



EL MOLINO AND SAN MATIAS HYDROELECTRIC PROJECTS

ENVIRONMENTAL IMPACT STUDY VOLUME III of V CHAPTER 5

DOCUMENT 2148-04-EV-ST-020-05

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5 IDENTIFICATION AND ASSESSMENT OF IMPACTS

5.1 GENERAL INFORMATION

Chapter 3 Describes the current characteristics of the environmental area in which the El Molino hydroelectric project is located, which served as the basis for the identification and assessment of the potential impacts that will be generated by its construction and operation (see Table 5-1), which were complemented with those identified in the 1999 environmental Guide of the year for hydroelectric project¹s .of the Environment Ministry, Housing and Territorial Development

Table 5-1 Impacts the El Molino hydroelectric project will generate.

Biotic Environment	Biotic environment	Socio-economic environment
Increasing the concentration of particular matter and gases	Changes in vegetation coverage	Changes in the levels of governance
Increase in sound pressure levels	Loss or fragmentation of habitats	Effects on the cultural heritage
Alteration of the river dynamics	Death and displacement of terrestrial fauna	Empowerment of conflicts
Changes in water quality	pressure Increase on natural resources	Displacement of infrastructure and housing
Decrease in the water availability	Changes in the San Matias River fish community	Changes in population dynamics
Changes in the physical and chemical properties of the soil	Changes in the structure of the aquatic biotope and biocenosis	Increase in the demand for goods and services
Modification of the landscape		Temporary employment generation
		Modification of the municipal finances and environmental corporations
		Generation of expectations
		Modification of the local mobility
		Allocation of the economic activities
		Pressure on the real estate market
		Inconvenience Generation to the community
		Changes in the soil use
		Increase in accident risk
		Variation in health levels
		Impairment on the archaeological heritage

¹ Environmental Guide for the hydroelectric sub sector. SENA, Environment Ministry. 1999

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5.2 METHODOLOGY

5.2.1 Qualitative Assessment

The identification and assessment impacts caused by the construction and operation of the project was carried out using an array of double entry, where components of the environment intersect (arranged in columns) with the activities of the project that may potentially cause impacts (arranged in rows). If an activity could cause changes on an environmental element, it is marked in the respective box, using a sign "X". The project activities and environmental elements that were considered in this evaluation, are presented in Table 5-2 and Table 5-3.

Table 5-2 Project activities

Activity	Description
Preliminary Stage	
Previous Activities	Reconnaissance Visits, surveying, presentations of the project, information process, land negotiation for the construction of the facilities.
Construction phase	
Land Purchase	Land acquisition for the construction of the collection facilities, facilities of generation, access roads, deposits and other facilities that are part of the hydroelectric project.
Hiring of labor	Selection and hiring of skilled and unskilled field workers for the construction and operation of the project.
Vegetation and bare soil removal	Cut of trees and shrub vegetation, and removal of soil surface layer in the areas of the facilities.
Surface Excavations	Cuts, loans, and filling for the adequacy of the Hydroelectric facilities.
Underground Excavations	Drilling, blasting and removal of materials during construction of the conduction tunnel.
Disposal of excavation leftovers	Adequacy and operation of storing sites for temporal or permanent storage of waste of the surface and underground excavations.
Transport and hauling	Transit of all kinds of vehicles for machinery transportation, equipment, materials, supplies,



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Activity	Description
	and waste within the work zone.
Operation of grinding and mixture plants	Classification, grinding and stacking of sterile materials. Preparation of mixtures.
Concrete pouring	Construction of simple concrete, reinforced, and cyclopean roller-compacted.
Construction and operation of camps and workshops	Mounting and operation of temporary facilities for the staff to work in the construction of the hydroelectric plant
Operative Phase of the project	
Operation of the central plant	Power Generation, discharge for occurrence of growing streams.

Table 5-3 Description of the environment elements

Element	Description
Air Component	
Concentration of particular matter and gases	Particulate material presence in the air of, CO, NO ₂ and OS ₂ , which defines its quality.
Sound pressure level	Intensity of the existing sound in the project area, to establish the possible interference that this has on the community settled in the area (interference in the communication between the people or their activities such as sleeping, reading, resting).
Water Component	
River Dynamics	Conditions of the rivers and streams, which are defined by the characteristics of their basins, and that depends on parameters such as geomorphology, geology, hydrology and existing vegetal coverage.
Physical and chemical quality	Resource Quality, which is defined by the concentration of certain physical and chemical parameters.
Soil Component	



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Physical and chemical properties	Soil properties: grain size, permeability and porosity, friability and texture, among others, which may be modified by any activity related to the project.
Landscape	Homogenous geographical space in terms of its physiognomy and composition, resulting from the interaction between climate, water, soil, flora, fauna and human activities.
Terrestrial Ecosystems Component	
Biocoenosis	Set of biological populations that share a given area, which can be characterized by the number of species and individuals, and laying down some kind of relations, which can be of dependence, feeding, development, among others.
Biotopes	Territory or space with particular environmental conditions, which allows the developing in it, of a certain community of living beings.

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Table 5-3 Description of the environmental elements. (Continued)

Element	Description
Aquatic ecosystems components	
Biocoenosis	Set of biological populations that share a given area, in this case in the water, and which provides some kind of relationship.
Biotopes	Territory or space in a body of water, with particular environmental conditions, which allows the development of a community of living beings.
Cultural Component	
Archeology and cultural heritage	The site's value by its archaeological features, historical, cultural.
ARTICULATOR Axis	Territorial references in a region, beliefs; ways of interaction in the population, which defines the organizational structure of the same.
Demographic Component	
Population Dynamics	Size, growth, distribution of the territorial mobility as a result of economic, social, cultural and political processes that is manifested in a territory, constituting significantly the factors that influence the conditions for the development of a location, as well as its economic, social and environmental sustainability.
Healthiness	State of the physical, mental and social well-being of a population, defined by parameters such as the morbidity, mortality and endemic diseases, prevention levels of risk factors, nutrition
Spatial Component	
Social and Public Services	Equipment and resources for the care of the basic services for the population in a given region (education, health, water supply, sewage, energy, phone).
Roads and transport	Structure of the communications network (highways,

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	roads, waterways), evaluated according to their state and its amount. Type of transport being used.
Economic Component	
Economic Activities	Development of an activity in the fields of production, processing, movement and other angles of economic life, having as its main purpose the satisfaction of needs or conveniences of economic life, in any or some of its manifestations

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Table 5-3 Description of the environmental elements. (Continued)

Element	Description
Economic Component	
Employment	Convention or agreement between a natural person (the worker) and a natural person or legal entity (the employer), for which the worker provides certain personal services, under the continued subordination of the employer, in exchange of a salary.
Politic Component	
Power Relations	Understood as the ability of some individuals or groups to influence, determine, condition or force the thinking and behavior of other individuals or groups, as a result of social interaction.
Conflict Structure	Presence of forces and interests in confrontation, existence phenomena of unfavorable coexistence

The matrix built for the identification of the impacts that the project will generate is presented in Table 5-4.

Table 5-4 Impact Identification Matrix

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Medio	Componente	Abiótico					Biótico				Social										
		Aire		Agua	Suelo		Ecosistema Terrestres		Ecosistema Acuático		Cultura		Demografía	Espacial	Económico	Político					
Actividades	Elementos	Concentración de material particulado y gases	Nivel de presión sonora	Dinámica fluvial	Calidad fisicoquímica	Propiedades físicas y químicas	Paisaje	Biocenosis	Biotopos	Biocenosis	Biotopos	Arqueología y patrimonio cultural	Ejes articuladores	Dinámica poblacional	Salubridad	Servicios sociales y públicos	Vías y transporte	Actividades económicas	Empleo	Relaciones de poder	Estructura del conflicto
Etapas del proyecto																					
Etapa preliminar																					
Actividades previas																					
Etapa de construcción																					
Compra de predios																					
Contratación de mano de obra																					
Remoción de vegetación y descapote																					
Excavaciones superficiales																					
Excavaciones subterráneas																					
Disposición de sobrantes de excavación																					
Transportes y acarreos																					
Operación de plantas de trituración y mezclas																					
Vaciado de concretos																					
Construcción y operación de instalaciones temporales y fijas																					
Etapa de operación del proyecto																					
Operación de la central																					

Once the environmental impacts were identified, the qualitative assessment took place, in which the methodology presented by Arboleda was used, that in the same way was developed by the Planning Natural Resources Unit of the Public Enterprises of Medellin in the year 1986, with the purpose of evaluating their hydraulic projects.

The parameters used in the evaluation and its definition are presented in Table 5-5

Table 5-5 Parameters used in the qualitative assessment

Parameter	Definition
Class (C)	Refers to the beneficial or harmful characteristics of an effect and its evaluation is qualitative; it can be: Positive (+, P) if it improves the analyzed environmental condition or negative (-, (N) if it impairs it.
Presence (P)	Certifies that the possibility that the effect can be given and it is expressed as a percentage of the occurrence probability. The ranges used for qualification are: <ul style="list-style-type: none"> • Certain. The effect occurs (P= 1) • Very likely. There is a high level of probability that the effect occurs (0.7 ≤P≤0.99) • Likely. There is an equal probability that the effect occurs or not occurs (0.4 ≤P≤0,69). • Unlikely. The probability that the effect is not present is high (0.2 ≤P≤0,39). • Not likely. The probability of the effect not happening is very low or remote (0.01

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	$\leq P \leq 0,19$)
Duration (D)	<p>Evaluates the period of active existence of the effect, from the moment they begin to express its consequences, until the duration of the effects on the considered environmental factor. It is expressed as a length of time function or lifetime permanence of the impact, according to the following classification:</p> <ul style="list-style-type: none"> • Very long or permanent. The effect lasts more than 10 years or it is permanent (D= 1) • Long. If the effect lasts between seven and ten years ($0.7 \leq D \leq 0.99$) • Medium. If the duration of the effect is between four and seven years ($0.4 \leq D \leq 0,69$). • Short. The effect lasts between one and four years ($0.2 \leq D \leq 0,39$). • Very short. If the effect lasts for less than a year ($0.01 \leq D \leq 0,19$)
Evolution (E)	<p>It assesses the quickness of the effect taken place; that is to say, the speed as this was developed from the moment of beginning of the affectations until the effect reaches its greatest value.</p> <p>It is expressed in terms of time elapsed between the starting of the affectations until the moment in which the impact reaches its greatest, in accordance with the following range:</p> <ul style="list-style-type: none"> • Very fast. The peak of the effect manifests itself in less than one month (E= 1) • Fast. When the greater effect is reached between one month to one year ($0.7 \leq E \leq 0.99$) • Medium. If the effect reaches its greatest value in a period of time between 12 months to 18 months ($0.4 \leq E \leq 0,69$). • Slow. The higher value of the effect is reached between 18 months to 2 years ($0.2 \leq E \leq 0,39$). • Very slow. If the greater effect is reached after two years ($0.01 \leq E \leq 0,19$)

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Table 5 5 Parameters used in the qualitative assessment. (Continued)

Parameter	Definition
Magnitude (M)	<p>Size of the change which has occurred in the environmental analyzed factor caused by an action from the project. It is expressed in terms of the percentage of affectation or modification of the factor, according to the following expressions:</p> <ul style="list-style-type: none"> • Very high. It affects more than 80% of the element, which means their total destruction (M= 1) • High. When the effect changes between 60% and 79% of the features or status of the element (0.7 ≤M≤0.99). • Medium. If the characteristics or status of the element is changed between 40% and 59% (0.4 ≤M≤0,69). • Low. The effect only reaches to change between 20% and 39% of the environment element (0.2 ≤M≤0, 39). • Very low. If the effect modifies only less than 19% of the element characteristics (0.01 ≤M≤0, 19).

Based on the parameters in the table above, it is estimated the environmental rating (Ca), which represents the seriousness or importance of the affectation that this is causing, whose mathematical expression is as follows:

$$Ca = C (P[7 \times E \times M+3 \times D]), \text{ where:}$$

- Ca= environmental rating, whose absolute value is greater than zero and less than or
- C=Class
- P= Presence
- E= Evolution
- M= Magnitude
- D= Duration

The estimated value is classified according to the established ranges in Table 5-6:

Table 5-6 Environmental impact Ranges of importance

Environmental Rating	Importance of the environmental impact
≤ 2,5	Little significant or irrelevant
>2,5 and ≤ 5,0	Moderately significant or moderate
>5,0 and ≤ 7,5	Significant or relevant
>7.5	Very significant or serious

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5.2.2 Cumulative Impacts

5.2.2.1 General Information

For the purpose of assessing the cumulative impacts that are generated by the construction and operation of the El Molino hydroelectric project, there will be an analysis of the information that exists in the HMV projects that are located in the basin of the Calderas River, and that they are licensed or in licensing process.

For the foregoing reasons, in this analysis, in addition to El Molino hydroelectric project, the following projects were considered:

- El Popal hydroelectric project, currently under construction: It is located in the municipality of Cocorná, on the veredas , of La Aurora, La Inmaculada, Los Mangos, San Lorenzo, La Pinuela; leverages the waters of the Cocorná River and has an installed capacity of 10 MW
- San Miguel hydroelectric project. Project with environmental license granted by CORNARE through Resolution 112-5075 from August 31, 2010. This plant, which is located between the municipalities of San Luis and San Francisco, takes the waters of the Calderas River and has an installed capacity of 42 MW.
- San Matias hydroelectric project. Central that at the moment is in licensing stage, and leverages the turbine waters of the El Molino hydroelectric project, to conduct them through a tunnel to bring them to a power house located on the vereda
- La Inmaculada of the municipality of Cocorná. Its capacity is 20 MW and is located between the municipalities of Cocorná and Granada.

To assess the cumulative impacts there are two types of methodologies:

- Those that identify how and where it presents a cumulative impact or interactive impact.
- The technical assessments, which establish the magnitude of the impact, based on its intensity.

To define which of the two methodologies of cumulative impacts, we should analyze the type of cumulative impact, which can be classified into the following three classes, according to the form of accumulation:

- Additive impact. Is the impact that is not combined with any other, but with the passing of time, past, present and future, increases its value. For example, the quality of a stream of water by the contribution of pollutants from various sources, or the existing noise in an area by the presence of several sources generating sound pressure.
- Interactive impact. Are individual impacts that combined, generate another different effect to each impact separately; the impacts are not necessarily generated by a single project. For example, the erosive activities with the transport processes of sediments.
- Indirect or secondary impact. They are caused by an action, but their effects are presented later or further away from the point where it occurs, but are still reasonably foreseeable. Indirect impacts may include induced changes in land use patterns, population density or rates of growth and effects related to air, water and other natural systems, including ecosystems. They are considered synonymous of secondary impact.

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Within the two methodologies are identified methods that identify the cumulative impacts, others are the technical assessment to determine the magnitude of the impact, based on their intensity and others that are classified in any of the two methodologies, as shown in Figure 5-1.

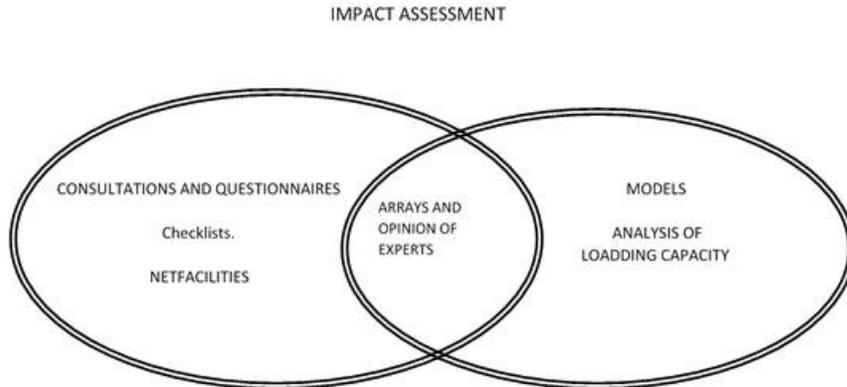


Figure 5-1 Methods and tools for the assessment of cumulative impacts

In practice, as can be seen in Figure 5-1, the different methods can be combined now that some of them identify how and where impacts will occur, others assess the impacts and some are useful for both purposes.

Given the current state of the used studies, one in phase of construction, another licensed and the other two in the process of licensing, it is not possible to select methodologies that use models or analysis of load capacity, as these are, to yield reliable results, it is required several years of information .

5.2.2.2 Accumulation Processes

The types of impacts defined in the previous section can accumulate over time or space, so it is necessary to perform the following tests:

- Spatial Analysis

The Space accumulation occurs when the proximity between the shocks is smaller than the distance required to eliminate or disperse them. Therefore they must describe the main considerations that the impact has on a spatial accumulation. For the impact spatial analysis it was considered:

- If the environmental change that is been assessed, has a definitive reach, local or regional.
- If the shocks are presented in a single point (concentrated), at various points in the zone of influence (scattered), or if they are present in the whole area of influence (continuous).

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- It must be determined the pattern as the disturbance is being presented or the geometric shape as the modification is being presented: timely, linear or area.

On the basis of the previous analyzes, it determines the space frontier or the geographical space, up to where the disturbance is presented and the existence of special situations that encourage change:

- Temporal analysis

The temporary accumulation occurs when the time interval between a disturbance and the successive is much too small to measure a system or a component of the system, to assimilate or recover from the disturbance. To analyze this aspect the following considerations are used:

- Characteristics of accumulation. The temporary accumulation requires that time and frequency of disturbance should be considered. It must incorporate a sufficient time horizon to discover in the long-term the increased environmental change and being able to visualize the differences. Also it must distinguish the events that are permanent with time, because the shocks are not always discrete events.
- Temporary border. In the same way as in the space, the considerations analysis of the temporal cumulative impact, it must produce an analysis scenario, which is considered important to determine the most significant milestones in the past, present and future that define the horizon past and future up to where the analysis will be extended. To define these times, it is required to know the traditional activities of the area, information available, development schemes, and useful life of the project.

Up to where it can reach this analysis depends on the quality and quantity of information. Also it must be determined if there are actions or events in the time that potentiate the disturbance

In addition, the Guide of the European Community suggests that the uncertainty in the development of an area that depends on the government's development plans and potential private projects, in the future analysis is no more than five years.

- Generated Consequences

One of the principles of the cumulative impact assessment is to evaluate those that are significant, for which it is important make assumptions about the type of change that can occur, as the following can be:

- Functional changes. The change includes the functional alterations in processes such as energy flows, sediment transport, economic flows, nutritive cycle, succession; or changes in properties such as capacity for assimilation, transport capacity or thresholds.
- Structural change. The structural change includes demographic changes, habitat modification, and alterations to geophysical resources (air, water, soil). It is essentially a space analysis, which should look at aspects such as the invasion of the spaces, the transfer of flows out of the original boundaries and the effects of fragmentation.

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5.2.3 Economic evaluation of impacts

5.2.3.1 General Information

Economic assessment of environmental impacts must be carried out taking into account the environmental delta that the project will generate. To model this environmental change it is necessary to ensure the collection of technical and economic information to advance a strategy of environmental economic assessment in the area before starting the project².

The technical manual for the evaluation of environmental impacts in projects of the Environment Ministry, Housing and Territorial Development - University of the Andes (2010), recommends developing the pricing strategy of impacts, taking into account the definition of environmental impact and internal and non-internal.

The Internal impacts are all those impacts that can be corrected or mitigated and can lead to a near state where it was before the impact. Are those arising from actions taken to produce or consume a good and may be reflected in its cost or price or if they affect activities of production or consumption. The internal impacts can be corrected by means of the implementation of environmental management plans that are effective to reverse the damages. In this case, the relationship impact - abatement is proportional. Which is, it can generate an impact on an ecosystem and can repair the natural resource to bring it to the state it had before the intervention.

The non internal impacts are impacts that may not be reflected in prices or that the allocation cannot be compensated (Asian Development Bank, 1996). It is expressed in terms of externalities that generate significant costs to the society and that threaten to ensure the sustainability of the natural capital, which is indispensable for the existence of future generations.

5.2.4 Impacts Projection

Along with the methodology for the economic assessment of impacts in the proposal Evaluation Manual of the Ministry³, a perform projection of impacts should be implemented as the basic element for the decision of economic assessment (see Figure 5-2).

For this projection it will be re-taken the impacts identified and evaluated during the construction and operation of the hydroelectric plant Los Molinos, which are featured in.

According to the guidelines of the Manual, is not technically feasible to provide the economic assessment of all identified environmental impacts; those of greatest impact are evaluated, under the assumption that the other can be controlled and generate residual revenue/costs⁴

In accordance with the table of identification and evaluation of impacts for El Molino hydroelectric project (see Table 5-8); it is shown an analysis is performed of the potential impacts of assessment and the methods to be used.

² Environment Ministry, Housing and Territorial Development - University of the Andes. Economic evaluation of projects environmental impacts. Technical Manual p 21

³ IBID

IBID, page 32⁴

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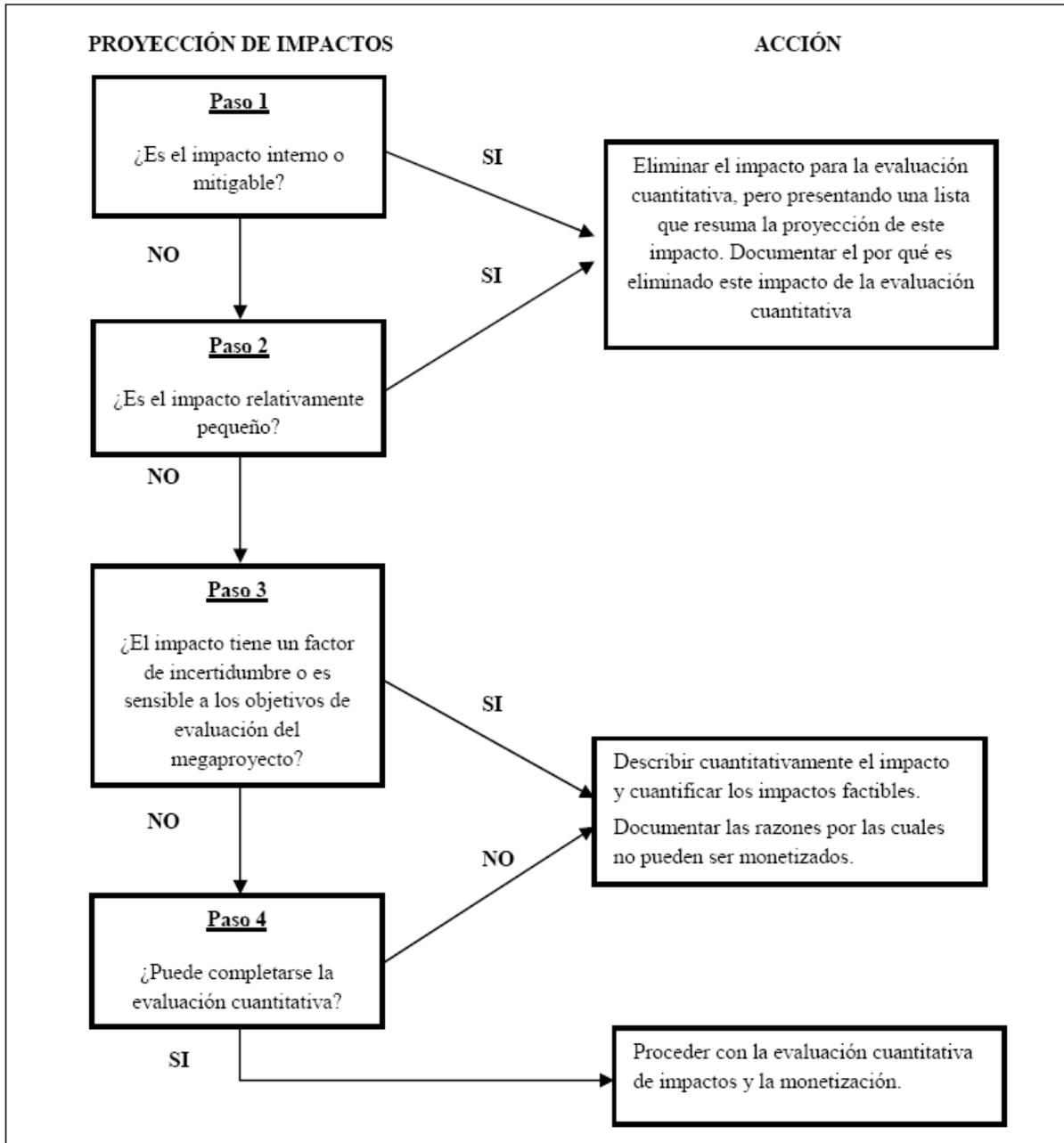


Figure 5-2 Projection Process and environmental impact control

Table 5-7 Assessment of the environmental importance of the impacts

Environmental Impact	Environmental Importance	
	Description	Rating

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Environmental Impact		Environmental Importance	
		Description	Rating
Physical Dimension	Changes in air quality	Moderate	-3.13
	Increase in sound pressure levels	Irrelevant	-2.55
	Alteration of the river dynamics	Moderate	-3.8
	Decrease in the availability of water	Moderate	-4.47
	Changes in the physical and chemical properties of the soil	Irrelevant	-1.73
	Modification of the landscape	Moderate	-4.06
Biotic Dimension	Changes in vegetation coverage	Moderate	-4.33
	Loss or fragmentation of habitats	Moderate	-4.9
	Death and displacement of terrestrial fauna	Moderate	-3.4
	Increase in the pressure of the natural resources	Relevant	-6.65
	Changes in the San Matias River fish community	Relevant	-5.7
	Change in the structure of the aquatic biotope and biocenosis	Moderate	-4.7
Social Dimension	Negative Impacts		
	Generation of expectations	Relevant	-5.1
	Generation of Inconvenience to the community	Relevant	-5.95
	Empowerment of conflicts	Moderate	-2.6
	Displacement of homes and families	Moderate	-3.8
	Changes in population dynamics	Irrelevant	-1.8
	Allocation of economic activities	Moderate	-2.8
	Pressure on the real estate market	Irrelevant	-0.8
	Damage caused to third parties		
	Alteration of the cultural heritage	Moderate	-3.8
	Change in land use	Moderate	-3.3
	Increase in the risk of accidents	Irrelevant	-2.2
	Variation in health levels	Irrelevant	-1.0
	Positive impacts		
	Temporary employment generation	Moderate	4.5
Change in the levels of governance	Relevant	5.7	

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Environmental Impact	Environmental Importance	
	Description	Rating
Increase in the demand for goods and services	Moderate	3.4
Modification of the municipal finances and the environmental corporations	Relevant	5.7
Modification of the local mobility	Moderate	4.4
Allocation of the archaeological heritage	Moderate	3.6

In the context of the assessment and in the particular context of analysis for the impacts of the El Molino hydroelectric project (the definition of internal and non internal impact and the importance of the environmental impacts); it is possible to make a first approximation of selection of susceptible impacts assessment.

Another of the elements to be considered is the methodology that can be used for the economic assessment of impacts presented in Table 5-7, which makes use of the scheme of total economic assessment TEV.

The TEV as a concept value is focused on the fact that any type of environmental or natural resource is characterized by having other values different from the value of direct use.

Below are the concepts of the assessment methods that are likely to be used in accordance with the impacts identified and its environmental importance:

5.2.4.1 Market price method

This method estimates the economic values of products or services of the ecosystems that are bought and sold in the commercial markets, and it is used to quantify the changes in value in the quantity or quality of a good or service. Within this included the changes in productivity, which are not otherwise than the measure of the physical changes in production due to environmental changes, using market prices for supplies and products.

The results of the analysis of changes in productivity should be given in unitary terms.

Taking into account the definition and even more, the intention to apply the term TEV (total economic value); the use of the method of changes in productivity may underestimate the real value to society.

5.2.4.2 Expenditure based method

These methodologies link the estimation of values of the costs incurred to remedy the damage. Assume that the costs of preventing damage or the replacement of ecosystems or services provide useful estimates of the value of these ecosystems or services.

The appropriate approach to these methodologies are the cost of replacing, shadow projects and cost - effectiveness.

The cost approach replacement that it is possible to measure the costs incurred to replace the damaged assets generated by the project. This cost can be interpreted as an estimation of the benefits related to the measures taken to prevent the occurred damage.

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5.2.4.3 Shadow Projects

Tries to estimate the cost of replacing a whole set of environmental goods and services threatened by the presence of a project. The importance of this method becomes important when you want to maintain the current conditions of a resource or environmental quality compared to the potential damage caused by the development of a project.

