ENVIRONMENTAL IMPACT STUDY FOR THE RUMICHACA - PASTO DUAL CARRIAGEWAY PROJECT ROAD, PEDREGAL – CATAMBUCO SECTION, UF.4 AND 5.1 CONCESSION CONTRACT UNDER SCHEME NO APP. 15 OF 2015

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Chapter 11.1.1. Environmental management program Abiotic

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11.1.1. ENVIRONMENTAL MANAGEMENT PLAN

This chapter contains the environmental management programs established under the Rumichaca - Pasto Dual Carriageway Road Project, Pedregal – Catambuco Section, which correspond to measures and management activities based on three aspects: characterization of the area of influence, Project characteristics and the environmental evaluation of possible impacts the project may have on abiotic, biotic and socio-economic environments.

The programs were formulated as a tool for environmental management of the Project; they are designed to prevent, mitigate, correct and / or compensate environmental impacts that may be generated by project activities that were previously identified in Chapter 8 of this study (Environmental Evaluation).

The content of this chapter is structured to respond to environmental impacts by component, reason why their actions pose a comprehensive response to the different impacts identified in the Project. Programs include aspects that allow providing clarity on the scope of each program.

The issues addressed in each Environmental Management Plan chart respond to the requirements of the terms of reference MM-INA-02 Version 2 gathered by Resolution of the Ministry of Environment, Housing and Territorial Development No. 751 of 2015. Based on this, the content of the environmental management charts will be structured as listed below.

1. **Program name:** corresponds to the description of each program, established according to the component to which it refers.
2. **Program identification:** corresponds to a consecutive code expressed with letters and numbers, which identifies each program in a simplified manner.
3. **Objectives:** presents the results to be obtained upon completion of the implementation of actions that are considered in the program.
4. **Goals:** defines the desired result measured quantitatively.
5. **Environmental Evaluation:** states project activities and the environmental and / or social impacts associated thereto for which the corresponding management measures are established.
6. **Stages to be implement:** specifies the times during project execution where management measures established in the programs apply.
7. **Type of measurement to execute**: corresponds to the classification of the measures that will allow reducing negative impacts and increasing positive project execution product. These may be a prevention, correction, mitigation and / or compensation measure.
8. **Actions to be taken:** refers to actions that will be carried out during project execution to meet program objective and goals.
9. **IMPLEMENTATION SITE:** Identifies one or several sites where the measure will be applied.
10. **Personal required:** refers to the human resources necessary for the implementation of the activities contained in each of the programs.
11. **Responsible for implementation:** registered organizations, companies or institutions responsible for implementing the programs.

12. **Follow-up and monitoring indicators:** measurement unit that quantifies and qualifies the level of compliance with management measures.
13. **Implementation schedule:** development of actions to be executed during the project term is specified.
14. **Costs:** specifies the values of supplies, personal and other items required by the implementation of management measures established in the programs.

The overall organization of the Environmental Management Plan takes into account the measures to be applied on the abiotic, biotic and social components that will be impaired or affected by the Rumichaca - Pasto road project Pedregal- Catambuco section, and in each of those environments requiring action programs for applicable prevention, mitigation, correction or compensation measures.

Table 11.1.1.1 presents the structure of the Environmental Management Plan that will apply for proper management of the abiotic environment during project implementation.

Table 11.1.1. 1: Structure of the Environmental Management Plan for the Project's Abiotic Environment

COMPONENT	PROGRAM	CODE	
ABIOTIC	SOIL RESOURCE MANAGEMENT	MRS-1	Handling and disposal of debris and excavation material
		MRS-2	Management of slopes and embankments
		MRS-3	Management and erosion control
		MRS-4	Material handling and construction equipment
		MRS-5	Domestic, industrial and hazardous waste management
		MRS-6	Handling and use of explosives
		MRS-7	Fuel handling and storage
	WATER RESOURCE MANAGEMENT	MRH-1	Handling diversions
		MRH-2	Handling water body crossings
		MRH-3	Runoff management
		MRH-4	Groundwater management

COMPONENT	PROGRAM	CODE	
		MRH-5	Management of household and industrial liquid waste
	MANAGEMENT AIR QUALITY	MRA-1	Management and control of noise sources
		MRA-2	Management and emission control in asphalt plants
		MRA-3	Management and emission control concrete plant
		MRA-4	Management and emission control crushing plant
		MRA-5	Management and control of emission sources
	LANDSCAPE MANAGEMENT	MP-1	Landscape management
	MANAGEMENT SAFETY AND HEALTH AT WORK	MSST-1	Management Safety and Health at Work
	SIGNALING MANAGEMENT	MS-1	Signage management

Follows development of these programs and charts management which can be adjusted according to specific conditions encountered during execution of the project, a situation that would be justified and reported immediately or in specific Environmental Compliance Reports, prior analysis and approval of the Environmental Supervision of the project.

- ***Soil resources management programs***

Table 11.1.1. 2: Management and disposal of debris and excavation material (ZODME)

ABIOTIC ENVIRONMENT							
MRS-1	**Management and disposal of debris and excavation materials (ZODME)**						
OBJECTIVE							
To control, prevent and mitigate impacts caused by handling, storage and disposal of surplus excavation materials activities that may affect soil and water resources, altering the visual landscape characteristics and air quality.							
GOAL							
Disposal of 100% of project's debris and surplus excavation materials in authorized ZODME during construction activities. Perform 100% shaping activities of each ZODME to ensure their stability. Ensure landscape, geomorphological and environmental recovery once all disposal tasks are concluded at all sites used for disposal of surplus excavated material.							
ENVIRONMENTAL EVALUATION							
Activity		**Impact**					
Debris and excavation materials management areas (ZODME) Excavations Top soil removal and stripping		- Mass removal processes - Slope Stability - Changes in soil structure - Modification of current land use - Landscape changes - Changes in the physicochemical conditions of surface waters. - Obstruction or alteration of riverbeds, banks and riparian corridors					
STAGES TO BE IMPLEMENTED							
PREOPERATIONS				**OPERATION AND MAINTENANCE**			
Pre-CONSTRUCTION		**CONSTRUCTION**	**x**	**Operation and maintenance**		**Dismantlement and abandonment**	

TYPE OF MEASUREMENT			
Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

1. Preliminary Environmental Management of disposal of debris and excavation materials Management Zones (ZODME)

The disposal of debris and excavation materials Management Zones (ZODME) can be understood as the geographical areas suitable for disposal of surplus materials from the Rumichaca - Pasto road project, Pedregal – Catambuco section, forming new deposits with such materials. Disposal, shaping and handling statements will address the specific actions and procedures of a legal, technical, social and environmental nature so that the impact on the different environmental components is minimal and assimilable, according to the descriptions, evaluations and other information contained in this EIA.

Surplus materials from excavation and demolition activities will be mobilized and deposited only in authorized sites thereto by the environmental authority and property owner, in addition, such places will be previously endorsed by the local authority in accordance with local planning as well as the environmental authority in accordance with the environmental license and sustainable solution of project needs.

Permission and approval of property owner will be managed by minutes or contract reflecting the details of the agreement reached with builder and / or Concessionary. Documents legally supporting ownership of the land on behalf of project Concessionary or Constructor can also support the land authorization.

Socio-environmental management of each ZODME will address the particular protection and proper management needs of conditions and constraints encountered in the environment of each zone, so there is no deterioration or unforeseen impacts on water resources, geospheric, biotic, economic, social or the landscape.

ZODMES areas were selected taking into account morphological ground conditions, strategic location in relation to the project, technical, social and environmental aspects seeking to generate the least possible environment impact.

The following tables shows ZODMES information to be used for UF4 and UF5.

General ZODME UF-4information

Identification	Location		Side of the road	Area (M2)	Capacity (M3)
	Abscissa	Sector			
Z4-1	K 0 + 000	Pilcuan	Right	20.473	311.253
Z4-2	K 0 + 400	Pilcuan	Right	3,950	5954
Z4-3	K 2 + 000	Pedregal	Right	13,321	29.415
Z4-4	K 5 + 200	Under Inantas	Left	62.865	757.346
Z4-5	K 5 + 200	Under Inantas	Left	36.798	694.854
Z4-6	K 8 + 600	Cocha Verde	Right	135.188	737.886
Z4-7	K 10 + 400	Obraje San Pedro	Right	116.241	1221882
Z4-8	K 12 + 680	Tangua	L Right aw	29,570	216.794
Z4-9	K 14 + 560	El Vergel	Right	45.619	465.186
ZR4-1	K 2 + 100	Pedregal	Right	11,419	52.164
ZR4-2	K 8 + 600	Cocha Verde	Right	36.771	93.158

General ZODME UF-5.1information

Identification	Location		Side of the road	Area (M2)	Capacity (M3)
	Abscissa	Sector			
Z5-1A	K 17 + 200	Chávez	Right	32.986	200.622
Z5-1B	K 17 + 350	Chávez	Right	24.445	76.935
Z5-2	K 17 + 600	Chávez	Left	23.363	140.646
Z5-3	K 18 + 900	Barley field	Left	330.045	3246017
Z5-4	K 19 + 300	Barley field	Left	6,117	9,400
Z5-5	K 19 + 600	Barley field	Left	19.732	127.177
Z5-6	K 20 + 900	Chávez	Right	38.056	181.432

Z5-6B	K 22 + 800	The drum	Left	13287.6	216,000
Z5-7	K 24 + 500	El Paramo	Left	9,983	32.345
Z5-8	K 25 + 000	El Paramo	Left	120.099	815.711
Z5-9	K 26 + 280	Marqueza Alto	Left	110.293	229.773
Z5-10	K 26 + 900	Marqueza Alto	Left	5,826	14,368
Z5-10 B	K28 + 400	palisade	Right	19132.14	75944.6
Z5-10C	K29 + 000	Vocational	Left	31800.2	69189.8
Z5-11	K 30 + 730	Vocational	Right	20.702	19,575
Z5-12	K 30 + 780	Vocational	Right	27.670	133.001
Z5-13	K 31 + 600	The mercy	Right	100.722	813.426
ZR5-1	20 + 100	Barley field	Left	51.561	537.224
ZR5-2	20 + 520	Barley field	Left	71.110	794.203
ZR5-3	22 + 450	The drum	Left	43.640	425.701
ZR5-4	30 + 950	The mercy	Law	42.817	509.423
ZR5-5	31 + 840	The mercy	Left	7,202	25.759

2. Initial ZODME management

Before disposing of the debris, materials such as doors, windows, sanitary ware, tables, etc. are removed. The owners will be allowed to remove and recover useful materials by signing minutes; such materials that remain mixed with the debris going to the ZODME will be collected and sold to recycling companies having the respective permits.

Before the disposal activity of excavation materials and / or debris at each site, ensure there is an agreement with land owners or occupants and thereafter confirm that the deposit design is finished including environmental management, social and technical measures according to the needs and characteristics of each ZODME.

3. ZODME Studies and designs

The scope of ZODME studies and designs includes all activities aimed at defining the technical feasibility of the sites, design parameters and geotechnical recommendations for building these sites.

The following activities were conducted for execution of the study, among others:

- Compilation of information available referring to previous studies in neighboring sites.
- Visit sites where all aspects that have a direct and indirect incidence in the project were identified, neighboring construction properties were identified and characteristics such as: topography, slopes, surface soil moisture, presence of outcrops, evidence of erosion and / or formation of gullies, drainage, vegetation were analyzed among others.
- Analysis of geological and geomorphological characterization of the sites.
- Running percussion boring with sample recovery.
- Laboratory testing of soil mechanics to define the properties of materials.
- Geotechnical stability analysis of slopes projected for ZODME embankments construction.
- A report including recommendations for construction of the ZODME and analysis report.
- Prepare site plans required for the construction of the ZODME.

The geotechnical examination is considered sufficient for the design and construction of the ZODME; however, during construction of the project different conditions may be encountered, which were not detected at the time of the study.

For the above reason, it is important that to have a Geotechnical Engineer review during construction of the ZODME if the hypothesis of the study correspond to those found in the field.

Follows the measures for proper ZODME management as proposed to the Project:

- **Land negotiation for construction of ZODMEs and their management**

Before starting the construction of the ZODME, to ensure that land negotiation provided thereto is accomplished and notarized by the Concession.

- **Reuse of excavation materials**

Materials from the excavation with good characteristics for use in the road construction of the will be selected and arranged in road sections requiring landfills. Suitable geotechnical materials will be disposed of in work sites that require them. Where possible there will be no temporary disposal sites, because double handling of these elements could degrade the material.

ZODME area characteristics

The concession considered low slope areas with clean pastures vegetal cover insofar as possible, sites with good geotechnical stability characteristics without disrupting permanent drains and maintaining the regulatory 30m for riverbeds and 100 m for fountainheads, being far enough from water bodies to ensure that at no time the high water level exceeds the lowest level of the materials placed in the deposit.

Confining disposed of materials

The materials disposed of in ZODMEs are arranged in homogeneous layers which will configure a perimeter trapezoidal profile to ensure good stability conditions and preventing the material from being entrained by runoff action, in accordance with the designs described annexed to this environmental study.

Management of slopes

In this case the formation of the ZODME with slopes 2.0H:1.0V or higher is proposed according to the study and detailed designs presented as an annex to this environmental study.

4. General construction methods for the ZODME

Before the disposal activity of excavation materials and / or debris at each site, ensure there is an agreement with the land owners or occupants and thereafter confirm that the deposit design is finished including environmental management, social and technical measures according to the needs and characteristics of each ZODME.

During the implementation process of sequential filling the following activities will be carried out:

_ Conditioning (improvement) of accesses to facilitate the equipment operation
_ Cleaning of shrubs and herbaceous
_ Top soil removal
_ Construction of filters, drains and embankments
_ Laying and compaction of material by layers
- Incorporation of organic soil

5. Material transport

- Materials will be transported in appropriate vehicle intended for that purpose, avoiding exceeding load capacity and avoiding maximum spillage material on the roads.

- Transported cargo will be covered with resistant materials to prevent generating particulate material and with applicable management measures in accordance with resolution 541 of 1994 of the Ministry of Environment and other applicable regulations.
- The dump trucks must be in good condition without cracks letting transported material out. The load must be protected with canvas or tarpaulins properly secured with hooks.
- Excess material should be transported and disposed of at the landfill authorized by the environmental authority.

6. Management inside the ZODME:

- An area inside the ZODME will be selected and delimited for temporary storage of the waste produced by personnel working in the ZODME. This site should be isolated from the area where there are personnel and must be covered to prevent generating polluted runoff and insofar as possible isolated from natural soil for easy cleaning.

7. Storage:

- There is a temporary storage site for excavation waste for reuse; which will be delimited with security tape in two rows supported by uprights with excavation materials covered with high density polyethylene.
- The material will be suitably stacked to remain confined to avoid contaminating the soil and runoff water.
- When there is a need to stack the debris in the area of direct influence of the work front, it will be collected for no longer than 3 days, making sure not to use green areas and ensuring vehicular and pedestrian flow is not curtailed at any time.
- Affected areas not impaired by the project will be recovered once excavation activities and total volume of debris is removed.

8. Grassing and revegetation

After the ZODME is configured, grassing and revegetation is planned with herbaceous species. Low areas surrounding the ZODME will also be grassed; this action is essential so the vegetation can protect the land from raindrops, remove excess moisture and help confine the soil. Photograph 11-.

Photograph 11-1 View of a grassed slope

Source: Team M & M

Regarding grassing of flat areas or low slope, for sites where the organic stripping material is insufficient, only one layer of organic soil will be applied, hoping that the grass germinates for natural regeneration; seeds can also be used, depending on soil characteristics.

For runoff control, provide conducting perimeter channels to collect runoff, correctly leading them to natural drainage sources or road discharges.

9. ZODME closure and final delivery

Once the ZODME is formed it will be delivery to the owner via minutes of closure specifying compliance with previously established agreements.
Sheet MRV-1 Slope protection presents detailed activities for this measure.

10. Other considerations

- Solid waste generated at work fronts may not be disposed of in the ZODME; management will be in accordance with the measures referred to sheet (domestic, solid, industrial, special and dangerous waste management).
- Use of personal protective equipment is mandatory for all personnel working and inspecting these areas.

ZODMES designs, capacity, access and measures to be implemented in each case are detailed in Section 3.2.5 Handling and disposal of excess excavation and construction and demolition materials and feasibility level Chapter 3.

IMPLEMENTATION SITE

Management measures of this program will be implemented in the areas of disposal of debris and excavation material areas (ZODME) which are located in the functional units of the project.

PERSONNEL REQUIRED

- Civil engineer specialized in Geo-technique
- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Head of section / Resident / supervisor / work inspector
- Social professional
- Environmental group

EXECUTION RESPONSIBLE

Concesionaria Vial Unión del Sur S.A.S

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
Disposal of 100% of surplus non-reusable excavation material in the authorized ZODMEs	(Volume of non-reusable disposed of material in authorized ZODME / volume of non-reusable items) * 100	100%	Monthly	- Disposed of record - Photographic record - Monthly report - ZODME permit
Perform 100% of the shaping activities for each ZODME, to ensure their stability	(ZODME number used by the project / number of ZODME shaped and stabilized * 100	100%	Monthly	- Photographic record - Monthly report - Check list
Control dump trucks transporting materials to the ZODMEs	(No. of dump trucks exceeding load capacity / No. Of inspected dump trucks) x 100	100%	Monthly	Inspection Program Inspection forms Photographic records

Implementation Schedule

STAGE	Time (years)																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Costs related to the handling and disposal of debris and excavation materials in selected and approved sites (ZODME), including the lease of the premises, the site survey, studies and analysis of soils to establish soil load capacity, studies and geotechnical works, stability and handling run-off and final grassing of operated sites are included in the total project budget and other costs of this environmental management plan.

