ENVIRONMENTAL IMPACT STUDY FOR THE RUMICHACA – PASTO TWO-LANE ROADWAY PROJECT PEDREGAL- CATAMBUCO ROAD SECTION, UF. 4 AND UF. 5.1. CONCESSION CONTRACT UNDER PUBLIC PRIVATE PARTNERSHIP (APP) SCHEME NR 15, 2015

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Chapter 11.1.2. Follow-up and Monitoring Plan to the Biotic Environment

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11.1.2. FOLLOW-UP AND MONITORING PLAN TO THE BIOTIC ENVIRONMENT

This plan aims to ensure environmental variables likely to be affected by the execution of works and activities related to the construction of the Rumichaca- Pasto two-lane roadway project.

The Follow-up and Monitoring Plan (PSM Spanish acronym) provides programs, which purpose is to study the validity and reliability of the application of environmental measures proposed in the Environmental Management Plan (PMA Spanish acronym) for the construction phase. In this regard, it seeks to monitor and verify the necessary information to establish the performance, efficiency and effectiveness of measures and controls implemented and identify insufficiencies and inconsistencies in the project enabling the implementation of any adjustment required, if needed.

This plan intends to achieve the purposes set in the programs outlined in the PMA, which will allow adjusting them to any new condition as it appears during construction works and project operation. Follow-up and monitoring programs for each environmental media to be executed by the concessionaire's personnel involved in the PMA.

As mentioned, this plan involves environmental media mainly affected according to the analysis of impacts conducted and the assessment of the actual intensity of changes that will occur because of the project. For this purpose, the following aspects were considered:

- Initial environmental conditions of the Area of Influence.
- Compliance with environmental standards.
- Components to be monitored, specifying sampling sites, parameters to measure, frequency and number of samples.

Each data sheet of the follow-up and monitoring program contains: Purposes, environmental components to be monitored, impacts to be controlled, location, type of control measure, description of the measure, frequency and sampling period, duration, analysis and interpretation of results , type and reporting period.

11.1.2.1. PURPOSES

- Establish actions to establish the compliance with protective measures.
- Verify that corrective measures proposed are effective and that the extent is reduced as minimum as possible.
- Allow the assessment of programs in compliance with the provisions of the management plan

11.1.2.2. PLAN STRUCTURE

The follow-up and monitoring plan for this study is divided as follows:

- Follow-up and monitoring to programs
- Follow-up and monitoring to environment trend

- ***Follow – up and monitoring to programs***

Measures to implement the environmental management plan need to be monitored to verify compliance thereof, and compliance with applicable environmental regulations in force. Based on this, this follow-up and monitoring program includes relevant aspects for biotic environment.

The follow-up and monitoring measures to be implemented are directed to actions proposed to be taken for the biotic environment because of access adaptation, and adaptation and operation of camps activities (catchment, air emissions, treatment and waste disposal), among other.

The following describes the aspects addressed in the contents of the programs for environmental management of the Rumichaca – Pasto, two-lane roadway Pedregal – Catambuco road section.

- **Actions to be taken:** Refers to actions taking place during project execution to meet the purposes and goals of the program.

- **Schedule for execution:** Describes the progress of actions to be executed during the term of the project execution.
- **Stages to be implemented:** The time is specified in the project duration, when the management measures developed by the program will be executed.
- **Program Identification:** Consecutive code expressed with letters and numbers, identifying each subprogram in a simplified manner.
- **Follow-up and monitoring indicators:** Includes the definition of follow-up and monitoring indicators for the execution of activities previously detailed in the program, their description, frequency of assessment, and record of compliance.
- **Application site:** Identifies the site or sites where the measure will be applied.
- **Participatory mechanisms and strategies**: Points out strategies to involve the community in the development of management measures.
- **Name of program and subprogram:** Corresponds to the denomination of each project, established according to the component to which it refers.
- **Purposes:** Outlines the results expected to be obtained upon completion of the actions contemplated within the program.
- **Target population:** The population that will benefit with the development of measures that will allow the reduction of negative impacts.
- **Type of measurement to be executed:** Corresponds to the classification of the measures that will allow reducing the negative impacts and increasing the positive ones during the project execution. These may be prevention, correction, mitigation and / or compensation measures.
- **Personnel required:** Refers to the human resources necessary for the carrying out of the activities contained in each program.