5.3 QUALITATIVE ASSESSMENT

5.3.1 Biotic Environment

5.3.1.1 Increasing the concentration of particular matter and gases

Table	1
Environment Biotic	Component: Air
Stage:	Construction
Activity (s)	Removal of vegetation and bare soil Surface Excavations Disposal of excavation leftovers Transport and hauling Operation of grinding and mixture plants Concrete pouring Construction and operation of camps and workshops
Conditions without project	^a According to the study of air quality made in the area of influence of El Molino hydroelectric project, which included monitoring stations on the veredas, Los Mangos, Campo Alegre, La playa and El Molino, it was found that in the area there are levels of PM 10, SO 2, 2 and CO that comply with the requirements of the current legislation, therefore do not represent any problem for the health of the people.
Description of the effect	The alteration of the quality of the air due to the generation of gases and particulate material, caused by the development of the activities carried out for the construction of the project, such as the operation of machinery, the movement of vehicles, the removal of vegetation, which can contribute with pollutants that can generate adverse effects at the regional level, such as the greenhouse effect, the destruction of the ozone layer and effects on the health of the population.
Location	<ul style="list-style-type: none"> • Areas where the main facilities will be implemented: veredas, El Molino,

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	<p>Campo Alegre and Mangos</p> <ul style="list-style-type: none"> Place where it will be built or adapted additional infrastructure such as access roads: veredas, El Molino, Campo Alegre and Mangos Places where, the disposal of excavation materials will take place, veredas, El Molino and Los Mangos Grinding Plants - mixing and pouring of concrete: vereda, El Molino and the Mangos 		
Conditions with project	<p>The implementation of activities such as vegetation removal, surface excavations, transport, hauling and disposal of surplus materials of excavation, executed during the construction phase of the project, will generate particulate material. At the same stage equipment, machinery and vehicles involved in the construction generate gases that modify the air quality in the project influence area.</p> <p>These new sources of pollution will alter the conditions of existing air quality in the area.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	-	The activities of construction and operation of the project will generate negative changes in the air quality.
Presence	Some	1	It is very likely to be present the impact associated with the increase in the concentrations of particular matter and gases associated with the development of the project activities.
Duration	Short	0.39	The main impact on the air quality will be presented during the construction of the facilities, in a period of approximately 2 and half years.
Evolution	Rapid	0.7	The effect is generated once all the activities associated with the construction facilities begin.
Magnitude	Medium	0.4	It is considered that the air quality can be affected, by 40% in relation to its initial state.
Environmental Rating of importance	3.13 - Moderately significant		
Indicator:	Variation of the air quality index (VAQI): Air quality index during construction/air quality index in the baseline		
Environmental	<ul style="list-style-type: none"> Program for handling and disposal of materials 		

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Management Plan that addresses the impact	<ul style="list-style-type: none"> • Program of sources of particulate matter, gases and noise emissions • Program for the management of solid waste, domestic, industrial and hazardous
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5.3.1.2 Increase in sound pressure levels

Table	2
Environment Biotic	Component: Air
Stage:	Construction and operation
Activity (s)	<p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Construction and operation of camps and workshops</p>
Conditions without project	<p>a In the study of air quality line to the base made for El Molino hydroelectric project, level noise sampling was carried out at different stations located in the influence area, on the vereda, Los Mangos, Campo Alegre, La Playa and El Molino</p> <p>The measurements presented areas of non-compliance with the permissible standards required by current environmental regulations for all sampling points in at nighttime, but in the daytime, compliance is presented in the points 2 and 4, located on the veredas, Campo Alegre and El Molino I respectively, just during the holidays. The foregoing should be in the majority of the presence of sources that generate tones at high frequencies and impulses, such as wild and domestic animals, insects, noise generated by the flow of the San Matias River, agricultural activities, tracks even specific streets where necessary vehicle traffic and people, increasing the final LAeq in 6dB.</p>
Description of the effect	The development of activities to be implemented for the construction and operation of the project, such as the operation of machinery, the movement of vehicles will generate an increase in noise levels existing in the project influence area, with local effects.
Location	<ul style="list-style-type: none"> • Areas where the main facilities will be implemented: veredas, El Molino, Campo Alegre and Mangos • Places where, the disposal of excavation materials will take place, veredas, El Molino and Los Mangos

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	<ul style="list-style-type: none"> Grinding Plants - mixing and pouring of concrete: vereda, El Molino and Los Mangos 		
Conditions with project	<p>Noise is generated by all construction activities, in particular where the main facilities are: veredas, El Molino and Los Mangos, although it will be temporarily while construction lasts. In the operation, the generation equipment will cause an increase of the noise on the vereda, Los Mangos.</p> <p>These new sources of pollution, will alter the conditions of existing air quality in the area.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	-	The activities of construction and operation of the project will generate negative changes in the air quality.
Presence	Some	1	It is very likely to be present the increase in sound pressure levels impact, associated with the development of the project activities.
Duration	Short	0.39	The main impact on changes in sound pressure levels will be presented during the construction, the operation of the project will generate allocation to a lesser extent, it is considered in this manner the duration impact within a range of 2 to 4 years
Evolution	Rapid	0.7	The effect is generated once all the activities associated with the construction facilities begin.
Magnitude	Low	0.2	It is believed that the sound pressure levels can be affected, 20% in relation to its initial state.
Rating of environmental importance	2.55 - Irrelevant.		
Indicator:	Variation in sound pressure levels (VSPL)= sound pressure levels during construction/sound pressure levels on the base line.		
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> Program for the handling of sources of particulate matter, gases and noise emissions 		

5.3.1.3 Alteration of the river dynamics

Table	3
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Environment Biotic	Component: Water
Stage:	Construction Operation
Activity (s)	Operation of the central plant
Conditions without project	<p>The hydroelectric development of the river El Molino is located in the basin of the San Matias River, a tributary of the Cocorná River, which in turn discharges its waters in the Calderas River. The main tributary of the River San Matías is the Tafetanes river that pours its waters 1,000 m before the site of collection.</p> <p>Considering the uses of the soil, the geomorphology and the climate system of the Samana basin north of the river, including the San Matias River, are equal, it can be applied the unitary solid performance of the Samana basin to determine the transport in suspension of the San Matias River in the collection site. With the case above, the contribution of suspended sediments of the San Matias River in the collection site would be of 102 kt/year.</p>
Description of the effect	<p>The construction of the flow bypass structure on the San Matias River for power generation, has implied the decrease of the same, a phenomenon that was associated with the emergence of effects such as:</p> <ul style="list-style-type: none"> • Decrease in the speed of the river • Possible emergence of mounds of rock and sediment • Changes in the geomorphologic behavior, downstream of the site of collection.
Location	The effect occurs in the area where there will be a flow reduction of the San Matias River, located downstream of the site of collection.
Conditions with project	<p>There will be a trench with declined flow, on the stretch between collection site and the power house; downstream of the project after the discharge, the San Matias River, given its new physical properties, by the withdrawal of the sediments in the collection area, will seek a new balance.</p> <p>In the case of El Molino hydroelectric project, the process of degradation that commonly occurs in the construction of dams has no influence, given that the retention of fine sediments in the poundage is minimal and the procedure of opening of the gate during the crescents, guarantees the drag of these toward the river bed.</p> <p>Also, the aggradations process by the formation of the delta sediments by the small poundage would not be significant, since the opening of the composed</p>

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	during crescents, facilitates this dragging, given the high slope that the river presents in the sector and under the weir.		
Criteria	Rating	Cj	Justification
Class	Negative	-	The changes caused by the facilities, alter the current conditions of the San Matias River and its tributary creeks.
Presence	Some	1	This impact will be generated by the development of the construction activities and operation of the project
Duration	Permanent	1	The changes that are occurring in the project area are permanent.
Evolution	Medium	0.4	The reduction in the flow of the San Matias River, in the stretch between collection and the power house, will be presented, when the construction activity of the bypass of the water begin, in less than a year.
Magnitude	Low	0.3	The magnitude of the resulting impact on the flow dynamics of the river San Matias is low, given the infrastructure work that will be built for the operation of the project will not generate a drastic decrease in the flow of the river.
Rating of environmental importance	3.8 - Moderate		
Indicator:	Seating capacity of downstream sediment after the discharge before the operation/Capacity of downstream sediment begins, down side of the discharge after initiation of the operation.		
Environmental Management Plan that addresses the impact	Program for the management of liquid waste Establishment of the ecological flow		

5.3.1.4 Changes in water quality

Table	4
Environment Biotic	Component: Water
Stage:	Construction Operation

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<p>Activity (s)</p>	<p>Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Transport and hauling Operation of grinding and mixture plants Construction and operation of camps and workshops Operation of the central plant</p>
<p>Conditions without project</p>	<p>a It was found that the index NSF - WQI of environmental health quality calculated for the different sampling stations established in the San Matias River, has a value above 60, it can therefore be sADI that the evaluated sector of the San Matias River presents a good sanitary water quality (category 4 of 5). 67% of the variables of interest, presented high levels (>80), except the coliforms that present low values in all the evaluated sites. Stand out the high values for OD, pH, T, BOD, ortho phosphates, nitrates and solid, all these important features for a healthy river, with the capacity to sustain diverse aquatic biota.</p> <p>The calculation index BMWP showed indicative values of waters Class I and II, which shows the temporal persistence of conditions of good quality and acceptable quality.</p>
<p>Description of the effect</p>	<p>The activities developed for the construction and operation of the El Molino hydroelectric project, can modify the properties of water sources, associated with parameters such as dissolved oxygen, turbidity and suspended solids.</p> <p>Activities developed in the operation of the hydroelectric plant can generate liquid discharges, which can change the concentrations parameters such as BOD and coliform bacteria.</p> <p>All these changes in the parameters associated with the quality of the water can lead to the loss of habitat for wildlife species and to the limitation of resources availability for the development of human activities, (recreation, consumption, agriculture).</p>
<p>Location</p>	<p>Over the San Matias River water sources, located in the direct influence area of the project, identified in section 3.2.7 uses of water.</p>
<p>Conditions with</p>	<p>The good quality of river water San Matias and its tributaries will decrease by the</p>

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project	fall of solid material originated in the construction facilities of the hydroelectric project. Will also be affected by spills of liquid substances used during the construction such as hydrocarbons and cement.		
Criteria	Rating	Cj	Justification
Class	Negative	-	There is a decrease in the water quality of the San Matias River and its tributaries
Presence	Likely	0.69	The same possibility exists that the impact is present or not
Duration	Very short	0.19	In case that pollution of the waters occurs, the effect will be very short, the effect may last for less than a year
Evolution	Very fast	1	In the moment that discharge pollutants into water sources a negative effect will be produced
Magnitude	Medium	0.6	Changes in the water quality can become medium, changing up to 40 % of the initial conditions, of the water body.
Rating of environmental importance	3.3 - Moderate		
Indicator:	Variation in the water quality: Value of the NSF - WQI during construction/ value of NSF - WQI of the base line		
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> • Program of liquid waste management • Program management and disposal of materials • Program of solid waste management, industrial and hazardous 		

5.3.1.5 Decrease in the water availability

Table	5
Environment Biotic	Component: Water
Stage:	Construction
Activity (s)	Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Operation of grinding and mixture plants

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	<p>Construction and operation of camps and workshops</p> <p>Operation of the central plant</p>		
Conditions without project	a	<p>For the direct influence area of the project, it has been identified a large water potential, formed by creeks of low flow rates, tributaries of the San Matias River, which are used by the population that inhabits the territory for the development of activities such as agriculture, cattle raising and human consumption.</p> <p>Although the territory is very depopulated by the social phenomena that occurred in the past, the few people who inhabit the territory, make use of existing water sources.</p> <p>In a future it is expected the return of people to the territory, a condition that generates the increase of the population, and this situation in turn will induce pressure on water resources, if control measures are not implemented for the proper utilization of the same, it will reach the point of the declining in the availability of water in the area of study.</p>	
Description of the effect	of	<p>The construction of the flow bypass structure on the San Matias River for power generation has implied the decline of the water resource on the river bed, in this way there will be a decrease in the availability of water resources. Also the construction of the conduction tunnel, located on the right bank of the San Matias River, which crosses the paths El Molino, Campo Alegre and Los Mangos, it can generate a decrease in the flow of the natural surface flows that it crosses.</p>	
Location		<p>On the San Matias River water sources and their tributaries, located in the direct influence area of the project, identified in section 3.2.7 uses of water.</p>	
Conditions with project		<p>The pressure that is generated on the water resource and the increase of the population and its use in the construction phase of the project causes changes in the availability of the same. The water streams located on the right bank of the San Matias River may have a lower flow rate to the historically recorded, because of the influence that the construction of the conduction tunnel may have.</p>	
Criteria	Rating	Cj	Justification
Class	Negative	-	It presents a possible reduction in the flow of the streams in the right margin of the San Matias River
Presence	Very likely	0.7	It is very likely that this impact is present with the development of the activities of construction and operation of the project
Duration	Permanent	1	The changes that are occurring in the project area are

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			permanent.
Evolution	Medium	0.69	The period in which to carry out the facilities of the central plant it will generated the effect:
Magnitude	High	0.7	In the event that the impact occurs it can affect 60 per cent of resource
Rating of environmental importance	4.47 - Moderate		
Indicator:	Flow in the currents that passes through the tunnel after the starting of the construction and the San Matias River/ flow of the currents that goes inside the tunnel prior to the construction and the San Matias River in a same hydrological time.		
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> • Program of liquid waste management • Program for managing and disposing of surplus materials • Program of solid waste management, industrial and hazardous • Establishment of the ecological flow. • Management Program for the water supply of the population that settled along the path of the conduction tunnel. 		

5.3.1.6 Changes in the physical and chemical properties of the soil

Table	6
Environment Biotic	Component: Soil
Stage:	Construction
Activity (s)	Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Construction and operation of camps and workshops
Conditions without project	a The soils of the study area are generally acidic with low to moderate fertility, limited in some areas by stoniness in the profile or by drainage, another of the characteristics of these soils are the phenomena of erosion that range from moderate to high, as mass movements. These features define soil suitable for agriculture, cattle rising and extensive forest plantations.

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Description of the effect	The activities associated with the construction of the project, could generate changes in the physical, chemical and biological properties of the soil by compaction, removal of the vegetation layer, spill clearance among other substances, a situation that leads to the decrease in the permeability and porosity of the soil, it can also submit toxicity by the increasing in the concentration of foreign substances and decline of the biological activity of the soil.		
Location	<ul style="list-style-type: none"> • Areas where the main facilities will be implemented: veredas, El Molino, Campo Alegre and Los Mangos • Where it will be built or adapted with additional infrastructure such as access roads: veredas, El Molino, Campo Alegre and Los Mangos 		
Conditions with project	Activities such as land removal for the construction of superficial facilities and adequacy and operation of deposit sites from surplus of excavation and the operation of the camps will affect the soil resource in specific areas.		
Criteria	Rating	Cj	Justification
Class	Negative	-	They affect physical and chemical properties of soil productivity, which in spite of present limitations by fertility they manage to maintain crops and grasses that make up the basic productive activities of the study area and natural coverage.
Presence	Some	1	This impact will be generated by the development of the project construction activities.
Duration	Short	0.39	The changes on the physical and chemical properties of the soil will be present during the construction phase of the project that is approximately 2 and half years.
Evolution	Medium	0.4	The period in which the facilities of the central plant are carried out will immediately generate an effect on the soil.
Magnitude	Low	0.2	It is believed that the impact has a low magnitude due to the fact that the soil resource will undergo changes in the physical and chemical properties in an extension of approximately 20% of the direct influence area of the project.
Rating of environmental importance	1.73 - Irrelevant		

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Indicator:	Index of affected areas: Area affected by the construction/estimated area in the design. Index of areas recovered: Area recovered/Area
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> • Management program and disposal of materials • Management program of liquid waste • Management program of solid waste , industrial and hazardous • Program for decommissioning and abandonment

5.3.1.7 Modification of the landscape

Table	7
Environment Biotic	Component: Landscape
Stage:	Construction Operation
Activity (s)	Removal of vegetation and bare soil Surface Excavations Disposal of excavation leftovers Operation of grinding and mixture plants Construction and operation of camps and workshops Operation of the central plant
Conditions without a project	The landscape of the study area corresponds to a landscape, in which its physiognomy has been modified by productive activities such as cattle raising and agriculture that are taking place in the area. The predominant are the grazing stubble coverage high and low, intervened forests, pastures, and to a less proportion are identified coverage such as, crops, bamboo and infrastructure, among others.
Description of the effect	The removal of vegetation coverage that defines the influence area of the project, leads to the disappearance of interconnected natural scenarios, giving way to the modification of the landscape, opening the way to the establishment of civil facilities structures associated with the generation of energy.
Location	<ul style="list-style-type: none"> • Areas where the main facilities will be implemented: veredas, El Molino, Campo Alegre and Los Mangos • Place where it will be built or adapted with additional infrastructure such as

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	access roads: veredas ,El Molino, Campo Alegre and Los Mangos		
Conditions with project	The construction of the project will introduce new landscape elements, leading to the establishment of civil facilities, such as collection, power house, piping, structure of discharge, which will be new referents for the communities.		
Criteria	Rating	Cj	Justification
Class	Negative	-	The presence of the project from construction generates changes in the landscape, with the exposure of surfaces and the introduction of new elements.
Presence	Some	1	This impact will be generated by the development of the construction activities and operation of the project
Duration	Permanent	1	The modification of the landscape caused by the construction of infrastructure for the project will be permanent, during the entire life of the project
Evolution	Slow	0.39	The maximum effect will be submitted when the project construction ends of which are approximately 2 and a half years.
Magnitude	Low	0.39	It is believed that the impact has a low magnitude due to the fact that the resource will suffer changes in the landscape in an approximate extension of 20 %.
Rating of environmental importance	4.06 - Moderate		
Indicator:	Total Area with infrastructure in the influence area of the project/ total area of the project influence area.		
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> • Management Program and disposal of materials • Management program of solid waste , industrial and hazardous • Program for decommissioning and abandonment • Program of Compensation for damage to the forest coverage 		

5.3.2 Biotic environment

5.3.2.1 Changes in vegetation coverage

Table	8
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**EL MOLINO AND SAN MATIAS
HYDROELECTRIC PROJECTS**

Doc.: 2148-04-EV-ST-020-05

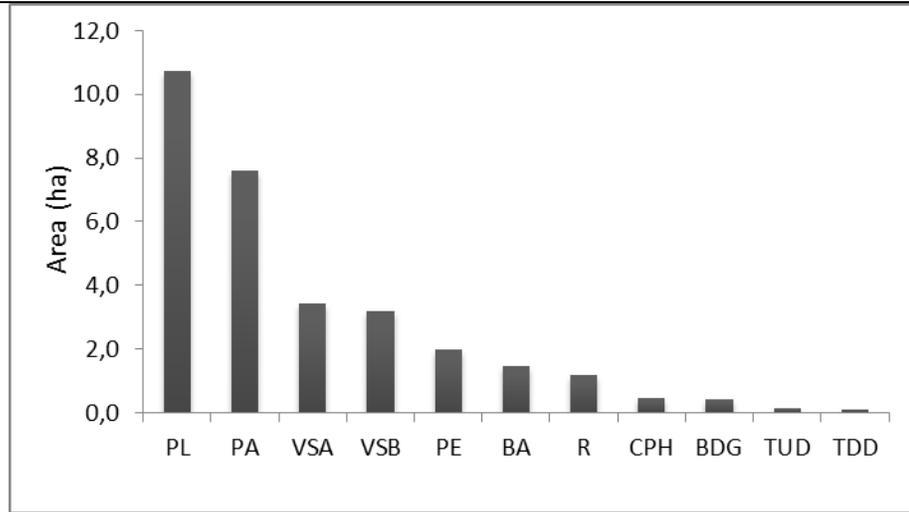
Rev. No.:0

2012-03-30

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Environment Biotic	Component: Terrestrial Ecosystem
Stage:	Construction
Activity (s)	Removal of vegetation and bare soil
Conditions without project a	<p>In the area of indirect influence the clean grasses dominate (PL), followed by the secondary low vegetation (VSB), high secondary vegetation (VSA) and the wooded pastures (PA), and located on the vereda, El Molino, Quebradona Abajo and Campo Alegre. The presence of these coverage's probably attributable to the social and economic conditions in the area, as well as to the location of the vereda. In the three, the land use has traditionally been agriculture and cattle rising; in fact El Molino and Campo Alegre have been considered as part of the territory of agricultural pantry of Cocorná. In addition the ease of access favors the establishment of agricultural activities.</p> <p>After the armed conflict, the families of these three villages returned earlier if compared with the vereda, Los Mangos, also in the influence area, where the return initiated more recently. In this last area of the project, it is observed in the vegetation coverage map a greater dominance of areas in the process of vegetation succession. In the vereda, prevails in the sugarcane cultivation with respect to other activities and the number of inhabitants is inferior.</p> <p>In the area of direct influence is conserved the trend to use the soil as described for the IIA, which influences the type of vegetative covers that are located in both areas. For ADI are: predominance of clean grass (34.9 %) grass trees (24.8 %), followed by high secondary vegetation (11.2 %) and low secondary vegetation (10.4 %), weeded grass (6.5 %), open forest (4.77 %), permanent arable crops (1.50 %) and dense forest of Guadua (1.32 %).</p>

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Description of the effect

For the construction of the facilities of the project surface, it is necessary to carry out woody vegetation cuts, shrub and herbaceous, which will affect the coverage that is drawn in the figure above.

It should be noted that the greater impairment occurs in clean pasture and woodlands.

Location

- The impact is located in the following facilities:
- Path to collection Guadua dense forest, open forest, high secondary vegetation , low secondary vegetation , clean grass, grass trees, weeded grass
 - Path to power house Open forest, high secondary vegetation , low secondary vegetation , clean grass, grass trees, weeded grass
 - Power house Clean Grass Field
 - Collection Grass trees, weeded grass
 - Deposit 1: Open Forest, high secondary vegetation, clean grass
 - Deposit 2: Low secondary vegetation, clean grass, grass trees
 - Deposit 3: Open forest, high secondary vegetation , low secondary vegetation , clean grass, grass trees, weeded grass
 - Deposit 4: Clean Grass, Grass trees, weeded grass
 - Deposit 5: Open forest, woodland pasture, weeded grass
 - Relief Pipe Line: High secondary vegetation, clean grass
 - Pressure Pipe Line: Clean Grass Field
 - Transmission Line: Open Forest, wooded pasture

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	– Substation: Clean Grass Field																						
Conditions with project	<p>Surface Facilities of the project, vegetative covers will be replaced. In the case of deposits, this replacement occurs only during construction, because once you have finished depositing the removed soil, coverage is recuperated.</p> <p>The following table shows the affected areas:</p> <table border="1" data-bbox="586 562 1312 1037"> <thead> <tr> <th>Vegetation coverage</th> <th>Area (ha)</th> </tr> </thead> <tbody> <tr> <td>Open Forest (BA)</td> <td>1.46</td> </tr> <tr> <td>Guadua Dense Forest (BDG)</td> <td>0.41</td> </tr> <tr> <td>High secondary vegetation (VSA)</td> <td>3.43</td> </tr> <tr> <td>Secondary low Vegetation (VSB)</td> <td>3.21</td> </tr> <tr> <td>Wooded grass fields (PA)</td> <td>7.61</td> </tr> <tr> <td>Weeded Grass Fields (PE)</td> <td>1.99</td> </tr> <tr> <td>Clean Grass Field (PL)</td> <td>10.72</td> </tr> <tr> <td>Perennial herbaceous (CPH)</td> <td>0.46</td> </tr> <tr> <td>Total</td> <td>29.29</td> </tr> </tbody> </table>			Vegetation coverage	Area (ha)	Open Forest (BA)	1.46	Guadua Dense Forest (BDG)	0.41	High secondary vegetation (VSA)	3.43	Secondary low Vegetation (VSB)	3.21	Wooded grass fields (PA)	7.61	Weeded Grass Fields (PE)	1.99	Clean Grass Field (PL)	10.72	Perennial herbaceous (CPH)	0.46	Total	29.29
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Clean Grass Field (PL)	10.72																						
Perennial herbaceous (CPH)	0.46																						
Total	29.29																						
Criteria	Rating	Cj	Justification																				
Class	Negative	-	The natural coverage in the influence area of the project has been affected by the economic activities which take place in it; however, there are still a few forest relicts that will be intervened by the project facilities.																				
Presence	Some	1	For the construction facilities of the project surface it is necessary to remove vegetation coverage																				
Duration	Very long	1	With the replacement of coverage's by the project facilities, there is no possibility that in the short term will retrieve the vegetation in these sites.																				
Evolution	Very fast	1	The impact is immediately apparent when the coverage is removed.																				
Magnitude	Very low	0.19	In the following table it is observed that in general, the affectation of the vegetation coverage is below 20% of the reported total for the area of study.																				