Table 11.1.1. 3: Management slopes and embankments

ABIOTIC ENVIRONMENT							
MRS-2	**Management of slopes and embankments**						
OBJECTIVE							
To avoid or mitigate erosion, landslides and instability in cut and fill slopes during the construction phase of the road.							
GOAL							
To properly conform 100% of slopes created or affected by project activities.							
ENVIRONMENTAL EVALUATION							
Activity				**Impact**			
• Condition existing road and access roads • Installation and operation of camps • Installation and operation of process plants • Vegetal cover and top soil removal; • Demolition • Debris and excavation material Operation Management Zone (ZODME) • Excavations and / or earthworks • Debris and excavation material operation management zones • Construction of hydraulic works and works of art • Foundations and piloting • Construction of superstructure for viaducts and bridges.				- Generate and / or activate landslide phenomena - Activate erosional processes - Changes in soil structure - Modify current land use - Modify landscape			
STAGES TO BE IMPLEMENTED							
Pre-operation				**OPERATION AND MAINTENANCE**			
Pre- operation	**X**	**Construction**	**X**	**Operation and maintenance**		**Dismantlement and abandonment**	
TYPE OF MEASURES							

Prevention	X	Correction	X
Mitigation	X	Compensation	
ACTIONS TO BE TAKEN			

Then measures for handling cut slopes of the road with heights greater than 10 m high, unstable sites identified along the corridor of the road to be intervened or affecting the existing road, slope cuts in functional units 4 and 5, where areas susceptible to moderate, high and very high landslides were identified as well as sites with landfills and embankments in very steep areas.

1. **Top soil removal and stripping**

Top soil removal and stripping are required for road construction, taking into account the guidelines specified in the Management Sheet removal of vegetation cover and stripping of this Environmental Management Plan.

2. **Shaping cut slopes and embankments**

Cut slopes are made based on road geo-technique, counteracting factors that compromise the stability of the final cut. Protection and erosion control works on slopes must be carried out where required.

Restrictions: No embankment shaping activities will be performed under rainy conditions, since these conditions create soil erosion and runoff.

Ground conditions in the area of the project present a medium - high level risk of landslides phenomena, however, in the event of a landslide the following actions will be taken:

- Immediate removal of landslide materials without harming existing works.
- When originating or reactivating geotechnical instability processes, the necessary works will be built to restore ground stability.

3. **Stabilization of cut slope and landfill**

To manage slopes, the nature and homogeneity of constituent materials must be considered, which are essential to raise and define the problem of stability of a slope in any of its many aspects.

During characterization of the environmental baseline the following unstable sites were identified, which must receive a stability evaluation; in the event a likelihood of failure is identified, the appropriate geotechnical measures must be taken:

Sectors with likelihood of instability

CODE	STAKING	OBSERVATIONS	GEOLOGY
1	K0 + 130 to k0 + 155	Colluvial deposit from slip affecting banking on the current road	Qc unit, blocks and angular edges andesite in clayey matrix.
2	K0 + 540 to K0 + 740	Accumulation of debris at the foot of the slide.	Colluvial product from slip affecting unit NQlp comprising Lavas, breccias and Pyroclasts
3	K0 + 820 to K0 + 960	Accumulation of rubble and debris flows marks by landslides on the road.	Qc colluvial deposits, affecting the geological unit NQlp
4	K2 + 780 to K2 + 920	Debris flows with rockslides in the canyon of the Magdalena valley.	Colluvial deposit from slip affecting unit NQlp comprising lavas, breccias and pyroclastic
5	K2 + 950 to K2 + 990	Debris flows with rockslides in the canyon of the Magdalena creek	Qc colluvial deposit from slip in fault zone of the Magdalena creek
6	K3 + 000 to K3 + 100	Ash and tuff slide, debris flows with rockfalls. Fault zone of the Magdalena creek.	Colluvial deposit from slip affecting unit NQlp comprising lavas, breccias and pyroclastic.
7	K3 + 220 to K3 + 360	Geotechnical instability area in ash and volcanic breccia, debris flows with rockfalls, deep drainage grooves.	Colluvium deposit affecting unit NQlp comprising ash and breccias.
8	K3 + 490 to K3 + 540	Colluvium matrix supported with angular fragments of intrusive volcanic rocks.	Colluvial deposit in Qc unit affecting NQlp, mainly volcanic breccias.
9	K3 + 770 to K3 + 850	Slips in ash and volcanic breccia, debris flows with rockfalls.	Colluvium deposits from flow washouts in NQlp unit composed of ash and breccias.
10	K4 + 470 to K4 + 520	Geotechnical instability zone in the lower part of the road layout, exacerbated by hollowing by fluvial action.	Qc colluvium deposit affecting NQlp unit composed by breccias and pyroclastic.
11	K5 + 100	Sliding corona in the lower road layout. Debris flows with rockfalls.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
12	K5 + 190 TO K5 + 250	Slip in breccias with blocks of varying size. Debris flows with rockfalls affecting the road.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
13	K6 + 400 to K6 + 440	Slip in breccias with blocks of varying size affecting the upper road layout.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
14	K6 + 800 to K6 + 950	Slip in breccias with blocks of varying size affecting the upper road layout.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.

15	K8 + 300	Slip in breccias with blocks of varying size affecting the upper road layout.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
16	K11 + 580 to K11 + 680	Slip in breccias with blocks of different size, affecting the toll zone.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
17	K11 + 760 to K11 + 960	Slip in breccias with blocks of different size, affecting the toll zone.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
18	K12 + 410 to K12 + 470	Slip in breccias with blocks of different size, affecting road embankment.	Colluvial deposit Qc affects NQlp, volcanic breccia unit.
19	K14 + 670 to K14 + 700	Slip in breccias with blocks of different size, affecting road embankment.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
20	K15 + 730 to K15 + 770	Zone instability from crown slip near the road embankment.	Qc colluvial deposit affecting NQlp unit, volcanic breccia..
21	K16 + 160 to K16 + 290	Slip scar affecting road embankment.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
22	K22 + 660 to K22 + 720	Zone of instability from waterlogging affecting volcanic ash.	Qc colluvial deposit affecting NQlp unit, volcanic breccia.
2. 3	K24 + 060 to K24 + 150	Slip affecting road embankment.	Qc colluvial deposit affects NQlp, volcanic material unit.

4. Stability analysis and slope stability works

To ensure the stability of the slopes, recommendations described in Volume V - Stability Study and slope stabilization must be followed as prepared by INGETEC (2016) for this project. In addition, on a permanent basis geotechnical and stability studies must carry out and the necessary measures must be taken so the slopes are geotechnically stable, according to the geotechnical study.

Special attention must be paid to the following slopes in Functional Unit 4, establishing the following management measures and geotechnical controls:

Rock reinforcement areas UF4

ABSCISSA		FAILURE MECHANISM	DIP PLANE (°)	CUT INCLINATION	REINFORCEMENT		COMMENTS
INITIAL	FINAL				L (m)	YE)	

K1 + 120	K1 + 660	Planar Overturned	61 83	0.45H: 1V	5.5	2.8	In the first two terraces
K6 + 720	K6 + 900	Planar	51	0.5H: 1V	8.0-12.0 16.0	2.3 3.0	Bolts in the first 30m Anchor tendons from 30m
K12 + 285	K12 + 340	Planar	51	0.5H: 1V	6.0	1.5	In the first 10m
K15 + 650	K15 + 770	Overturning	83	0.7H: 1V	6.0	1.5	In the first 10m

Source. INGETEC, 2016

Cutting and slope protection recommendations

SECTION		INCLINATION (°)	HEIGHT BETWEEN SHOULDERS (m)	BERM WIDTH (m)
START	FINAL			
K0 + 000	K0 + 500	0.45H: 1V	20	3
K0 + 500	K0 + 890	0.75H: 1V	20	3
K0 + 890	K2 + 200	0.45H: 1V	20	3
K2 + 200	K3 + 090	0.50H: 1V	20	3
K3 + 090	K3 + 860	0.7H: 1V	20	3
K3 + 860	K4 + 150	0.6H: 1V	20	3
K4 + 150	K12 + 610	0.50H: 1V	20	3
K12 + 610	K12 + 830	0.75H: 1V	20	3
K12 + 830	K15 + 660	0.6H: 1V	20	3
K15 + 660	K15 + 750	0.7H: 1V	20	3

Source. INGETEC, 2016

In areas where cut stability is determined by the presence of the water level and areas with cut sectors exceeding 40m, install 12 m long horizontal drains. Abscissae delimiting these areas are shown in the following table:

Areas with horizontal drains

ABSCISSA	
START	END
K1 + 120	K1 + 750
K5 + 500	K5 + 740

K7 + 080	K7 + 240
K12 + 285	K12 + 340
K12 + 610	K12 + 830
K13 + 670	K13 + 780
K15 + 650	K15 + 750

Source. INGETEC, 2016

To achieve this goal, studies and detailed design of construction of stabilization works with walls in gabions, crowning ditches, culverts, among others, designed based on specific and punctual geotechnical studies are considered.

5. Runoff control works

Among the management of slopes works and major geotechnical stability taken into account are waterworks where new slopes are generated, so that runoff does not adversely affect the stability of the slope. The aforesaid taking into account management measures of (MRH-3 Operation runoff) sheet.

6. Compaction of material

Once the cut and fill slopes are shaped, necessary engineering techniques will be applied so component materials are compacted with no water or wind erosion.

7. Management of sediment and erosion control

To verify that the following actions set out in the Program Management and Erosion Control of this Environmental Management Plan are met.

CONSIDERATIONS

Execution of Rumichaca - Pasto road project Pedregal - Catambuco section works consider executing earthworks, excavation and embankments to give rise to new road conditions as specified by the geometric design of the road. This involves establishing measures to ensure the stability of the slopes in cuts and fills of the road corridor, as well as the ZODMEs, process plant areas, camps and other sectors associated with project execution.

- The timing of applying environmental management measures on slopes will depend on the technical engineering process and of a preventive, mitigating or corrective nature applicable in each execution. Actions are directly related to the purposes of stabilizing and draining of the engineering program. Factors influencing specific measures to be applied on project slopes are, among others: typography of

the work (cutting, embankment, etc.), type of materials that make up the slope, climatic conditions of the work period, excavation or construction technology, pre-defined slope design (slope and height) and socio-environmental guidelines previously raised.

- A first tool to determine risk levels and take preventive actions against the behavior of cuts, fills and other works is the geotechnical zoning contained in the EIA.
- Determinations and actions for specific management of each slope must consider weather conditions and other external factors.

RESTRICTIONS

Restriction 1: Embankment shaping activities must not be carried out under rainy conditions or under unforeseen runoffs on intervened land, since the processes of erosion and instability of materials under these conditions are accelerated resulting in a high risk of landslides.

Restriction 2: Take into account the local conditions of medium to high risk against the occurrence of rockfalls and landslides in general; so before starting slopes shaping work by cut or filling, engineering, environmental management and safety measures should be taken, ensuring safe working conditions for personnel, community and the environment.

IMPLEMENTATION SITE

The activities identified in this project will be implemented in embankments slopes and cut areas.

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Head of section / Resident / Supervisor / Work inspector
- Environmental team

RESPONSIBLE FOR EXECUTION

The Concesionaria Vial Unión del Sur S.A.S will be responsible for execution and performance of this program.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	FCOMPLIANCE	FREQUENCY	RECORD

(Number of cut slopes shaped with stabilization works for the implementation of the Project / Number of slopes identified to stabilize) * 100	Excellent = 90-100% Good = 75 - 89% Fair = 50 -74% Poor> 50%	100%	Biannual	- Photographic record - Semiannual Report

Implementation Schedule

STAGE	Time (years)																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	2.3	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

The costs of the works and actions to ensure geotechnical stability of slopes cuts and embankments in the areas involved in the project, including drainage works suitable for controlling runoff, and application of bioengineering techniques are part of the total project costs.

Table 11.1.1. 4: Management and erosion control

ABIOTIC ENVIRONMENT	
MRS-3	**Management and erosion control**
OBJECTIVE	
To avoid or mitigate erosion processes and minor instability in slope cuts and fill during the construction phase of the road.	
GOAL	
To have a stable corridor and with proper management and control of erosive foci, thus fulfilling actions to mitigate the risk of instability phenomena.	
ENVIRONMENTAL EVALUATION	

Activity	Impact
• Installation and operation of camps • Top soil removal and stripping • Removal of forest cover • Excavations and / or earthworks • debris and excavation material operation management zones • Construction of hydraulic works and artworks • Foundations and piloting Construction of superstructure for viaducts and bridges.	- Mass removal processes - Erosive generation processes

STAGES TO BE IMPLEMENTED							
PRE-OPERATION				OPERATION AND MAINTENANCE			
Pre-construction		Construction	x	Operation and maintenance	X	Dismantlement and abandonment	

TYPE OF MEASURES			
Prevention	X	Correction	X
Mitigation	X	Compensation	

ACTIONS TO BE TAKEN

1. Previous activities

During stripping activities, the threat and vulnerability of slopes exposed must be reduced therefore the soil should be preferable and immediately removed after removing the topsoil, thus avoiding prolonged exposure to the erosive action of rain and wind.

In the event of evidence of erosive phenomena generation or activation or mass removal movements, remedial works will be constructed or measures to prevent the escalation of these processes and the recovery of the affected area will be applied.

This must be complemented with construction works for proper management of surface and subsurface waters and containment structures, in order to protect the slopes at those sites where there are water outcrops or where runoff can cause concentrated erosion to facilitate retention of sediments and auto fill of gullies.

The main erosive phenomena identified in the project area are identified: only treatments proposed for each cut slopes:

2. Identification of exposed sites

These are events related to surface erosive phenomena and breakout of cuttings, which are obvious give the slopes of the existing road and if not timely controlled, can turn into major landslides and concentrated erosion events, affecting construction and operation of the road.

Eerosive phenomena in existing cut slope

LOCATION	DESCRIPTION
K0 + 090	Detritus breakout / erosion
K0 + 250	Erosion
K0 + 912	Detritus breakout / erosion
K1 + 005	Detritus breakout / erosion
K1 + 100	Detritus breakout / erosion
K1 + 690	Erosion
K1 + 800	Erosion
K2 + 600	Detritus breakout / erosion
K2 + 800	Detritus breakout
K2 + 960	Erosion
K3 + 040	Erosion
K3 + 100	Erosion
K3 + 720	Detritus breakout
K4 + 086	Detritus breakout / erosion
K4 + 365	Erosion
K4 + 400	Erosion
K4 + 505	Detritus breakout / erosion
K4 + 720	Detritus breakout / erosion
K4 + 890	Detritus breakout / erosion
K4 + 924	Detritus breakout / erosion
K5 + 000	Detritus breakout / erosion
K5 + 180	Detritus breakout / erosion
K5 + 200	Detritus breakout / erosion
K5 + 292	Guillies
K5 + 502	Erosion
K5 + 671	Erosion
K5 + 800	Erosion

K5 + 890	Detritus breakout / erosion
K5 + 950	Detritus breakout / erosion
K6 + 000	Detritus breakout / erosion
K6 + 220	Erosion
	Detritus breakout / erosion
	Erosion
	Detritus breakout / erosion
	Detritus breakout / erosion
	Erosion
	Erosion
	Erosion
K10 + 497	Detritus breakout / erosion
K10 + 815	Detritus breakout / erosion
K11 + 100	Detritus breakout / erosion
K11 + 368	Erosion
K11 + 640	Erosion
K11 + 860	Detritus breakout / erosion
K12 + 200	Detritus breakout / erosion
K12 + 320	Erosion
K12 + 780	Detritus breakout / erosion
K12 + 980	Detritus breakout / erosion
K13 + 574	Detritus breakout / erosion
K14 + 292	Detritus breakout / erosion
K15 + 120	Detachment detritus / erosion
K15 + 470	Detachment detritus / erosion
K15 + 500	Detritus breakout / erosion
K15 + 300	Detritus breakout / erosion

Source: INGETEC, 2016

3. Proposed protection measures

Based on above table recognizing erosional processes, and taking into account the susceptibility of the land to this type of phenomena, it is necessary to protect the embankments of functional units 4 and 5 with biomantles. In areas with slopes of greater height materials with heterogeneous granulometry and with evidence of falling material from erosion, a geotextile reinforced with a steel mesh is foreseen to ensure the permanence of the biomantle and the substrate on slopes higher than 20m, as indicated in the following tables:

Geotechnical protection by type of erosion

AREAS WITH STEEL MESH REINFORCED GEOTEXTIL PROTECTION		PROTECTED AREAS GEOMEMBRANE	
Abscissa		Abscissa	
K1 + 000	K1 + 150	K0 + 210	K0 + 500
K1 + 440	K1 + 750	K0 + 880	K1 + 000
K2 + 350	K2 + 750	K1 + 150	K1 + 440
K3 + 140	K3 + 165	K1 + 750	K1 + 900
K3 + 450	K3 + 560	K3 + 165	K3 + 190
K3 + 900	K3 + 950	K3 + 560	K3 + 775
K5 + 370	K5 + 450	K3 + 880	K3 + 900
K5 + 500	K5 + 740	K3 + 950	K4 + 040
K7 + 120	K7 + 200	K4 + 085	K4 + 210
K7 + 810	K7 + 870	K4 + 410	K4 + 550
K12 + 170	K12 + 285	K5 + 080	K5 + 370
K12 + 610	K12 + 830	K5 + 450	K5 + 500
K13 + 670	K13 + 780	K5 + 740	K5 + 980
		K7 + 060	K7 + 120
		K7 + 200	K7 + 240
		K7 + 345	K7 + 410
		K7 + 870	K7 + 905
		K7 + 985	K8 + 110
		K9 + 235	K9 + 335
		K9 + 225 *	K9 + 280 *
		K10 + 390	K10 + 450
		K10 + 580	K10 + 610
		K10 + 625	K10 + 650
		K12 + 620 *	K12 + 890 *
		K12 + 830	K12 + 950
		K12 + 970	K13 + 005
		K13 + 505	K13 + 675
		K13 + 790	K13 + 830
		K13 + 890	K13 + 950
		K14 + 070	K14 + 210
		K14 + 740	K15 + 410
		K15 + 560	K15 + 750

* Embankments on the right hand road

Source: INGETEC, 2016.