Responsible for Execution: It records the organizations, companies or positions within the company with the responsibility for the implementation of programs.

Table 11.1.2.1 Structure of the Project Environmental Management Plan

COMPONENT	PROGRAM	CODE	Projects
BIOTIC	FOLLOW-UP AND MONITORING OF SOIL AND FLORA RESOURCES	SMRSF-1	Follow-up to the management of land cover removal and land clearing
		SMRSF-2	Follow-up to flora management
	FOLLOW-UP AND MONITORING TO FAUNA RESOURCE	SMRF-1	Follow-up to fauna management
	FOLLOW AND MONITORING TO HABITATS MANAGEMENT	SMH-1	Follow-up to the management and conservation of habitats
	FOLLOW-UP AND MONITORING TO BIOTIC ENVIRONMENT QUALITY TREND	SMTMB	Follow-up and monitoring to the biotic environment quality trend

11.1.2.2. Follow-up to Biotic Environment Programs

Follow-up and monitoring of each of the activities proposed will be performed through visual inspections, where one can get photographic or film records to prove the veracity of each activity developed.

Supports and activity records are a tool to assess the activities and works for each component over time. Data sources for measuring indicators will be reviewed since it will allow to take appropriate measures or make adjustments to management plans in order to provide preventive, corrective, mitigation or compensation response to project impacts.

Follow-up and monitoring program to soil and flora resources management

Table 11.1.2.2 Follow-up to land cover removal and land clearing (SMRS - 1)

BIOTIC ENVIRONMENT	
FOLLOW – UP AND MONITORING PROGRAM TO SOIL AND FLORA RESOURCES MANAGEMENT	
SMRSF-1	**Follow-up to land cover removal and land clearing**
PURPOSE	
Produce information to allow establish the effectiveness of the implementation of measures stipulated in Data sheet - 1 MRSF Handling of land cover removal and land clearing of the Soil and Flora Resources Management Program of the Environmental Management Plan.	
ACTIONS TO BE TAKEN	
· Produce documentary material supporting the implementation of measures for forest harvesting, bush clearing, land clearing and management of wood-based products, waste and land clearing material. · Prepare a consolidated semiannual report summarizing the compliance with the measures implemented.	
MEASUREMENT CRITERIA	
The following information must be produced using formats, spreadsheets, photographic record, etc. *Forest harvesting* - Date and location of the carrying out of forest harvesting activities, species and number of individuals felled per specie, total and commercial volume, area and type of ecosystem intervened. - Location of temporary collection sites of forest harvesting products, volume gathered, and time spent. *Bush Clearing* - Date and location where the clearing took place, area and type of ecosystem intervened.	

BIOTIC ENVIRONMENT	
FOLLOW – UP AND MONITORING PROGRAM TO SOIL AND FLORA RESOURCES MANAGEMENT	
SMRSF-1	**Follow-up to land cover removal and land clearing**

- Location of temporary collection sites of bush clearing material, volume gathered, and time spent.

Land clearing

- Date and place of execution of land clearing activities, intervened area, and volume generated.
- Location of temporary collection sites, volume gathered, measures implemented to protect the material, time spent.

Management of wood-based products, green waste and bush clearing

- Date and place of reuse of wood-based products, types of wood –based products used, location, use given to wood, reused volume.
- Date and place of wood donation, recipient, species and volume of wood donated, intended use by the recipient.
- Date and place of reuse of vegetable waste (leaves and branches), specify whether the material was crushed or chipped, area processed (ha), reason for reuse therein, reused volume.
- Date and place of reuse of land clearing material, processed area (ha), reason for reuse therein, volume reused.
- Date and place of final disposal of green waste and land clearing material, type of material volume.