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			Cobertura Vegetal	Área (ha) All	Área (ha) AID	% afectación
			Bosque denso (BD)	3,4	0	0
Bosque abierto (BA)	63,9	1,46	2			
Bosque denso gudua (BDG)	26,7	0,41	2			
Vegetación secundaria alta (VSA)	131,7	3,43	3			
Vegetación secundaria baja (VSB)	148,2	3,21	2			
Pasto arbolado (PA)	127,9	7,61	6			
Pasto enmalezado (PE)	16,5	1,99	12			
Pasto limpio (PL)	207,7	10,72	5			
Cultivo permanente herbáceo (CP)	53,5	0,46	1			
Cultivo transitorio (CT)	0,6	0	0			
Total	780,1	29,29	4			

Rating of environmental importance	4.33 - Moderate
Indicator:	Area per type of coverage removed by project facilities / Area by type of coverage in the area of study
Environmental Management Plan that addresses the impact	Management of vegetation coverage and bare soil. Compensation for the affectation of forest coverage

5.3.2.2 Loss or fragmentation of habitats

Table	9
Environment Biotic	Component: Terrestrial Ecosystems
Stage:	Construction Operation
Activity (s)	Removal of vegetation and bare soil
Conditions without project	<p>The natural coverage of the influence area of the project has been intercepted by the traditional economic activities of the area. In the vereda, Molinos, Campo Alegre and Quebradona Abajo, there is a clear predominance of cattle rising among other activities and in addition, are placed transient and permanent crops, of which sugarcane emphasizes the most.</p> <p>In this first sector, the landscape is shaped by the array of grasses, with patches of crops and some discontinuous corridors, along the water currents.</p> <p>Toward the vereda, Los Mangos and the La Inmaculada, now close to the confluence of the San Matias River into the Cocorná, in spite also be lodged for</p>

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	<p>cattle raising and agricultural activity, both are developed with lower intensity by these veredas, more remote routes of communication; the return after the armed conflict, especially toward Los Mangos, is more recent and is less populated than the first three. These conditions have allowed that in this sector are located some areas in different states of succession, forming a mosaic of patches and a network of corridors on the array of pastures.</p> <p>In both sectors, the wooded pasture and secondary low vegetation are in sites (stepping stones) for wildlife and can probably be fulfilling the functions of connectivity with the forest coverage favoring the genetic flow.</p>
<p>Description of the effect</p>	<p>By the construction of the surface facilities of the project are involved some coverage's in different states of succession that conform discontinuous corridors along the streams of water and isolated patches in an array of pastures.</p>
<p>Location</p>	<ul style="list-style-type: none"> - Path to collection Guadua dense forest, open forest, high secondary vegetation , low secondary vegetation, grass trees - Path to power house Open forest, high secondary vegetation , low secondary vegetation grass trees, - Deposit 1: Open forest, high secondary vegetation - Deposit 3: Open forest, high secondary vegetation , secondary low vegetation, grass trees - Deposit 5: Open Forest, wooded pasture - Relief Pipe Line: High secondary vegetation - Transmission Line: Open Forest, wooded pasture
<p>Conditions with project</p>	<p>With the construction of the collection path some coverage's are fragmented forest, which as seen in Cartography 2148-04-EV-DW-031, are isolated and do not constitute patches of significant size. Are located on an array of grass and by its shape and size, it is likely that is presenting an edge effect that favors strong interactions with the matrix (colonization, nutrient and competition)</p> <p>The way to the power house is located toward sector to vereda, Los Mangos and the La Inmaculada), which is also a permanent labor, fragmented forest coverage, as well as the transmission line. As noted above, in this coverage sector are located different states of succession, that could be considered as more connected than those located in sector one, shaping as whole, larger patches?</p> <p>The three facilities, roads and pipe line, will shape artificial corridors that can become barriers to the movement of wildlife.</p>

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	Deposits are transitional facilities and its affectation then we will be permanent.		
Criteria	Rating	Cj	Justification
Class	Negative	-	The fragmentation of the forest relict and hedges that function as conjunctive and offer sites of passage for fauna, reduces the availability of viable habitats and affect the genetic flow and nutrients. In addition to increase the edge effect of by the reduction in the patches size.
Presence	Some	1	With the removal of coverage it reduces the size of the patches and with the construction of permanent facilities, paths of collection and power house, and the transmission line, will make up barriers for the wildlife movement. The reduction in the patch size increases the edge effect and reduces the viable habitats for fauna, especially of the dependent on forest the coverage. It generates loss of genetic viability by reducing the size of the population, for the reduction of resources, increase in the population and environmental fluctuations.
Duration	Very long	1	Fragmentation occurs by permanent facilities that cross forested areas and coverage's that meet connectivity features.
Evolution	Slow	0.39	The reduction impact in the size of wildlife populations, as a consequence of the fragmentation and the reduction in genetic flow, manifests itself in a period exceeding 18 months
Magnitude	High	0.70	Their effects on the forest coverage located in the area of influence and to those considered sites of passage for some species of fauna function as connectors; these are shown in the following table. It notes that there is no more than 3% in the case of the forest patches and high secondary vegetation and that the most affected will be on the wooded pasture

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		Cobertura Vegetal	Área (ha) AII	Área (ha) AID	% afectación
		Bosque abierto (BA)	63,9	1,46	2
		Bosque denso gудua (BDG)	26,7	0,41	2
		Vegetación secundaria alta (VSA)	131,7	3,43	3
		Vegetación secundaria baja (VSB)	148,2	3,21	2
		Pasto arbolado (PA)	127,9	7,61	6
		<p>This reduction in the areas of woodland patches will have its greatest impact on species dependent on the forest and with some category of threat. Among the mammals: <i>Saguinus leucopus</i> (Titi gray), <i>Proechimys magdalenae</i> (spiny rat) and <i>santanderiensis Microsciurus flaviventer and mixed-species</i> (ardita cusca), <i>Aotus lemurinus</i> (marteja or mico at night) and <i>Leopardus wiedii</i> (Ocelot). <i>Saguinus leucopus</i> and <i>Proechimys magdalenae</i> are species with restricted geographic distribution.</p> <p>In birds the base line samplings of sites identified of greatest diversity those with more connectivity and that they are in various successional stages interconnected (low secondary vegetation , high secondary vegetation and open forest), indicating the importance of this connection to the populations of avifauna.</p> <p>For amphibians most species are reported in the coverage with greater structural complexity, pointing to a high availability of shelter, food and breeding areas, conditions that favor the maintenance of populations of this group.</p> <p>Therefore, considering that the reduction of patches of woodland and high secondary vegetation does not exceed 3 %, but this disturbance can have an impact on endangered species, as well as in the forest dependent, describes the magnitude of the effect as high, ignoring the currently available information in the range of transformation.</p>			
Rating of environmental importance		4.9 - Moderate			
Indicator:		% Of reduction in the patch size = patches area with project facilities /			

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	actual area of remnant patches
Environmental Management Plan that addresses the impact	Management of vegetation coverage and bare soil. Compensation for affectation of forest coverage Study of terrestrial vertebrate fauna

5.3.2.3 Death and displacement of terrestrial fauna

Table	10
Environment Biotic	Component: Terrestrial Ecosystems
Stage:	Construction
Activity (s)	<ul style="list-style-type: none"> - Removal of vegetation and bare soil - Surface Excavations - Disposal of excavation leftovers - Transport and hauling
Conditions without project	<p>In the influence area of the project are located dependent wildlife of the vegetation covering in different states of succession, some of them in threat category: <i>Saguinus leucopus</i> (Titi gray), <i>Proechimys magdalenae</i> (spiny rat) and <i>santanderiensis Microsciurus flaviventer and mixed-species</i> (ardita cusca), <i>Aotus lemurinus</i> (marteja or mico at night) and <i>Leopardus wiedii</i> (Margay), by habitat loss and by the hunting pressure that is exerted on them for use as pets</p> <p>Of the recorded birds in the study area, some are used as food source although the hunters action is not very frequent. Of these, two families are consumed: (the Tinamus or gallinetas de monte and the <i>Crypturelus soui</i> - La llorona) and Columbidae (turtledoves or pigeons, mainly the <i>Leptotila verreauxi</i> - caminera whitetail, Pacific doves)</p> <p>For amphibians were found frog species threatened by hunting pressure that is exerted on them to commercialize them; others are dependent on habitats with certain structural complexity. In reptiles it was noted that in general are persecuted by the fear of their bite. In the study area in fact there have been several ophiADIn accidents.</p>
Description of the effect	With the removal of vegetation and bare soil will affect sites of food, shelter and wildlife breeding, forcing their displacement. Very likely the death of individuals will be produced by the same coverage clearance and because the increase of hunting activity during the displacement. The bare soil, the surface excavations

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	<p>and the provision of excess excavation supplies, can affect mammal burrows and positions sites of amphibians.</p> <p>With the transport and hauling it scares off wildlife and can originate collisions.</p>		
Location	<p>The impact is located mainly in the areas that the forest coverage is removed, including open forest, high secondary vegetation and the dense forest of guadua. In these sites are located fauna species that show little adaptation to open areas and with lower response to anthropogenic activities.</p>		
Conditions with project	<p>For the construction of the project, is it required to remove vegetation covering and make bare soil, in addition to surface excavations and depositing the removed soil. These activities affect shelter areas, food and reproduction.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	-	<p>The lost of fauna individuals will affect the size of the populations, reducing its capacity to respond to anthropogenic events, natural random and unpredictable processes.</p> <p>Offsets can affect the load capacity in the sites to which are directed the displaced individuals, in addition they are exposed during the movement to the action of predators, given that in the study area, the patches of woodland are on an array of grasses.</p>
Presence	Some	1	<p>The death and displacement of fauna is presented as a result of the activities of the project related with removal of vegetation and soil movement. These activities have to be made for the construction of surface facilities.</p>
Duration	Short	0.39	<p>The effect manifests itself primarily during the construction phase of the project, which will begin with the removal of vegetation and earth movements.</p>
Evolution	Slow	0.39	<p>The effect will be manifested throughout the construction period</p>
Magnitude	High	0.80	<p>Because of the risk to affect these species with the displacement, the death of individuals, species that are endangered, precisely by the small size of their populations.</p>

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Rating of environmental importance	3.4 - Moderate
Indicator:	Presence of individuals in dead animals Presence of individuals in species dependent on forest in open areas
Environmental Management Plan that addresses the impact	Management of vegetation covering and bare soil. Compensation for affectation of forest coverage Study of terrestrial vertebrate fauna

5.3.2.4 Pressure Increase on natural resources

Table	11
Environment Biotic	Component: Terrestrial Ecosystems
Stage:	Construction Operation
Activity (s)	Previous activities (topography) Construction of access
Conditions without project	<p>In the study area, especially in the low part of the San Matias basin in its confluence with the Cocorná River, is traditional the extraction of commercial wood.</p> <p>The hunting is presented in a smaller proportion and its aimed primarily at the capture of some birds species to feed: Woodcocks Tinamus, <i>Crypturelus soui</i> (La Llorona), turtledoves or pigeons, mainly the <i>Leptotila verreauxi</i> (caminera whitetail, Pacific doves)</p>
Description of the effect	<p>With the opening of roads increases the pressure on the flora resources , because access facilitates its extraction.</p> <p>It is likely that there is an increase in hunting with the presence of topography commissions and the linking of labor to the project.</p> <p>The improvement in the access encourages the opening of new areas for the establishment of pasture and crop.</p>
Location	<p>The impact occurs in the forest areas adjacent to the roads that are built for collection and power house.</p> <p>It is expected that its demonstration would be better in the power house sector that has recently been subject of timber extraction.</p>

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<p>Conditions with project</p>	<p>For access to the power house and collection it is necessary the construction of roads that pass through open forest areas and high secondary vegetation in which are timber species: <i>Heliocarpus americanus</i> (white balsum), <i>Cinnamomum triplinerve</i> (Laurel Perillo), <i>Nectandra</i> spp., <i>Jacaranda copaia</i> (Chingale), Aniba cf. <i>Muca</i> (Laurel inciden), <i>Ficus popayanensis</i> (salary), in addition to other with various uses in the area as the palma <i>Euterpe precatória</i> (Palm-kernel oil). All of these species have been subject to pressure and very surely with the roads it will increase its extraction.</p>		
<p>Criteria</p>	<p>Rating</p>	<p>Cj</p>	<p>Justification</p>
<p>Class</p>	<p>Negative</p>	<p>-</p>	<p>The pressure on the resources affects flora and fauna of the area biodiversity.</p>
<p>Presence</p>	<p>True</p>	<p>1</p>	<p>In the area of study the activity of timber extraction from various species and the use of Euterpe are traditional. Most preserved areas are located in difficult access areas. With the opening of roads these accesses will improve and facilitate the extraction of timber and non-timber products.</p>
<p>Duration</p>	<p>Long</p>	<p>0.99</p>	<p>Timber extraction begins with the construction of roads and can be continued on a smaller scale, during the operation of the project by the availability of access. It is likely that in some sectors there is pressure on the resource for expanding the agricultural frontiers.</p>
<p>Evolution</p>	<p>Rapid</p>	<p>0.75</p>	<p>The extraction of timber species is performed on a larger scale once the roads of the project are build, which will be delayed. In operation it can continue with less intensity.</p>
<p>Magnitude</p>	<p>High</p>	<p>0.70</p>	<p>With the extraction of individual timber species it is affected the structure and composition of the forest coverage. The area that is directly affected by the facilities of the project may be extended significantly.</p>
<p>Rating of environmental importance</p>	<p>6.65 - Relevant</p>		
<p>Indicator:</p>	<p>Reports of timber extraction</p>		

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	Hunting Reports Expansion of areas for confirmation of pasture land and/or crops
Environmental Management Plan that addresses the impact	Management of vegetation covering and bare soil. Compensation for affectation of forest coverage Environmental education Project Institutional Coordination

5.3.2.5 Changes in the San Matias River Ichthyic community

Table	12
Environment Biotic	Component: Aquatic ecosystem
Stage:	Operation
Activity (s)	Operation of the central plant
Conditions without project	<p>For Fish were recorded 15 individuals grouped in five species: <i>Astroblepus homodon</i> (capitancito), <i>Hemibricon boquiae</i> (sardine), <i>Trichomycterus caliense</i> (briola), <i>Chaetostoma leucomelas</i> (Cucho) and <i>Cordylancistrus</i> sp (Cucho) .</p> <p>The greatest abundance in number of individuals is presented in the Siluriformes (80.0 %), while the Characiformes presented a very low abundance. Biomass for the two collected orders presented the same behavior finding a greater contribution to the Siluriformes (63.0 %)</p> <p>The results both in number of individuals as in biomass keep the trends of the Neotropics ecosystems , which present a high abundance of these two fish orders, while others are little abundant (Lowe-Mc Connell 1987). The family with the highest number of individuals in the collections were Astroblepidae with seven individuals, followed by Loricariidae and Characidae with three individuals each, while for the family Trichomycteridae only two individuals were collected.</p> <p>The number of species found is low (5) and none of these have been reported as migratory. The low species richness is a behavior that often occurs in this kind of environments, high mountain ecosystems, in which the strong flows, the steeped topographies, and the shortage of indigenous food supply are some of the main factors that determine the low diversity.</p>
Description of the effect	<p>In the area of flow decrease some individuals may be trapped in residual pools.</p> <p>It can show niches Isolation, which would result in the death of the individuals</p>

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Location	Between collection and discharge, section in which the flow decreases		
Conditions with project	The diminishing of the flow will interrupt the continuity of the flow, in which the organic derived will be affected. In addition, it decreases the wet perimeter that is reflected in the habitat reduction of crowding population, increase in surface area lateral to the solar heating with heat transfer to the column of water, and reduction of oxygen solubility, decrease in height of the water column (increase light penetration and ficobenthic productivity), reduction of competition (increase in the rate of clogging and compaction of the bed, reduction of the flabbiness and mobility of the substrate), and increase in hydraulic retention ponds, all of which is reflected in the survival of the fish.		
Criteria	Rating	Cj	Justification
Class	Negative	-	With the decrease of the flow it affects the available habitat for fish, affecting the abundance of individuals of the species that make up the fish community in the concerned tranches
Presence	Likely	0.69	For the study area the largest number of species is reported in the discharge zone, followed by the middle and finally collection. The number of species and their spatial distribution in the three stages evaluated is the result of the ecophysiological characteristics (adaptive) of each one of them, in relation to the presence of habitat types. The apparent absence of species in all the stages, is due to the limitation imposed by restrictions (high flow rates, high sediment loads, frequent avalanches), of the hydrological time sampling, joined to the natural restrictions of the sector, areas of jets and presence of jumps of great height, which are an insuperable barrier for many species. Under these conditions, taking into account that the knowledge about the found species ecology does not allow making inferences about its capacity to adapt, it is considered likely that the impact will be present.
Duration	Very long	1	The effect lasts while operating the central Plant
Evolution	Slow	0.39	It is expected that the change in the fishing communities reaches its maximum expression from the second year of

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			operation, time which during they may or may not have been given the adaptations to the new conditions of flow.
Magnitude	High	0.9	If the species do not manage to adapt to the new conditions of reduced flow, changes in population size and composition of the communities can be significant.
Rating of environmental importance	Value: - 5,7 Significant		
Indicator:	Species richness Diversity of the association Abundance and biomass		
Environmental Management Plan that addresses the impact	Research Project. Strategy management of aquatic ecosystems Establishment of the ecological flow		

5.3.2.6 Changes in the structure of the aquatic biotope and biocenosis

Table	13
Environment: Biotic	Component: Aquatic ecosystem
Stage:	Operation
Activity (s)	Operation of the central plant
Conditions without project	<p>The area of interest for the assessments of the limnological sector PCH Molinos on the San Matias River is located between the altitudes 1290 and 790 MASL. The collection area presents a stretch with a low slope (1 %), in an area with slopes in high stubble and fields. The channel presents large stones ($\varnothing \approx 1.0$ m), pools and puddles of 3 - 10m in length and 0.4 - 2.0 m depth. The middle part shows an average gradient (6 - 15 %), has a high frequency of rapids with pools and short vertical jumps of 1 - 5m; slopes covered with pastures used for cattle raising, sugarcane and pockets of secondary forests in the rugged shores. In the discharge with a gradient of 2 %, in an area with slopes covered in stubble under fields for cattle raising, the channel presents rocks, large stones ($\varnothing \approx 2.0$ m), pools and puddles of 1 - 6m in length and 0.3 - 2.0 m in depth, with bed slabs of rock, gravel, pebbles and sand.</p> <p>With regard to the biocenosis the field samples indicate:</p>

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	<ul style="list-style-type: none"> - Benthic Microalgae: 29 taxon of five algal divisions, distributed as follows: 15 Chrysophyta, eight of Cyanophyta, three of Chlorophyta, two of Euglenophyta and one of Cryptophyta. The greatest numerical wealth (27 taxa) and individuals density of (29265/cm²) was registered in the section of collection, where the genera Lyngbya and Fragillaria, which correspond to filamentous forms, were dominant. In the middle stretch only 12 taxon were recorded. - Aquatic Macro-invertebrates: 33 taxon were recorded (21 families and eight orders) for the three stages evaluated, and a collected total of 1901 individuals. <i>Camelobaetidius</i> (Baetidae: Ephemeroptera) was the most abundant taxon, representing 69.5 %, accompanied by <i>Baetodes</i> (10.3 %) and Glossosomatidae sd (Trichoptera) (6 %). - Ichthyofauna: were registered 15 individuals grouped in five species: <i>Astroblepus homodon</i> (capitancito), <i>Hemibricon boquiae</i> (sardine), <i>Trichomycterus caliense</i> (briola), <i>Chaetostoma leucomelas</i> (Cucho) and <i>Cordylancistrys</i> sp (Cucho) . 		
<p>Description of the effect</p>	<p>With the flow reduction it will change the environmental conditions of the habitats in the stretch between collection and power house, which will impact the structure of the aquatic biota.</p> <p>Changes in habitat conditions are reflected in changes of the substrate, water depth, current speed and complexity of the space-time physical habitat.</p>		
<p>Location</p>	<p>Stretch between collection and houses of engines</p>		
<p>Conditions with project</p>	<p>When operating the central plant it will affect the conditions of the riparian habitat especially the ones submerged or half submerged. Rheologic Change in the habitat, which are rocks that present surfaces directly exposed to the hydraulic stress (and generate hydraulic shadows) and columns of the section continuously exposed to current flow, which are utilized by torrenticolas species (benthic microalgae, macro phytes, macro invertebrates).</p>		
<p>Criteria</p>	<p>Rating</p>	<p>Cj</p>	<p>Justification</p>
<p>Class</p>	<p>Negative</p>	<p>-</p>	<p>Changes in habitat affect the resources for aquatic biota</p>
<p>Presence</p>	<p>Very likely</p>	<p>0.95</p>	<p>Changes in moisture conditions of the substrate, in addition to brightness, will affect the populations of the benthic micro algae, focusing on the macro invertebrates that depend of them.</p>
<p>Duration</p>	<p>Very long</p>	<p>1</p>	<p>The modification is presented during the operation of the</p>

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			project
Evolution	Medium	0.4	Although the effect is presented from the start of the operation, the maximum changes are expected to be given after one year of operation
Magnitude	High	0.70	Changes to the physical characteristics of the habitat in the stretch between collection and power house may be significant, affecting in a relevant manner the composition of benthic communities and of the macro invertebrates.
Rating of environmental importance	4.7 - Moderate		
Indicator:	Density and wealth		
Environmental Management Plan that addresses the impact	Research Project: Management strategy of aquatic ecosystems Establishment of the ecological flow		

5.3.3 Socio-economic environment

5.3.3.1 Changes in governance levels

Table	14
Environment: Socioeconomic	Component: Political-organizational
Stage:	Construction, operation.
Activity (s)	Hiring of labor Land Purchase Operation of the project
Conditions without project	<p>a Unlike many other sub regions of the department of Antioquia and the country, Eastern Antioquia has counted with the presence of various institutions of national and departmental order. It has been reducing the support and accompaniment in the local management, mainly from the departmental government, beginning the process of administrative decentralization,</p> <p>In the local order, from the moment that the municipalities are beginning to assume the decentralization, it takes place the creation and consolidation of sector organizations, with advances in the inter -institutional articulations of strategies</p>

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	<p>with the communities.</p> <p>At the present time there is a greater closeness of the administrative entities among themselves and with the communities, outside of the traditional relations political - bipartidism. The previous statement does not mean, however, that has been abandoned neither the practice of political patronage and sponsorship to political organizations, nor that they will put aside the search to defend its actions in the traditional bipartisanship.</p> <p>Compared to the credibility of institutions and the image that these project, perceptions vary from one municipality to another, as well as between different entities, whether these are on the local order, national or departmental. This situation depends largely on the degree of commitment, performance, and continuity of the person in charge.</p> <p>The growth of the electoral abstention in the past periods of popular election⁵, allows inferring some sort of discredit of the democratic institutions. However large part of this abstention was due to the repression of the armed conflict. In addition, there are sectors of the population who refuse to participate in the processes of popular elections, as there still is the association of the practice with political corruption. Even middle population sectors (professionals), are inhibited from taking part in the public administrations for fear of being involved in such practices.</p> <p>In this sense it must be noted however, while during the conflict in Cocorná and Granada began to take place a series of atypical periods in which the two traditional groups in power agreed to launch in each election a single candidate, looking to ensure that there was no opposition whatsoever and in this way not affecting the public order, when these periods ended and the elections regularized, then took place a reactivation of the traditional electoral confrontation.</p>
<p>Description of the effect</p>	<p>Governance has to do with the existing conditions for the exercise of government in a particular place, in relation to the demands of the citizens. Likewise, with the criteria of political representation, the levels of political participation, the existing systems of political parties and with the regulation of relations between the legislative and executive branches.⁶</p>

⁵The percentage of voter turnout for the first popular period was 31 %, for a third of 50% and for the next period of 69 %, (ESAP, 1999).

⁶Alcántara, M.: *Governance, crisis and change* , Center for Constitutional Studies, Madrid, 1994.



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	<p>In this case, the impact "Changes in the governance levels " is directly linked to some particular situation in the municipalities in the influence area: A long tradition of participation and community management, as well as in other regions of the country, should comply and accommodate their projects and interests to the interests of the municipal government, as well as the different governmental and non-governmental entities that invest in the region communities. However the community organizations: assemblies of communal Action, Parents' Associations, Productive Partnerships, were torn apart during the last decade by the wave of violence that lived the Eastern Antioquia, forcing the inhabitants of the direct influence area (ADI) to abandon the vereda, victims of the armed movement.</p> <p>This impact also relates to a system of government that has been characterized by the customary dispute of power, between political branches belonging to or coming from the same traditional political party, the conservative party, and with a administration subject to a limited municipal budget, whose scope and destination have little impact on the resolution of problems related to the rate of unmet basic needs.</p> <p>As soon as the agreement and implementation of management measures, also when the project begins to generate transfers, it is very possibly the enhance of conflicts of interest at the political level and stimulation of the opportunism in the municipality, as well as the distribution of political quotes to a level of both, the Boards of Communal Action, as the Council and the Municipal Administration.</p>
Location	<p>The El Molino hydroelectric project includes in its direct influence area the header sites of the municipalities of Cocorná and Granada, as well as veredas , of San Juan, El Chocó, El Molino, Campo Alegre, Los mangos, La Inmaculada and San Lorenzo in the municipality of Cocorná; as well as Quebradona Abajo and Las Faldas in the municipality of Granada.</p>
Conditions with project	<p>Being the project in operation, the generated transfers will go to increase considerably the public budget, taking into account that both municipalities are of sixth category. The proper management of the relationship between the company and the communities, and the proper implementation of a fully concerted, Management Plan will contribute to the strengthening of the same around some common purposes, as well as to the improvement of the relationship between the community-based organizations and the administration, to be the later on involved in the processes inherent to the management plan and the social responsibility projects, to the extent that these get developed.</p>

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On the other hand the company, due to the impulse that its presence can give to the municipal development and to the finances, it will have a strong influence on the administrations of Cocorná and Granada; equally and in the same direction, it will constantly be required by the demands of the communities, which by their condition of vulnerability, still composed largely by displaced people of the return process, they can see the company as a replacement of the state.

Then it is very probable, that with the implementation of this project, a positive change in the current governance levels can be given, now that that the community has to be informed, consulted and involved in the development of the facilities and the changes that this implies for the territory. In the same way, the municipal administration shall receive resources that must be invested in the stated municipal development plan, with priority for projects of basic sanitation and environmental improvement, as stipulated in article 45 of Law 99 of 1993, transfers law.

Criteria	Rating	Cj	Justification
Class	Positive	(+)	The implementation of a management plan concerted with the communities will strengthen the organizational capacity of the same and its relationship with the municipal administration; positively affecting the levels of governance of the municipalities.
Presence	Very likely	0.99	The transfers contribution, the management plans and projects for corporate social responsibility, these last ones on a voluntary basis, will award the company some level of participation in the municipalities public affairs. On the other hand, the development of management plans, as well as the insertion of the communities in the development of the project, will encourage the strengthening of the community organizational processes.
Duration	Very long	0.99	The capacity that the communities develop to organize themselves, as well as the possibility of concerting spaces with local administrations and with the company to discuss the implementation of programs and projects that will redound around the communitarian benefit, will last in time, at least as long as the project is in operation, and as



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			long as there are opportunities of participation in which the presence to the company and the communities is evident.
Evolution	Medium	0.69	The stimulus that the company can give to the area at the entrance level, regarding the implementation of organizational processes between the communities of the direct influence area, will be significant but gradual, and it will depend on a consultation process that takes time, but looking to get results in the short and medium term.
Magnitude	Medium	0.69	The settled communities in the direct influence area, even if they are just beginning to return, have already well-based instituted organizations, as well as community projects, in part due to the help they have received by agencies by both national and international entities; as well as by their apparent ability of resilience. The project then, rather than contribute to the transformation of a state of things, it can contribute to enhance organizational dynamics already present in a receptive environment. The magnitude that these processes can achieve will be reduced, however, to the dimensions that allow the inherent conflicts of interest to the close involvement of the members of this type of organizations in the scenarios of local politics.
Rating of environmental importance	6.2 - Significant or relevant.		
Indicator:	<ul style="list-style-type: none"> • Organizations or associations that are generated with the Project/Number of existing organizations or associations without the project. • Number of projects in which the community participates with Project/Number of projects in which the community participates without Project. • Number of alliances or conventions deployed between the municipal administration, communities and project owner to be articulated to the measures set forward by the Institutional Strengthening Program. 		

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Environmental Management Plan that addresses the impact	Program Information and Community Participation. Institutional strengthening Program
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5.3.3.2 Effects on the cultural heritage

Table	15
Environment: Socioeconomic	Component: Cultural
Stage:	Construction
Activity (s)	Land Purchase Hiring of labor Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Transport and hauling Operation of grinding and mixtures plants Concrete pouring Construction and operation of camps and workshops
Conditions without project	<p>Without doubt, the cultural references, support of the cultural system of the population of the vereda, that make up the influence area, are based on inherent aspects in the culture of Antioquia, such as food, shelter, economic activities, the parties and religious elements crossed by a very particular conception of work and productivity of the Antioquia peasant. Another element that adds value to the identity of the people in the area, is the family as integrating axis and carrier of identity.</p> <p>Likewise, patterns, symbols, practices and cultural references, are collective expressions rooted in memory, in the collective unconscious and reflect the aesthetic, ethical, or spiritual values, that are converted into intangible and tangible heritage of the same communities and distinguish these from other populations of the department and from the country.</p>
Description of the effect	Usually when a hydroelectric project is implemented in a given area, people from other different locations come to work or to provide their services; this fact can lead to a transformation in the cultural system of the traditional inhabitants in the area

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	<p>where the project would be stationed (practices, traditions, vision of the world, customs, values, knowledge, consumption patterns, beliefs, etc.), and which are a part of the tangible or intangible cultural heritage of this population, as a result of the inter cultural relations and transformations of the environment introduced by the work activities. These processes can be evident in the social changes (increasing of issues such as drug abuse, prostitution, single motherhood, and teen pregnancy, among others), change of traditional values and the consequent reinterpretation of tradition, as foreign cultural models. Changes in the levels of consumption, economic and productive cycles .</p> <p>In summary, a good part of practices, and symbolic and territorial pattern referents, the particular appropriation of natural resources, values, the landscape as a whole, could be affected by the construction of some of the facilities of the small Hydroelectric Central El Molino.</p>
<p>Location</p>	<p>The possible affectation of the cultural heritage (tangible and intangible) could manifest itself in the communities of the veredas of direct influence area of the project: veredas Los Mangos, Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada and San Lorenzo of the municipality of Cocorná and veredas Las Faldas and Quebradona Abajo of the municipality of Granada. On the vereda, Los mangos there will be placed deposits SM2, SM3 and SM4, the power house, the house of valves to the substation, and it will be crossed by a stretch of the house of valves and the road to the power house.</p> <p>In the veredas Chocó and San Juan there will be no location of facilities, but the existing road will be used, now that that crosses these veredas as access road to the project, similar situation to the one in the village of San Lorenzo. Vereda, Campo Alegre will be crossed by a road that leads to the house valves. On the vereda El Molino deposits 1, 2, 3 and 5 will be located same as the road that leads to collection. In the vereda, Quebradona Abajo and Las Faldas facilities will not be placed but in the first there may be effects at the levels of the built territoriality by its people through time, as the site of collection is located near to a few sites that have been traditionally used as natural bathing sites by owners and visitors.</p>
<p>Conditions with project</p>	<p>To run the project it is necessary to recruit skilled and unskilled labor; usually for the recruit skilled and unskilled labor, is hired local labor because it does not exist a supply of skilled labor in the area to perform tasks that require a specialized technical knowledge, outside labor is recruited, it is usual that this population get</p>

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settled in areas adjacent to where the project's main facilities will be build, for reasons of accessibility, economics and time. In addition new population will arrive to offer services and establish business or trading in the area.

The presence of the new population, with different customs and habits from the existing among the populations of the villages in the influence area, it is possible the adoption of other customs and habits among the local population. It is plausible that among these people expectations will be directed to different lifestyles, different patterns of consumption and new social habits not in line with the context.

Also the practice of new trades and occupations different to the traditional economic activity, where there is a dependency on a crop or a daily wage compared to the regularity of a fixed salary raises new forms of relationship and economic purchasing power that could generate a change of vocation with the abandonment of the traditional activity.