As to erosion control on existing road, a Geotextile with Mesh is foreseen as shown in the following table:

Erosion control points and rehabilitation section of existing road.

ABSCISSA		OBSERVATION
Start	End	
PR46 + 100	PR46 + 130	According to this analysis, implementation of a geotextile mesh is recommended in order to control and prevent erosion in shown points
K3 + 200	K3 + 350	
K4 + 780	K4 + 970	
K6 + 000	K6 + 100	
K6 + 370	K6 + 390	
PR51 + 735	PR51 + 775	
PR52 + 375	PR52 + 435	
PR53 + 180	PR53 + 230	
PR53 + 330	PR53 + 390	
K11 + 100	K11 + 120	
K11 + 550	K11 + 600	
K11 + 870	K11 + 900	
K12 + 720	K12 + 760	
K12 + 810	K12 + 830	

Source: INGETEC, 2016

4. Runoff control works

Construction of culverts, box culvert, drains and discharges is considered in order to properly handle runoff and prevent destabilization of the slopes along the road. Additionally, at the base of the cut sites a gutter that collects the waters of the slope is foreseen leading to nearby sewers that collect water and lead to a discharge.

IMPLEMENTATION SITE

Activities identified in this project are implemented in area slopes and embankments cutting with evidence of surface erosion phenomena and those identified in the preconstruction phase.

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST

- Head of section / Resident / supervisor / inspector work
- environmental group

RESPONSIBLE FOR COMPLETION

Concesionaria Vial Unión del Sur S.A.S will be responsible for the execution and performance of this program.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	FULFILLMENT	FREQUENCY	REGISTRY
(Number of slopes cut protection works operated with no / Slope identified to stabilize) * 100	Excellent = 90-100% Good = 75 - 89% Fair = 50 -74% Poor> 50%	100%	Biannual	- Photographic record - Semiannual Report
(Number of sites built control works runoff / N ° of sites requiring runoff control works) * 100				

Implementation Schedule

STAGE	Time (years)																													
	1	2	3	4	5	6	7	8	9	10	eleven	12	13	14	fifteen	16	17	18	19	twenty	twenty-one	22	2.3	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

The costs of the works and actions to ensure geotechnical stability of cut slopes and embankments in project areas, including drainage works suitable for controlling runoff and implementation of bioengineering techniques, are part of the total project costs.

Table 11.1.1. 5: Material and construction equipment management

ABIOTIC ENVIRONMENT							
MRS-4	**Material and construction equipment management**						
OBJECTIVE							
- To establish environmental management measures for building materials so they are implemented to prevent or minimize the deteriorating environmental conditions in the area. - Define actions for environmental management of the use of construction equipment at the worksite and temporary stockpiling yards.							
GOAL							
- Meet 100% of the required measures for handling building materials - 100% implementation of measures for the management of equipment and machinery. - 100% of the areas used for the installation of camps and gathering areas, must be dismantled, recovered and delivered.							
ENVIRONMENTAL EVALUATION							
Activity				**Impact**			
Top soil removal and stripping				- Mass removal processes - Generate erosional processes - Landscape modification - Changes in soil structure - Modification of the current land use - Change in air quality - Change in sound pressure levels			
Excavations							
Operating machinery							
Construction of superstructures and bridges							
Debris and materials management area (ZODME)							
Top soil removal and stripping							
STAGES TO BE IMPLEMENTED							
PRE-OPERATION				**OPERATION AND MAINTENANCE**			
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							

Prevention	X	Correction	X
Mitigation	X	Compensation	

ACTIONS TO BE TAKEN

1. Material management

The materials required for the execution of construction activities will be drawn from existing sources of material in the region having their respective mining title and environmental permit. Should the Concessionaire need to obtain its own source of materials, to request the respective permits and temporary extraction authorizations.

The following aspects are taken into account regarding management of materials:

Transportation:

- Vehicles transporting materials will comply with the regulations set out in the Management and Disposal of Surplus Excavation Materials Program and in accordance with the provisions of Resolution 541 of 1994.
- Before transporting materials, appropriate roads and accesses to transport construction materials were identified, which will be informed to dump truck drivers establishing management measures and special traffic signaling devices required.

Storage:

- The material stored in stockpiling centers or work fronts must be arranged so as to not cause alterations to traffic flow or surface runoff.
- Control particulate emissions to the atmosphere as a result of exposure of new surfaces to the action of wind and rain; therefore, the formation of these materials should the smallest exposure surfaces, as with conical or pyramidal piles.
- In the event of extended storage (over 24 hours), the deposits must be covered with tarpaulins, canvas, plastic or other materials to prevent particles emissions to the atmosphere.
- Another action aimed at minimizing particulate emissions is to avoid unnecessary movement of materials except for transfer to the construction sites or to reshape deposits.

Management:

Personnel handling building materials must always use their assigned personal protection equipment according to the position, which includes hard hat, disposable dust mask, gloves, goggles or mono goggles with ventilation and safety boots.

Concrete works management

Workers belonging to the concrete crew will be trained to handle cement and other measures listed below.

- The work front there will have the material required for the work day. Cement used to make concrete mixes should be stored in dry places and isolated from the soil. The condition of stored material will be permanently verified to prevent its expiration.
- The cement that remains at the work front must be covered and organized in stacks of no more than one meter high or in silos for applicable activities. The stockpiling area must remain clearly marked.
- There will be metal trays to prepare concrete mixtures, which are placed on plastic to avoid soil contamination. The preparation site will remain properly delimited and demarcated with vertical delineators and safety tape.
- In the event of an accidental cement spill, the material will be gathered including contaminated soil and disposed of in the authorized areas – ZODME. This waste must not be disposed of in slopes or areas near the road corridor.

The work area will be cleaned at the end day by gathering materials and other work surplus elements. Waste will be temporarily gathered and then moved to the final disposal site. It is forbidden to wash equipment and machinery in the work sites. Personnel designated to handle equipment should use personal protective equipment -PPE- required for this activity.

Handling of asphalt mixes

- During the development of the activity, waste asphalt will be collected once the daily activity is completed; it must not be left in temporary work sites because the rain could entrain this material into water bodies, contaminating and affecting water wildlife. In the event of an accidental cement spill, the material will be gathered including contaminated soil and disposed of in the authorized areas – ZODME. This waste must not be disposed of in slopes or areas near the road corridor.
- In case of rejection of asphalt mixes, the material will be disposed of in authorized sites or in land accesses near the road after consultation with the owners of the premises.
- Primer and / or ruteadoras equipment will be used for joint sealing and / or tack activities.

2. Equipment and machinery management

There will be certified operators in each equipment and machinery participating in the different tasks: Among the main operators: crane operator, heavy equipment (backhoe, bulldozer) welder, high pressure truck operator, etc. Each operator will be highly experienced.

- Routine maintenance inspection will be conducted by visual and operating checks. This inspection will be conducted daily by the machine operator in order to detect component faults or deterioration so the machinery, equipment and vehicles will work properly.
- Preventive maintenance: This service is due approximately every 250 accumulated work hours. This maintenance is performed preferably in authorized sites for this purpose; work site maintenance will take place in a site authorized by the environmental Professional, site that will be cordoned off with appropriate signs considering the following:
    - Oil, filters and hoses must be regularly changed using geo textile protection.
    - Maintenance will be done y certified and licensed personnel.
    - Maintenance will be done far from fuel or flammable substances stockpiling areas.
    - Waste from these activities will be collected and delivered to authorized companies.
- Maintenance equipment must include i) adequate engine combustion; ii) adjustment of mechanical components; iii) tire alignment and balancing.
- Decree 2222/93 Min. Mines, Decree 948/95 must be complied with regarding equipment, machinery, tools.
- Vehicle operators shall comply with traffic rules and signs to avoid conflicts with authorities and especially traffic accidents.
- Vehicles will have the safety equipment regulated by the National Transportation Code, full road equipment (tools, first aid kit, fire extinguisher, spare tire) at all times, without exception.
- Technical-mechanical inspection certificates of vehicles will be maintained. They must also have SOAT and driving license.
- The maximum travel speed allowed front of the work site is 20 Km / h.
- Car washing in front of the work site, near bodies of water, roads surrounding public space as established by Law 769 of 2002 of the Ministry of Transport is prohibited.
- Dump trucks transporting materials to the work site and to disposal areas should keep their volco level and covered with a tarp.
- A machinery and equipment mobilization route must be designed on roads interfering the least with normal population activities and work site drivers must abide thereby.
- Lubricants used to fuel lighters, torches, etc., objects forbidden by the air resource protection legislation are prohibited.

- Machinery batteries must be replaced by an authorized workshop. Batteries changed at the work site will be temporarily stored in safe places and isolated to prevent contaminating other elements with battery acid. They are subsequently sent to companies recycling such materials

Maintenance of machinery and vehicles used

Both machinery and dump trucks working construction materials must be in perfect mechanical condition. The equipment should be regularly serviced to reduce air emissions from combustion engines, following provisions of the Management and control of sources of emissions and noise Sheet. In addition, maintenance will emphasize avoiding mechanical failures causing fuel and lubricant spills to the natural environment.

Moving Machinery

Machinery will be moved in a low bed that complies with the technical and safety specifications required for machinery transport in accordance with national regulations.

Low bed and escorts will have light signs on top of the roof and in perfect working order to warn other vehicles of danger. The follow recommendations must also be followed:

- Check the condition of access ramps to the lower bed.
- Wedges or wooden skids are placed on loaded machine to guarantee its stability in the low bed.
- A load larger than 2.6 m (width) and less than 3.6 m wide will require two (2) escort vehicles traveling in front and in back of the low bed.
- Machinery traveling on a low bed must be accompanied by escorts vehicles.
- At the time of loading and unloading machinery, no person shall remain in the vehicle or on the pallet.
- Forward and reverse signaling vehicles will be used as a long load danger, danger wide load and others, as warranted.

10 PM limits per construction supplies

Pollutant	Contaminant flow (kg / h)	Allowed emission standards of pollutants (mg / m3)
Particulate material (PM)	≤ 0.5	250
	> 0.5	150

3. Runoff and oily water management

Runoff water management

Temporary storage areas and required machine shop areas will have management and runoff control works as gutters, gathering channels and discharges with energy dissipators in order to prevent water accumulation, erosion and silting. Collected runoff will be routed to natural channels so as to not generate erosion.

Oily water management

In the case of machinery maintenance workshops, the perimeter thereof will be defined and an oily water raceway will be built to the grease trap, as shown in the liquid waste management sheet for disposal by third party duly certified in this type of waste.

Discharge of surplus industrial or construction liquids, such as paints, solvents, concrete admixtures, adhesives, resins and generally any product whose quality or composition necessarily is toxic and harmful to the environment is not allowed. This waste should be stored in drums or cans with lids for reuse or recycling.

IMPLEMENTATION SITE

Project intervention areas and associated infrastructure

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Head of section / Resident / supervisor / inspector work
- Environmental team
- Civil engineer
- Machinists

RESPONSIBLE FOR THE EXECUTION

Concesionaria Vial Unión del Sur S.A.S

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	REGISTRY
Meet 100% of required measures for handling of	(Management measures implemented in the handling of construction	100%	biannual	- Photographic record - Check list

building materials	materials / management measures required * 100			
100% implementation of measures for equipment and machinery handling	(Number of maintenance on machinery / number of scheduled maintenance) * 100	100%	biannual	- Maintenance records

EXECUTION SCHEDULE

STAGE	Time (years)																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21e	22	2.3	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Twenty-two million one hundred eighty-five thousand pesos ($ 22,185,000 COL).

ACTIONS TO BE TAKEN	REQUIREMENT	UNITS	UNIT COST	TOTAL COST
Cover materials with plastic	Canvas or shade meshes mts	150	$ 9,900	$ 1,485,000
Insulating implements (pallets)	Leak-proof pallets	fifteen	$ 780,000	$ 11,700,000
Using leak-proof kit	Leak-proof kit	10	$ 300,000	$ 3,000,000
Stockpiling centers of roofing materials		2	$ 3,000,000	$ 6,000,000
TOTAL				$ 22,185,000

Table 11.1.1. 6: Management of domestic, industrial special and hazardous solid waste.

ABIOTIC ENVIRONMENT

MRS-5	Management of domestic, industrial special and hazardous solid waste

OBJECTIVE

Establish necessary management measures for proper management of domestic, industrial, special and hazardous solid waste generated from all Project activities.

GOAL

- Manage and properly dispose of 100% of domestic solid waste generated by the project
- Manage and properly dispose of 100% of the special solid waste generated by the project
- Manage and properly dispose of 100% of the hazardous solid waste generated by the project
- Deliver 100% of the waste generated by the project to authorized companies

ENVIRONMENTAL EVALUATION

Activity	Impact
Installation and operation of temporary infrastructure	Generation of hazardous solid and common waste
Installation and operation of residential camps	
Installation and operation of process plants (asphalt, concrete, crushing)	
Excavations	
Debris and excavation material management areas	
Base, subbase and paving	
Construction of superstructures for bridges and viaducts	
Paving structures	
Dismantling of temporary facilities	
Final cleaning of work sites	
Cleaning and maintenance of culverts and artworks	
Recovery of the asphalt layer	

STAGES TO BE IMPLEMENTED

PRE-OPERATION				OPERATION MAINTENANCE			
Pre-Construction	X	Construction	X	Operation and maintenance		Dismantlement and abandonment	X

TYPE OF MEASUREMENT

Prevention	**X**	**Correction**	
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

Management of domestic, industrial, special and hazardous solid waste is holistically considered for the different resources that may be affected by Project related activities.

1. **Waste identification**

- Organic Solid Waste

Organic waste will be taken to a nearby sanitary landfill licensed as the Antanas sanitary landfill of the municipality of Pasto, which has licensed by CORPONARIÑO or other authorized third party with the appropriate authorization for this activity.

- Recyclable Solid Waste will be recycled at the source using properly color identified bins, which will have their gray bag (materials such as paper, cardboard, newspaper and the like), blue (plastic materials such as polypropylene, polyethylene, bags, bottles).

Ecological waste points will be installed at strategic locations in the camp areas, work sites, asphalt plants, prefabricated and crushed.

- Residual waste

Non-recyclable waste will be stored in green-colored bags and bins adequately covered and marked for later disposal by the cleaning and gathering utilities company.

- Special and Hazardous Waste

Wastes considered hazardous or special should be stored in metal 55 gallons cans or red bags depending on the condition of the waste and its source. This waste must be properly sealed during storage and removed from areas of activities to prevent spills, as well as containment barriers and proper signs according to regulations specifying the type of health and environmental hazard.

Waste must be labeled for delivery with basic information allowing authorities or the transport and final disposal company to fully identify the waste and amount generated.

Waste will be delivered to companies with the necessary operational environmental permits and must issue the disposal certificate of waste collected.

Classification of solid waste

The following table shows the solid waste classification according to the Environmental Technical Guide - GTA 40.

Solid Waste Classification

TYPE	CLASSIFICATION	EXAMPLE	MANAGMENT
NONHAZARDOUS	USABLE	File papers, kraft, cardboard, newspaper. Foldable, cardboard and glass. Plastic: cans, bags, glasses, PET. Metals Tetra pack	Recycling reuse
	NOT USABLE	Tissue paper: Toilet, napkins, hand towels, diapers. Waxed and foil paper Ceramics Swept material Cigarette butts Polystyrene	Final disposal
	BIODEGRADABLE ORGANIC	Food waste Vegetal material	Composting Vermiculture
HAZARDOUS		WEEE Batteries Chemical products Medicines Used oils Biological	Treatment Incineration Safety cell disposal
SPECIAL		Debris Tires Mattresses Furniture Shelves	Special collection service

		Muds	

Source: Adapted from the GTA-24

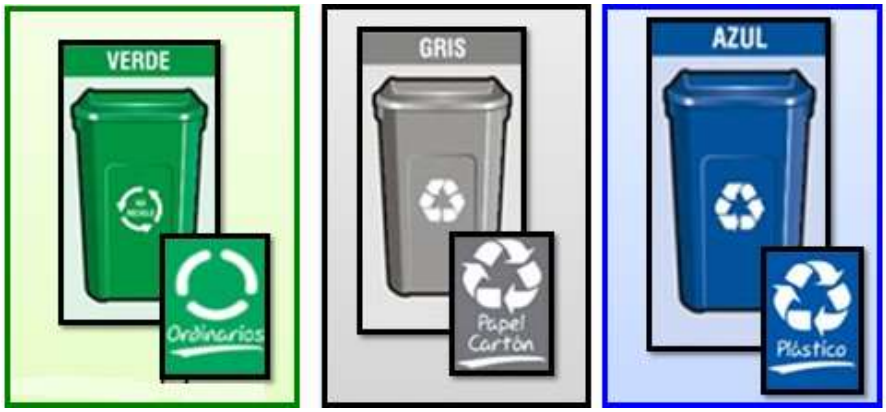
2. Separation at the source and Temporary Storage

- Separation at the source

Solid waste separation at the source uses bins and bags of the same color, properly identified. Several waste separation stations are placed at strategic sites in the work front, camps, asphalt plants, crushing concrete plants, all regularly collected by collecting companies in the region contracted for waste recycling.

