



# EL MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS

## ENVIRONMENTAL IMPACT STUDY VOLUME III OF V CHAPTER 7

DOCUMENT 2148-04-EV-ST-020-07

### REVIEW No. 0

Review	Modifications	Date
0	Original Version	2012-03-30

### Elaboration - Review - Approval

Review	Developed by:		Reviewed by:		Approved by:	
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**ENVIRONMENTAL IMPACT STUDY**

**GENERAL CONTENT**

<b>VOLUME I</b>	
<b>Description</b>	<b>Document</b>
Executive Summary	2148-04-EV-ST-020-00
Chapter 1 – General	2148-04-EV-ST-020-01
Chapter 2 - Description of the Project	2148-04-EV-ST-020-02
<b>VOLUME II</b>	
Chapter 3 - Baseline characterization	2148-04-EV-ST-020-03
<b>VOLUME III</b>	
Chapter 4 - Demand, use, exploitation and/or affectation of natural resources	2148-04-EV-ST-020-04
Chapter 5 - Environmental assessment	2148-04-EV-ST-020-05
Chapter 6 - Zone of environmental management of the Project	2148-04-EV-ST-020-06
Chapter 7 - Environmental management plan	2148-04-EV-ST-020-07
Chapter 8 - Plan follow up and monitoring of the project	2148-04-EV-ST-020-04
Chapter 9 - Contingency plan	2148-04-EV-ST-020-09
Chapter 10 - Abandonment and final restoration Plan	2148-04-EV-ST-020-10
Chapter 11 -Investment plan of 1%	2148-04-EV-ST-020-11
Bibliography	2148-04-EV-ST-020-12
<b>VOLUME IV</b>	
Annexes	2148-04-EV-ST-020-13
<b>VOLUME V</b>	
Cartographies	2148-04-EV-ST-020-14

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**TABLE OF CONTENTS**

	<b>Pag.</b>
7 ENVIRONMENTAL MANAGEMENT PLAN .....	7-1
7.1 OPERATION STRUCTURE.....	7-5
7.1.1 Environmental supervision group.....	7-5
7.1.1.1 Objectives.....	7-5
7.1.1.2 Stage.....	7-5
7.1.1.3 Actions to develop .....	7-5
7.1.1.4 Implementation Schedule .....	7-6
7.1.1.5 Budget.....	7-6
7.1.2 Environmental Management Group .....	7-8
7.1.2.1 Objectives.....	7-8
7.1.2.2 Stage.....	7-8
7.1.2.3 Actions to develop .....	7-8
7.1.2.4 Implementation Schedule .....	7-9
7.1.2.5 Budget (direct, Staff).....	7-9
7.2 ABIOTIC ENVIRONMENT .....	7-10
7.2.1 Program for handling and disposal of materials .....	7-10
7.2.1.1 Objectives.....	7-10
7.2.1.2 Justification.....	7-11
7.2.1.3 Regulations .....	7-11
7.2.1.4 Stage.....	7-11
7.2.1.5 Impacts to control .....	7-11
7.2.1.6 Type of Measure.....	7-11
7.2.1.7 Application place .....	7-14
7.2.1.8 Schedule .....	7-14
7.2.1.9 Budget.....	7-14
7.2.1.10 Responsible.....	7-14
7.2.2 Particulate material, Gases and Noise Emissions Management Plan .....	7-16
7.2.2.1 Objectives.....	7-16
7.2.2.2 Justification.....	7-16
7.2.2.3 Regulations .....	7-16
7.2.2.4 Stage.....	7-17

**ENVIRONMENTAL IMPACT STUDY**

7.2.2.5	Impacts to control .....	7-17
7.2.2.6	Type of Measure.....	7-17
7.2.2.7	Targets and monitoring indicators.....	7-17
7.2.2.8	Actions to develop .....	7-18
7.2.2.9	Application place .....	7-19
7.2.2.10	Schedule .....	7-19
7.2.2.11	Budget.....	7-20
7.2.2.12	Responsible.....	7-21
7.2.3	Liquid waste treatment.....	7-21
7.2.3.1	Objectives.....	7-21
7.2.3.2	Justification.....	7-21
7.2.3.3	Regulations .....	7-21
7.2.3.4	Stage.....	7-22
7.2.3.5	Impacts to control .....	7-22
7.2.3.6	Type of Measure.....	7-22
7.2.3.7	Targets and monitoring indicators.....	7-22
7.2.3.8	Actions to develop .....	7-22
7.2.3.9	Application place .....	7-26
7.2.3.10	Schedule .....	7-27
7.2.3.11	Budget.....	7-27
7.2.3.12	Responsible.....	7-27
7.2.4	Management Program of domestic, industrial and hazardous solid waste. ....	7-27
7.2.4.1	Objectives.....	7-27
7.2.4.2	Justification.....	7-27
7.2.4.3	Regulations .....	7-27
7.2.4.4	Stage.....	7-28
7.2.4.5	Impacts to control .....	7-28
7.2.4.6	Type of Measure.....	7-28
7.2.4.7	Targets and monitoring indicators.....	7-28
7.2.4.8	Actions to develop .....	7-28
7.2.4.9	Application place .....	7-32
7.2.4.10	Schedule .....	7-32
7.2.4.11	Budget.....	7-32

**ENVIRONMENTAL IMPACT STUDY**

7.2.4.12	Responsible.....	7-32
7.2.5	Estimate the Instream flow.....	7-32
7.2.5.1	Objectives.....	7-32
7.2.5.2	Justification.....	7-33
7.2.5.3	Regulations .....	7-33
7.2.5.4	Stage.....	7-33
7.2.5.5	Impacts to control .....	7-33
7.2.5.6	Type of Measure.....	7-33
7.2.5.7	Goals and monitoring indicators.....	7-33
7.2.5.8	Actions to develop .....	7-33
7.2.5.9	Application place .....	7-52
7.2.5.10	Schedule .....	7-52
7.2.5.11	Budget.....	7-52
7.2.5.12	Responsible.....	7-52
7.2.6	Management Program for water supply, for the people settled along the path of the conduction tunnel.....	7-52
7.2.6.1	Objectives.....	7-52
7.2.6.2	Justification.....	7-53
7.2.6.3	Regulations .....	7-53
7.2.6.4	Stage.....	7-53
7.2.6.5	Impacts to control .....	7-53
7.2.6.6	Type of Measure.....	7-53
7.2.6.7	Goals and monitoring indicators.....	7-53
7.2.6.8	Actions to develop .....	7-54
7.2.6.9	Application place .....	7-54
7.2.6.10	Schedule .....	7-54
7.2.6.11	Budget.....	7-54
7.3	Biotic ENVIRONMENT .....	7-55
7.3.1	Management of vegetation covering and bare soil.....	7-55
7.3.1.1	Objectives.....	7-55
7.3.1.2	Justification.....	7-55
7.3.1.3	Regulations .....	7-55
7.3.1.4	Stage.....	7-55

**ENVIRONMENTAL IMPACT STUDY**

7.3.1.5	Impacts to control .....	7-55
7.3.1.6	Type of Measure.....	7-55
7.3.1.7	Targets and monitoring indicators.....	7-55
7.3.1.8	Actions to develop .....	7-56
7.3.1.9	Application place .....	7-58
7.3.1.10	Schedule .....	7-58
7.3.1.11	Budget.....	7-58
7.3.1.12	Responsible.....	7-59
7.3.2	Flora Rescue .....	7-59
7.3.2.1	Objective .....	7-59
7.3.2.1	Justification.....	7-59
7.3.2.2	Regulations .....	7-59
7.3.2.3	Stage.....	7-59
7.3.2.4	Impacts to control .....	7-59
7.3.2.5	Type of Measure.....	7-60
7.3.2.6	Goals and indicators.....	7-60
7.3.2.7	Actions to develop .....	7-60
7.3.2.8	Application place .....	7-65
7.3.2.9	Schedule .....	7-65
7.3.2.1	Budget.....	7-66
7.3.2.1	Responsible.....	7-66
7.3.3	Compensation for woodlands hedges affectations - Formation of a biological corridor 7-66	
7.3.3.1	Objective .....	7-66
7.3.3.2	Justification.....	7-66
7.3.3.3	Regulations .....	7-67
7.3.3.4	Stage.....	7-67
7.3.3.5	Impacts to control .....	7-67
7.3.3.6	Type of measure.....	7-67
7.3.3.7	Targets and monitoring indicators.....	7-67
7.3.3.8	Actions to develop .....	7-67
7.3.3.9	Application place .....	7-70
7.3.3.10	Schedule .....	7-70

**ENVIRONMENTAL IMPACT STUDY**

7.3.3.11	Budget.....	7-70
7.3.3.12	Responsible.....	7-71
7.3.4	Study of terrestrial vertebrate fauna.....	7-71
7.3.4.1	Objective .....	7-71
7.3.4.2	Justification.....	7-71
7.3.4.3	Regulations .....	7-72
7.3.4.4	Stage.....	7-72
7.3.4.5	Impacts to control .....	7-72
7.3.4.6	Targets and monitoring indicators.....	7-72
7.3.4.7	Type of measure.....	7-72
7.3.4.8	Actions to develop .....	7-72
7.3.4.9	Application place .....	7-73
7.3.4.10	Schedule .....	7-73
7.3.4.11	Budget.....	7-73
7.3.4.12	Responsible.....	7-74
7.3.5	Research Project: Management strategy of aquatic ecosystems .....	7-74
7.3.5.1	Objectives.....	7-74
7.3.5.2	Justification.....	7-74
7.3.5.3	Regulations .....	7-74
7.3.5.4	Stage.....	7-74
7.3.5.5	Impacts to control .....	7-74
7.3.5.6	Type of Measure.....	7-74
7.3.5.7	Targets and monitoring indicators.....	7-75
7.3.5.8	Actions to develop .....	7-75
7.3.5.9	Application place .....	7-75
7.3.5.10	Schedule .....	7-75
7.3.5.11	Budget.....	7-75
7.3.5.12	Responsible.....	7-76
7.4	SOCIOECONOMIC ENVIROMENT .....	7-76
7.4.1	Information and community participation.....	7-76
7.4.1.1	Objectives.....	7-76
7.4.1.2	Justification.....	7-76
7.4.1.3	Regulations .....	7-76

**ENVIRONMENTAL IMPACT STUDY**

7.4.1.4	Stage .....	7-77
7.4.1.5	Impacts to control .....	7-77
7.4.1.6	Type of Measure.....	7-77
7.4.1.7	Targets and monitoring indicators.....	7-77
7.4.1.8	Actions to develop .....	7-78
7.4.1.9	Application place .....	7-79
7.4.1.10	Schedule .....	7-79
7.4.1.11	Budget.....	7-82
7.4.1.12	Responsible.....	7-82
7.4.1.13	Annexes-formats .....	7-83
7.4.2	Environmental Education for workers .....	7-87
7.4.2.1	Objectives.....	7-87
7.4.2.2	Justification.....	7-87
7.4.2.3	Regulations .....	7-87
7.4.2.4	Stage.....	7-87
7.4.2.5	Impacts to control .....	7-88
7.4.2.6	Type of Measure.....	7-88
7.4.2.7	Targets and monitoring indicators.....	7-88
7.4.2.8	Actions to develop .....	7-88
7.4.2.9	Application place .....	7-89
7.4.2.10	Schedule .....	7-89
7.4.2.11	Budget.....	7-89
7.4.2.12	Responsible.....	7-89
7.4.3	Community Environmental Education .....	7-89
7.4.3.1	Environmental education Project .....	7-89
7.4.3.2	Reading and writing project for adults.....	7-96
7.4.3.3	Institutional and community strengthening.....	7-99
7.4.4	Relocation of infrastructure and housing.....	7-103
7.4.4.1	Objectives.....	7-103
7.4.4.2	Justification.....	7-103
7.4.4.3	Regulations .....	7-103
7.4.4.4	Stage.....	7-104
7.4.4.5	Impacts to control .....	7-104

**ENVIRONMENTAL IMPACT STUDY**

7.4.4.6	Type of measure.....	7-104
7.4.4.7	Goals and monitoring indicators .....	7-104
7.4.4.8	Actions to develop .....	7-105
7.4.4.9	Application place .....	7-105
7.4.4.10	Schedule .....	7-105
7.4.4.11	Budget.....	7-106
7.4.4.12	Responsible.....	7-106
7.4.5	Hiring Labor .....	7-106
7.4.5.1	Objectives.....	7-106
7.4.5.2	Justification.....	7-107
7.4.5.3	Regulations .....	7-107
7.4.5.4	Stage.....	7-107
7.4.5.5	Impacts to control .....	7-107
7.4.5.6	Type of Measure.....	7-107
7.4.5.7	Targets and monitoring indicators.....	7-107
7.4.5.8	Actions to develop .....	7-108
7.4.5.9	Application place .....	7-108
7.4.5.10	Schedule .....	7-109
7.4.5.11	Budget.....	7-109
7.4.5.12	Responsible.....	7-109
7.4.6	Restoration of economic conditions Program.....	7-109
7.4.6.1	Objective .....	7-109
7.4.6.2	Justification.....	7-109
7.4.6.3	Regulations .....	7-109
7.4.6.4	Stage.....	7-110
7.4.6.5	Impacts to control .....	7-110
7.4.6.6	Type of measure.....	7-110
7.4.6.7	Goals and monitoring indicators .....	7-110
7.4.6.8	Actions to develop .....	7-110
7.4.6.9	Application place .....	7-111
7.4.6.10	Schedule .....	7-111
7.4.6.11	Budget.....	7-111
7.4.6.12	Responsible.....	7-111

**ENVIRONMENTAL IMPACT STUDY**

7.4.7	Rural entrepreneurship .....	7-111
7.4.7.1	Objectives.....	7-111
7.4.7.2	Justification.....	7-112
7.4.7.3	Regulations .....	7-112
7.4.7.4	Stage .....	7-112
7.4.7.5	Impacts to control .....	7-112
7.4.7.6	Type of measure.....	7-113
7.4.7.7	Goals.....	7-113
7.4.7.8	Monitoring Indicators .....	7-113
7.4.7.9	Actions to develop .....	7-113
7.4.7.10	Application place .....	7-115
7.4.7.11	Schedule .....	7-115
7.4.7.12	Budget.....	7-115
7.4.7.13	Responsible.....	7-116
7.4.8	Archeology and cultural heritage.....	7-116
7.4.8.1	Objective .....	7-116
7.4.8.2	Justification.....	7-116
7.4.8.3	Regulations .....	7-117
7.4.8.4	Stage.....	7-117
7.4.8.5	Impacts to control .....	7-117
7.4.8.6	Type of measure.....	7-118
7.4.8.7	Targets and monitoring indicators.....	7-118
7.4.8.8	Actions to develop .....	7-119
7.4.8.9	Application place .....	7-119
7.4.8.10	Schedule .....	7-119
7.4.8.11	Budget.....	7-120
7.4.8.12	Responsible.....	7-121
7.4.9	Restitution Program of the affected infrastructure .....	7-121
7.4.9.1	Objectives.....	7-121
7.4.9.2	Justification.....	7-121
7.4.9.3	Regulations .....	7-121
7.4.9.4	Stage.....	7-122
7.4.9.5	Impacts to control .....	7-122

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

7.4.9.6	Type of measure.....	7-122
7.4.9.7	Targets and monitoring indicators.....	7-122
7.4.9.8	Actions to develop .....	7-122
7.4.9.9	Application place .....	7-123
7.4.9.10	Schedule .....	7-123
7.4.9.11	Budget.....	7-123
7.4.9.12	Responsible.....	7-123
7.4.10	Archeology and disclosure rescue .....	7-123
7.4.10.1	General Information.....	7-123
7.4.10.2	Archaeological Excavation in area.....	7-124
7.4.10.3	Stratigraphic Sampling.....	7-126
7.4.10.4	Archaeological Monitoring .....	7-129
7.4.10.5	Laboratory Phase - Analysis of the cultural materials recovered during excavations.....	7-130
7.4.10.6	Archaeological Outreach Program of El Molino and San Matias hydroelectric projects .....	7-130
7.4.10.7	Implementation Schedule for the Archaeological Management Plan....	7-131
7.4.10.8	Budget.....	7-132



	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

## LIST OF TABLES

	<b>Pag.</b>
Table 7-1 Summary of Environmental Management Plan .....	7-1
Table 7-2 Budget (direct, personal), environmental field supervisors .....	7-7
Table 7-3 Budget (direct, staff), environmental management group .....	7-10
Table 7-4 Deposits El Molino hydroelectric project.....	7-13
Table 7-5 Schedule for the management program and material disposal.....	7-14
Table 7-6 Management plan goals for particulate material, gases and noise emissions sources.....	7-17
Table 7-7 Schedule for particulate material, gases and noise emissions management plan ..	7-20
Table 7-8 Criteria for source separation .....	7-30
Table 7-9 Analyzed variables in the methodology for determining flow rates of environmental guarantee EPM (Grecco 2005). .....	7-34
Table 7-10 Rating Parameters - Variable 1 .....	7-34
Table 7-11 Rating Parameters - Variable 2 .....	7-35
Table 7-12 Rating Parameters - Variable 3 .....	7-36
Table 7-13 Rating Parameters - Variable 4 .....	7-37
Table 7-14 Rating Parameters - Variable 5 .....	7-37
Table 7-15 Rating Parameters - Variable 6 .....	7-38
Table 7-16 Rating Parameters - Variable 7 .....	7-39
Table 7-17 Rating Parameters - Variable 8 .....	7-40
Table 7-18 Rating Parameters - Variable 9 .....	7-40
Table 7-19 Rating Parameters - Variable 10 .....	7-42
Table 7-20 Medium and minimum flow rates at the collection point.....	7-43
Table 7-21 Length qualification of dry section .....	7-43
Table 7-22 Estimation of NSF – WQI index on influence section .....	7-44
Table 7-23 NSF-WQI rating for the projects .....	7-44
Table 7-24 Rating of the chemical oxygen demand for influence section .....	7-45
Table 7-25 Rating of fishing importance on the influence section.....	7-45
Table 7-26 Rating fish migration on influence section .....	7-46
Table 7-27 Rating fish migration on influence section .....	7-46
Table 7-28 Characterization of the biological water quality on influence section. ....	7-47
Table 7-29 Rating fish migration on influence section .....	7-47

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Table 7-30 Rating landscape modification on influence stretch.....	7-48
Table 7-31 Qualification of water uses in the altered flow sector.....	7-49
Table 7-32 Qualification variables according to the EPM methodology for influence section..	7-49
Table 7-33 Environmental Instream Flow for the influence section, according to the CGA - EPM (Q GAMB) methodology .....	7-50
Table 7-34 Selected Environmental Instream Flows .....	7-51
Table 7-35 Average Flow remnant.....	7-51
Table 7-36 Species in need of rescue.....	7-60
Table 7-37 Samplings of fauna .....	7-73
Table 7-38 Overall sampling costs.....	7-73
Table 7-39 Management strategy budget of aquatic ecosystems.....	7-75
Table 7-40 Information Program Action Plan and community participation for 12 months, project El Molino. ....	7-80
Table 7-41 Budget for direct costs and social professionals for 12 months .....	7-82
Table 7-42 Schedule for the community environmental education program .....	7-93
Table 7-43 Families to resettle.....	7-103
Table 7-44 Schedule of the relocation infrastructure program .....	7-105
Table 7-45 Budget for direct costs and the social professionals.....	7-106
Table 7-46 Budget program for the restoration of economic conditions.....	7-111
Table 7-47 Schedule for the rural entrepreneurship program .....	7-115
Table 7-48 Budget of direct and personal costs .....	7-115
Table 7-49 Schedule for the memory and heritage program .....	7-119
Table 7-50 work areas which require archaeological monitoring .....	7-129
Table 7-51 General schedule for field activities.....	7-131
Table 7-52 General schedule for lab activities .....	7-131
Table 7-53 Budget for archeological rescue in El Molino and San Matias hydroelectric projects.....	7-132
Table 7-54 Budget for monitoring and disclosure in El Molino and San Matias. Hydroelectric projects.....	7-133
Table 7-55 Summary of the costs of rescue, monitoring and disclosure programs.....	7-134

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### FIGURE LIST

	<b>Pag.</b>
Figure 7-1 General outline of the treatment system .....	7-23
Figure 7-2 Grease Trap Scheme.....	7-24
Figure 7-3 Schematic sediment .....	7-24
Figure 7-4 Gutters for rainwater collection .....	7-25
Figure 7-5 Visual Estimate of the basin in the intervene section on the San Matias River ..	7-48
Figure 7-6 Natural Flow, Instream Flow and remnant average.....	7-52
Figure 7-7 Natural Flow, Instream Flow and remnant average.....	7-57
Figure 7-8 Areas planned for the biological corridor.....	7-68

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**ANEXXES LIST**

Annex 16. Sewage treatment system

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

## 7 ENVIRONMENTAL MANAGEMENT PLAN

Based on the assessment of environmental impacts caused by the construction and operation of El Molino hydroelectric project, which are presented in chapter 5 of this report is designing the Management Plan which presents programs to control identified impacts which may be of prevention, mitigation, control, protection, surveillance, or compensation, and how and where these should be applied.

Table 7-1 presents a summary of the Environmental Management Plan and in its location on Cartography 2148-04-EV-DW-040.

**Table 7-1 Summary of Environmental Management Plan**

Management Plan	Impacts to control	Costs ( \$ )
Environmental supervision group		418,500,000
Environmental Management Group		476,367,700
Disposal of materials management program	Increase in the concentration of particulate material and gases Changes in the physical and chemical properties of the soil Modification of landscape	This project's costs are included within civil facilities
Management of particulate material, gases and noise emissions	Increase in the concentration of particulate material and gases Increase in sound pressure levels Empowerment of Conflicts Generation of expectations	93,000,000
Liquid waste treatment.	Water quality changes Water availability reduction River dynamics alteration Changes in the physical and chemical properties of the soil	This project's costs are included within civil facilities
Management of domestic, industrial and hazardous solid waste	Increase in the concentration of particulate material and gases Water quality changes Reduction of water availability Changes in the physical and chemical properties of the soil Modification of landscape Empowerment of Conflicts	109,000,000

**ENVIRONMENTAL IMPACT STUDY**

<b>Management Plan</b>	<b>Impacts to control</b>	<b>Costs ( \$ )</b>
	Generation of nuisances to the community Variation in health levels	
Instream flow estimation	River dynamics alteration Changes in the fish community of San Matias River Changes in the structure of biotope and aquatic biocenosis	Costs are included in the economic analysis of the project.
Water supply, to the people settled along the conducting tunnel	Changes in water quality and availability Empowerment of conflicts. Generation of expectations Generation of nuisances to the community	680,000,000

**Table 7-1 Summary of the Environmental Management Plan (Continued)**

<b>Management Plan</b>	<b>Impacts to control</b>	<b>Costs ( \$ )</b>
Management of vegetation covering and bare soil		12,995,000
Flora Rescue	Changes in vegetation covering Increased pressure on natural resources	77,088,430
Compensation of affectation to woodlands - Formation of biological corridor	Changes in vegetation covering Loss or fragmentation of habitats Increased pressure on natural resources	456,201,400
Study of terrestrial vertebrate fauna	Loss or fragmentation of habitats Death and displacement of terrestrial fauna Increased pressure on natural resources	323,450,000
Aquatic ecosystem management strategy	River dynamics alteration Change in the fish community of San Matias River Change in the structure of aquatic biotope and biocenosis	92,775,000
Information and community participation program	All the identified impacts	61,070,000
Environmental Education to the community	Involvement of cultural heritage Empowerment of conflicts. changes in Population Dynamics Increase in the demand for goods and services Variation in health levels	59,520,000
Community Environmental		



**MOLINO AND SAN MATÍAS  
HYDROELECTRIC PROJECTS**

Doc.: 2148-04-EV-ST-020-07

Rev. No.:0

2012-03-30

**ENVIRONMENTAL IMPACT STUDY**

Education		
Environmental education Project	<ul style="list-style-type: none"> <li>Generation of expectations</li> <li>Generation of nuisances to the community</li> <li>Empowerment of conflicts</li> <li>Increase in the concentration of particulate material and gases</li> <li>Increase in sound pressure levels</li> <li>Water quality changes</li> <li>Changes in vegetation covering</li> <li>Death and displacement of terrestrial fauna</li> <li>Increase pressure in natural resources</li> </ul>	135,300,000
Reading and writing project for adults		32,400,000
Institutional and community empowerment	<ul style="list-style-type: none"> <li>Generation of expectations</li> <li>Temporary employment generation</li> <li>Modification of local mobility.</li> <li>Increase in the demand for goods and services</li> <li>Modification of the municipal finance and the environmental corporations.</li> <li>Changes in governance levels</li> <li>Cultural heritage affectation</li> <li>Empowerment of Conflicts</li> <li>Variation in health levels</li> </ul>	40,000,000

**Table 7-1 Summary of the Environmental Management Plan (Continued)**

<b>Management Plan</b>	<b>Impacts to control</b>	<b>Costs ( \$ )</b>
Relocation of affected existing houses and infrastructure	<ul style="list-style-type: none"> <li>Infrastructure and housing displacement</li> <li>Changes in Population dynamics</li> <li>Generation of expectations</li> <li>Empowerment of conflicts</li> <li>Economic activities affectation.</li> <li>Generation of inconveniences to the community</li> </ul>	203,009,000
Labor recruitment	<ul style="list-style-type: none"> <li>Generation of expectations</li> <li>Temporary employment generation</li> <li>Affectation of Economic activities</li> <li>Generation of nuisances to the community</li> </ul>	Costs are included in the environmental management group

**ENVIRONMENTAL IMPACT STUDY**

	Empowerment of conflicts Infrastructure and housing displacement	
Restoration of economic conditions Program	Generation of expectations Modification of local mobility. Infrastructure and housing displacement Affectation of Economic activities Generation of nuisances to the community Changes in the use of soil	42,000,000
Rural entrepreneurship	Generation of expectations Empowerment of conflicts Changes in Population dynamics Increase in the demand for goods and services. Affectation of Economic activities Changes in employment level Infrastructure and housing displacement Affectation of cultural heritage	359,500,000
Memory and cultural heritage	Generation of expectations Affectation of cultural heritage Modification of local mobility. Infrastructure and housing displacement Changes in Population dynamics Pressure on the real estate market Generation of inconveniences to the community Affectation of archaeological heritage.	37,200,000
Restoration of affected infrastructure	Involvement of cultural heritage Empowerment of conflicts Damage caused to third parties Generation of expectations	Costs are included within the Environmental Management Group and the civil facilities
Archeology rescue and disclosure	Archaeological heritage impairment Involvement of cultural heritage	180,950,000
Monitoring and follow up plan		308,677,800
CONTINGENCY PLAN		303,570,000
<b>Total</b>		<b>4,502,574,330</b>

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Within these strategies are not considered measures for handling quarries, because the loan materials will be resulting materials from the excavation, and the fine materials will be purchased in authorized quarries

## **7.1 OPERATION STRUCTURE**

For the implementation of the Environmental Management Plan two groups must be formed. Environmental Management Group and an Environmental supervision Group

### **7.1.1 Environmental supervision group**

#### **7.1.1.1 Objectives**

Monitor proper implementation of the Environmental Management Plan, evaluating its efficiency and effectiveness.

Identify environmental problems not considered within the Environmental Impact Study, and follow up with the solutions.

Ensure that the construction of the project, meets the current environmental regulations.

Participate in the communications with the entities and external authorities responsible for the supervision of the project (CORNARE and municipal authorities of Granada and Corcorna).

#### **7.1.1.2 Stage**

During the construction phase.

#### **7.1.1.3 Actions to develop**

The Environmental supervision group is formed by a coordinator and three field supervisors, who will depend directly on the supervision Direction of the project construction:

Within their functions will be:

#### **Environmental Supervision Coordinator**

The Coordinator must be a professional in the areas of engineering, geology, social or biology, with experience in the environmental area. Within his functions are:

Inspect the execution of daily activities part of the Environmental Management Plan.

Request the necessary corrective measures in the event that a failure is identified in the programs or the current environmental regulations.

Plan and perform regular meetings with the Environmental Management Group, to assess the Management Plan development, and define the settings that must be performed.

Design the monitoring and field work evaluation formats and the data management support for the evaluation of indicators for the assessment of environmental impacts identified in chapter 5.

Support the relationships of the project with local and environmental authorities, as well as with the surrounding communities.

#### **Environmental field supervisors**

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

The environmental group of Supervisors shall be composed of two professionals, with different profession than the coordinator, and which can be an engineer or geologist with experience in the environmental area, a biologist, agronomist or forest engineer, or a professional in social area, whose functions will be the following:

Fill out the formats designed by the Supervision Coordinator, to assess the development programs that form the Environmental Management Plan.

Evaluate the efficiency and effectiveness of the measures outlined in the management strategies, as well evaluate the measures designed to address impacts not identified in the Environmental Impact Study.

Designing and maintaining an updated database in which are recorded important facts from the environmental point of view (date, site of occurrence, event type, possible causes identified, corrective action implemented), as well as the records for the indicators evaluation to assess the impacts.

Develop monthly reports on the activities carried out by the Contractor, noting their strengths and drawbacks that have occurred in the application of the Management Plan.

#### **7.1.1.4 Implementation Schedule**

The Environmental supervision group will operate during the construction of the project.

#### **7.1.1.5 Budget**

Table 7-2 presents the budget for the Environmental supervision group.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-2 Budget (direct, personal), environmental field supervisors**

**ENVIRONMENTAL IMPACT STUDY**

	Unit	Value ( \$ )	Months	Total ( \$ )
<b>Staff costs</b>				<b>9,000,000</b>
Coordinator	H-month	2,000,000	1	2,000,000
1 Professional (engineer, geologist, biologist, agronomist, forest engineer, social area)	H-month	2,000,000	1	2,000,000
2 Professional (engineer, geologist, biologist, agronomist, forest engineer, social area)	H-month	2,000,000	1	2,000,000
Location bonus	Month	1,000,000	3	3,000,000
<b>Direct Costs</b>				<b>4,500,000</b>
Vehicle	Unit	3,500,000	1	3,500,000
Paper work and reports	SG			1,000,000
<b>Total Cost per month</b>				<b>13,500,000</b>
<b>Total Cost</b>				<b>418,500,000</b>

## 7.1.2 Environmental Management Group

### 7.1.2.1 Objectives

- Execute the attention of the planned strategies
- Ensure compliance with current environmental regulations at the time of building and operation of the project.
- Identify environmental problems not considered initially, and propose solutions.
- Provide requested information by the environmental authorities or by Banks.

### 7.1.2.2 Stage

During the construction phase of the project.

### 7.1.2.3 Actions to develop

As the Environmental Management Group will be responsible for implementing all the outlined strategies, should be made up of professionals from different disciplines, which will have a professional coordinator.

Within their functions will be:

- Coordinator of the Environmental Management Group.

The Coordinator must be a professional in the areas of engineering, geology, social or biology, with experience in the environmental area. Within his functions are:

- Ensure the implementation of the strategies adopted to address the generated impacts.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Develop a schedule of implementation strategies which must be articulated with the construction program of the project, and ensure its compliance.
- Keep control of costs generated by the application of the outlined strategies.
- Establish the relationship of the project with local environmental authorities (CORNARE, in the municipalities of Granada and Cocorná), as well as with the surrounding communities.
- Participate in scheduled meetings with the community and institutions, to deal with topics related to the project.
- Develop monthly reports of environmental activities that have taken place in the period.
- Prepare the final report, evaluating the compliance of each of the strategies, and pointing out which were the drawbacks during its execution.
- Professionals of the Environmental Management Group

The environmental management group is composed of three persons: a communicator, and two other professionals with a different profession than the coordinator, who can be an engineer or geologist with experience in the environmental area; a biologist, an agronomist or forest engineer or a professional in the social area.

In addition the Management Group will have a crew of three workers, to carry out activities included in the Environmental Management Plan.