Between the affectations and changes that may occur, is possible to find evidence on the transformation in cultural patterns, preferences toward certain consumer goods, changes in family structure accompanied by the single motherhood or teenage pregnancy, increase of the consumption of psychoactive substances, increased domestic violence, an increase of the consumption of liquor and growth of prostitution.

Also, in the construction of some of the project facilities, it is likely to affect elements of the tangible cultural heritage as stretches of ancient roads, especially on the vereda, where facilities will be located or roads will be constructed.

Criteria	Rating	Cj	Justification
Class	Negative	(-,N)	This impact is negative, since the arrival of new population to the area, can bring changes on processes of cultural patterns, loss of values and traditions and adoption of customs and habits of consumption not consistent with the usual dynamics in the territory.
Presence	Very likely	0.8	This effect takes place as a direct result of the construction of the project by the influence of new population in the area by the "natural" predisposition of human beings to accept some changes, and in this case, of the inhabitants of the vereda, to adopt ways of life

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			different from their own, which may be attractive, precisely by the novelty of it.
Duration	Very long or permanent	1	Even after the construction of the project is finished, the effects that have been caused among the local population and their customs, traditions and habits in general in the interaction with elements of the ecological environment will remain in the surroundings for a long time, being difficult for the processed elements return to their initial condition.
Evolution	Medium	0.5	By the dynamics of the development of this type of project and the estimated time for the facilities construction, it is likely that between a year or two new practices, habits, patterns of consumption will be adopted, with the resulting transformation of the elements that make part of the tangible and intangible cultural heritage of the local population, as a product of the interaction with the people that arrive to work.
Magnitude	Medium	0.5	It is possible that some elements that are part of practices, traditions and values incorporate elements of change will be transformed completely by the relationships and influence of the outsider population; as well as elements of the territory that represent values and symbolic relating for the local population could be changed completely as a result of the facilities.
Rating of environmental importance	3.8 - Moderate		
Indicator:	<p>Changes in values, traditional references, a traditional activity and cultural patterns by other newly evidenced.</p> <p>Manifested changes in consumption patterns, .</p> <p>Affectations of collective infrastructure, environment, and landscape in general, that are registered.</p>		
Environmental Management Plan that addresses the impact	<p>Program information and community involvement</p> <p>Memory program and cultural heritage</p> <p>Environmental education program for workers and the community</p>		

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5.3.3.3 Empowerment of conflicts

Table	16
Environment Socioeconomic	Component: Political-administrative
Stage:	Stage of construction, Operative Phase of the project.
Activity (s)	Land Purchase Hiring of labor Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Transport and hauling Operation of the central plant.
Conditions without project	<p>a</p> <p>The armed conflict in eastern Antioquia, which confronted the guerrilla and paramilitary groups, the police and the national army, in the late nineties and well into the decade of 2000, has its origins in the positioning of the paramilitary groups of the middle Magdalena, and the emergence of structure of the guerrilla (specifically the ELN) during the late seventies and early eighties in eastern Antioquia.</p> <p>The structure of Ramon Isaza alias "the old man" and his family, extended over the years throughout the eastern Antioquia, emerged in the seventies in Puerto Triunfo in the form of peasant self-defense forces, and slowly positioned in different municipalities, up to Sonson.</p> <p>In the nineties arrived to the sub region, the "Metro Block", which divided up the territory with the Isaza clan, defining as a divisor line the same Medellin-Bogota highway. But around the year 2003 they were cornered by the small narco-army of Diego Fernando Murillo alias "Don Berna" and four other paramilitary factions.</p> <p>In the mid-nineties, also arrived to make military presence in the region two structures of the FARC, in both the highway and toward the interior of the municipalities. These were the front 9, which moved between Sonson and Abejorraly and front 47 with a strong presence in San Carlos. Toward the beginning of the decade," says the foundation Asovida of Granada - "The ELN had 80% o control over the municipality and 20% the FARC, by the end of the decade,</p>

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the FARC had already 80% and the ELN 20% ⁷.

"The war", as they call it in the middle of Antioquia, can be understood as a period during which several armed groups or factions positioned themselves fighting for territory control in a specific time period. An episode of the regional history of the conflict, in which by means of constant violations to life integrity of the civilian population, fragmenting the social dynamics, trade, labor, transportation and social services, ending in the partial displacement of both municipalities: Cocorná and Granada.

These municipalities, as well as almost the entire Eastern Antioquia, lived an intensification of the conflict during the years 2000-2001; and then a step backwards approximately toward the year 2006 ,after the demobilization of the Uribe government reconfigures the power at the interior of the drug-terrorism world in the country, leading to various factions in conflict to retreat.

When the army began to attack, in a frontal manner, the active guerrilla fronts assets in the sub region, these retreated to protect their redoubts, corridors in the mountains and their coca crops, intensifying the mining of houses, land, and roads. Today, there is registration of several accidents of MAP and MUSE in vereda, La Inmaculada, Los mangos, Campo Alegre, El Molino and San Lorenzo in Cocorná, as well as Las Faldas and La Arenosa in Granada⁸.

Currently, the local politics of both municipalities is framed in a post-conflict scenario; the demobilization of paramilitary structures during the government of Uribe and the deportation of the paramilitary leaders to the US, specifically "Don Berna" (commander of the Block Cacique Nutivara); "El Viejo" (Old man) (Commander of the united paramilitary force of the middle Magdalena), the military defeat of the guerrilla, left the vereda semi abandoned.

The military control deployed by outlaw groups diminished considerably, although new structures are emerging.

In the veredas, the presence of "Social Action" has become a constant, with projects such as "Returning is to live", which guarantees since 2011, to those inhabitants of the region that possess a letter of displacement, receive certain state aid.

⁸Acquired testimonies among the inhabitants of the vereda, included in the aid of the El Molino hydroelectric project during the field work.

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<p>Description of the effect</p>	<p>The relationship between the administration and the municipal council, between this and the Communal Action Assemblies; between the exercise and the projects developed by each community; between the development of the local, regional and national elections in the veredas, and its reflection in the vote. These are aspects directly relevant to the exercise of community leaders, and their relation with the public. It depends on it if their requests are or are not attended by municipal administrations.</p> <p>Relations are transformed and updated at the pace of articulation of all the interests of all social actors involved, around the arrival of a new actor, developer of infrastructure projects, in a post-conflict situation.</p> <p>The arrival of a new actor is associated with the increasing of availability of resources, which leads to changes in social and political relations of the population of the project influence area.</p> <p>In addition, the arrival of workers⁹, as well as the flow of floating population in search of employment and the increase in the supply of commercial services, involves the insertion of newcomers to the everyday life of the village and its inhabitants, and taking into account the extreme situation of violence to which to communities Cocorná and Granada were subjected, it is expected conflicts with the inhabitants of the influence area, by the deep psychological and emotional consequences that were generated during the conflict</p> <p>In addition the needs of development for a project of this type (land, demand for goods and services), can produce friction in the daily order. In fact, a concern that comes up repeatedly in the meetings with the people from the vereda, is precisely the security and public order.</p>
<p>Location</p>	<p>The communities of the influence area of the El Molino hydroelectric project are located along the watershed of the rivers Cocorná and San Matias, and occupy a territory shared by 9 veredas, two are part of Grenada, Quebradona Baja and Las Faldas; the other seven are part of Cocorná, that is to say San Lorenzo, La Inmaculada, San Juan, El Chocó, El Molino, Campo Alegre and Los Mangos. These veredas, are generally inhabited by a majority of the displaced population in a return situation, a minority composed of those who stayed in the middle of the war and a growing number of children under 10 years old.</p>

⁹The project El Molino requires 270 workers, 130 of them unskilled

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<p>Conditions with project</p>	<p>In the influence area of the project, there is a great variety and number of actors with presence in both municipalities, which can be reflected in a complex relationship among, and they and the communities.</p> <p>The entry of a new actor, in this case, a developer of hydroelectric power projects, will have an impact on the socio-economic dynamics in both the municipal level and veredas of the influence area of the project, where they may affect roads, the employment and even some of the housing structures, in addition it will increase the public budgets, becoming at the end one more element in the dispute over the political power that has been held for long time, the factions from the traditional conservatism of Antioquia, taking turns for the public offices in both Cocorná and Granada, as in the departmental government.</p> <p>In addition, the negative perception that some sectors have on the development of the hydroelectric project, can degenerate into tighter relationships with communities and groups that exist in the sub region.</p>		
<p>Criteria</p>	<p>Rating</p>	<p>Cj</p>	<p>Justification</p>
<p>Class</p>	<p>Negative</p>	<p>(-N)</p>	<p>The arrival of the company to the region implies an increase in transfers to the municipalities in the influence area, investment in environmental management plans and the deployment of a series of social responsibility policies, in addition to the generation of a significant number of transitional jobs, both skilled and unskilled. But behind this new income of capital, the boost to employment and trade, there is also a series of political and economic powers that can search for the greatest possible control and influence, with electoral purposes and for personal gain, resulting in the proliferation of behaviors associated with the patronage and corruption. At the same time, this can attract illegal groups and even stimulate the resurgence of displacement episodes.</p>
<p>Presence</p>	<p>Likely</p>	<p>0.69</p>	<p>Some activities for the project construction, such as the land purchase the arrival of floating population and workers during the construction period, the increase in transfers to municipalities, the increase in demand for goods and services, can generate conflict, in addition it is</p>

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			<p>the ideal setting for both the emergence of practices related to the lobbying and corruption, as for the reactivation of strategies of territorial control by the groups outside of the law.</p> <p>The emergence of friction between the company or its employees and the communities, in the context of the development of everyday life, is a source of conflict almost inevitable, but reducible, if these are channeled properly.</p>
Duration	Very long	1	The project will have a presence of at least 50 years in the area, the same that the transfers and the occupation of the channel.
Evolution	Slow	0.2	This effect can reach its peak, after more than one year of the project being in the area.
Magnitude	Medium	0.5	The environmental factors analyzed, meaning, the social structure of relations and the structure of the local power, have the quality to adapt and accommodate themselves in a manner they can integrate the introduced factor, that is to say, the project. The presence of conflict will be regulated as the company implements mechanisms for channeling the same and that the actors involved assume a position which will allow them to live with the project.
Rating of environmental importance	2.6 - Moderate		
Indicator:	<ul style="list-style-type: none"> • Complaints submitted by the community. • Increase in the number of armed actions, reports of the presence of armed groups in the area. • Public demonstrations against the project. • Increase in the rates of alcoholism and drug addiction. • Increase in the rate of unwanted pregnancies and teenage pregnancies. 		
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> • PIPC. • Environmental education program to workers and the community. • Program of labor recruitment. 		



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- Restitution Program of affected infrastructure
- Institutional strengthening program.

5.3.3.4 Displacement of infrastructure and housing

Table	17
Environment: Socioeconomic	Component: Economic
Stage:	Construction.
Activity (s)	Land Purchase
Conditions without project	<p>The vereda, Los Mangos is inhabited by 13 family nucleus, almost all, if not all, relatives. In total there are around 7 people. In the vereda lives the Aristizabal family, which occupies a lawn with three homes. These are of Manuel Tiberius Giraldo Gómez, his brother Miguel Angel and his son Evelio Giraldo Aristizabal.</p> <p>The first is a house built in clay, about 45 years old, associated with a sugarcane compound. The house of don Miguel Angel is built in brick, the roof is made of tile and cement floor; the structure is about 100 years old, and is usually found in poor condition and the floor has cracks. The housing of Evelio of Jesus Giraldo Aristizabal is built in brick, the roof is made of zinc and cement floor; both have cracks on the floors and walls, and while it has electrical energy, the connection is illegal.</p>
Description of the effect	<p>At least with respect to the first two houses, this impact does not generate a break with the inhabited environment. In any case it generates tensions within the family nucleus, by the attachment to the houses and the inherent nuisances in the transfer itself; however, it can also be the opportunity to improve the living conditions of families. In any case, it depends on the type of relocation chosen by families within the framework of the relocation program for families, projecting which can be the effect of the impact on themselves. But the main effect, in case of their choice being relocated or moved to another part, it has to do with the breakdown of relationships and social ties with the neighbors, family, high school or school in the case of young people, the productive activities and community activities, and so on.</p>
Location	The three homes that are going to be moved because of the construction of the

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	project are located in the vereda, Los Mangos, to the southeast of the municipality of Cocorná and close to the occidental shore of San Matias River ¹⁰ .		
Conditions with project	<p>The three homes in the Zuluaga family will be relocated in a home with the same or better features than the old one and in the place chosen by them, or one with similar characteristics to the previously occupied.</p> <p>The families of don Manuel Tiberius and don Miguel Ángel expressed in both cases their desire to be relocated in the same venue; on the other housing there was no response because the head of the household was absent and the topic must be discussed with him.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	(-)	Although the relocation is a negative impact, as it is not voluntary, it can be said that this activity can be beneficial for the three families, due to the poor state of the housing, which will be an improvement in terms of infrastructure; even more if their owners request being transferred within the same premises, as is the case of two of the houses.
Presence	Some	1	Due to the design of the facilities, it is necessary to relocate three homes.
Duration	Very long or permanent	1	The displacement of housing is definitive in any case.
Evolution	Medium	0.6	The process of displacement and consequent relocation must be performed between one and two years
Magnitude	Very low	0.19	The impact affects only three of the 26 families that are distributed between the two vereda. The percentage is still far lower if it is taken into account the total population affected by the project.
Rating of environmental importance	3.8 - Moderate		
Indicator:	<p>Number of resettled families / Number of families to resettle.</p> <p>Satisfaction of the resettled families</p>		
Environmental Management Plan that	<p>PIPC</p> <p>Relocation Program for infrastructure and housing.</p>		

¹⁰The coordinates of the houses to relocate are in the impact : affectation in the of commercial activities.

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addresses the impact	Restitution Program of affected infrastructure
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5.3.3.5 Changes in population dynamics

Table	18
Environment: Socioeconomic	Component: Demographic
Stage:	Construction
Activity (s)	Land Purchase Hiring of labor Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Transport and hauling Operation of grinding and mixture plants Concrete pouring Construction and operation of camps and workshops
Conditions without project	<p>a</p> <p>In the municipality of Granada is evident the aftermath of the armed conflict, which is reflected in the decrease of the population. According to data of the Development Plan of the Municipality, 2008-2011, "it is estimated that <i>in the years of the conflict, the population decreased by 64% and that in Granada now are only living 9,800 inhabitants. Granada has a birth rate of 13.69 per 1,000 inhabitants and the mortality rate for 2003 was 10.73 per 1,000 inhabitants however for the past three years this rate is lower due to the municipality breathes an atmosphere of tranquility, improving</i> " .</p> <p>On the other hand, according to data from the Statistical Yearbook of Antioquia, 2009, the intercensal growth rate of Cocorná and Granada between the period 1993 and 2005 was -3,58 and -5,43 respectively. According to the Management Scheme of the municipality of Granada, this negative growth in the population denotes " <i>The lack of sources of employment, coffee crisis, few incentives from the Government toward the Agriculture, social phenomena such as violence, lack of education in applicable areas, outside paradigms that create false expectations especially in the young, high agricultural production costs, difficulties in marketing</i> " .</p>

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Similarly, population mobility, and the future trend of this, it can be said that is framed in a reciprocal relationship of provision and service search, because the phenomenon of urbanization of the Valle de Aburrá has expanded the radius of influence and demands of the city towards a supply of environmental services and public, as well as the exploration and exploitation of resources projected toward power generation and tourism, for example.

In addition, a fact that cannot be ignored in this context on the dynamics of mobility in the area is the armed conflict and its direct effect on the displacement of the population; this has resulted in several municipalities presenting a total decrease of the population and in the rural area in several municipalities there are evidences of a significant decrease in its population who migrated to the city as a way to safeguard life.

" In the area of reservoirs only three municipalities have a growth in its population these are Alexandria, El Penol and Guatapé, in the rest the population decreases. In this zone, the municipality which presents the greatest decrease in its population is San Carlos followed by Granada.

In the forests area is presented a slight growth in the population in the municipalities of San Francisco and San Luis, but a decrease in the municipality of Cocorná. Situation is not very clear, because this area has been hit the hardest by the violence phenomenon , which has generated forced displacement of its inhabitants ".

In the municipalities Cocorná and Granada, as in the others in the sub region, the mobility is also linked the subsistence strategies, therefore this population maintains some circuits of territoriality confined to the Highway Medellin - Bogota, as it has been stated.

On the other hand, in regard to the mobility and their motivations, according to the Bulletin DANE 2005 General Census, Profile Cocorná, Antioquia, the 31.7 % of the population of Cocorná that changed residence in the past five years did so because of threat to their life. 24,5% for family reasons, 31.7 % because of difficulty obtaining work, and 31,7% thread to their life

Similarly, with regard to the reasons of mobility of the population of the municipality of Granada, as stated in the Bulletin DANE 2005 General Census, Profile Granada, Antioquia, 36.2 % of the population of Granada that changed residence in the past five years, made it because of threat to their life. 26.6 % for

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family reasons and the 16.2 % because of difficulty in obtaining work.

In this context it is important to take into account the dynamics that are generated around the construction of infrastructure projects, since they almost always influence the transformation of the existing population density in the concerned territories . In the same way, another aspect that is important to note, are the effects caused by the armed conflict, given that in the area there have been events of forced displacement, which has influenced the population dynamics, with an additional ingredient in the present, the return process that the state promotes. In the table presented below it can be seen the population data from the vereda of the ADI.

Population by vereda,ADI

Municipality	Vereda,	Km ²	Population	Density Hab./Km ²
Cocorná	Campo Alegre	1.18	80	0.14
	The Chocó	1.64	119	72.56
	El Molino	3.06	133	43.46
	San Juan	2.20	205	93.18
	Los Mangos	2.93	65	22.18
	La Inmaculada	1.83	27	14.75
	San Lorenzo	10.31	472	22.18
Total	5	11.01 Km²	602	-----
Granada	Las Faldas	2.95	94	31.86
	Quebradona Abajo	2.10	95	45.23
Total	2	5.05 Km²	189	---
Grand Total	7	16.06 Km²	791	----

Source: Governor of Antioquia Department of administrative planning. 2007 vereda, Atlas Department of Antioquia. Second edition

Description of the effect

The expectations that are generated around the construction of the project, stimulate migration processes toward the area for the establishment of permanent or temporary population that is offered labor or that projects to provide goods and services. It is certain that this situation temporarily increases the number of inhabitants of the ADI of the project and probably at the bedside of the two municipalities and, in consequence, it becomes evident an increase of population density, and a change in the distribution of population by area, sex and age. It is

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	<p>also possible that when the construction of the project is completed some people will decide to settle down in the area.</p>		
Location	<p>The headwaters of the municipalities of Cocorná and Granada and the veredas, of the direct influence area of the project: Los Mangos, Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada and San Lorenzo of the municipality of Cocorná and vereda, Las Faldas and Quebradona Abajo of the municipality of Granada</p>		
Conditions with project	<p>With the construction of the project it is possible that a greater flow of people toward the two urban municipalities or toward the vereda of ADI, looking forward to be hired as workers or to provide services to the company and the population. This migration can affect temporarily or permanently the demographic behavior of the municipality.</p> <p>In fact, there is a great probability that with the arrival of the project, municipalities such as Granada and Cocorná change its historical behavior in terms of population dynamics and present a greater concentration of people in their urban headers. In any way, it has to be taken into account the "natural" trend to migrate of the population area and the spirit of traders that characterizes them, which drives them out to other cities in the country such as Cali, Bogota, Barranquilla in where they have relatives that have business.</p> <p>In addition, it is important to bear in mind the phenomenon of forced displacement suffered by this population between the years 2000 and 2002, as a result of armed conflict, element that adds particular characteristics to the population dynamics of the two municipalities and their veredas, because until now much of the population that was displaced is returning, a situation that propels a dynamic and evolving character to factors such as size, growth, distribution, mobility and composition of the population.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	(-,N)	<p>This impact is negative because the different effects that originate from the arrival of more population to the area have an impact on the local population by altering their everyday life.</p> <p>These changes in the historical population dynamics are usually sudden and new for the context receptor; as a result, pressure is exerted on the local population on the</p>

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			environment and local institutions in the municipalities with the demand for services and for the composition of the population structure, which requires another type of policies and measures.
Presence	Likely	0.6	The change in population dynamics can be caused by different circumstances; however, in the case of the construction of infrastructure projects this is the main reason for changes in this regard, it is therefore logical to expect a composition of the population dynamics of the two municipalities with the arrival of the project. However it must be taken into account that in the construction of this type of projects, this effect has not been evident
Duration	Short	0.39	Considering that the estimated time for the construction of the project is 32 months, that is to say about 3 years, it can be said that the duration of the effect on the population dynamics of the municipality and veredas, is short, because, when the facilities are completed, it is possible that the population that came to the area by the expectations generated by the project, leave the village looking for new opportunities.
Evolution	Medium	0.7	Although the population dynamics will begin to be altered from the start of facilities, the peaks of the demand for labor are presented after a year of being in construction.
Magnitude	Low	0.39	At the present time, Cocorná and Granada have their own population dynamics, as municipalities in which the previous year, the return of the displaced population has been stimulated, with the insertion of state programs and with the arrival of another hydroelectric project as the hydroelectric project El Popal.
Rating of environmental importance	1.8 - Irrelevant		



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Indicator:	<p>Population size of the municipality without a project/ population size of the municipality with project</p> <p>Population density in the rural area with project/ population density in rural areas without a project.</p> <p>Population density in the urban area with project/ population density in urban areas without a project.</p>
Environmental Management Plan that addresses the impact	<p>Program Information and community involvement</p> <p>Program of labor recruitment</p> <p>Institutional strengthening Program</p> <p>Environmental education program for workers and the community</p>

5.3.3.6 Increase in the demand for goods and services

Table	19
Environment: Socioeconomic	Component: Economic
Stage:	Construction, Operation
Activity (s)	<p>Land Purchase</p> <p>Hiring of labor</p> <p>Transport and hauling</p> <p>Construction and operation of camps and workshops</p> <p>Operation of the central plant.</p>
Conditions without project	<p>a During the armed conflict period , the price of the property following in the paths of the area of direct influence, fell disproportionately. The population abandoned their properties or offered them at very low prices, and many farms were abandoned due to the departure of their owners and to the presence of MAP and MUSE. Now, with the displacement, also the social services in the villages were being dismantled: cchools, health posts, roads, and school restaurants.</p> <p>Currently, due to the inadequacy of the roads and the isolation that suffer the communities in the influence area, some more than others, each vereda, has at least one or more establishments like billiards or canteen and some other business, whose clients is almost entirety between the same neighbors of the town. But between the establishments from the vereda, the constant is a grocery store, which often does not have a good variety of products and in most cases, these are far more expensive than in the main municipalities. The only exception is</p>

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	<p>El Molino, where there is a community store, managed by the same president of the Action Board Community; therefore the people even in the more remote veredas, travel on Sunday to the town to buy groceries, either to the town of Cocorná or Granada, which would be cheaper.</p> <p>In general, all those who live in the area are owners of their parcels, there is currently no class of tourism and it is difficult to get accommodation.</p> <p>The transport supply is also quite poor; in Cocorná, a ladder bus leaves the village three times a day and reaches up to the veredas, of San Juan, El Chocó, El Molino and Campo Alegre.</p> <p>Same conditions are presented for Granada and its veredas.</p>
<p>Description of the effect</p>	<p>The increase in the demand for goods and services is associated with the arrival of outside population to the area, looking to be inserted into the economic dynamics generated by the project, both directly and indirectly. Although we must bear in mind that this population will be installed in the village or at least on the outside area of the project direct influence ,</p> <p>In any way, their active presence in the commercial dynamics on the veredas, creating a demand in terms of basic goods and services. The inhabitants respond to the demands in some cases, launching small businesses and increasing the number of stores, as well as the variety and quantity of products; in other cases, adapting their homes to receive guests, mostly workers of the project. Similarly, begins to be noticed an increase in the flow of traders, peddlers and goods on credit.</p>
<p>Location</p>	<p>The header site of the municipality of Cocorná and veredas, of the same municipality within the influence area of the project: San Lorenzo, La Inmaculada, San Juan, El Chocó, El Molino, Campo Alegre and Los mangos. And to a lesser extent, the vereda, of Granada, located within the ADI of the project: Quebradona Abajo and Las Faldas.</p>
<p>Conditions with project</p>	<p>They will begin to emerge in the area of commercial stores, warehouses, restaurants, bars, canteens, sexual services and billiards among others. Also an increased demand for transport.</p> <p>In this sense, and as has been demonstrated during the construction of the hydroelectric project El Popal, new demands of the population arise; a specific case, different means of transportation, since many of the project workers have bought motorcycles, and in that case, gasoline consumption becomes an extra</p>

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	<p>spending for persons the vereda.</p> <p>Gradually, and as they trade sets, there finally will be a noticeable rise in the living cost, a phenomenon associated with the scarce supply in place, in contrast with the sudden growth in demand. This especially with what has to do with accommodation, food and other products.</p>		
Criteria	Rating	Cj	Justification
Class	Positive	(+)	The increase in the demand for goods and services, in an environment without neither the infrastructure, nor the suitable preparation to meet the population that arrives to the area, has as its counterpart the rising in living costs; but can also be converted into a element for reactivating the economy at a local level and become a source of income for the inhabitants of the veredas.
Presence	Very likely	0.99	It is expected that with the population increase , also increases the demand for goods and services, and consequently the offer of the same. It is a widely documented fact in the literature about mining or hydrocarbons projects, as well as electric power generation.
Duration	Short	0.39	As soon as the facilities are completed and stabilize the population, the effect will tend to decrease, causing a negative impact, the deficit of demand in contrast to the supply installed.
Evolution	Medium	0.50	Once construction begins, it will launch an increase in the demand for goods and services, which will begin to climb up to the peak of the recruitment, which is expected to be after a year of construction
Magnitude	Medium	0.65	Because of the way in which the construction facilities are being constructed, it will be possible to generate significant demands on the veredas, El Chocó, El Molino and Campo Alegre.
Rating of environmental importance	3.4 - Moderate		
Indicator:	Increase in the number of commercial stores.		

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	<p>Increase in the housing sites supply.</p> <p>Increase in the number of motor vehicles, specifically motorcycles among the workers</p> <p>Increase in the quantity and frequency of public transport.</p>
Environmental Management Plan that addresses the impact	<p>PIPC.</p> <p>Environmental education program for workers and the community.</p> <p>Program of labor recruitment.</p> <p>Relocation Program for infrastructure and housing.</p> <p>Restitution program of affected infrastructure .</p> <p>Institutional strengthening program.</p>

5.3.3.7 Temporary employment generation

Table	20
Environment: Socioeconomic	Component: Economic
Stage:	Preliminary Construction
Activity (s)	<p>Previous Activities</p> <p>Removal of vegetation and bare soil</p> <p>Surface Excavations</p> <p>Underground Excavations</p> <p>Disposal of excavation leftovers</p> <p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Concrete pouring</p> <p>Construction and operation of camps and workshops</p>
Conditions without project	<p>a At the data level of the Department sub region in 2004, the population of the East is engaged mainly in farming activities coinciding with the situation in the two municipalities in the influence area of the project.</p> <p>With regard to the municipality of Cocorná, according to data presented by the Development Plan of the Village 2008-2011, the activity in which there is a higher percentage of employed population is agriculture, with a 50.7 %, followed by trade with a 19.9 %, the third place is the industry with 14.1 % and the sector that less possibilities offers is services with 12.3 %. On the other hand, the municipal</p>

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administration represents a 12.7 % occupancy between the labor market of the village.

In regard to the municipality of Granada, is the agricultural sector which brings a greater number of direct jobs, for that reason, a large part of the population is engaged in these activities, either working on their own parcel or as laborers. While the commercial sector is dynamic and increasingly developing, it is not enough to occupy the entire labor of the municipality; there are also small carpentry, locksmiths and bakery shops, where the demand for labor is very low.

In addition, in the municipality there is significant unemployment, which leads a good part of the population migrate to other municipalities in search of work opportunities.

In accordance with the data submitted by the Statistical Yearbook of Antioquia, the activity which deals with a greater percentage of people is agriculture with a 50.2 %, followed by trade with 24.3 % and services with 17.1 %. The activity which represents a lower percentage of occupation is the industry with 3.1 %. For its part, the Municipal Administration provides a 4.36 % employment in the Municipality.

The inhabitants of the villages in the area of direct influence concentrate its occupation in agricultural activity; this is the pillar of the economy and one of the most important in the generation of employment and concentration of the labor force.

