRONMENTAL IMPACT STUDY FOR THE RUMICHACA - PASTO DUAL  
CARRIAGEWAY, PEDREGAL – CATAMBUCO SPAN, CONCESSION CONTRACT UNDER  
SCHEME APP NO. 15 OF 2015



Géminis Consultores Ambientales S.A.S



EXECUTIVE SUMMARY

San Juan de Pasto, March 2017

The Rumichaca -Pasto dual carriageway road project is a project of national interest and one of the most important in the department of Nariño, which is part of the Pedregal- Catambuco span, subject matter of this Environmental Impact Study (EIS). Given its technical characteristics, which can lead to serious deterioration to the renewable natural resources, or the environment, or introduce significant or notable changes to the landscape, the project is subject of environmental licensing for its **implementation**, reason why it is submitted to consideration of the National Authority of Environmental Licenses - ANLA-, in compliance with provisions of decree 1076 of 2015, as well as the terms of reference for road projects, gathered by resolution 0751 of 2015.

The EIS is developed by Gemini Environmental Consultants SAS and contains the environmental characterization of the territory where the project of the second carriageway will be constructed, as well as the description of the actions and interrelation of the natural resources with said works.

On the other hand, the title holder thereof is the Concesionaria Vial Unión del Sur and is part of the eight second wave projects of the Fourth Generation of Road Concessions that are governed by the guidelines set forth in the CONPES document 3760 of 2013 and by the regulations (Law 1508 of 2012) related to Public Private Partnerships (PPPS) and who are in charge of the Ministry of Transportation, through the National Infrastructure Agency (ANI).

Structuring the EIA in accordance with area characteristics has led to the development of specific activities such as the Archaeological Management Plan and Prior Consultation activities, since according to the resolutions issued by the Ministry of the Interior (resolutions 22 and 23 of 2016) certifies the presence of ethnic communities. Therefore, the activities to be carried out and achievement of proposed objectives are subject to the results of these processes.

### General Information

The existing road has an origin-destination length of 82.91 km consisting of a two-way road, composed of 2 3.65 m wide lanes and berms of between 0.50 m and 1.00 m approximately, on a plot of land between undulating and steep. The road, in addition to connecting the main cities in the south of Colombia, is the international axis joining Colombia and Ecuador enabling trade and improving the living conditions of the inhabitants of the region as a whole. Crossed municipalities are: Ipiales, Contadero, Iles, Imues, Tangua, Yacuanquer and Pasto, with the road subject matter of this study adjacent to the Pedregal and Tangua populated centers.

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The fundamental purpose of the Project is to convert the existing infrastructure in a high specification dual carriageway road, improving communications of all the country's southwest between Cali, Popayán, Pasto and the border with Ecuador. This aims to improve the current road with slopes and steep lengths, in general of high values reaching maximums close to 9% and with very small radii of curvature in the order of 40 m resulting in the road operating with average travel speeds around 35 km/h, that even for light vehicles makes it practically unfeasible to safely pass cars.

The cross-section of the road is currently a two-way street with a 8.30 m roadway section with 3.65 m wide lanes and 0.50 berms, however, there are spans where the carriageway width can reach 9.30 m. The purpose of this project is to improve the route, giving the road a configuration of two one-way roads with two lanes each. For such end, the road improvement is designed by adapting the circulation of the existing roadway to dual carriageway.

The estimated length of the Pedregal – Pasto sector is approximately 37.96 Km, the sector that corresponds to this environmental impact study is between Pedregal and Catambuco, consisting of approximately 32.76 Km, divided into two Functional Units (UF); UF-4 Pedregal - Tangua with an approximate length of 15.76 Km, UF-5 subsector 1 Tangua - Catambuco with an approximate extension of 16.94 Km and the first 60 meters of length of UF-5 sub-sector 2 Catambuco-Pasto, for a total length of 32.76 km, the remaining 5.2 Km of the UF-5 sub-sector 2 are not covered in this study.

**Table 1: Division de Functional Units UF4 and UF5**

UF	Beginning			End			Total Length	Sector
	PK	Coordinates		PK	Coordinates			
		N	E		N	E		
UF4	PK 00+000	606679.9 0	957013.4 0	PK 15+760	613384.7 3	966117.8 7	15.76 km	Pedregal- Tangua
UF5.1	PK 15+760	613384.7 3	966117.8 7	PK 32+700	619975.1 8	975562.4 8	16.94 km	Tangua- Catambuco
	PK 32+700	619975.1 8	975562.4 8	PK 37+959	623684.6 2	977560.7 0	5.26 km	Catambuco- Pasto
<b>Total double carriageway construction length</b>							32.76 km	
<b>Total Length</b>							37.96 km	

Source (Géminis Consultores Ambientales, 2016)

The UF-4 Pedregal-Tangua corridor is between PR43+217 to PR 60+020 of national highway 2501 for a total of approximately 15.76 km of road which run through a topography with longitudinal slopes and notorious cross-sections given the natural landforms. PK0+000 of this Functional Unit is located approximately 1.6 km before crossing the Pedregal populated center, municipality of Imues and ends at PK15+760, in the municipality of Tangua, works are planned in its layout, such as:

- Relief-road in the Pedregal town between abscissas (PK1+750 to PK2+300).
- Roundabout type overpasses intersection (PK2+150) to access to the Pedregal town and a bypass road toward Imues, Túquerres and the southwestern region.
- A bridge over the Guaitara river between abscissa PK2+780 and PK3+080
- El Placer toll in abscissa PK6+200.
- Crossing structure in the La Magdalena Creek, in K7+000.
- Overpass connection in abscissa PK8+600.
- Turnaround between abscissa PK12+600 - PK13+000 and PK14+050- KP 14+500 at the Tangua town entrance and exit.