MEASUREMENT FREQUENCY
Weekly for forest harvesting activities. Monthly for land and bush clearing activities. Quarterly management activities for wood –based products, vegetable waste and land clearing.

BIOTIC ENVIRONMENT	
FOLLOW – UP AND MONITORING PROGRAM TO SOIL AND FLORA RESOURCES MANAGEMENT	
SMRSF-1	**Follow-up to land cover removal and land clearing**
PROOF OF INDICATOR OF REPRESENTATIVENESS	
Indicators proposed will allow us to know in detail both the progress of the measures and the effectiveness of their implementation.	

Table.3: Follow-up to flora management

BIOTIC ENVIRONMENT	
SMRSF-2	**FOLLOW-UP AND MONITORING PROGRAM TO SOIL AND FLORA RESOURCES MANAGEMENT**
	Follow-up to flora management
PURPOSE	
Produce information to allow establish the effectiveness of the implementation of measures stipulated in Data sheet 2 of MRSF Flora Management of the Soil and Flora Resources Program of the Environmental Management Plan.	
ACTIONS TO BE TAKEN	
· Produce documentary material supporting the implementation of measures of rescue, relocation and maintenance of endangered plant species · Prepare a semiannual report summarizing the compliance with the measures implemented.	
MEASUREMENT CRITERIA	
The following information must be produced using formats, spreadsheets, photographic record, etc. *Rescue of vegetal material* - Date and location of rescue, species and number of individuals rescued per species, treatment and physical and health conditions. *Care while in the temporary collection site* - Date and number of individuals per species entering the collection center, spent time of the vegetal material, treatments performed, physical and health condition, survival rate. *Relocating the vegetal material rescued* - Date and location of relocation (cartographic material will be presented in compliance with the model established by geographic filing standards), relocated species and number of individuals, type of ecosystem where the relocation was carried out.	

BIOTIC ENVIRONMENT	
SMRSF-2	**FOLLOW-UP AND MONITORING PROGRAM TO SOIL AND FLORA RESOURCES MANAGEMENT**
	Follow-up to flora management
Maintenance of vegetal material relocated - Date and type of treatments performed, survival rate.	
MEASUREMENT FREQUENCY	
Weekly for rescue and relocation. Semiannual for maintenance.	
JUSTIFICATION	
Indicators proposed allow us to know in detail both the progress of the measures and the effectiveness of their implementation.	

Follow-up and monitoring program to fauna resource management

Table 11.1.2.4: Follow –up to fauna management

Biotic Environment	
SMRF-1	**FOLLOW-UP AND MONITORING PROGRAM TO FAUNA RESOURCE MANAGEMENT**
	Follow-up to faun management
PURPOSE	
Produce information to allow establish the effectiveness of the implementation of measures stipulated in Data sheet 1 of MRSF Fauna Management of the Fauna Resources Program of the Environmental Management Plan.	
ACTIONS TO BE TAKEN	

Produce documentary material supporting the implementation of measures of rescue, relocation and maintenance of endangered flora species Prepare a semiannual report summarizing the compliance with the measures implemented.
MEASUREMENT CRITERIA
The following information must be produced using formats, spreadsheets, photographic record, etc. *Displacement* - Displacement date and location, type of measure implemented (sound, smell, etc.). Area subject to the measure, species and number of individuals displaced. *Wildlife rescue and relocation* - Date and number of individuals rescued, method of capture, process between capture and relocation, condition of species captured, transfer conditions, relocation site. *Fauna crossings* - Date and location of wildlife crossings, type of structure, verification of the measure effectiveness (sightings of the use of wildlife crossings), types of species using these structures. *Signaling* - Date and location of signs installed, type of signs, justification of signs.
MEASUREMENT FREQUENCY
Weekly displacement, rescue and relocation measures. Semiannual for fauna crossings and signaling

JUSTIFICATION
Indicators proposed allow us to know in detail both the progress of the measures and the effectiveness of their implementation.