However, this productive branch cannot be considered as an alternative formal economic form, since all of these tasks are carried out by the farmers themselves, owners of their land, focusing on a subsistence economy. In the veredas ,men also work as day laborers, however, by the same circumstances lived with the forced displacement and in the present with the return, few jobs are generated.

On the other hand, the hydroelectric project El Popal, being built at the moment on behalf of the Consortium BMS, and whose owner is the HMV Engineers Company, providing a number of jobs in some of the veredas that are part of the project, as can be seen in the following table

Municipality	vereda,	Number of jobs generated up to January 2012
Cocorná	Los Mangos	5
	La Inmaculada	8



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		San Lorenzo	39	
	Total		52	
Description of the effect	Usually the construction of hydroelectric projects demands a number of skilled and unskilled labor, the last one is usually recruited among the population of the villages in the influence area of the project, and the qualified staff will be in nearby areas or in the important centralities of the sub region and possibly in Medellin. Usually this impact brings an improvement of the population living conditions of the area where the project is to be carried out. In any case, it should be borne in mind that these jobs are temporary, now that that they end at the same time that the completion of the facilities construction, which at the same time, that the project is being developed, it must consider measures that favor the idea that the hired people in the area continue or return to their traditional activities, after the completion of the construction or the time of the contract.			
Location	The main village of the municipalities of Cocorná and Granada and the veredas, of direct influence area of the project: Los Mangos, Chocó, San Juan, Campo Alegre, El Molino and La Inmaculada of the municipality of Cocorná and vereda, Las Faldas and Quebradona Abajo of the municipality of Granada.			
Conditions with project	The construction of the project will require a significant amount of labor, which in good part will be contracted in the veredas, of the influence area of the project. This staff shall be temporarily hired according to the criteria of the contractor, the labor policies of the company that owns the project, and as stipulated by the labor laws in Colombia.			
Criteria	Rating	Cj	Justification	
Class	Positive	(+,P)	The generation of employment, even though temporary, is positive, since it is an opportunity for economic improvement and access to some social services on the part of the family group.	
Presence	Some	1	It is from the construction of the hydroelectric power project that originates the demand for local and outside labor, therefore, the generation of temporary employment; therefore the presence of impact is certain. It is estimated that the project El Molino will generate a number close to 295 jobs in total, 140 of which will be unskilled workers.	
Duration	Short	0.39	The generation of employment is temporary and according	

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			to the ranges set by the methodology adopted for the assessment of impacts is short, given that the estimated time for the construction of the project is 32 months.
Evolution	Medium	0.8	Immediately after construction of the project is started , the manifestation of the impact will be evident and the highest peak of recruitment will be presented at the 12th month with a duration between 12 and 18 months.
Magnitude	Medium	0.6	Like it has been recorded previously, at the present time the hydroelectric project El Popal generates 52 jobs among the populations of the veredas, in the area, for its part, the Project El Molino, for unskilled workers, will require 140 people. In accordance with these data, taking into account the vocation of the population and its dedication to agricultural activities, it can be said that the change that can be operated in regard to the labor supply, it is of average size.
Rating of environmental importance	4.5 - Moderate		
Indicator:	<p>Level of employment in the municipality without a project/ level of employment in the municipality with project</p> <p>Number of employees hired/ Number of jobs offered</p> <p>Number of local employees/total jobs of the project.</p> <p>Unemployment rate in the municipality with project/ unemployment rate in the municipality without a Project</p> <p>Unskilled labor-moderately labor- Qualified labor offered in the influence area of the Project / Unskilled labor-moderately labor- Qualified labor linked to the Project</p> <p>Origin of the labor associated with the Project</p>		
Environmental Management Plan that addresses the impact	<p>Program information and community involvement</p> <p>Program of labor recruitment</p> <p>Program restoration of economic conditions</p> <p>Rural entrepreneurship program</p>		

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5.3.3.8 Modification of the municipal finances and environmental corporations

Table	21
Environment Socioeconomic	Component: Economic and political
Stage:	Construction Operation
Activity (s)	Land Purchase Operation of the Central
Conditions without project	<p>a According to the Law 136 of 1994, all municipalities in Colombia are classified into six categories according to their population and their fiscal resources. Cocorná belongs to the category 6° in accordance with the Law 136 of 1994, while the Statistical Yearbook of Antioquia in 2009, reported a population 15,119¹¹, its current revenues of free destination (ICLD) are within the range established by the Act, and i.e. are not greater than fifteen thousand (15,000) minimum legal monthly wage. Although no data is collected from current revenues of free destination of the municipality, in the statistical yearbook of Antioquia of the year 2009, it is pointed out an initial income budget of municipalities in Antioquia by sub region in 2010 of, \$5,542,226,000 million, for Cocorná. However, current revenue free destination of the municipality is approximately \$1,800,000,000 million.</p> <p>Granada also belongs to the sixth category, with a population of 9,789 people and current revenue of free destination of \$1,491,671,983 Million Pesos, according to municipal Agreement No. 34, which sets the amount of income and expenditures of the budget for the tax period between 1 January and 31 December 2011.</p> <p>The budget of the Autonomous Regional Corporation Rionegro - Nare - CORNARE, according to the agreement 246 of December 2010 1°</p> <p>By means of which it approves the budget of income and expenditure of the (Corporación Autónoma Regional)l of the basins of the rivers Negro and Nare CORNARE - for the fiscal year of 2011, is THIRTY TWO THOUSAND FIVE HUNDRED AND NINETY-SEVEN MILLION three hundred forty thousand pesos (\$32,597,340,000).</p>

¹¹ Sixth category. All those districts or municipalities with population less than or equal to ten thousand (10,000) inhabitants and with current revenues of free annual destination not exceeding fifteen thousand (15,000) minimum legal monthly wage.



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Description of the effect	<p>With the payment of the energy transfers established by Law 99 of 1993, the budget of the municipalities in the influence area of the project will increase, to earn income for payment of taxes and compensation that should make the project owner. On the other hand the Corporación Autónoma Regional Rionegro - Nare - CORNARE-, will receive the corresponding money, in accordance with article 45 of the mentioned law.</p> <p>In addition, the municipalities and the Corporation shall receive income derived from the Act No. 56 of 1981 in the following items: Compensation for property tax payment, property taxes by buildings and houses owned by the project; payment of taxes for Industry and Trade and Payment of the Special Fund of investments.</p>
Location	<p>The municipalities of Cocorná and Granada, in addition to the municipality of Santuario</p>
Conditions with project	<p>Article 45 of Law 99 of 1993, provides:</p> <p>"ART. 45. -Transfer of the electricity sector. The hydro-electric generating companies whose total installed power rating exceeds the 10,000 kilowatts, will transfer 6% of the gross sales of energy generation by itself, in accordance with the fee for block sales that points out the energy regulatory commission, as follows:</p> <p>"1. 3% for the regional autonomous corporations which have jurisdiction over the area where the watershed and the dam are located, which will be destined to the protection of the environment and to the defense of the river basin and the influence area of the project.</p> <p>"2. 3% for the municipalities and districts located in the water basin, distributed as follows:</p> <p>A) 1.5 % for the municipalities and districts of the river basin that discharge at the the dam, different to the topic of the following literal, and</p> <p>B) 1.5 % for the municipalities and districts where the dam is located . When municipalities are at the same time basin and dam, will participate proportionally in the transfers that refers to the sub paragraphs (a) and (b) of the second section of this article.</p> <p>"These funds may be used only by the municipalities in facilities in the Municipal Development Plan, with priority for projects of basic sanitation and environmental improvement".</p> <p>In this case CORNARE will receive the corresponding resources as well as the</p>

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three municipalities located in the influence area of the project.

At the same time, by provisions of the Act 56 of 1981; "which promulgates rules for public facilities of power generation and aqueducts, irrigation systems and others, regulating the expropriations and easements of property affected by such facilities".

ARTICLE 1st. Relationships that arise between the entities claiming the public facilities that are constructed for generation and transmission of electrical energy, aqueducts, irrigation and regulation of rivers and streams and the municipalities affected by them as well as the compensation and benefits arising from these relations, shall be governed by this Law.

ARTICLE 4th. The owner of the facilities will recognize annually to the municipalities the 1st article of this Law.

A) A sum of money to compensate for the property tax not being received by the property acquired.

B) The property tax that corresponds to the buildings and the permanent housing of their property, not including dams, generating stations and other public facilities or their equipment.

PARAGRAPH. The compensation of literal a) of this article shall be calculated by applying to the whole area acquired by the entity - valued by the tax value on average per rural hectare , in the rest of the municipality - a fee equal to 150% of the area that corresponds to the current property tax for all the sites in the municipality.

ARTICLE 5th. The municipalities in the territory of which the facilities are built, to which this Law refers, shall constitute special funds whose resources will be allocated to investment, in the facilities and programs that the socio-economic study referred to in article 6 of this Law, recommends.

These funds will come from the payment that the entities must do to the municipalities of a value equal to the sum of the valuations of all the tax parcels that such entities acquire or are planning to acquire at any title in the area and that it will be paid, only once, to the respective municipalities, regardless of the payment of the purchase price to their owners. The tax appraisal, the basis for this will be the last payment made by the Institute of Geography "Agustin Codazzi" or by the regional entities authorized to do so, the date on which the area of the facilities to which this law is concerned, will be declared in public utility.

Article 7 of the Act also establishes: NOTE OF VALIDITY 1: Article 51, section1.,

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of the Law 383 of 1997 provides that "the generation of electrical energy will continue to be taxed in accordance with the provisions of article 7 of Law 56 of 1981".

The definition of such tax is obtained by multiplying the block sales price of the kW

(Adjusted in accordance with the national rate of increase in the cost of life certified by DANE), by the power-generation capacity installed, measured in number of kW. The Government shall fix by decree the proportion in which the tax should be distributed among the different municipalities affected by the construction.

For this project the values are the following:

TRANSFERS:

1. 3% For the Regional Autonomous Corporations:

Cornare 100%

$$120.700.000 * 62,87929 * 3\%$$

Value to transfer annually: \$ 227.7 Million

2. 1.5 % For the municipalities in the basin:

Municipality	ha	% Area	Value to transfer annually: (Millions Pesos)
Cocorná	732	6.82	7.8
El Santuario	2,189	20.40	23.2
Granada	7,809	72.79	82.9
Total basin	10,730	100.00	113.8

3. 1.5 % For the municipalities of the reservoir:

Municipality	m ²	% Area	Value to transfer annually: (Million Pesos)
Cocorná	5,849	48.81	55.6
Granada	6,133	51.19	58.3
Total basin	11,982	100.00	113.8

INDUSTRY AND TRADE

For the municipalities where the facilities are being developed: Cocorná y Granada.

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	21000*423		
	Industry and Trade Value: \$8.9 Million		
Criteria	Rating	Cj	Justification
Class	Positive	(+,P)	This impact is positive, given that from the project income generated stipulated by the legislation of Colombia, in additionally to the budget of the municipalities, and with the possibility of investment in basic sanitation projects, among others, to improve the quality of life of the population of the influence area. Likewise, this income generates the obligation of maintenance and conservation of natural resources, in this case the providers of the basin, which are targeted to the management of the environmental authority with jurisdiction in the area, in this case CORNARE.
Presence	Some	1	In accordance with the legislation established in Colombia, the generation of income for the municipalities is present in some cases, from the land demanded for the project, same wise from the moment that the society for the construction of the project is conformed, and once it starts to operate, starts the obligation to pay transfers.
Duration	Very long or permanent	1	The additional revenue generated for the municipalities, either by transfers, property tax and industry and commerce, are awarded during the entire life of the project.
Evolution	Rapid	0.99	After completion of the negotiations for land purchase starts, it begins to generate income for the municipalities where those lawns are located, equally in the moment it starts to operate the project, the rendered payment begins.
Magnitude	Low	0.39	Taking into account the current flows of income for free destination, the municipalities that receive contributions for the construction and operation of the small central plant, it can be said that the changes in the budgets of the

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			administrations are of low magnitude, given that it will increase the resource of the same, close to 20% of its current budget.
Rating of environmental importance	5.7 - Relevant		
Indicator:	Total transfers to the municipality with Project/Total income that the municipality receives without a Project The ICLD of the municipality with Project/ICLD of the municipality without a Project Total property tax to be raised with Project/ property tax collected without a Project The total budget of CORNARE with Project/ Total budget of CORNARE without the project Total tax on industry and trade to be raised with Project /Tax on industry and trade collected without a Project		
Environmental Management Plan that addresses the impact	Program Information and Community Involvement Institutional Strengthening Program		

5.3.3.9 Generation of expectations

Table	22.
Environment Socioeconomic	Component: Political
Stage:	Preliminary Construction Operation
Activity (s)	Previous Activities Land Purchase Hiring of labor Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers



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	<p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Concrete pouring</p> <p>Construction and operation of camps and workshops</p> <p>Operation of the central plant</p>
<p>Conditions without project</p>	<p>9 veredas, in total will be affected by the El Molino hydroelectric project; the total population (according to data from the field work), is of 1,722 people. Of these, 1,452 from the municipality of Cocorná, which represents 9.60 % on the total population of the municipality, which is 15,119 people. For its part of the municipality of Granada there are 270 people which corresponds to 2.75 % of the total population of the municipality (9,789), covering a total area of 28.2 km². Almost 100% of the population of the veredas, are labeled in a poverty state, which reflects very difficult living conditions.</p> <p>This population in their majority, peasants are engaged in agriculture, especially the cultivation of sugar cane for the production of panela. Women, children and young people have few opportunities, because the family group concentrates its workforce in the livelihood of the same. Some veredas, are very isolated from the most important population centers and even more on the urban center of the municipalities, due to this, some children do not complete its primary education cycle.</p>
<p>Description of the effect</p>	<p>The making of a project as the construction of the El Molino hydroelectric project raises expectations among the population, by curiosity, personal interest, questions about the labor hiring. Equally the rumors about the project can generate fear or rejection in the inhabitants of the influence area of the project, which are disturbed by the possible impacts that the development of the facilities can bring. Generally among the population that inhabit the area of the project, out of the aspects that generate more expectations are, employment generation, land purchase and physical transformations of the territory.</p> <p>In addition, you can generate expectations in the municipal administrations by the benefits provided by the Colombian law, given that these revenues (the property tax payment, trade and industry, or the generation of transfers among others), modify the municipal budget. Likewise, some administrations can expect to reach some agreements with the enterprise that owns the project, for the development of benefit programs for the population of the municipality.</p>

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Location	The main village of the municipalities of Cocorná and Granada and the veredas, of direct influence area of the project: Los Mangos, Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada and San Lorenzo of the municipality of Cocorná and vereda, Las Faldas and Quebradona Abajo of the municipality of Granada..		
Conditions with project	<p>The construction of the project will generate expectations of all kinds; however, it is evident that the more related to the interest for the community are the opportunity of an improvement in the way of life, the hope of obtaining higher income, and social security benefits for the individuals and their families. It also creates expectations in regard of demand for services such as accommodation, food, laundry, transport of people and equipment.</p> <p>In fact, with the launch of the project, the eventual delivery of any good or service, will contribute somehow to the increase of family income, the families of the villages in the area of direct influence and some inhabitants of the municipality header site. According to the study of characterization of the influence area, at the present time the greater expectations revolve around the purchase of premises for the implementation of projects for community benefits, of the labor hiring and, of the adequacy of the roads, among others.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	(-,N)	This impact is negative, because the expectations bring anxiety, stress and in some cases can also lead to disagreements between the inhabitants of the area of direct influence of the project. If expectations are not resolved or satisfied, can cause discomfort or disappointment among the population, thus leading to generate among the local inhabitants, an attitude of rejection of everything that has to do with the project. Also, expectations may arise, in the sense that the financial capacities, and his competence in state or public matters of the project owner, are over dimensioned, thereby favoring the emergence of conflict and frustration among the local population.
Presence	Some	1	The generation of expectations is a common effect caused by the development of infrastructure projects such as the hydroelectric projects. Therefore, it is inevitable that

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			expectations will emerge among the local population of the area where the small Central plant will be build.
Duration	Short	0.39	The period of existence of this impact can be considered short, because with the beginning of the construction on the project, it is defined aspects related to the hiring of staff; the negotiation of specific sites is reached. In addition, the duration of this impact is determined by the estimated time for the project construction, which is about three years.
Evolution	Rapid	0.7	Once it is reported the implementation of the project, rumors and comments begin circulating about the same. Indeed, it is usual that from the stage of previous studies already the people with to whom they have come in contact are expectant at the possible generation of employment and land purchase.
Magnitude	High	0.8	The generation of expectations among the local population by the construction of the project can cause significant changes at the level of relations between the same population of the veredas, among this population and the local authorities. In addition, it will disturb some of the features of everyday life, for example, in regard to the mobility of the population, which at the time it is difficult and a priority for these people and because of this fact it could increase the level of expectations.
Rating of environmental importance	5.1 - Relevant		
Indicator:	<p>Number of complaints received and served in the offices destined for it or received by the company staff.</p> <p>Number of meetings held to socialize aspects related to the project and address the concerns of the community</p> <p>Record of the results of negotiation and management of sites/number of parcels to be negotiated before the construction</p>		
Environmental	Program information and community involvement		

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Management Plan that addresses the impact	<p>Program of labor recruitment</p> <p>Relocation Program for infrastructure and housing.</p> <p>Restitution Program of affected infrastructure</p>
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5.3.3.10 Modification of the local mobility

Table	23.
Environment Socioeconomic	Component: Space
Stage:	Construction, Operation
Activity (s)	<p>Removal of vegetation and bare soil</p> <p>Surface Excavations</p> <p>Underground Excavations</p> <p>Disposal of excavation leftovers</p> <p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Concrete pouring</p> <p>Construction and operation of camps and workshops.</p>
Conditions without project	<p>a Between the roads and highways that allow the connection of the main village with the different municipal veredas, nearby towns or the veredas close to them, it is highlighted: Highway Medellin - Bogota, with its branch to Cocorná; road Cocorná - Granada; the old road that connects to the main village of Cocorná and San Francisco.</p> <p>Currently, the veredas, in the ADI of the project counts with the road that goes from Cocorná to Granada, which passes through San Juan and El Chocó where it detaches, going to the veredas El Molino y Campo Alegre.</p> <p>The community of Los Mangos on the other hand, must move from Campo Alegre through a rough path that takes approximately forty minutes to be transited; but it could also be used the road that goes to sector Eight, located in the old road that connects San Francisco with Cocorná, out of which comes out an ancient road. Besides there is a new road, built by the hydroelectric project El Popal, reaching the sector Playa Loca, crossing a vereda sector.</p> <p>Another road, which also comes out of the Chocó, going to the edge of the river but just up to the vereda Las Faldas, there, over the river, there used to be a bridge which communicated the veredas of Cocorná with those of Granada, but</p>

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	this was washed out by a crescent in early 2010. Therefore, the communication of these veredas, is carried out in this moments, by the road to Galilee.		
Description of the effect	To the extent that the existing access roads to the project could be improved and new pathways to the facilities at the interior of the veredas are built, the mobility of the nearby towns will be positively amended, enabling them to make the trip up to the municipal main village and up to the highway in shortest time, and in some cases linking sectors between the veredas, and the veredas themselves.		
Location	Vereda, San Juan, El Chocó, El Molino, Campo Alegre and Los Mangos in Cocorná.		
Conditions with project	With the improvement of existing roads (Road stretch Cocorná - Granada until Chocó and Road the Chocó - Campo Alegre, in addition to the new road: power house, collection and relief pipeline) and increase in the population, there will be also an increase in the demand of the public transport and in the frequency and quantity of the transport vehicles. Additionally, with the opening of the new roads, will begin to strengthen relations between the communicated sectors and veredas, as well as to new linkages between them.		
Criteria	Rating	Cj	Justification
Class	Positive	(+)	The changes in the road infrastructure will enable the veredal populations to move quicker and easily, both between veredas, as from these toward the main village of Cocorná or toward the highway, as the case may be.
Presence	Certain.	1	The modification in the road structure will lead to an increase in the supply of transport and in the flow of people across the territory.
Duration	Very long or permanent	1	Changes in the road structure will survive with time even after the completion of the project life spawn.
Evolution	Slow	0.39	The culmination of the amendments requires a period of time between eighteen months and two years.
Magnitude	Medium	0.5	The changes in the road infrastructure, will have an impact on the mobility of all or almost all of the population from the veredas, now that 7 km of roads will be built.
Rating of environmental importance	4.4 - Moderate		

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Indicator:	Number and frequency of vehicles driving on the roads without a project/number and frequency of vehicles driving through roads with project.
Environmental Management Plan that addresses the impact	PIPC

5.3.3.11 Allocation of economic activities

Table	24.
Environment Socioeconomic	Component: Economic
Stage:	Construction
Activity (s)	<p>Land Purchase</p> <p>Removal of vegetation and bare soil</p> <p>Surface Excavations</p> <p>Underground Excavations</p> <p>Disposal of excavation leftovers</p> <p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Construction and operation of camps and workshops</p>
Conditions without project	<p>While, in the two municipalities in the influence area, there are different economic activities, characterized by agriculture and cattle rising, that is to say, the primary sector. In Cocorná, for example, there are important crops of sugarcane, coffee, yucca, bananas, fruit trees, banana and sugar cane, there is also a cattle ranch. For its part, in Granada stand out the crops of coffee, sugar cane, tomato and cucumber, in addition there are extraction of timber and cattle rising.</p> <p>It is important to bear in mind that by the effects of the armed conflict which has been influential in various areas of the socio-economic relations, farming activities were also affected, reflecting a decline of the same.</p> <p>In the veredas of the influence area, the agricultural activity is the mainstay of the economy; in this protrude the production of sugarcane, bananas, coffee, beans, maize, yuca and citrus fruits. In the villages of the municipality of Granada protrude tomato and cucumber. As well, cattle rise for milk and meat production, this one does not cover local demand; the milk is usually for their own</p>

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	<p>consumption and for the manufacture of cheese and butter, which is marketed to the veredas. Similarly, in low proportion is the breeding of pigs and chickens.</p> <p>Almost in all cases, the work field is done by the owners, as farmers that cultivate their land in a subsistence economy. Therefore, the technology used is in its in most cases is incipient; depending on the type of crop, it is applied traditional knowledge or techniques that have been implemented with the advice of the UMATA and SENA for the improvement of sugarcane cultivation, for example.</p>								
<p>Description of the effect</p>	<p>With the construction of hydroelectric projects, it is possible that some economic activities will be affected, given that the realization of civil facilities in some areas limits the normal development of the economic activities that are regularly carried out by the inhabitants of the area. Also the project may require farms which are currently being used as areas of sugarcane cultivation , crushing and processing of panela.</p>								
<p>Location</p>	<p>The veredas of the direct influence area of the project: Los Mangos, Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada and San Lorenzo of the municipality of Cocorná and vereda, Las Faldas and Quebradona Abajo of the municipality of Granada.</p>								
<p>Conditions with project</p>	<p>This impact is presented in the work surroundings. In accordance with the technical specifications and characteristics of the project, this does not generate flooding of land in the area. On the other hand this is an area which emphasizes the cultivation of cane and small-scale cattle rising, which denotes a remarkable intervention of the environment. The greater effect will be presented in the surrounding of the sites occupied by Manuel Tiberius Giraldo Gómez, his brother Miguel Ángel Giraldo Gomez and his son Evelio Giraldo Aristizabal, because of the building of the sub-station, the road that leads to the substation and the layout of the transmission line. In this venue it is also possible the location of a deposit; also close to these facilities there is a sugarcane cultivation field. The sites involved with their respective owners, economic activity and location are presented in the following table:</p> <table border="1" data-bbox="462 1766 1432 1921"> <thead> <tr> <th data-bbox="462 1766 706 1843">Labor</th> <th data-bbox="706 1766 1031 1843">Name of the owner or possessor</th> <th data-bbox="1031 1766 1258 1843">Activity of the venue</th> <th data-bbox="1258 1766 1432 1843">vereda, and municipality</th> </tr> </thead> <tbody> <tr> <td data-bbox="462 1843 706 1921">Road to the substation and power house.</td> <td data-bbox="706 1843 1031 1921">Manuel Tiberio Giraldo Gómez</td> <td data-bbox="1031 1843 1258 1921">Sugarcane Cultivation and</td> <td data-bbox="1258 1843 1432 1921">Los Mangos-Cocorná</td> </tr> </tbody> </table>	Labor	Name of the owner or possessor	Activity of the venue	vereda, and municipality	Road to the substation and power house.	Manuel Tiberio Giraldo Gómez	Sugarcane Cultivation and	Los Mangos-Cocorná
Labor	Name of the owner or possessor	Activity of the venue	vereda, and municipality						
Road to the substation and power house.	Manuel Tiberio Giraldo Gómez	Sugarcane Cultivation and	Los Mangos-Cocorná						

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	X-883284,19 m Y-1160564,03 m		production of pana	
	Substation X-883070,82m Y-1160609,84m	Miguel Angel Giraldo Gómez	Citrus Fruit	Los Mangos- Cocorná
	Transmission Line X-883135,96 Y-1160512,64m	Evelio of Jesus Giraldo Aristizabal	Citrus fruit and cane	Los Mangos- Cocorná
Criteria	Rating	Cj	Justification	
Class	Negative	(-,N)	Three houses with their respective productive areas are affected, damage to the cultivation of sugar cane and other productive areas (panea compound).	
Presence	Some	1	The damage that is generated to the cultivation of cane and to panel compound , are caused by the establishment of the substation and the construction of the road which leads to the same, and to the power house, in the productive area of these three families, affecting the economic activity that serves as a support to these people.	
Duration	Medium	0.69	The duration of the effects on the economic activities, is determined by two factors, first by the time that elapses for its restoration and second by the capacity of the environmental management of the project to ensure that the inhabitants of the area do not abandon its traditional activity by the labor requirements of the project.	
Evolution	Rapid	0.99	This impact is expressed at the time of facilities beginning, mainly with the opening of trails, or routes for machinery entrance, drilling for soil studies, among others. And subsequently with the hiring of labor on behalf of the project	
Magnitude	Very low	0.1	Only affects a pana compounds of the influence area of the project, and three homes.	
Rating of environmental importance	2.8 - Moderate			
Indicator:	An inventory of productive areas close to the facilities, before the			

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	<p>project begins. With corresponding neighborhood records.</p> <p>Number of hectares of productive areas required for the construction of facilities by vereda, /Total of productive hectares existing on the veredas, where the facilities will be built.</p> <p>Number of hectares of sugarcane crops and pastures for Project use/Total hectares of existing sugarcane crops and pastures.</p> <p>Number of requests, complaints (PQR) met/Number of PQR received</p> <p>Service Date - receipt date of PQR</p> <p>PQR completed Number/number of PQR received</p>
Environmental Management Plan that addresses the impact	<p>Information Program and community participation,</p> <p>Program for the restoration of economic conditions.</p> <p>Relocation Program for infrastructure and housing.</p> <p>Restitution Program of affected infrastructure</p> <p>Rural entrepreneurship program</p>

5.3.3.12 Pressure on the real estate market

Table	25.
Environment Socioeconomic	Component: Economic
Stage:	Preliminary Construction
Activity (s)	Previous Activities Land Purchase
Conditions without a project	<p>As a particular feature in the structure of the property, the municipality of Cocorná, it is evident a high splitting of the ground and the greater part of the rural population is located in small production units. The trend is the segmentation in increasingly small areas.</p> <p>According to the schema of Territorial Organization from the sub region forests, "[...] With respect to rural areas, the possession of the land is characterized by the preponderance of smallholdings, there are no landlords. In 78 veredas, it is estimated that all farmers have land to work in productive units, which is considered an advantage; in this area some of the most notorious problems are: low profitability of the crops, poor quality of the housing and gaps in basic sanitation".</p>