This group functions shall be the following:

- Execute the programs that make up the Environmental Management Plan.
- Define the measures that must be taken in case an impact is not identified in the Environmental Impact Study.
- Ensure the maintenance of machinery and the equipments that participate in the construction of the project, in accordance with regulations.
- Design and maintain a database where there is record of expenses and used resources in the implementation Plan.
- Comply with the proposed implementation schedule
- Perform all activities related to the community, such as meetings, design information tools, disseminating messages, among others.

#### **7.1.2.4 Implementation Schedule**

The Environmental Management Group will operate during the construction of the project as part of the Contractor and until it is successfully delivered to HMV, which will be responsible during the operation stage

#### **7.1.2.5 Budget (direct, Staff)**

The costs presented in the table below, only applies to the construction phase.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-3 Budget (direct, staff), environmental management group**

	Unit	Value ( \$ )	Months	Total ( \$ )
<b>Staff costs</b>				<b>10,566,700</b>
Coordinator	H-month	2,000,000	1	2,000,000
1 Professional (engineer, geologist, biologist, agronomist, forest engineer, social area)	H-month	2,000,000	1	2,000,000
2 Professional (engineer, geologist, biologist, agronomist, forest engineer, social area)	H-month	2,000,000	1	2,000,000
Professional 3 (Social communicator)	H-month	2,000,000	0.5	1,000,000
Workers	H-month	566,700	1	566,700
Location bonus	Month	1,000,000	3	3,000,000
<b>Direct Costs</b>				<b>4,800,000</b>
Rental office	Month	300,000	1	300,000
Vehicle	Unit	3,500,000	1	3,500,000
paper work publications	SG			1,000,000
<b>Total Cost per month</b>				<b>15,366,700</b>
<b>Total Cost</b>				<b>476,367,700</b>

## 7.2 ABIOTIC ENVIRONMENT

Below are the environmental management plans where the actions to be developed to prevent, correct, mitigate the environmental impacts generated by the implementation of the hydroelectric development are defined.

### 7.2.1 Program for handling and disposal of materials

#### 7.2.1.1 Objectives

- Design measures to prevent, mitigate and control the impacts that may be generated by the adequacy and operation of the reservoir zones on the natural resources.
- Define the criteria for proper selection of the reservoir sites.
- Ensure the minimum impact on the project influence area by the management of the required materials for the construction of the project.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.2.1.2 Justification

During the construction of El Molino hydroelectric project, materials will be needed for building the facilities infrastructure; in addition activities such as adequacy of roads and terrain, among others will generate excavation material excess. In order to preserve the natural resources or avoid a widespread affectation, it must be establish management measures to prevent and mitigate the effects that may be generated by identified environmental impacts.

### 7.2.1.3 Regulations

- Decree – Law 2811 of 1974. Natural resources code Mention the factors that damage the environment, air, water, soil pollution, or other renewable resources, understood by contamination the alteration of the environment by human activity.
- Decree 3930 of 2010: Establishes the provisions related to the uses of the water resource, the management of the water resource and discharge to the soil and to sanitary sewer.
- Decree 1594 of 1984. Establishes the criteria of water quality according to the uses and standards for discharges to a body of water.
- Decree 1791 of 1996. This establishes the need to apply for a forest development permit of Single type.
- Resolution 601 of 2006 by establishing the air quality standard of emission levels, for all the national territory in reference conditions.
- Resolution 627 of 2006 to establish the national standard for noise emission and ambient noise.
- Resolution 541 of 1994 by means of which regulates the loading, unloading, transport, storage and disposal of rubble.

### 7.2.1.4 Stage

Construction and operation

### 7.2.1.5 Impacts to control

- Increase in the concentration of particulate material and gases
- Changes in the physical and chemical properties of the soil
- Modification of landscape

### 7.2.1.6 Type of Measure

Prevention and Mitigation

Targets and monitoring indicators

#### • Goals

- Verify that 100% of the material used for the construction, comes from sites that comply with the current environmental regulations

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Properly dispose the 100% of the resulting material from the Project construction

- **Indicators**

- Volume of material from quarries with existing environmental permits / volume of used material in the construction work X 100
- Volume of disposal material in reservoir areas/volume of non usable excavated material.
- Volume of material used in the labor/volume of usable excavated material.
- Actions to develop

- **Management of Construction Materials.**

- Any material that is received in the facilities must have the support registers of the purchase in areas that comply with all the current environmental regulations.
- Adaption of a central area for the storage of building materials to be used in the work, which will be brought to the work front when required.
- In the event that a construction material should stay a long time in the construction area, will be covered with plastic or other items that protect it from the wind.
- In regard to the material transportation, must be taking into account all the regulations of resolution 541 of 1994, complying with the activities described below:
- Must ensure that spills do not occur in the material transportation. Therefore, the containers or platters of vehicles used, must be formed by a continuous structure which doesn't present cracks, holes, slots or spaces where the load can fall or spillover of the transported material.
- The containers of the vehicles used to transport the construction material must be in perfect maintenance condition.
- The cargo of building materials must be accommodated in such a way that their volume is flat even with the platter or container, that is to say. flush with the lower top edges of the container or platter
- In order to avoid dispersion, is compulsory to cover the transported cargo; the coverage element must be resistant and firmly grasped.
- Concrete mixers vehicles and other elements with high moisture content must have the necessary safety devices to prevent spillage of mixing material during transportation.
- If complying with all of the above measures there is a loss of material from the vehicles, this must be immediately collected by the carrier, for which they must have the necessary equipment.

- **Selection of the reservoir sites**

For the selection of the deposit sites at any stage of the project, should be considered the following criteria:

- Closeness to the villages. Look for reservoir zones that are not close to population centers existing in the project influence area, to reduce the impacts on the population.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Optimize the distance of haulage of the material to be deposited at these sites in order to avoid the impacts generated by the transport of this type of material.

Following these criteria and others of technical type, were selected the following deposits for El Molino hydroelectric project (see Table 7-4)

**Table 7-4 Deposits El Molino hydroelectric project**

Deposit	Location	Capacity
M1	Top of the hill, in the right margin of the road which leads to the Vereda, El Molino, at less than 300 m from the start of the collection section.	200,000 M <sup>3</sup>
M2	South of the Vereda, El Molino and east of the M1 deposit	230,000 M <sup>3</sup>
M3	Located in the abscissa Km0+690m of the collection access route	235,000 M <sup>3</sup>
M4	Located in the abscissa Km1+100m of the collection access route	120,000 M <sup>3</sup>
M5	Next to the tunnel entrance gate.	65,000 M <sup>3</sup>
SM2	Bottom of the power house road, close to the abscissa Km0+400m	23,000 M <sup>3</sup>
SM3	Located toward the top of the track to power house, close to the abscissa Km0+750m.	100,000 M <sup>3</sup>
SM4	It is on the way to power house, close to the abscissa Km1+490m	85,000 M <sup>3</sup>

- **Operation of Deposit Sites.**

- Must be well-marked and delimited, making it possible to establish the specific area for the reservoir. Will be bare soil before starting the construction of the deposits.
- The bare soil will be stored in nearby sites, where it does not affect the execution of the work in these formation areas, because they will be reused in the closure of these areas.
- The disposal material carried will be classified as common and rock, depositing them in different sectors, in order to prevent the contamination of some materials with others.
- It is recommended that the placement of common material be done in layers that do not exceed a thickness of 0.40 m, although the final thickness shall be defined in the field, according to the material characteristics.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Same as the common material, it is recommended that the rock is compacted in layers of 0.80 m thick, but the final thickness will be established at the time of tank operation. The compaction will be done with the transport equipment, which should not always ride around the same site.
- Completed the material disposition, or to the extent permitted by the reservoir formation, water interceptor channels will be constructed in the crown and along the way. The outfall of these channels must be carried up to the natural currents near the site.
- For the ultimate shape of the deposit slopes, protection work will be accomplished, such as the reforestation of the cut slopes and the construction of coronation rounds
- The excavation materials must be removed immediately from the work areas and placed in the reservoir zones, bearing in mind that the selected sites be close to the front, in a way that hauls are minimum.
- No materials will be deposited in riverbeds of creeks, geological faults or in places where the brook capacity of the soil means destabilization risks of the field.

#### **7.2.1.7 Application place**

The management measures defined in this environmental management plan must be applied in the temporary storage sites of the construction material, the access roads to the project and the deposit sites of excess excavation material.

#### **7.2.1.8 Schedule**

The adequacy of deposite areas must be made prior to the beginning of the infrastructure construction, in order to ensure that there are areas to dispose the excess material from these facilities. In Table 7-5 presents the work schedule proposed for activities raised in this WFP, as for the periodicity and supports that must be considered.

#### **7.2.1.9 Budget**

The deposits will operate in the construction phase of the project, and their costs are included within civil engineering facilities.

#### **7.2.1.10 Responsible**

- The owner of the project in the construction and operation stages.
- The contractors that execute infrastructure work in the construction phase.

**Table 7-5 Schedule for the management program and material disposal**



**MOLINO AND SAN MATÍAS  
HYDROELECTRIC PROJECTS**

Doc.: 2148-04-EV-ST-020-07

Rev. No.:0

2012-03-30

**ENVIRONMENTAL IMPACT STUDY**

Activity	1	2	3	4	5	6	7	8	9	10	11	12	Period	Activity support
<b>handling of Construction materials</b>														
Purchase record of building materials in authorized areas													Monthly	Format delivered monthly for the construction phase of the project
Adequate a storage area for the construction materials													At the beginning of the construction phase	Photographic Record
Protection of construction materials in work fronts													When required	Photographic Record
Review of maintenance vehicles transporting material													Quarterly	Format and photographic record. The format should control the condition of the containers or platters (without cracks, holes, slots or spaces), material coverage, equipment for the collection of material (shovels, gloves etc.)
<b>Reservoir sites operation</b>														
Signaling and demarcation of the reservoir areas													Each time it is adequate and starts with a reservoir operation	Photographic Record
Store bare soil in a place close to the deposit, for using it later in the tank closure													Each time it is adequate and starts with a reservoir operation	Photographic Record
													Each time it is adequate and starts with a reservoir operation	Photographic Record
Build protection facilities, such as slope reforestation coronation rounds, water channels interceptors throughout the deposit													Each time the tank is formed and to carry out its closure	Photographic Record

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

## 7.2.2 Particulate material, Gases and Noise Emissions Management Plan

### 7.2.2.1 Objectives

- Establishing prevention measures, mitigation and control of emissions of particular material, gases and noise generated during the construction process of El Molino hydroelectric project.
- Protect the health of populations associated with the influence area and the workers inside the project.
- Comply with air quality current environmental regulations.

### 7.2.2.2 Justification

Some activities that will be implemented during the construction of El Molino hydroelectric project, such as removal of vegetation, surface excavations, underground excavations and material transportation generate particulate material, altering the initial conditions of air quality in the area. In addition, the equipment used for the implementation activities mentioned above are noisy, which can cause discomfort to the settled community in the project influence area, generating impacts as generation of expectations and empowerment of conflicts. In order to prevent, control and mitigate the effects generated by the construction activities of the project on the air resource, it is necessary to design the management measures that should be performed which are exposed in this environmental management plan.

### 7.2.2.3 Regulations

- Law 769 of 2002. This promulgates the National Code of Land Transit and other provisions.
- Decree 948 of 1995 of the Environment Ministry. Controlling the emission of pollutants produced by mobile sources, environmental quality criteria of fuels for use for internal combustion engines in motor vehicles.
- Decree 2107 of 2005. By means of which is partly modified Decree 948 of 1995.
- Decree 979 of 2006. Amending articles 7, 7.10, 93, 94 and 108 of the decree 948 of 1995
- Resolution 610 of 1997 By which are established the emission factors from which permission for atmospheric emissions of stationary sources is required
- Resolution 601 of 2006 By establishing the standard for air quality or emission level, for all the national territory in terms of reference
- Resolution 610 of 2010 by amending the resolution 601 of 2006.
- Resolution 627 of 2006 to establish the national standard for noise emission and ambient noise.
- Resolution 650 of 2010 by adoption of the Monitoring and Follow-up of Air Quality Protocol.
- Resolution 8321 of 1983 the Ministry of Health in Colombia. By which promulgates rules on the protection and conservation of audition.

**ENVIRONMENTAL IMPACT STUDY**

- Resolution 1792 of 1990 of the Ministry of Health and the Ministry of Labor and Social Security in Colombia. For which permissible limit values are taken for occupational noise exposure.
- Resolution 541 of 1994 by means of which regulates the loading, unloading, transport, storage and disposal of rubble.

**7.2.2.4 Stage**

Construction and operation

**7.2.2.5 Impacts to control**

- Increase in the concentration of particulate material and gases
- Increase in sound pressure levels
- Empowerment of Conflicts
- Generation of expectations

**7.2.2.6 Type of Measure**

Prevention, control and mitigation

**7.2.2.7 Targets and monitoring indicators**

The targets and indicators for this program are related to maintain the air quality in equal conditions to those existing in the influence area of El Molino hydroelectric project, complying with the parameters set by the current environmental regulations, Resolution 610 of 2010 and 627 of 2006 or anyone which modifies it; the maximum values for the evaluation parameters are presented in Table 7-6.

**Table 7-6 Management plan goals for particulate material, gases and noise emissions sources**

Parameter	Reference Value
<b>Air quality (resolution 610 of 2010)</b>	
PST total suspended particles ( $\mu\text{g}/\text{m}^3$ )	100 ( $\mu\text{g}/\text{m}^3$ )
PM10 particulate material ( $\mu\text{g}/\text{m}^3$ )	60 ( $\mu\text{g}/\text{m}^3$ )
Nitrogen Dioxide $\text{NO}_2$ ( $\mu\text{g}/\text{m}^3$ )	100 ( $\mu\text{g}/\text{m}^3$ )
Sulfur Dioxide $\text{SO}_2$ ( $\mu\text{g}/\text{m}^3$ )	80 ( $\mu\text{g}/\text{m}^3$ )
Carbon Monoxide CO	100000( $\mu\text{g}/\text{m}^3$ )
Ozone $\text{O}_3$	80( $\mu\text{g}/\text{m}^3$ )
<b>Resolution 627 of 2006</b>	
LD (business day) dB (A)	80 dB
LD (holiday) dB(A)	80 dB
LN (business day) dB(A)	70 dB
LN (holiday) dB(A)	70 dB

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Comparing the data obtained in air monitoring with the reference values set out in the current environmental regulations. Monitoring should be performed in the same places where the samples are executed in the Environmental Impact Study.

#### 7.2.2.8 Actions to develop

The activities of prevention, mitigation and control should be focused on the elements: particulate material, gases and noise.

- **Particulate material Control**

For particles control is necessary to implement the following actions:

- **Wetting of the areas.** The areas with moving vehicles such as service roads and squares plaza, must have sufficient moisture to minimize the uplifting of particulate material; the programming and irrigation frequency will be determined in accordance with work progress
- There must be established a regeneration process in the uncovered areas immediately after its abandonment to decrease the emission of particulate material.
- In the transport of excess excavation and construction materials, it must be ensured that there will not be any spills or loss of material. Therefore, the container or Platter should be formed by a continuous structure that does not contain cracks, holes, slots or spaces, in addition to be in perfect condition. It is compulsory to cover the transported cargo, in order to avoid dispersion; the coverage must be of sturdy material and be firmly grasped. As set out in the Management Plan and material disposal, section 7.2.1

Depending on the effectiveness of the measures above, controls must be complemented with the coverage with resistant plastic material in the collection areas and deposit materials that may be generating changes in air quality.

- **Gas emissions Control**

The machinery and equipment involved in the construction, must comply with the mechanical preventive and corrective maintenance in agreement with the record of work hours; in addition, vehicles must have a valid certificate of the technical-mechanical inspection and gases emission.

- **Noise control**

It is required to ensure that all the machinery that is used during the construction and operation of El Molino hydroelectric project, will perform a preventative maintenance which includes the correction of loose parts, especially the metallic components or evaluate the need to soundproof the machinery with the installation of rubber complements The foregoing will be supplemented by the establishment of working hours.

According to article 104 of the Act 769 of 2002, all vehicles must be equipped with a device to produce intense acoustic signals not exceeding the identified by the environmental authorities, usable only for the prevention of accidents and emergency events.

Prohibits the use of horns on private vehicles the use and installation of all kinds of devices or accessories designed to produce noise, such as valves, resonators and whistles systems adapted to the low system and air brakes; the use of resonators in the exhaust gases of any

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

mobile source and movement of vehicles that have no muffler system in proper operating condition.

In the operation of the hydroelectric power station and according to the monitoring results done about air quality and noise, will verify if it must carry out a noise procedure for the control line ventilation system, in addition to other control measures in other areas of the project.

- **Signaling**

To decrease lifting particulate material and reduce noise levels produced by the traffic, there will be a speed limit of 20 km/h (max vel = 20 km/h), in the project influence area, for vehicles linked to the construction and operation. This measure is also important to reduce the risk of accidents on the access roads.

The signs of all the roads must comply with the provisions of the Traffic Signs Manual (Ministry of Transport, May 2004), which dictate the regulation of traffic on streets, highways and cycle route programs in Colombia. And must install:

- **Regulatory signals.** Are intended to indicate the limitations to the road users, prohibitions or restrictions on their use and which violation constitutes a punishable act
- **Preventive signals.** Aim to warn the road user of the existence of a hazard and the nature of it.
- **Informative Signs.** Aim to identify road and guide the user, giving the information he may need.
- **Temporary signals.** May be regulatory, preventive or informative and will be orange. Temporarily change the speed of normal use of the road.

#### 7.2.2.9 Application place

The management measures defined in this Environmental Management Plan must be applied in the sites that are described below:

- Areas where there will be implemented the main facilities: Veredas, El Molino, Campo Alegre and Los Mangos
- Place where will be built or adequate annex infrastructure such as access roads: Veredas, El Molino, Campo Alegre and Los Mangos
- Places where the disposal of excavation materials will be carried out. Veredas, El Molino and the Los Mangos
- Grinding Plants - Concrete mixing and pouring: Veredas, El Molino and the Los Mangos
- Roads access to the area: Veredas, San Juan, El Chocó, San Lorenzo

#### 7.2.2.10 Schedule

This program should be implemented during the 31 months that it takes for the construction of El Molino hydroelectric project according to the progress of project works; Table 7-7 sets the activities schedule for this management plan.

**ENVIRONMENTAL IMPACT STUDY**

**Table 7-7 Schedule for particulate material, gases and noise emissions management plan**

Activity	1	2	3	4	5	6	7	8	9	10	11	12	Period	Activity support
<b>Particulate material Control</b>														
Moisten the circulation areas of vehicles, such as service roads and squares plaza.													When required, in summer	Photographic Record
<b>Gas emissions and noise control</b>														
Technical mechanical and exhaust emission certificates inspection of machinery and vehicles that work in the Project.													Annual, according to the expiration date of the certificate	Append the valid certificates of technical mechanical and gas emission inspection for existing vehicles that perform operations in the project
Certificates inspection of mechanical preventive and corrective maintenance													When required, according to the operation sheet of the machinery or vehicle	Append the operation record of the machinery and certificates of preventive maintenance carried out
Implementing corrective measures to mitigate noise emissions and gases (natural or physical barriers, etc)													When required, according to the results of the monitoring of air quality and noise	Photographic Record
Signaling													At the beginning of the construction of access roads to the project, and maintenance	Photographic Record

**7.2.2.11 Budget**

Staff costs are included within the Environmental Management Group. Down below are discriminated some direct costs of this Management Plan, the rest are listed in the civil facilities costs

**ENVIRONMENTAL IMPACT STUDY**

Item	Unit	Quantity	Total value ( \$ )	Total value ( \$ )
Operation of tanker truck	<b>Month</b>	1	2,000,000	2,000,000
Signaling equipment	<b>SG</b>			1,000,000
<b>Total Cost per month</b>				<b>3,000,000</b>
<b>Total Cost of construction</b>				<b>93,000,000</b>

### 7.2.2.12 Responsible

- The owner of the project in the construction, operation stages and project closure.
- The contractors that execute any infrastructure work in the construction phase.

### 7.2.3 Liquid waste treatment

#### 7.2.3.1 Objectives

- Establish measures of prevention, mitigation and control of contamination on the surface and groundwater flows, as a result of domestic and industrial activities of the project.
- Treat domestic and industrial wastewater generated during the project development activities, before carrying out any kind of discharge.

#### 7.2.3.2 Justification

During the construction and operation of the El Molino hydroelectric project are generated liquid residuals in different activities (underground excavations, provision of leftover excavation, plants operation for processing materials, pouring of concrete, construction and operation of offices and workshops), which must be treated prior to discharge complying with Colombian environmental regulations.

#### 7.2.3.3 Regulations

- Decree – Law 2811 of 1978. The natural resources code Mention the factors that damage the environment, air, water, soil pollution, or other renewable resources, understood by contamination the alteration of the environment by human activity.
- Decree 3930 of 2010. : Establishes the provisions related to the uses of water resource, the management of water resource and discharge into water resource, the soil and to the sanitary sewer.
- Decree 1594 of 1984. Establishes the criteria of water quality according to the uses and standards for discharges to a water body.
- Decree 1541 of 1978. Defines the procedures for water use
- Decree 1729 of 2002. Through which defines the steps for the development and management of a Hydraulic basins.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Decree 1575 of 2007. Sets the System for the Protection and Control of Water Quality for Human Consumption.

#### **7.2.3.4 Stage**

Construction and operation

#### **7.2.3.5 Impacts to control**

- Water quality changes
- Water availability reduction
- River dynamics alteration
- Changes in the physical and chemical properties of the soil

#### **7.2.3.6 Type of Measure**

Prevention, control and mitigation

#### **7.2.3.7 Targets and monitoring indicators**

- **Goal**

Ensure compliance with environmental regulations related to wastewater discharge in water streams 100% of the times.

- **Indicator:**

% of compliance with environmental about wastewater regulation: (Parameters that meet environmental regulations/ parameters evaluated) \* 100

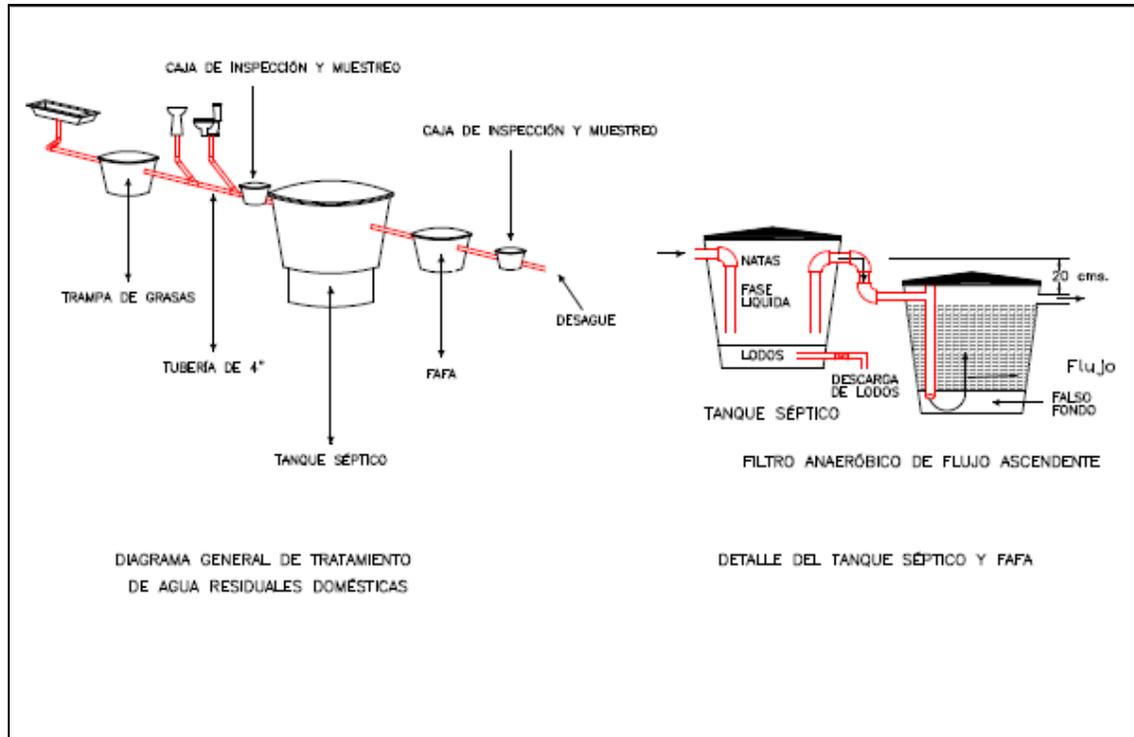
#### **7.2.3.8 Actions to develop**

The main strategy is to implement the necessary treatments, both for domestic and industrial wastewater; this will ensure that there will not be wastewater discharges without prior treatment.

- **Treatment of domestic wastewater**

Domestic wastewater arise in the area of camps, offices, workshops and every sector where sanitary facilities, showers or kitchens exist Its treatment will be performed by using a grease trap system, septic tank and an anaerobic filter, which is presented in Figure 7-1 and in Annex 16.

**ENVIRONMENTAL IMPACT STUDY**



**Figure 7-1 General outline of the treatment system**

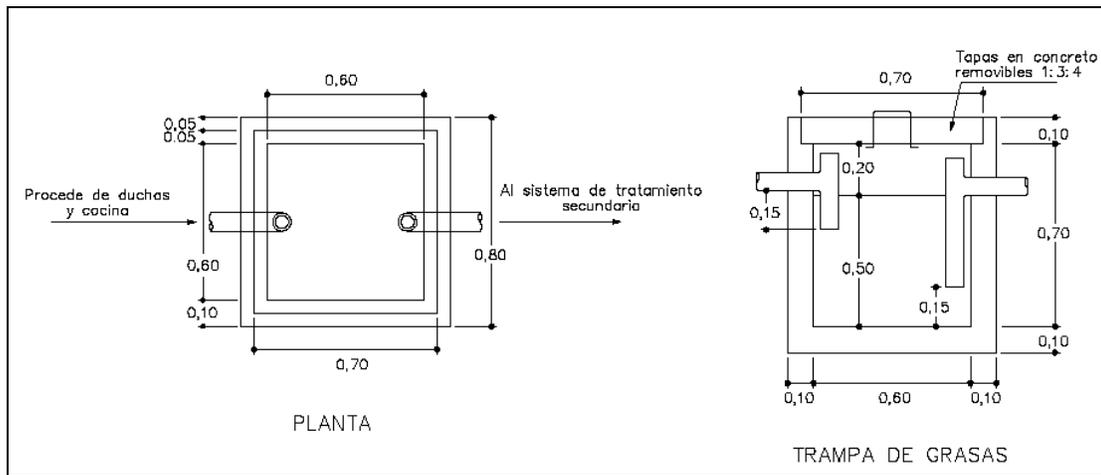
This system will ensure compliance with the provisions in article 72 of decree 1594 of 1984, or current regulations to pour waters into San Matias River.

- **Treatment of industrial wastewater**

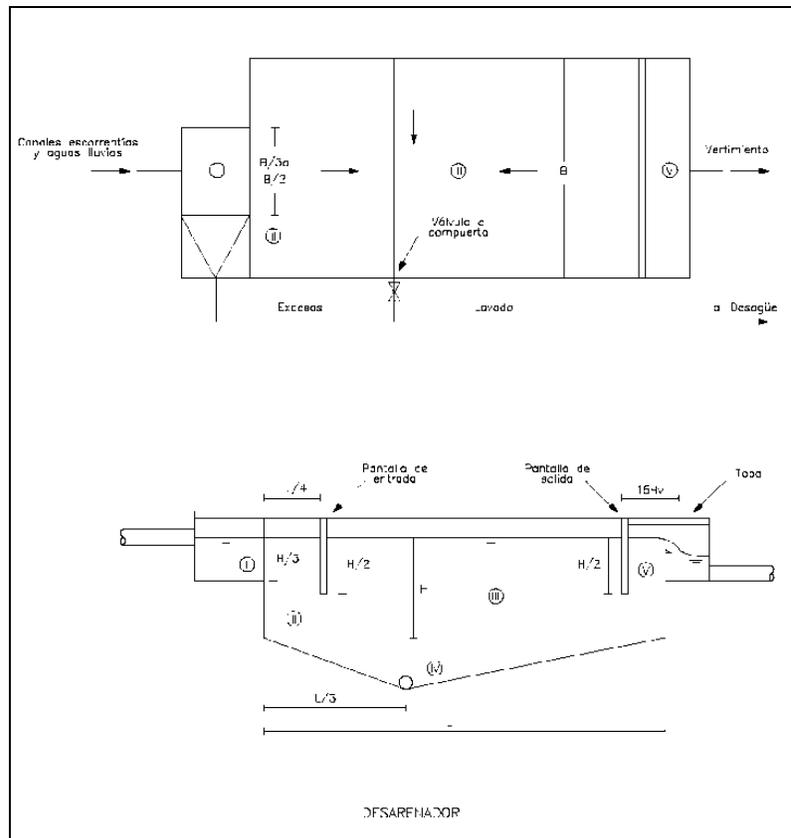
Industrial wastewater is characterized by the contamination of greases, oils, or other solvents used in the work developed in the maintenance workshops of equipment and machinery; industrial waters are also generated by the main drilling facilities, where their main pollutant is the contribution of solids. Its treatment will be carried out in accordance with the schemes presented in Figure 7-2 and Figure 7-3 To perform the discharge of treated wastewater is necessary to have the respective permission required by the competent environmental authority.

It must monitor the effluent quality which is obtained after the proposed treatments (see chapter 8 Wastewater Management Plan).

**ENVIRONMENTAL IMPACT STUDY**



**Figure 7-2 Grease Trap Scheme**



**Figure 7-3 Schematic sediment**

**– Repair site**

For the workshops area there will be installed grease traps that intercept greases and oils produced in workshops areas, and consist of small tanks, where grease comes to the surface and is retained, to avoid these substances being transferred to receiving water bodies.

**ENVIRONMENTAL IMPACT STUDY**

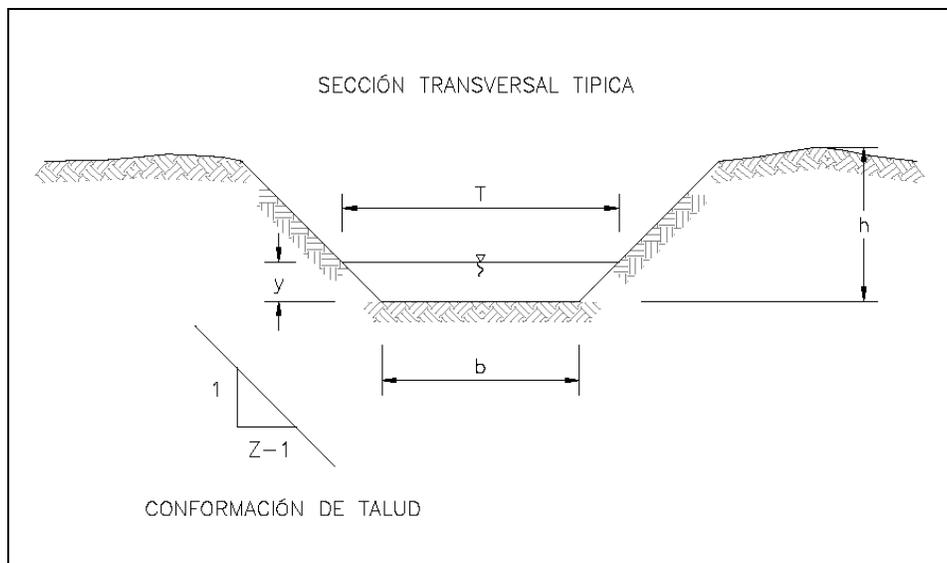
Greases and oils collected from these traps will be disposed in accordance with the current environmental legislation.

– **Substation area, deposits, power house**

Settlers will be constructed to allow the separation of suspended particulates. Once activities begin in the reservoir areas, substation, power house, it should be carried out a characterization of residual water to determine the relevance or not of this type of treatment, based on the provisions contained in the current environmental legislation.