Temporary storage sites called "eco points" will be conditioned where the contractor has established collection routes.

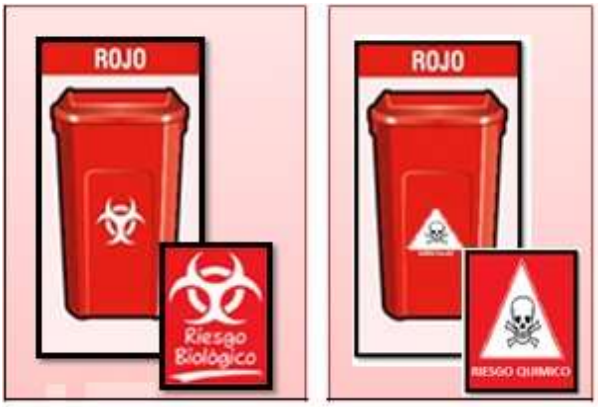
Follows the color scheme to be used for the separation of waste at the source:



Organic biodegradable substances (food scraps, vegetable waste). Non-recyclable material	Recyclable Material Paper, cardboard	Plastic Polypropylene, polyethylene, bags, bottles and glass

Source: Adapted from the GTC-24

Hazardous waste must contract storage services if applicable and use, recovery, treatment or disposal companies with environmental licenses. permits or authorizations.



Source: Adapted from the GTC-24

- Temporary storage

Industrial camps will use temporary storage to gather solid waste in the ecological points of each work front. The storage structure must be built on concrete floor, covered and closed to prevent the ingress of animals and rodents. The design of the structure must be suitable for the production of solid waste.

- Transport

Solid waste will be transported from the work fronts to industrial camps where the temporary storage is; this activity should be performed in compliance with transport regulations and in compliance with the code of transit for cargo and special waste transportation in the event this type of waste is generated in the work fronts.

Waste must be prepared and stored in bins located in waste collection centers located in camps for initial collection. These containers must be properly labeled indicating the type of waste and security measures to be considered.

- Final disposal

Final disposal takes into account the classification of solid waste and selection made by the Concessionaire regarding final disposal; the third party must have the necessary environmental operating permits.

- Organic waste: delivered to a company with an environmental license for management and disposal of this waste.
- Non-usable waste: must be disposed of on land that is licensed for handling, treatment and disposal thereof.
- Usable waste: will be delivered to a recycling company duly incorporated in the area.
- Hazardous and special waste: will be delivered to a company with an environmental license for the handling and disposal of such waste.

IMPLEMENTATION SITE

Its implementation is on all fronts construction, industrial camps, concrete plants, asphalt and crushed.

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Head of section / Resident / supervisor / inspector work
- Environmental Crew

RESPONSIBLE FOR EXECUTION

The Concesionaria Vial Unión del Sur S.A.S will be responsible for the execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	ECORD
100% use of recyclable waste	(Kg Recyclable Waste delivered to recycling companies or (weight) / kg of recyclable waste generated) x 100	100%	Bimonthly	Record or certificate of delivery of waste for disposal
100% adequate disposal of domestic solid waste produced	(Kg solid domestic waste delivered to authorized / Kg Companies of domestic solid waste generated) x 100	100%	Bimonthly	Registration or certificate of delivery of waste for disposal
100% proper disposal of special solid waste	(Kg Special Waste delivered to authorized companies for final disposal (weight) / kg	100%	Bimonthly	Record or certificate of delivery of waste for disposal

	of hazardous waste generated) x100			
100% proper disposal of hazardous solid waste	(Kg of hazardous waste delivered to authorized companies for final disposal (Peso) / kg of hazardous waste generated) x100	100%	Bimonthly	Record or certificate of delivery of waste for disposal
100% proper disposal of special liquid waste	(Gallons Special Liquid Waste delivered to authorized companies for final disposal/ Gallons of special liquid waste generated) x100	100%	Bimonthly	Record or certificate of delivery of waste for disposal
100% proper disposal of hazardous liquid waste	(Gallons of hazardous liquid waste delivered to authorized companies for final disposal/ gallons of liquid hazardous waste generated) x100	100%	Bimonthly	Record or certificate of delivery of waste for disposal

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	2.3	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Twenty-one million two hundred pesos ($ 21,200,000 COP).

ACTIONS TO BE TAKEN	REQUEST	UNITS	UNIT COST	TOTAL COST
Ecopoints	Ecological point	10	$ 350,000	$ 3,500,000
Waste collection centers		4	$ 2,500,000	$ 10,000,000
Using leak-proof kit	Leak-proof kit	4	$ 300,000	$ 1,200,000

	Tags		400	$ 5,000	$ 2,000,000
	Storage bins	55 gallons – Reusable	0	-	-
	Final disposition	Ton	30	$ 150000	$ 4,500,000
	TOTAL				$ 21,200,000

Table 11.1.1. 7 Explosives management program

ABIOTIC ENVIRONMENT							
MRS-6	**Explosives management program**						
OBJECTIVE							
Establish measures for safe storage, transport and use of explosives on the Rumichaca - Pasto dual carriageway road project.							
GOAL							
Apply 100% of proposed measures to manage each powder magazine located in the area of influence of the project. Avoid complaints from the community.							
ENVIRONMENTAL EVALUATION							
Activity			**Impact**				
Use explosives for cuts, excavations in rocky terrain; demolition and / or construction of superstructures			Change in soil structure Landscape modification Change in sound pressure levels Change in vegetal cover Conflict generation				
STAGES TO BE IMPLEMENTED							
PRE-OPERATIONS				**OPERATION AND MAINTENANCE**			
Ppre-construction		**construction**	**x**	**Operation and maintenance**		**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**		**Correction**		**X**		
Mitigation	**X**		**Compensation**				
ACTIONS TO BE TAKEN							
Use, storage and transport of explosives requires the respective use permit and possession of these by the Colombian military industry INDUMIL according to provisions of Decree 334 of 2002.							

1. Classify explosives to be used.

These should be in accordance with pro INDUMIL provisions therefore explosives can only be if registered in the registration and control movement book as provided for in the legislation.

The classification shall be according to their application and sequence as follows:

- Primary explosives or primers: whose objective is to initiate the detonation of a mass.
- Secondary or basic explosives: breaker trigger effect

Given that the explosives are chemicals that under normal temperature and pressure conditions are safe, but that by means of an initiator can pass to a gaseous state producing an increase in temperature and pressure therefore special care must be taken when storing and transporting them because primary and secondary explosives cannot be mingled, hence the importance of their proper classification.

2. Transport of explosives

Vehicles carrying explosives must have the following security measures:

- Be in good mechanical and electrical conditions, with the body firmly connected to the chassis and coated inside with rubber or wood, so non-sparking. Otherwise wooden boxes made especially for this purpose, previously authorized by the military forces of Colombia will be used.
- Vehicles must have grounded safety chains to discharge static electricity, and carry fire extinguishers.
- Load distribution in the vehicle will not allow movement in the body.
- The load must be located away from the vehicle engine.
- Explosives must be transported in their original factory packaging, and detonators or other initiators must never be transported with another explosive.
- The maximum load is 80% of the vehicle bearing capacity.
- No other material or tool can be transported.
- Vehicle loaded with explosive will always take the shortest route and with less traffic.
- The speed should not exceed 50 kilometers per hour, avoiding bumps and jolts.
- It is strictly forbidden to transport personnel in the vehicle with explosives.
- The carrier vehicle should have signaling system according to NFPA and a yellow flag.

3. Reception of explosives

The quantity, quality, power, type and size of stored explosives must be controlled. Any anomaly should be immediately rejected informing the responsible who in turn informs the military.

Keep the explosives control book updated and easy to access.

4. Storage of explosives

These should be stored under strict safety rules and regulations in powder magazines (physical storage of explosive places), these sites must be approved and are monitored by the general command of twenty-third military brigade of the national army of Colombia.

Given that the kind of powder magazine to implement will be buried covered with loose soil, a sufficiently strong ceiling ensuring no intersection with any other work or activity.

The surroundings of the powder magazines must remain free of combustible materials in a radius of no less than fifty meters (50 meters).

Regularly inspect fire extinguishers or water sprays located on the outside of the magazine to keep them in good condition.

Verify that the explosives are not damaged and are perfectly clean.

All empty containers must be immediately removed from the powder magazine.

Powder magazine must be fenced to prevent ingress by people, vehicles or animals.

Entering the powder magazine carrying matches, lighters or other igniter, or metallic elements that can create sparks is forbidden.

Personnel unrelated to the powder magazine cannot enter unless authorized by the respective responsible.

The powder magazine must have perfect ventilation and easy handling of the explosives.

Explosives in poor conditions should not be stored.

Access to the magazine must be marked by red flags.

5. Management of damaged or expired explosives

Destruction of explosives according to their nature shall be made using any of the following preliminary procedures prior report to the military forces of Colombia:

- Frozen, exudate, decomposed due to loss of the stabilizer, or for any other reason dangerously increasing their sensitivity must be destroyed.
- Due to combustion
- Due to explosion or provoked and controlled denotation
- Delivered to the Twenty-Third Brigade

6. Handling and use of explosives

The use of explosives is closely linked with earthwork activities, such as cuts and excavations where explosives are required mainly for earthmoving, taking steps to minimize flying fragments.

The design should be related to the geological structure of the site.

Check that there are no outsiders or animals in the demolition site in a radius that guarantees that most of the explosive charge to control will not affect them.

If there are housing units nearby, tell the occupants to open their windows.

By introducing the combustion wick in the detonator avoid any friction with fulminant substance.

Reviewing the calculations for explosive charges, so as to ensure that the exact amount will be used.

Before ordering the firing of the charges, verify that all service is in place and knows the firing order.

Having defined the need for explosives, all work front personnel will be informed on the blasting schedule no less than two days in advance, this schedule should indicate the hours and access bans to the site.

IMPLEMENTATION SITE
Rumichaca Pasto dual carriageway road project area of influence
PERSONNEL REQUIRED

- Social professional
- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Head of section / Resident / supervisor / work inspector
- Machinists

RESPONSIBLE FOR EXECUTION

Concesionaria Vial Unión del Sur S.A.S

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
Apply 100% of proposed measures for handling each powder magazine located in the area of influence of the project.	Industrial accidents by improper handling of explosives / total labor accidents occurred	100%	Quarterly	Accident record
	Complaints and claims by the community for handling and / or storage of explosives / total claims and complaints filed	100%	Quarterly	Record of complaints and claims filed

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														

	DISMANTLING AND ABANDONMENT																											

COSTS
Costs related to the explosives are part of the construction costs of the project.

Table 11.1.1. 8 Storage and use of fuels program

ABIOTIC ENVIRONMENT							
MRS-7	**Management and fuel storage program**						
OBJECTIVE							
Formulate environmental management measures to provide, dispose of and control the use of fuels that must be carefully handled, stored and used.							
GOAL							
Avoid adding fuel to drainage systems, soil in the area of influence of the project.							
ENVIRONMENTAL EVALUATION							
Activity	**Impact**						
Installation and operation of process plants	Change in soil structure Change in physicochemical composition of groundwater Change in the physicochemical characteristics of surface water Freshwater habitat alteration						
Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles.							
Operation and maintenance of machinery and / or equipment							
STAGES TO BE IMPLEMENTED							
PRE-OPERATION				**OPERATION AND MAINTENANCE**			
Pre-construction		**Construction**	x	**Operation and maintenance**	x	**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**	**Correction**	**X**				
Mitigation	**X**	**Compensation**					
ACTIONS TO BE TAKEN							
Before starting the construction phase, the fuel supplier authorized by the Ministry of Mines and Energy, whose certificate must be available in the camp.							

Any changes in supplier must be reported in the Environmental Compliance Report.

A record on fuel consumption, type of machinery or vehicles filled, fuel filling authorization by the administrative area must be kept.

A report must be prepared in the event of a spill and an anti-spill kit must be used.
Prepare a report on fuel supply and maintenance of vehicles and machinery, also indicating the number of oil spills, place, day.

Fueling supply in production centers should be transported in tank cars meeting with provisions of Decree 1609 of 2002 from the Ministry of Transport and Decree 1521 of 1998 from the Ministry of Mines and Energy and ICONTEC NTC 1692

1. Fueling

- Park the vehicle (car tank) where it does not interfere, and in quick exit position in case of emergency.
- Ensure there is of a multipurpose fire extinguisher near the fuel supply, at a distance of no less than 3m.
- Check that there are no ignition sources (burning cigarettes, flames, asphalt heaters, welding, etc.) around the supply site.
- Verify correct hose coupling in order to avoid dripping or fuel leakage.
- The operator must be located where filling positions can be seen and in quick access pump position.
- The operator must wear his/her personal protective equipment assigned to the activity

Avoid storing large amounts of fuel and try to have easy handling amounts.

Fuel surplus must be stored and delivered to companies specialized in disposal of hazardous waste.

Storage tanks when being emptied or already empty must be delivered to special waste management companies who must have due environmental permits.

When there are accidental fuel spills on the ground, the operator must notify the controller or the person in charge from the Builder on the contingency and the incident address with the spill kit and contaminated waste will be handled as special according to the solid waste management sheet.

2. Signage

Material Safety Data Sheet of the stored product must be visibly placed indicating precautions with stored fuel.

The storage area must be closed to prevent the entry of personnel other that those authorized for handling and fueling.

IMPLEMENTATION SITE

32 camps located in the area of influence ofg the Rumichaca Pasto dual carriageway road project.

REQUIRED PERSONNEL

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

Concesionaria Vial Unión del Sur S.A.S

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
Avoid pouring fuel to drainage systems, soil in the area of influence in the project.	Industrial accidents from improper handling of fuel / total labor accidents occurred	100%	Quarterly	Record any work accidents
	Fuel generated spills / total spill of contaminants in soil and / or drains	100%	Quarterly	Record any spills

IMPLEMENTATION SCHEDULE

STAGE	Time (years)																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS
Costs related to the explosives are part of the construction costs of the project

- ***Water resource management program***

Table 11.1.1. 9: Water intake management.

ABIOTIC ENVIRONMENT	
MRH-1	**Water intake management**
OBJECTIVE	
Establish management measures to prevent and mitigate water resources impairment during water intake activities for industrial use, aimed at promoting proper use and correct water resource management actions.	
GOAL	
• Control 100% of intake flow for industrial use in approved facility. • Meet 100% of the scheduled maintenance for intake systems • Comply 100% with required water monitoring for each intake point	
ENVIRONMENTAL EVALUATION	
Activity	**Impact**

<table>
<tr><td rowspan="3">

- Installation and operation of process plants
- Excavations.
- Top soil removal and stripping
- Construction of hydraulic works and artworks
- Installation and operation of camps
- Installation and operation of temporary infrastructure

</td><td>Changes in physicochemical and bacteriological characteristics of surface water</td></tr>
<tr><td>Change in transport capacity of water resources.</td></tr>
<tr><td>Change in Water Resource Availability.</td></tr>
</table>

<table>
<tr><th colspan="8">STAGES TO BE IMPLEMENTED</th></tr>
<tr><th colspan="4">PRE.OPERATIONS</th><th colspan="4">OPERATION AND MAINTENANCE</th></tr>
<tr><td>Pre-Construction</td><td>X</td><td>Construction</td><td>X</td><td>Operation and maintenance</td><td></td><td>Dismantlement and abandonment</td><td></td></tr>
<tr><th colspan="8">TYPE OF MEASUREMENT</th></tr>
<tr><td colspan="2">Prevention</td><td>X</td><td colspan="2">Correction</td><td colspan="3"></td></tr>
<tr><td colspan="2">Mitigation</td><td>x</td><td colspan="2">Compensation</td><td colspan="3"></td></tr>
<tr><th colspan="8">ACTIONS TO BE TAKEN</th></tr>
<tr><td colspan="8">The following actions are presented to protect water sources from where water intake will be made to satisfy industrial use needs, to note that the sources to be intervened are those with permit granted by applications obtained in this study as well as proposed intake systems which are described at a feasibility level in chapter 7.

Follows some minimum conditions for proper operation of the intake strip.

• Conditioning and / or construction of roads that will eventually be required for surface water intake. It is suggested to not generate forest impact, seek existing roads and savannah and pastures areas.
• The intake area must be marked to prevent accidents.
• Service the water tank truck, the storage tank and other associated devices in order to prevent accumulation of sediments that can plug the distribution networks.
• Under no circumstances will material from the excavations will be disposed of in the vicinity of drainage works or runoff reaching bodies of water, as the channel may be blocked with sediment or increased turbidity and thus deteriorating populations of aquatic resources. Excavation materials will only be disposed of in authorized sites.</td></tr>
</table>

- Washing machinery and equipment in surface currents in the area of influence of the project not be allowed is not allowed, preventing waste oils and lubricants can reach water bodies; vehicles can only be washed at camp arranged sites or authorized municipal car washes.
- Monitor water intake at the points proposed for water intake for industrial use semiannually and / or when required by the environmental authorities.

Follows the information concerning the intake points of water for industrial use (water source, coordinates, abscissa and source flow)

UF	SOURCE	INTAKE POINT LOCATION	COUNTY	MUNICIPALITY	FLOW
4	Rio Bobo	E: 960614.499 N: 608230.956	Inantas Bajo	Yacuanquer	6200
4	La Magdalena	E: 961207.8592 N: 610757.4195	Inantas Alto	Yacuanquer	55
4	La Chaquita	E: 967138.506 N; 614073.608	Chavez	Tangua	2.2
5	La Magdalena	E: 965266.302 N: 615222.642 E: 965235.384 N: 615213.430	El Cebadal	Tangua	55
5	La Marquesa	E: 968222.919 N: 617028.3	El Tambos	Tangua	5.4

Source (Gemini Consultants SAS)

For each point of proposed supply water a maximum flow of 1.5 L / s intake is expected to meet project requirements.