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	<p>The highest percentage in the form of tenancy representing the homeowners with 80 %, while the other forms of acquiring is represented in 5% each (tenants, lessees and inheritance).</p> <p>In the municipality of Cocorná the highest percentage of farms correspond to those who are between 10 ha to 20 ha, with a 70 %, followed by 5 ha - 10 ha, with a 15 %. The large venues of more than 50 hectares represent a minimum percentage of 5% in relation to the previous ones. This confirms the high splitting of the village ground.</p> <p>The situation of the structure of ownership in the municipality of Granada is not very clear, in sources consulted as the outline of Land Use and Development Plan of the municipality does not provide specific details in this regard. The only reference that is in the Scheme of spatial order, asserts that in the municipality there is " <i>High land fragmentation and lack of legalization of farms. In the municipality there is a high percentage of venues between 0 and 3 hectares, as well as a large percentage of venues without legalization, this is due to the fact that the lots are in a constant process of division since the majority are being more limited, due to the fact that many of these venues are obtained by inheritance, which is why a high percentage of the population is not concerned to legalize their farms; as a result, this produces a widening of the agricultural frontier and the intensive use of the soil, which is detrimental to the natural resources</i> " .</p> <p>As problematic elements are mentioned: the per cent of venues under 3 ha is equivalent to 76.66 %, 45.10 % of lawns that are legal, the remaining percentage face unresolved processes and there is an increase in the recreational farms.</p>
<p>Description of the effect</p>	<p>In accordance with the current context as to possession and size of the land and the inadequacy of some families to ensure their livelihood from what is produced on the family land, it is possible that some of them are tempted to sell their land to people who come from Medellín or from other cities and with this evidences a worsening of the processes of fragmentation of the land, and that is conducive to the concentration of the land by a few owners and with this, to encourage people who may have strategic interests in the territory. Likewise, speculators experts can make presence in order to increase or decrease the price of land in the area, for their convenience, and on the basis that the project will require large amount of land for its construction.</p>

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Location	The veredas, of the direct influence area of the project: Los Mangos, Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada and San Lorenzo of the municipality of Cocorná and veredas, Las Faldas and Quebradona Abajo of the municipality of Granada. It is possible that in the urban center of the two municipalities some people acquire properties to give them a commercial use		
Conditions with project	With the construction of the project new population arrives to the area with different purposes, generating new dynamics. Among these people there are those who are interested in the purchase of venues, either for commercial purposes, or in order to establish second homes or vacation homes. This effect, in addition, can bring collateral causes as composition in the degree of urbanization or rural area of the two municipalities, associated this to the adequacy and construction of roads that facilitate the mobility. The increased demand of land for construction, for some of the facilities of the project, will be seen in the vereda Los Mangos.		
Criteria	Rating	Cj	Justification
Class	Negative	(-,N)	This impact is negative, since these dynamics and transformations affect not only economic aspects but also have an effect on division and alteration of the territory from the physical and symbolic elements that compose it, the social and cultural aspects that the populations deploy in it (social relations, social organization, productive systems, territoriality, etc.).
Presence	Likely	0.5	It is likely that this impact would be presented in the current conditions of land ownership, land size and low production capacity of some family groups, it is also important to take into account the potential for tourism that the area has. It also has to be considered that the law and public order situation has improved, which can attract people who are interested in purchasing land in the influence area.
Duration	Short	0.39	Taking into account the characteristics of the land size and the existing type of ownership, the effect may last a short time, due to a limited supply of land or to the saturation of the territory from the veredas, by construction

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			of new homes.
Evolution	Very slow	0.19	The evolution of this impact can be slow, because the people who are interested can take some time to analyze how the construction of the project develops, it can also happens that sale processes develop by unresolved holdings , features in the area.
Magnitude	Low	0.39	The level of change may be low, because although there are families interested in selling part of their lands, other people want to remain in their veredas, even after being displaced by the armed conflict returning to their land with the hope of remaining in it.
Rating of environmental importance	0.8 - Irrelevant		
Indicator:	Average size of the property prior to the project/average the size of the property after the project State of the real estate market without a project/ state of the real estate market with project		
Environmental Management Plan that addresses the impact	Information Program and Community participation. Relocation Program for infrastructure and housing. Restitution Program of affected infrastructure Institutional strengthening Program Memory Program and heritage		

5.3.3.13 Generation of Inconvenience to the community

Table	26.
Environment Socioeconomic	Component: Political
Stage:	Preliminary Construction
Activity (s)	Previous Activities Land Purchase Hiring of labor Removal of vegetation and bare soil



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	<p>Surface Excavations</p> <p>Underground Excavations</p> <p>Disposal of excavation leftovers</p> <p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Concrete pouring</p> <p>Construction and operation of camps and workshops</p>
<p>Conditions without project</p>	<p>a</p> <p>The population that inhabits the influence area of the project is composed of peasants dedicated mainly to the cultivation of cane and small food crops of bananas, cassava, tomatoes, onion, cucumber and some citrus fruit and passion fruit. Some families also have between one and five cattle heads, which produce milk for their own consumption and in some cases dairy products such as cheese and butter for sale and consumption. The inhabitants of the area have great mobility problems, by the poor condition of the roads and existing trails.</p> <p>In the shaping of the existing settlement patterns in the study area in addition to the houses, there are local logical constructions of a territoriality around the traditional roads that exist, for example, between the vereda, Los Mangos, Campo Alegre and la Inmaculada. Also the road that leads from the town center of Cocorná up to the vereda, Campo Alegre. The road that leads from the town center of Granada, until the village of Santa Ana, passing through Galilee, is a poor alternative because the state of this route is very bad.</p> <p>The life of these people currently runs relatively quiet, after having suffered a difficult time because of the armed conflict, which led to successive forced displacements in the late 90s and early 2000. This situation has left deep scars in this population that lived through the death of family members and neighbors by the hands of the various armed groups who were in dispute of the territory.</p> <p>In the present, these people recover from this situation, and some have returned with the intention to begin again in its old parcels and in which were their homes.</p>
<p>Description of the effect</p>	<p>The construction and operation of the project, will generate some nuisances to the population that lives in the influence area of the facilities, motivated by the damage that can cause in the infrastructure of their lands, temporary interruption of access, presence or increase in transit of vehicles, noise, dust and concern regarding the presence of people from outside the area, elements that alter the daily rhythms of the inhabitants of the different veredas.</p>

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Location	The veredas, of the direct influence area of the project: Los Mangos, Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada and San Lorenzo of the municipality of Cocorná and vereda, Las Faldas and Quebradona Abajo of the municipality of Granada.		
Conditions with project	<p>The construction of the project requires transporting heavy machinery, equipment and staff, in the same way, in some moments, it will be necessary to carry out closures of access and roads; this situation can cause an inconvenience to the community, especially to the people that transit the paths and roads in order to get access at services or for transporting panela and other products to the urban center of the municipalities of Cocorná and Granada.</p> <p>On the other hand, in the areas adjacent to the construction, the operation of machinery and equipment, can cause air pollution by suspended particles, noise, and production of gas.</p> <p>Also, for the implementation of some of the facilities, it is necessary the use of explosives and other heavy tools that alter the routine of the local population.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	(-,N)	This impact is negative, since the nuisances to the community are unexpected situations for the inhabitants of the area and that generally interfere with the daily rhythms of the local population, and may lead to discontent and hostility toward the project, in the given case that a proper and timely process of information to the community is not executed
Presence	Some	1	The generation of inconveniences to the community is inherent in the implementation of the various activities of the project; very probably the people that will experience greater concern will be the inhabitants of the veredas, Los Mangos and El Molino, without discarding veredas, as Quebradona Abajo by its closeness to the sites where the collection facilities are placed.
Duration	Short	0.39	In accordance with the duration of the project construction, which is estimated at 32 months, the discomfort that may take place will remain until the time in which the appropriate measures to minimize the discomfort are

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			applied.
Evolution	Rapid	0.99	This impact can start to occur since the completion of the previous activities of the project and escalate with the construction of the same, in case of not been applied the relevant measures in the right moment.
Magnitude	Medium	0.69	Some of the conditions of the environment and everyday life of the population will be transformed with the arrival of the project, causing inconvenience to the community by several factors, such as alteration in the mobility, production of noise and dust, frustrated expectations for employment generation, among others.
Rating of environmental importance	5.95 - Relevant		
Indicator:	Number of scheduled meetings/ Number of meetings held Number of complaints and claims answered / number of complaints and claims received x 100. Number of complaints and claims completed/amount of complaints received X 100		
Environmental Management Plan that addresses the impact	Information Program and Community participation. Program of labor recruitment Environmental education program to workers and the community		

5.3.3.14 Changes in the soil use

Table	27.
Environment Socioeconomic	Component: Economic
Stage:	Construction Operation of the project
Activity (s)	Land Purchase Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers



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	<p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Concrete pouring</p> <p>Construction and operation of camps and workshops</p> <p>Operation of the central plant</p>
<p>Conditions without project</p>	<p>a</p> <p>While, there are different economic activities in the municipalities, stand out the agriculture and cattle rising, that is to say, the primary sector. In Cocorná, for example, there are important crops of sugarcane, coffee, yucca, bananas, fruit trees, banana and sugar cane, there is also a cattle ranch. For its part, in Granada, stand out the crops of, coffee, sugarcane, tomato and cucumber, in addition there is extraction of timber and cattle rising.</p> <p>In Cocorná, in regard to cattle rising, there is a dual-purpose livestock, which has been developed locally in the warmer areas, without covering the demands of meat for the municipality itself. For its part, tourism has developed in some corridors of the municipality, given the advantage of abundance of water resources and the beauty of the landscape.</p> <p>The uses of the soil in Granada are characterized by a predominance of agricultural activity, followed by cattle production and trade. The permanent crops more representative of the municipality are coffee, sugarcane and to a lesser extent the bananas. There are also crops surge (yearly) as chonto tomato, corn, beans, potatoes, carrots, cabbage and cucumber.</p> <p>In the cattle sector the main activity is the dual-purpose cattle raising, followed in order by the poultry, pigs and to a lesser scale beekeeping.</p> <p>In the veredas, of the influence area, the use of the soil in large part is devoted to the agricultural activity, which is the mainstay of the economy; in this protrude the production of sugarcane, bananas, coffee, beans, maize, cassava and citrus fruits. In the villages in the municipality of Granada, protrude the tomato and cucumber. A part of the soil, although in low proportion, is dedicated to raise cattle for meat and milk production; this does not cover local demand, the milk is usually for their own consumption and for the manufacture of cheese and butter that is marketed to the surrounding veredas. Similarly, in low proportion, the breeding of pigs and chickens.</p>
<p>Description of the effect</p>	<p>With the implementation of the project it will require areas of sites that are currently used primarily for the cultivation of cane, which will lead to a change of</p>

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	<p>land use, specifically in the areas of construction and projected surrounding roads. Also the operation and maintenance of the project involves restrictions in the use of the soil in areas close to the facilities. In this way, the effects are related to the limitations for the future use of the soil in some sectors of the different veredas.</p>																																				
Location	<p>This impact by the facilities of the project, will be presented primarily in the veredas, Los Mangos and El Molino. While in the other veredas, may also be present the vocation change by other factors such as the sale of land for construction of the first houses and recreation houses.</p>																																				
Conditions with project	<p>For the implementation of project facilities, there have been established a few areas which currently are used for agricultural and industrial purposes; mainly sugarcane cultivation and panela compounds. There are also areas of pasture, which generally harbor some cattle. From the moments that construction begins, these spaces may not be used in the usual activity.</p> <p>In accordance with this, the areas where the project facilities will develop and where change can occur in the use of the soil is presented in the following table</p> <table border="1" data-bbox="464 1024 1435 1923"> <thead> <tr> <th data-bbox="464 1024 786 1077">Labor</th> <th data-bbox="786 1024 1110 1077">vereda,</th> <th data-bbox="1110 1024 1435 1077">Use of the soil</th> </tr> </thead> <tbody> <tr> <td data-bbox="464 1077 786 1129">Deposit SM3</td> <td data-bbox="786 1077 1110 1129">Los Mangos</td> <td data-bbox="1110 1077 1435 1129">Paddocks-Cattle raising</td> </tr> <tr> <td data-bbox="464 1129 786 1182">Deposit SM4</td> <td data-bbox="786 1129 1110 1182">Los Mangos</td> <td data-bbox="1110 1129 1435 1182">Paddocks-Cattle raising</td> </tr> <tr> <td data-bbox="464 1182 786 1234">Substation</td> <td data-bbox="786 1182 1110 1234">Los Mangos</td> <td data-bbox="1110 1182 1435 1234">Paddocks-Cattle raising</td> </tr> <tr> <td data-bbox="464 1234 786 1287">Power house</td> <td data-bbox="786 1234 1110 1287">Los mangos</td> <td data-bbox="1110 1234 1435 1287">Paddocks-Cattle raising</td> </tr> <tr> <td data-bbox="464 1287 786 1339">House of valves</td> <td data-bbox="786 1287 1110 1339">Los Mangos</td> <td data-bbox="1110 1287 1435 1339">Paddocks-Cattle raising</td> </tr> <tr> <td data-bbox="464 1339 786 1444">Paths to substation</td> <td data-bbox="786 1339 1110 1444">Los Mangos</td> <td data-bbox="1110 1339 1435 1444">Paddocks-Cattle rising and sugar cane crops.</td> </tr> <tr> <td data-bbox="464 1444 786 1539">paths to house of valves</td> <td data-bbox="786 1444 1110 1539">Campo Alegre</td> <td data-bbox="1110 1444 1435 1539">Pastures and forest - Cattle raising and wood</td> </tr> <tr> <td data-bbox="464 1539 786 1633">Deposit 1:</td> <td data-bbox="786 1539 1110 1633">El Molino</td> <td data-bbox="1110 1539 1435 1633">Pastures and forest - Cattle raising and wood</td> </tr> <tr> <td data-bbox="464 1633 786 1728">Deposit 2:</td> <td data-bbox="786 1633 1110 1728">El Molino</td> <td data-bbox="1110 1633 1435 1728">Pastures and forest - Cattle raising and wood</td> </tr> <tr> <td data-bbox="464 1728 786 1822">Deposit 3:</td> <td data-bbox="786 1728 1110 1822">El Molino</td> <td data-bbox="1110 1728 1435 1822">Pastures and forest - Cattle raising and wood</td> </tr> <tr> <td data-bbox="464 1822 786 1923">Deposit 5:</td> <td data-bbox="786 1822 1110 1923">El Molino</td> <td data-bbox="1110 1822 1435 1923">Pastures and forest - Cattle raising and wood</td> </tr> </tbody> </table>	Labor	vereda,	Use of the soil	Deposit SM3	Los Mangos	Paddocks-Cattle raising	Deposit SM4	Los Mangos	Paddocks-Cattle raising	Substation	Los Mangos	Paddocks-Cattle raising	Power house	Los mangos	Paddocks-Cattle raising	House of valves	Los Mangos	Paddocks-Cattle raising	Paths to substation	Los Mangos	Paddocks-Cattle rising and sugar cane crops.	paths to house of valves	Campo Alegre	Pastures and forest - Cattle raising and wood	Deposit 1:	El Molino	Pastures and forest - Cattle raising and wood	Deposit 2:	El Molino	Pastures and forest - Cattle raising and wood	Deposit 3:	El Molino	Pastures and forest - Cattle raising and wood	Deposit 5:	El Molino	Pastures and forest - Cattle raising and wood
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	Collection	El Molino	Without known use
	Road to collection	El Molino	Paddocks - Cattle raising and dispersed residential use
	NOTE: The Cattle raising is in low proportion, between 1 and 6 heads		
Criteria	Rating	Cj	Justification
Class	Negative	(-,N)	This impact is negative, since because of the demands of the project, some traditional uses of the soil can be transformed or suffer limitations, thereby affecting the vocation, customs and economic practices of the local population, which, is getting over with the aftermath of the armed conflict and forced displacement.
Presence	Some	1	Changes will be presented in the use of the soil, due to the destination of cultivated areas and pastures as locations of some of the project facilities and for the construction of access roads to the project.
Duration	Very long or permanent	1	Once, areas of crop or pasture get oriented to the location and construction of the project facilities, these may not be re-used for agricultural production or cattle rising.
Evolution	Slow	0.39	The top effect will be reached when the hydroelectric project is built
Magnitude	Very low	0.10	The changes will be evident in less than 4% of the study area.
Rating of environmental importance	3.3 - Moderate		
Indicator:	Uses returned/uses affected Transformed Uses/ suggested alternatives usage Applied Alternatives usage/ suggested alternatives usage		
Environmental Management Plan that addresses the impact	Information Program and Community participation. Relocation Program for infrastructure and housing. Restitution Program of affected infrastructure Rural entrepreneurship program		

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5.3.3.15 Increase in accident risk

Table	28.
Environment Socioeconomic	Component: Space
Stage:	Construction, Operation.
Activity (s)	Removal of vegetation and bare soil Surface Excavations Underground Excavations Disposal of excavation leftovers Transport and hauling Operation of grinding and mixture plants Concrete pouring Construction and operation of camps and workshops Operation of the central plant.
Conditions without project	<p>Traffic accidents, according to the Municipal Development Plan for Cocorná, - are in the third place among the leading causes of mortality in the village, where some of the veredas that will be affected by the project facilities are located, and hence, for the construction and improvement of access roads¹². And does not have a program of immediate reaction to accidents on the roads. On the other hand, the emergency care plan was formulated by an external entity with some community participation, but little has been implemented¹³.</p> <p>Now that, however, the number of accidents on the roads is relatively high, these are not common in the veredas, within the influence area. During the year 2007, there were approximately 150 episodes of this type in the village, but all of them took place in the urban area or in the stretch of the Highway Medellin - Bogota located in jurisdiction of the municipality¹⁴.</p> <p>For the veredas, in the municipality of Granada, there are no reports of traffic accidents</p>
Description of the effect	The increase in the accident rates is related to both the construction of roads and the improvement of the existing access, with the consequent increase in vehicular

¹²Municipal Development Plan, Municipality of Cocorná 2007-2011. P.27

¹³ Op cit. P. 39.

¹⁴ Op cit. P. 54

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	<p>traffic, as to the activities related to the construction and operation of the plant.</p> <p>These may be on one side, collisions, pedestrian hittings and overturn or siding off of vehicles; and, on the other side, adding to the accidents characteristic of an agricultural economy, workplace accidents directly related to the company: falls, cuts, fractures, and bruises, burns caused by exposure to heat or by abrasion, electrocution and bites of poisonous animals among others.</p>		
Location	<p>Veredas, in the direct influence area belonging to the municipality of Cocorná: San Lorenzo, La Inmaculada, San Juan, El Chocó, El Molino, Campo Alegre and Los mangos.</p>		
Conditions with project	<p>With the settlement of the road and the construction of new accesses, the rates of traffic accidents may tend to increase, to the extent that traffic flow increases; even more if it is added to this increase other dynamics related to the project, such as the supply of sites dedicated to the sale of alcohol in the area and the consequent increase in the consumption by drivers.</p>		
Criteria	Rating	Cj	Justification
Class	Negative	(N)	The occurrence of accidents, both traffic and those related to the construction and operation of the project, will generate costs of medical care and eventually legal costs, economic loss, inconvenience to the community, as well as costs in terms of time spent in the care and attention of the same.
Presence	Likely	0.5	It is likely that with the construction and improvement of roads, as well as to the activities related to the construction and operation of the project, may occur some kind of accident or occurrence of work-related accidents.
Duration	Very long or permanent	0.99	The risk of accidents is obviously higher during the construction phase of the project.
Evolution	Medium	0.50	The peak of the effect is reached when all the roads are operating and the facilities construction find its peak.
Magnitude	Low	0.39	Due to the roads to be improved, as well as the roads to build are not going to be paved, both the traffic of vehicles and the speed will not be very high. In the same sense, the improvements will probably include appropriate road signals, which directly influence the risk of traffic

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			accidents.
Rating of environmental importance	2.2 - Irrelevant		
Indicator:	Number of accidents without project/number of accidents with project.		
Environmental Management Plan that addresses the impact	<p>Program Information and Community Participation.</p> <p>Environmental education program for workers and the community.</p> <p>Program for the handling of sources of particulate matter, gases and noise emissions.</p>		

5.3.3.16 Variation in health levels

Table	29.
Environment Socioeconomic	Component: Demographic
Stage:	Construction
Activity (s)	<p>Hiring of labor</p> <p>Removal of vegetation and bare soil</p> <p>Surface Excavations</p> <p>Underground Excavations</p> <p>Disposal of excavation leftovers</p> <p>Transport and hauling</p> <p>Operation of grinding and mixture plants</p> <p>Concrete pouring</p> <p>Construction and operation of camps and workshops.</p>
Conditions without project	<p>a " <i>The morbidity in the Municipality of Cocorná -sADI the Development Plan of the municipality 2008 - 2011- is the result of the interaction of the health models developed to date in the village by a series of variables, social, cultural, demographic and geographic, which show a highly sick population, high levels of consultation and a process of non culture of access to health services.</i></p> <p><i>The component of unmet basic needs in 35% of the population coupled with unemployment, low income of the population and the low productivity of the soil, draw an environment that requires the effective intervention in development</i></p>

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	<p><i>planning in the health component of the municipality for a population that is highly affected by morbid processes¹⁵ .</i></p> <p><i>Also in Granada, the Plan expresses that " the inhabitants of the municipality are suggesting that you must expand the coverage in the services in such a way that the appointments are not for the next day, but it would be improved in the promptness; they further requested the extension of the extramural programs in order to provide the possibility of a complete health care, quality and timely"¹⁶ .</i></p> <p>Public services in the direct influence area are weak: There are veredal, aqueducts, but none of them has water treatment system; the majority of the houses dispose their wastewater to the open field, also their waste, which can be reflected in the health of their inhabitants</p>		
<p>Description of the effect</p>	<p>The deterioration in the water quality due to discharges, or the bad management of wastewater, as well as the deterioration in the air quality, can become a cause of respiratory and digestive diseases among the population.</p> <p>Same wise, problems such as alcoholism, drug addiction, and sexually transmitted diseases can arise.</p>		
<p>Location</p>	<p>Vereda, Cocorná in the ADI of the project: San Lorenzo, La Inmaculada, San Juan, El Chocó, El Molino, Campo Alegre and Los mangos.</p>		
<p>Conditions with project</p>	<p>It is expected that with the arrival of personel to the facilities during the construction phase, as well as with the arrival of floating population and people offering goods and services, the demand for health services will increase, in both urban and rural areas, in addition new health problems can arise such as sexually transmitted diseases among the population, as well as the increase in the consumption of alcohol and drugs, with the consequences that this entails in terms of both diseases.</p>		
<p>Criteria</p>	<p>Rating</p>	<p>Cj</p>	<p>Justification</p>
<p>Class</p>	<p>Negative</p>	<p>(-)</p>	<p>The variation in healthiness levels within the influence area of the project is negative due to, the increase in population will require a greater demand on the water resource, increasing the sewage discharge into the water sources.</p>

¹⁵Development Plan for the Municipality of Cocorná 2008-2011. Cocorná, 2007. P.27

¹⁶ Ibid. P. 61

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			<p>Regarding the air quality, the increase of vehicular traffic, as well as certain activities relating to the construction, become emission sources of pollutant gases and particular matter that contribute to air deterioration, which is reflected in the health of the population.</p> <p>Another factor associated with the impact, is the increase in the supply of goods and services related to pleasure, such as gambling, sexual services, alcohol, drugs and prostitution, characteristic of projects of this type; due to the spread of venereal diseases, unwanted pregnancies and the increase in both diseases associated with the consumption and personal injury.</p>
Presence	Likely	0.4	Changes in the quality of the environment, can generate some health problems, that it is likely that with the arrival of floating population, problems of drugs, alcohol and sexual services, which can be reflected in the health of the population.
Duration	Short	0.39	The impact is linked specifically to the construction phase of the project.
Evolution	Medium	0.5	The greatest effect on health, presents itself at the peak of the construction, which is expected to be reached after the first year of construction.
Magnitude	Medium	0.4	Given the conditions in the zone, and by the type of facilities that will be executed, it is not expected a major change in the health levels in the area.
Rating of environmental importance	1.0 - Irrelevant.		
Indicator:	<ul style="list-style-type: none"> •Increased consultation and medical treatments by cause of illnesses and aches related to the pollution of the air and the water sources after the construction starts / increase in consultations and medical treatments cause of illnesses and aches related to the air pollution and the water sources before starting the construction •Venereal diseases after starting the construction/ venereal disease 		

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	<p>before starting the construction</p> <ul style="list-style-type: none"> •Number of cases attended because of usage of drugs and alcohol after the beginning of the construction/ Number of cases attended because of use of drugs and alcohol before starting the construction
Environmental Management Plan that addresses the impact	<ul style="list-style-type: none"> •PIPC •Environmental education program for workers and the community. •Institutional strengthening program. •Program of liquid waste.

5.3.3.17 Impairment on the archaeological heritage

Table	30.
Environment Socioeconomic	Component: Cultural
Stage:	Construction
Activity (s)	<p>Removal of vegetation and bare soil</p> <p>Surface Excavations</p> <p>Underground Excavations</p> <p>Disposal of excavation leftovers</p> <p>Transport and hauling</p> <p>Construction and operation of camps and workshops</p>
Conditions without a project	<p>Methodologically, the archaeological survey done was conceived as a systematic sampling in areas where there will be civil facilities, trying to find and characterize landscape units in which traces of past human occupations were found, with the aim of carrying out an assessment on the archaeological potential likely to be affected by the construction of the facilities.</p> <p>Although they are mini - hydroelectric plants, with small areas of influence, they are important for the exercise of archaeological research, because they are located in a very particular geographical area, which corresponds to the mountain toward the middle Magdalena, where the Cocorná and San Matias rivers converge. This area has been the subject of other hydroelectric projects development, which together deliver a corpus of valuable archaeological information, that has allow the</p>



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	<p>understanding of the particularities of the occupation dynamics of this part of the mountain range of the middle Magdalena (in correlation with the low-lying areas of the same river), with traces of pre ceramic occupations. Going to Pottery of early and late periods.</p> <p>At the identified, archaeological sites, were recovered ceramic and lithic vestiges, whose features allow formulating a sort of hypothesis, that the basin of the San Matias River, in the prospected stretch, was occupied from the early ceramic period</p> <p>At the 12 identified archaeological sites, were recovered 263 ceramic vestiges and 40 lithic elements, in cultural deposits identified in the landscape units, formed by dark organic soil with average thickness of 60 cm.</p>
Description of the effect	<p>The execution of a archaeological study prior to the development of any type of infrastructure work, seeks to provide compliance to the requirements of the Law 163 of 1959, the regulatory decree 264 of 1963, as well as the General Law of Culture 397 of 1997 reformed and updated under the law 1185 of 2008, along with what is contemplated in the 1991 Constitution in its articles 63 and 72, where it is declared the archaeological heritage as a tangible cultural asset that belongs to the Nation, and that is inalienable, irretrievable and indefeasible. In this sense, this type of study is looking to diminish the impact produced by the facilities carried out in the infrastructural development of the country, involving the alteration of the subsoil, and that consequently, somehow, could alter or harm, any vestige of human activity developed in the pre-Hispanic, colonial or republican eras, that constitute the cultural heritage of the nation.</p> <p>The concept of archaeological cultural heritage is part of the definition given by the General Law of Culture or Law 397 of 1997 in its fourth article: "The Cultural Heritage of the Nation is composed of all the goods and cultural values that are an expression of the Colombian nationality, such as the tradition, the customs and habits, as well as the set of intangible assets and materials, movable and immovable, that have a special interest in historical, artistic, aesthetic, plastic, architectural, urban, archaeological, environmental, ecological, linguistic, sound, music, audiovisual, video footage, scientific, testimonial evidence, documentary, literary, bibliographical, anthropological and the manifestation, the products and the representations of popular culture".</p>
Location	<p>The prospecting delivered as a result, the identification of 12 archaeological sites located in the direct and indirect influence area of the facilities of the El Molino and San Matias hydroelectric projects that will be affected by the construction of the</p>

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	same. Among these veredas, are El Molino; Los Mangos, Campo Alegre, Quebradona Abajo.																																																																																																
Conditions with project	According to the methodology used for the assessment of the archaeological impact in the studied deposits and which are detailed in the correspondent report, the results are presented in the table below.																																																																																																
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10 Los Mangos	883532	1160350	Deposit Area 3 San Matias	Complex El Oro	19	High																																																																																											
6A La Inmaculada	884968	1159593	Power house Area 2 San Matias	Complex El Oro	19	High																																																																																											
6B La Inmaculada	885024	1159606	Power house Area 2 San Matias	Complex El Oro	19	High																																																																																											
Criteria	Rating	Cj	Justification																																																																																														
Class	Negative	(-,N) (+,P)	This impact is positive and negative. Negative, since in the event that damage occurs to the identified archaeological artifacts, these and the value they represent to the cultural heritage of the nation cannot be returned. On the other hand, in some cases, when there are findings that contribute to the increase of knowledge about the people who inhabited the area long time ago, and makes a contribution to the enrichment of the archaeological and cultural heritage of the nation, the effect could be considered as positive.																																																																																														
Presence	Likely	0.69 0.69	The existence of this impact is likely, when failure to follow the recommendations and not taking into account the results of the archaeological monitoring. Also, ignore the																																																																																														