The UF 5 Tangua – Pasto corridor is located between PK15+760 and PK37+959 for a total of 22.20 km of road approximately and is subdivided in two sub-sectors as follows:

The UF-5 Tangua-Catambuco Sub-sector 1 corridor is located between PK60+020 and PK77+062 of national highway 2501 for a total of 16.94 km of road approximately, crossing topography with high gradient longitudinal, however, the transversal development becomes softer resulting in more appropriate planimetrically areas, beginning in PK15+760 and ending in PK32+700 in the province of Catambuco in the municipality of Pasto. The following works, among others, are foreseen in the delineation of functional unit 5 sub-sector 1 are projected:

- Relief-road Alberto Quijano between PK22+600 and PK23+800
- Oval type operational turnaround between PK19+000 -PK20+000 Yacuanquer and Cebadal entry
- Bowtie type operational turnaround between PK26+500 - PK26+900
- Bowtie type operational turnaround PK28+800- PK29+400
- Pedestrian bridge Bavaria K31+300

The second sub-sector of Functional Unit 5 is located between the highway interchanger south of the eastern Pasto (Catambuco) relief road and the entrance to the Pasto urban area, where rehabilitation of the existing road is considered, bearing in mind that rehabilitation is considered to be the "reconstruction of transportation infrastructure to

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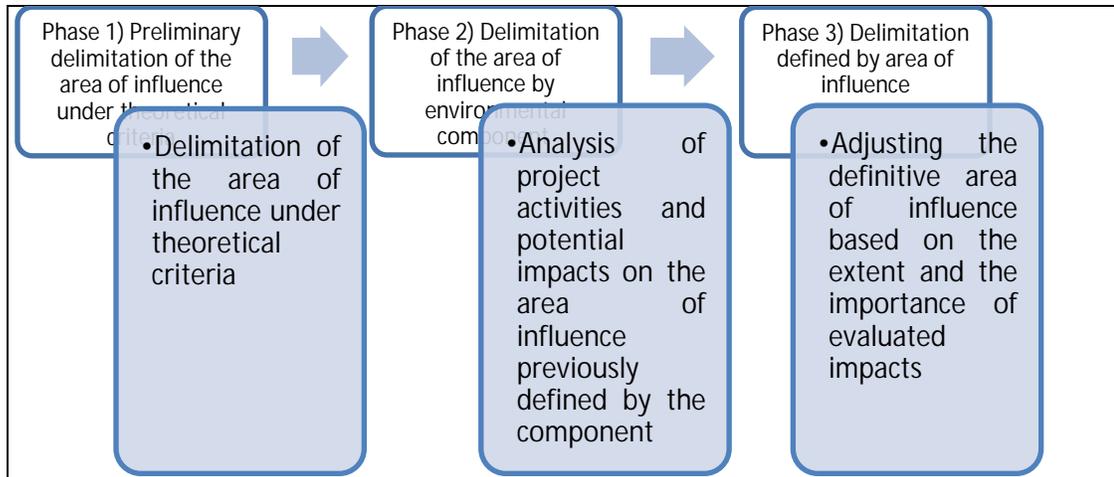
return it to the initial state for which it was built", For this reason, Sub-sector 2 of UF5 is not part of this Environmental Impact Study with the exception of its first 60 meters in the Catambuco province given that an access to this town is foreseen.

**Area of influence**

The area of influence of the Rumichaca - Pasto dual carriageway road project, Pedregal – Catambuco span was defined based of the technical characteristics of the project and the environmental and social characteristics of the area. This definition envisaged the impacts that can occur in the abiotic, biotic and socio-economic development aspects based on execution of project activities.

Among the technical and socio-economic development aspects taken into account when delimiting the area of influence are those primarily associated to constructive activities, which are present in the area of intervention of the road project, defining the latter as the layout of the project which establish as delimitation parameters the flat line surfaces shown in the design, the extension of the right-of-way and suitability of access. In addition, the project associated infrastructure corresponding to Camp Areas, the Waste Management and the Excavation Material Areas (ZODME) and their access roads were considered.

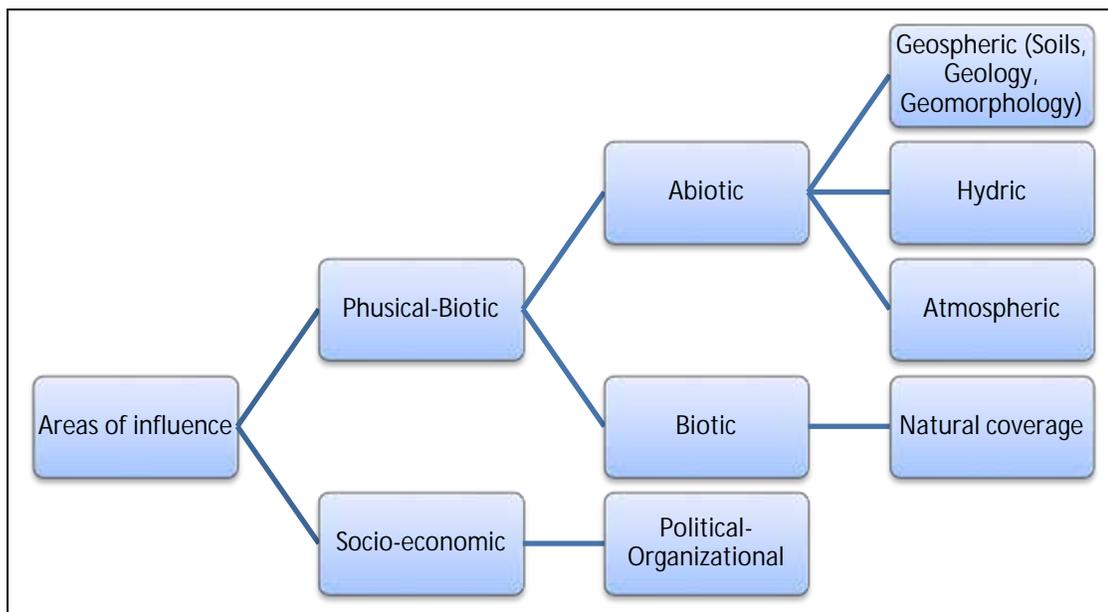
Initially, a preliminary identification of the physical-biotic and socio-economic areas of influence was made, analyzing the components that make up these means, to theoretically support the elements that define the geographical delimitation of each one thereof. Later, and based on the impacts identified by Project activities, intermediate areas were identified for each component to define the physical or abiotic, biotic and socio-economic areas of influence, where direct Project effects are foreseen and for which baseline characterization, evaluation and identification of impacts and control strategies, mitigation and compensation activities were developed. This corresponds to the methodological scheme presented in the following Figure 0.1, which is divided into three phases.