IMPLEMENTATION SITE

Water intake points in the area of the Rumichaca Pasto dual carriageway road project Pedregal – Catambuco section.

PERSONNEL REQUIRED

- Environmental coordinator
- Safety and Health at Work Professional -SST-
- Environmental resident
- Environmental inspector
- SST inspector

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial Unión Del Sur will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS				
GOAL	**INDICATOR**	**COMPLIANCE**	**FREQUENCY**	**RECORD**
100% control of intake flow in authorized places	(Volume of intake water (L / s) / Total volume of authorized water (L / s)) x 100	100%	Quarterly	- Supervision Reports. - Meter record. - Photographic record
Comply 100% with water monitoring required for each intake point	(Number of executed water monitoring / Number of scheduled water monitoring or required) x 100	100%	Semiannual and / or when required	- Water monitoring report - Photographic record
Meet 100% of scheduled maintenance for intake systems	(Number of maintenance performed / Number of scheduled maintenance) x 100	100%	Monthly	- Maintenance Record - Photographic record

IMPLEMENTATION SCHEDULE

STAGE	Time (years)																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	2.3	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Five hundred and fifty-five million one hundred and seventy-five pesos ($ 555,175,000 COL)

ACTIONS TO BE TAKEN	REQUEST	UNITS	UNIT COST	TOTAL COST

	Improved access				$ -
	Signage				$ -
	Motor pump		7	$ 1,000,000	$ 7,000,000
	Tank truck service day		48	$ 8,000,000	$ 384,000,000
	Line driving Mts		25	$ 7,000	$ 175,000
	Intake structure		5	$ 20,000,000	$ 100,000,000
	Storage tanks		4	$ 15,000,000	$ 60,000,000
	TOTAL				$ 551,175,000

Table 11.1.1. 10: Management of water bodies crossings.

ABIOTIC ENVIRONMENT	
MRH-2	**MANAGEMENT OF WATER BODIES CROSSINGS**
OBJECTIVE	
Minimize the impact caused by the construction of structures for water body crossings.	
GOAL	
- Build 100% of the necessary project structures. - Comply 100% with proposed environmental measures.	
ENVIRONMENTAL EVALUATION	
Activity	**Impact**
- Installation and operation of process plants - Excavations - Top soil removal and stripping - Construction of hydraulic works and artworks - - Installation and operation of camps	Changes in physicochemical and bacteriological characteristics of surface water
	Change in transport capacity of water resources.
	Change in the availability of water resources.
STAGES TO BE IMPLEMENTED	
PRE-OPERATION	**OPERATION AND MAINTENANCE**

Pre-Construction		Construction	X	Operation and maintenance	X	Dismantlement and abandonment	
TYPE OF MEASUREMENT							
Prevention	**X**	**Correction**					
Mitigation	**x**	**Compensation**					

ACTIONS TO BE TAKEN

- **Water resources management**
- Excavation materials from of water body crossing works should be brought to the ZODMEs, if not possible, they will be arranged at a distance of minimum 30 m of water bodies and will not remain there for more than a day to avoid sedimentation to nearby sources.
- Before intervention of river bodies with project hydraulic works, the adjustments, deviations and reconnection of existing water pipes, hoses or derivations must be made according to uses (especially human and domestic consumption).
- Previously inform the community on any contingent cuts or service interruptions, also keep records of minutes on temporary or definitive agreements made regarding the use of water resources.
- In water bodies where the use of water by the community is identified, written notice will be sent to the community, administrative aqueduct county boards AID, on the works to be executed, the estimated time and preventive measures to consider.
- Construction works are recommended during the summer or low rainfall to avoid or minimize the use of temporary structures to channel the water. Install the necessary machinery and equipment in a defined area to avoid interventions compromising the stability and environmental quality of the streams.
- Installing the machinery and equipment necessary in a defined area to avoid interventions to compromise the stability and environmental quality of the streams.
- Subsequently, once construction is completed at the crossing, all kinds of debris or excess material will be removed. These wastes will be disposed of in accordance with provisions of the management plan for management of domestic, industrial, special and hazardous solid waste project.

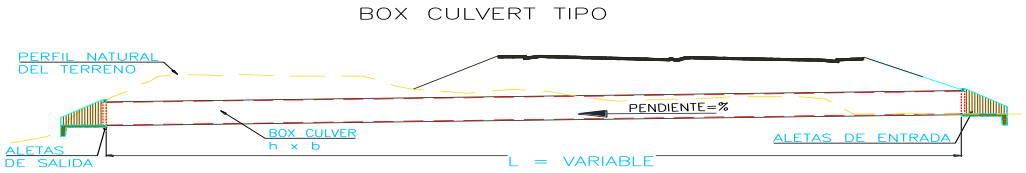
The following hydraulic structures are considered for this section:

- Major works

Work	Temporary	X	Y
Box Culvert	Intermittent	957,047.31	606,812.38
Box Culvert	Intermittent	957,244.83	607,134.24
Box Culvert	Intermittent	966,054.29	613,847.89

Box Culvert	Intermittent	966,463.97	614,224.22
Box Culvert	Permanent	966,316.92	614,532.46
Box Culvert	Permanent	968,211.90	617,051.11
Box Culvert	Permanent	968,401.55	617,052.44
Box Culvert	Permanent	971,538.78	618,399.85
Box Culvert	Permanent	974,562.53	619,262.35

Source: Consorcio SH 2016

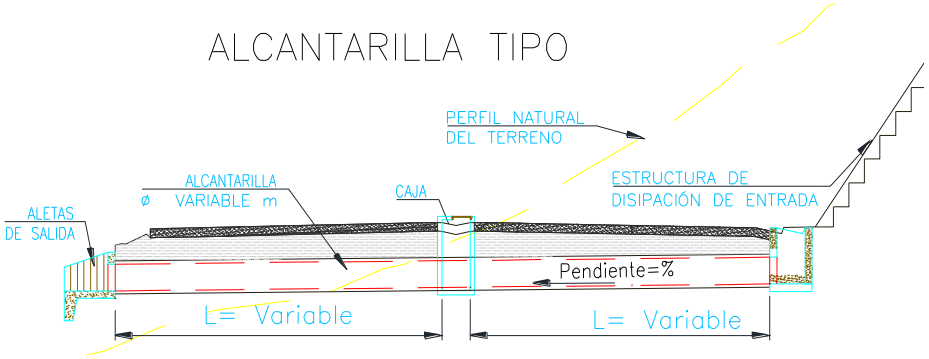


- Minor works

Work	Temporary	X	Y
Sewer	Intermittent	957,422.11	607,418.41
Sewer	Intermittent	957,713.63	607,593.36
Sewer	Intermittent	960,309.21	608,351.84
Sewer	Intermittent	960,799.92	608,696.81
Sewer	Intermittent	961,026.52	609,126.32
Sewer	Intermittent	961,001.70	609,357.53
Sewer	Intermittent	961,917.55	609,388.54
Sewer	Intermittent	961,527.44	609,395.69
Sewer	Intermittent	960,945.11	609,578.11
Sewer	Intermittent	961,376.30	609,685.16
Sewer	Intermittent	961,284.71	609,785.59
Sewer	Intermittent	961,952.73	609,834.95
Sewer	Intermittent	960,965.38	609,864.83
Sewer	Intermittent	961,219.79	609,953.13
Sewer	Intermittent	960,953.94	610,052.01
Sewer	Intermittent	962,055.75	610,314.61

Sewer	Intermittent	962,022.83	610,391.43
Sewer	Intermittent	962,059.50	610,496.19
Sewer	Permanent	963,993.73	612,735.40
Sewer	Intermittent	964,749.07	613,064.25
Sewer	Intermittent	964,901.36	613,116.88
Sewer	Intermittent	965,103.51	613,134.59
Sewer	Intermittent	957,088.00	606,897.65
Sewer	Permanent	966,628.23	613,872.95
Sewer	Permanent	966,804.19	614,104.07
Sewer	Intermittent	965,650.28	614,271.26
Sewer	Intermittent	965,523.92	614,365.54
Sewer	Intermittent	967,757.43	616,132.46
Sewer	Intermittent	967,956.17	616,411.06
Sewer	Intermittent	968,021.64	616,858.83
Sewer	Intermittent	967,963.74	616,866.44
Sewer	Intermittent	971,265.67	618,605.51
Sewer	Intermittent	974,942.99	619,381.41
Sewer	Intermittent	965,071.95	613,086.56

Source: Consorcio SH 2016



- Drains occupation

  Drains will have special management measures such as gabion retaining walls in order to avoid direct contact with drainage and thus affect their physical and chemical characteristics guaranteeing their current condition.

UF	SOURCE NAME	Z	COOR X	COOR Y
4	Unnamed 47	ZR4-2	962,015.46	609,351.57
5	Nameless 48	1A Z5-	966922.095	614183.361
5	Quebrada El Cebadal	Z5-4	965,452.173	614,710.126
5	Quebrada El Cebadal	Z5-5	965,641.521	614,799.297
5	Quebrada El Cebadal	ZR5-1	966,192.508	615,125.672
5	Quebrada El Cebadal	ZR5-2	966,457.206	615,301.222
5	Quebrada El Quelal	Z5- 6	967,153.256	615,406.352
5	Unnamed 49	ZR5- 3	967738.808	616222.181
5	Unnamed	Z5-6B	967940.122	616697.946
5	Quebrada El Establo	Z5-9	970,308.908	618,527.763
5	Quebrada El Establo	Z5-10	970,904.009	618,856.601
5	Quebrada Cubijan	Z5- 13	974,878.476	619,293.950

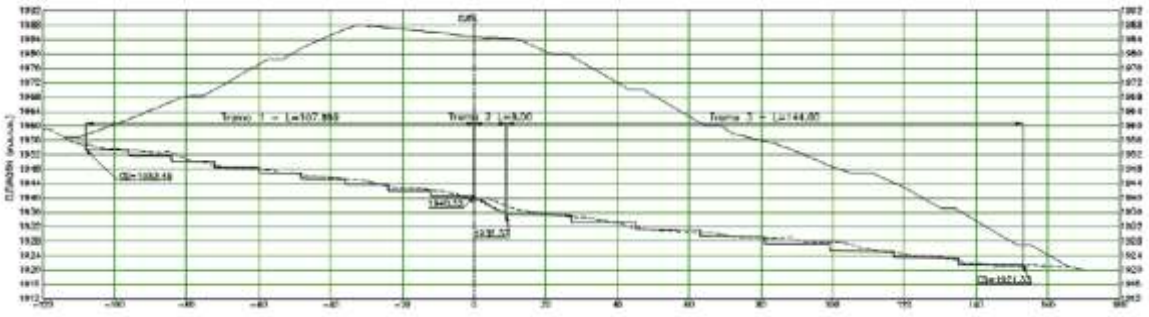
- Special crossings

The road project has two special crossings of great ecological importance which are the Guáitara River and the Magdalena stream. Chapter 3 of this study shows the hydraulic works designs;, on the other hand the monitoring and follow up plan sheet SMRH2 presents everything concerning the biannual water quality monitoring made to these two drains in order to ensure that development of hydraulic works has no impact on hydrological conditions of currently identified sources. To design these works, hydraulic studies made to allow designing maximum and minim flow conditions for different return periods (max 100 years).

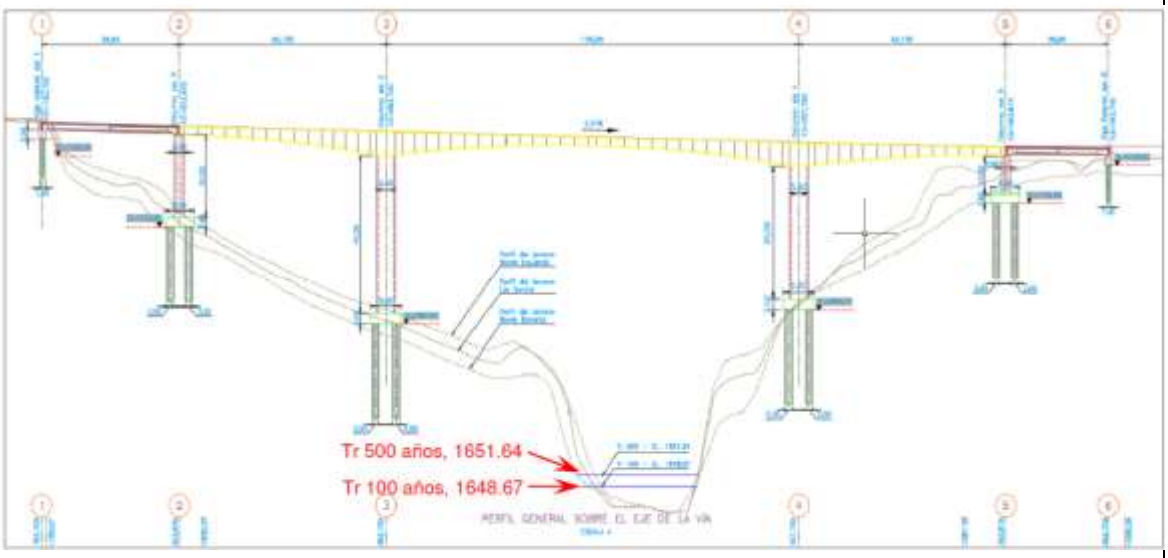
UF	SOURCE NAME	TYPE	TEMPORARY	COOR_X	COOR_Y
4	Rio Guáitara	Bridge and / or Viaduct	Permanent	958736.4812	608557.6715
4	Quebrada Magdalena	box	Permanent	961059.5957	610155.9585

In the case of the Magdalena creek a domed structure designed with three different types of steps or jumps, characterized by two types of flow, two of them were designed with Nappe Flow and an intermediate zone with Skimming Flow is proposed. The methodology described by H. Chanson in his book HYDRAULIC DESIGN OF STEPPED CASCADES, CHANNELS, WEIRS AND SPILLWAYS was used in areas with

nappe flow. The nappe flow is characterized by a subcritical flow and sizing of the length of the step (l), that allows developing the steps, allowing the flow to return to the subcritical condition, and so on down the steps. The following figure shows the profile design for the hydraulic work foreseen in the Magdalena stream.



In respect the bridge over the Guáitara River, batteries are located outside the wetted perimeter of the hydraulic section, so a local scour analysis was not necessary. From the analysis of the return periods between 100 and 500 years it was determined that water levels remain fully channeled, reason why the location of the batteries will not impact the water source directly. The following figure shows the levels of the water layer for the bridge over the Guáitara River:



Protection of drains and water bodies.

- Delimit the area to be intervened by the works on water stream.
- If necessary, install transverse barriers in order to retain sediment and material that can escape from the work, the temporary barriers can be levees with a height allowing the passage of water, burlap barriers or stakes, meshes, among others.
- After returning the stream to its natural course, clean riverbanks and water bodies to prevent silting.
- Drains on riverbanks should be isolated and protected against any possible project intervention. This requires not installing portable toilets within 30 m of runoff patterns and minor surface drains.
- Activities such as stripping and cutting must be developed so that falling material to surface water bodies in case of a fall are promptly removed is minimized.
- Gathering building materials or debris close to drains crossed by the project is not allowed. Materials, equipment, waste, etc. must be stored outside the water corridor.
- Avoid storing material or refuse heap in places where rain water can entrain them.
- Maintenance and cleaning of machinery and equipment used in the works in water bodies or natural soil is prohibited. These activities should be performed in an authorized site.

IMPLEMENTATION SITE

Places where construction works will be performed in water bodies, as specified in Chapter 7 of this study.

REQUIRED PERSONNEL

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health at Work Inspector -SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

La Concesionaria Vial Unión Del Sur will be responsible for the execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD

Build 100% of the necessary project structures	(Number of built structures / number of authorized and planned to build structures) x 100	≥90%	Quarterly	Log designs tracking Photographic Record
100% compliance with proposed environmental measures.	(Environmental measures implemented / proposed environmental measures and / or required) X 100	≥80		Daily reports Supervisor Check list Photographic record

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	16	17	18	19	20	21	22	2.3	24	25	26	27	2	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Forty-seven million six hundred and forty-nine thousand eight hundred pesos ($ 47,609,800 COP).

ACTIONS TO BE TAKEN	REQUIREMENTS	UNITS	UNIT COST	TOTAL COST
Sedimentary barriers	Shade meshes m2	150	$ 9,900	$ 1,485,000
Line reconnection	Global	1	$ 1,000,000	$ 1,000,000
Geotechnical work gabions		8	$ 450,000	$ 3,600,000

	Timber stakes	ml	8	$ 65,600	$ 524,800
	crosswalks		8	$ 2,000,000	$ 16,000,000
	Signage		1	$ 5,000,000	$ 5,000,000
	Sedimentary barriers	Global	100	$ 200,000	$ 20,000,000
	TOTAL				**$ 47,609,800**

Table 11.1.1. 11: Runoff Management

ABIOTIC ENVIRONMENT							
MRH-3	**RUNOFF MANAGEMENT**						
OBJECTIVE							
- Establish the necessary measures to ensure management, treatment and delivery of natural drainage runoff in project infrastructure. - Avoid development of erosive processes, contribution of sediment to natural drainage, contamination and alteration of river dynamics.							
GOAL							
- Perform 100% of the maintenance of the runoff works. - Build 100% of the structures designed to manage runoff.							
ENVIRONMENTAL EVALUATION							
Activity						**Impact**	
Excavations Top soil removal and stripping Installation and operation of residential camps Excavations						Change in transport capacity of water resources. Change in availability of water resources.	
STAGES TO BE IMPLEMENTED							
PRE-OPERATIONS				**OPERATION AND MAINTENANCE**			
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**	**Correction**					
Mitigation	**x**	**Compensation**					
ACTIONS TO BE TAKEN							

Implement additional works to manage rain and runoff management in areas of processes such as roads is essential to prevent generating erosion processes and give a longer life to these works.