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			<p>proposals of the rescue and monitoring plan during the construction of the project can increase the presence of this impact.</p> <p>The obligation to perform preventive archeology in the development of this type of project, ensures that part of the knowledge related to the first occupants of this territory will be recovered.</p>
Duration	Very long or permanent	1	<p>In the event that the reported archaeological material is affected and the one additionally found, this effect is permanent, because of the loss of material and information that could be provided by this material</p> <p>In addition, the knowledge that is acquired with the archaeological work is permanent</p>
Evolution	Slow	0.39	<p>The top effect occurs when the project facilities are completed, which will take around 32 months.</p> <p>The knowledge about the potential occupants of this territory, is obtained when the studies of prospecting and rescue, are finished which last for more than a year</p>
Magnitude	High	0.8	<p>In the event that damage occurs on the archaeological heritage, it can cause the total destruction of information that would contribute knowledge about past cultures of the territory in the influence area, for the sub region of eastern Antioquia and the country.</p> <p>The research being conducted in this sub region of eastern Antioquia has allowed to begin to understanding the particularities of the occupation dynamics of this part of the mountain range in the middle Magdalena.</p>
Rating of environmental importance	3.6 - Moderate		
Indicator:	<p>Formulated Archaeological management plan / executed archaeological management plan</p> <p>Areas to monitor archaeologically/ archaeologically monitored Areas</p> <p>Identified Archaeological Material/ Rescued archaeological material</p>		
Environmental	Archaeological Management Plan		

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Management Plan that addresses the impact	Information Program and Community participation.
	Memory Program and heritage
	Environmental education program for workers and the community

5.3.4 Conclusions of qualitative evaluation

In Table 5-8 and Table 5-9 are the identification matrix of impacts and outcomes of the qualitative evaluation of El Molino Hydroelectric Project. They concluded:

Table 5-8 Effects Identification Matrix

Medio	Abiótico					Biótico				Social											
						Ecosistema Terrestres		Ecosistema Acuático		Cultura	Demografía	Espacial	Económico		Político						
	Componente	Aire	Agua	Suelo	Terrestres	Acuático	Cultura	Demografía	Espacial				Económico	Político							
Actividades	Elementos	Concentración de material particulado y gases	Nivel de presión sonora	Dinámica fluvial	Calidad fisicoquímica	Propiedades físicas y químicas	Paisaje	Biocenosis	Biotopos	Biocenosis	Biotopos	Arqueología y patrimonio cultural	Ejes articuladores	Dinámica poblacional	Salubridad	Servicios sociales y públicos	Vías y transporte	Actividades económicas	Empleo	Relaciones de poder	Estructura del conflicto
Etapa preliminar																					
Actividades previas																					
Etapa de construcción																					
Compra de predios																					
Contratación de mano de obra																					
Remoción de vegetación y descapote																					
Excavaciones superficiales																					
Excavaciones subterráneas																					
Disposición de sobrantes de excavación																					
Transportes y acarreo																					
Operación de plantas de trituración y mezclas																					
Vaciado de concretos																					
Construcción y operación de instalaciones temporales y fijas																					
Etapa de operación del proyecto																					
Operación de la central																					

Table 5-9 Qualitative Assessment Effects

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Impacto	Parámetros	Presencia	Duración	Evolución	Magnitud	Calificación	Clasificación
Aumento de la concentración de material particulado y gases		1,00	0,39	0,70	0,40	3,1	Moderada
Aumento de los niveles de presión sonora		1,00	0,39	0,70	0,20	2,2	Irrelevante
Alteración de la dinámica fluvial		1,00	1,00	0,40	0,30	3,8	Moderada
Cambios en la calidad del agua		0,69	0,19	1,00	0,60	3,3	Moderada
Disminución de la disponibilidad del agua		0,70	1,00	0,69	0,70	4,5	Moderada
Cambios en las propiedades físicas y químicas del suelo		1,00	0,39	0,40	0,20	1,7	Irrelevante
Modificación del paisaje		1,00	1,00	0,39	0,39	4,1	Moderada
Cambios en la cobertura vegetal		1,00	1,00	1,00	0,19	4,3	Moderada
Pérdida o fragmentación de hábitats		1,00	1,00	0,39	0,70	4,9	Moderada
Muerte y desplazamiento de fauna terrestre		1,00	0,39	0,39	0,80	3,4	Moderada
Aumento de la presión sobre los recursos naturales		1,00	0,99	0,75	0,70	6,65	Relevante
Cambios en la comunidad íctica del río San Matías		0,60	1,00	0,39	0,90	3,3	Moderada
Cambios en la estructura del biotopo y biocenosis acuático		0,95	1,00	0,40	0,70	4,7	Moderada
Cambios en los niveles de gobernabilidad		0,99	0,99	0,69	0,69	6,2	Relevante
Afectación del patrimonio cultural		0,80	1,00	0,50	0,50	3,8	Moderada
Potenciación de conflictos		0,69	1,00	0,20	0,50	2,6	Moderada
Desplazamiento de infraestructura y viviendas		1,00	1,00	0,60	0,19	3,8	Moderada
Cambios en la dinámica poblacional		0,60	0,39	0,70	0,39	1,8	Irrelevante
Incremento en la demanda de bienes y servicios		0,99	0,39	0,50	0,65	3,4	Moderada
Generación temporal de empleo		1,00	0,39	0,80	0,60	4,5	Moderada
Modificación de las finanzas municipales y de las corporaciones ambientales		1,00	1,00	0,99	0,39	5,7	Relevante
Generación de expectativas		1,00	0,39	0,70	0,80	5,09	Relevante
Modificación de la movilidad local		1,00	1,00	0,39	0,50	4,4	Moderada
Afectación de las actividades económica		1,00	0,69	0,99	0,10	2,8	Moderada
Presión sobre el mercado inmobiliario		0,50	0,39	0,19	0,39	0,8	Irrelevante
Generación de molestias a la comunidad		1,00	0,39	0,99	0,69	5,95	Relevante
Cambios en los usos del suelo		1,00	1,00	0,39	0,10	3,3	Moderada
Incremento en los riesgos de accidentalidad		0,50	0,99	0,50	0,39	2,2	Irrelevante
Variación en los niveles de salubridad		0,40	0,39	0,50	0,40	1,0	Irrelevante
Afectación al patrimonio arqueológico		0,69	1,00	0,39	0,80	3,6	Moderada
Afectación al patrimonio arqueológico		0,69	1,00	0,39	0,80	3,6	Moderada

	Irrelevante		Relevante		Positivo
	Moderada		Grave		

- The El Molino hydroelectric project generates 30 impacts: seven in the biotic environment, six in the physical environment and 17 in the socio-economic environment, some of them positive and negative.
- Of those 30, five impacts are positive, all of them are presented in the socio-economic environment, two with relevant rating: Changes in the levels of governance, and modification of the municipal finances and regional corporations, with ratings of 6.2 and 5.7 , respectively.

Three of the four positive impacts are classified in the moderate range: Increase in the demand of goods and services (3.4), generation of temporary employment (4.5) and modification of the local mobility (4.4).

- There is another impact on the socio-economic environment that is positive and negative, affectation of the archaeological heritage, which it gains a moderate rating (3.6).The positive effect is presented by compliance with Act 163 of 1959 and the decree 264 of 1963, where they make projects such as El Molino, to perform a task of preventive

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archeology, which retrieved part of the knowledge of the early inhabitants of the influence area of the project.

- The greatest negative effect that the construction of the El Molino hydroelectric project, generates is presented in the biotic environment: Increase pressure on natural resources, which gained a negative rating of 6.65, classifying it as relevant. The value of this impact is considering the synergy that can occur with another one that the project generates, which is positive: Modification of the local mobility, and that the community will have access to reach the forest areas and to exploit them.
- With the construction of the access roads to power house and collection site, the population of the influence area will be able to access more easily to the forested hedges with timber species such as: *Heliocarpus americanus* (white balsam), *Cinnamomum triplinerve* (Laurel Perillo), *Nectandra spp.*, *Jacaranda copaia* (Chingale), *Aniba cf. Muca* (Laurel inciden), *Ficus popayanensis* (salary), in addition to other with various uses in the area as the palma Euterpe precatoria (Palm-kernel oil).
- This effect is mitigated with environmental education programs aimed at the population of the influence area, and a teamwork of the project owner, with the municipal administrations in Cocorná and Granada, as well with CORNARE.
- Of the seven negative impacts identified in the biotic environment, two obtained the qualification of irrelevant: Increased levels of sound pressure (2.2) and changes in the physical and chemical properties of the soil (1.7). The last one, in the areas where it occurs cannot be avoided, since the ground is replaced by a hard surface, so that it can compensate with reforestation programs and mitigate with suitable management of excavations during construction; however, the obtained qualification is explained because the affected area is less than 2% of the influence area of El Molino hydroelectric project.
- The five other impacts of the biotic environment were classified in the range of moderate; four of them can be prevented or mitigated: Increasing the concentration of particulate material (3.1), alteration of river dynamics (3.8), changes in the water quality (3,3), and modification of the landscape (4.1).

The other impact on the biotic environment is the beginning of decline in water availability (4.5), which is related to the possible effect that can generate the conduction tunnel, in the surface currents located along its alignment. For this effect it was implied in the Management Plan, a management program for the water supply, the settled population along the path of the conduction tunnel, which includes hydro geologic studies, design and construction of veredal aqueducts.

- The other five impacts of the biotic environment, which obtained a moderate rating, can be mitigated or prevented. The impact; changes in the fish community of San Matias River (3.3) and structure changes in the aquatic biotope and biocoenosis (4.7), is mitigated with the establishment of a flow that minimizes ecological changes that may occur in the stretch of the river between the collection and discharge sites.

For the management of the other three impacts of the biotic environment (changes in the vegetation (4.3), Loss or fragmentation of habitats (4.9) and death and displacement of terrestrial animals (3.4)) is very related with measures to mitigate the effect related to changes in vegetation covering and with the environmental education program that includes a component that is related to the management of natural resources.

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- Of the 11 negative impacts identified in the socio-economic environment, which are preventable or mitigated, two obtained a qualification of relevant: Generation of expectations (5.09) and Generation of inconvenience to the community (5.95), which is explained by the conditions experienced in the area in recent times, and the position of some organizations with regard to the electric generation projects. These two effects can be prevented with the development of an information program and community participation, accompanied by environmental education programs, and a program of labor recruitment.

Four other impacts are in the category of irrelevant: Changes in population dynamics (1.8), pressure on the real estate market (0.8), increase in the risk of accidents (2.2) and va The rest, five, were rated as moderate: Affection of economic activities (2,8), involvement of the cultural heritage ((3,8), empowerment of conflicts (2.6), travel infrastructure and housing (3.8) and changes in land use (3.3)

- For the impacts identified in this environment, as well as in the biotic and biotic environments, three programs should be run that will be used to prevent or mitigate the effects of the project: a Program for Information and community involvement, and a program of institutional and community strengthening , and a Education Program.
- To analyze the identification impact matrix, it is noted that the activity of the central plant operation modifies 14 elements of the environment (three of the biotic environment, two of the biotic environment and nine of the socio-economic environment).

They are followed by: Surface excavations that modifies 12 elements (six of the biotic environment, four of the biotic environment and two of the socio-economic environment); as well as number of modifications that generates the construction and operation of camps and workshops, but it modifies more elements of the socio-economic environment, nine in total, only three of the biotic environment.

5.4 ASSESSMENT OF CUMULATIVE IMPACTS

5.4.1 Biotic Environment - alteration of water quality

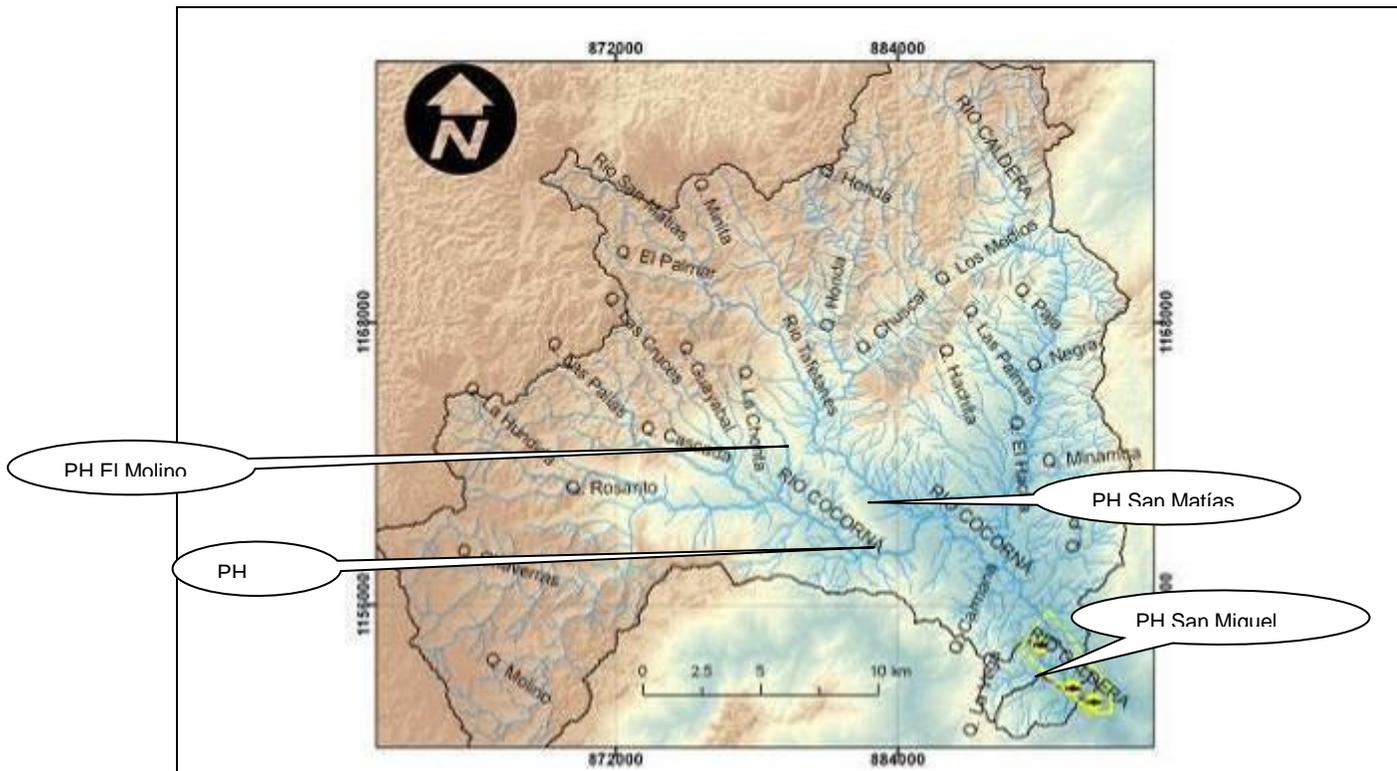
For the types of projects that HMV ENGINEERS is developing in eastern Antioquia, the only cumulative effect that could occur is the modification of the water quality of the Calderas River, which would reflect the effect of the four mentioned projects in section 5.2.2.

There is no change in the river dynamics, related to the change in the regime of sediments, because all the projects to be constructed on water edge area, do not have a dam that functions as a sediment trap.

5.4.1.1 Modification of the water quality in the Calderas River basin riation of sanitation levels (1.0).

I. DESCRIPTION OF THE IMPACT
Description The basin of the Calderas River is located east of the department of Antioquia, on the Central mountain range, in the jurisdiction of the municipalities of Cocorná, Granada, Santuario, Carmen de Viboral, San Carlos, San Francisco and San Luis, up to where the impact analysis is performed, as you can see in the following figure

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The main tributary of the Calderas River is the Cocorná River, where is located El Popal hydroelectric project, located in the western area of the basin, and this in turn is tributary by the San Matias River (where is located the San Matias hydroelectric projects and El Molino) and Tafetanes, and the villages Molinos, Chaverras, Rosarito, La Hundida, Las Pailas, Guayabal, La Cascada, La Camana, among others. To the east, the Calderas River is tributary by the Creeks Los Medios, Paja, Negra, El Hacha, El Hachita, El Poral, and Minarriba among others.

Nature	Positive	<input checked="" type="checkbox"/>	Negative	<input checked="" type="checkbox"/>	Undetermined	
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Relationship with other impacts:
 This impact is also reflected in aquatic ecosystems and in the communities located downstream of the project.
 In addition, the water quality is affected by the change in the pattern of sediment transport, for alteration of the erosion rate, such as changes in vegetation coverage.

Sources of the impact	A single activity		Multiple activities	<input checked="" type="checkbox"/>
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External activities that cause it:

- The agricultural and domestic that are presented in the whole basin of the Calderas River
- Construction materials exploitation.

II. CHARACTERISTICS.

II. 1 accumulation process: (Additive or interactive)

Additive: The water quality is changing as new pollutant loads are added and has not enough time or space to

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recover through the natural purification processes.

Interactive : Water quality is affected by the modification of the flow rate that generates hydroelectric projects located in the basin.

II. 2 Spatial Aspects

Geographic Scope	Form of distribution	Configuration
<p>Local : changes in the quality of the water of the Calderas River, will affect the existing ecosystems, in the stretches affected by hydroelectric projects analyzed in this study</p>	<p>Dispersed : wastewater discharges are performed along the entire basin.</p>	<p>Linear : the effect is reflected along the river flow.</p>

II. 3 temporal Aspects

Time Horizon	Frequency
<p>Changes in water quality of the streams in the basin of the Calderas River, began right from the very moment of the occupation by the first inhabitants, who changed the landscape, changed the land uses, and generated wastewater, affecting the quality of the resource.</p> <p>The establishments of population centers that discharge their waste into rivers without any type of treatment, as they do in Cocorná and Granada, have continued with this change.</p> <p>However, there is no information to allow it to analyze with reliability, which has been the cumulative process that has been presented in the water quality of the streams belonging to the Calderas River basin.</p> <p>Therefore in this analysis, it is only considered the information gathered for the four projects listed above</p>	<p>Permanent : The pollutant inputs in the basin from the anthropic activities that are developed in it, shall be maintained until such activities prevail</p>

III. NECESSARY INFORMATION FOR MPACT EVALUATION .

To evaluate this impact the following information is required:

- Records of water quality in the rivers and the basin of Calderas River
- Models of water quality.

Now that the used information only applies to a monitoring campaign done for environmental studies on the four

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projects, it is not feasible to calibrate a model that allows predicting the future water quality of the Calderas River.

• **Indicator**

To build a quality profile of the river, the Index of Water Quality (WQI) will be used, developed by the National Sanitary Foundation of the United States¹⁷.

This index considers nine parameters of evaluation, to which they are given a relative weight, according to their importance in the definition of the water quality.

The parameters considered and defined weights are presented in Table 5-10.

Table 5-10 Parameters for the WQI development.

Variable	Relative Value
Dissolved Oxygen (DO)	0.17
Fecal Coliforms	0.15
PH	0.12
Biochemical Oxygen Demand (BOD)	0.10
Nitrates	0.10
Phosphates	0.10
Temperature	0.10
Turbidity	0.08
Total solids	0.08
Total	1.00

And the index is obtained by the following expression:

$$WQI = \sum_{i=1}^9 V_i * L_i$$

Where

- WQI = Index of water quality
- V_i = relative weight of parameter i
- L_i = value of the parameter i.

Once the index is calculated, the quality of the resource is classified according to the range defined in Table 5-11.

Table 5-11 Water quality in accordance to the WQI

¹⁷ Canter, Larry W., Manual of Environmental Impact Assessment, 1999

Type	WQI Value
Excellent	91-100
Good	71-90
Regular	51-70
Bad	26-50
Very bad	0-25

• **Diagnosis of the basin**

With the data of water quality the Index of water quality was built, for all the sampled points in the analyzed studies, which can be seen in the data collected in the analyzed studies shown in Figure 5-3

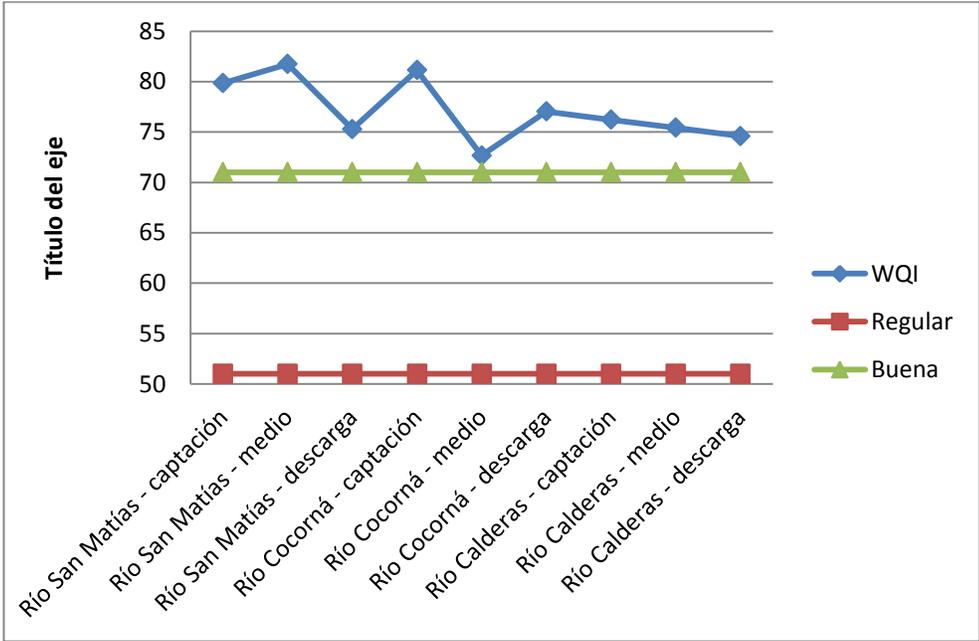


Figure 5-3 Quality Index NFS-WQI in the Calderas River basin

As noted, the water quality of the Rivers San Matías, Cocorná and Calderas can be considered as good, which indicates that so far, the activities that are been run in the area where the hydroelectric project will be constructed El Popal, San Miguel, San Matias and El Molino, are not generating a cumulative process, although it must be borne in mind that there is very few data to reach a reliable conclusion.

This analysis will continue with the information collected in the implementation of the management plans of the hydroelectric projects.

5.4.2 Biotic environment

The cumulative impacts of the biotic environment are related to the vegetation coverage, and a change in the aquatic ecosystems in the study area.

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Table 5-12 presents the identified impacts in the consulted environmental studies in the projects to build in the middle and low basin of the San Matias River, project Popal under construction in the middle basin of Cocorná and project San Miguel in Calderas River middle basin.

Table 5-12 Impacts associated with the biotic environment, identified in the consulted environmental studies

Cumulative Impact	HIDROELETRIC PROJECT EL MOLINO	San Matias hydroelectric project	Hydroelectric Project Popal	Hydroelectric Project San Miguel
Modification of the vegetation covering	<ul style="list-style-type: none"> • Changes in vegetation coverage • Loss or fragmentation of habitat • Death and displacement of fauna species • Pressure Increase on natural resources 	<ul style="list-style-type: none"> • Changes in vegetation coverage • Loss or fragmentation of habitat • Death and displacement of fauna species • Pressure Increase on natural resources 	<ul style="list-style-type: none"> • Changes in vegetation coverage • Loss or fragmentation of habitat • Death and displacement of fauna species • Pressure Increase on natural resources 	<ul style="list-style-type: none"> • Changes in vegetation coverage • Loss or fragmentation of habitat • Death and displacement of fauna species • Pressure Increase on natural resources
Modification of the aquatic systems	<ul style="list-style-type: none"> • Changes in the fish community of San Matias River. • Changes in the structure of the aquatic biotope and biocenosis 	<ul style="list-style-type: none"> • Changes in the fish community of San Matias River. • Changes in the structure of the aquatic biotope and biocenosis 	<ul style="list-style-type: none"> • Changes in the fish community of Cocorná River • Changes in the structure of the aquatic biotope and biocenosis 	<ul style="list-style-type: none"> • Changes in the fish community of Calderas River • Changes in the structure of the aquatic biotope and biocenosis

5.4.2.1 Modification of vegetation covering

I. DESCRIPTION OF THE IMPACT
<p>Description</p> <p>In the influence area of the hydroelectric projects Molinos, San Matias, Popal and San Miguel, the main traditional activities that develop in the area are agriculture, cattle rising and timber extraction. They have led to a modification of the natural hedges, being the clean pasture and weeded, the predominant coverage</p>



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To these changes is added the ones generated by the construction of hydroelectric projects, since it requires removing vegetation for the construction of the superficial facilities (house of engines, substation, line, deposits, accesses, camps) and the formation of the reservoir for the San Miguel project

In addition, the establishment of the project induces changes in the use of the soil, since the four projects include the establishment of a biological corridor along the rivers San Matias, Cocorná and Calderas, between the collection sites and power house of each one of them, which increases the availability of forested areas that offer a habitat for wildlife, connects fragments, restoring ecosystem functions related to the flow of energy and matter, and restores environmental services associated with water regulation and protection of the soil.

Nature	Positive	<input checked="" type="checkbox"/>	Negative	<input checked="" type="checkbox"/>	Undetermined	
Type	For a project on the environment		<input checked="" type="checkbox"/>	Of the project environment		<input checked="" type="checkbox"/>

Relationship with other impacts:

The modification of vegetation covering and uses of soil is related to the pressure on natural resources and the loss and fragmentation of habitats for terrestrial animals.

Sources of the impact	A single activity		Multiple activities	<input checked="" type="checkbox"/>
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External activities that cause it:

Opening of agricultural and cattle raising frontier, timber extraction.

II. CHARACTERISTICS.

II. 1 accumulation process: (Additive or interactive)

Additive: The modification accumulation of the vegetation coverage's it has been given temporarily due to the appearance of the projects and activities that affect it and spatially by overlapping the influence areas.

II. 2 Spatial Aspects

Geographic Scope	Form of distribution	Configuration
Regional : The modification covers the influence area of the analyzed hydroelectric projects : Molinos, San Matías, Popal y San Miguel	Continued: The modifications in vegetation covering has effects on the elements that constitute the landscape (patches, matrix, and corridors) and relations between these are given by their distribution across the evaluated surface , which can correspond physiographical to landscape units or sub landscape.	Area: The configuration is presented by surfaces.

II. 3 temporal Aspects

Horizon (Time Framework)	Frequency
The changes in vegetation covering has been	Discreet: Changes in the composition in vegetation covering

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<p>made in the area since they started the first settlements in the river Calderas basin , with the construction of access roads to the populated centers located in the area, and with changes in land use that is made with these settlements as a result of agricultural activities, cattle raising and timber.</p>	<p>is caused by discontinuous events in time.</p>
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------

III. NECESSARY INFORMATION FOR IMPACT EVALUATION .
<p>Air photographs, satellite images, which allow to assess the changes that have been presented through time in vegetation covering.</p> <p>For this analysis of cumulative impacts, It was analyzed the existing information in the environmental studies of the hydroelectric projects Molinos, San Matias, Popal and San Miguel.</p>

- **Indicators**

As the modification of vegetation coverage affects the terrestrial flora and fauna, indicators were defined for each one of them:

The indicators with which the impact will be assessed are obtained from a formula that expresses the relationship of the area in a given coverage in a year compared to the area in this cover in a year of reference, which in this case it is assumed as for 2011.

- **Flora Indicator**

$$\text{Modificación } CV_x = \frac{CV_{\text{año evaluado}}}{CV_x \text{ año } 2011}$$

Where

- CVx vegetation coverage assessed.

- **Fauna Indicator**

➤ *Relación tamaño medio fragmentos* = $\frac{MPS \text{ CV } x \text{ año evaluado}}{MPS \text{ CV}_x \text{ 2011}}$

➤ *Índice media de forma* = $\frac{MSI \text{ CV } x \text{ año evaluado}}{MSI \text{ CV } x \text{ 2011}}$

➤ *Relación perímetro / área* = $\frac{MPAR \text{ CV } x \text{ año evaluado}}{MPAR \text{ CV } x \text{ 2011}}$

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➤ *Media relación fractal* =
$$\frac{MFRACT\ CV\ x\ año\ evaluado}{MFRACT\ CV\ x\ 2011}$$

• **Diagnosis of the basin**

In accordance with the environmental studies on the four analyzed hydroelectric projects , in the influence area dominate the pasture; in the influence area of the hydroelectric project Molinos, of 29.29 ha of the direct influence area that will be affected by the project, 10.72 are clean pastures. In San Matias of 13.85 ha, 4.32 are clean pastures (32% of the total). For Popal 20.72 ha have been reported in these pastures, which are equivalent to 68% of the total area to be affected and finally for San Miguel occupies 9.99 ha that is equivalent to 45% of the total.