The collection of rain and runoff water must be performed by means of channels that allow adequate management and treatment, in order to reduce the contribution of solid bodies to the receptors.

In camps, offices, workshops and in general in all the labor areas, must be built a perimeter channel for the collection of rain and runoff water to prevent these from entering the facilities, as presented in Figure 7-4.



**Figure 7-4 Gutters for rainwater collection**

– **Collection Area**

The opening of the background gate in the weir may only be carried out in winter, to avoid strong changes in water quality by an increase in sediment concentration.

• **Other liquid waste**

In case of required oil changes or fuel supply shall be done in the right place for that purpose (workshop).

For accidental spills greater than 10 gallons of fuel, greases, oils, it will be necessary to remove the contaminated soil for its treatment. Small volumes can be collected using sawdust, rags, sand, or synthetic absorbents.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- **Main facilities area**

- Settlers will be built for waters crossing the areas of the main facilities, in order to remove the thin material.
- Settlers must allow the deposit at the bottom, of all those particles with speed of  $V_c$  (erythrocyte sedimentation rate), which is related to the retention time and the tank depth using the following expression<sup>1</sup>:  $V_c = \text{Depth} / \text{detention time}$
- In camps, offices, workshops and in general in all labor areas, it must be built a perimeter channels for collection of rain and runoff water to prevent these from entering the facilities.
- The channels, which dimensions will depend on the flow rates established for each area, must have concrete coating or in bags of cement soil, which lead the water to a sand remover tank, in order to eliminate sedimentary particles and the sand.
- The sand removers should be designed in a way that the speed must be in a range between 0.2 m/s and 0.4 m/s. Must construct minimum two units, each with a capacity to operate with the flow design 2 .
- The sand remover must possess a direct by-pass line, which may be enabled according with the conditions presented in the rainwater and runoff.
- Within the sand remover design it must be taken into account:
  - Length to width ratio. A rectangular tank, with a ratio length to width (L/B) between 3/1 and 5/1. Is recommended.
  - Minimum and maximum depth. The specified minimum depth is 1, 50 m and the maximum of 4.50 m.
  - Sludge storage depth. Will have a maximum depth of 0, 40 m. The slopes of the bottom should be between 1% and 8 %, in order that the sludge rolls easily toward the waste pipe and manual cleaning is safe for the operators.
  - Hydraulic retention time. The time taken by a particle of water to enter and leave the tank should be between 0.5 hours and 4 hours.
  - Shallow hydraulic charge. Defined as the flow set per unit of surface area, must be between 15 and 80  $\text{m}^3 / \text{m}^2 \cdot \text{d}$ .
- Collection system for disposal of domestic and industrial wastewater.

#### **7.2.3.9 Application place**

Wastewater treatment is applied in the areas where deposits, camps, offices, collection area, power house are located; infrastructure that is located in the Veredass, El Molino and Los Mangos of the municipality of Cocorná

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1 Metcalf & Eddy. Wastewater Engineering. Treatment, disposal and reuse. Third edition. McGraw Hill. 1998.

2 GENERAL DIRECTORATE OF DRINKING WATER AND BASIC SANITATION. General Aspects of drinking water systems and basic sanitation. PM10

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.2.3.10 Schedule

The wastewater treatment systems shall be constructed in the first three months.

### 7.2.3.11 Budget

Costs are included within the Environmental Management Group and the civil facilities

### 7.2.3.12 Responsible

- The owner of the project in the construction stages, operation and project closure.
- The contractors that execute any infrastructure work in the construction phase.

## 7.2.4 Management Program of domestic, industrial and hazardous solid waste.

### 7.2.4.1 Objectives

- Separate, storage and properly disposal of domestic, industrial, hazardous solid waste, generated in the different labor fronts and project facilities.
- Train personnel linked to the project, in the proper management of domestic, industrial and hazardous solid waste, in topics such as the separation, storage, and disposal.

### 7.2.4.2 Justification

It is necessary to design the prevention, mitigation and control measures, for the proper management of solid waste, because during the construction and operation of El Molino hydroelectric project will generate solid waste which must be separated, stored and properly disposed will be generated; this will prevent changes in the water, soil and air quality.

### 7.2.4.3 Regulations

- Law 9 of 1979. By which sanitary measures are stated.
- Law 430 of 1998. Dictates prohibitive rules in environmental matters, relating to hazardous waste.
- Decree 4741 of 2005. By partially regulating the prevention and management of the waste or hazardous waste.
- Decree 1713 of 2002. This lays down rules to regulate the cleaning public service in the framework of comprehensive management of the regular solid waste, in matters relating to its components, levels, classes, procedures, quality, and the regime of the persons providing the service and users.
- Decree 1505 of 2003. Partly Modify Decree 1713 of 2002, in connection with the plans of integrated solid waste management.
- Decree 1140 of 2003. Amending partially Decree 1713 of 2002 in relation to the topic of storage units and other provisions.
- Decree 838 of 2005. Amending Decree 1713 of 2002 on final disposal of solid waste and other provisions.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Decree 2676 of 2000. By which regulates the integral management of hospital waste and similar.
- Decree 1609 of 2002. By which establishes the requirements for dangerous substances transportation.
- Decree 1446 of 2005. By which establishes procedures for handling of fuels.

#### **7.2.4.4 Stage**

Construction and operation

#### **7.2.4.5 Impacts to control**

- Increase in the concentration of particulate material and gases
- Water quality changes
- Water availability reduction
- Changes in the physical and chemical properties of the soil
- Modification of landscape
- Empowerment of Conflicts
- Generation of nuisances to the community
- Variation in health levels

#### **7.2.4.6 Type of Measure**

Prevention, control and mitigation

#### **7.2.4.7 Targets and monitoring indicators**

- **Goals**

- Correctly disposal 100% of the solid waste generated.
- Have trained 100% of the personnel working in the project

- **Indicators**

- % Waste recovered = (Total waste recovered / Total waste produced) X100
- % Waste properly disposal = (Total waste deposited in the landfill / Total waste generated) X100
- % Of Training = (people who received training/ Total staff)X100

#### **7.2.4.8 Actions to develop**

- **Staff Training**

There will be sensitization and education to employees associated with the construction and operation of the project, with the purpose of generating a commitment with activities that must be executed for the project success

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- **Characterization of solid waste**

Once the work begins, it should be done a characterization of the solid waste to be able to define how it will be handled. Must be a sampling record in each work front, defining the weight, volume of the produced solid waste in addition to its quality, that is to say the state in which it comes out (contaminated, mixed).

With the above information, there will be the management of waste generated, considering source separation, defining the containers for the different types of waste, being classified as follows:

- Biodegradable waste, regular and inert: Which shall be deposited in a container labeled as "non-recyclable"
- Recyclable Waste. Must be deposited in two containers, one labeled "paper and cardboard" and another as "plastic, metal and glass".
- Hazardous Waste for oils, oiled rags, and biological risk waste generated in infirmary, and some containers of chemicals can be stored in containers labeled as "hazardous waste".
- For the batteries, jars of paint and other hazardous waste, there must be conditioned spaces with stacks, clearly delimited and flagged for storage.

The final disposition of each type of waste will be adjusted to what it is stated in the Colombian law: non recyclable waste shall be deposited in the landfill of the municipality of Cocorná; for hazardous waste we shall comply with what it is established in the Decree 4741 of 2005.

For the recyclable waste, a search for its marketing in the project area will be implemented. In case there is no type of organization as needed, it will be taken to the sanitary landfill for final disposal.

- **Source Separation**

This activity is necessary to optimize the process of recovery and reuse of materials because it is the way to ensure the quality of the exploitable waste

It will be implemented in sites such as offices, camps, food court, workshops, there will be pots or containers properly identified, allowing the proper separation of the waste. These sites must be located strategically, visible, perfectly identified and marked. Preferably these containers must comply with the standard color code ICONTEC (GTC 24).

- **Storage**

It must be built or adapted a temporary storage site for the waste generated, in order to ensure the quality, the generation of contaminants and odors. The storage site must comply with the following features:

- Do not allow the increasing of humidity of the waste by water exposure
- Have the appropriate signaling for the separation of waste according to their characteristics.
- Prevent spills or exaggerated waste accumulation in the temporary storage sites.

**ENVIRONMENTAL IMPACT STUDY**

All containers must be located strategically, visible, perfectly identified and marked. These containers must be installed in area of camps, offices, workshops and at staff continuous displacement sites.

• **Internal Transport**

The vehicle used for transportation must ensure that the waste is not spilled during transport; in addition, these must be covered to prevent from changing their properties, by wetting by an eventual rain or by loss of moisture by exposure to the sun.

Must determine the routes and the frequency of collection, which will depend on the rate of waste production; the frequency should not exceed three days of storage.

• **Waste utilization.**

It is understood as the alternatives to reuse or recycle the waste generated to obtain economic and ecological benefits.

Some of the alternatives that can be implemented, depending on the volume of waste (see Table 7-36), are:

**Table 7-8 Criteria for source separation<sup>3</sup>**

Initial approach of separation	Description	Example of materials
Exploitable non-hazardous waste	Any material, object, substance or element that has no value of direct or indirect use for those who generate it, but that is susceptible of incorporation to a production process. It is recommended that this type of waste is not in contact with other materials that prevent its use	<ul style="list-style-type: none"> <li>- Paper, cardboard, pullout, newspaper or similar.</li> <li>- All kinds of clean glass.</li> <li>- Plastics.</li> <li>- Scrap metal, scrap metal.</li> <li>- Textiles.</li> <li>- Wood.</li> <li>- Leather.</li> <li>- Packing with layers of different materials.</li> </ul>
Food waste or similar	Such as husks, remnants of vegetables and fruits, scraps of food, garden waste or similar materials.	<ul style="list-style-type: none"> <li>- Pruning of trees or plants.</li> <li>- Waste of food.</li> </ul>
Hazardous Waste	Are those waste that their characteristics is infectious, combustible, flammable, explosive, radioactive, volatile, corrosive, reactive or toxic that can cause harm to human health or the environment. Hazardous waste is also those which, although not in its original form were transformed by natural processes into hazardous	<ul style="list-style-type: none"> <li>- Infectious: hospitable (pathogens), pathological waste, for hospitals, clinics or similar, syringes, needles, hypodermic, healing gauze, thermometers, among others.</li> <li>- Oily: oils and lubricants, petroleum products.</li> <li>- Organic: halogenated solvents and non-</li> </ul>

<sup>3</sup> ICONTEC. GTC 24 Environmental Management. Solid Waste, Guide to the source separation and selective collection. 2004.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

	waste. Additionally the packaging is considered hazardous waste, or packaging that has been in contact with them.	halogenated, paints, resins. - Explosives: TNT, nitroglycerine. - Corrosive: hydrochloric acid, caustic soda and sulfuric acid. - Flammable Liquids: alcohols, acetone, benzene, ethyl isocyanine. - Toxic: pesticides, chloroanilines.
Special Waste	Are those that by their nature require a particular management way.	- Rubble. - Waste of large volume as for example: mattresses, tires, scrap metal.

The use of biodegradable solid waste to make compost.

Recycling of materials that can be used in the manufacture of new objects.

- **Final Disposition**

For residues that are not exploitable, or that were not found marketable, the disposal will be made in the landfill of the municipality of Cocorná.

- **Management of Hazardous Waste.**

In the event that hazardous waste is generated, it must comply with the provisions of the Decree 4741 of 2005. The hazardous or special waste must have a separate and careful treatment due to its high potential for contamination.

For the management of hazardous waste must be taken into account the following measures:

- Users or waste generators must separate the solid waste or solid special residues of the domestic or regular solid waste.
- Should not be allowed for any reason the burning of solid waste or hazardous special.
- The special solid or hazardous waste must be arranged in tightly sealed containers with a lid specially designed for the type of material that is generated in each work front.
- The operators should strictly follow the handling standards and use protective equipment for each case.
- It is prohibited the disposal of hazardous or special waste in different locations than those intended. Abandonment or provision of these on the ground, water currents, among the vegetation, is subject to sanctions.
- In general all containers that contain some kind of special or dangerous waste must be marked indicating the characteristics of the product and the risks they face if the container is opened.
- The burned oils or used from machinery, vehicles, plants or workshops should be stored in metal clinging that is in good condition, with anti-corrosive paint and well-sealed. Once the trash can is full, this must be delivered to companies that recycle or seize industrially or moved to the landfill where there are deposited in the domestic solid waste.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### 7.2.4.9 Application place

The actions defined by this Environmental Management Plan, as the source separation, collection, storage and proper final disposal will be applied in the work zone of El Molino hydroelectric project such as offices, workshops, camps, gathering areas, among others.

#### 7.2.4.10 Schedule

The program of waste management will be implemented from the beginning of construction of the hydroelectric project and throughout the life of the project.

#### 7.2.4.11 Budget

The following table presents the budget for this program, excluding staff costs of the Environmental Management Group.

Description	Unit	Value ( \$ )	Dedication	Total ( \$ )
<b>Staff Costs</b>				<b>2,000,000</b>
Assistant Engineer	H-month	2,000,000	1	2,000,000
<b>Direct Costs</b>				<b>1,500,000</b>
Elements of the program (bags, ribbons, containers, primers, billboards)	SG			1,000,000
Weighs	SG			500,000
<b>Total Cost per month</b>				<b>3,500,000</b>
<b>Total Cost</b>				<b>109,000,000</b>

#### 7.2.4.12 Responsible

- The project owner in the construction and operation stages, and project closure.
- The contractors that execute any infrastructure work in the construction phase.

### 7.2.5 Estimate the Instream flow

The estimate of the Instream flow is performed for the section of the San Matias River understood between the uptake of the El Molino hydroelectric project and the discharge of the San Matias Hydroelectric Project. That is to say, it is a joint analysis of the two projects that will operate in chain.

#### 7.2.5.1 Objectives

Guarantee a flow rate in the section between the collection and discharge site, in order to minimize the impacts that are generated in the fish communities and benthos macro invertebrates.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.2.5.2 Justification

By the operation of the El Molino and San Matias hydroelectric projects, there will be a flow reduction in the San Matias River in the section between the capture and download sites, which can affect the fish communities, macro invertebrates and algae, by which it is necessary to define a flow that must always cross at this stage, in order to avoid alterations in aquatic ecosystems.

### 7.2.5.3 Regulations

- Decree 2857 of 1981.
- Decree 1729 of 2002.

### 7.2.5.4 Stage

Operation Stage

### 7.2.5.5 Impacts to control

- River dynamics alteration
- Changes in the fish community of San Matias River
- Changes in the structure of biotope and aquatic biocenosis

### 7.2.5.6 Type of Measure

Compensation

### 7.2.5.7 Goals and monitoring indicators.

The goal for this project is:

- Meet the 100% of the time with the established guarantee Instream flow.

That will be evaluated using the following indicator:

- Rate flow measured in the structure of the Instream flow / environmental Instream flow  $\geq 1$ , 100% of the times.

### 7.2.5.8 Actions to develop

In the present section presents the estimate Instream flow with the methodology proposed by Grecco (2005), on the section to be affected by the El Molino and San Matias hydroelectric projects, located between the municipalities of Cocorná and Granada in the department of Antioquia. It is used hydrological information flows of generated at the point of collection of the project, and data of limnological studies carried out over the area of interest, which are presented in section 3.2.5 of this report. The objective of this study is to estimate the annual cycle of flow rates that ensure environmental sustainability in the section involved in the operation of the projects under physical, biotic and social criteria that guarantee to a certain extent the assessment of the most important aspects when performing this type of analysis.

This methodology suggests that natural ecological flows correspond to the minimum monthly flows multi- annual of the section studied. From there, it uses a multivariate analysis that

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

involves 10 aspects (physical, biotic and social), which are presented in Table 7-9, each with a weighting factor of 10 %, to determine how much of these flows can be taken for use; however, it is possible to look over these weights according to the particularities of each section studied.

**Table 7-9 Analyzed variables in the methodology for determining flow rates of environmental guarantee EPM (Grecco 2005).**

Variable	Variable analyzed	Parameter
1	Length of drastically reduced conduit flow rates	Physical
2	Water quality in the river	Physical-chemical
3	Water requirements for dilution of pollutant load that enters the concerned sector.	Physical-chemical
4	Importance of the fishing activity	Socioeconomic
5	Fish migration	Biotic
6	Biological water quality	Biotic
7	Endangered or Threatened Species	Biotic
8	River Transport	Social
9	Modification of landscape	Social
10	Water uses in the reduced flow sector	Social

• **Evaluation Parameters**

The following describes each of the parameters for evaluation.

– **Length of the river with drastic reduction of flow:**

Dimensions the length of the basin that will suffer the greater severity, the flow reduction when the project is in operation. Its intention is to punish with a higher percentage of water requirements, those projects that provide long-distance channel with drastically reduced flow. This length is represented from the collection point to the point of discharge, after the power house, as it is the section directly affected by the operation, and it is evaluated according to the points raised in Table 7-10.

**Table 7-10 Rating Parameters - Variable 1**

**ENVIRONMENTAL IMPACT STUDY**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Length of conduit flow rates drastically reduced	Cartographic measurement and accumulation flows curve	Km	0	0
			1	1
			2	2
			3	3
			4	4
			5	5
			6	6
			7	7
			8	8
			9	9
>9	10			

– **Physical - Chemical quality of the waters that characterize the affected stretch.**

Aims to qualify the physic-chemical water quality of the stream affected by assigning a higher percentage of requirements in the Instream flow , for those currents that have maintained their waters in little altered conditions (see Table 7-11). This aspect, with the qualified IFSN index, developed by the Foundation for the National Health in the United States of America, and described in section 3.2.7 of this report..

**Table 7-11 Rating Parameters - Variable 2**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Water quality in the river	Index of water quality (IFSN)	Excellent	91 - 100	10
		Good	86 – 90	9
			81 – 85	8
			76 – 80	7
			71 – 75	6
		Regular	66 – 70	5
			61 – 65	4
			56 – 60	3
			51 – 55	2
		Bad	26 – 50	1
Very bad	0 – 25	0		

– **Water Demand for dilution of pollutants in the concerned sector:**

Aims to qualify the load of pollutants that enter the streambed with reduced flow, from the tributaries of the sector (see Table 7-12). Greater pollutant load will require additional percentages of environmental guarantee flow to improve the mixing and dilution.

**Table 7-12 Rating Parameters - Variable 3**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Water requirements for dilution of pollutant load that enters the concerned sector.	Determination of chemical oxygen demand	MG/L	1 – 5	0
			5 - 7	1
			7 – 9	2
			9 – 11	3
			11 – 13	4
			13 – 15	5
			15 – 16	6
			16 – 17	7
			17 – 18	8
			19 – 20	9
> 19	10			

The demand for oxygen in natural or residual water, is the amount of oxygen that is consumed by the contaminants that are in the water during a certain time, whether organic or inorganic. The techniques based on the oxygen consumption are the chemical oxygen demand (COD), the biochemical oxygen demand (BOD) and total organic carbon (TOC). The COD, in particular, is the amount of oxygen in mg/l consumed in the oxidation of the reducing substances that are in the water. This parameter is determined by averaging the results at the level of main tributaries of the sector, between the dam site and the discharge, from the power house, as is the water quality which will require additional or no flow for the dilution of pollutants.

– **Importance of the fishing activity**

It intends to measure the importance of fishing activity for municipalities with territorial jurisdiction in the channel sector that will be affected with the flow reduction. Assumes that greater participation of fishing activity in the gross domestic product of the municipalities (if there are records), or by economic or sports importance that represents the resource in the region, will be assigned a higher percentage of environmental Instream flow (see

Table 7-13).

**ENVIRONMENTAL IMPACT STUDY**

**Table 7-13 Rating Parameters - Variable 4**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Importance of the fishing activity	Percentage of participation of the fishing sector in the Gross Domestic Product of the municipality	Average percentages of each municipality (if there are several)	0	0
			0 – 1	1
			1 – 2	2
			2 – 3	3
			3 – 4	4
			4 – 5	5
			5 – 10	6
			10 – 15	7
			15 – 20	8
			20 – 25	9
>25	10			

**– Fish Migration**

Aims To identify the presence of fish species to perform the activity of migration within the channel sector that will experience the flow reduction. Their presence will require the additional flow supply of environmental guarantee (see Table 7-7and Table 7-14).

**Table 7-14 Rating Parameters - Variable 5**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	
Fish Migration	Determination of the number of species that perform migration		0	0	
			Local	1	1
				2	2
				3	3
			Regional:	1	4
				2	5
				3	6
				4	7
			Supra-	5	8
				1	9

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

		regional	>1	10
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There are of two types of fish population movements: 1). Longitudinal movements up and down the river, where the distances traveled by the individuals are considerable; and 2). Lateral movements (mainstream), where the distances are much smaller. In the case of finding species that carry out longitudinal migrations, should be assessed the economic and biological importance of these events, therefore the need to study in different points along the route altered, the minimum width and depth of the water body, determining the required flow rate to ensure the migration process in the respective times of the year.

– **Presence of aquatic species threatened or in danger of extinction:**

Aims to determine the presence or absence of species of aquatic organisms threatened or in danger of extinction. The given fact of identifying at least one species in this category, qualifies the variable with the highest total score possible to allocate, and therefore with a flow rate percentage in environmental quality guarantee, which might even be equivalent to 100% of the actual ecological flow, which corresponds to the curve of the historical monthly minimum flow rates available in the series of data (see Table 7-15) This information should be corroborated in the list of the World Conservation Union (IUCN), Red Book, which presents this information.

**Table 7-15 Rating Parameters - Variable 6**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Endangered or Threatened Species	Redbooks IUCN - IAvH	Species with wide distribution		0
		Endangered or Threatened Species		10

– **Biological water quality**

Intends to qualify water quality based on the presence of aquatic macro-invertebrates, by assigning a higher value to those indicators with good water quality. A high value of the index implies that a greater percentage in the water that should be used to meet the flow requirements for environmental guarantee. It is considered that an aquatic environment presents a good biological quality when it has natural features that allow in its sinus the development of communities of organisms inherent to them

For the biological evaluation of the waters quality it is used the BMWP index (Biological Monitoring Working Party Score System), which is based on the existence of a macro invertebrate community that acts as environmental sensor (see

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Table 7-16).

**Table 7-16 Rating Parameters - Variable 7**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	
Biological water quality	The BMWP Value Index	Very critical	<15	0	
		Critical	16 – 35	1	
		Doubtful	36 – 60	2	
		Acceptable	61 – 70	3	
			71 – 80	4	
			81 – 90	5	
			91 - 100	6	
			101 - 110	7	
				111 - 120	8
		Good	121 - 130	9	
Very good	>131	10			

– Importance of river transportation

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Aims to identify the river importance in the stretch that will not be affected by the flow reduction, in terms of its use as a waterway or transport. According to its use and the season of the year in which this can be done, it will be qualified with a higher value, which means the allocation of more flow in quality of environmental guarantee (see Table 7-17).

**Table 7-17 Rating Parameters - Variable 8**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
River Transport	Presence			0
	Absence	Occasional		5
		Permanent		10

– **Modification of landscape**

Seeks to identify the different transited points for people, (roads, cores, villages, etc.) from where it can have visibility on the part of the river that will suffer flow reduction. It is assumed that for a greater length of observable basin, greater is the score it receives and, therefore, higher the percentage rate flow of environmental guarantee that will require (see

Table 7-18).

**Table 7-18 Rating Parameters - Variable 9**

**ENVIRONMENTAL IMPACT STUDY**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Modification of landscape	Visual Basin (Sum, lengths in meters, the streambed with reduced flows that can be seen from different points of the basin)	Absent	0	0
		Present	1 - 100	1
			100 - 200	2
			200 - 300	3
			300 - 400	4
			400 - 500	5
			500 - 600	6
			600 - 700	7
			700 - 800	8
			800 - 900	9
>900	10			

Most of the approaches to the visual analysis of the landscape, attach great importance to the identification of visible areas from different points. This implies to define the surface from where it is observed the point or the sequence of points analyzed, or rather the horizon observable from the same place. For this there are manual methods that produce maps of visibility by means of field diagrams. However, this analysis has only been approached in a systematic way and with a certain amount of rigor in recent years, with the implementation of the microcomputer, and geographic information systems.

The visual basin encompasses all the possible observation points from where the action is visible. Their determination delimits the scope of the visual impact that is cause and which might alter the visual of all these points with a new artificial element to modify the territory conditions.

– **Water uses in the altered flow sector:**

Aims to protect and qualify water uses to be identified in the area of the river that will be affected with the reduction in flow, by assigning a higher flow value of environmental guarantee to greater uses identified in the study area (see

Table 7-19).

If uses of the water are found for agricultural activities, livestock, human consumption, or any other use, it must be assigned the rating in accordance with the percentage between the sum of flow required for different uses and the average of the natural ecological flow of the river for the given site; in other words, must answer the question: What percentage represent the current uses of water in relation to the flow of the natural ecological river in the affected sector?

**Table 7-19 Rating Parameters - Variable 10**

Environmental Aspect	Methodology	Descriptor	Range	Weighting
Water uses in the reduced flow sector	Percentage between the addition of the used flows  [In relation to the average of the natural ecological flows per c/month ( % )]	Absent	0	0
		Present		1
				2
				3
				4
				5
				6
				7
				8
				9
	>0.9	10		

The results obtained in the evaluation, must be tabulated and coded according to the environmental component to which they belong. It continues with the analysis referred to the qualification that best defined them, concluding with obtaining an environmental rating of the affected section, which as a whole evaluates the main features of the mentioned environment and ultimately determines the periodic percentages of required flow rate in the stretch affected by subtraction.

- **Water supply on San Matias River at the height of the collection site of the EI Molino hydroelectric project**

- **Hydrological Available Data**

For the flow assessment of environmental guarantee in the section to be intervened within the EI Molino and San Matias hydroelectric projects, it was used the hydrological information that is presented in section 3.2.5 of this study. The series of flows in the collection point has 28 years of information at daily scale (1974-2002) and the average multi annual flow corresponds to 9.54m<sup>3</sup>/s.

**Annual cycle of flow at the collection point of the EI Molino hydroelectric project**

To estimate the flow variability over an average year in the section of San Matias River, were estimated minimum flow averages (see

Table 7-20), presenting extreme ends in the month of July (0.69 m<sup>3</sup>/s) in the month of October (2, 35 m<sup>3</sup>/s)

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-20 Medium and minimum flow rates at the collection point**

Month	Minimum
January	1.11
February	0.91
March	1.42
April	2.12
May	1.37
June	1.15
July	0.69
August	0.76
September	0.78
October	2.35
November	2.32
December	2.16

- **Application of the Grecco methodology to estimate the Instream flow**
- **Qualification of environmental aspects evaluated in the methodology**
- **Length of the river with drastic reduction of flow**

Variable evaluated by means of the cartographic analysis, or with measurement length of the river in the specific usage section. The section is length shorted or "semi-dry stretch", is derived from measuring the distance between the projected points for collection and discharge. That distance for this section is 6.2km by which the rating is 6 (see Table 7-21).

**Table 7-21 Length qualification of dry section**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Length of conduction flow rates drastically reduced	Cartographic measurement and accumulation flows curve	Km	0	0	
			1	1	
			2	2	
			3	3	
			4	4	
			5	5	
			6	6	
			7	7	
			8	8	
			9	9	
			>9	10	

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

➤ **Physical and chemical water quality that characterize the affected section**

The water quality index WQI-NSF-USA evaluates the concentrations of dissolved oxygen, biochemical oxygen demand, phosphorus, nitrates, total solids, and the presence of coliforms, the values of turbidity and pH, and the changes in temperature. The index values close to 100 represent a good water quality, while the opposite relates to values close to zero. Table 7-22 presents the values for each parameter, the total weight on the index and the NSF in the section of interest on the San Matias River. It is noted that the variation range on the value found in the index is 81.27.

**Table 7-22 Estimation of NSF – WQI index on influence section**

Variable	Weight	Section
Dissolved Oxygen	0.17	98
Coliforms	0.16	37
PH	0.11	93
DBO	0.11	>61
Temperature	0.1	93
Orthophosphates	0.1	>94
Nitrates	0.1	>96
Turbidity	0.08	92
Solid	0.07	87
<b>NFS-WQI</b>		<b>&gt;81.27</b>

As shown in Table 7-23, the weighting in this case is 8 for which according to the description used by Grecco (2005), the physical and chemical quality would be in a "good" state.

**Table 7-23 NSFQI rating for the projects**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Water quality in the river	Index of water quality (IFNS-USA)	Excellent	91 - 100	10	
		Good	86 – 90	9	
			81 – 85	8	
			76 – 80	7	
			71 – 75	6	
		Regular	66 – 70	5	
			61 – 65	4	
			56 – 60	3	
			51 – 55	2	
		Bad	26 – 50	1	
Very bad	0 – 25	0			

– **Water demand for dilution of pollutants in the affected sector**

In the sampling sites, levels of COD show average values of 12.0 mg/l during sampling. If the COD is interpreted as coming from organic matter difficult to degrade, found mainly in

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

industrial discharges, it is inferred that the San Matias River receives no significant tributary features of industrial wastewater. According to the criteria of methodology CGA-EPM (Grecco 2005), the score to assign is 4 for Instream flow (see Table 7-24).

**Table 7-24 Rating of the chemical oxygen demand for influence section**

	Methodology	Descriptor	Range	Weighting	Rating
Water requirements for dilution of pollutant load that enters the affected sector.	Determination of chemical oxygen demand	MG/L	1 – 5	0	
			5 – 7	1	
			7 – 9	2	
			9 – 11	3	
			11 – 13	4	
			13 – 15	5	
			15 – 16	6	
			16 – 17	7	
			17 – 18	8	
			19 – 20	9	
			> 19	10	

– **Importance of the fishing activity**

In the vicinity of the analyzed sections of the San Matias River, the fishing activity is not reported as economically representative for the municipalities in the project influence area, in addition to the very abrupt topography, difficulty access, and ichthyofauna of little importance in fishing. However, there could be activities of traditional and recreational fishing. Therefore, it is assigned a caution score (1) (see Table 7-25).

**Table 7-25 Rating of fishing importance on the influence section**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Importance of the fishing activity	Percentage of participation of the fishing sector in the Gross intern Product of the municipality	Average percentages of each municipality (if there are some)	0	0	
			0 – 1	1	
			1 – 2	2	
			2 – 3	3	
			3 – 4	4	
			4 – 5	5	
			5 – 10	6	
			10 – 15	7	
			15 – 20	8	
			20 – 25	9	
			>25	10	

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

– **Fish Migration**

According to polls and literature review, there is no phenomenon of fish migration on the section of the studied river. Therefore, it is assigned a value of 1 (see

Table 7-26).

**Table 7-26 Rating fish migration on influence section**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Fish Migration	Determination of the number of species that perform migration	Local	0	0	
			1	1	
			2	2	
			3	3	
		Regional:	1	4	
			2	5	
			3	6	
			4	7	
			5	8	
		Super - regional	1	9	
>1	10				

– **Presence of aquatic species threatened or in danger of extinction**

According to the analysis carried out, this type of species is not present in the evaluated section, so it is assigned a score of 1 to this parameter (see Table 7-27).

**Table 7-27 Rating fish migration on influence section**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Endangered or Threatened Species	Redbooks IUCN - IAvH	Species with wide distribution		0	
		Endangered or Threatened Species		10	

– **Biological water quality**

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

There is a maximum value of 107 for the BMWP index on the points of analysis in San Matias River. The score, according to the ranges set by Grecco (2005), is 7 for this value of BMWP. According to this description, the quality of the water in the section is in an acceptable condition (see Table 7-28).

**Table 7-28 Characterization of the biological water quality on influence section.**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Biological water quality	The BMWP Value Index	Very critical	<15	0	
		Critical	16 – 35	1	
		Doubtful	36 – 60	2	
		Acceptable	61 – 70	3	
			71 – 80	4	
			81 – 90	5	
			91 - 100	6	
			101 - 110	7	
		111 - 120	8		
		Good	121 - 130	9	
Very good	>131	10			

– **Importance of river transportation**

In the section under evaluation, it is not reported any kind of activity related to river transport, mainly due to hydraulic restrictions, which makes stretches difficult and do not guarantee the implementation of this class of activities (see Table 7-29). It was reassigned the weighting of this component to the fish migration, so the final score is zero (zero).