Actions will be applied in areas where concentration of runoff flows or ponding of water occur, according to land slopes and surface evidence of erosion in furrows and gullies.

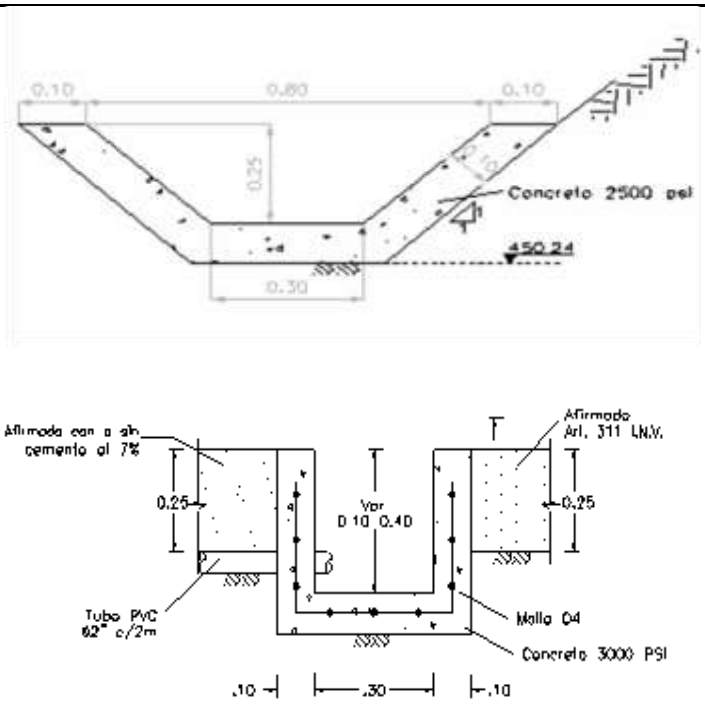
- *Drains and artwork*

To properly handle rainwater, runoff on the road and associated infrastructure, a drainage system must be built to have:

- Pumping: is the cross slope given to the road and associated infrastructure to allow water falling on the surface to flow toward perimeter ditches of supporting and lateral infrastructure of the road. This slope should be between 1 and 3% so that water does not form puddles.

- Curbs: if required inside the location and access road will be built specifically to drive rains and runoff to sewers or water ditches.

- Ditches: to build a cement perimeter system in the location area to intercept and handle runoff water. These ditches should be made in cement and may be triangular, trapezoidal, semicircular or rectangular.



Trapezoidal perimeter ditch
Source: Japan Road Association, 1984 (Japan Road Association, 1984)

- Discharges: they are structures built on concrete or filled sacks with soil-cement mixture to carry rainwater collected to natural drainages preventing these download sites from eroding.

Ditches side ditches will be built on roads to manage rain and runoff water with discharges into natural drains, these discharges will have dissipative structures in cement to prevent erosion of the slopes that overlook the drains.

Works to be built will have perimeter ditches in order to collect runoff water leading to the sedimentation tank, to prevent entrainment of suspended solids and oils or fats to natural sources. Diches, sand traps and sedimentary barriers will be serviced, ensuring that each of these structures fulfill its function (avoid excessive clogging); the filtered sediment will be disposed of in the nearest ZODME.

- Measures to prevent contamination and deterioration of surface water

Under no circumstances will material from the excavations in the vicinity of drainage or runoff reach bodies of water, as they may block the river bed with sediments or increased turbidity thus deteriorating populations of aquatic resources. Excavation materials will only be disposed of in authorized sites.

These actions will be taken into account during recovery of the asphalt pavement layer during the operating phase.

In operation and temporary storage areas, management and runoff control works will be built as crown ditches, ditches, gathering channels and drains with energy dissipaters to prevent the appearance of erosive processes, accumulation of water and silting. Collectors and channels in front of work sites should be covered insofar as possible with physical barriers inhibiting entrainment of solid materials generating pollution; this barrier may be using shade mesh.

Collected runoff to natural channels will be delivered so as to not generate erosion.

IMPLEMENTATION SITE

Works to control drainage and runoff.

REQUIRED PERSONNEL

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial Unión Del Sur will be responsible for the execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
Perform 100% of the runoff maintenance management works	(Number of maintenance / number of scheduled maintenance) * 100	100%	Quarterly	- Log designs tracking - Photographic record

Construction of 100% of the runoff management	(Number of built structures / Number of scheduled structures) x 100			- Maintenance Report

Implementation Schedule

STAGE	Time (years)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
PRE-CONSTRUCTION																									
CONSTRUCTION																									
OPERATION AND MAINTENANCE																									
DISMANTLING AND ABANDONMENT																									

COSTS

Nine hundred and ninety thousand pesos ($ 990,000 COPG).

ACTIONS TO BE TAKEN	REQUIREMENTS	UNITS	UNIT COST	TOTAL COST
Ditches				$ -
Discharges				$ -
Ditch crowns				$ -
Sedimentary barriers	Shade mesh m2	100	$ 9,900	$ 990,000
TOTAL				$ 990,000

Table 11.1.1. 11: Groundwater Management

ABIOTIC ENVIRONMENT	
MRH-4	**Groundwater Management**
OBJECTIVE	
• Establish management measures aimed at protecting identified sources in the corridor. • Avoid affecting or intervention of the corridor of each spring, considering the groundwater flow and the protective spring vegetation.	

- Avoid affecting the quality of spring water.
- Establish a monitoring plan of water springs potentially affected by construction activities.
- Ensure continuity of the flow of water to the source.

GOAL

- Meet all the activities proposed to protect the springs.
- Ensure that the quality of water from the springs is not altered.
- Run the monitors set in the environmental management plan.

ENVIRONMENTAL EVALUATION

Activity	Impact
• Condition the existing and new roads • Installation and operation of camps • Installation and operation of process plants • Removal of vegetal cover and top soil; • Demolition • Excavations and / or earthworks	- Alteration of the water table - Changes in water quality of the aquifer - Modification of vegetation cover

STAGES TO BE IMPLEMENTED

PRE-OPERATION				OPERATION AND MAINTENANCE			
Pre-Construction	**X**	**Construction**	**X**	**Operation and maintenance**		**Dismantlement and abandonment**	

TYPE OF MEASUREMENT

Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE DEVELOPPED

The following environmental management program is aimed at protecting the springs inventoried during the survey of primary EIA information. All inventoried springs are being altered in their physical, chemical and resource availability as a result of improper handling by area residents and proximity to the current road. Even though, follows measures to manage groundwater points:

1. Environmental training

Is addressed to all project personnel without exception. This is a preventive measure performed before starting the activities and subsequently twice a year depending on work progress, and verification of possible springs in intervened area.

Emphasis will be placed on the environmental and social importance of the springs; the following theme is proposed, although the professionals in charge of training may include other issues they consider of interest:

- Basic concept of spring
- Criteria for recognizing a spring site
- Recharge zones and discharge zones
- Importance of vegetation in spring conservation
- Protection of the spring corridors
- Integrated waste management and interaction with the springs
- Environmental regulations

2. Jobsites signage

Prior to excavation and stripping activities, place signs at each groundwater site located less than 100 m of the activities. Each of point should be identified as established in the EIA or the environmental permit.

3. Demarcation and insulation of springs

During the demarcation works of the corridor to be intervened for opening and shaping the right of way, springs located 100 meters on either side of the projected road axis must be located and marked. Wooden or metal fences may be used for signage alluding to the presence of springs.

Springs located downstream or less than 50 meters from the projected axis distance, will be protected by isolating with shade mesh 2 meters high, in order to avoid affecting water quality or protective vegetation, by effects of accidental fall of sediments.

Construction of wooden stake fences is also proposed with four wooden boards 0.30 meters wide, supported on wooden buxom stakes 10 cm in diameter, 2.0 meters high and buried 50 cm; the separation between stakes should be 1.5 meters. These stake fences will initially allow protecting and isolating the spring; and secondly, they prevent material contribution that could eventually affect water quality.

Signaling and isolation of springs and plant repopulation activities must have the consent of the owner (s) of the property where the spring is located. For such end, the social component of the project will participaty by signing a memorandum of agreement.

4. Flow monitoring

Low levels in the springs will be recorded before, during and after construction, to ascertain the behavior of natural upwelling (spring) during project construction.

5. Physicochemical water quality monitoring

Physicochemical water quality of the springs will be monitored and will be reported in the ICA. Physicochemical parameters to be evaluated are: chlorides, conductivity, BOD, surfactant, turbidity, total hydrocarbons, dissolved oxygen, pH, temperature, SST, SDT, fats and oils. Samples will be ad hoc basis.

6. Construction of drainage filters

Within springs located 100 meters on either side of the projected path axis, if presence of underground water flow is detected and to allow the natural course of this underground flow, one draining filter 40 meters long will be installed on the bottom of the ditch. In the ends of the draining filter, the trench must be waterproofed to ensure that the groundwater flow does not flow through the ditch.

7. Vegetable repopulation

In the case of springs located less than 50 meters from projected axis and that are unprotected, vegetal repopulation and isolation activities will be carried out with wooden fences and barbed wire. This activity is optional and should be implemented in agreement with the landowner.

8. Sprigs identified as "new" in the corridor

To always check for the presence of new springs, which will be reported to the ANLA in the compliance reports as well as described protection and preservation measures.

IMPLEMENTATION SITE

The activities outlined in this project will be implemented in areas of embankments and cut slopes.

REQUIRED PERSONNEL
– Coordinator / Resident / Environmental Inspector – Coordinator / Resident / Safety and Health Inspector-SST – Social professional – Head of section / Resident / supervisor / inspector work – Environmental team
RESPONSIBLE FOR COMPLETION
The Concesionaria Vial Unión del Sur S.A.S will be responsible for execution and performance of this program.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
(Number of cut slopes shaped with stabilization works from implementation of the Project / Number of slopes identified to be stabilize) * 100	Excellent = 90-100% Good = 75 - 89% Fair = 50 -74% Poor> 50%	100%	Biannual	- Photographic record - Semiannual Report

Implementation Schedule

STAGE	TIME (years)																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS
The costs of the works and actions to ensure geotechnical stability of cut slopes and embankments in the areas involved in the project, including drainage works suitable for controlling runoff and implementation of bioengineering techniques are part of the total project costs.

Table 11.1.1. 12: Domestic and industrial Liquid Waste Management

ABIOTIC ENVIRONMENT	
MRH-5	**DOMESTIC AND INDUSTRIAL LIQUID WASTE MANAGEMENT**

OBJECTIVE

To control and mitigate the impact generated by domestic and industrial liquid waste, resulting from the different construction activities of the Rumichaca - Pasto dual carriageway road project.

GOAL

- To properly handle 100% of domestic and industrial wastewater
- To meet 100% the legal guidelines for the management, treatment and disposal of liquid waste
- Perform 100% maintenance on treatment units

ENVIRONMENTAL EVALUATION

Activity	Impact
• Installation and operation of camps and process plants	Change in the physicochemical composition of surface water
	Increased demand of water resources

STAGES TO BE IMPLEMENTED

PRE-OPERATION				OPERATION AND MAINTENANCE			
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	

TYPE OF MEASUREMENT

Prevention	**X**	**Correction**	
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

1. Domestic Wastewater Management (ARD)

– Portable Sanitary Units Work Fronts

Portable sanitary units are foreseen in work fronts and / or camps facilities (hiring a service company). Waste water from these units is made directly gathered in the tanks included in portable toilets (with capacities from 50 to 80 gallons).

- ✓ The contractor for this service must have all environmental permits for the installation, operation and maintenance of sanitary portable units, considering that said contractor is responsible for the disposal of waste generated there.
- ✓ The installation of one (1) mobile sanitary unit for every fifteen (15) workers (differentiating gender) is recommended at no more than 60 meters from the worksite.
- ✓ Generally these portable units will be contracted together with a waste gathering system (generally by vacuum suction), for final disposal by the service provider company. The respective environmental licenses for such activity will be verified and operational capacity of the contractor will be considered due to the conditions of project development.

– Residential camps

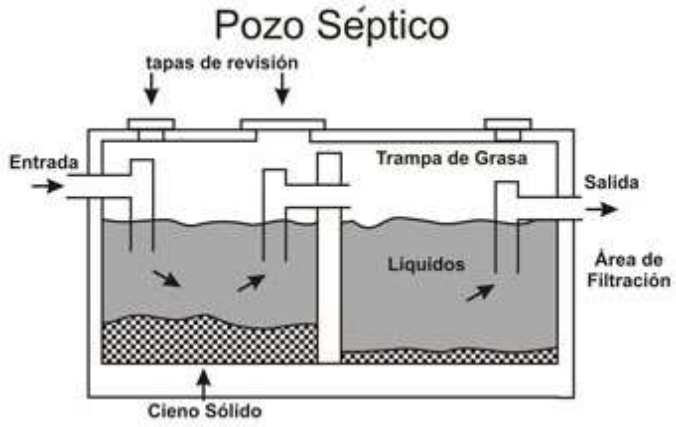
The waters from the camp (showers, sinks, dishwashers, and washing machines), are characterized by suspended materials and vegetable fats. The rate of organic pollution in these waters is less than sanitary or black water. These waters will be led independently to a grease trap whose effluent will join the cesspit with a removal efficiency of 80%, to be arranged in the infiltration field to meet the RAS 2000required standards, which specifies minimum distances of 50 meters from any water body.

- Grease trap

As a first step a grease trap (physical process) for fat retention will be implemented, this is located between the kitchen exit and the workshop oil storage in order to prevent clogging problems, adhesion, and bad odors, among others. For its implementation, the established design parameters will be considered.

- Septic tank

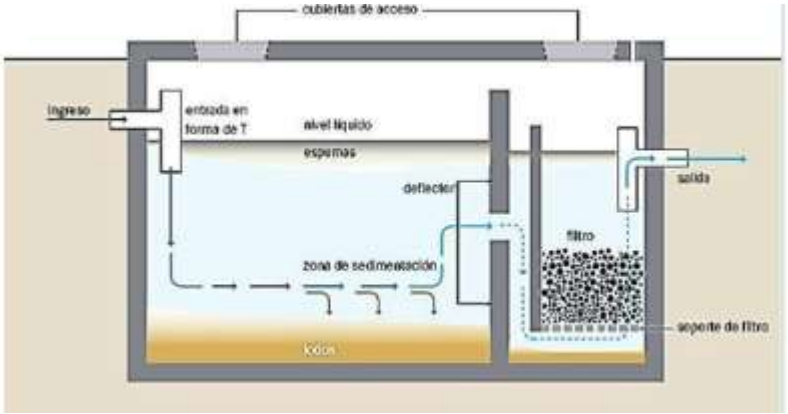
Septic tank function is to receive and decontaminate wastewater product of tasks such as cooking, washing with detergents containing high fat loading and biological waste. When contaminated water enters the tank solid waste go to the bottom, in a process called sedimentation.



Basic operation of septic tank
Source Guide orientation and basic sanitation, 2016

- Up flow anaerobic filter

It is a highly efficient system complementary to slop tank-digestion. It can reduce between 50 to 70% of BOD over previous removal. It consists of a closed tank or chamber, made up by a bed of crushed rock and gravel where the influent from the above treatments passes upwardly through the interstices and biological film formed on the surface of the granular material, performs anaerobic digestion and reduction work.



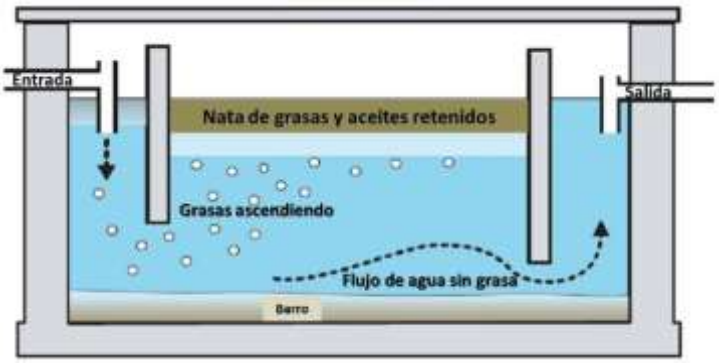
FAFA model system
Source Water Alliance, 2016

2. Industrial Wastewater Management (ARI)

For handling industrial water from transformation processes, maintenance and cleaning of machinery equipment and surfaces of process plants, to have a water collecting system which will be routed through perimeter channels to a processing system for removing dissolved solids (sodium and potassium) and suspended (calcium carbonate), among others. Follows the proposed treatment system:

- Grease trap for oily water

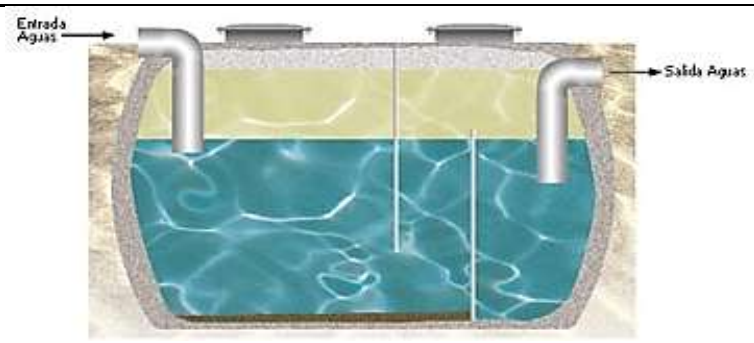
The contribution of fats and oils basically comes from fuel spills and oils used for machinery, fuel storage areas and maintenance shops. The items to be removed, which usually occur in this type of wastewater, comprising free oils and emulsified, phenols, nitrogen and sulfur compounds, from dams for tanks, equipment cleaning, rainwater of drilling sites, multiple areas and machines see. Therefore effective control of these you need to install a grease trap that allows retain these materials, it is clear that the minimization of oils and fats depends on the good behavior of personnel should be trained.