**Figure 0.1. Area of influence delimitation phases**

Source: (Géminis Consultores Ambientales, 2016)

Given that the areas of influence for this study correspond to the set of half the product of integrating the abiotic and biotic environment on the one hand, and to the socio-economic environment on the other, it is important to note the cartographic elements that were part of the final established definition, as shown below. **Figure 0.2**



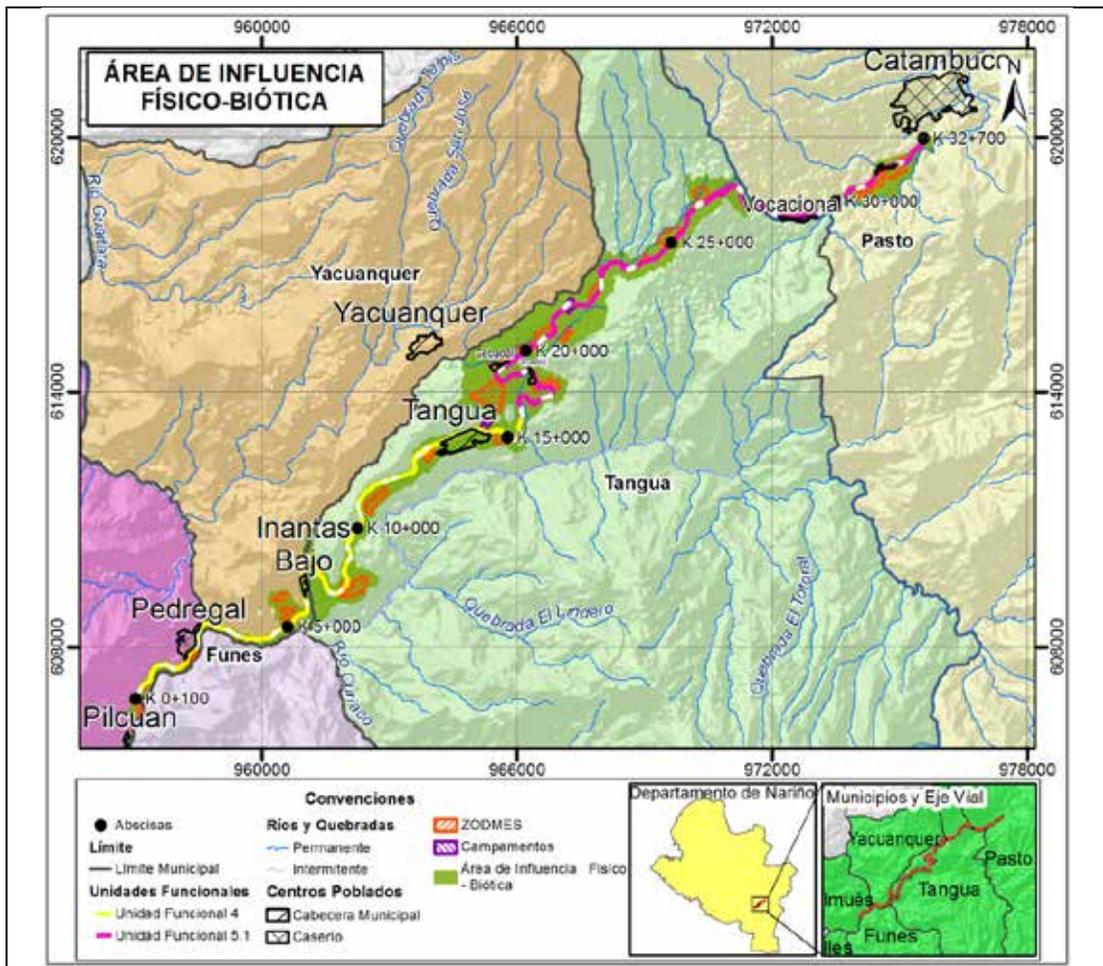
**Figure 0.2 Cartographic processing scheme**

Source: (Géminis Consultores Ambientales, 2016)

*The physical-biotic area of influence*

For the abiotic environment, the area of influence was determined based on the analysis of the water, atmospheric and geospherical components, taking into account the type of impacts that may be generated on these last ones. In this regard three polygons (water, atmospheric and geospherical) were delimited.

For the biotic environment, the main input was the analysis of the existing natural cover. From these two components the physical –biotic area of influence was obtained as shown below. Figure 0.4

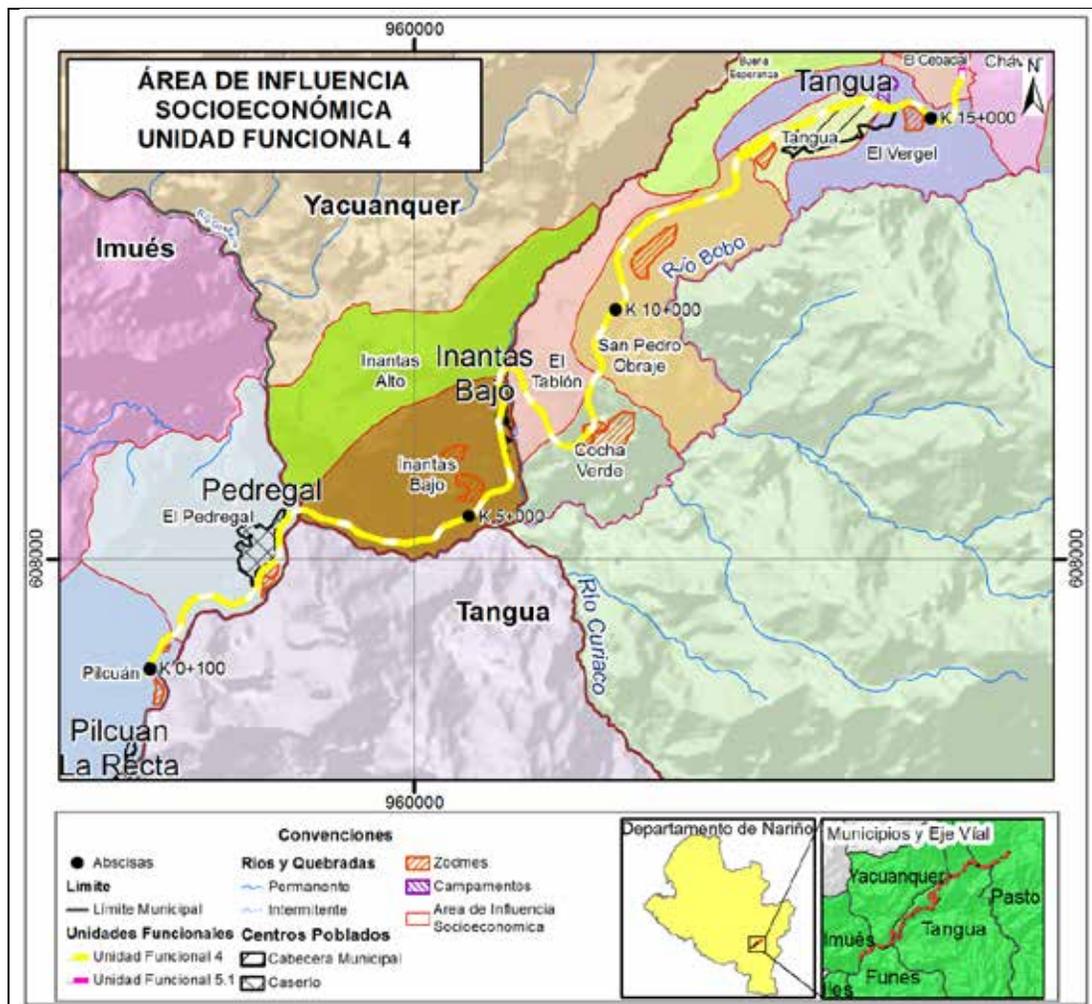


**Figure 0.3: Physical-biotic area of influence**

Source (Géminis Consultores Ambientales, 2016)