**Table 7-29 Rating fish migration on influence section**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
River Transport	Absence			0	0
	Presence	Occasional		5	
		Permanent		10	

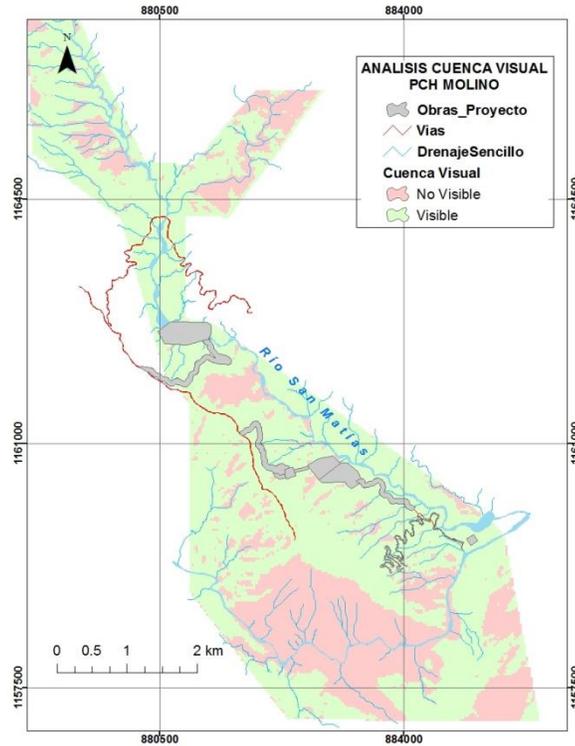
– **Modification of landscape**

This approach was evaluated by means of the mapping analysis (GIS), as a means to analyze the visibility from strategic points, based on the detailed topography of the area. In this case, it evaluates the landscape from the existing roads.

As base information of the topography of the area, was used a digital terrain model in a pixel resolution of 25mx25m. It was implemented the calculation tool of *the visual basin*, to evaluate the visibility from these points within the direct project influence area.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

By doing this analysis, it is verified that the section has a visibility of the changed landscape with lengths greater than 1 km from the points corresponding to the road (green areas Figure 7-5)



**Figure 7-5 Visual Estimate of the basin in the intervene section on the San Matias River**

In addition, it presents high waterfalls with visibility from the Medellín -Bogotá Highway in sector La Mañosa. In summary, under this analysis the weighting score of this component within the EPM methodology would be 10 (see Table 7-30).

**Table 7-30 Rating landscape modification on influence stretch**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
Modification of landscape	Visual Basin (sum, lengths in meters, of the stream bed with reduced flows that can be seen from different points of the basin)	Absent	0	0	
		Present	1 – 100	1	
			100 – 200	2	
			200 – 300	3	
			300 – 400	4	
			400 – 500	5	
			500 – 600	6	

**ENVIRONMENTAL IMPACT STUDY**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating
			600 – 700	7	
			700 – 800	8	
			800 – 900	9	
			<b>&gt;900</b>	<b>10</b>	<b>10</b>

**Water uses in the altered flow sector**

There are not reported uses of the water resource on the impact zone, according to what is presented in section 3.2.6 of this study, the assigned rating is 1 (see Table 7-31).

**Table 7-31 Qualification of water uses in the altered flow sector.**

Environmental Aspect	Methodology	Descriptor	Range	Weighting	Rating	
Water uses in the reduced flow sector	Percentage between the amount of flow used	Absent	0	0		
		Present			1	
					2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	
					>0.9	10

**Calculations and results**

Table 7-32 presents the analysis of the variables that the methodology CGA – EPM proposes, in the interest section of the San Matias River and its justification.

**Table 7-32 Qualification variables according to the EPM methodology for influence section**

Variable	Rating	Justification	Weighting (%)	Rating
Length of channel with flows Drastically reduced	<b>6</b>	L= 6.2 km Measurement in map	10	<b>6</b>
Water quality in the river	<b>8</b>	IFSN: >81	10	<b>8</b>
Water requirements for dilution Entering pollutant load In the concerned sector	<b>4</b>	DQOT ~ 12.0 mg/L	10	<b>4</b>
Importance of the fishing activity	<b>1</b>	Very steeped topography, difficulty of access, fish fauna of little importance in fishery	10	<b>1</b>
Fish migration	<b>1</b>	Local Migration	10	<b>1</b>
Biological water quality	<b>7</b>	BMWP = 107	10	<b>7</b>
Endangered species or in	<b>1</b>	<i>Fish torrenticolas</i>	10	<b>1</b>

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Variable	Rating	Justification	Weighting (%)	Rating
Danger of Extinction				
River Transport	<b>0</b>	Not present	0	<b>0</b>
Modification of landscape	<b>10</b>	Considerable Visibility	10	<b>10</b>
Water uses in the journey With reduced flows	<b>1</b>	Not present	10	<b>1</b>
<b>Total</b>	39		100	<b>39</b>

With the weighting previously done, with a result of 39% in the section to be taken advantage by the project, and using as a base the hydrological monthly minimum flows that are presented in

Table 7-20, it proceeds to calculate the Instream flow rates (see Table 7-33).

**Table 7-33 Environmental Instream Flow for the influence section, according to the CGA - EPM (Q<sub>G</sub>Amb) methodology**

Months	Q <sub>G</sub> Amb (m <sup>3</sup> /s)
<b>January</b>	0.43
<b>February</b>	0.35
<b>March</b>	0.55
<b>April</b>	0.83
<b>May</b>	0.53
<b>June</b>	0.45
<b>July</b>	0.27
<b>August</b>	0.30
<b>September</b>	0.30
<b>October</b>	0.92
<b>November</b>	0.90
<b>December</b>	0.84

The multi variable analysis of the methodology CGA – EPM, shows a weighting of 39% which can be interpreted as a low impact on the section to be hydraulically exploited by the Project.

This rating, associated with the environmental nature of the methodology, presents as variables with low impact the water requirements for dilution of pollutant load that enters in the affected sector and the fishing activity, river transport, and water uses in the stretch. Other variables such as length of the altered channel, landscape modification, and the biological water quality, have considerable qualifications. It appears that, according to this methodology, the impact on the section will be relevant on the social and physical and chemical variables being evaluated. The EPM Instream flow methodology shows environmental character values, given that it weighs the use that society makes of the section with the physical, chemical, and biotic socioeconomic attributes.

However, following the policy established by CORNARE for the other project that HMV engineers have in the east of Antioquia, it is been decided to increase by 40% the estimated

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

value, although in terms of reference it is not specified, so that the Instream flow arrives to the values that are presented in Table 7-34.

**Table 7-34 Selected Environmental Instream Flows**

Month	$Q_{GAmb}$ selected (m <sup>3</sup> /s)
January	0.60
February	0.49
March	0.77
April	1.16
May	0.74
June	0.63
July	0.38
August	0.42
September	0.42
October	1.29
November	1.26
December	1.18

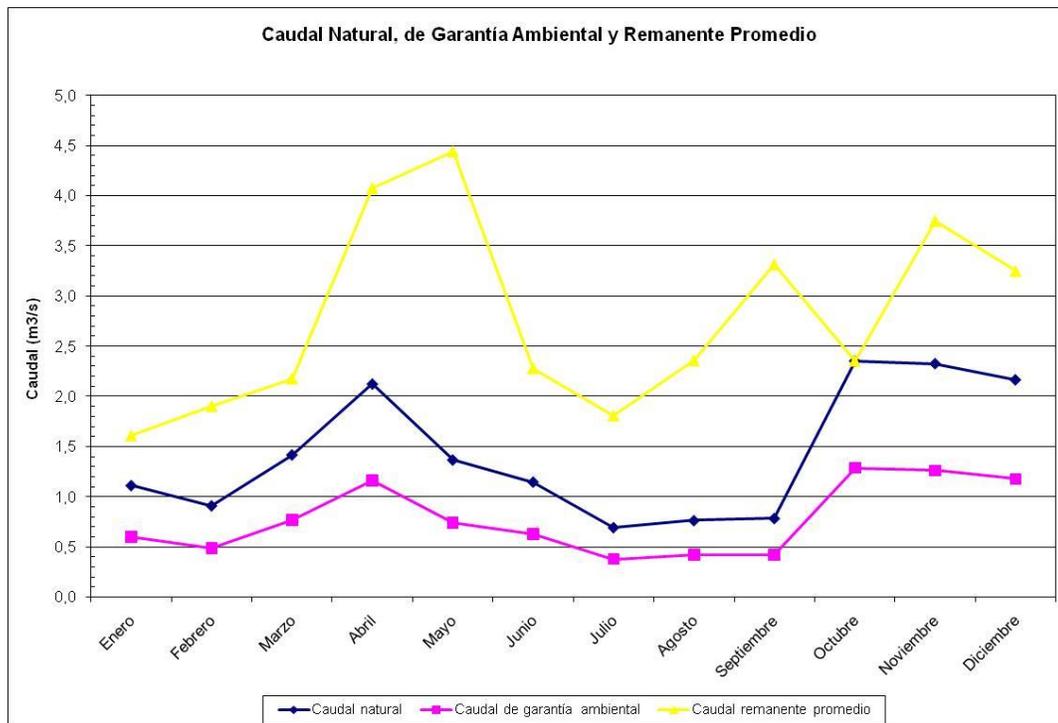
Table 7-35 presents the average flow remnant, which is the difference between the flow that passes before collection and flow derived for generation, meaning, it is the flow that runs effectively by the affected section and that is not used in generation, which at no time will lower the selected Instream flow rate. As it can be seen, the remaining flow presents average values between 1.81 m<sup>3</sup>/s and 4.44 m<sup>3</sup>/s, these values way above the CGA selected.

**Table 7-35 Average Flow remnant**

Month	$Q_{Remnant}$ (m <sup>3</sup> /s)
January	1.61
February	1.90
March	2.18
April	4.08
May	4.44
June	2.28
July	1.81
August	2.36
September	3.32
October	2.35
November	3.75
December	3.25

In Figure 7-6 shows the natural flow or at least the environmental Instream flow remaining average.

**ENVIRONMENTAL IMPACT STUDY**



**Figure 7-6 Natural Flow, Instream Flow and remnant average**

**7.2.5.9 Application place**

The guarantee environmental flow must be left in the section of the San Matias River comprised between the collection site of the El Molino hydroelectric project and discharge zone of the San Matias Hydroelectric Project

**7.2.5.10 Schedule**

The guarantee environmental flow begins to be fulfilled, once the operation of the hydroelectric project of El Molino begins.

**7.2.5.11 Budget**

The costs of this program are included within the economic and financial costs of the project,

**7.2.5.12 Responsible**

The owner of the projects

**7.2.6 Management Program for water supply, for the people settled along the path of the conduction tunnel.**

**7.2.6.1 Objectives**

Ensure an adequate water supply to the community settled in the left margin of the San Matias River, which can be affected by the construction of the conduction tunnel.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.2.6.2 Justification

In the lower part of the Veredass, El Molino Campo Alegre and Los Mangos, where it crosses the conducting tunnel of the El Molino hydroelectric project, the inhabitants are supplied with water springs and creeks in the sector.

These currents could be affected by the construction of the conduction tunnel, which can generate a decline in their flow rates, since the work could function as a filter.

That is why it must be guaranteed to the population, the water supply so they can develop their daily activities without restrictions of any kind.

### 7.2.6.3 Regulations

Decree 1575 of 2007. Sets the System for the Protection and Control of Water Quality for Human Consumption.

### 7.2.6.4 Stage

Preliminary stage and construction

### 7.2.6.5 Impacts to control

- Changes in water quality and availability
- Empowerment of conflicts.
- Generation of expectations
- Generation of nuisances to the community

### 7.2.6.6 Type of Measure

Compensation

### 7.2.6.7 Goals and monitoring indicators

The goals for this program are three, though two of them depend on the outcome of the first:

- Perform a hydro geological study in the direct influence area
- If required, design a system of supply to the people settled along the path of the tunnel.
- Build the system if it is required
- For evaluation, it will be used the following indicators:
  - A report on the hydro geology of the area.
  - A report of the supply system design
  - A built supply system of

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.2.6.8 Actions to develop

The construction of the conduction tunnel of the El Molino hydroelectric project can lead to the reduction in the water currents flow in the left margin of the San Matias River in the section between the collection site and the house of valves.

To ensure the water supply to the community settled in this sector it should be carried out more detailed surveys to establish with precision which are the real effects of the tunnel in such flows.

That is why this program has been proposed in two phases:

- The first phase will be to carry out a hydro geological study in the area, by means of which it will be established the actual affectation of surface water.
- The second phase will be implemented, depending on the results of the first. If the hydro geological study concludes that it will affect the surface currents, it must be designed and constructed a supply system for the population settled in the tunnel area

### 7.2.6.9 Application place

The Veredas, El Molino, Campo Alegre and Los Mangos where the conducting tunnel will come cross.

### 7.2.6.10 Schedule

Now that the conduction tunnel is suggested to begin in the second half of the construction, the hydro geological study should be initiated one year prior to the construction, in order to ensure that, in case that a conclusion is reached stating that in fact the flow of surface water will be affected, there will be time to design and build the supply systems.

Activity	Month																				
	-12	-11	.10	.	..	...	..	..	-6	..	..	..	-3	-2	-1	0	1	2	..	..	6
Hydro geological Study																					
Design of the system																					
Construction of the system																					

### 7.2.6.11 Budget

The aqueduct to the Veredas, The Aurora and La Inmaculada must be built before starting the facilities related to the conduction tunnel.

The Environmental Management Group will be responsible for carrying out the entire information process

Description	Unit	Value:	Dedication	Total
<b>Direct Costs</b>				
Hydro geological Study	SG			50,000,000
Supply System Design	SG			30,000,000

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Aqueduct Construction	SG			600,000,000
<b>Total Cost</b>				<b>680,000,000</b>

### 7.3 BIOTIC ENVIRONMENT

#### 7.3.1 Management of vegetation covering and bare soil

##### 7.3.1.1 Objectives

Minimize the removal of vegetation by means of appropriate management measures, allowing to retain most of the existing vegetation and to facilitate its removal and subsequent use.

##### 7.3.1.2 Justification

The natural coverage of the project influence area has been affected by the economic activities of the area, agriculture and livestock. However, there are still kept remnants of dense forests, open with high secondary vegetation that provide habitat for various species of fauna, some of them threatened as *Saguinus leucopus* and *Aotus lemurinus* .

In these coverage's, are located in addition, species of flora characteristic of the local and regional area, some of them in categories of threat and other with use and non-use values.

Control over the slices of vegetation will reduce the damage to the forested areas that provide habitat for wildlife and reduce the loss of individuals of flora species.

##### 7.3.1.3 Regulations

- Law 2811 of 1974 Code of Natural Resources
- Decree 1449 of 1977. Provisions on the protection and conservation of water, forest, terrestrial and aquatic flora.
- Law 165 of 1994. Convention on Biological Diversity (CBD). Recognize the importance of biological diversity for evolution and life of the biosphere

##### 7.3.1.4 Stage

Construction phase

##### 7.3.1.5 Impacts to control

- Changes in vegetation covering
- Loss or fragmentation of habitats

##### 7.3.1.6 Type of Measure

Control

##### 7.3.1.7 Targets and monitoring indicators

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Description	Measured parameter control
Assessment of the requirements for pruning or cutting in all planned sites for the project facilities.	N°. Sites evaluated/N°. sites with forest cover) x 100 Photographic record of the sites before and after the intervention
Signaling of individuals selected for logging and pruning.	N°. Individuals to cut and prune/ N°. individuals marked) Photographic record of the activity
Keep records with the dasometric parameters: circumference at height -CAP-, total height -AT in meters - and the commercial height or stem -AC in meters	Record with number of individuals, species, and volumes removed Photographic record of the activity
Selection of suitable sites for the layout of the removed plant material	Photographic record of the sites before and after the material provisions

### 7.3.1.8 Actions to develop

Prevention activities will be focused, as explained in the objectives, to optimize the cuts of vegetation, and include the signaling from of the work areas, up to the pruning and removal of the material, trying to keep useful germplasm for reforestation of slopes and enrichment areas of the compensation program.

This program establishes measures to control the logging and pruning of trees, being done only in the areas and to the individuals that require it, this will allow to optimize the cuts and to prevent damage to the remaining vegetation, inside of which there are species in category of threat. The identification and marking of these individuals, along with the rescue program of flora will enable to preserve these natural populations.

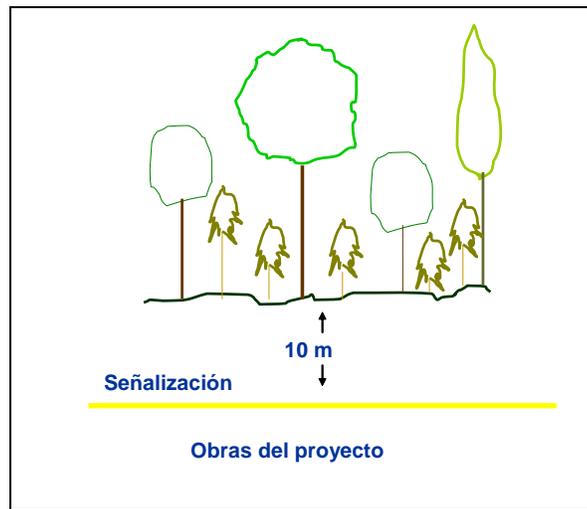
The personnel that will do the work of intervention of the vegetation must be trained in logging and cutting trees labor; in order to ensure the success of the program for the handling of vegetation removal.

This program will be complemented by the rescue of flora, and will initiate before the construction begins, to facilitate the identification of the polygons that will be subject to intervention and individuals to cut down.

- **Signaling**

- Transit areas and the work sites will be delimited and will identified to control the impacts on vegetation, that can multiply if they are not precisely bounded to the intervention area.
- The measure will apply in the labor sites close to forests, tall stubble and springs.
- The adjacent areas to facilities will be signaled, while maintaining a minimum distance of 10 m of the coverage that have woody shape and can be affected by the movement of people, animals, vehicles and machinery (see Figure 7-7)

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			



**Figure 7-7 Natural Flow, Instream Flow and remnant average**

- The signaling will have reflective tape or yellow paint to make them visible.
- **Pruning and clearing of vegetation covering**
  - Unnecessary cut of vegetation will be reduced and restricted, especially in forest areas and tall stubble. For clearance, it will be taken into account the type of vegetation (height, growth habit, and canopy) and the morphology of the terrain.
  - The clearance will be done implementing the method of guide signals, by directing the fall of the arboreal vegetation in the cutting process and will be done as follows:
    - *Selective pruning or cutting of vegetation*, in order to facilitate construction activities without affecting vegetation or individuals that would interfere with the facilities. The selection refers to the strict delimitation of the sites of pruning and tree cutting, taking into account the construction requirements and approach risks in order not to do bare tree cutting, only the individuals that interfere with the work.
    - *The pruning and logging operations required for the suitability of land* will be done previously pointing out the individuals by the cut side, chosen this according to the slope, to direct the fall in a way that affects the less surrounding vegetation. The cuts will be carried out with machete or chainsaw, as the case may be, using gloves, goggles, earmuffs and safety helmet.
    - *For the prune operation of the material that remains without being removed*, they will be cut even with the ground so that there are not tips in bezel to decrease risks of accidents.
- **Collection of removed material and vegetation waste disposal**
  - The contractor must take into account at all times the owner of the venue, to establish what the use will be of the plant material resulting from the cut, and its collection will be held in locations in agreement with the owner of the parcel.
  - The cycle of nutrients from the soil will probably be affected by the logging of the plant material. This affectation can be mitigated with the return of parts of the removed material to the affected sites to facilitate the regeneration of the coverage.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

In order to achieve this it will be done as follows: usable wood will be disposed, to the places previously accorded with the owner of the venue, and the remnants of vegetation that have no commercial value or use, such as branches, leaves and parts of stems, will be distributed in the surrounding areas to the facilities in the affected sites, previously splitting the branches and trunks. This same material may serve as a source of germplasm for slopes reforestation, degraded areas and the enrichment of the areas proposed in the compensation program.

- **Control of Mobilization Machinery and Staff.**

The control in the mobilization of machinery, vehicles and staff, will allow controlling the increase in the magnitude of the impact generated by the removal of vegetation for the facilities construction.

- For the implementation of this measure it will be important that the training is performed through the environmental education program, to the people working in the project and to the community, focusing in this training to highlight the importance of conserving vegetative covers and the species of flora associated with these.
- Transit staff will not cut down or eliminate individuals from the vegetation or parts of it.
- There will not be signals that affect the crust and trunks of arboreal and hedgerow species.
- Vehicles, machinery and staff will transit through the delimited access and approved by the supervision.

#### **7.3.1.9 Application place**

The management measures will be applied in work sites, located on Veredas, San Juan, Las Playas, El Chocó, El Molino, Campo Alegre, La Inmaculada, San Lorenzo and Los Mangos of the municipality of Cocorná.

#### **7.3.1.10 Schedule**

Development activities are planned to be carried out continuously during construction, taking into account that the work fronts may have different execution times. It will begin a month before the beginning of the construction activities of the project to ensure the evaluation on time of the zones to be intervened and continue throughout the construction stage, performing the signaling in advance to the development, to continue with the logging and pruning.

#### **7.3.1.11 Budget**

The program will be developed with a forest engineer and four field auxiliaries, including the chainsaw operator.

The cost of forest utilization is calculated as overall cost per hectare; includes the activities of clearing the land for access to the boles, the operator with the chainsaw and fuel, an assistant, two field auxiliaries, operations of chopping and minor transport from the site to the platform of the truck.

The budget is estimated considering open wooded forest coverage and dense forest of Guadua bamboo, and high secondary vegetation

**ENVIRONMENTAL IMPACT STUDY**

Concept	Unit	Quantity	Unitary value (\$)	Total value (\$)
Removal and transportation of wood	Hectare	5.3	1,000,000	5,300,000
Forest Engineer	Month	3	2,000,000	6,000,000
<b>Subtotal</b>				<b>11,300,000</b>
<b>IAU 15%</b>				<b>1,695,000</b>
<b>Total</b>				<b>12,995,000</b>

### 7.3.1.12 Responsible

This program must be performed by the owner of the project

### 7.3.2 Flora Rescue

#### 7.3.2.1 Objective

Rescue individuals of flora with ecological importance that may be affected by the activities of the project

#### 7.3.2.1 Justification

In the project influence area there are preserved forest relicts where species with ecological importance can be found, for being these in some category of threat and by having a commercial value, cultural, medicinal, food for animals. Among them stand out: *Ageratum conyzoides* (Manrubio), with medicinal value, *Asterogyne martiana* (Panga), with cultural value, *Hymenaea courbaril* (Algarrobo) almost threatened, *Euterpe precatoria* (Palm-kernel oil, macana), with human food value, commercial value, medicinal value, almost threatened LC, dispersed by birds such as toucans present in the study area

Rescue individuals of flora will prevent the damages caused to the species diversity of the study area, keep those that are in some category of threat and those that have value, both for use and non-use.

#### 7.3.2.2 Regulations

- Law 2811 of 1974 Code of Natural Resources
- Decree 1449 of 1977. Provisions on the protection and conservation of water, forest, terrestrial and aquatic flora.
- Law 165 of 1994. Agreement on Biological Diversity (CBD). Recognize the importance of biological diversity for evolution and life of the biosphere

#### 7.3.2.3 Stage

Construction phase

#### 7.3.2.4 Impacts to control

- Changes in vegetation covering
- Increased pressure on natural resources

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.3.2.5 Type of Measure

Prevention

### 7.3.2.6 Goals and indicators

Description	Measured parameter control
Perform the transplant of 100 % of the individuals identified as rescue objects	N°. Individual's rescued / N°. of identified individuals to rescue) x 100 Photographic record of the rescued individuals
Achieve the establishment of at least 70% of the transplanted individuals	No. individuals established / No. individuals transplanted) ≥ 70 % Photographic record of the activity
Documenting the process from its beginning until the end of the monitoring and tracking	Register number of transplanted individuals per species Record number of established individuals per species Film and photographic record of the activity
Involve the community surrounding the process	People in the community who are participating in the process ≥ 3
Disseminate the process and outcome of the flora rescue activities	Guided tours of the educational institutions in the area ≥ 4 Video of process = 1

### 7.3.2.7 Actions to develop

The rescue of flora will begin before construction and will continue along the project.

- **During construction**

Defined with precision the project facilities, it will be determined which of them cross open forest coverage, dense forest of Guadua, high secondary vegetation and low secondary vegetation, to focus on them, the rescue before the movement of land start

On the cover of grass trees and weedy grass, the area it will be evaluated before the beginning of the construction process, to determine if it is necessary to perform the rescue of any individual. This measure will be a preventive character and will be carried out during the inventory and in areas adjacent to the facilities, were identified species as the carob tree (*Hymenaea courbaril*) that by its ecological importance can be the subject of rescue.

In the areas above mentioned, they will be identified and marked the seedlings objects of rescue, taking as a base the listing that is presented in Table 7-36 and the following criteria:

**Table 7-36 Species in need of rescue**

Scientific name	Common Name	Food Animals	Human Food	Scientific Value	Medicinal Value	Commercial Value	Cultural Value	Ornamental	Cat. Threat	CITES Appendix	Endemic

**ENVIRONMENTAL IMPACT STUDY**

Scientific name	Common Name	Food Animals	Human Food	Scientific Value	Medicinal Value	Commercial Value	Cultural Value	Ornamental	Cat. Threat	CITES Appendix	Endemic
<i>Ageratum conyzoides</i>	Manrubio, fart, herb goat				X						
<i>Alchornea cf. acutifolia</i>	Pandeyeso						X				
<i>Alchornea megalophylla</i>							X				
<i>Anthurium formosum</i>								X			
<i>Asterogyne martiana</i>	Panda, panga, rooster tail						X	X	LC		
<i>Baccharis trinervis</i>	Maruchinga, chilco, machuco		X		X						
<i>Bactris gasipaes Bactris setulosa are found cf.</i>							X				
<i>Echinoderms exhibit fivefold Bellucia</i>	Coronillo, guava of pava, guava of Monte, guava from mico		X				X	X			
<i>Caladium bicolor</i>	Ajenjilla							X			
<i>Calathea crotalifera</i>	Bihao, mantagorda					X	X	X			
<i>Calophyllum brasiliense</i>	Oil, Oil mary, barcino				X						
<i>Casearia arborea</i>	Escobo, niguito					X	X				
<i>Casearia mariquitensis</i>						X	X				
<i>Casearia silvestris</i>						X	X	X			
<i>Castilla elastic</i>	Black Rubber, rubber female						X				
<i>Cecropia angustifolia</i>	Yarumo, Yarumo black						X	X			

**Table 7-36 Species in need of rescue**

Scientific name	Common Name	Food Animals	Human Food	Scientific Value	Medicinal Value	Commercial Value	Cultural Value	Ornamental	Cat. Threat	CITES Appendix	Endemic
<i>Cespedesia spathulata</i>	Paco, Pedro boys read, Alejandro, language e' cow					X	X				
<i>Cestrum cf. schlehtendahl</i>							X				
<i>Cestrum mariquitense</i>							X				
<i>Cinnamomum triplinerve</i>	Laurel Perillo, laurel, aguacatillo					X	X				
<i>Citrus aurantium</i>	Naranja				X	X	X				
<i>Clibadium surinamense</i>	Salvia, lengua de vaca, mastranto		X		X						
<i>Cordia dwyeri</i>	Arm of tiger, hen paw						X				
<i>Cordia nodosa</i>	Tumbatoro, turmetoro, bolas de gato						X				
<i>Cordia sp.</i>							X				
<i>Costus allenii</i>	Canaguata				X		X	X			
<i>Costus Lasius</i>	Canaguata				X		X				

**ENVIRONMENTAL IMPACT STUDY**

<i>Crotalaria nitens</i>	Cascabelito						X				
<i>Croton Trinitatis</i>					X		X				
<i>Cupania cinerea</i>	Mantequillo, cariseco, Guacharaco, mestizo						X				
<i>Dendropanax arboreus</i>	Platero						X				
<i>Desmodium adscenden</i>	Amorseco, pegapega, Cadillo				X		X				
<i>Erythrina rubrinervia</i>	Chocho				X	X		X			
<i>Eugenia florida</i>					X		X				
<i>Euterpe precatoria</i>	Palm-kernel oil, macana	X			X		X		LC		
<i>Ficus maximum</i>	Rubber, dairy and lechudo						X				
<i>Genipa americana</i>	Jagua, árbol de tinta, huito	X			X	X	X	X			
<i>Gloeospermum sphaerocarpum</i>	Monte Guayabito		X			X	X				
<i>Graffenrieda galeottii</i>	White Niguito						X				
<i>Guadua angustifolia</i>	Guadua					X	X	X			
<i>Guarea guidonia</i>	El Trompillo cedrillo, cocoa of Mt.					X	X	X			
<i>Guatteria bolivian</i>	Garrapato						X				
<i>Guatteria sp.</i>	Garrapato						X				
<i>Hedyosmum racemosum</i>	Silbasilba, hail						X				
<i>Heliocarpus americanus</i>	Balso, balsó blanco, pestaña de mula						X				
<i>Hibiscus verbasciformis</i>								X			

**Table 7-36 Species in need of rescue**

<i>Scientific name</i>	Common Name	Food Animals	Human Food	Scientific Value	Medicinal Value	Commercial Value	Cultural Value	Ornamental	Cat. Threat	CITES Appendix	Endemic
<i>Hieronyma sp.</i>	Leno						X				
<i>Hymenaea courbaril</i>	Algarrobo, pecueca almohada		X			X	X		N T V U		
<i>Arboretum Hyptidendron</i>	Aguanoso, white and black vulture, Borrajo						X			B1ab(iii)	
<i>Hyptis atrorubens</i>	Buttonwood, Cartagena, mastranto		X								
<i>Indent. 6</i>	Palma							X			
<i>Indent. 7</i>	Palma							X			
<i>Inga cf. pezizifera</i>			X				X				
<i>Inga cf. samanensis</i>			X				X				
<i>Inga alba</i>	Churimo		X				X				
<i>Inga sp. 1</i>			X				X				
<i>Inga sp. 2</i>			X				X				
<i>Inga sp. 3</i>			X				X				
<i>Inga sp. 4</i>			X				X				
<i>Inga sp. 5</i>			X				X				
<i>Inga sp. 6</i>			X				X				
<i>Inga sp. 8</i>			X				X				
<i>Inga thibaudiana</i>			X				X				

**ENVIRONMENTAL IMPACT STUDY**

<i>Jacaranda copaia</i>	Chingale, escobillo, pavito					X							
<i>Justice filibracteolata</i>						X							
<i>Lacistema aggregatum than</i>	Mountain Coffeet.						X	X					
<i>Lantana armata</i>	Successful								X				
<i>Miconia affinis</i>	Niguito							X					
<i>Miconia dodecandra</i>								X					
<i>Miconia elata</i>	Colorado mortiño						X	X					
<i>Miconia theaezans</i>	Inciden white, niguito							X					
<i>Myrcia fallax</i>	Arrayán		X				X	X	X				
<i>Myrcia sp. 1</i>			X				X	X	X				
<i>Myrcia sp. 2</i>			X				X	X	X				
<i>Myrcia sp. 3</i>	Arrayán		X				X	X	X				
<i>Myrsine pellucidopunctata</i>	Espadero							X					
<i>Nectandra cf. microcarpa</i>	Laurel pavito							X					
<i>Nectandra cuspidata</i>	Laurel pavito							X	X				
<i>Nectandra sp. 1</i>								X					
<i>Nectandra sp. 2</i>								X					
<i>Nectandra sp. 3</i>								X					
<i>Nectandra sp. 4</i>								X					

**Table 7-36 Species in need of rescue**

<b>Scientific name</b>	<b>Common Name</b>	<b>Food Animals</b>	<b>Human Food</b>	<b>Scientific Value</b>	<b>Medicinal Value</b>	<b>Commercial Value</b>	<b>Cultural Value</b>	<b>Ornamental</b>	<b>Cat. Threat</b>	<b>CITES Appendix</b>	<b>Endemic</b>
<i>Ocotea macropoda</i>	Laurel					X	X				
<i>Palicourea sp. 1</i>						X	X				
<i>Palicourea sp. 2</i>						X	X				
<i>Palicourea cf. garciae</i>						X	X				
<i>Panicum pilosum</i>				X							
<i>Peltaea sessiliflora</i>	Black Malva						X				
<i>Persea americana</i>			X			X	X				
<i>Persea sp.</i>							X				
<i>Philodendron cf. inaequilaterum</i>							X	X			
<i>Philodendron sp. 1</i>							X	X			
<i>Philodendron sp. 2</i>							X	X			
<i>Philodendron sp. 3</i>							X	X			
<i>Philodendron sp. 4</i>							X	X			
<i>Picramnia antidesma</i>						X					
<i>Piper aduncum</i>	Ribbing				X		X				
<i>Piper arboreum</i>	Ribbing				X		X				
<i>Piper crassinervium</i>	Ribbing						X				
<i>Piper sp. Nov! 1</i>	Guayaquil			X							
<i>Piper sp. Nov! 2</i>				X							
<i>Discolor Piptocoma</i>	Vulture, mulato, pigweed	X				X	X	X			

**ENVIRONMENTAL IMPACT STUDY**

<i>Bicolor Pourouma</i>	Cirpo, cirpo male		X				X					
<i>Spiralis Pseudelephantopus</i>	Welded, love dry, Amargón				X							
<i>Psidium guajava</i>	Guayabo		X			X						
<i>Psychotria brachiata</i>								X				
<i>Renealmia cf. thyrsoides</i>	Platanillo, Berber				X	X	X	X				
<i>Rhodostemonodaphne kunthiana</i>				X		X	X					
<i>Rubus urticifolius</i>									NT		Crit. V 3.1 ii	
<i>Schefflera morototoni</i>	Arracacho					X		X				
<i>Senna bacillaris</i>							X	X				
<i>(DIA)s rhombifolia,</i>	Broom lasts, broom slug				X			X				
<i>Simarouba amara</i>					X	X	X					
<i>Tapirira guianensis</i>	Cedrillo, shrubs, palo balsudo		X			X	X	X				
<i>Tovomita weddelliana</i> are excluded	Carate						X	X				
<i>Tovomita weddelliana</i> are excluded	Carate						X	X				

Table 7-36. Species in need of rescue. (Continued)

<b>Scientific name</b>	<b>Common Name</b>	<b>Food Animals</b>	<b>Human Food</b>	<b>Scientific Value</b>	<b>Medicinal Value</b>	<b>Commercial Value</b>	<b>Cultural Value</b>	<b>Ornamental</b>	<b>Cat. Threat</b>	<b>CITES Appendix</b>	<b>Endemic</b>
<i>Trichilia pallida</i>	Guacharaca, wolf				X		X				
<i>Virola sebifera</i>	Soto, blood toro					X	X				
<i>Vismia baccifera</i>	Carate, sealing wax				X		X				
<i>Vismia macrophylla</i>	Seven hides						X				
<i>Vismia sp. 1</i>	Tongue Tip						X				
<i>Vismia sp. 2</i>	Tongue Tip						X				
<i>Vochysia sp.</i>						X	X				
<i>Regia Welfia</i>	Thousand pesos, San Juan					X	X		LC		

- State of the individual: the individual presents conditions that justify its transfer; among them, it does not display phytosanitary problems and has a degree of development (or size) that facilitates its transplant.
- Location: that the seedlings are inside the area of project intervention or in the immediate vicinity of large trees, which, at the time of use (or logging), have a high probability of affecting the surrounding seedlings

The plants identified to perform the transfer will be marked with reflective tape to identify them during the transplant, in addition of the complete individual, a rescue will be performed of reproductive structures that may contribute to the attainment of seedlings for the compensation program which is explained later.