To analyze the areas of forest coverage that will be intercepted by the projects, including forests and high secondary vegetation, is:

Project	Dense Forest	Dense Forest of Guadua	Open Forest	High secondary vegetation
Molinos	-	0.41	1.46	3.43
San Matías	0.60	1.55	0.57	3.08
Popal	0.10	0.15	1.58	2.16
San Miguel	0.23	0.21	4.9	4.76
Total	0.93	2.32	8.51	13.43

These changes of coverage will be compensated by the proposals raised in the management plans of the environmental studies analyzed, which formulate formation of biological corridors along the rivers San Matias, Cocorná and Calderas:

- The hydroelectric project Molinos will compile a strip of protection between collection and power house of 57.80 ha.
- It is projected with the hydroelectric project San Matías, next to the corridor formed in Molinos, constitute another corridor to join the proposed one for E Popal. The first will occupy an area of 48.97 ha.
- In project Popal is expected to be conformed a biological corridor of 89 ha from collection to the confluence of the San Matias and Cocorná, by joining the planned for Molinos and San Matias. This corridor has already started to be conformed.

For the Calderas River, as compensation for the allocation of forest coverage by the facilities of the project San Miguel, it is formulated the formation of a corridor of 116 ha.

On the whole, the four projects will conform an area of 331, 77,ha of corridors

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In conclusion, with the four hydroelectric projects affect 25.19 ha of forest cover will be affected, including Guadua and high secondary vegetation , which 331, 7 ha, of biological corridors with forest will be compensated.

5.4.2.2 Modification of aquatic ecosystems

I. DESCRIPTION OF THE IMPACT				
Description				
<p>In the influence area of the four projects (El Molino, San Matias, Popal, San Miguel), it is highlighted the fact that none of the found species is migratory. The low diversity of species is a behavior that occurs frequently in this kind of environments, which is of high mountain ecosystems, in which the strong dragging efforts , the steeped topographies, the absence of indigenous food supply, are some of the main factors that determine the low diversity</p>				
Nature	Positive		Negative	X Undetermined
Relationship with other impacts:				
<p>The changes in aquatic ecosystems is related to changes in the river dynamics of the rivers San Matias, Cocorná, and Calderas generated by the hydroelectric project Molinos, San Matias, Popal and San Miguel.</p>				
Impact Sources	A single activity		Multiple activities	X
External activities that cause it:				
<p>In the evaluated stretches in the environmental studies on the three projects, there is no evidence of activities in the environment that may have an impact on aquatic ecosystems. Spills that are made do not reach to modify the water quality up to limit the presence of aquatic biota and despite of intensive timber extraction that could increase the inputs of sediments, there is no evidence a high burden of solids.</p>				

II. CHARACTERISTICS.		
II. 1 accumulation process: (Additive or interactive)		
<p>Additive: As it regulates the flow, especially the of the San Matias River that contemplates the two hydroelectric projects in its middle and lower watershed, Molino and San Matias, the habitat conditions, are altered affecting the composition and structure of the aquatic biota.</p>		
II. 2 Spatial Aspects		
Geographic Scope	Form of distribution	Configuration
<p>Regional : It is a regional impact because it affects the biota of the San Matias River, Cocorná and Calderas.</p>	<p>Continued: The changes are manifested throughout the course of the rivers San Matias, Cocorná and Calderas</p>	<p>Area: The configuration is linear.</p>

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II. 3 temporal Aspects	
Horizon (Time Framework)	Frequency
The regulation of flow starts from the collection of project Molinos on the San Matias River and continues with the San Matias project. On his part the Cocorná River regulates the hydroelectric Popal and the Calderas River the San Miguel hydroelectric	Discreet. It is given by the extent of the regulation the flow

III. NECESSARY INFORMATION FOR IMPACT EVALUATION .
For the study of the modification of the aquatic systems it was used the information of the samplings in the rivers San Matias, Cocorná and Calderas during environmental studies on the projects Molinos, San Matias, Popal and San Miguel.

- **Indicator**

To assess the impact following indicator will be used:

Deterioration of Aquatic Ecosystems (DAE) = Richness of fish species, micro algae and macro invertebrates.

- **Diagnosis of the basin**

In accordance with the studies of the hydroelectric projects Molinos and San Matias, torrent conditions limit the presence of fish and their abundance. The last one responds to a typical pattern of Andean ecosystems, in which the upper parts of the river have less number of individuals; the sampling notes for the collection area for Molinos low abundances when compared with those found in the discharge of the San Matias in confluence with the Cocorná River.

For both the San Matias River as for rivers Cocorná and Calderas, the studies show that the most abundant families match those described in the literature on the environments located in the Andean zone (Patino 1974), where the temperatures and attitudinal gradient are very wide, and aquatic lotic ecosystems (Creeks) have physical, topographic and environmental limitations, favoring the more abundant and frequent families of fish which are Trichomycteridae, Astroblepidae and Characidae.

5.4.3 Socio-economic environment

The cumulative impacts of the socio-economic environment are related to the increase in municipal revenue and the regional corporations as well as the modification of social relations.

Table 5-13 presents the identified impacts in the environmental studies consulted in the projects to be built in the river basin of Calderas, which are related to these cumulative impacts

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Table 5-13 Impacts associated with the socio-economic environment, identified in the consulted environmental studies

Cumulative Impact	HIDROELETRIC PROJECT EL MOLINO	San Matias hydroelectric project	Hydroelectric Project Popal	Hydroelectric Project San Miguel
Income Increase of the municipal and regional corporations	Modification of the municipal finances and the environmental corporation	Modification of the municipal finances and the environmental corporation	Modification of the municipal finances and the environmental corporation	Modification of the municipal finances and the environmental corporation
Modification of social relations	<ul style="list-style-type: none"> • Generation of expectations. • Changes in population dynamics. • Displacement of infrastructure and housing. • Empowerment of conflicts. • Changes in employment levels • Modification of the local mobility 	<ul style="list-style-type: none"> • Generation of expectations • Changes in population dynamics • Displacement of infrastructure and housing • Empowerment of conflicts. • Changes in employment levels • Modification of the local mobility 	<ul style="list-style-type: none"> • Generation of expectations. • Changes in population dynamics • Allocation of infrastructure and housing • Empowerment of conflicts • Changes in employment levels • Modification of the local mobility 	<ul style="list-style-type: none"> • Generation of expectations. • Changes in population dynamics • Allocation of infrastructure and housing • Empowerment of conflicts. • Changes in employment levels • Modification of the local mobility

5.4.3.1 Increase in municipal revenue and the Regional Corporation

I. DESCRIPTION OF THE IMPACT
<p>Description</p> <p>In accordance with the characterizations of the environment that are presented in the environmental studies on El Molino hydroelectric projects, San Matias, El Popal and San Miguel, the main economic activities in the influence area is agriculture, cattle breeding and the extraction of timber, therefore the municipal income is mainly related to the taxes generated by these activities, which are very low and barely enough to cover the operating costs, and the budget available for investment in the environment and basic sanitation is almost null</p> <p>In Colombia the electric generation projects must make transfers of money to the municipalities and environmental</p>

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corporations as a compensatory mechanism for the use of the natural resources and territories, which for the hydroelectric projects correspond to the 6% of gross sales per generation, in accordance with Law 99 of 1993 and that has a specific destination for the environment conservation.

By the presence of the four hydroelectric projects in the middle basin of the Calderas River, new revenues are generated for the municipalities in the influence area of the projects, as well as to the Environmental Corporation with competition in the basin of the river.

Nature	Positive	<input checked="" type="checkbox"/>	Negative	<input type="checkbox"/>	Undetermined	<input type="checkbox"/>
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Relationship with other impacts:

The modification of income of environmental corporations and municipalities change the governance capacity of the administrations of the municipalities in the influence area of the hydroelectric projects.

Impact Sources	A single activity	<input checked="" type="checkbox"/>	Multiple activities	<input type="checkbox"/>
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External activities that cause it:

Non

II. CHARACTERISTICS.

II. 1 accumulation process: (Additive or interactive)

Additive: All the hydroelectric projects that will be built in the basin of the Calderas River generate transfers to municipalities that are upstream of the dam sites of the analyzed projects . For the autonomous regional corporation, joined the transfers of all generation projects that operate and develop in their jurisdiction.

II. 2 Spatial Aspects

Geographic Scope	Form of distribution	Configuration
Regional : This is an effect located in each municipality located upstream of the sites for collection of hydroelectric projects Molinos, San Matias, Popal and San Miguel and it is regional due to the coverage of the Corporación Autónoma Regional - CORNARE.	Continues: There is spatial continuity given the closeness of the municipalities involved	Area: Presented by surfaces that corresponds to the extension of the municipalities.

II. 3 temporal Aspects

Horizon (Time Framework)	Frequency
The obligation to transfer to the municipalities and the	Discreet. It is given each time a hydroelectric project is

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Regional Autonomous Corporations the 6% of the gross sales of energy, arises with the entry of Law 99 of 1993.	built
----------------------------------------------------------------------------------------------------------------	-------

III. NECESSARY INFORMATION FOR IMPACT EVALUATION .
For the analysis of this impact is used the information to be found in the environmental studies of the hydroelectric projects Molinos, San Matias, Popal and San Miguel

- **Indicator**

The indicators to evaluate this impact are:

- For the Corporation: $VIC = \frac{\text{total ingresos año con transferencias}}{\text{total ingresos sin transferencias}}$
- For the municipalities: $VIM = \frac{\text{Presupuesto del año con transferencias}}{\text{Presupuesto del año sin transferencias}}$

- **Description of the basin**

Within the financial instruments it has been considered that transfers from the electricity sector, as one of the rents for the Autonomous Regional Corporations and municipalities, resources that should be spent with specific purposes, associated with the compensation and assurance of the availability of the resource by electric power generation.

Article 45 of Law 99 of 1993 provides that the power-generating companies, whose total installed power rating exceeds the 10,000 kilowatts, must transfer the 6% of the gross sales of energy generation, by itself, in accordance with the fee for sales in that block, point the Energy Regulation Commission.

This 6% should be distributed in a 3% for the Autonomous Regional Corporation and 3% for the municipalities located in the watershed that the project takes place.

After analyzing the available information for the four projects is concluded:

- **San Miguel**

Will Transfer the 6% of the gross sales of energy per year, divided into a 3% that will receive CORNARE and another 3% for the municipalities and districts located in the basin distributed as well: a 1.5 % for the municipalities of San Luis and San Francisco where it is located the small dam, and the other 1.5 % for the municipalities of the watershed, which make the municipalities of Granada, Cocorná, El Carmen de Viboral, San Carlos and El Santuario, San Francisco and San Luis. The municipality also will benefit from the annual compensation for property tax and annual payment of property taxes by constructions of ownership of the project (article 4° law 56/81), also there will be a collection concerning the annual payment by concept of industry and commerce.

According to the above, it is estimated that CORNARE will receive by the generation of energy from project San Miguel, \$480.0 million Pesos

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On the municipal transfers San Francisco will receive \$96.4 million and San Luis \$143.6 million per year for being the two municipalities where the dam is located, for being a part of the hydrographic basin seven municipalities will receive a total of \$240.0 million Pesos distributed in the following way.

- Carmen de Viboral \$54.3 million
- Cocorná \$68.8 million
- Granada \$71.8 million
- San Carlos \$2.9 million
- San Francisco \$900,000
- San Luis \$27.0 million
- Santuario \$14.3 million

By industry and commerce the municipality of San Luis, it is estimated to raise \$15,391,320

In terms of annual compensation for property taxes, it is estimated that San Francisco would collect for the first year \$139 and San Luis \$150,684 , while the property tax from buildings and houses would have \$93 to San Francisco and 13,754 in San Luis.

– **Popal**

It is estimated that CORNARE will receive by the generation \$229.6 million (1.02 % more income for transfers with respect to the received in 2008).

On the municipal transfers Cocorná will receive \$114.8 million for being the municipality where the dam is located. For being part of the basin, Cocorná will receive \$53.6 million, El Carmen de Viboral \$57.9 million and El Santuario \$3.3 million.

By industry and commerce, Cocorná will raise \$7,329,200 .

In terms of annual compensation property taxes will be raised in Cocorna, a estimated for the first year of \$148,837 , while the property tax from buildings and houses would have a value of \$38,314

– **San Matias and Molinos**

For each of these two projects which have the same installed capacity the income will be the following:

By the generation the Corporation will receive \$227.7 million

The 1.5 % for municipalities in the basin is distributed like this (annual):

- Cocorná: \$7.8 Million
- El Santuario: \$23.2 Million
- Granada: \$82.9 Million

The 1.5 % for the municipalities of the dam (annual)

- Cocorná: 55.6 Million
- Granada: 58.3 Million

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By industry and commerce, Cocorná collected 8.9 million

Table 5-14 shows a summary of the revenues from the four projects for the Corporation and municipalities

Table 5-14 Cumulative transfers

Transfer Tax	Annual Income (millions of pesos)							
	Cornare	Cocorná	San Francisco	San Luis	Granada	San Carlos	Santuario	Carmen de Viboral
3% PER generation	1.165							
1.5 % Dam		226	96	143.6	106.6			
1.5 % Basin		138	0.9	27.07	237.6	2.9	64	112.2
Industry and Trade		16.2		15.4				
Total	1.165	380.2	96.9	186.07	344.2	2.9	64	112.2

5.4.3.2 Modification of social relations

I. DESCRIPTION OF THE IMPACT					
Description					
<p>The presence of hydroelectric projects in a region generates expectations in the population related to the size of the same, the potential impacts on infrastructure, cultural changes by the arrival of outside population and employment options among others.</p> <p>For its part, the necessary interaction with the local population of those who arrive with the project is the result of transformations in diverse order: deterioration of the social relations by the generation of feelings of individual and collective competence, increased demands for goods and services and the urban type pressures, among others. In addition, changes in social relations are also presented by the emergence of new economic actors in the region, which may provide an opportunity to attribute competence obligations of the state or take it as a pretext for various types of claims.</p> <p>With the emergence of new projects, the possibility of generating jobs stimulates the economy by reducing the rates of unemployment and underemployment, in addition it allows the inhabitants of the influence area to remain in their site.</p>					
Nature	Positive		Negative	X	Undetermined
Relationship with other impacts:					
This impact is related to the impacts of the socio-economic meADI identified in the reviewed environmental studies					

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I. DESCRIPTION OF THE IMPACT			
Impact Sources	A single activity	X	Multiple activities
External activities that cause it:			
<p>The armed conflict changed social relations and the return of the displaced population with the accompaniment of non-governmental organizations, United Nations and the formation of groups, such as life, Justice and Peace led by the Social Pastoral, have also had its effect on the social relations of the inhabitants of the basin of the Calderas River, including the areas covered in the influence area of the projects Molinos, San Matias, Popal and San Miguel.</p>			

II. CHARACTERISTICS.		
II. 1 accumulation process: (Additive or interactive)		
<p>Additive: Due to the closeness between the projects, and to their influence areas share part of the territory, their effects add up.</p>		
II. 2 Spatial Aspects		
Geographic Scope	Form of distribution	Configuration
<p>Regional: Takes place in the influence area of the municipalities in which will be built hydroelectric projects Molinos, San Matias and San Miguel, in addition to the project under construction El Popal</p>	<p>Continues: There is spatial continuity in terms of geographic location, since the three projects analyzed, presented a sequence of space in the territory.</p>	<p>Area: occurs on surfaces that correspond to administrative units or to nucleated centers.</p>
II. 3 temporal Aspects		
Horizon (Time Framework)	Frequency	
<p>The impact is presented because of all the socio-political changes that have been submitted in the influence area of the three projects.</p> <p>These changes would be reinforced by the construction and startup of the four hydroelectric projects analyzed</p>	<p>Discrete: The impact it is associated with separate events.</p>	

III. NECESSARY INFORMATION FOR IMPACT EVALUATION .
<p>For the analysis of this impact is used the existing information in the environmental studies of the hydroelectric projects Molinos, San Matias, Popal and San Miguel</p>

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- **Indicator**

The indicators to evaluate this impact are:

- Family and neighborhood functional networks identified without a project/ Family and neighborhood functional networks modified by the project
- Number of concerns received/number of concerns dealt with and resolved
- Type and quantity of community conflicts and between the different groups and their inside, because of the project.
- Increase of family breakdown, change of the type of family, breaks of relationships and ties between relatives due to the link to the project or by functional loss.
- Incidents submitted in meeting sites of the veredas of the influence area of the project.

- **Description of the basin**

For Projects El Molino and San Matias, located in the municipalities of Cocorná and Granada, the traditional activities have been the crop and cattle raising, and these same are predominant in the influence area of El Popal project in the left margin of the Cocorná River, compared to the right margin, sector of the Mañosa and creek San Lorenzo, where due to its proximity to the high way Medellin - Bogota combines the activities with the agricultural trade, especially hotels, restaurants and other services focused to bid for vehicles running on the road.

These activities have greatly influenced the social relations of the area. Agriculture with the cultivation of sugarcane is predominant, followed by other short-cycle and the cattle raising of the extensive type, are carried out with family labor in the vast majority of the production units and with traditional productive systems, what embraces the population as peasant, especially those located along the San Matias River and in the right margin of the Cocorná.

In these rural communities the kingship relations contribute to establish close ties between the people with social relations that in most of the influence area are of solidarity and mutual support.

In the sector of la Mañosa and in the village of San Lorenzo of the municipality of Cocorná could be said that by its close proximity to the highway and the dynamic that is exercised from it on the inhabitants of the area by the continuous flow of foreign population, the social fabric has been fragmented in some sort of way, however inside this dynamic are located in working groups on environmental issues, and of small producers.

In the influence area of the project San Miguel, the population density is lower and it just starts the return after the armed conflict. This last circumstance does not make it possible to show the restoration of a strong social fabric, based on the relations of solidarity that are expected of the peasant communities.

5.5 ECONOMIC EVALUATION OF IMPACTS

Beginning again with the rating table of environmental impacts and the schema of projection of impacts (see Table 5-7), it will be analyzed the relevance of valuation for each one of the impacts; the impacts will be analyzed with qualifications equal to or greater than the category of "moderate", and the method for finding a economic value.

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In accordance with the foregoing, the impact changes: the physical and chemical properties of the soil, increase in sound pressure levels, changes in population dynamics, pressure on the real estate market, increase of accident risks, variation in the levels of sanitation; shall not be subjected to the screening of impacts and therefore to a quantitative assessment will not be carried out, since its rating becomes irrelevant.

5.5.1 Biotic Impacts

5.5.1.1 Increasing the concentration of particular matter and gases.

The implementation of activities such as vegetation removal, surface excavations, transport, hauling and disposal of surplus materials of excavation, executed during the construction phase of the project, will generate particulate material. At the same stage the equipment, machinery and vehicles involved in the construction, generate gases that modifies the air quality in the project influence area.

This is an impact that although, its valuation has been of moderate, the impact is reducible, internal; their costs are determined by the management that is done to mitigate the effect on the air quality; which means that is discarded to the quantitative assessment.

5.5.1.2 Increase in sound pressure levels.

The development of activities to be implemented for the construction and operation of the project, such as the operation of machinery, the movement of vehicles will generate an increase in existing noise levels in the influence area of the project, with local effects. It is a reducible Impact, internal; which means, it is discarded for the quantitative evaluation.

5.5.1.3 Alteration of the river dynamics and decline in the water availability.

Hydroelectric development El Molino is located in the basin of the San Matias River, a tributary of the Cocorná River, which in turn discharges its waters in the Calderas River. The main tributary of the River San Matías is the Tafetanes River that pours its waters 1,000 m before the site of collection.

Considering the uses of the soil, the geomorphology and the climate system of the Samana basin north of the river, including the San Matias River, are equal, it can be applied the unitary solid performance of the Samana basin to determine the transport in suspension of the San Matias River in the collection site. With the case above, the contribution of suspended sediments of the San Matias River in the collection site would be of 102 kt/year.

There will be a section with declined flow, on the stretch between the collection site and the power house; downstream of the project after the discharge, the San Matias River, given their new physical properties, by the withdrawal of the sediments in the collection area, will seek a new balance.

In the case of El Molino hydroelectric project, the process of degradation that commonly occurs in the construction of dams has no influence, given that the retention of fine sediments in the pondage is minimal and the procedure of opening of the gate during the growing streams, guarantees the dragging of these toward the river bed.

Also, the aggradations process of the formation of the delta sediments by the formed small pondage, would not be significant, since the opening of the gate during growing streams,

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facilitates this dragging, given the high slope that the river presents in the sector and under the weir.

These two impacts are analyzed jointly for the economic valuation since the construction of the structure of flow bypass on the San Matias River for electric generation, has implied the decline of the water resource on the river bed, in this way there will be a decrease in the availability of water resources. Also the construction of the conduction tunnel, located on the right bank of the San Matias River, which crosses the paths El Molino, Campo Alegre and Los Mangos, it can generate a decrease in the flow of the natural surface flows that it crosses.

This impact can be analyzed with the method of replacement costs by measuring the costs incurred to repair the damage or affection to the water resource given the decrease in flow. It can be calculated that the construction of an aqueduct for a useful life of 20 years, taking into account that with this method it is estimated the damage to a single service of the resource (human consumption).

In general the previous affection is valued in terms of the complexity of its control, not that it has some degree of uncertainty about the true affection of the impact and its alteration on a unique resource and irreversible in terms of its restoration¹⁸.

5.5.2 Biotic Impacts

5.5.2.1 Changes in vegetation coverage.

With Surface Facilities of the project, vegetative covers will be replaced. In the case of deposits, this replacement occurs only during construction, because once is finished depositing the removed soil, coverage is recuperated.

This impact is considered internal given that is reversible, non-unique and controllable with a compensation program. Its value is the amount of monetary investment in activities to control the impact.

5.5.2.2 Loss or fragmentation of habitats.

Their effects on the forest coverage located in the influence area, are sites of passage for some species of fauna and functions as connectors. These coverage's do not exceed the 3% in the case of the patches of forest and secondary high vegetation and the most affected will be the wooded pasture. This reduction in the areas of woodland patches will have its greatest impact on species dependent on the forest and with some category of threat. Among the mammals: *Saguinus leucopus* (Titi gray), *Proechimys magdalenae* (spiny rat) and *santanderiensis Microsciurus flaviventer and mixed-species* (ardita cusca), *Aotus lemurinus* (marteja or mico at night) and *Leopardus wiedii* (Margay), *Saguinus leucopus* and *Proechimys magdalenae* are species with restricted geographic distribution.

In birds, the base line sampling identified sites of greater diversity of more connectivity and that they are in various successional interconnected stages (low secondary vegetation, high secondary vegetation and open forest), indicating the importance of this connection for the populations of avifauna.

¹⁸ STUDY CENTER FOR ECONOMIC DEVELOPMENT. Economics Faculty of University of Los Andes, MAVDT. PAGE 91

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For amphibians most species are reported in the coverage with greater structural complexity, pointing to a high availability of shelter, food and breeding areas, conditions that favor the maintenance of populations of this group.

Therefore, considering that the reduction of patches of woodland and high secondary vegetation does not exceed 3 %, but this disturbance can have an impact on endangered species, as well as in the ones of forest dependency, describes the magnitude of the effect as high, ignoring the currently available information in the range of transformation.

With respect to the values of use Oksanem, M. (1997), states that the notion of economic valuation of biodiversity is only able to recognize those values associated with a ethic position called anthropocentric subjectivism. So then, the economic values are not in the biological diversity or in the biological entities that determine it, but are generated by people who value it. In the population area settled in the zone, it has not fully identified the value and information about the sites of origin of birds, it is not obtained easily (this would imply interviews outside the area of influence).

In the methods of non-use, and considering the contingent value and indicated preferences , the scenic value has a high component of subjectivity that entails having a sample of persons interviewed widely so that it can be determined a reliable sampling error; in addition there is a lack of information related to value by genetic resource and functions of species that are lost, because with the sampling effort conducted during the EIS it would not guarantee that it will have all the possible species of the influence area; it would require to extend to at least two times the sampling, obtaining accumulation curves.

To assess in a more complex level, is needed in addition, information related to flight routes, frequencies, seasons, species.

In conclusion, this impact would be discarded from the economic valuation, also taking into account that it is not associated with a target audience on which you can measure the degree of utility or welfare for these non marketable goods .

The above findings apply equally to the impact on death and displacement of terrestrial animals.

5.5.2.3 Increased pressure on natural resources.

For access to the power house and collection site, it is necessary the construction of roads that pass through open forest areas and high secondary vegetation in which there are timber species: *Heliocarpus americanus* (white balsum), *Cinnamomum triplinerve* (Laurel Perillo), *Nectandra* spp., *Jacaranda copaia* (Chingale), Aniba cf. *Muca* (Laurel inciden), *Ficus popayanensis* (salary), in addition to other with various uses in the area as the palma *Euterpe precatoria* (Palm-kernel oil).

All of these species have been subject of pressure and very surely with the roads it will increase its extraction.

This is an external situation that the project can cause, however, the impact has an uncertainty factor quite high since the border of the affectation of timber species may be extended, that will make even more difficult the valuation in economic terms of the species on which the individuals are able to perform utilization.

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Part of the valuation of this impact, is given by the control measures that are used to prevent and control it.

5.5.2.4 Changes in the fish community of San Matias River.

As a result of the flow reduction, interruption will be presented of the continuity of the flow, where the organic derived will be affected. In addition, it decreases the wet perimeter that is reflected in the habitat reduction of crowding population, increase in surface area lateral to the solar heating with heat transfer to the column of water, and reduction of oxygen solubility, decrease in height of the water column (increase light penetration and ficobenthic productivity), reduction of competition (increase in the rate of clogging and compaction of the bed, reduction of the flabbiness and mobility of the substrate), and increase in hydraulic retention ponds, all of which is reflected in the survival of the fish.

The presented affectations are associated with changes in the ecosystems being overexploited, not reflected in the utility functions for the inhabitants downstream of the construction facilities and subsequent operation of the plant. Given that the economic valuation has a primarily anthropocentric approach, with the information obtained from the on-line database is not envisioned as an affectation of individuals or human communities, in which a first approximation valuation can be done in regard to the usage values.

5.5.2.5 Changes in the structure of the aquatic biotope and biocoenosis.

This impact applies the previous conclusions.

5.5.3 Socio-economic impacts

In terms of socioeconomic impacts as generation of expectations and inconvenience caused to the community, the costs can be calculated as internal, since basically these impacts relate to do a good work of information to control false expectations and to the management of discomfort, the approach is to perform a good management of the project to coexist with the community from the previous studies. There are physical damages (possible damage to an access, to an access, to a crop) that can be compensated and that may also be calculated as a domestic impact. This is also applicable to the impact of damage caused to third parties.

5.5.3.1 Affectation of cultural heritage.

This impact is negative, since the arrival of new population to the area, can bring change processes of cultural patterns, loss of values and traditions and adoption of customs and habits of consumption not consistent with the usual dynamic of the territory.

This is an external impact which contains a high degree of uncertainty as the affectation of the intangible cultural heritage is associated with a proper economic dynamic of the rationality of the project that at the end, its rating could be positive in terms of changes in the life quality of the people associated with the new activity of construction and operation of the hydroelectric plant.

5.5.3.2 Displacement of homes and families.

This impact does not generate a break with the inhabited environment . In any case it generates tensions within the family nucleus, because of the attachment to the houses and

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the inherent discomfort in the transfer itself; however, it can also be the opportunity to improve the living conditions of families.

This impact is considered that it will not generate externalities from the social point of view, being the value of the impact, calculated within its extent of the management plan for relocation or relocation of homes.

5.5.4 Benefit/Cost analysis

Cost of aqueduct compensation (costs of engineering in facilities) \$ 750,000,000

Monthly maintenance for 20 years: \$ 7.500.000

Benefit: Treatment of drinking water for human consumption \$100,000,000

Monthly maintenance for 20 years: \$4,000,000 .

5.5.5 Conclusions

The approach uses indirect information obtained from the conventional markets on assets related to environmental, to estimate a demand equation for the conventional assets that allows finding in a "indirect" way the value of the assets or environmental services.

The impacts valued in this exercise were made under this approach, meaning that the assumptions for the valuation only reached an element of the total economic value now that the possible surveys to inquire about the availability to be paid and comply with the direct approach, were not appropriate given the uncertainty in the affectation either by the same conditions of impact of the project or by the uncertainty in the affectation of future generations.

It should be borne in mind that from the point of view of welfare economics, the significant impacts are those that have to do with the welfare affectation of an economy.