*Socio-economic area of influence*

Pursuant to the terms of reference for the preparation of EIA for road and/or tunnel projects, the areas of influence are defined by units of analysis, which for the purposes of the socio-economic environment correspond to higher territorial units (municipalities), and minor as the minimum unit of analysis (provinces (C), counties (V), neighborhoods (B)). See Figure 0.5 and Figura0.6.



**Figure 0.4: Socio-economic area of influence UF 4**

Source: (Géminis Consultores Ambientales, 2016)



**Table 2: Use of natural resources and required permits**

USE OF NATURAL RESOURCES AND REQUIRED PERMITS	
Diversion permit	4 diversion points: Bobo River and La Magdalena, La Chaquita, La Marqueza Streams
Riverbed occupation permit	35 works along the project
Discharge permit	2 ground discharges through infiltration fields with two areas per camp of the span subject matter of the study.
	2 discharges on surface water with two discharge points each
Emissions permit	Crushing, concrete and asphalt plants
Forest use	3657,77m <sup>3</sup> of forest volume to be used
Lifting of prohibition	Forest and epiphytes species present in the area of intervention of the project. (Requested to the Ministry of Sustainable Environmental Development)

Source: (Géminis Consultores Ambientales, 2016)

There is no request for permission for quarrying since the materials to be used in the project will be provided by third parties.

### Impact Assessment

The environmental impact assessment was conducted on the Conesa Fernandez Methodology (2010) for scenarios with and without project.

For the without project scenario the negative impact on the environment is analyzed, based on the environmental importance (IA) of the impacts, which are generated by anthropogenic activities on environmental elements.

Among project activities, livestock has a moderate impact on the stability of water banks and the landscape; likewise, with a severe impact on soil structure and physical-chemical and biological characteristics of the water and availability of water resource. Agriculture generates a severe and negative impact on the vegetation cover, the fragmentation of wildlife habitats, the structure and composition of the hydro-biological communities; generating at the same time a moderate impact on the protective vegetation of the water bodies.

For the scenario with project the activities that could generate greater impact on the biotic and abiotic environment are clearing, topsoil removal and excavations. The socio-economic environment impacts evaluated are of a positive nature, mainly by employing local labor, acquisition of lands and municipal intercommunication.

### Environmental Zoning

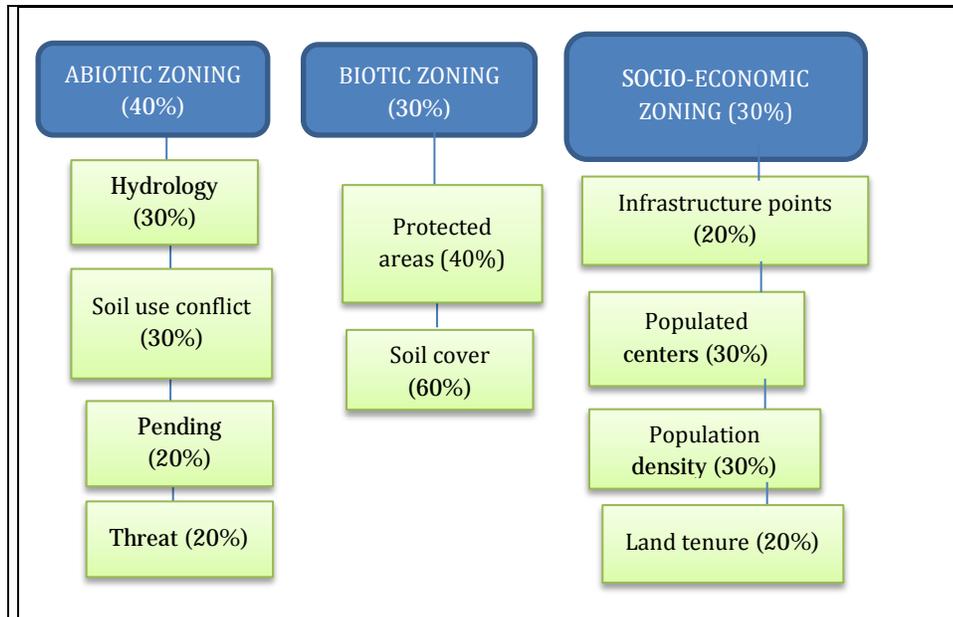
Based on the environmental characterization of the area of influence, the environmental zoning of the Rumichaca -Pasto dual carriageway road project , Pedregal Catambuco span, had as purpose to identify areas in which according to sets of abiotic, biotic and socio-economic parameters, reflect degrees of potentiality or fragility relatively homogeneous within a given area but dissimilar. Zoning sought to delimit and typify areas of homogeneous characteristics, interpreting them in terms of area environmental sensitivity, without project, without them losing their interrelationships with the set of activities they have as scenario; this in accordance with requirements in the terms of reference for Environmental Impact Studies for Construction of Roads and/or Tunnels, stipulated by the MADS in Resolution 751 of 2015.

The environmental zoning involved considerations framed within a set of potential parameters that, in each dimension, reflect the prevailing conditions in the region; whose comprehensive analysis is done by setting a relative rating system in such a way that the expressions between parameters are comparable.

The methodology when establishing the environmental zoning of the project was taken from the methodology proposed by the Ministry of the Environment, Housing and Territorial Development (2010), by Resolution 1503 of 2010, which suggests some variables to be taken into account.

Figure 0.7 presents the methodological framework defined to prepare the environmental zoning of the Rumichaca - Pasto dual carriageway road project, Pedregal – Catambuco span.