The whole process of identification and marking will be provided with auxiliary personnel of the area that has full knowledge of the flora of the region.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Individuals transplanted will be brought to transitional nurseries and subsequently the seedlings will be planted as part of the enrichment of the proposed area for compensation.

These nurseries will have the nature of conservation nurseries and will be part of strategies of obtaining the material that it is required for establishing the areas of protection and recovery of habitats that are proposed in the compensation program, these nurseries will be designed to take advantage of the materials from the area, the presence of forested areas that provide shade and to facilitate the management of native species that are generally not produced in commercial areas. With them it is additionally intended, promote the participatory research with the people of the community who conform the work group and do promotional work regarding the local and regional biodiversity by means of guided tours.

In the proper transplantation will be taken into account the following:

- Remove at least a pan-layer or volume of soil around the root system areas that ensure relocation of the processes and continuity of the root zone, probably for some of the species; involves their partnership with soil microorganisms.
- The volume of the pan-layer will cover at least a 6 cm radius around the base of the stem and will ensure at least 80% of the roots
- Transportation will be as quickly as possible to avoid hydric stress
- For the re-plant process there will be a previous dibbling in the receiving areas and ensure that the seedling retains the pan-layer of the soil with an appropriate height, so that the level of the base of the stem is located flat even.
- The work of transplantation will be carried out with personnel of the area; there will be a recorded film with the participation of the flora experts of the region and the technicians who accompany the work, which will document the entire process, with emphasis, among other things, in the reason why the flora rescue, the ecological importance of the species that are transplanted, how the experts recognize it. This footage will be released in the schools in the area and will serve as the basis for the elaboration of an informative booklet.

### 7.3.2.8 Application place

Areas of direct influence of the project affecting the coverage of open forest, dense forest of Guadua, high secondary vegetation, low secondary vegetation, weeded grass and trees.

### 7.3.2.9 Schedule

The schedule below shows the formulated associated activities for the project.

Activity	Year 1				Year 2				Year 3			
	Tr 1	Tr 2	Tr 3	Tr 4	Tr 1	Tr 2	Tr 3	Tr 4	Tr 1	Tr 2	Tr 3	Tr 4
Signs of seedlings												
Land purchase for compensation program (Areas receptors) *												
Rescue and relocation for nurseries conservation												
Transplant to receptor areas												
Maintenance, monitoring and Tracking												
Disclosure in the project influence area												
Disclosure outside the project influence												



	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

habitats for wildlife species and conserve plants that are in some degree of threat or that meet relevant ecological functions.

### 7.3.3.3 Regulations

- Law 2811 of 1974 Code of Natural Resources
- Decree 1449 of 1977. Provisions on the protection and conservation of water, forest, terrestrial and aquatic flora.
- Law 165 of 1994. Agreement on Biological Diversity (CBD). Recognize the importance of biological diversity for evolution and life of the biosphere

### 7.3.3.4 Stage

Construction and operation

### 7.3.3.5 Impacts to control

- Changes in vegetation covering
- Loss or fragmentation of habitats
- Increased pressure on natural resources

### 7.3.3.6 Type of measure

Mitigation and compensation

### 7.3.3.7 Targets and monitoring indicators

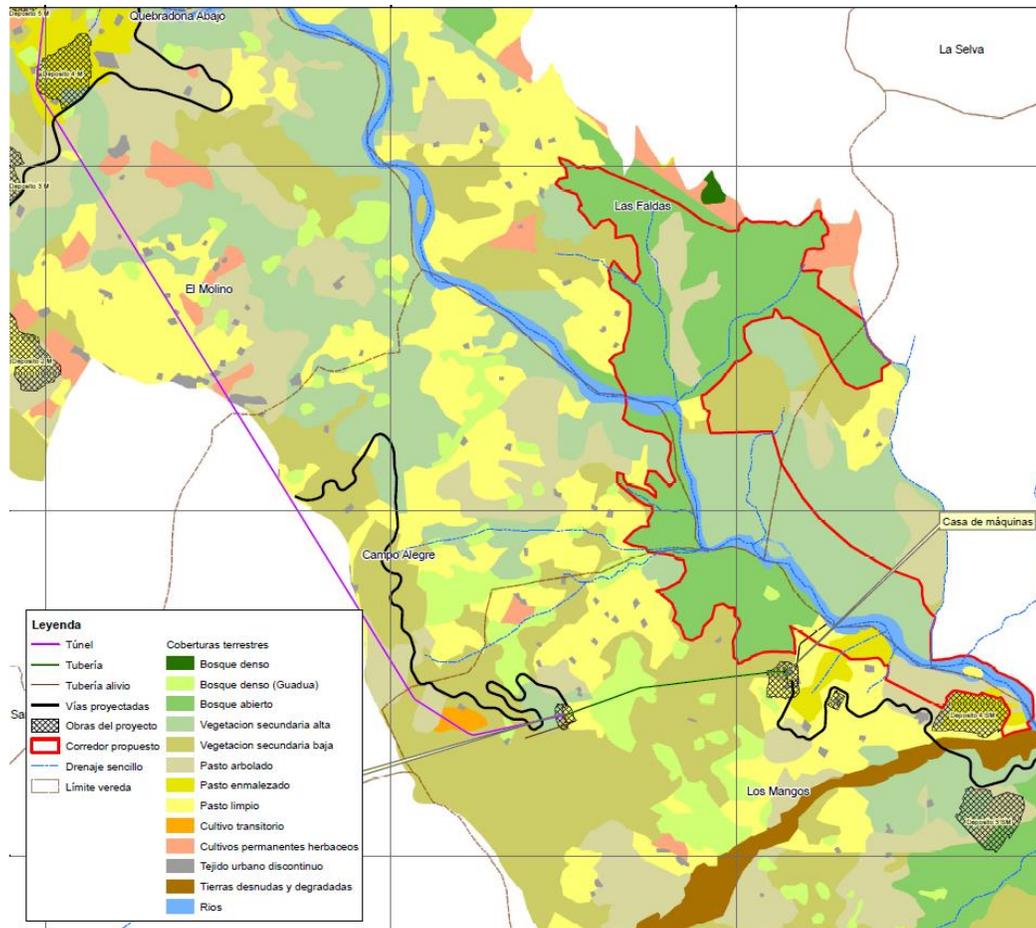
Description	Measured parameter control
Increase the coverage of forested areas (forests and high shrub vegetation high)	Increase in area by coverage type
Improving the connectivity of the forested coverage	Modification in the connectivity indexes
Evaluate changes in composition and structure	Diversity indexes Diametric classes
Carry out studies of plant succession	1 In the first year of operation 1 In the fifth year of operation 1 in the tenth year of operation
Involve the community surrounding the process	People in the community who are participating in the process $\geq 3$
Disseminate the results of the studies of succession	1 Publication in the sixth year of operation 1 Publication in the tenth year of operation
Formulation of projects or productive alternative activities	N°. of projects $\geq 3$ in the second year of construction
Implementation of projects or productive activities	No. of projects implemented $\geq 3$ in the second year of operation

### 7.3.3.8 Actions to develop

**ENVIRONMENTAL IMPACT STUDY**

- **Areas to compensate**

To compensate for the damages to the forest coverage the corridor was delimited as shown in Figure 7-8. The project will make the compensation in the basin of the San Matias River, connecting the wooded remnants in the study area which in accordance with the characterization represent important corridors for the transit of fauna, including species as *Saguinus leucopus* (tití gris), endemic primate of Colombia which is reported as vulnerable.



**Figure 7-8 Areas planned for the biological corridor**

- **Purchase of land**

For the purchase of land there will be a team of negotiators in which will be a topography surveyor, a lawyer and a professional in the biotic area. This group will have the support of the social area to provide clear and on time information to the community and to the land owners.

For the purchase of land are provided the following stages:

- **Stage 1. Definition of the buying criteria and valuation of the land and a closer approach to the community**

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

At this stage the negotiating team will define the criteria for land purchase and payment for the same, considering aspects associated with the method of valuation, which documents are needed, the state of progress in taxes updating in Cocorná and Granada, with emphasis on the interest area

Through property tax review it will be inquired about the parcel sizes and planning regulations for both municipalities on minimum size with the purpose of not affecting owners by fractioning their properties in areas where they will not be able to make use of the soil.

With this information, a clear picture of the negotiation will be determined, which will be presented to the owners by means of meetings, in which additionally would explain the purpose of the biological corridor formation.

The program will include the steps to follow in the negotiation and the responsibilities of both parties

– **Stage 2. Measurement of farms**

In the event that in the tax property is not updated the venue area, it will be measured along with the owner or his representative; it shall be outlined the area object of purchase to submit this information to the municipal tax office to be verified in the departmental system.

– **Stage 3. Land Purchase**

Once obtained the complete documentation the negotiation will take place

The 1 and 2 will be essential before starting the following.

• **Isolation and enrichment of areas**

As the purchase of land progresses, the isolation is done and starts the transfer of rescued flora individuals to the areas of the biological corridor, considering their ecological requirements.

As explained in the flora rescue program there will be temporary nurseries which will be located close to the planting sites identified in the biological corridor. There are nurseries of support for the adaptation of individuals rescued and for the production of material in small amounts of the species from which seeds are obtained. It will consist of simple structures and will be assembled with materials of the area.

• **Formulation of alternative projects**

As a strategy to control the pressure on resources and conservation of the biological corridor, work will be done on the formulation of at least three productive projects that improve the agricultural and livestock activities currently being undertaken in the study area or identifying other complementary activities.

The Environmental Management Group will work with the community in the identification of alternative productive projects or alternate activities or complementary to those currently being developed, that can make more efficient the production systems and help reducing the pressure on resources.

The formulation of projects will depart from the complementation of the aspects covered in the characterization of the baseline with respect to the productive systems, through rapid participatory diagnostics with the community around the project which will be identified: Local patterns of production, limiting factors physic-chemicals characteristics of the soil, slopes,

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

weather conditions, planning production strategies used by the traditional knowledge of the communities settled in the area, weaknesses of the current systems, market limitations and transportation, producers associations, special distribution of soil uses, alternative activities, including the extraction of forest products, policies and programs of national and local government that have an impact on the production whether they are known or unknown to farmers but can affect positively or negatively the productivity of the systems, international programs that can be applied to the area and promote the development of alternative projects taking into account that this is a region in which forced displacement has called the attention of different organizations.

With these diagnostics, it is intended to have a complete picture of the current state of the social systems in the area, to facilitate the formulation of projects and frame them on the local reality, including the logic of the producers, and allows to perform a joint analysis between the technicians and the community of the economic and technical feasibility of the proposed projects.

Once this analysis is completed will follow the implementation phase and precise targets will be defined to follow up.

**7.3.3.9 Application place**

The media will be implemented in the basin of the San Matias River

**7.3.3.10 Schedule**

**In construction**

Activity	Construction (Year/quarter)												Operation (Year)									
	Year 1				Year 2				Year 3				1	2	3	4	5	6	7	8	9	10
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4										
Land purchase																						
Insulation																						
Enrichment																						
Maintenance Monitoring and Tracking																						
Results publication																						
Formulation projects																						
Projects Implementation																						

**7.3.3.11 Budget**

Concept	Unit	Quantity	Unitary value (\$)	Total value (\$)
<b>Direct Costs</b>				
Professional 1. Lawyer for land purchase	Month	5	1,200,000	6,000,000

**ENVIRONMENTAL IMPACT STUDY**

Professional 2 Assistant lawyer	Month	5	1,200,000	6,000,000
Surveyor	Month	5	1,000,000	5,000,000
1 Professional biotic area	Month	6	1,900,000	11,400,000
1 Field auxiliary for measuring sites	Month	6	566,700	3,400,200
Land purchase	Hectare	57	2,000,000	114,000,000
2 Auxiliary for enrichment and isolation	Month	36	566,700	20,401,200
<b>Subtotal</b>				<b>166,201,400</b>
<b>Indirect Costs</b>				
Tools: Stakes, wire, staples and paint	Global			35,000,000
Field Staffing endowment *	Global			20,000,000
Publications	Global			10,000,000
Formulation and implementation of alternative projects or activities.				200,000,000
Transport	Trip	50	250,000	12,500,000
Allowances	Day	250	50,000	12,500,000
<b>Subtotal</b>				<b>290,000,000</b>
<b>Total</b>				<b>456,201,400</b>

### 7.3.3.12 Responsible

Owner of the project

### 7.3.4 Study of terrestrial vertebrate fauna

#### 7.3.4.1 Objective

Conduct periodic inventories of terrestrial vertebrate fauna in the project influence area to generate information that contributes to the knowledge of the areas diversity and to generate proposals for management and conservation.

#### 7.3.4.2 Justification

The information on terrestrial vertebrate fauna in the study area is scarce and there are no timely reports on the area.

During the Environmental Impact Study for the community of mammals were recorded eight orders, 19 families and 45 species, with three records of endemic species, *Saguinus leucopus* (Titi gray), *Proechimys magdalena* (spiny rat) and *santanderiensis Microsciurus flaviventer and mixed-species* (cusca ardita) and four vulnerable, *Saguinus leucopus* (Titi gray), *Aotus lemurinus* (marteja or mico at night) *Lontra longicaudis* (Otter) and *Leopardus wiedii* (Ocelot).

For birds, the EIA reports the species *Capito hypoleucus* ( El Torito capiblanco), endemic; according to the IUCN is located in the category (endangered), A4c Vu B2 ab (ii, iii) and according to the Alexander von Humboldt Institute in category in C2a, by the deterioration of the habitat and indiscriminate hunting and wildlife trafficking. In addition it was found in the sector of the Vereda, Los Mangos, *Ortalis columbiana* (Colombian guacharaca) which, according to Proaves, 2010, is located in the category IN (endangered), by the deterioration of the habitat, indiscriminate hunting and wildlife trafficking.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Of the reptile species reported in the baseline of the EIA, the black Hunter, Clelia, are quoted in appendix II, amphibians and *Pristimantis penelopus* are located in the IUCN Red List as VU.

Given the limited knowledge of the fauna species in the project influence area and reports on endangered species, the study will expand this knowledge and give the necessary elements to establish conservation strategies.

#### 7.3.4.3 Regulations

- Decree 1449 of 1977. Provisions on the protection and conservation of water, forest, terrestrial and aquatic flora.
- Law 165 of 1994. Convention on Biological Diversity (CBD). Recognize the importance of biological diversity for evolution and life of the biosphere

#### 7.3.4.4 Stage

Operation

#### 7.3.4.5 Impacts to control

- Loss or fragmentation of habitats
- Death and displacement of terrestrial fauna
- Increased pressure on natural resources

#### 7.3.4.6 Targets and monitoring indicators

Description	Measured parameter control
Make four inventories of terrestrial vertebrate fauna in year 1, 2, 4 and 6 of operation	No. inventories $\geq$ 4
Dissemination of information	Reports delivered to Cornare = 4 Field Guides illustrated = 200 Outreach Workshops $\geq$ 4

#### 7.3.4.7 Type of measure

Compensation

#### 7.3.4.8 Actions to develop

##### • Inventories of vertebrate fauna

With the study of vertebrate fauna is intended to perform periodic inventories for 6 years, which will include the four groups: amphibians, reptiles, birds and mammals.

It is proposed to carry out four samples per year, one every three months, to cover summer and winter seasons and have at least two data by season. Each sample will have an intensity of five days and in all cases will use the same methodology, including the months of sampling: January, April, July, October, so that it may be possible to make comparisons.

The first two samplings will be conducted on an annual basis and from the second year will be two others, one in year 4 and another in the year 6 as shown in Table 7-37

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-37 Samplings of fauna**

Sampling	Year 1	Year 2	Year 4	Year 6
January	X	X	X	X
April	X	X	X	X
July	X	X	X	X
October	X	X	X	X

• **Information Generation**

For each group will generate information related to composition, species richness, similarity indexes, habitat, exclusivity, altitudinal distribution.

Will be presented to the Corporation the results by sampling year and the sixth year will include proposals for the conservation and management that have as their basis, information generated during the six years of inventory.

In addition, the information obtained for each year of sampling will be disclosed to the community in field guides illustrated, easy-to-read, and accompanied by workshops, to promote knowledge of the richness of the fauna in the area and some elements of management and conservation.

The workshops and guides will include didactic material related to the aspects of vertebrate fauna that are defined as higher interest (species, ecology of the species, conservation status).

**7.3.4.9 Application place**

The environment will be implemented in the basin of the San Matias River

**7.3.4.10 Schedule**

Activity	Year 1				Year 2				Year 4				Year 6			
	Tr 1	Tr 2	Tr 3	Tr 4	Tr 1	Tr 2	Tr 3	Tr 4	Tr 1	Tr 2	Tr 3	Tr 4	Tr 1	Tr 2	Tr 3	Tr 4
Inventory																
Report Cornare																
Elaboration of illustrated guides																
Outreach Workshops																

**7.3.4.11 Budget**

Table 7-38 presents the overall costs by sampling year, these include the outreach activities

**Table 7-38 Overall sampling costs**

Year	Overall cost ( \$ )
Year 1	70,000,000
Year 2	75,000,000
Year 4	83.000.00

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Year 6	95,450,000
<b>Total program</b>	<b>323,450,000</b>

#### 7.3.4.12 Responsible

Owner of the project

### 7.3.5 Research Project: Management strategy of aquatic ecosystems

#### 7.3.5.1 Objectives

- Establish measures for the compensation of the disturbance to the flow regime and the flow generated continuity by the dam construction and the derivation of flow rates for the hydroelectric project El Molino.
- Comply with current environmental regulations with regard to the environmental flows.
- Generate scientific knowledge, which will result in the protection of the biodiversity of Andean aquatic ecosystems.

#### 7.3.5.2 Justification

In general in the country are few studies of Andean aquatic ecosystems and the effects on the aquatic biota, as a result of the regulation of flow rates by hydroelectric projects there is not sufficient documentation.

Generate diversity information and the relationship with stream flow variables, temporary space variation studies will allow obtaining information about the dynamics of these ecosystems, including the adjustments for the biota to environmental changes.

#### 7.3.5.3 Regulations

- Decree 1449 of 1977. Provisions on the protection and conservation of water, forest, terrestrial and aquatic flora.
- Law 165 of 1994. Agreement on Biological Diversity (CBD). Recognize the importance of biological diversity for evolution and life of the biosphere

#### 7.3.5.4 Stage

Construction and operation.

#### 7.3.5.5 Impacts to control

- River dynamics alteration
- Change in the fish community of San Matias River
- Change in the structure of aquatic biotope and biocenosis

#### 7.3.5.6 Type of Measure

Compensation

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

### 7.3.5.7 Targets and monitoring indicators

Description	Measured parameter control
Make four sampling, one quarterly per year	No. of sampling = 4
Compare and assess the biological diversity with hydro metric variables	Quarterly Reports = 4 Final Report with analysis four (4) sampling = 1

### 7.3.5.8 Actions to develop

Scientific research project, with experimental design, which allows generating knowledge about the association between the hydrometric variables tranches of lotic and biological diversity.

The research project includes the sampling in tranches of five rivers, or streams in the basin of Cocorná, San Matias and Calderas rivers, in uniform conditions as possible, to allow comparisons between sampling sites with respect to its diversity and the relationship with variables of the stream flow.

### 7.3.5.9 Application place

The management measures (compensation) apply in different stages of creeks and rivers located in the basin of the Calderas River.

### 7.3.5.10 Schedule

Will take place during the second year of operation, quarterly sampling for a total of four, covering winter and summer.

### 7.3.5.11 Budget

Table 7-39 presents the program costs which include the sampling in five flows, laboratory for the determination of sampling and statistical analysis of the information.

**Table 7-39 Management strategy budget of aquatic ecosystems**

Concept	Unit	Quantity	Total value (\$)	Total value (\$)
Staff for field sampling	Day	25	300,000	7,500,000
Allowances	Day	25	70,000	1,750,000
Transport	Day	5	350,000	1,750,000
Field Transport	Day	5	50,000	250,000
Guides	Day	5	35,000	175,000
Laboratory	Sample	5	6,000,000	30,000,000
Equipment Rental	Equipments	5	70,000	350,000
Inputs	Global	5	100,000	500,000
Gauging	Global	5	2,000,000	10,000,000
SIG	Global	5	900,000	4,500,000
Professionals	H-month	3	5,000,000	15,000,000

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Concept	Unit	Quantity	Total value ( \$ )	Total value ( \$ )
Statistics	Global	5	3,500,000	17,500,000
Editing reports	Report	5	700,000	3,500,000
<b>Total</b>				<b>92,775,000</b>

### 7.3.5.12 Responsible

Owner of the project

## 7.4 SOCIOECONOMIC ENVIROMENT

### 7.4.1 Information and community participation

#### 7.4.1.1 Objectives

- Inform the authorities, organizations and population of the influence area of the different stages of the project.
- Facilitate the participation of local authorities and communities of the project influence area, in the process of completing the environmental studies and during the different stages of the project, in order to obtain reliable information of the characteristics of the territory, the environmental impacts and the management measures to minimize them.
- Inform the communities of the direct project influence area, about the main elements of the Environmental Management Plan proposed for the prevention, mitigation and compensation of the effects.
- Promote the control of conflict situations originated during the construction of the project through a timely and effective response to the concerns or complaints of the community.

#### 7.4.1.2 Justification

This program is oriented toward the compliance of the existing environmental legislation in the country, which has as its basis the constitutional precept that certifies the right of citizens to be informed and to participate in matters that affect them. In addition, the Program of Information and community participation is the support for the implementation of an Integral Environmental Management, to ensure the appropriate integration of the project, and the sustainability.

In this case, for its development should take into account the type of population that settles in the area of influence and the circumstances experienced by these people because of the armed conflict, with events of forced displacement, which can cause an even greater fear in front of the arrival or presence of outsiders in the area.

#### 7.4.1.3 Regulations

- Law 99 of 1993 of the Environment, in its Title X: Modes and procedures for citizen participation:
- Article 69, on the right to intervene in the environmental administrative procedures: Any natural person or legal entity, public or private, without the need to demonstrate any legal

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

interest, may intervene in the administrative proceedings initiated for the issue, cancellation or modification of permits or licenses that affect or may affect the environment or for the imposition of sanctions or revocation for failure to comply with the rules and environmental regulations.

- Article 72 of the Administrative Public Hearings on environmental decisions in the process.
- Article 74, the Right to Request information.
- Article 76, of the indigenous and black communities; legislates on the exploitation of natural resources that should be done without impairing the integrity of cultural, social or economy of the indigenous and traditional black communities in accordance with Law 70 of 1993 and section 330 of the National Constitution, and the decisions on the subject will be taken after consultation with the representatives of such communities.
- Law 143 of 2003, in its Article 53 provides that: "During the phases of study and as a condition to execute projects of generation and interconnection, the corporate owners of the projects, must inform the affected communities, by referring to them: first, the environmental impacts; second, the measures provided for in the Environmental Management Plan; and, third, the necessary mechanisms to involve them in the implementation of the Environmental Action Plan".
- The Decree 330 of February 8th. Of 2007, which regulate the Environmental Public Hearing.
- With regard to the specific legislation on citizen participation, in Colombia it is accounted with Act 134 of 1994, on Citizen Participation, which defines the various mechanisms of participation. In its Article 1 - Purpose of the Act provides that: "*The present statutory law of the mechanisms of people participation, regulates the popular initiative legislation and regulations, the referendum, the popular consultation, the national order, departmental, municipal and local; the revocation of the mandate, the plebiscite and the town hall meeting*".

#### **7.4.1.4 Stage**

Preliminary Construction and operation

#### **7.4.1.5 Impacts to control**

All the impacts caused by the project

#### **7.4.1.6 Type of Measure**

Prevention, mitigation, remediation, and compensation.

#### **7.4.1.7 Targets and monitoring indicators**

As goals are defined the following:

- Inform the 100% of the communities and local authorities in the influence area on the activities of the project owner, policies, criteria for environmental management and other aspects of the Environmental Impact Study (EIS) and of its Environmental Management Plan (EMP).

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Establish strategies and mechanisms for communicating with the community, during the construction phase, consistent with their characteristics and needs.
- Consider and respond promptly 100% of the requests, complaints and concerns related to the implementation of the project.
- Make the investment projects of 1 %, in accordance with the existing needs for conservation of the basin, in conjunction with the municipal administration of the municipalities of Cocorná and Granada and with the population of the direct influence area.

**Monitoring indicators are:**

- Information meetings: Meetings scheduled/meetings carried out X 100 (includes meetings with authorities and communities).
- Workshops for identifying impacts and management measures with communities: scheduled workshops/workshops X 100 (includes briefings to present results of the EIA and workshops with communities of the direct influence area).
- Attention of complaints and claims: the amount of complaints received/ amount of complaints and claims answered X 100 (sets and monitors the managed number of claims and complaints received).
- Meetings for the definition of investment projects of the 1 %: number of scheduled meetings/number of meetings held X 100 (includes meetings with authorities and communities, post-licensing).

**7.4.1.8 Actions to develop**

- **Information meetings**

Conduct meetings with local authorities, and settlers of the (DIA), to promote the project, identify opinions, and clarify related concerns.

- **Identifying Impacts Workshops and Management Measures with the community**

Collect timely the results to present them to the communities in the baseline area of the Environmental Impact Study, identified environmental impacts and the management measures proposed, for through a job with participatory techniques, gather views and provide feedback for the identified impacts and the management measures proposed by the technical team.

- **Information to communities at the work site**

This activity should be done by establishing an information booth or office close to work, where the population can turn to in case they require information or to make claims. This post or office must also coordinate the information strategy to explain the work, features and implications and duration every time a work begins, which due to their size can cause discomfort to the community. For this it is recommended to make use of the radio stations at a time that people is used to listen to them, make loud speaker, distributing leaflets in schools, stores, and in sites and meeting moments of the community, such as board meetings of communal action, zonal meetings and religious services.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

On the other hand, in the post or office of information, also must implement the protocols and deliver or accompany the formats set out for the receipt of complaints. In addition, the person or persons in charge shall, subsequent to the presentation of the complaint, ask for a neighborhood Act or fill the format established where states, prior agreement with the affected, the satisfaction or processing, resolution or given course to the complaint, with photographic record or film footage if it is relevant. These complaints will be reviewed later by the person responsible for environmental supervision by the project owner.

Four times per year, during the construction phase, the management team must perform a social opinion poll among local authorities and the population of the direct influence area of the project development, in order to identify the aspects that need to be adjusted or improved, according to the environmental conditions. This activity must be verified and reviewed by the person responsible for supervision of the environmental project. This poll does not apply to the entire population, but among a representative sample of employees of the municipal administration, local authorities and population (that is to say half plus one of the population, or 60% of the total population).

#### **7.4.1.9 Application place**

The strategies and mechanisms of the information program and community participation should be applied between the municipal administrations in the two municipalities and communities of the project influence area. In this case, the Vereda, San Juan, El Chocó, El Molino, Campo Alegre, and Los Mangos in the municipality of Cocorná, La Inmaculada, San Lorenzo; and Quebradona Abajo the Vereda, Las Faldas in the municipality of Granada.

Likewise, between organized groups, guilds and relevant associations in the area and that show interest or request information about the project.

#### **7.4.1.10 Schedule**

The period of implementation and scope of the Program of Information and Community Participation develops in correspondence with the technical stage of the project (pre feasibility, feasibility, design and construction).

During the design stage, and once the license is granted, will be holding meetings with all the communities of the influence area, to inform you about the license granting, as well as inform them about the process that will continue with the project.

In the construction phase, will be deployed and perform the Management Plan programs, which include community projects arising from the measures of compensation; therefore, special attention should be p(DIA) to the information process, for which you must keep a constant communication with communities in the area of influence and with the municipal administration of the two municipalities, with the end of each party assuming their management responsibilities, co-management and self-management of the various programs and projects.

Furthermore, it should be a schedule of activities in accordance with the duration of the project implementation, as shown in the following action plan, which although designed for 1 year, must be adjusted every year in accordance with the execution of the project and context needs (see Table 7-40).