Follow-up and monitoring program to habitat management

Table 11.1.2.5: Follow-up to the management and conservation of habitats

BIOTIC ENVIRONMENT	
SMH-1	FOLLOW-UP AND MONITORING PROGRAM TO HABITAT MANAGEMENT
	Follow-up to terrestrial habitat and freshwater aquaculture management
PURPOSE	
Produce information to allow establish the effectiveness of the implementation of measures stipulated in Data sheet 1 of MH Habitat Management of the Environmental Management Plan.	
ACTIONS TO BE TAKEN	
Produce documentary material supporting the implementation of rescue, relocation and maintenance measures for endangered flora species Prepare a semi-annual report summarizing the compliance with measures implemented.	
CRITERIA MEASUREMENT	
The following information must be produced using formats, spreadsheets, photographic record, etc. *Isolation of habitats* - Date and location of isolation, isolation type, length, area, and type of ecosystem to be protected.	

BIOTIC ENVIRONMENT	
SMH-1	**FOLLOW-UP AND MONITORING PROGRAM TO HABITAT MANAGEMENT**
	Follow-up to terrestrial habitat and freshwater aquaculture management

Delimitation of intervention sites

- Date and location of the delimitation, type of delimitation installed, length, delimited areas, type of ecosystem in which it is located.

Implementation of containment measures

- Date and location of containment measures, type of work the measurement requires, type of containment measure (stake fences, sacks, etc.).

Prohibition signs

- Date and location of signs, type of signs, and ecosystem subject to signaling.

MEASUREMENT FREQUENCY
Monthly for all measurements.
JUSTIFICATION
Indicators proposed allow us to know in detail both the progress of the measures and the effectiveness of their implementation.

- ***Follow-up and monitoring the trend of the biotic environment quality***

The following describes the issues addressed in the contents of the follow-up and monitoring plan to the trend of the biotic environment of the Rumichaca – Pasto two-lane roadway, Pedregal – Catambuco road section.

- Purposes
- Environmental component to monitor
- Location of sampling sites
- Management measures that influence the trend
- Process
- Frequency and duration of monitoring
- Criteria for the analysis and interpretation of results
- Indicators

Monitoring conducted by laboratories will be with equipment and under the methodologies certified by the IDEAM.

Table 11.1.2.8 Follow-up to the biotic environment trend

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT
PURPOSE
Identify, mitigate and monitor the direct and indirect impacts of project activities on different biotic components of the area of influence through the implementation of monitoring measures for each case, in order to ensure the protection, conservation and normal development thereof.
ENVIRONMENTAL COMPONENTS TO MONITOR
Flora Fauna Hydrobiological communities
LOCATION OF SAMPLING SITES
- Fauna and Flora All areas involved in the project

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT
. Hydrobiological communities Sampling points
MANAGEMENT MEASURES AFFECTING THE TREND
MRSF – 1 Land cover and land clearing removal management MRF - 1 Fauna management MH – 1 Management and conservation of terrestrial and freshwater habitats
PROCESS
FLORA Monthly verification of recue- related tasks and relocation of sapling individuals and epiphytes prior the carrying out of forest harvesting activities. Verify that the use of vegetation in areas not required for the project and the disposal of liquid or solid waste into the land cover of the riparian forest is prohibited. Emphasize the importance of not- hunting wildlife, and how this activity affects the flora of the region. Monitoring and verification of these activities will be done through education and training program for staff involved in the project, and through direct observation of the different activities. Reports will be submitted to the Project Environmental Supervision about the activities carried out concerning the education and training programs offered to the personnel involved in the project **FAUNA** To obtain primary information, three monitoring will be held for 3 years, to be carried out each year. Each monitoring will consist of a field visit (15 days), followed by a report. · Amphibian: Observation tours (breeding and egg-laying sites) and search for specimens in transects (VES). · Reptiles: Observation tours (caves, logs, rocks) and search for specimens in transects (VES). · Birds: Watching tours and capture with mist-nets.