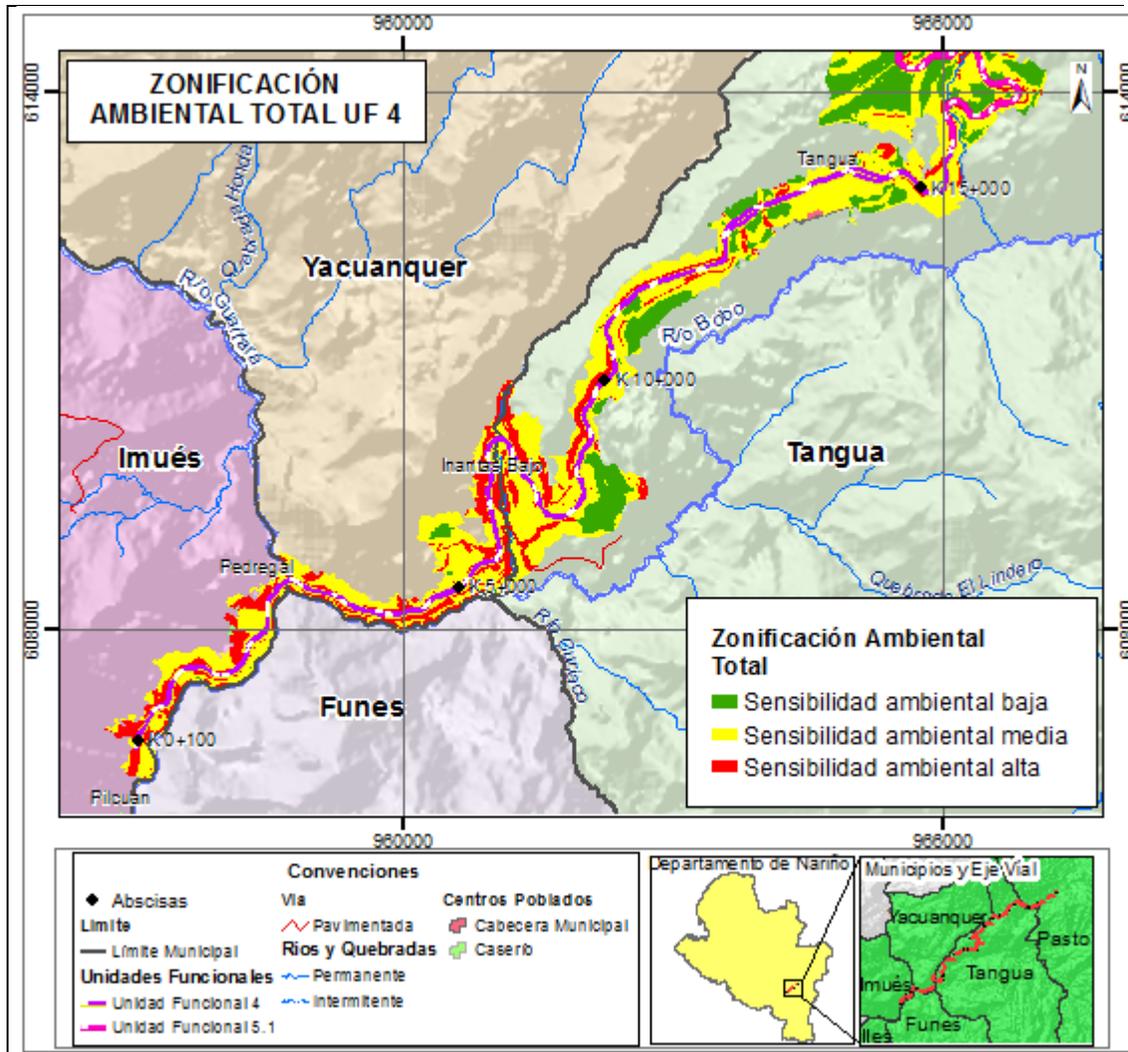
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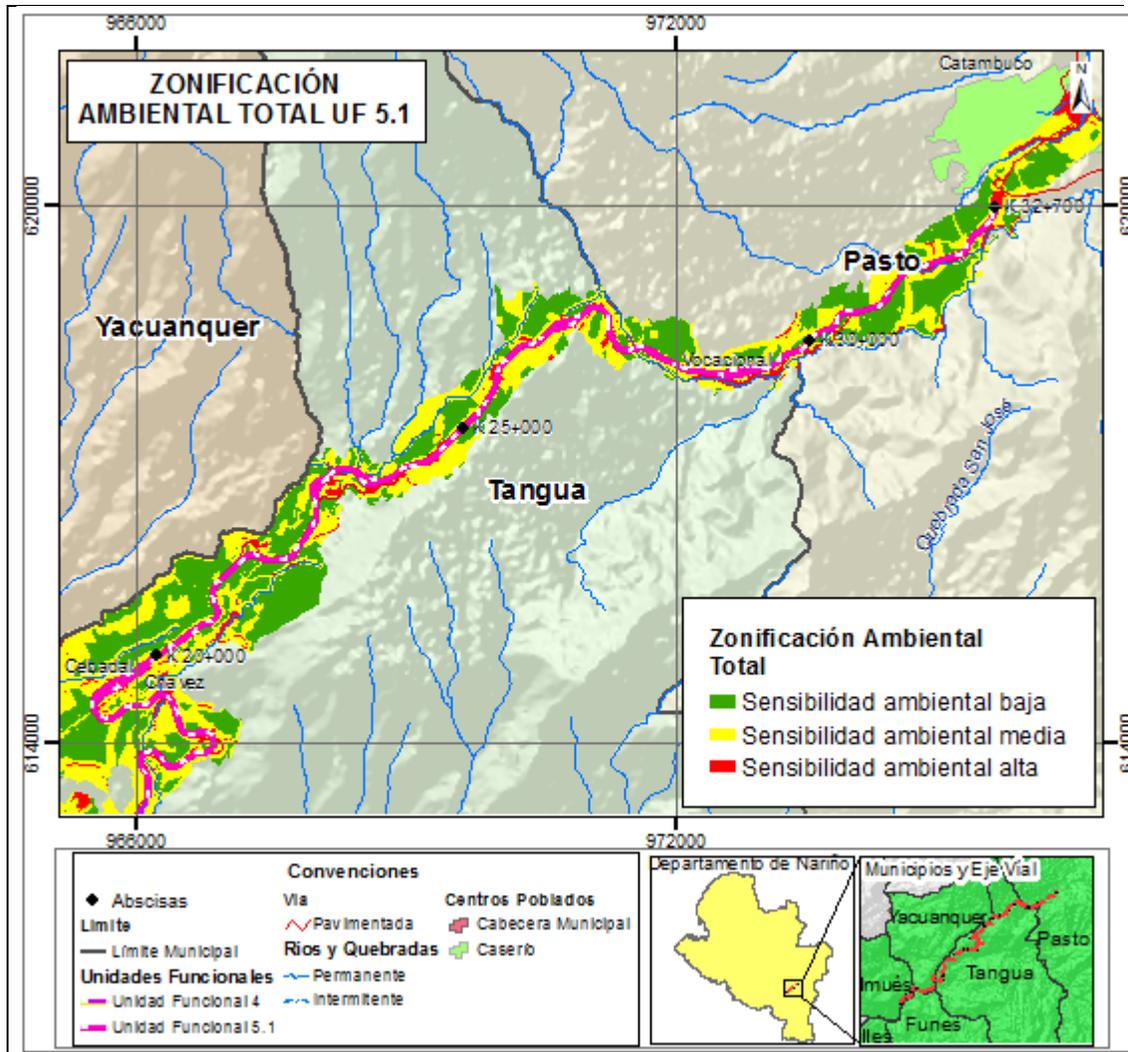
**Figure 0.6: Environmental zoning methodology scheme**