Grease trap operation
Source **Invalid source specified.**

- Desanders and sedimenters

The desander unit is a hydraulic structure whose function is to remove particles of a certain size, so a horizontal flow desandar was established to increase retention time, by achieving longer sedimentation times higher sedimentation of present solids is attained.



Desander tank
Source **Invalid source specified.**

- Sedimentary pit

The pit will be located adjacent to the camp where the water from the treatment and highly clarified with a percentage of 80% removal is considered optimal for recirculation in industrial processes and the wetting roads; should this water smell bad to use odor control products. Generated sludge product of the wastewater treatment will be transported by dump trucks to an authorized ZODME. To note that as with the other proposed systems, these will have follow up and monitor management conditions specified in the management plan, see section 11.1.1 of this study.

- Final disposal

Treated water will be recirculated in industrial processes and wetting of roads, so it is estimated that 95% of the water will be used in these activities and 5% will be poured into surface water sources, this within the concept of zero discharge where water reuse is the best choice to meet the closure of the production cycle.

IMPLEMENTATION SITE
Camping areas, processing plants and work sites where portable toilets are installed Rumichaca Pasto dual carriageway road project Pedregal – Catambuco section
p
• Coordinator / Resident / Environmental Inspector • Coordinator / Resident / Safety and Health Inspector-SST • Social professional • Head of section / Resident / supervisor / inspector work • Environmental team
RESPONSIBLE FOR COMPLETION

The Concesionaria Vial Unión Del Sur will be responsible for execution and performance of this program by its contractors throughout project development.				
FOLLOW UP AND MONITORING INDICATORS				
GOAL	**INDICATOR**	**COMPLIANCE**	**FREQUENCY**	**RECORD**
100% proper dispose of liquid industrial waste	(Volume industrial wastewater discharged / Total volume of discharge water allowed) x 100	100%	Monthly	- Minutes of disposal - Photographic record
Meet 100% the legal guidelines for the handling, treatment and disposal of liquid waste	Number of parameters fulfilled / number of parameters required by the regulations Res 615 of 2015 decree 3930 of 2010	100%	Monthly	- Photographic record - Lab results
100% maintenance of treatment units	Number of maintenance / number of scheduled maintenance	100%	Monthly	Maintenance log - Check list - Photographic record
IMPLEMENTATION SCHEDULE				

STAGE	TIME (years)																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRE-CONSTRUCTION																															
CONSTRUCTION																															
OPERATION AND MAINTENANCE																															
DISMANTLING AND ABANDONMENT																															

COSTS

Eighty-six million eight hundred thousand pesos ($ 86.8 million COP).

ACTIONS TO BE TAKEN	REQUIREMENTS	UNITS	UNIT COST	TOTAL COST
For domestic discharges	Grease trap	4	$ 1,500,000	$ 6,000,000
	Septic tank	4	$ 1,500,000	$ 6,000,000
	FAFA	4	$ 1,200,000	$ 4,800,000
For domestic discharges	Grease trap	4	$ 1,500,000	$ 6,000,000
	Desander tank	4	$ 3,000,000	$ 12,000,000
	Settlement pit	4	$ 2,500,000	$ 10,000,000
Soil Study	Percolation tests	4	$ 10,500,000	$ 42,000,000
TOTAL				**$ 86,800,000**

- ***Air Quality Management Programs***

Table 11.1.1. 13: Management and control of air emission sources

ABIOTIC ENVIRONMENT	
MRA - 1	**Management and control of emission sources**

OBJECTIVE

To establish environmental management measures to reduce and control the emission of pollutants into the atmosphere.

GOAL

100% compliance of established management measures for pollution control.

ENVIRONMENTAL EVALUATION

Activity	Impact
Installation and operation of temporary infrastructure	Change in air quality
Installation and operation of camps	
Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles	
Operating machinery	
Excavations	
Debris and excavation materials management zones ZODME	
Rolling structure	
Vehicle traffic	
Recovery of the asphalt layer	

STAGES TO BE IMPLEMENTED

PRE-OPERATION				OPERATION AND MAINTENANCE			
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	

TYPE OF MEASUREMENT

Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

- **Management of air quality**

Transportation, unloading, storage of materials at work sites.

Measures for mobile sources of emissions:

- Use of light and heavy vehicles in good condition and with current technical and mechanical vehicle certification. Proper maintenance and operation of the vehicles assigned for the works will be required for the entire vehicle fleet, which shall have the respective synchronization and emissions certification.

Submit and comply with a preventive maintenance program for equipment and machinery adjusted to the recommendations and standards of manufacturers, which ensures good mechanical and carburizing condition, in order to generate lower emissions of pollutants and noise to the atmosphere. Maintain a log indicating maintenance activities and their date. Table 11.1.1. 14: Management and control of air emission sources

BIOTIC ENVIRONMENT

- Vehicles must comply with Decree 948/95, Resolution 005/96 and Resolution 909/96 of the Ministry of Environment, Housing and Territorial Development MAVDT, regarding the quality of emissions in idle condition. As well as provisions established in the National Land Traffic Code (Law 769 of 2002).
- Demolished or excavated material remaining in industrial camps must be covered with geotextile to prevent the emission of particulate material and enclose and protect with shade mesh the demolition areas in the road.
- Dump trucks transferring materials to the construction sites and surplus excavation storage areas must have canvas to protect transported material from the wind so that particulate emission is minimized during the trip.

Measures for fixed emission sources:

- Annex 7.6.1 has the application forms for air emissions from emission sources.
- Use control systems in stationary sources such as filters, emissions gauges and other alternatives to reduce the level of emissions to the atmosphere.
- Regularly review the performance of material processing plants as well as control systems in order to assess their performance and determine their efficiency.

Gaseous and particulate emissions from mobile sources (equipment, construction machinery, transportation vehicles)

Submit and comply with a preventive maintenance program for equipment and machinery adjusted to recommendations and standards of manufacturers, which ensures good mechanical and carburizing condition in order to reduce emissions of pollutants and noise to the atmosphere. Maintain a log indicating maintenance activities and their date. Operation of vehicles without a current technical and mechanical review from an authorized diagnosis center is prohibited.

Contaminante No Convencional	Nivel Máximo Permisible ($\mu g/m^3$)	Tiempo de Exposición
Benceno	5	Anual
Plomo y sus compuestos	0,5	Anual
	1,5	24 horas
Cadmio	5×10^{-3}	Anual
Mercurio inorgánico (vapores)	1	Anual
Tolueno	260	1 semana
	1.000	30 minutos
Vanadio	1	24 horas

Contaminante	Nivel Máximo Permisible ($\mu g/m^3$)	Tiempo de Exposición
PST	100	Anual
	300	24 horas
PM10	50	Anual
	100	24 horas
PM2.5	25	Anual
	50	24 horas
SO_2	80	Anual
	250	24 horas
	750	3 horas
NO_2	100	Anual
	150	24 horas
	200	1 hora
O_3	80	8 horas
	120	1 hora
CO	10.000	8 horas
	40.000	1 hora

Road wetting measures

- Clean vehicular load access road to guarantee no generation of contributions of suspended particles to the atmosphere, measure to be coordinated with the community.
- Wetting roads when required according to area climatic conditions so as to prevent generating particulate material. Wetting water will be taken from intake points authorized by the environmental authority.

IMPLEMENTATION SITE

The implementation is on all work fronts, road corridor, ZODME and industrial camps.

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
100% compliance with air quality standard	(No. of parameters that meet regulatory limits for air quality / No regulatory parameters set out in Resolution 0909, 2008) * 100	100%	Defines the environmental authority competent	Monitoring results Comparison with standard Photographic record

IMPLEMENTATION SCHEDULE

STAGE	Time (years)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	22	23	24	25
PRE-CONSTRUCTION																									
CONSTRUCTION																									

OPERATION AND MAINTENANCE	
DISMANTLING AND ABANDONMENT	

COSTS

One billion nine hundred eighteen thousand five hundred million pesos ($ 1,918,500,000 COP).

ACTIONS TO BE TAKEN	REQUIREMENTS	UNITS	UNIT COST	TOTAL COST
Automotive certificate	Certified automotive diagnostic	200	$ 90,000	$ 18,000,000
Coverage of materials	Geotextile m2	3000	$ 3,500	$ 10,500,000
Enclose work fronts	Shade mesh m2	10,000	$ 9,000	$ 90,000,000
Emission Laboratory	Measurement of atmospheric contaminants	100	$ 18,000,000	$ 1,800,000,000
Wetting roads	Recirculated water		$ -	$ -
TOTAL				**$ 1,918,500,000**

Table 11.1.1.15: Management and emission control in asphalt plants

ABIOTIC ENVIRONMENT							
MRA - 2	**Management and emission control of asphalt plants**						
OBJECTIVE							
To establish environmental management measures to reduce and control emission of pollutants into the atmosphere attributable to the operation of asphalt plants of the Rumichaca – Pasto dual carriageway road project Pedregal – Catambuco section.							
GOAL							
100% compliance with established management measures for pollution control.							
ENVIRONMENTAL EVALUATION							
Activity						**Impact**	
Installation and operation of asphalt plants						Change in Air Quality	
STAGES TO BE IMPLEMENTED							
PRE-OPERATION							
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**			**Correction**		**X**	
Mitigation	**X**			**Compensation**			

ACTIONS TO BE TAKEN

1. Air quality management.

- **Transport, unloading and storage of materials**

Management of materials and construction equipment will be made taking into account the activities set out in the MRS-3 Project (Management of Materials and Construction Equipment). In addition the following measures should be considered:

– Without exception, vehicles used by the concession for transporting materials should have containers or appropriate truck beds so the load placed on them remains fully contained, avoiding loss, propagation and dispersion of particulate material or runoff of wet material during transport.

- The unloading doors of vehicles transporting the material must remain closed and secured during transit, in order to prevent loss or leakage of material to the ground and cause emission of particles by wind action.
- During transportation cycle (source - final destination) and collection inside the plant, the load must be covered with a resistant material that will not break or tear to prevent scattering of particles.

- **Gaseous and particulate emissions from mobile sources**

- For political and legal regulations, the Concessionary requires current gas emissions and mechanical technical review certificates for all vehicles involved in the project. This procedure should be done in diagnostic centers authorized by any of the environmental authorities.
- Machinery and equipment not providing any services must remain switched off in order to save fuel and prevent the discharge of emissions into the atmosphere.
- Equipment and transport vehicle used should be at all times in optimal operating conditions; for such end, a preventive maintenance program must be established, ensuring good timing and carburation of engines so that the emissions quality of exhausts is improved, both from machines and transport vehicles.

- **Air quality control in asphalt plants**

Each plant will be permanently serviced, especially the mechanical parts and / or pollution control equipment and vehicles transporting material associated therewith.

Follows the necessary measures to manage emissions for each plant mentioned:

- Two particle traps collects the dust. The range of larger particles is captured by an inertial collector while the fine particulate is caught by a reverse flow type bag filter that, to clean the sleeves passed a stream of reverse clean low pressure. The sleeves are made of NOMEX from Dupont (MR), resistant to temperatures up to 180 degrees Celsius and can be washed.

This technology eliminates the detrimental use of compressed air for cleaning sleeves and tears and impregnates them with oil. Moreover, the pleat eliminates the use disposable cartridges made with low temperature resistance cloths.

- To have control equipment for furnace gases in asphalt plants such as scrubbers, cyclone or baghouse with filter media for temperature. Additionally, to have excellent combustion to ensure reduction of gaseous pollutants. - To monitor air quality in order to verify effectiveness of implemented measures. Evaluated parameters are particulate matter, gases (CO, SOx, NOx).
IMPLEMENTATION SITE
It is implemented in all project asphalt plants, Pedregal – Catambuco section.
PERSONNEL REQUIRED
• Coordinator / Resident / Environmental Inspector • Coordinator / Resident / Safety and Health Inspector-SST • Social professional • Head of section / Resident / supervisor / inspector work • Environmental team
RESPONSIBLE FOR COMPLETION
The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
100% compliance with quality and air standard	(No. of parameters meeting the regulatory limits for air quality / Number of regulatory parameters established in Resolution 601 of 2006 and Resolution. 610 2010) x 100	100%	Defines the environmental authority competent	- Monitoring results. Comparison with the standard. -Photographic record.
Ensure 100% of vehicles operating in the project have current emission and mechanical	(Number of vehicles with current of emission and mechanical and technical review certificate / Number of vehicles	100%	Monthly	-Follow up format - Vehicle certificates - Photographic record

technical review certificate	operating in the project) x 100			

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
PRE-CONSTRUCTION																									
CONSTRUCTION																									
OPERATION AND MAINTENANCE																									
DISMANTLING AND ABANDONMENT																									

COSTS

One million eight hundred thousand pesos ($ 1,800,000 COP).

ACTIONS TO BE TAKEN	REQUIREMENT	UNITS	UNIT COST	TOTAL COST
Lower MP gases and other atmospheric contaminants	Filters			$
	Ventilation systems			$
	Sprinkler system			$
	Gas filters (asphalt plant)			$
Spill-proof kit	Spill-proof kit	6	$ 300,000	$ 1,800,000
TOTAL				**$ 1,800,000**

Table 11.1.1. 15: Management and emission control in concrete plants

ABIOTIC ENVIRONMENT							
MRA - 3	**Management and emission control in concrete plants**						
OBJECTIVE							
Establish environmental management measures to reduce and control emission of pollutants into the atmosphere, attributable to the activities of the Rumichaca - Pasto Dual Carriageway Road Project, Pedregal – Catambuco Section.							
GOAL							
100% compliance with established pollution control management measures.							
ENVIRONMENTAL EVALUATION							
Activity						**Impact**	
Installation and operation of concrete plants						Change in Air Quality	
STAGES TO BE IMPLEMENTED							
PRE-OPERATION							
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**			**Correction**		**X**	
Mitigation	**X**			**Compensation**			

ACTIONS TO BE TAKEN

1. Management of air quality.

- **Transport, unloading and storage of materials**

Material and construction equipment will be managed taking into account the activities set out in the MRS-3 Project (Management of Materials and Construction Equipment). In addition the following measures should be considered:

– Without exception, vehicles used by the concession for transporting materials should have containers or appropriate truck beds so the load placed on them remains fully contained, avoiding loss, propagation and dispersion of particulate material or runoff of wet material during transport.

- The unloading doors of vehicles transporting the material must remain closed and secured during transit, in order to prevent loss or leakage of material to the ground and cause emission of particles by wind action.
- During transportation cycle (source - final destination) and collection inside the plant, the load must be covered with a resistant material that will not break or tear to prevent scattering of particles.

- **Gaseous and particulate emissions from mobile sources**

- For political and legal regulations, the Concessionary requires current gas emissions and mechanical technical review certificates for all vehicles involved in the project. This procedure should be done in diagnostic centers authorized by any of the environmental authorities.
- Machinery and equipment not providing any services must remain switched off in order to save fuel and prevent the discharge of emissions into the atmosphere.
- Equipment and transport vehicle used should be at all times in optimal operating conditions; for such end, a preventive maintenance program must be established, ensuring good timing and carburation of engines so that the emissions quality of exhausts is improved, both from machines and transport vehicles.

- **Air quality control in concrete plants**

Each plant will be permanently serviced, especially the mechanical parts and / or pollution control equipment and vehicles transporting material associated therewith.

Follows the necessary measures to manage emissions for each plant mentioned:

- Concrete plant to be used has storage structures for materials during the operation, controlling production of particulate material; cement is stored in metal silos which have bag filter and safety valves for controlling air emissions.
- This plant also features automatic cleaning of the mixer, filter or Airbag to prevent dust emissions, protective cover against climatic influences
- The plant's conveyor belts have covers that will prevent further contamination in the environment.
- Precaution must be taken with the control equipment of the concrete plants, since cement silos are being fed by pneumatic pumps from trucks they must have filters with greater than pump capacity. The same should be considered for hopper scales and vehicle loading that must also be controlled by means of filters that can

handle an adequate flow. This control must be accompanied by a covered ventilation system to the loading and hopper scales area.

- Keep a maintenance record for cement equipment as recommended by the trading house, so that engines and equipment are synchronized.

IMPLEMENTATION SITE

It is implemented in all concrete plants, Pedregal – Catambuco section.

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	FULFILLMENT	FREQUENCY	REGISTRY
100% compliance with quality and air standard	(Number of parameters meeting regulatory limits for air quality / Number of regulatory parameters established in Resolution 601 of 2006 and Resolution. 610 2010) x 100	100%	Defines the environmental authority competent	- Monitoring results. Comparison with the standard. -Photographic record.
Ensure 100% of vehicles operating in the project have current emission and mechanical technical	(No. of vehicles with current emission and mechanical certificates / Number of technical certified vehicles operating	100%	Monthly	-Follow-up format -Vehicle certificates - Photographic record

review certificate technical review	in the project) x 100			

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
PRE-CONSTRUCTION																									
CONSTRUCTION																									
OPERATION AND MAINTENANCE																									
DISMANTLING AND ABANDONMENT																									

COSTS

One million eight hundred thousand pesos ($ 1,800,000 COP).