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT

· Mammals: Observation tours (traces, feeding tracks, skeletal remains, skins, feces, burrows); sampling using camera-traps, Sherman and Tomahowk traps in transects and mist nets for the study of bats.

HYDROBIOLOGICALCOMMUNITIES

Two hydrobiological and physical-chemical monitoring will be carried out in the monitoring plan in water bodies determined in this EIS. This monitoring will be conducted along with a laboratory duly certified by the IDEAM. The following parameters are taken into account:

Physiochemical parameters to monitor in the field:

Determination	volume required	Container	Preservation	Recommended maximum storage. Hour (H) - Days (d)
Turbidity total Acidity Alkalinity	1000 ml	Plastic	Keep cool ≤ 6 ° C	48 h
Total Dissolved Solids (TSS mg / L) Total Suspended Solids (TSS mg / L)	1000 ml	Plastic	Keep cool ≤ 6 ° C	7d
Color	500 ml	Plastic	Keep cool at least 6 ° C	48 h
Metals (Hg)	500 ml	Plastic	To filter immediately dissolved metals, add HNO3 to pH <2	6 m
DOQ - calcium hardness - Total Nitrogen	1000ml	Amber	Keep cool ≤6 ° C. Add H2SO4 to pH <2	28 d
Metals (Ba, Cd, Cu, Cr, Ni, Pb, Ag, Se, Zn	1000 ml	Plastic	Add HNO3 to pH <2	6 m
Phenol	500 ml	Amber	Keep cool ≤6 ° C. Add H2SO4 to pH <2 Place aluminum cover	28 d
Phosphorus	500 ml	Amber	Keep cool ≤6 ° C. Add H2SO4 to pH <2	28 d
DBO	1000 ml	Amber	Keep cool ≤6 ° C.	28 d

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT

Fecal coliforms and total coliforms	250 ml	Whirl pack	Keep cool ≤6 ° C.	28 d
oils, fats	1000ml	Wide mouth glass	Keep cool ≤6 ° C. Add H2SO4 to pH <2	48 h

Hidrobiological parameters

Monitoring to phytoplankton, zooplankton; macro-invertebrates, macrophytes and ichthyo fauna:

Community	Method used	
	SAMPLING	Analysis
phytoplankton	10200B SM	Semina 1978: UNESCO 1978
Zooplankton	10200B SM	Paggi Paggi, 1995: Lopretto and Tell, 1995
Benthos	10500B SM	10500C SM
Periphyton	Rivera and Zapata (2009)	10300C, SM modified
Macrophytes	10400 C, D SM; Ramirez, (2006)	10400D, SM
Ichthyofauna	EPA / 600/ R-92/111	EPA / 600/ R-92/111

FREQUENCY AND LOCATION OF MONITORING

Component	Follow-up and monitoring plan	Frequency	Duration (Semiannual)					
			SEM1	SEM2	SEM 3	SEM 4	SEM 5	SEM 6
FLORA	Through information systems, perform analysis of changes to the loss of land cover Vs landscape management through implementation of re-planting measures on areas intervened.	semiannual	X	X	X	X	X	X
FAUNA	Through field trips and primary data collection, perform analysis of changes in species abundance and richness	Annual		X		X		X

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT								
HYDROBIOLOGICAL COMMUNITIES	Through field trips and primary data collection, to perform analysis of changes in species abundance and richness (phytoplankton, zooplankton, macro-invertebrates and macrophytes) and physico-chemical monitoring in the field.	Annual		**X**				**X**

CRITERIA FOR ANALYSIS AND INTERPRETATION OF RESULTS

FLORA

The analysis will be performed using geographic information, and field verification visits.