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-40 Information Program Action Plan and community participation for 12 months, project El Molino.**

Objective	Goal	Stage	Activity	Responsible	Schedule												
					1	2	3	4	5	6	7	8	9	10	11	12	
Promote the control of conflict situations originated during the construction of the project through a timely and effective response to the concerns or complaints of the community.	Consider and respond promptly 100% of the requests, complaints and concerns related to the implementation of the project.	Construction	Information to communities at the work site Establish a permanent information office of receipt and processing of complaints and claims	Project owner and contractor													
			Explain the work, features and implications and the length of time, every time a work start, which, due to their size can cause discomfort to the community (stations, over loud speakers, flyers)														

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>		Doc.: 2148-04-EV-ST-020-07
			Rev. No.:0      2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-40 Information Program Action Plan and community participation for 12 months, project El Molino. (Continued)**

Objective	Goal	Stage	Activity	Responsible	Schedule													
					1	2	3	4	5	6	7	8	9	10	11	12		
Promote the control of conflict situations originated during the construction of the project through a timely and effective response to the concerns or complaints of the community.	Inform the 100% of the communities and local authorities in the influence area on the activities by the project owner, policies, criteria for environmental management and other aspects of the Environmental Impact Study (EIS) and of its Environmental Management Plan (EMP)	Construction	At least one meeting with the administrations in the municipalities of Granada and Cocomá.  At least one meeting with the communities that are part of the direct influence area	The owner of the project														
		Construction	Implement the Management Plan Program and the community projects arising from compensation actions and/or the programs of social responsibility of the owner of the project	The owner of the project														
	Construction	Make the investment projects of 1 %, in accordance with the existing needs for conservation of the basin, in conjunction with the municipal administration of the municipalities of Cocomá and Granada and with the population of direct influence area.	The owner of the project															

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-40 Information Program Action Plan and community participation to 12 months, project El Molino (Continued)**

Objective	Goal	Stage	Activity	Responsible	Schedule											
					1	2	3	4	5	6	7	8	9	10	11	12
			Perform an opinion poll, between local authorities and the population of the direct influence area on the development of the project, in order to identify aspects that need to be adjusted or improved, according to the environmental conditions.													

**7.4.1.11 Budget**

The costs of the Environmental Management Group are calculated in section 7.1.2. Below are the direct costs and the social auxiliary.

**Table 7-41 Budget for direct costs and social professionals for 12 months**

	Unit	Value ( \$ )	Quantity	Months	Total value ( \$ )
<b>Pre-feasibility Stage</b>					
<b>Staff Cost</b>					<b>18,000,000</b>
Professional social area	H-month	1,500,000	1	12	18,000,000
<b>Direct Costs</b>					<b>5,640,000</b>
Outreach Materials (flyers, radio spots, folding)	Month	300,000		12	3,600,000
Refreshments (52 meetings with community)	Person	1,000	1,560		1,560,000
Paper Work	Month	40,000		12	480,000
<b>Total Cost per year</b>					<b>23,640,000</b>
<b>Cost during construction</b>					<b>61,070,000</b>

**7.4.1.12 Responsible**

The Information Program and community involvement is led by the project owner during the construction and operation phase. The construction phase of the PIPC will be under the responsibility of the project owner and the contractor, among which will coordinate the

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

implementation activity and the management measures rose in each one of the WFP programs.

#### 7.4.1.13 Annexes-formats

Annex 1. Format for reporting complaints, requests and claims (QSyR)

Annex 2. Format for opinion poll

Annex 3. Record Format for assistance

<b>EL MOLINO HYDROELECTRIC PROJECT COMPLAINTS, REQUESTS AND CLAIMS REPORT</b>		
Date of the claim/request/complaint	D/M/Y	
Name of the person and ID card No.		
Request, complaint or claim	<b>Note:</b> Clearly state the facts in a simple and concrete way and identify the name of the Veredas, or residence municipality, address and phone number. <b>Briefly summarize the subject of this request, complaint or claim:</b>	
Received by/Date	D/M/Y	
Response Date	D/M/Y	
Response		
Satisfaction closing date		
Reviewed by:		
Approved by:	D/M/Y	
	<p>-----</p> <p>-----</p> <p>Signature of the complaining person    Signature of the official who handles the case</p>	
Comments		

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Photographic Record or film (when the situation required)	

<b>EL MOLINO HYDROELECTRIC PROJECT OPINION POLLING FORMAT</b>	
<b>Name and identity card:</b>	
<b>Vereda,/ municipality</b>	
<b>Date</b>	
<p>As an inhabitant of the community where the project is developed, or as an officer of the municipal administration, please complete the following survey, in order to convey their views to the Environmental Management Team and the project owner in which should be fed back the form of insertion of the project, the relations with the community and the various measures in the Environmental Management Plan (EMP). Mark with an X the number that corresponds with your opinion.</p> <p><b>1 Means very bad, 2 bad, 3 regular, 4 good and 5 excellent.</b></p>	
 <b>Bad</b>  <b>Bad</b>  <b>Regular</b>  <b>Good</b>  <b>Excellent</b>	
<b>Questions</b>	<b>Rating</b>
The way in which the community has been linked to the project	5  4  3  2  1 
What degree is consistent with the following statements? (Circle the number which best corresponds to your opinion).	
The Project in no way contributes to the improvement of the quality of life of the local community and the region	5  4  3  2  1 
The project contributes to the improvement of life quality of the local community and the region	5  4  3  2  1 
Resources provided by the project to the municipal administration are reflected in the welfare of the community...	5  4  3  2  1 
The commitments made by the company and the contractor have been met	5  4  3  2  1 

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

<b>EL MOLINO HYDROELECTRIC PROJECT OPINION POLLING FORMAT</b>	
<p>Do you have any questions about the development of the project?</p>	
<p>How should the project keep informed the inhabitants of the influence area on the progress of the facilities that are carried out in the area (mark all that apply with a X)</p> <p>Through regular meetings with the residents ( )</p> <p>Through regular reports on radio programs ( )</p> <p>By placing reports on the progress of the facilities at public institutions ( )</p> <p>Including the reports in the web page of the city hall ( )</p>	
<p><b>To improve the Information Program and community participation and the relations with the community, please write below your additional comments</b></p> <p>We appreciate your cooperation in completing this questionnaire. Please return it duly completed</p>	
Made by/Date	
Reviewed by:	
Approved by:	



	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

## 7.4.2 Environmental Education for workers

### 7.4.2.1 Objectives

- Train workers in environmental issues, that will be commensurate with the needs of the area with respect to the management and conservation of natural resources, and with the guidelines proposed in the LDCS, creating an awareness of care toward the environment in which the project is developed.
- Sensitize the contractor staff, workers and employees of the project owners, toward the attitude and way of socializing with the local population, in order to avoid negative effects on the population and the environment.

### 7.4.2.2 Justification

The Environmental Education Program for workers is important given that it supports for an appropriate relationship with the environment in which the project is developed, which facilitates the planning and execution of various activities.

It is imperative that the Contractor plan executes the cycles of environmental education workshops and facilitate the design or purchase of educational materials, in order to promote the workers knowledge of the characteristics in the influence area, of the facilities and the proper handling of the environment, to prevent the negative effects that may be caused by negligent workers attitude in the development of the different construction and operation activities

The intention is to have a proper implementation and sustainability of the project, with the implementation of workshops that develop among others the following content: current environmental standards (disposal of solid and industrial waste, handling and disposal of materials, water management); environmental policy implications against the breach of the statutory provisions, characteristics of the environment, preventive measures for the spread of sexually transmitted diseases, among others.

### 7.4.2.3 Regulations

- Political Constitution of Colombia 1991.
- National Policy on Environmental Education of the Ministry of Education.
- Law 2811 of 1974 or code of renewable natural resources and environment protection.
- Law 99 of 1993: Article 5, section9: Adopt jointly with the Ministry of National Education outreach programs and non-formal education.
- Colombian NTC Technical Standard - ISO 14001, section4.4.2: Training, awareness and competence.
- Law 134 of 1994: Community Participation.

### 7.4.2.4 Stage

Previous studies, construction and operation.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### **7.4.2.5 Impacts to control**

- Involvement of cultural heritage
- Empowerment of conflicts.
- Changes in Population Dynamics
- Increase in the demand of goods and services
- Variation in health levels

#### **7.4.2.6 Type of Measure**

Prevention, compensation.

#### **7.4.2.7 Targets and monitoring indicators**

The goals for this program are:

To make known to the 100% of the workers the acquired environmental commitments by the contractor

Train 100% of the staff linked to the project on environmental issues

Facilitate the implementation of all programs and measures that are part of the Environmental Management Plan, in a coordinated effort between contractor and owner of the project

Achieve the 100% participation of workers in the environmental workshops and lectures.

This may be assessed using the following indicators:

Number of workers with training and working/ Number of workers in the project.

Number of workers with monthly training/ Number of linked workers

#### **7.4.2.8 Actions to develop**

- Perform the environmental education sessions for groups of workers each time there is a new linking process. In these should be given the characteristics of the environment where the project is developed, the proposed measures for the management of the identified impacts and other commitments with the environmental authority.
- To make the lectures on environmental education daily in one of the work fronts, at a time not less than 10 minutes. These talks are under the responsibility of a person, or as may be necessary depending on the topic, the socio-environmental team of the contractor.

The lectures also must provide feedback on those aspects in which have been found failure or on which they have received claims or complaints by local population. However, should also take into account the following topics:

- Management of solid and liquid waste
- Respect of commitments with the community
- Use of agreed access and spaces
- Water Sources Care.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Design and development of a manual of good environmental practices, including in this guideline a respectful relationship with the local population. This manual will be distributed, promoting the adoption of practices among all recruited staff.
- Provide in the work done by the contractor, the time required for workers to attend the lectures on environmental education.

#### 7.4.2.9 Application place

This activity will be carried out in the enabled sites in labor fronts and in all areas where begins activities related to the project, particularly in the camps; must will be performed on suitable sites, taking into account the objective, topic and duration of the talks.

#### 7.4.2.10 Schedule

This program will be implemented throughout the construction time of the project, workshops should be performed every time a new work front initiates, at the beginning of the daily work in all fronts.

#### 7.4.2.11 Budget

	Unit	Value ( \$ )	Quantity	Months	Total value ( \$ )
<b>Staff Cost</b>					<b>18,000,000</b>
Professional social area	H-month	1,500,000	1	12	18,000,000
<b>Direct Costs</b>					<b>5,040,000</b>
Edition of good practice manual	SG	15,000	200		3,000,000
Outreach Materials (Flyers, folding, manual of good practices)	Month	130,000		12	1,560,000
Stationery	Month	40,000		12	480,000
<b>Total Cost per year</b>					<b>23,040,000</b>
<b>Total Cost</b>					<b>59,520,000</b>

#### 7.4.2.12 Responsible

The responsible for executing the program of environmental education to workers is the contractor.

The Environmental Supervision should control the process, to make sure the contractor is complying with this program and the commitments with regard to the environmental education program for workers. For this reason, during the construction of the project, it will perform the monitoring and evaluations and also will make recommendations to do the relevant adjustments to improve the program results. In addition, will verify the provision resources and logistics necessary for the execution

### 7.4.3 Community Environmental Education

#### 7.4.3.1 Environmental education Project

- **Objectives**

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Train the population from the Vereda, of the direct influence areas of the project on different environmental issues, in order to help them make better use of natural resources of their environment and appreciate the natural assets of their territory.
- Reduce effects which due to the anthropic activities that have been developed over a period of time in the area, have influenced the disappearance of species of fauna and flora, due to water pollution in the emergence of erosive processes among other effects, which are reflected in environmental problems identified in the area.

• **Justification**

The environmental education program to the community is important, to the extent that it makes possible for the inhabitants of the project influence area to become more aware of their own relationship with the environment, in addition they can acquire and provide knowledge that will enable a better interaction and proper use of natural resources. On the other hand, any environmental education process should be undertaken with communities, favors the adoption of practices that although on a small scale can be steps to a more balanced relationship with the environment which provides the subsistence resources. In addition, the importance of the environmental education program lies in the fact that a well-focused process contributes to treat aspects related to a conception of the human beings as part of the environment that surrounds it and hence the educational process that may include elements that favor an integral formation.

In accordance with the characterization, the main environmental problems that are currently identified in the project influence area are:

- Use of non suitable land for cultivation of cassava, sugar cane and paddocks
- Existence of a significant number of illiterate population or with low schooling level
- Existence of a low self-esteem level among a portion of the population, especially among women
- The basin is understood as a stream of water, but not as a territory that involves multiple interactions with multiple effects
- Family labor is used intensively for the production of panela in a traditional way, technological and community presses which brings high desertion rates in schools.
- Illegal Logging
- Erosion associated with inadequate agricultural practices.
- Water wastage, associated with the idea that this is inexhaustible
- Excessive spending of electrical energy by the low cost
- Effect on the of birds and mountain animals because of hunting by local inhabitants and people who come from other municipalities or other parts of the same municipality
- Use of agrochemicals and fungicides to increase the production performance and pest management in different crops
- Low opportunities to access education by isolation or by low population density, there are places where they attend 5 children per school

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- School children early dropout
- Teachers with provisional charges with expectations of proper assignments in urban areas and they usually are from other regions

- **Regulations**

- Political Constitution of Colombia 1991.
- National Policy on Environmental Education of the Ministry of Education.
- Law 2811 of 1974 or code of renewable natural resources and environment protection.
- Law 99 of 1993: Article 5, section9: Adopt jointly with the Ministry of National Education outreach programs and non-formal education.
- Law 134 of 1994: Citizen Participation.

- **Stage**

Preliminary stage and construction

- **Impacts to control**

- Generation of expectations
- Generation of nuisances to the community
- Empowerment of conflicts
- Increase in the concentration of particulate material and gases
- Increase in sound pressure levels
- Water quality changes
- Vegetation covering changes
- Death and displacement of terrestrial fauna
- Pressure Increase on natural resources

**Type of measure**

Mitigation and compensation.

**Targets and monitoring indicators**

As goals of the Environmental Education Program to the community, are defined the following:

- Perform two environmental education workshops per year with adults of each one of the Veredas, of the influence area, of 8 hours each and a minimum participation of 15 people in each workshop.
- Make a yearly meeting with the environmental workshop participants performed in each Veredas, to exchange experiences and adopt practices, in a place in the influence area of project, defined through consultation with participants in the workshops by Vereda, with eight hours duration.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Perform three (3) environmental education workshops per year, with six hours duration, with students and teachers in the schools of the Vereda, of the project influence area.
- Make a yearly meeting with school children and teachers who are part of the carried out environmental education process.
- Revive and strengthen the existing environmental groups in the Vereda, of Campo Alegre "Nature watchers", San Lorenzo "Recover what is ours" and San Juan "Future Warriors" and facilitate through a convention the accompaniment and advice by an organization or competent institution with expertise on the subject, that is to say, Universidad Católica de Oriente or Universidad de Antioquia, among others to these groups. In addition, logistically support the creation of these groups on the Vereda, in which they do not exist.
- Implement or strengthen a school garden per school in each Vereda, with products that help balancing children diet as tomatoes, celeriac, chives, beans, carrots and breeding of smaller animals such as chickens for fattening and laying hens

Monitoring indicators are:

- Number of adults participating per workshop /Adults convened
- Summation of workshops conducted with adults /summation of participating adults
- Record number of students and teachers participating in the workshops x school
- Practices, values and attitudes promoted for a better relationship with the environment/registration of at least one practice adoption, a change of attitude and a value promoted and saved during and after the formative process between adults and children.
- Environmental groups reactivated and strengthened with at least a friendly intervention with the environment in their Vereda,.
- Nine school gardens implemented and productive (one for each Vereda, school)

• **Actions to develop**

The environmental workshops with adults will have duration of 8 hours each and will be coordinated by the representatives of every Vereda, under the guidance of the environmental team.

The minimum participation of the workshops will be of 15 participants. By means of the Boards of Communal Action or environmental groups from the Vereda, will establish the number of persons per Vereda, the realization site and the date. To school teachers, it will define the day, time, and the group of students to participate.

It is proposed to conduct eighteen workshops per year, with the communities in the influence area, two (with each Vereda, with adult population; and twenty-seven, three by each school, with school population.

Perform a monthly 10 minutes radio program, to complement the training cycle on the topics they have chosen. This will be transmitted by the (Station Cascada Stereo), which is the only one in the municipality. This must be designed in a comic strip format with the population language and broadcast at a time of extensive tune by the rural population.

In these environmental workshops and radio programs should be developed the following topics:

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Exposure and disclosure of the Environmental Management Plan approved by CORNARE.
- To publicize the project specifications.
- Management, conservation and protection of water sources and the basins of the San Matias and Cocorná Rivers
- Waste Management and source separation
- Dissemination and importance of the flora and fauna species of the project influence area, emphasizing the need to avoid the hunting of these species.
- Meaning and representation of road signs
- Meaning of the signals in work sites
- Elaboration of the duel by losses associated with the armed conflict
- Self-image, self-concept, self-esteem
- Sexual and Reproductive Health
- Nutrition, balanced diet and preparation of recipes with the environment basic ingredients.
- Importance of school gardens and the rising of small animals as an alternative for the family diet enrichment, due to the implementation of a school garden in the schools of every Vereda, with small animal husbandry as fattening chickens and laying hens.

• **Application place**

The Environmental Education Program to the Community will apply between the communities and school population of the Vereda, Los Mangos, El Chocó, San Juan, Campo Alegre, El Molino, La Inmaculada, San Lorenzo, Las Faldas and Quebradona Abajo.

• **Schedule**

The workshops with the adult and school population must be performed during the first year of the project construction, as well as implementation of school gardens and the revival or creation of environmental groups and other proposed activities, in order to ensure the continuity in the remaining time and its sustainability after the construction is completed. Table 7-42 presents the proposal for an Action Plan for the first 12 months, taking into account that in the first year should be made all the adjustments and relevant programming agreements with the executed results until the end of this first period.

**Table 7-42 Schedule for the community environmental education program**

Objectives	Goal	Activity	Responsible	Schedule													
				1	2	3	4	5	6	7	8	9	10	11	12		
Train the population in the Vereda, of direct influence area of a project on different environmental	Perform 2 environmental education workshops per year with adults of each of the paths of the	18 Workshops a year in total, with the communities in the influence area Two workshops for	Project owner company - Environmental management Team														



**MOLINO AND SAN MATÍAS  
HYDROELECTRIC PROJECTS**

Doc.: 2148-04-EV-ST-020-07

Rev. No.:0

2012-03-30

**ENVIRONMENTAL IMPACT STUDY**

Objectives	Goal	Activity	Responsible	Schedule												
				1	2	3	4	5	6	7	8	9	10	11	12	
issues	influence area.	each Vereda, with adult population														
Reduce effects caused by the anthropic activities	Make a meeting for the year with the workshop participants environmental analysis conducted in each of the Vereda,	Hold a meeting with adult participants of the Environmental Education Program	Project owner company - Environmental management Team													

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-42 Schedule for the community environmental education program (Continued)**

Objectives	Goal	Activity	Responsible	Schedule														
				1	2	3	4	5	6	7	8	9	10	11	12			
	Perform three environmental education workshops per year, with 6 hours length with students and teachers in the schools of the Vereda, of the project influence area	Make twenty seven workshops (27), three (3) for each school with scholar population.	Project owner company - Environmental management Team															
	Make a meeting for the year, with the students and teachers	Perform an encounter of school children participating in the PEA of the project	Project owner company - Environmental management Team															
	Revive and strengthen the existing environmental groups  In addition, logistically support the creation of these groups on the Vereda, in which they do not exist.	Establish an agreement with an institution responsible for the reactivation, strengthen	Project owner company - Environmental management Team															
	Implement or strengthen a school garden per school from each Vereda,	Implement a school garden per school of every Vereda,	Project owner company - Environmental management Team															

• **Budget**

The budget presented below is an estimate, which must be adjusted after the first year of its implementation.

	Unit	Value ( \$ )	Quantity	Months	Total value ( \$ )
<b>Staff Cost</b>					<b>27,000,000</b>
Agronomist with professional training in	H-month	1,500,000	1	18	27,000,000

**ENVIRONMENTAL IMPACT STUDY**

agro ecology					
<b>Direct Costs</b>					<b>108,300,000</b>
Cost of workshop with adults (refreshments in the morning, lunch, material)	Workshop	100,000	18		1,800,000
Cost encounter with adults (transportation to the community, lunch, refreshments, material)	Meeting	800,000	1		800,000
Cost per workshop with children (material, lunch, snack)	Workshop	100,000	27		2,700,000
Cost of encounter with children (transportation to the community, refreshments in the morning, lunch, material)	Meeting	800,000	1		800,000
Cost of school orchard	Orchard	800,000	9		7,200,000
Outreach materials (posters, flyers, folding)	SG				2,000,000
Radio Program of 10 minutes	Program	300,000	1	31	9,300,000
Stationery	SG				700,000
Allowances	2 People	50,000	50		2,500,000
Transport staff	Vehicle 1	350,000	30		10,500,000
Convention for reactivation, accompaniment, and advisory services to environmental groups		70,000,000	1		70,000,000
<b>Total Cost</b>					<b>135,300,000</b>

#### 7.4.3.2 Reading and writing project for adults

This project is considered within the Environmental Education Program given that in almost every Vereda, was detected that part of the population doesn't know how to read or write, important aspect to undertake in the educational process in the environmental education

- **Objectives**

- Articulate the process of environmental education, with other elements that are important for the integral education of the population from the Vereda, of the project influence area.
- Provide basic tools of literacy to the inhabitants of the Vereda, in the project influence area with relevant methodology, in order to facilitate the integration between this process and the needs of daily activities.
- Acquire theoretical tools and practices about the importance of good nutrition, how to have a balanced diet with the right combination of food that the environment offers, and how to achieve the sustainability of school orchards, as a principle of food security and opportunity for the enrichment of the daily diet.

- **Justification**

The project of reading and writing must articulate and bind the process of environmental education, with other elements that are important (such as acquire theoretical practices tools

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

about the importance of good nutrition, how to have a balanced diet with foods of the environment, sustainability of school orchards as a principle of food security and opportunity for the enrichment of the daily diet) for the integral education of these people, who by the circumstances as a result of the armed conflict present a high level of vulnerability.

During the informative workshops and identification of impacts and management measures, it was identified that a majority of its population are functionally illiterate because if they know how to sign, do not dare to write or read in public, and have difficulties to perform mathematical calculations. It is well known that those with functional illiteracy can be manipulated or intimidated easily and with greater probability are exposed to risks associated with health, stress, and can receive unfair wages and be more vulnerable to another type of threat.

Training in nutrition, school gardens and small-scale animal husbandry, allows them to share experiences for educational development from content courses in sciences, mathematics and society, in adults and children, giving them the opportunity to acquire the necessary skills and abilities for their development in daily life and with the necessary relevance, in accordance with the environment and the culture of the local population. In addition to that it can improve the levels of existing nutrition and lay the foundation for promoting initiatives as food security for the inhabitants of the various Veredas, of the influence area.

Finally, *“education for the rural population is crucial to achieve the goals of Education for All (EFA) and the Millennium Development Goals (MDGS) to eradicate extreme poverty and hunger, ensure the fulfillment of primary education in 2015, promote gender equity and ensure the sustainability of the environment. In 1996, the World Food Summit (Rome) emphasized the expansion of access to education for the poor and members of disadvantaged groups, including the rural population, as a key factor in achieving the eradication of poverty, food security, a lasting peace and sustainable development. In 2002, the World Summit on Sustainable Development (Johannesburg) also emphasized the role of education”*.<sup>4</sup>

- **Targets and indicators**

- Train at least 40% of the population in the Vereda, of the project influence area who don't know how to read or write.
- Achieve that at least 40% of the population in the Vereda, of the project influence area, do basic mathematic calculations necessary for their development in daily life.
- Achieve that at least 50% of the population introduce in their daily diet new food preparations that allow them to enrich and balance their diet to lower malnutrition among children and adults
- Realize a link with the program MANA from the Government of Antioquia to make a nutritional diagnosis of children in school age from the Vereda, in the influence area, and later in the formation process determinate according to expert criteria to monitor closely the adoption of practices that aim to improve the nutritional welfare of children.

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4 FAO - IIEP - OREALC with the support of the Italian Development Cooperation and collaboration of the IICA. 2004. **Seminar on "Education for the Rural Population (EPR) in Latin America": Food and Education for All**. Santiago de Chile, Chile.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

The indicators used, shall be the following

- Number of adults, young people and children by Vereda, that know how to read and write after the literacy project/ Number of adults project, young people and children who can read and write before the literacy project.
- At least 40 classes of literacy per year.
- At least 20 adults of all the Vereda, of the influence area that may learn to read and write with the WFP literacy project.
- Performing at least one practice for preparing a variety food and balance the usual diet.
- Introduction of at least one food that allows the improvement of the nutritional status of children and adults.
- At least 10 lectures or nutrition classes a year per Vereda,

• **Actions**

Implement the project of literacy in the paths of the project influence area. According to the location of the school or place where the classes will be taught. These classes will be conducted once a week, with a previous consultation with the interested people.

Integrate the contents of the literacy project with the contents of nutrition and balanced diet with the work in the school orchard.

Conduct classes to prepare any recipe through practical demonstration, and linking content of mathematics, nutrition and the school orchard.

Education should support the activities of the school orchard, seeking to integrate the educational process of literacy and take advantage of the orchard as a practical space for teaching and learning.

• **Schedule**

This project must be carried out in parallel with the Environmental Education Program and in accordance with the planning required to achieve the proposed objectives.

• **Budget**

This budget is made for 10 months, considering that in this time, it is feasible to achieve the objectives of the project of reading and writing, otherwise the corresponding adjustments should be made.

	Unit	Value ( \$ )	Quantity	Months	Total value ( \$ )
<b>Staff Cost</b>					<b>19,800,000</b>
Professional in education with experience in working with peasant population	H-month	1,500,000	1	10	15,000,000
Professional in nutrition and dietetics with experience working with communities	Day	200,000	24		4,800,000
<b>Direct Costs</b>					<b>12,600,000</b>
Literacy class materials (drafts,	Workshop	100,000	30		3,000,000

**ENVIRONMENTAL IMPACT STUDY**

notebooks, pencils, sheets of notepad, flip charts, scissors, colors, sticky tape, glue, card stock, colored paper, draft board, markers)					
Allowances for a professional nutritionist	Day	50000	24		1,200,000
Vehicle for the mobilization of professional nutritionist	Day	350000	24		8,400,000
<b>Total Cost for 10 months</b>					<b>32,400,000</b>

• **Responsible**

The realization of the reading and writing project is the responsibility of the company that owns the hydroelectric project.

**7.4.3.3 Institutional and community strengthening**

• **Objectives**

- Raise the levels of governance in communities, organizations and social groups present in the direct area of influence of the El Molino hydroelectric project, by means of a training program which fosters the participation of the communities and create favorable conditions for the formation of different mechanisms for citizen participation, such as supervision committees and environmental meetings, facilitating the accumulation of social and symbolic capital, which allows the company to improve the coordination of relations with the municipal, environmental, and military authorities, and others with relevance in the sector.
- Involve within the everyday culture of the different communities in the project influence area, elements that are conducive to the exercise of citizenship based on the primacy of public life, democratic coexistence, individual initiative, collective solidarity and tolerance.

• **Justification**

Community participation is not possible without the prior awareness and community organization. For the stimulation of a given social group culture, it is essential that individuals organize themselves, grouped together and strengthen around their needs, interests and desires.

It is understood by social and institutional strengthening the process through which the people, social organizations, public and private institutions, from their different visions, unify efforts in cooperation areas, to define common goals and implement the necessary means to achieve them. In other words increase the means and accumulate social and symbolic capital.

In the villages in the direct influence area, the communal action committees are the most representative organizations. These entities are the vector by which the various secretariats, committees, non-governmental organizations, CORNARE and the groups with presence in the village, channeled their projects and programs.

In Cocorná, community participation has been increasing since years ago, after the violent deaths of many community leaders. Since 2003 it has been developing the process for a Constituent Assembly, which however, has had its ups and downs, related to matters of

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

public order and political will. According to the current development plan, "*little by little, this process has been positioned in the village and is recognized by the different social, political and government actors bringing closer the Municipal Administration with the community, with the impetus of organizational strengthening activities of the zone centers of social control in the management of public discussion on the participation as law and democratic governance as an alternative. At present time the Assembly articulates much of the living forces of the municipality, constituting the largest local scenario where deliberates on central issues of this territory*"<sup>5</sup>.

In Cocorná, the Communal Action Committees and the different organizations and associations have a poor support for their participation and little strengthening in their community work. The armed conflict has been one of the main causes by which the participation has not had the desired results, as well as the little political will of the managers on duty.

There are currently 68 formed committees for rural communal action and four committees of urban communal action, but they are five committees in cancellation process by the legal representative since the Vereda, are without inhabitants due to the armed conflict.

In Granada, before and after the guerrilla warfare in 2000, calls for the attention of numerous groups, associations that have arisen from the communities to organize themselves. One could say that Grenada is a seed of alliances. However, the most curious thing is that these have been spontaneous. There have formed among all public and private sectors, and the community itself, with or without conventions.

Until the year 1998, the municipality of Granada was doing important work in the promotion and strengthening of community action; there are obvious achievements up to that date, reflected in opening and maintenance of roads, community infrastructure, engraving, communal huts and schools, among others.

Before 2000, the year in which violence increased, in each one of the Vereda, and work of the Community Action Board with a total of 2,620 affiliates. Currently there are ways that do not have this figure due to its desertion, but the existing ones in spite of problems in its representativeness are not exploited by the development of their activities and for the objectives fulfillment.

- **Normatively**

- Constitution of National Politics
- Environmental Law (99 of 1993)
- Law on mechanisms of participation (134 of 1994), which regulates the popular initiative legislation and regulations, the referendum, the popular consultation, order of the national, departmental, district, municipal and local; the revocation of the mandate, the plebiscite and the town city hall meeting establishes the fundamental rules that governed the democratic participation of civil organizations.

In addition should follow the guidelines outlined in the social land-use planning schemes of the existing two municipalities in the project influence area and its compliance as agreed

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<sup>5</sup> Municipality of Cocorná. Development Plan 2008 - 2011: Development with equity. Ministry of Planning. 2008.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

within the Plans of Development corresponding to the current municipal administrations, as well as the Strategic Plan of CORNARE.

- **Stage**

Construction and operation

- **Impacts to control**

- Generation of expectations
- Temporary employment generation
- Modification of local mobility.
- Increase in the demand for goods and services
- Modification of the municipal finance and the environmental corporations.
- Changes in governance levels
- Cultural heritage affectation
- Empowerment of Conflicts
- Variation in health levels

- **Type of measure**

Prevention, control and compensation.

- **Goals and monitoring indicators**

- Train the 100% of the communities in the area of direct influence.
- Strengthen and accompany the creation of organized groups in the four villages (100 %) of the project influence area.
- Train at least one organization from each of the Vereda, of the direct area of influence.
- Create an environmental committee in the direct project influence area.
- Elaboration of a diagnostic study of the institutional management in the area.
- Structure a strategy for organizational policy focused on institutional coordination and community.
- Assess the training, with at least 20% of the attendees to the training, through questionnaires or evaluations.

This may be assessed using the following indicators:

- Type and number of attendees to the training sessions.
- $(\text{Amount of organizations or community active groups existing by Vereda,} / \text{number of paths of the direct influence area}) \times 100$
- $(\text{Amount of organizations or community groups trained} / \text{number of Veredas, in the project influence area}) \times 100$
- Creation of an environmental bureau.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Elaboration of a diagnosis.
- Elaboration of a strategy of organizational policy for the area.
- (Number of assessments carried out in the period / evaluations planned for the period) x 100
- Compliance with the schedule drawn up for the program.
- Rank obtained in the training sessions through the questionnaires or evaluations.
- **Actions to develop**
  - Realization of a sensitization process to communities on the importance of creation or strengthening the organizations or community groups.
  - Training members of the different organizations on issues related to the concept of institutional strengthening, the governance and the creation of supervision committees and environmental meetings
  - Elaboration of a pre diagnostic, and after a final diagnosis set of institutional management in the area, with its strengths and weaknesses.
  - Structuring of a joint strategy of organizational policy, focused on the institutional coordination, to create a space of social, cultural and economic reactivation of the territory that will integrate the different organizations, institutions and entities with the community.
  - Assessments of the type pretest-posttest to the attendees at each training on the topic and later analysis.
  - Evaluate and monitor each month, the realization of the program in accordance with the guidelines presented and proposed indicators.