Source: (Géminis Consultores Ambientales, 2016)

Having defined the intermediate zones for each environment, the cartographic overlay that allowed establishing the final environmental zoning was made, as shown below in Figure 0.8 and Figure 0.9.



**Figure 0.7: Environmental zoning UF 4**  
Source: (Géminis Consultores Ambientales, 2016)



**Figure 0.8: Environmental zoning UF 5.1**  
Source: (Géminis Consultores Ambientales, 2016)

**Environmental management zoning**

The Environmental Management Zoning is the result of the interrelation of the biotic, abiotic and socio-economic sensitivity area zoning, in regard environmental assessment of the activities to be carried out in the project area (functional units 1, 2 and 3), which determine the possible levels of intervention.

Thus, to define the project's Environmental Management zoning, the analysis of these two aspects was the basis to pinpoint the areas where the project intends to intervene and that require special measures, very restrictive measures (geotechnical works), compensating measures (reforestations, isolations), or medium and low restriction measures, where environmental management measures would any way be implemented.

The methodology to analyze and relate the project's environmental zoning of the area of influence and the impact assessment consisted in developing two main steps:

- a) Review the different abiotic, biotic and socio-economic sensitivity areas taking into account project activities that generate potential critical, severe and moderate impacts during the construction phase, the operation phase or during the implementation two phases of the project, in order to establish the desired environmental management category. The criteria used for this purpose were of a legal, social and ecological nature.
- b) Identify and review areas with environmental risk characteristics, taking into account project activities that generate potentially severe and moderately high impacts, during the construction and operation phases in order to establish the recommended environmental management category.

Areas identified and qualified under different types of management were subdivided into management units based on their main characteristic attributes to then define the restrictive or recommended measures to be implemented for each project activity in terms of the potentially severe and moderately high impacts during the phases of the project. Classification used met the terms of reference for Environmental Impact Studies for Projects of Road Construction and/or Tunnels with their accesses, stipulated by the MADS in Resolution 751 of 2015.

Each management unit was analyzed in a qualitative and quantitative manner, using geographical information systems where the units were classified into the following management areas:

- Exclusion areas.
- Intervention areas with restrictions.
- Intervention areas.

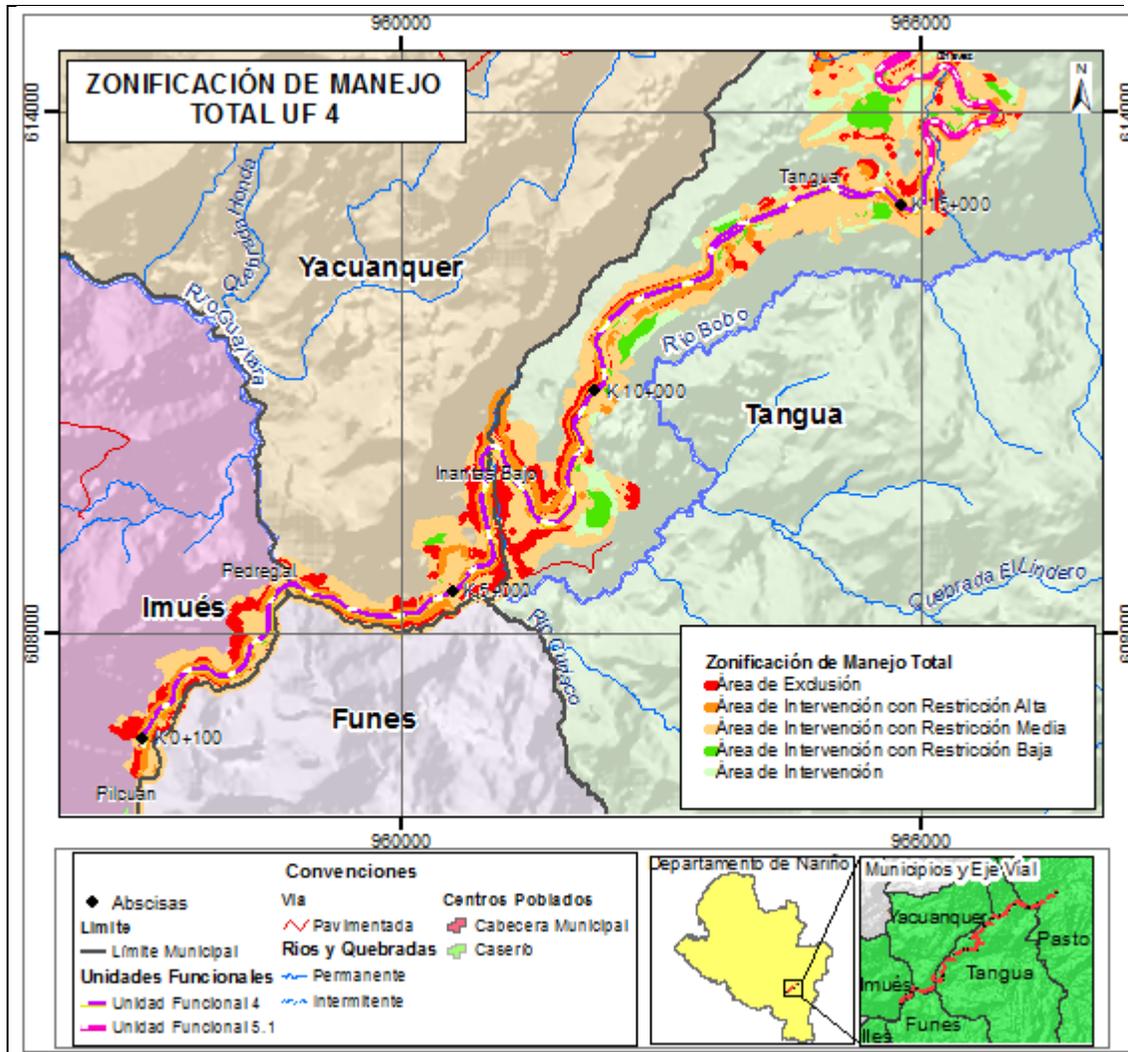
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In keeping with the aforesaid, management zoning were conducted for each of the environments, in order to obtain a total or final management zoning, which was established in terms of area, being the average restriction that of the highest percentage, with 31% of its area, as shown below in table 3:

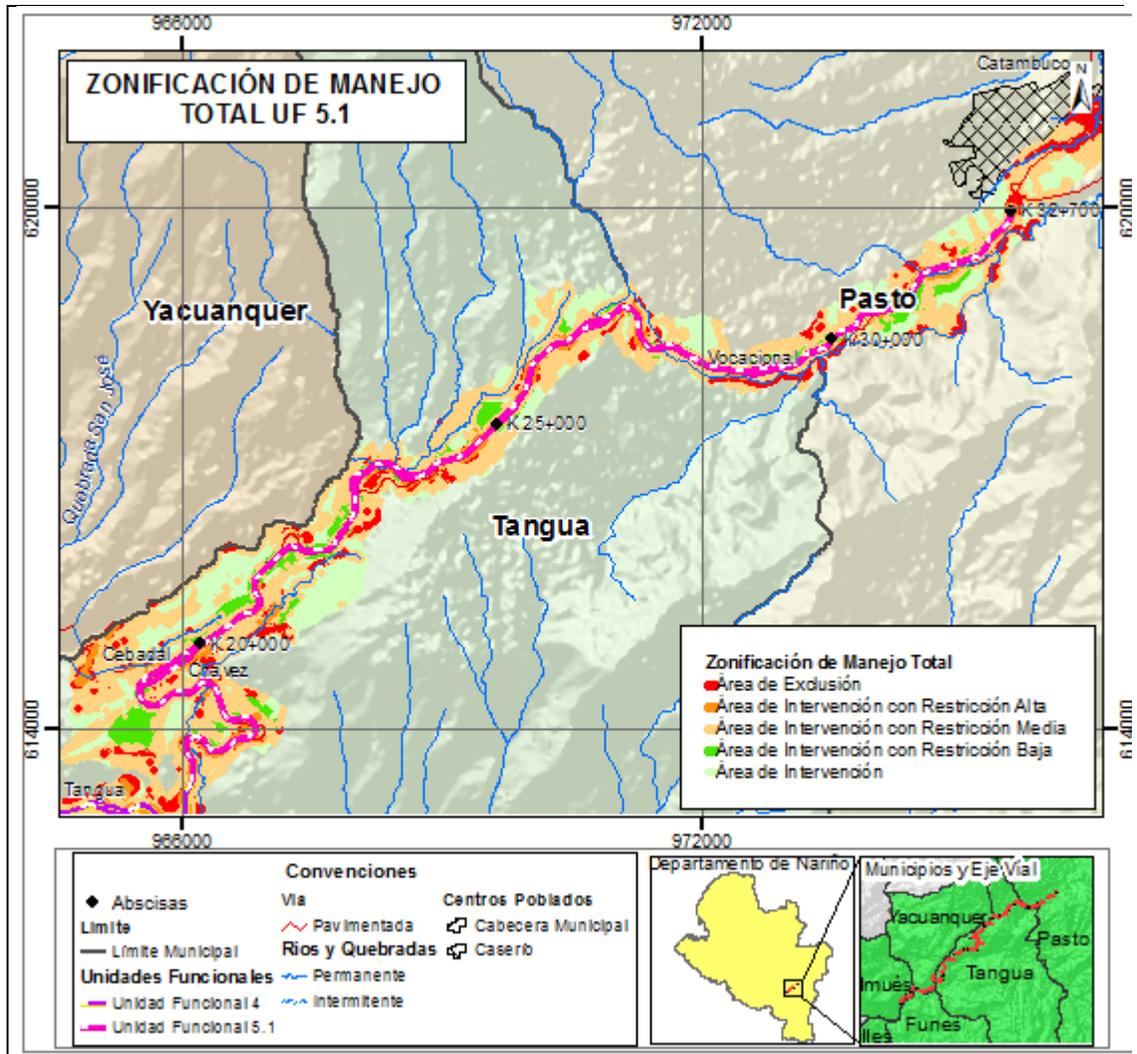
**Table 3 Total environmental management zoning**

TOTAL ENVIRONMENTAL MANAGEMENT ZONING	AREA OF INFLUENCE	%
Exclusion	176,8	9,14
High restriction	114,27	5,9
Medium restriction	1070,78	55,37
Low restriction	105,79	5,47
Intervention	465,94	24,09
<b>TOTAL</b>	<b>1933,6</b>	100,00

Source (Géminis Consultores Ambientales, 2016)



**Figure 0.9: Total management zoning UF 4**  
Source: (Géminis Consultores Ambientales, 2016)



**Figure 0.10: Total management zoning UF 5.1**  
Source: (Géminis Consultores Ambientales, 2016)

### Environmental Management Plan

The Environmental Management Plan formulated for the project responds to the potential impacts identified by the project based on characterization of the area of influence of the abiotic, biotic and socio-economic environments. Formulated programs and projects include prevention, mitigation, compensation and correction activities for each environment.