FAUNA

Indicators to establish the relative abundances per groups of fauna and sampling site will be proposed.

Calculation of the various wealth and diversity indexes will be held.

Characterization of habitats associated with registered species.

Discussion of results comparing the monitoring findings (T = 1) with the previous inventory (characterization information of line base of this EIS (T = 0)) and similar ecosystems.

HYDROBIOLOGICAL COMMUNITIES

Characterization of habitats associated to registered species

indicators that establish the relative abundances of the hidrobiota in sampling site will be proposed:

Calculation of various wealth and diversity indexes will be held

Monitoring will be conducted to know the change in the composition and abundance of the monitored species (comparing results to findings in monitoring (T = 1) with previous inventory (characterization information of line base of this EIS (T = 0)) and similar ecosystems)

Taking into account: Organic Matter Contamination Index, ICOMO, Mineralization Contamination Index, ICOMI, Suspended Solids Contamination Index, ICOSUS in order to know the quality of water bodies.

The results of physicochemical analyzes are compared with the standards established by the

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT

competent authorities by means of Decree 1594 of 1984, in accordance with Chapter III including surface waters: "about the generic destination of surface water, groundwater, marine, estuaries and waste water "in its articles 38, 39 and 40 defining the characteristics for the use of water in domestic, agricultural and livestock activities.

INDICATORS

COMPONENT	INDICATOR	KIND	SPECIFICATION
FLORA	Changes in land-cover during the project execution.	**Qualitative**	This qualitative indicator allows to establish changes in land coverage as long as the project progresses.
	% Of forest cover at the end of the project /% forest cover initially identified	**Quantitative**	This indicator establish the change of land cover in a quantitative manner.
	% Of areas re-planted by the project /% of forest cover affected by the project	**Qualitative**	This indicator allows to identify the relation of the areas to affect Vs areas re-planted as a compensation measure.
FAUNA	Change in composition of wildlife present in the area of influence	**Qualitative**	This qualitative indicator allows to establish changes in abundance and diversity as the project progresses.
	- Number of amphibians, reptiles, birds and mammals in monitoring sampling (T = 1) / Number of species in the T = 0 (this EIS). A result <1 implies declining species = 1 the same number of Spp, and> 1 indicates increase of species. -Shannon diversity index in T = 0 vs. Shannon diversity in T = 1. - Comparison of abundance of species found in each monitoring. Abundance T = 1 / T = 0 abundance. - Registration of new species found = number of new species reported in each monitoring.	**Quantitative**	These quantitative indicators allow to know the statistical changes in the ecological dynamics of animal species in the project area

SMTMB – FOLLOW-UP AND MONITORING THE TREND OF THE BIOTIC ENVIRONMENT			
HYDROBIOLOGICAL COMMUNITIES	**Physicochemical:** Organic Matter Contamination Index, ICOMO. Mineralization Contamination Index, ICOMI Suspended Solids Contamination Index ICOSUS in order to know the quality of water bodies	**Quantitative**	This quantitative indicator contains indexes that provide insight into the physicochemical characteristics of water sources where the hydro biota is.
	Change in composition hydrobiologic resource present in the area of influence	**Qualitative**	This qualitative indicator allows to establish the changes in abundance and diversity as the project progresses.
	Number of phytoplankton, zooplankton species, macro-invertebrates, macrophytes and fish fauna monitoring sampling (T = 1) / Number of species in the T = 0 (this EIS). A result <1 implies declining species = 1 the same number of Spp, and> 1 indicates increase of species. -Shannon Diversity Index in T = 0 vs. Shannon Diversity in T = 1. -Comparison of abundance of species found in each monitoring. Abundance T = 1 / T = 0 abundance. - Registration of new species found = number of new species reported in each monitoring.	**quantitative**	These quantitative indicators allow to know the statistical changes of hydrobiological communities in the project area.