- **Application place**

This program has its field of action in the nine villages in the direct influence area of the El Molino hydroelectric project, as well as in the administrations of the municipalities of Cocorná and Granada and other organizations and groups with relevance in the project area.

- **Schedule**

Phase	Topic	Time
<b>1</b>	Identification and preliminary diagnosis of the organizations and community groups in the project direct influence area.	It is proposed to carry out this phase during the first two months of construction.
<b>2</b>	Institutional Analysis - identification of the required actions for its strengthening	It is proposed to carry out this second phase during the two months after Phase 1
<b>3</b>	Development and implementation of institutional strengthening strategy.	This phase will start during the construction of the project immediately after the completion of Phase 2 and will continue during operation

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- **Budget**

For its implementation an entity will be recruited with expertise in the development of this type of project.

The estimated cost is \$ 40,000,000

#### **7.4.4 Relocation of infrastructure and housing**

##### **7.4.4.1 Objectives**

Identify and list the infrastructure and housing to be relocated by project facilities

Relocate all the infrastructure and housing, within a clear and transparent negotiation between the parties, taking into account not only the physical aspect but also economic and social.

Consider different alternatives of negotiation in addition to the relocation, as direct negotiation, in the event that the owner demands it.

Reduce the expectations generated by the future movement through a clear and efficient management of the information about the whole relocation process.

##### **7.4.4.2 Justification**

When there are hydroelectric projects developed it is usual to present loss or detriment elements that can be an important part of the territory, concerning guidance, identity, religion, community infrastructure (communal house, school, tennis courts, old houses, a tree, a rock formation, a path, a community water source or Vereda, aqueduct), or required the relocation of homes affected by the construction of a project.

The disappearance of these elements involves a mismatch with respect to the territoriality built over time, which in turn, may affect how relationships of belonging and roots with the territory are established. It is important to bear in mind, that sometimes, even when restitution is done, the community infrastructure does not recover its historical value. Therefore, the process of restitution must be made as legally possible, and in accordance with the symbolic value and economic infrastructure that represents to the community.

For the construction of the facilities of the El Molino hydroelectric project, three houses and a (trapiche) small mill located in the Vereda, Los Mangos, of the municipality of Cocorna will be relocated

**Table 7-43 Families to resettle**

<b>Project Facilities</b>	<b>Owner or possessor</b>	<b>Activity of the venue</b>
Track at the substation and power house	Manuel Tiberio Giraldo Gómez	Sugarcane Cultivation and production of panela
Substation	Miguel Angel Giraldo Gómez	Citrus Fruit
Transmission Line	Evelio de Jesus Giraldo Aristizabal	Citrus fruit and cane

##### **7.4.4.3 Regulations**

- Political Constitution of Colombia Articles 1 and 2

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Law 99 of 1993.
- Law 134 of 1994.
- Law 143 of 1994.
- Decree 1818 of 1998.
- Decree 2811 of 1974 Title XII.
- Decree 1715 of 1978.
- Law 388 of 1997
- Law 3 of 1991
- Decree 1420 of 1998 Method of valuing the property affected

#### **7.4.4.4 Stage**

Preliminary stage and construction

#### **7.4.4.5 Impacts to control**

- Infrastructure and housing displacement
- Changes Population Dynamics
- Generation of expectations
- Empowerment of Conflicts
- Affectation of Economic Activities.
- Generation of inconveniences to the community

#### **7.4.4.6 Type of measure**

Mitigation and compensation.

#### **7.4.4.7 Goals and monitoring indicators**

- The goals for this program are:
- Establish the necessary conditions for the families to relocate so they perceive a permanent support and a good flow of information from the company, that allow them to be as comfortable as possible during the process.
- Relocate the dwellings in an optimal way complying with the economical, social and physical criteria demanded for the well being of the family so that its inhabitants are in equal or better conditions than those they had in terms of infrastructure, access to public and social services and access to communication.
- To reach an agreement with both parties and where all the parties involved are satisfied.
- Reimburse the 100% of the infrastructure affected by the project in the first quarter of the construction phase.

This will be evaluated using the following indicators:

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Housing conditions in terms of infrastructure, communication channels and access to public and social services before the project / housing conditions in terms of infrastructure, communication channels and access to public and social services after the project.
- Satisfaction Surveys.

#### 7.4.4.8 Actions to develop

- Perform a diagnosis of recognition of the status of the families that were affected by the construction of the main facilities.
- Through a survey of farms and homes, identify the demographic, social, economic and cultural characteristics that allow defining a vulnerability scale to select the best alternative for negotiation.
- Define in conjunction with those affected, the territorial space of resettlement of the families and their characteristics. In addition to the way in which will take place the resettlement, to select which they believe is the most convenient (relocation or direct negotiation).
- The owner of the project will be responsible for acquiring the land for resettlement, if it is not direct negotiation. As well as to perform the transfers to the new sites
- The owner of the project, within this program, will encourage the sustaining of the dominant economic activity in the area, which in this case is agriculture. Simultaneous with the negotiation process of the property it will develop a program to support the production and support of the family unit.
- Community meetings with small groups, in order to clarify all the doubts and concerns that arise.

#### 7.4.4.9 Application place

Housing and infrastructure to relocate are located in the Vereda, Los Mangos of Cocorna

#### 7.4.4.10 Schedule

For this program have been defined three stages, which are described in Table 7-44

**Table 7-44 Schedule of the relocation infrastructure program**

Phase	Actions	Time
1	Perform a diagnosis of recognition of the status of the families that were affected by the construction of the main facilities. Through a survey of farms and homes, identify the demographic, social, economic and cultural characteristics that allow defining a vulnerability scale to select the best alternative for negotiation. Define in conjunction with those affected, the territorial space of resettlement of the families and their characteristics. In addition to the way in which will take place the resettlement, to select which they believe is the most convenient (relocation or direct negotiation).	It is proposed to carry out this phase during the first month of construction of the project

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

2	<p>The owner of the project will be responsible for acquiring the land for resettlement, if it is not direct negotiation. As well as to perform the transfers to the new sites.</p> <p>The owner of the project, within this program, will encourage the sustaining of the dominant economic activity in the area, which in this case is agriculture. Simultaneous with the negotiation process of the property, it will develop a program to support the production and support of the family unit.</p>	<p>This phase will start at the beginning of the construction of the project and will culminate when families are fully relocated in the new housing, and stabilized its agricultural production capacity.</p>
3	<p>Community meetings with small groups, in order to clarify all the doubts and concerns that arise.</p>	<p>It is suggested that these meetings are made throughout the relocation process.</p>

#### 7.4.4.11 Budget

Table 7-45 presents the relocation costs of the three houses and (trapiche) small mill considering the value of a new home as social interest. The accompaniment will be done by the Environmental Management Group.

**Table 7-45 Budget for direct costs and the social professionals**

	Unit	Value ( \$ )	Quantity	Months	Total value ( \$ )
<b>Direct Costs</b>					<b>203,009,000</b>
Relocation (trapiche) small mill 1	SG		1		50,000,000
Relocation housing	House	51,003,000	3		153,009,000
<b>Costs</b>					<b>203,009,000</b>

#### 7.4.4.12 Responsible

The project owner company.

#### 7.4.5 Hiring Labor

##### 7.4.5.1 Objectives

- Prioritize access to temporary employment generated by the project for the resident population in the direct influence area (DIA).
- Lead the generation of income on a temporary basis to the population of the (DIA), looking for the improvement of living conditions of the population.
- Facilitate the recruitment of persons that are in the process of return to their Vereda, in order to promote the resettlement and reconstruction of the social ties disintegrated by the armed conflict.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### **7.4.5.2 Justification**

The labor recruitment program is important as it can contribute to a temporary increase in the income of the population that is settled in the project influence area, through the recruitment of non-skilled labor required during the development of the different activities of the construction phase. This in turn enables an improvement in the quality of life, while at the same time energizes the economy of the municipalities where the project will be developed.

However, it is important to define a clear policy of recruitment, which contemplates an accompaniment and relevant guidance to traditional production activities which are not relegated to the background or where abandoned completely.

#### **7.4.5.3 Regulations**

- Political Constitution of Colombia Articles 1 and 2
- Law 99 of 1993
- Law 134 of 1994
- Law 143 of 1994. Chapter X, Article 53.
- Decree 1818 of 1998.
- For the OIT Declaration on fundamental principles and rights of work.
- Substantive Labor Code.
- Law 100 of 1993 and other related legal rules

#### **7.4.5.4 Stage**

Construction and operation

#### **7.4.5.5 Impacts to control**

- Generation of expectations
- Temporary employment generation
- Economic activities affectation
- Generation of nuisances to the community
- Empowerment of conflicts
- Infrastructure and housing displacement

#### **7.4.5.6 Type of Measure**

Compensation and mitigation.

#### **7.4.5.7 Targets and monitoring indicators**

As program goals are set out the following:

- Define a recruitment policy that incentive the roots and will support the strengthening of the local productive activities.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Linking the larger amount of unskilled workers required for the construction of the project, on the Vereda, where are located the most important project facilities.
- Define the following Indicators:
- Sum of recruitment required in each Vereda, by activity/sum of recruitment made by activity in each Vereda, x 100.
- Number of people in the (DIA) contracted/ Total of unskilled staff hired.
- Amount of plots and (trapiche) small mill after the project productive/amount of plots and productive (trapiche) small mill before the project.

#### **7.4.5.8 Actions to develop**

Constitute a recruitment office duly equipped with the necessary elements to ensure a good attention and guidance to the staff.

The office of recruitment should be disseminated widely in written media and radio stations.

When hiring new staff by the beginning of construction works, this information should be disclosed through local radio stations, in addition, shall be fixed in bulletin boards in public places and meeting areas of the population in the header of the municipalities and the Veredas, of the direct area of influence.

Shaping a recruitment committee, this shall consist of a representative of the administration of each municipality in the area of indirect influence, professionals in the social area of the contractor and the presidents of the JAC from the Vereda, of the direct area of influence.

The recruitment committee shall be responsible for informing about the job requirements, verifying that the résumé delivered belong to population of the project direct influence area.

Will hire at least one person from each family in the Vereda, of the influence area, and if they are interested and meet the requirements established for their recruitment. Preventing the abandonment of the local productive activities. When in the Vereda, there is not enough staff, it is needed to do a record which registers such situations. The contractor may find staff in other Veredas, or sectors in the area of influence.

The Contractor shall coordinate with the recruitment committee the selection and subsequently make all the arrangements of social security for each new worker as stipulated in the Colombian labor legislation.

At least every month, the number of generated jobs will be disseminated by printed media

#### **7.4.5.9 Application place**

The program of labor recruitment will focus on the recruitment of unskilled workers, first, in the population of the project direct influence area, that is the inhabitants of the Veredas, of Quebradona Abajo and Las Faldas of the municipality of Granada, and El Molino, Campo Alegre, Los Mangos, El Chocó and San Juan of the municipality of Cocorná. Then the inhabitants of the municipalities of Cocorná and Granada.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### **7.4.5.10 Schedule**

The schedule shall be determined in accordance with the defined starting the construction of the project and the environmental management group will be responsible for leading this activity, with the accompaniment of a professional in the social area.

#### **7.4.5.11 Budget**

The costs of this program are included in the Environmental Management Group.

#### **7.4.5.12 Responsible**

The contractor is responsible for carrying out the program of labor recruitment with the accompaniment of the supervision environmental management group.

### **7.4.6 Restoration of economic conditions Program.**

#### **7.4.6.1 Objective**

- Restore the farming activities or agricultural business that has been a base for the economy of families who owned the land that will be affected by the construction of the project facilities.
- Facilitate the recovery of levels of productivity and income that are diminished by the construction of the project.
- Guide to the peasant family as a productive unit to develop processes that promote the sustainability of the activities that have been a source of livelihood for the family group.
- Compensate for the losses on the productive activities, and the families work that is affected by the Project.

#### **7.4.6.2 Justification**

This program is important because it seeks to minimize the impact of the project between the local populations that can be affected by the development of the facilities. It is essential to ensure the inhabitants of the Vereda, in where the facilities are to be placed, the sustainability of their economic conditions with the refund and/or the timely and fair payment of the affected areas, so that they can quickly reset the productive activities that are a source of livelihood and constitute the families patrimony.

#### **7.4.6.3 Regulations**

- Political Constitution of Colombia Articles 1 and 2
- Law 99 of 1993.
- Law 134 of 1994.
- Law 143 of 1994. Chapter X, Article 53.
- Decree 1818 of 1998.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### **7.4.6.4 Stage**

Construction and operation

#### **7.4.6.5 Impacts to control**

- Generation of expectations
- Modification of local mobility.
- Infrastructure and housing displacement
- Economic activities affectation
- Generation of nuisances to the community
- Changes in the soil use

#### **7.4.6.6 Type of measure**

Compensation and mitigation

#### **7.4.6.7 Goals and monitoring indicators**

Goals are defined as following:

- Compensate in a timely manner the owners of the affected properties by the construction of the project.
- Provide advice and technical support until getting the proposed achievements to restore the economic conditions of the affected families.
- Restore 100% of the families income affected by loss of productive areas, as a result of the project.
- Laying down the following indicators:
  - Owners compensated / owners affected
  - Total Number of sites required by the project
  - Number of affected/ number restored
  - Detailed record of the monitoring processes developed with each of the property owners affected in its economic activity.

#### **7.4.6.8 Actions to develop**

- Define the criteria and methodology for calculating the affectation
- Collect the data to prove the income of the economic activity affected to calculate its compensation.
- Raise an Act of the performed management.
- Develop records of agreement which specifies the values, based on information obtained directly from the owners, managers in the venue. This act will also set out the actions that are responsibility of the company that owns the project to restore the initial levels of

**ENVIRONMENTAL IMPACT STUDY**

productivity and the family income. In addition, must be clearly set forth the commitments for the recovery or improvement of the life quality of the affected families. This act must be accompanied by photographic record or film footage.

- Planning and executing technical assistance for the production, which should facilitate the adoption of environment and production sustainability

**7.4.6.9 Application place**

This program will run on those sites, located on the Vereda, El Molino Campo Alegre, Los Mangos, La Inmaculada, and San Lorenzo, in the municipality of Cocorná, which will be affected by the construction of some project facilities.

**7.4.6.10 Schedule**

The restoration of economic conditions should be carried out in accordance with the project construction Schedule, doing a parallel accompaniment work and guidance to affected families.

**7.4.6.11 Budget**

Table 7-46 presents the cost of the program of the overall investment, for the refund of economic activities. The accompaniment will be done by the environmental management group

**Table 7-46 Budget program for the restoration of economic conditions**

	Unit	Value ( \$ )	Quantity	Months	Total value ( \$ )
<b>Staff Cost</b>					<b>12,000,000</b>
Agronomist with knowledge in sugarcane cultivation and production of panela		2,000,000	1	6	12,000,000
<b>Direct Costs</b>					<b>30,000,000</b>
Investment to perform	SG				10,000,000
Staff mobilization vehicle	Journey	350,000	50		17,500,000
Allowances	Day	50,000	50		2,500,000
<b>Total Cost</b>					<b>42,000,000</b>

**7.4.6.12 Responsible**

Responsible for the implementation of this program is the company that owns the project.

**7.4.7 Rural entrepreneurship**

**7.4.7.1 Objectives**

Provide training for small producers that want to leverage their skills and knowledge to identify, develop and promote new agricultural business initiatives, to assemble a project of agro-industrial development, and to give added value to agricultural production, which contributes to the social and economic development of the community that lives in the project influence area.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### 7.4.7.2 Justification

While in the two municipalities in the influence area, there are different economic activities, characterized by agriculture and cattle raising. In Cocorná for example, are important crops of sugarcane, coffee, yucca, bananas and fruit trees, there is also a cattle ranch and in Granada stand out the crops of coffee, sugar cane, tomato and cucumber, in addition there is extraction of timber.

It is important to bear in mind that because of the armed conflict effects which has been influential in various areas of the socio-economic relations, farming activities were also affected, reflecting a decline.

In the Vereda, 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 does not cover local demand; the milk is usually for their own consumption and for the manufacture of cheese and butter, which is marketed in the Vereda,. Similarly, in low proportion presents the breeding of pigs and chickens.

In almost all cases, the field work is done by their owners such as farmers that cultivate their land in the subsistence economy. Therefore the technology used is in its infancy in most cases; 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.

With the construction of hydroelectric projects, it is possible that some economic activities are 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 sugarcane cultivation areas, also for crushing and processing panela.

#### 7.4.7.3 Regulations

- **Law 101 of 1993.** General Law of agricultural development and fishing.
- **Law 590 of 2000.** By which dictate provisions to promote the development of micro, small and medium-sized businesses.
- **Law 69 of 1993.** By establishing the Agricultural Insurance in Colombia, it creates the National Fund for Agricultural risks and other provisions in the field of agricultural credit
- Law 731 of 2002. By which promulgates rules to favor the rural women.
- Law 1152 of 2007. By which dictates the status of rural development, reform of the Colombian Institute of Rural Development -Incode- and other provisions.

#### 7.4.7.4 Stage

Construction and operation

#### 7.4.7.5 Impacts to control

- Generation of expectations

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Empowerment of Conflicts
- Changes in Population dynamics
- Increases in demand for goods and services.
- Economic activities affectation.
- Changes in employment level
- Infrastructure and housing displacement
- Cultural heritage affectation

#### **7.4.7.6 Type of measure**

Compensation

#### **7.4.7.7 Goals**

Provide entrepreneurship training to the inhabitants of the Vereda, in the project influence area.

Support the assembly of at least two productive projects in the influence area.

#### **7.4.7.8 Monitoring Indicators**

- Number of trained people.
- Number of productive projects with a drawn up business plan.
- Project Number and financial equilibrium

#### **7.4.7.9 Actions to develop**

A professional of the social area will approach and call the residents of each Vereda, in order to motivate them toward the conservation of the agricultural vocation.

During these approaches there will be a first identification of potential projects or alternative activities described in the program of compensation of the hedges and woodlands biological corridor, through workshops of Participatory Rapid Diagnostic that will enable to identify as already explained in the program mentioned above, the strengths and weaknesses of the production processes, as well as possible marketing chains and funding possibilities.

The proposal of the formulated projects focuses on strengthening the management capacity of the settled communities in the project influence area, to facilitate the development of its autonomy and improve their conditions of life.

The Entrepreneurship program comprises two stages. The first contains the basic concepts and the motivation for the proper management of their resources, i.e. with those accounted by the family unit.

At this stage the main theme is called "business motivation", which it is intended to accompany the population with many lectures, in order to remind small producers that they have a very important undertaking which is the earth and that good results depend on handling it.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Includes the following modules:

- **Module 1**

- What is an entrepreneurship?
- What is an entrepreneur?
- Characteristics of an entrepreneur.
- Fears of an entrepreneur
- Motivations to be an entrepreneur
- What is entrepreneurship?
- What are the functions of the employer
- Motivations to be an entrepreneur in the rural area.

- **Module 2**

- Possibilities to identify a business idea
- Economic Environment
- Market
- Legislation
- Technology
- How to identify an opportunity for a business idea.
- Importance of teamwork.
- Characteristics of team work.
- After obtaining the diagnosis for each of the possible projects to implement, we will develop a second stage in which consolidates the formulation and implementation of business plans for the creation of an agro-industrial company that suits the conditions of the area and that complies with the relevant legislation. At this stage assistants will be trained in accordance with the following topics:

- **Module 1 Planning the Company**

- Identification of the target market.
- Steps to identify the market.
- Characterization of the market.
- Why is important to know about the target market.
- How and where you can obtain information from the market and the customer.

- **Module 2**

- What is an association?
- Why is partnership important?

**ENVIRONMENTAL IMPACT STUDY**

- What is associatively?
- Key aspects of associatively.
- What is the solidarity sector?

The lectures and the counseling will be made with a simple and concrete language, adapted to the type of production and in general to the particular conditions of the inhabitants of every Vereda,

**7.4.7.10 Application place**

The beneficiaries are the inhabitants of the project direct influence area; the communities of the Vereda, Quebradona Abajo and Las Faldas of the municipality of Granada. Equally El Molino, Campo Alegre, Los Mangos, El Chocó and San Juan de Cocorná.

**7.4.7.11 Schedule**

Table 7-47 shows the schedule for the program of rural entrepreneurship that will begin when construction starts and will run until the end of the first year of operation. Time for a final evaluation of the results and the fulfillment of their goals to determine whether if it is necessary to continue.

**Table 7-47 Schedule for the rural entrepreneurship program**

Activity	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	
1. Approaches and invitations to the inhabitants													
2. Development of Phase 1 "Motivation business"													
3. Development of stage 2. "Planning the company."													
4. Accompaniment in the creation of the company, subject to the agreement (after the first year)													
5. Permanent monitoring and evaluation of results													

**7.4.7.12 Budget**

The budget for this program is presented in Table 7-48 and accompanying will be done by the Environmental Management Group.

**Table 7-48 Budget of direct and personal costs**

	Unit	Value ( \$ )	Months	Total value ( \$ )
<b>Staff Cost</b>				<b>34,500,000</b>
Social Area professional (economist or related)	H-month	1,500,000	15	22,500,000
Professional Adviser	H-month	2,000,000	6	12,000,000

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>		Doc.: 2148-04-EV-ST-020-07	
			Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>				

<b>Direct Costs</b>				<b>325,000,000</b>
Vehicle	Month	3,500,000	6	21,000,000
Assemblage and implementation of the agro-industrial infrastructure	SG			300,000,000
Working Material	SG			4,000,000
<b>Costs of the Project</b>				<b>359,500,000</b>

#### 7.4.7.13 Responsible

Owner of the project

#### 7.4.8 Archeology and cultural heritage

##### 7.4.8.1 Objective

- Generate social processes in the communities of the project influence area, which contributes to the strengthening of collective identities and the development of artistic and cultural practices that give possibilities of expression to the children and young people of the project influence area.
- Preserving the social structure, the construction of "citizenship" and a sense of belonging, with the referent practices and specific cultural patterns in a framework of respect and admiration for the peasant cultures.

##### 7.4.8.2 Justification

Without doubt the cultural references support the cultural system of the Vereda, population which conform the influence area are based in inherent aspects of the Antioquia culture, as feeding, housing, economic activities, partying, and religion, elements crossed by a work conception and productivity very unique of the Antioquia peasant. Another element that increases the identity of people from the area is family union as an integral axis and conveyor of identity

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 to the communities and distinguish these from other populations in the department and the country.

Usually when running a hydroelectric project in a given area, arrives staff from other locations to work or to provide services; this fact can lead to a transformation in the cultural system of the traditional inhabitants of the area where the project would be stationed (customs, practices, traditions, vision of the world, customs, values, knowledge, consumption patterns, beliefs, etc. ) The tangible or intangible cultural heritage of this population as a result of inters cultural relations and transformations of the environment introduced by the work activities.

These processes can be evident in the social changes (increase in issues such as drug abuse, prostitution, single mothers, and teen pregnancy, among others), change of traditional values and the consequent interpretation of tradition as foreign cultural models. Also because changes in consumption levels, economic, and productive cycles.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

In addition a large part of practices, patterns, related and territorial symbols, the particular appropriation of natural resources, values, and the landscape as a whole, could be affected by the construction of the project facilities.

#### **7.4.8.3 Regulations**

By which dictates action on defense and conservation of the historical, artistic and public monuments of the nation.

- Decree 264 of 1963, the Ministry of Finance and Public Credit, by which regulates the Law 163 of 1959, on the defense and conservation of the historical, artistic and public monuments in the nation.
- Decree 1397 of 1989, the Ministry of Finance and Public Credit, by which regulates the Law 163 of 1959, on the defense and conservation of the historical, artistic and public monuments in the nation.
- Resolution 49 of 1990 Council of National Monuments, which revokes resolution N° 015 of 1990, and establish the registration of archaeological goods furniture.
- Articles 63 and 72 of the 1991 Constitution of Colombia, and as enshrined in articles 1, 7, 8, 10, 70, 95 and 313, the State recognizes and protects our ethnic diversity, ethnic, cultural, natural and of cultural heritage.
- Law 99 of 1993. Environmental Law, Article 5, section9: Adopt jointly with the Ministry of National Education outreach programs and non-formal education.
- Law 397 of 1997, Act of the General Culture, develops articles 70, 71 and 72 of the Constitution of 1991, referred to the cultural heritage of the Nation.
- Decree 833 of the April 26 2002, by which partially regulates Law 397 of 1997, in the area of national heritage and other provisions.
- March 1185 Act 2008, amended central aspects of the General Law of Culture, relating to the cultural heritage. This is a comprehensive reform of the Law 397 of 1997, as it pertains to the conceptualization, management, sustainability and protection of cultural heritage. This standard places Colombia in the forefront of legislation in Latin America and in tune with the more recent conventions of UNESCO, on intangible heritage and cultural diversity.
- In addition, should follow the guidelines outlined in the social Scheme of Territorial Order in force of the municipalities of Cocorná and Granada and its compliance as agreed within the Development Plan corresponding to the current Municipal Administration, as well as the Strategic Plan of the (Corporacion Autonoma Regional - CORNARE)

#### **7.4.8.4 Stage**

Construction and operation

#### **7.4.8.5 Impacts to control**

- Generation of expectations
- Cultural heritage affectation
- Modification of local mobility.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Infrastructure and housing.
- Changes in Population dynamics
- Pressure on the real estate market
- Generation of inconveniences to the community
- Archaeological heritage affectation.

#### **7.4.8.6 Type of measure**

Prevention and compensation

#### **7.4.8.7 Targets and monitoring indicators.**

The goals for this program are:

- Train the communities of the Vereda, located in the project influence area, in aspects related to the concept of memory and cultural heritage, and associate it with its surroundings with the territory they inhabit.
- Train children and young adults in the communities of the project influence area, in expressions and techniques of fine arts, visual, and representative, focusing on the valuation and knowledge of their cultural heritage.
- Acquire a complete listing of practices, patterns, symbols, and cultural references of the various Veredas, in the project influence area.
- Implement a comprehensive cultural agenda with all the Veredas, of the project influence area, through a series of events and cultural schedules, recreational and artistic, around the memory and local cultural heritage.
- Provide the communities of the (DIA) with a series of educational materials that describe the characterization carried out with regard to the heritage and memory, such as folding, books, posters, videos, sticker albums and/or other documents.
- This may be assessed using the following indicators:
- Type and number of attendees to the training.
- $(\text{Number of communities operated by the program} / \text{total Communities of the direct influence area}) \times 100$
- $(\text{Number of persons trained by established periods} / \text{total number of persons budgeted to train}) \times 100$
- $(\text{Topics covered in the workshops} / \text{Topics planned for the workshops}) \times 100$
- $(\text{Number of realized DRP Vereda,} / \text{number of paths in the direct influence area}) \times 100$
- $(\text{Number of stories realized in the Vereda,} / \text{number of villages in the direct area influence}) \times 100$
- $(\text{Number of sectors with implemented cultural agenda} / \text{sectors of the direct influence area}) \times 100$
- $(\text{Number of cultural events performed by sector} / \text{events planned by sector}) \times 100$

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- (Number of assessments per year / number of evaluations planned per year) x 100
- (Number of outreach materials delivered to the Vereda, and the municipal villages) x 100
- Compliance with the schedule drawn up for the program.

**7.4.8.8 Actions to develop**

- Develop a participatory diagnostic on the cultural and artistic status of the Vereda, of the direct influence area.
- Conduct meetings of sensitization and initial motivation.
- Perform training courses aimed to the communities of the Veredas, located in the project influence area, in aspects related to memory and cultural heritage, and associate it with its surroundings and the territory they inhabit.
- Train children and young adults in the communities of the project influence area in expressions and techniques of fine arts, visual, and representative, focusing on the valuation and knowledge of their cultural heritage.
- Develop a complete listing of practices, patterns, symbols, and cultural references of the different Veredas, of the project influence area.
- Implement a cultural agenda with all the Veredas, of the project influence area, through a series of events of cultural, recreational and artistic schedules, around the memory and the local cultural heritage.
- Design and edit educational materials to give an account of the characterization carried out on heritage and memory, such as folding, books, posters, videos, sticker albums and other documents.

**7.4.8.9 Application place**

The strategy of memory and cultural heritage has its application field in the communities of the Vereda, of the project influence area: San Lorenzo, Las Inmaculada, San Juan, El Chocó, El Molino, Campo Alegre and Los Mangos, all within the municipality of Cocorná; as well as the Vereda, Quebradona Abajo and Las Faldas of the municipality of Granada.

**7.4.8.10 Schedule**

Table 7-49 presents the schedule for this program, which must be executed in 12 months.

**Table 7-49 Schedule for the memory and heritage program**

Activity	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	
1. Diagnosis development of the cultural and artistic state. Prior sensitization and initial motivation actions.													
2. Identification of actions and strategies. Development of the cultural agenda.													

**ENVIRONMENTAL IMPACT STUDY**

<p>3 Development of a complete listing of practices, patterns, symbols, and cultural references of the various Vereda, in the project influence area.</p>												
<p>4. Training the communities of the Vereda, in the project influence area in aspects related to the concepts of memory and cultural heritage. 6. Training children and young adults in the communities of the project influence area, in expressions and techniques of fine arts, visual, and representative, focused on the valuation of the cultural heritage and memory.</p>												
<p>7. Implementation of the cultural agenda. 8 Design and editing of materials such as folding, books, posters, videos and documents. (Scrapbook stickers).</p>												

**7.4.8.11 Budget**

Within the Environmental Management Group, will be required a professional of the social area with experience in the implementation of environmental projects, community participation and a professional in arts, with experience in community participation.

**ENVIRONMENTAL IMPACT STUDY**

	Unit	Value ( \$ )	Months	Total value ( \$ )
<b>Staff Cost</b>				<b>12,000,000</b>
Professional in social area	H-month	1,500,000	4	6,000,000
Professional in arts	H-month	1,500,000	4	6,000,000
<b>Direct Costs</b>				<b>25,200,000</b>
Round trip transportation to the municipality and internal transport for staff	Month	4,000,000	3	12,000,000
Outreach material (Scrapbook stickers), training materials	200	50,000		10,000,000
Refreshments	SG	400,000	8	3,200,000
<b>Total Cost</b>				<b>37,200,000</b>

#### 7.4.8.12 Responsible

- **Owner of the project** (Team of Environmental Management): During construction and operation of the project, it will coordinate with the Secretary of Education, the institute of sports and recreation and the (Casa de la Cultura) of the municipality, as well as with the communities of the project direct influence area the development of a complete program or agenda related to the memory and the local cultural heritage.
- **Environmental Supervision:** During the construction of the project, it will do a proactive monitoring to the different activities of the program, and will inform the environmental and cultural authorities on their evaluations when required. In addition, ensure the proper implementation of the commitments made with the community and make the necessary recommendations for the proper development of the program.

#### 7.4.9 Restitution Program of the affected infrastructure

##### 7.4.9.1 Objectives

Establish a procedure for fair and equitable care, compensation or mitigation of the damage caused to housing and infrastructure, for the execution of the facilities.

##### 7.4.9.2 Justification

The movement of heavy vehicles, the realization of excavations and other activities related to the construction of the El Molino hydroelectric project can disrupt or cause injury or damage to the resident population, housing, pastures and crops. In the event of an incident, the contractor will contact the owners involved, and will assess the affectation degree and the value of the damage.

Before work begin, it is necessary to identify the requirements for space and services that will be used.