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14 projects are established for the abiotic environment distributed in the soil resources management, water resources management, air resources management and landscape management programs. See Table 4

**Table 4: Abiotic management program**

PROGRAM	CODE	PROJECTS
SOIL RESOURCES MANAGEMENT	MRSZ-1	Debris and excavation material disposal management
	MRS-2	Slopes, hillsides and erosion control management
	MRS-3	Materials and construction equipment management
	MRS-4	Domestic, industrial and hazardous solid waste management
	MRS-5	Explosives management and storage
	MRS-6	Fuel management and storage
HYDRIC RESOURCES MANAGEMENT	MRH-1	Water collection management
	MRH-2	Water bodies crossings management
	MRH-3	Runoff water management
	MRH-4	Domestic and liquid waste management
AIR QUALITY MANAGEMENT	MRA-1	Noise sources management and control
	MRA-2	Process plant emissions management and control
	MRA-3	Emission sources management and control
LANDSCAPE MANAGEMENT	MP-1	Landscape management

Source: (Géminis Consultores Ambientales, 2016)

6 soil, flora and fauna, habitat protection, revegetation and compensation projects were presented for the biotic environment. See Table 5

**Table 5: Biotic management programs**

PROGRAM	CODE	PROJECTS
SOIL RESOURCES MANAGEMENT	MRS-1	Vegetal cover and topsoil removal management
FLORA AND FAUNA RESOURCES	MRFF-1	Flora management flora

MANAGEMENT	MRFF-2	Fauna management
	MRFF - 3	Habitats management and conservation
REVEGETATION	MRV-1	Revegetation management of intervened areas
	MRV-2	Compensation management for affected soil cover

Source: (Géminis Consultores Ambientales, 2016)

7 programs and projects will be implemented in the socio-economic environment during development of the Rumichaca - Pasto Road Project, Pedregal – Catambuco span, Concession Contract under APP N° 15 of 2015 scheme, in each one of the stages established therein.

**Table 6: Socio-economic management programs**

PROGRAM	CODE	PROJECT
User support	MSC-1	User support
Education and training program for project staff	MSC-2	Education and training program for project staff
Labor contracting program	MSC-3	Labor contracting
Information and community participation program	MSC-4	Information and community participation
Institutional management capacity support program	MSC-5	Institutional management capacity support
Training, education and awareness of project surrounding community program	MSC-6	Training, education and awareness of project surrounding community
Road culture program	MSC-7	Road culture
Socio-land management coaching program	MSC- 8	Socio-land management coaching

Source: (Géminis Consultores Ambientales, 2016)

## Investment Plan

Based on the need of collecting water resources and as a measure of retribution the investment of 1% plan as laid down in article 4 of Decree 1900 of June 12 of 2006. For formulation thereof, the Bobo River basin and the Marqueza, La Chaquita and La Magdalena micro-watersheds were considered as priority areas. The activities set out in the plan correspond to 4 action lines:

- **Conservation and management of micro-basins:** Land acquisition and/or improvements in moor areas, cloud forests and areas of influence of fountainheads and recharge of aquifers, major reservoirs and riparian corridors. Preservation and conservation of the System of National Parks, found in the respective basin in accordance with the management plans.
- **Environmental education:** Environmental training to train community promoters on topics related in the foregoing subparagraphs, in order to contribute to the environmental management of watersheds.
- **Protection and conservation of aquifer recharge areas:** c) Land acquisition and/or improvements in moor areas, cloud forests and areas of influence of fountainheads and recharge of aquifers, major reservoirs and riparian corridors. Preservation and conservation of the System of National Parks, found in the respective basin in accordance with the management plans.
- **Reforestation:** Land acquisition and/or improvements in moor areas, cloud forests and areas of influence of fountainheads and recharge of aquifers, major reservoirs and riparian. Preservation and conservation of the System of National Parks, found in the respective basin in accordance with the management plans.

Appropriate activities to formulate the investment Plan were identified based on reviewing water resource management documents as the Guitar River POMCH, municipal development plans, land management schemes, CORPONARIÑO management plan, sanitation plans and discharge management-PSMV, water resource management plan PORH. Meetings were also held with the entities responsible for management of these resources, among them municipal town halls, municipal planning secretariats, Municipal Environmental Units- UMATAS and CORPONARIÑO in order to identify both the measures referred to in the medium and long-term on-going recovery projects. The 1% execution plan amount is \$474,579,727

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## Risk Management Plan

Construction of roads and, in general, the of road infrastructure works involve natural, physical and human-induced type risks which require adopting a risk management policy to minimize the likelihood of occurrence or situations which may give rise to adverse consequences.

For such end threats on vulnerable elements were assessed, basis to qualify threat and vulnerability as follows:

**Table 7: Vulnerability qualification criteria**

CRITERIA	WEIGHTED VALUE
Impact on people	35%
Economic losses and impacted infrastructure	20%
Environmental damages	35%
Loss of image	10%

Source (Géminis Consultores Ambientales, 2016)

The result of this evaluation allowed identifying those activities that represent the most threats, such as earth removal, volcanic activity and public order situations. With regard to the vulnerability the most significant activities are handling of explosives, volcanic activity and earthquakes, identified in Table 8.

MATRIZ CALIFICACIÓN DEL RIESGO						
AMENAZA	Frecuente	5	Presencia de animales	Accidentes de tránsito		
	Moderado	4	Situaciones de orden público	Remoción en masa	Actividad Volcanica	
	Ocasional	3	Accidentes de trabajo	- Acciones terroristas - Incendios forestales - Daños a redes de servicios públicos - Derrames de sustancias químicas	Movimiento telúrico	
	Remoto	2				
	Improbable	1	Inundaciones			Manejo de Explosivos
	CALIFICACIÓN		Insignificante -1	Marginal -2	Crítico -3	Desastroso -4
VULNERABILIDAD						

**Table 8: Risk qualification**

Source: (Géminis Consultores Ambientales, 2016)

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Taking into account the results of the risk rating, strategies to reduce the risk of each the event were designed as well as strategies for emergency attention, resources and logistical support.

**Table 9: Risk management plan strategies**

<b>STRATEGIES</b>	
Signage	<ul style="list-style-type: none"> <li>-Appropriate places for vehicular and pedestrian traffic</li> <li>-Places where events may occur where staff circulate or stay</li> <li>-Location of the basic safety implements (fire extinguishers, masks, phones, etc...)</li> <li>- Evacuation routes</li> <li>- Muster points</li> </ul>
Actions and decisions to handle an emergency	<ul style="list-style-type: none"> <li>- Individual actions</li> <li>- Group actions</li> <li>- Decision makings</li> </ul>
Risk reduction	<ul style="list-style-type: none"> <li>Dissemination and training</li> <li>Control of events</li> </ul>

Source: (Géminis Consultores Ambientales, 2016)

### **Dismantling and abandonment plan**

This plan is formulated with the purpose of carrying out the closure of constructive activities under management measures that can help prevent creating new impacts or the control and mitigation of the impacts generated by the project’s temporary infrastructure. It comprises executing three main activities:

- Dismantling the project associated infrastructure and the equipment.
- Landscape restoration activities focused on slopes, right of way, areas of plants and camps, ZODME.
- Information strategies directed at the community and authorities of the area of influence.

The activities contained in this plan will be executed as constructive activities are closed in the different work fronts.

### **Cost and schedule**

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