##### 7.4.9.3 Regulations

- Law 99 of 1993. Law of Environment.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Law 134 of 1994. Law of participatory mechanisms.
- Law 388 of 1997. Law of territorial management.

#### **7.4.9.4 Stage**

Previous studies, construction and operation.

#### **7.4.9.5 Impacts to control**

- Involvement of cultural heritage
- Empowerment of Conflicts
- Damage caused to third parties
- Generation of expectations

#### **7.4.9.6 Type of measure**

Prevention, compensation.

#### **7.4.9.7 Targets and monitoring indicators**

The goals are:

- Respond assertively to 100% of the actions that originate damage to third parties.
- Respond to 100% of the damage, which repair shall be satisfactory in the shortest possible time.
- Prevent and avoid causing damage to the surrounding population in the work sites.
- This may be assessed using the following indicators:
- Number of complaints registered, act of visits / number of claims served - satisfaction closure act.
- Number of lectures on damage prevention made to the workers.
- Number of neighborhood records processed from start to finish (final).

#### **7.4.9.8 Actions to develop**

Before the start of construction, it must perform an inventory of the areas condition and public and private assets existing in the precise area of influence. For this record shall raise neighborhood acts, where will register the current status of the construction or infrastructure evaluated which must be accompanied with a photographic record.

Each one of the building's owners will be informed about the different construction activities that can entail damages to their property. Also will be informed on the procedure to be followed in the event of damage to his property or feel aggrieved by any construction activity.

In the event that an incident occurs, the contractor will contact the owners of the property housing or affected infrastructure, and will evaluate the degree of affectation and the value of the damage.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Will produce a report on the different damage or damages, claims made by third parties, payment amount and time to solve the affectation.

Subsequently, there will be a cancellation receipt, which must be signed by the person who suffered the affectation

#### **7.4.9.9 Application place**

The different activities associated with the construction of the El Molino hydroelectric project can cause injury and damage to property of third parties in the project direct influence area, i.e. housing and infrastructure of the Vereda, of El Molino, Campo Alegre, Los Mangos, La Inmaculada, San Lorenzo, El Chocó and San Juan in the municipality of Cocorná, in which will be located associated facilities. Occasionally it could affect some infrastructures in the municipalities of Cocorná and Granada.

#### **7.4.9.10 Schedule**

This program will be implemented during all stages of the El Molino hydroelectric project.

#### **7.4.9.11 Budget**

Costs are included within the Environmental Management Group and the civil facilities

#### **7.4.9.12 Responsible**

- **Owner of the Project** Establish responsibilities with the contractor and supervision on the development of the neighborhood records, records of agreement and closing records to the satisfaction, as the case may be.
- **The contractor** will attend the population requests and when it is damaged make the payments for claims in regard to damages caused by providing truthful information and developing transparent mechanisms of negotiation and management.
- The environmental supervision: Review and take the corresponding records on the implementation of this project and accompany the activities related with the elaboration of the different records (visit, agreements closed to satisfaction: initial and final).

#### **7.4.10 Archeology and disclosure rescue**

This program covers the influence areas of the El Molino and San Matias hydroelectric projects; the rescue activity, monitoring and outreach, will be assumed by the El Molino hydroelectric project, for being the first one to be built.

##### **7.4.10.1 General Information**

The archaeological management measures are part of a set of specific actions to perform at identified archaeological sites, by means of which it is intended to mitigate the impacts that the construction of El Molino and San Matias hydroelectric projects will cause to the archaeological heritage. The management measures or Archaeological Environmental Plan, consist of the following actions: systematic excavation surveys, sampling and Stratigraphic cuts in area, and in the realization of archaeological monitoring in the areas of work in which were identified archaeological sites and in those that they found no vestiges, but by its

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

geomorphology are considered to be of archaeological potential, therefore it is recommended a proactive monitoring.

These management measures are proposed in fields with a high degree of impact: **7, 10, 6A and 6B**; in them the archaeological activities will begin with systematic boreholes and subsequently, samples will be taken in the Stratigraphic deposits 7, 6A and 6B, and a cut in reservoir area 10.

The boreholes are small excavations of 50 cm, systematically carried out, i.e. with regular spacing, throughout the geological formation, to obtain a grid. The distance from the regular spacing depends on the size of the geological formation and the level of resolution intended for the information recovery. The boreholes made, shall be recorded in a Cartesian plane, with numbers that increase their value from south to north and letters from east to west; in this way, the identification of each of the surveys is carried out with an alpha numeric code, for example 1A, 2B, 3C, etc.

The boreholes must be dug out in arbitrary levels of 5 cm in thickness, while respecting the identified soil horizons, collecting the amount of excavated levels, amount of archaeological remains found by level and a description of the observed Stratigraphic. With the realization of the boreholes (or systematic sampling of the landscape unit), is looking for information on the characteristics of the soil and the dispersion of the cultural materials to vertical and horizontal levels, information that will be used to understand the formation process of the site, the differentiation of activity areas or occupations, and also to define the place where the cut area will be and the Stratigraphic sampling.

#### **7.4.10.2 Archaeological Excavation in area**

The excavation in area will be in a Stratigraphic cut of 20 m<sup>2</sup>. As already mentioned, for the location of the excavation area, will take into account the results of the boreholes that indicates an archaeological site, which combines high contents of archaeological evidence in correlation with a layer of important soil thickness, which identifies several soil horizons.

The excavation must be carried out by grids of m<sup>2</sup> and using the technique of arbitrary levels of 5 cm in thickness, carrying a vertical and spatial register of the relics found and the physical characteristics of the soil, making readings in the Stratigraphic profiles and taking soil samples to perform physical and chemical analysis, which can help to understand the Stratigraphic and coal dating.

The excavations in the area are searching for:

- Retrieve a corpus of structured information in archaeological aspects such as the vertical location (Stratigraphic column) and spatial archaeological cultural material, which will allow the recognition of activity areas within the same or the differential uses that was given to the spaces in ancient times. It will also seek information aimed at the identification of the site components in terms of the number of occupations, in correlation with the ordering in the Stratigraphic and deposition sequence of materials.
- Obtain information on the presence of other features that can be identified on the basis of alterations and changes in the Stratigraphic, as traces of housing structures, wells used for the storage of food or to deposit waste and bonfires, among others. This type of traces of specific activities carried out in the site; also indicate a differential use that was given to the spaces in ancient times.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- Obtain soil samples for chemical analysis of organic contents, physical and chemical, palynological, starches, phytoliths and coal dating.
- Keep a record of vertical space and materials, which includes, for each level of excavation of 5 cm, the exact location of each archaeological identified element (ceramic, lithic, coal and seeds, among others), traits (traces of the past). During the excavation process must also be made other activities such as natural disturbances (produced by roots, animals and erosive processes, among others) and by recent man made processes (plows for crops, fences, salting), and other elements that will help identifying the formation processes of the site.
- **General Characteristic's deposit 10, Los Mangos, recommended for excavation area.**

The archaeological site 10, Los Mangos, is located in the municipality of Cocorná, on the Vereda, Los Mangos, in the Cartography coordinates X: 883,532 - Y: 1,160,350, At a height of 992 meters above sea level, on the right bank of the San Matias River, among the ravines El Tejar and Los Tubos. The landscape unit corresponds to a terracing on the rest of the hillside, with an area approximately of 1247 m<sup>2</sup>. This presents a vegetation covering of grasses for livestock and fruit trees. On the surface are not observed recent alterations. This emphasizes the presence of a small slope, indicating that in pre-Hispanic times there was a benching for the establishment of a housing unit. With regard to the civil facilities, this landscape unit is located in the area intended for deposit 3 for the hydroelectric project San Matias.

- **Stratigraphic and cultural material deposit 10, Los Mangos**

In the prospecting were carried out two boreholes in this deposit, in which cultural material recovered is represented in 35 fragments of pottery. The profile of the modal pit 2 is formed by a Stratigraphic column 45 cm thick, which identifies five soil horizons: about 3 cm thick, reddish brown (10yr 3/6, Munsell), loam and clayey structure in sub angular blocks without cultural material; Horizon **A1**, about 9 cm thick, brown (10yr 4/3, Munsell), clayey sand texture and structure in fine sub angular blocks, with coal and 14 ceramics fragments; Horizon**2** , of about 13 cm thick, brown (10yr 4/4, Munsell), clayey sand texture and structure In blocks sub angular media, with coal and 17 ceramic fragments; Horizon**3** , 12 cm thick, brown yellowish (10yr 5/4, Munsell), clayey sand texture and structure in fine sub angular blocks, with coal and three ceramic fragments; Horizon **AB** , of about 8 cm in thickness, color red yellowish (5YR 5/6, Munsell), texture and structure in frank sub angular fine blocks, without cultural material; and finally a B Horizon , which begins to insinuate itself into the 45 cm deep, (5YR 5/8, Munsell), red yellowish texture and clayey silt structure in fine sub angular blocks.

The distribution of the ceramic material by excavation levels of and soil horizons, indicates a quantitative ontogeny that starts in the A3 horizon and ends in the horizon A1, with a bimodal distribution, indicating that presents two peaks, in levels 5 and 3. However, the characteristics of the ceramics seem to indicate the presence of a single occupation associated with the early ceramics in the area, called Complex (El Oro).

The ceramic paste presents dark red colors, brown and dark yellow, of polished and eroded surfaces, in thicknesses between 5 mm and 15 mm, with an average of 7.8 mm. This objects contains particles of quartz, gold and feldspar of medium sizes. In the sample there are two much averted edge fragments, thickened in the middle and thinned toward the end. Although

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

there are no decorated fragments, the characteristics of the paste, the types of edges and its Stratigraphic location, establish an association with the ceramic complex (El Oro), referenced to the region.

#### 7.4.10.3 Stratigraphic Sampling

The Stratigraphic sampling are small excavations carried out with dimensions between 2 m<sup>2</sup> (2 m x 1 m), <sup>2 and 3 m</sup> (3 m x 1 m). As in the cut area, in order to make the Stratigraphic sampling will taken into account the information obtained in the boreholes, related to the behavior of the soils and the relics at spatial and vertical level, in the entire intervened landscape unit.

In consequence in the selected fields for Stratigraphic sampling (7, 6A, 6B), are made between one and four Stratigraphic samplings; the amount and size of the sampling Stratigraphic unit in each landscape will depend of the archaeological information obtained in the boreholes previously made, the size and the observed differences in Stratigraphic density of materials to vertical and spatial level. This means that the Stratigraphic sampling must be done by prioritizing those sectors of the landscape units showing different thicknesses of the cultural layer or different densities and material qualities.

The Stratigraphic sampling will dig grids of m<sup>2</sup> using the technique of arbitrary levels of 5 cm in thickness, carrying a vertical register of the relics found and the physical characteristics of the soil, making readings in the Stratigraphic profiles and taking soil samples to perform physical and chemical analysis, which can help to understand the Stratigraphic and coal dating.

With the Stratigraphic sampling will search information relating to the soils (pedo genesis), in correlation with the stratification of cultural materials (pedo Stratigraphic), as well as retrieve information on the deposition processes of the materials and samples from which determine occupation chronologies of the landscape unit, as well as the cultural association and eventually the use that ancient men gave to different spaces<sup>6</sup>.

- **General characteristics of reservoir 7, recommended for Stratigraphic sampling**

Archaeological site 7, Los Mangos, is located in the municipality of Cocorná, on the Vereda, Los Mangos, in the Cartography coordinates X: 882,760 - Y: 1,160,711, At a height of 1,128 meters above sea level, on the right bank of the San Matias River. Its geomorphology corresponds to a break of medium slope, which covers an area of 1,575 m<sup>2</sup>. Presents a grass and trees vegetative cover. In this unit are presented alterations because of the construction of a (trapiche) small mill and creeps the surface by cattle rising. With regard to the civil facilities, is located in the intended area for the power house construction of the El Molino hydroelectric project.

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<sup>6</sup> It should be noted that the difference between a cut in area and a stratigraphic sampling is that in the first analyzes can be performed to answer questions about the spatial distribution of activities conducted at the site through time (emphasis horizontal with vertical control), while with the stratigraphic sampling, the analysis focuses on the vertical control of the remnants, aimed at identifying the deposition and chronological sequence of the materials and the site occupation.

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

- **Stratigraphic and cultural material, deposit 7**

In the borehole is identified a soil layer of 75 cm thick, with a Stratigraphic column composed of a succession of six soil horizons: Ap horizon , of about 6 cm thick, brown (7.5YR 4/6, Munsell), clay texture and structure in fine sub angular blocks, contains four ceramic fragments; Horizon **ABp** , some 13 cm in thickness, brown (7.5YR 5/6, Munsell), sandy clay texture and structure in fine sub angular blocks, and we found nine ceramic fragments; Horizon **Ab** , about 25 cm in thickness, color red yellowish(5YR 4/6, Munsell), sandy clay texture and structure in fine sub angular blocks, and contains 53 ceramic fragments and five lithic elements; horizon **A1** , a few 11 cm thick, red yellowish (5YR 5/6, Munsell), loam and clayey structure in fine sub angular blocks, where found nine ceramic fragments and five lithic; Horizon **AB** , about 12 cm thick, reddish yellow (7.5YR 6/8, Munsell), loam and clayey structure in fine sub angular blocks, where were found six ceramic fragments; B Horizon , that begins around 67 cm of depth, color yellow-reddish brown (7.5YR 7/8, Munsell), texture and clayey silt structure in fine sub angular blocks and does not contain cultural material.

The distribution of the ceramic material by levels of excavation and soil horizons indicates a quantitative ontogeny that starts in the horizon AB, linked to the beginnings of the site occupation between 55 cm and 67 cm in depth. Then the amount of pottery begins a slight decrease in horizon A1, between 44 cm and 55 cm in depth, to continue progressively rising among level 9 (40 cm - 45 cm) and 5 (20 cm - 25 cm), in what corresponds to the soil horizon buried AB, which contains the greater frequency of ceramics, which would indicate a more intense occupation or already consolidated landscape unit

Subsequently, in horizon **ABp**, ceramics descends, in what seems to correspond to time which may be indicating the abandonment process of the site. This corresponds to a layer of soil that goes from 10 cm to 20 cm in depth.

Finally, in the **AP soil horizon**, again increasing the amount of ceramics in a ground array quite scrambled some 6 cm in thickness, which indicates that this pottery was removed by recent anthropogenic intervention.

- **General characteristics of the deposit 6A, recommended for Stratigraphic sampling.**

The archaeological site 6A, La Inmaculada, is located in the municipality of Cocorná, on the Vereda, La Inmaculada, in Playa Loca, in the Cartography coordinates X: 884,968 - Y: 1,159,593, At a height of 809 meters above sea level, on the left bank of the Cocorná River and right banks of the San Matias River. Its geomorphology corresponds to a second alluvial terrace level, adjacent to another identified deposit by Cardona and Yepes (2009b), which has been identified as site 6A. Presents an area of 1,908 m<sup>2</sup> and seems to have suitability (terracing). Presents a vegetation covering of cattle grazing and no recent alterations are observed on the surface. With regard to the civil facilities, this is located in the area devoted to the power house of the San Matias hydroelectric project.

In this unit were two boreholes, which recovered cultural material that consists of 17 fragments of ceramic and eight lithic elements.

- **Stratigraphic and cultural material of deposit 6A**

In test pit 1, it was identified a Stratigraphic column composed of a succession of seven soil horizons, in a layer 53 cm thick, whose sequence is: Horizon about 6 cm thick, dark reddish brown (10yr 3/2, Munsell), texture and structure in sub angular medium blocks, in which was not found any cultural material; Horizon **1** , about 7 cm thick, dark brown reddish (5YR 3/3,

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

Munsell), texture and structure in frank sub angular fine blocks, which contains carbon and fragments of pottery; Horizon<sup>2</sup>, 13 cm thick, brown (7.5YR 3/3, Munsell), clayey sand texture and structure in fine sub angular blocks, where coal was found, six ceramic and lithic fragments; horizon **A3**, about 9 cm thick, dark brown and red yellowish (10yr 4/4, Munsell), texture and clayey sand structure in fine sub angular blocks, in which coal was found, five fragments of ceramic and lithic two elements; **Ab horizon of about 8** cm thick, dark brown yellowish (10yr 4/6, Munsell), clayey sand texture, structure in fine sub angular blocks, and which was removed ceramic and lithic fragments a; Horizon **AB**, about 10 cm thick, brown yellowish (10yr 5/6, Munsell), silt clay texture and structure in fine sub angular blocks, which was not found any cultural material; and a B horizon, **which begins** to insinuate itself into 53 cm in depth, yellowish brown (10yr 6/8, Munsell), texture clayey silt and structure in fine sub angular blocks and does not contain any cultural material.

The distribution of the ceramic material by excavation levels of and soil horizons, indicates a quantitative ontogeny that starts in horizon Ab (level 10), and ends on horizon A1 (level 4). In the deeper levels are the lower frequencies, standing in level 8 no ceramic found; later, towards level 6, are the higher frequencies, which begin to decrease in the following levels, 5 and 4. Due to the low frequencies in the deeper levels, the hiatus or level 8 without ceramics does not seem to indicate the presence of occupations, which seems to be corroborated by the ceramics characteristics.

- **General characteristics of the deposits 6B, La Inmaculada, recommended for Stratigraphic sampling**

The archaeological site 6B, La Inmaculada, is located in the municipality of Cocorná, on the Vereda, La Inmaculada, in Playa Loca, in the Cartography coordinates X: 885,024 - Y: 1,159,606, At a height of 793 meters above sea level, on the left bank of the Cocorná River and right banks of the San Matias River. The geomorphologic unity corresponds to a second alluvial terrace level, adjacent to the terraces outlined as deposit 6 (Cardona and Yepes, 2009b), and 6A, described in the preceding section; the area is 1,600 m<sup>2</sup>. This site presents recent alterations by the construction of a fence and a gap about 3 m in diameter which is full of water. With regard to the civil facilities, this is located in the power house area of the San Matias hydroelectric project.

In this deposit were two boreholes, which recovered cultural material composed of eight fragments of ceramic and nine lithic elements.

- **Stratigraphic and cultural material of deposit 6B.**

In test pit 1, was identified a Stratigraphic column of six soil horizons, in a layer 53 cm thick. The characteristics of the Stratigraphic column are the following: Horizon, about 10 cm thick, dark brown reddish (5YR 3/2, Munsell), texture and structure in fine sub angular blocks, in which are not found any cultural material; Horizon<sup>1</sup>, about 14 cm thick, dark brown reddish (5YR 3/3, Munsell), texture and structure in fine sub angular blocks, which found coal and a pottery fragment; Horizon<sup>2</sup>, about 10 cm thick, reddish brown (5YR 4/3, Munsell), loam and clayey structure in fine sub angular blocks, where coal was extracted, five ceramic fragments and a lithic element; Horizon<sup>3</sup>, about 11 cm thick, brown (7.5YR 4/4, Munsell), loam and clayey structure in fine sub angular blocks, where coal was found, two ceramic fragments and three lithic items; Horizon **AB**, of about 8 cm thick, brown yellowish (7.5YR 5/6, Munsell), texture and clayey silt structure in fine sub angular blocks and does not contain any cultural material; and a B Horizon, which begins to insinuate itself into 53 cm deep, red yellowish

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

(10yr 6/8, Munsell), texture and clayey silt structure in blocks and not fine sub angular, does not contains cultural material.

The distribution of the ceramic material by excavation levels and soil horizons, indicates a quantitative ontogeny that starts in the horizon A3 (level 9), and ends on the horizon A1 (level 5). The distribution of pottery presents very low frequencies that do not indicate a quantitative ontogeny, but it does for higher frequencies toward level 6 of excavation (horizon TO2).

#### 7.4.10.4 Archaeological Monitoring

The archaeological monitoring consists in carrying out monitoring or inspection to the mine clearance process of soil during the construction of the civil facilities, with the purpose to prevent the destruction of vestiges and perform the recovery of archaeological information they can supply, in correlation with the information produced in the early stages of the archaeological work carried out in the study area and in the context of the regional and national archeology. The follow-up to the removal of soil aims in this way to obtain information for complementing the results obtained in the archaeological excavations.

The procedure consists that once the archaeological monitor find an important concentration of vestiges, traits or funerary structures, during the land removal work will divert the removal of soil to another area, to carry out the respective rescue. Not being able to divert the removal of soil, it will proceed to temporarily stop work until the rescue of the found remains is carried out, with the appropriate archaeological techniques respecting the context and the archaeological findings.

The archaeological monitoring activities will be developed in all facilities areas, including the sites of high involvement for being rescued, those of medium involvement and those areas in which there was no archaeological evidence, but due to its geomorphologic characteristics are considered to be archaeological potential.

The duration of the monitoring activities depend on the civil facilities schedule, because during the process of soil removal which is where they discover many of the archaeological remains previously unidentified, is required the presence of an archaeologist, who must define up to when the site no longer is of archaeological interest. In accordance with this, and with results of the prospecting evaluation of the civil facilities impact on the archaeological component, the deposits which only requires monitoring, are evaluated as medium-impact (Sites 3, 4 and 9) and low (Sites 1, 2, 5, 6 and 8), as shown in the Table 7-50.

The monitoring is subject to the mine soils during the development of the civil facilities. Therefore, if once completed the planned time for the implementation of the Archaeological Management Plan for the El Molino and San Matias hydroelectric projects is (5 months), have not been completed the soil removal works, there is a need to continue with the archaeological monitoring until concluding these activities.

**Table 7-50 work areas which require archaeological monitoring**

Área de obra	Deposits in the area	Coordinates		Comments
		X	AND	
Bordering collection area	1, Quebradona	880,538	1,163,332	
Bordering collection area	2, Quebradona	880,932	1,162,671	
	3, Quebradona	881,053	1,162,645	

**ENVIRONMENTAL IMPACT STUDY**

Área de obra	Deposits in the	Coordinates		Comments
Area 1 deposit El Molino		880,449	1,161,797	Vestiges not found but requires proactive monitoring
Area 2 deposit El Molino		880,820	1,161,554	Vestiges not found but requires proactive monitoring
Collection Area and deposits 3 and 4 El Molino	4 El Molino	880,742	1,161,947	
	5 El Molino	881,001	1,162,019	
Area 5 deposit El Molino		880,937	1,162,461	Vestiges not found but requires proactive monitoring
Deposit Area 1 San Matias		884,094	1,159,716	Vestiges not found but requires proactive monitoring
Deposit Area 2 San Matias		883,867	1,160,220	Vestiges not found but requires proactive monitoring
Deposit Area 4 San Matias	6 Los Mangos	883,423	1,160,610	
Deposit Area 3 San Matias	8 Los Mangos	883,484	1,160,319	
Deposit Area 3 San Matias	9 Los Mangos	883,510	1,160,329	
Power house Area 1 El Molino	7 Los Mangos	882,760	1,160,711	In addition, it is proposed, conducting surveys and systematic stratigraphic sampling
Power house Area 2 San Matias	6A Inmaculada La	884,968	1,159,593	In addition, it is proposed, conducting surveys and systematic stratigraphic sampling
Power house Area 2 San Matias	6B Inmaculada La	885,024	1,159,606	In addition, it is proposed, conducting surveys and systematic stratigraphic sampling
Deposit Area 3 San Matias	10 Los Mangos	883,532	1,160,350	It is further proposed, conducting surveys and systematic archaeological excavation in area

**7.4.10.5 Laboratory Phase - Analysis of the cultural materials recovered during excavations.**

During this stage the processing is done, analysis and interpretation of all the recovered archaeological information on the contexts, Stratigraphic, deposition processes, cultural and historical components, as well as all the information coming from specialized analyzes relating to chronology, pollen, phytoliths and soils.

Later there will be a classification and analysis of the recovered materials remains geared to estimate shared degrees of similarity, that enable them to make groupings (Clarke, 1984), or associations between states of attributes, to detect recurrences or atipicidades through time, which will allow comparisons with ceramic and lithic groups already established for the surrounding regions. These regularities can be interpreted in the light of questions about the society that produced the vestiges, analyze and show changes or differences to its interior, which over time occupied the basin of the San Matias River.

**7.4.10.6 Archaeological Outreach Program of El Molino and San Matias hydroelectric projects**

The outreach program of the archaeological study seeks to publicize the results in addition to raising awareness of the importance about protection, preservation, and raising the value of the archaeological heritage of the Nation, based on the awareness toward the knowledge of the historical processes, local social and cultural, from the actual knowledge of our past and

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

current legislation for the defense, protection and preservation of the national archaeological heritage.

Outreach activities include informative talks aimed at staff linked to the construction site (contractors and supervision), focused on the training procedure to follow in case of archaeological findings during the removal of soil in the development of the civil facilities construction. In addition, they will emphasize on the importance of knowing and valuing the archaeological heritage as a legacy of our past.

Other lectures will be directed to the staff of the municipal administration of the municipalities of Cocorná and Granada, as well as the general public, and will be focused toward the importance of knowing the archaeological heritage as part of those tangible and the intangible expressions that contain information that enables the reconstruction of the knowledge of our memory and past.

#### 7.4.10.7 Implementation Schedule for the Archaeological Management Plan.

- **General work program for field activities**

For field activities are estimated a length of month and a half, with a team comprised of 13 people: an archaeologist director, two archaeologist's assistants, four and six auxiliary workers. The activities are distributed as shown in the Table 7-51.

**Table 7-51 General schedule for field activities**

Activity	Month 1				Month 2			
Stratigraphic Excavations	X	X	X	X	X	X		
Archaeological Monitoring			X	X	X	X		
Outreach Activities					X	X		
Monthly activity report					X			

- **General work program for laboratory activities**

The lab activities are estimated to last three and a half months, with a team of six people: an archaeologist director, an archaeologist assistant and four assistants. Table 7-7 shows the duration of the laboratory phase, discriminated against the activities.

**Table 7-52 General schedule for lab activities**

Activity	Month 1				Month 2				Month 3				Month 4	
Washing and marking the cultural materials	X	X	X	X										
Classification of the cultural materials				X			X	X	X	X				
Spatial and Stratigraphic Analysis									X	X	X	X	X	
Outreach Activities							X							
Monthly activity report	X						X				X			
Preparation of the final report	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Edition final report													X	X

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

#### 7.4.10.8 Budget

From Table 7-53 to Table 7-55, presents the costs of the Archaeological Management Plan for El Molino and San Matias hydroelectric projects

**Table 7-53 Budget for archeological rescue in El Molino and San Matias hydroelectric projects**

Staff			
CHARGE	Value/ Month	H-month	Total
Archaeologist director	\$ 4.000.000	5	\$ 20.000.000
Archaeologist assistant 1	\$ 3.000.000	5	\$ 15.000.000
Archaeologist assistant 2	\$ 2.400.000	5	\$ 12.000.000
Archeology Auxiliary 1	\$ 1.600.000	5	\$ 8.000.000
Archeology Auxiliary 1	\$ 1.600.000	5	\$ 8.000.000
Archeology Auxiliary 2	\$ 1.400.000	2.5	\$ 3.500.000
Archeology Auxiliary 2	\$ 1.400.000	2.5	\$ 3.500.000
worker	\$ 1.000.000	1.5	\$ 1.500.000
worker	\$ 1.000.000	1.5	\$ 1.500.000
worker	\$ 1.000.000	1.5	\$ 1.500.000
worker	\$ 1.000.000	1.5	\$ 1.500.000
worker	\$ 1.000.000	1.5	\$ 1.500.000
worker	\$ 1.000.000	1.5	\$ 1.500.000
<b>Total staff for field rescue</b>	<b>.000</b>		<b>\$ 79.000.000</b>
Transport			
Item	Value/Month	Months	Total
Vehicle/month	\$ 7.500.000	3	\$ 22.500.000
<b>Total transport rescue excavations</b>			<b>\$ 22.500.000</b>

**ENVIRONMENTAL IMPACT STUDY**

**Table 7 53 Budget for archeological rescue in El Molino and San Matias hydroelectric projects (Continued)**

<b>Allowances</b>			
<b>Staff for field rescue</b>	<b>Value/ Month</b>	<b>Months</b>	<b>Total</b>
Archaeologist director	\$ 1.500.000	1.5	\$ 2.250.000
Archaeologist assistant 1	\$ 1.500.000	1.5	\$ 2.250.000
Archaeologist assistant 2	\$ 1.500.000	1.5	\$ 2.250.000
Archeology Auxiliary 1	\$ 1.500.000	1.5	\$ 2.250.000
Archeology Auxiliary 1	\$ 1.500.000	1.5	\$ 2.250.000
Archeology Auxiliary 2	\$ 1.500.000	1.5	\$ 2.250.000
Archeology Auxiliary 2	\$ 1.500.000	1.5	\$ 2.250.000
<b>Total allowances for rescue field staff</b>	<b>\$ 10.500.000</b>		<b>\$ 15.750.000</b>
<b>Specialized Analysis</b>			
<b>Item</b>	<b>Value/Unit</b>	<b>Quantity</b>	<b>Total</b>
Pollen and phytoliths	\$ 1.000.000	10	\$ 10.000.000
Radiocarbon dating	\$ 1.350.000	4	\$ 5.400.000
Physical - chemical soil	\$ 45.000	48	\$ 2.160.000
<b>Total specialized analysis</b>			<b>\$ 17.560.000</b>
<b>Direct Costs</b>			
<b>Field and laboratory materials</b>	<b>Global</b>		<b>\$ 2.000.000</b>
<b>For Local laboratory</b>	<b>Value/Month</b>	<b>Months</b>	<b>Total</b>
With local services	\$ 900.00000	3.50	<b>\$3,150,000</b>
<b>Total archaeological rescue</b>			<b>\$ 139.950.000</b>

**Table 7-54 Budget for monitoring and disclosure in El Molino and San Matias. Hydroelectric projects.**

<b>Staff</b>			
<b>Staff</b>	<b>Value/ Month</b>	<b>H-month</b>	<b>Total</b>
Archaeologist director	\$ 4.000.000	1	\$ 4.000.000
Archaeologist assistant	\$ 3.000.000	1	\$ 3.000.000
<b>Total monitoring staff</b>			<b>\$ 7.000.000</b>
<b>Allowances</b>			
<b>Staff</b>	<b>Value/ Month</b>	<b>H-month</b>	<b>Total</b>
Archaeologist director	\$ 1.500.000	1	\$ 1.500.000
Archaeologist assistant	\$ 1.500.000	1	\$ 1.500.000
<b>Total allowances monitoring staff</b>			<b>\$ 3.000.000</b>
<b>Transport</b>			
<b>Item</b>	<b>Value/Month</b>	<b>Cnt months</b>	<b>Total</b>
Vehicle/month	\$ 7.500.00000	1	\$ 7.500.00000
<b>Total transport for monitoring</b>			<b>\$ 7.500.00000</b>

	<b>MOLINO AND SAN MATÍAS HYDROELECTRIC PROJECTS</b>	Doc.: 2148-04-EV-ST-020-07	
		Rev. No.:0	2012-03-30
<b>ENVIRONMENTAL IMPACT STUDY</b>			

**Table 7-54 Budget for monitoring and disclosure in El Molino and San Matias. Hydroelectric projects. (Continued)**

<b>Laboratory</b>			
<b>Staff</b>	<b>Value/ Month</b>	<b>H-month</b>	<b>Total</b>
Archaeologist director	\$ 4.000.000	0.5	\$ 2.000.000
Archaeologist assistant	\$ 3.000.000	0.5	\$ 1.500.000
<b>Total staff monitoring laboratory</b>			<b>\$ 3.500.000</b>
<b>Disclosure</b>			
<b>Results Dissemination of the archeology program</b>	<b>Global</b>		<b>\$ 20.000.000</b>
<b>Total program of monitoring and disclosure</b>			<b>\$ 41.000.000</b>

**Table 7-55 Summary of the costs of rescue, monitoring and disclosure programs**

<b>Activity</b>	<b>Value ( \$ )</b>
<b>Archaeological Rescue</b>	<b>139,950,000</b>
<b>Monitoring</b>	<b>21,000,000</b>
<b>Disclosure</b>	<b>20,000,000</b>
Total Archaeological Management Plan	180,950,000