ACTIONS TO BE TAKEN	REQUIREMENTS	UNITS	UNIT COST	TOTAL COST
Lower MP gases and other atmospheric contaminants	Filters			$
	Ventilation systems			$
	Sprinkler system			$
	Gas filters			$
Spill-proof kit	Spill-proof kit	6	$ 300,000	$ 1,800,000
TOTAL				**$ 1,800,000**

Table 11.1.1. 16: Management and emission control in crushing plants

ABIOTIC ENVIRONMENT							
MRA - 4	**Management and emission control of crushing plants**						
OBJECTIVE							
Establish environmental management measures to reduce and control the emission of pollutants to the atmosphere, attributable to the Rumichaca - Pasto Dual Carriageway Road Project activities, Pedregal - Catambuco section.							
GOAL							
100% compliance with established management measures for pollution control.							
ENVIRONMENTAL EVALUATION							
Activity					**Impact**		
Installation and operation of crushing plants					Change in Air Quality		
STAGES TO BE IMPLEMENTED							
PRE-OPERATION							
Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**			**Correction**		**X**	
Mitigation	**X**			**Compensation**			

ACTIONS TO BE TAKEN

1. Air quality management

- **Transportation, unloading and storage of materials**

Material and construction equipment will be managed taking into account the activities set out in the MRS-3 Project (Management of Materials and Construction Equipment). In addition the following measures should be considered:

- Without exception, vehicles used by the concession for transporting materials should have containers or appropriate truck beds so the load placed on them remains fully contained, avoiding loss, propagation and dispersion of particulate material or runoff of wet material during transport.

- During transport cycle (source - final destination) and collection into the plant, it must cover the load resistant material that will not break or tear, in order to prevent scattering of particles.

- **Gaseous and particulate emissions from mobile sources**

- Machinery and equipment not in service must remain switched off to save fuel and prevent the discharge of emissions to the atmosphere.

Equipment and transportation vehicles to be used should be at all times in optimal operating conditions; for such end a preventive maintenance program will be established, ensuring good synchronization and carburation of engines, so as to improve the quality of emissions by the exhausts, in both machines and transport vehicles.

- **Control of air quality in crushing plant**

Each plant will be permanently serviced, especially the mechanical parts and / or pollution control equipment and vehicles transporting material associated therewith.

Follows the necessary measures to manage emissions for each plant mentioned:

- Concrete plant to be used has storage structures for materials during the operation, controlling production of particulate material; cement is stored in metal silos which have bag filter and safety valves for controlling air emissions.
- This plant also features automatic cleaning of the mixer, filter or Airbag to prevent dust emissions, protective cover against climatic influences
- The plant's conveyor belts have covers that will prevent further contamination in the environment.
- Precaution must be taken with the control equipment of the concrete plants, since cement silos are being fed by pneumatic pumps from trucks they must have filters with greater than pump capacity. The same should be considered for hopper scales and vehicle loading that must also be controlled by means of filters that can handle an adequate flow. This control must be accompanied by a covered ventilation system to the loading and hopper scales area.
- Keep a maintenance record for cement equipment as recommended by the trading house, so that engines and equipment are synchronized.

To monitor air quality in order to verify effectiveness of implemented measures. Minimum evaluated parameters are particulate material, gases (CO, SOx, NOx).

- Keep a maintenance record for cement equipment as recommended by the trading house, so that engines and equipment are synchronized..
- To monitor air quality in order to verify effectiveness of implemented measures. The parameter to be evaluated is PM10.

IMPLEMENTATION SITE

It is implemented in all concrete, asphalt and crushing plants, Pedregal - Catambuco section.

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
100% compliance with quality and air standard	(No. of parameters meeting regulatory air quality limits / Number of regulatory parameters established in Resolution 601 of 2006 and Resolution 610 2010) x 100	100%	Defines the competent environmental authority	- <Monitoring results. Comparison with the standard. -Photographic record.
100% compliance	(Number of solved complaints /	100%	Defines the	-Format of complaints.

with the measures provided for in this program and applicable to the project	Number of air emissions complaints) x 100		competent environmental authority	-Monthly report. -Photographic record.

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
PRE-CONSTRUCTION																									
CONSTRUCTION																									
OPERATION AND MAINTENANCE																									
DISMANTLING AND ABANDONMENT																									

COSTS

One million eight hundred thousand pesos ($ 1,800,000 COP).

ACTIONS TO BE TAKEN	REQUIREMENT	UNITS	UNIT COST	TOTAL COST
Decreased MP gases and other atmospheric contaminants	Filters			$
	Ventilation systems			$
	Sprinkler system			$
	Gas filters (asphalt plant)			$
Spill-proof kit	Spill-proof kit	6	$ 300,000	$ 1,800,000
TOTAL				**$ 1,800,000**

Table 11.1.1.17: Management and control of noise source activities

ABIOTIC ENVIRONMENT	
MRA - 5	**Management and control of noise source activities**
OBJECTIVE	
Establish environmental management measures to reduce and control generation of environmental noise attributable to project activities	
GOAL	
100% compliance with management measures established to control noise generated by the project	
ENVIRONMENTAL EVALUATION	
Activity	**Impact**
Installation of temporary infrastructure	Change in sound pressure levels
Mobilization of construction materials, supplies, machinery, equipment, waste and vehicles	
Machinery operation	
Excavations	
Debris and excavation materials management zones ZODME	
Base, subbase and paving	
Installation and operation of process plants (asphalt, concrete and crushing)	
Construction of hydraulic works and artworks	
Foundations and piloting	
Construction of superstructures for bridges and viaducts	
Rolling structure	
Vehicle traffic	
Recovery of the asphalt layer	
STAGES TO BE IMPLEMENTED	
PRE-OPERATION	**OPERATION AND MAINTENANCE**

Pre-Construction		**Construction**	**X**	**Operation and maintenance**	**X**	**Dismantlement and abandonment**	

TYPE OF MEASUREMENT			
Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

Management of noise and vibration levels

- All equipment used in the project will be in perfect working conditions so as to not increase noise decibels due to malfunction and lack of maintenance. If necessary, install mufflers in work equipment and machinery to minimize sound pressure levels produced and avoid exceeding established standards.
- Verbal and written instructions will be given to machinery and vehicle operators to avoid unnecessary use of trumpets or horns.
- Establish speed policies for vehicles on unpaved roads to avoid suspension of particulate material from speeding and maintain road safety, especially during the dry season; 20 km / h is the recommended travel speed considering that the community associates speed and vibration with deterioration of their homes
- Together with air quality monitoring, monitor noise in camps and work sites.
- Any nocturnal activities and vehicle movements must be informed to the communities as well as travel speed.
- Run semiannual internal control sound measurements at the work fronts, processing plants and major recipients that could be affected.

Using ear protection

- During the construction phase of the project, workers must use respective hearing protection elements, such as insertion ear plugs and / or cup to avoid health injuries. Operators of drilling rigs and those attending such activity shall wear double hearing protection in their working hours in order to achieve greater hearing protection.

Sector	Subsector	Estándares máximos permisibles de niveles de emisión de ruido en dB(A)	
		Día	Noche
Sector A. Tranquilidad y Silencio	Hospitales bibliotecas, guarderías, sanatorios, hogares geriátricos.	55	50
Sector B. Tranquilidad y Ruido Moderado	Zonas residenciales o exclusivamente destinadas para desarrollo habitacional, hotelería y hospedajes.	65	55
	Universidades, colegios, escuelas, centros de estudio e investigación.		
	Parques en zonas urbanas diferentes a los parques mecánicos al aire libre.		
Sector C. Ruido Intermedio Restringido	Zonas con usos permitidos industriales, como industrias en general, zonas portuarias, parques industriales, zonas francas.	75	75
	Zonas con usos permitidos comerciales, como centros comerciales, almacenes, locales o instalaciones de tipo comercial, talleres de mecánica automotriz e industrial, centros deportivos y recreativos, gimnasios, restaurantes, bares, tabernas, discotecas, bingos, casinos.	70	60
	Zonas con usos permitidos de oficinas.	65	55
	Zonas con usos institucionales.		
	Zonas con otros usos relacionados, como parques mecánicos al aire libre, áreas destinadas a espectáculos públicos al aire libre.	80	75
Sector D. Zona Suburbana o Rural de Tranquilidad y Ruido Moderado	Residencial suburbana.	55	50
	Rural habitada destinada a explotación agropecuaria.		
	Zonas de Recreación y descanso, como parques naturales y reservas naturales.		

IMPLEMENTATION SITE

It is implementation on all work fronts, corridor, ZODMEs, industrial camps, concrete, asphalt and crushing plants.

REQUIRED PERSONNEL

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS				
GOAL	**INDICATOR**	**COMPLIANCE**	**FREQUENCY**	**RECORD**
100% compliance of the measures provided for in this program and applicable to the project	(Number of noise monitoring /Number of scheduled noise monitoring) x100	100%	Defines the competent environmental authority	Monitoring Report Photographic record
	(Measured noise decibels / Allowed noise decibels) x100 Res 627 2006	100%	Defines the competent environmental authority	Sound reading results Photographic record
100% compliance with installed mufflers on required equipment and machinery	(Number of mufflers installed / Number of required mufflers) * 100	100%	Defines the competent environmental authority	Check list Photographic record

IMPLEMENTATION SCHEDULE

STAGE	**TIME (years)**																													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														

DISMANTLING AND ABANDONMENT	
COSTS	
Two hundred million pesos ($ 200.000.000 COP).	

ACTIONS TO BE TAKEN	REQUIREMENTS	UNITS	UNIT COST	TOTAL COST
Sound level measurements	Sound level meter	100	$ 2,000,000	$200,000,000
TOTAL				**$200,000,000**

- ***Landscape Management Program***

Table 11.1.1.18 Landscaped Management

ABIOTIC ENVIRONMENT	
MP-1	**LANDSCAPE MANAGEMENT**
OBJECTIVE	
Control and mitigate landscape impacts from project construction activities.	
GOAL	
– Execute 100% of the protection measures in sites of landscape sensitivity. – Execute 100% landscape conditioning of intervention areas – Execute 100% restoration of intervention areas	
IMPACTS TO MANAGE	
Activity	**Impact**
Temporary facilities and infrastructure operation Installation and operation of camps Machinery operation Top soil removal and stripping Demolition	Landscape modification

Excavations Debris and material management area ZODME Rolling structure Foundations and piloting Construction of superstructures for bridges and viaducts	

STAGES TO BE IMPLEMENTED							
PRE-OPERATION							
Pre-construction		**Construction**	**x**	**Operation and maintenance**		**Dismantlement and abandonment**	

TYPE OF MEASUREMENT			
Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

Landscape management for the project is related to setting of the spaces in the road corridor and eventually scenic sites of interest. Follows actions to be developed.

1. Landscape management measures for work fronts during project execution

In areas of landscape sensitivity of road layout sites and associated infrastructure as camps, plants and ZODMEs intersects with ingress to premises or road crossings, it is recommended to implement protective measures with perimeter barriers such as shade mesh use to reduce the visual impact of the construction phase. Installation of these barriers reduces visibility on work areas.

It also allows mitigating any dust fall, acting as a particle filter. These meshes also allow separating work areas that will not be intervened and from seeing the construction's own actions.

2. Measures for landscape management on the road

Landscape management will take place once the construction activity in each sector is finalized, taking into account the following:

- Roadside slopes will be managed in accordance with provision of the project (management of embankments, slopes and erosion control).

- No trees will be planted on the right of way for road safety reasons; these areas must be free of obstacles that increase the risks of accidents by users.

IMPLEMENTATION SITE

Road corridor and associated infrastructure Rumichaca Pasto dual carriageway road project

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Social professional
- Head of section / Resident / supervisor / inspector work
- Environmental team

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
Execute 100% work protection measures in sites of landscape sensitivity.	(Sites with visual protection measures / sites intended to establish visual protection measures) * 100	100%	Biannual	- Semi-annual report -Photographic record

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	267	27	28	29	10
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS
The costs for handling slopes are covered within the overall project costs.

- ***Handling Explosives and Blasting Program***

Table 11.1.1.20 Handling Explosives and Blasting

ABIOTIC ENVIRONMENT	
MEV-1	**EXPLOSIVES AND BLASTING MANAGEMENT**
OBJECTIVE	
Establish measures for safely transporting, storing and using explosives at construction sites as required.	
GOAL	
– Meet 100% of defined measures for storing explosives – Meet 100% of defined measures for the use of explosives	
MANAGEMENT IMPACTS	
Activity	**Impact**
Excavations Foundations and piloting Construction of superstructures for bridges and viaducts	Change in air quality Change in sound pressure levels
STAGES TO BE IMPLEMENTED	
PRE-OPERATION	

Pre-construction		**Construction**	**x**	**Operation and maintenance**		**Dismantlement and abandonment**	

TYPE OF MEASUREMENT			
Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

1) Verification of use permits for explosives

To apply with Ministry of National Defense for a permission to use explosives for the specific work.

2) Transport of material

When transporting explosive substances in land vehicles, provisions of standard "NTC 3966 Transport of Hazardous Goods. Class 1 Explosives. Ground transportation" must be taken into account. The good structural condition of the container or vehicle used to transport explosives must be visually examined as follows: - Before loading explosives in a container or vehicle, explosives should be examined to verify that there are no residues from a previous shipment, that the vehicle is in good structural conditions and in its floor and interior walls have no protrusions. - Deterioration of any element within the container or vehicle is inadmissible, regardless of their construction material. Vehicles used for transporting explosives and ignition elements must have a solid, resistant body with specific isolation characteristics, with wooden floor, no cracks, nails or any metal that can produce sparks from bumps or friction. If the vehicle is not isolated, isolation must be provided with a layer of sawdust or shavings on the floor and with cardboard or canvas on the sides of the vehicle interior and the weight of the explosive charge must not exceed 80% of vehicle capacity. Open vehicles carrying explosives must always travel protected with waterproof, fireproof tarps and in perfect mechanical conditions, with sufficient fuel and lubricants, with dry chemical powder fire extinguishers in good conditions, with DAGMA emissions certificate, with warning signs indicating the truck is loaded with explosives or ignition elements and the speed cannot exceed 45 Km / h.

3) Storage at the worksite

If explosives require temporary storage to have a site with a temporary arrangement site location plan with the following characteristics:
- Separate sections for each type of material.
- Be located at a safe distance from buildings, railways, roads.
- Be provided with adequate lighting and optimum natural ventilation with humidity and temperature recommended by the manufacturer for the conservation of explosives.
- Provided damping and resonance chamber.

- Have iron doors with secure locks.
- Having lightning arresters and no more openings than necessary for material ingress and ventilation.
- Keep floors and ceilings and surrounding areas clean and dry. Not store explosives with detonators (blasting caps) or with explosive baits. This site should not store paintings, wood, trash, cardboard, cables, metal objects and substances or materials of a different nature.

The maximum storage area should be 60% of the total site area and the remaining 40% will be for material transit and movement. No electrical installations or repairs can be done inside the temporary storage site or in areas with a radius greater than 10 m from it. Its electrical installations must be properly protected and isolated, as well as lighting systems and telephony.
Workers entering the powder magazine or that remain in the work area should not smoke.
Explosives must not be stored at a height over 1.60 m for comfort and safety in handling and staked boxes of explosives must always have the lids indicating up.
Explosives should be placed on wooden platforms with a minimum height of 10 to 30 cm above the floor to protect them from moisture, vibration, shock and ensure proper ventilation.
Baits and baited explosives must not be prepared inside the site.

4) Use of protection elements

Workers should not carry explosives or detonators in pockets or jackets. Always try to have a minimum number of people handling explosives and as strictly necessary; each person should have their roles clearly defined. All workers who handle, transport and store explosives should wear industrial use gloves, safety boots, hard hats and coveralls or work clothes without zippered as friction or accidental bumps could cause a spark. These personal protection elements must meet quality specifications.

5) Handling of explosives

- Acquisition from the Ministry of National Defense and its military industry (INDUMIL).
- Have transportation and handling permission from military authorities (INDUMIL)
- Keep detailed daily inventory of explosives to avoid leaving any in the field or accidents or theft.
- Only expert personnel will handle explosives.
- Waste packaging of explosives and other materials that have been in contact with tem will be temporarily stored as set out in MRS-04 (Management of domestic, industrial and special solid waste), to be subsequently transported to the acquisition site for final disposal.

IMPLEMENTATION SITE
Road corridor and associated infrastructure Rumichaca Pasto dual carriageway road project
PERSONNEL REQUIRED
- Coordinator / Resident / Environmental Inspector - Coordinator / Resident / Safety and Health Inspector-SST - Head of section / Resident / supervisor / inspector work

- Explosions handler
- Operators

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
Meet 100% of defined measures for storing explosives	(Number of storage sites complying with established measures / Number of storage required sites) * 100	100%	Biannual	- Semi-annual report - Photographic record - Explosives handling forms
Meet 100% of defined measures for the use of explosives.	(Number of blasts made / Number of planned blasts) * 100	100%	Biannual	- Semi-annual report - Photographic record - Explosives handling forms

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	267	27	28	29	10
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Costs for handling explosives are covered within the overall project costs.

- ***Management of Health and Safety at Work Program***

Table 11.1.1.11 Safety and Health at Work

ABIOTIC ENVIRONMENT							
MSST-1	**SAFETY AND HEALTH AT WORK MANAGEMENT**						
OBJECTIVE							
Establish Safety and Health at Work measures required by current regulations and how many others may be necessary to safeguard the physical integrity of all workers involved in the work.							
GOAL							
– 100% induction of personnel involved in the project – Comply 100% training of workers in safety and health at work – Keep statistics of accidents and occupational diseases							
MANAGEMENT IMPACTS							
Activity				**Impact**			
All project activities							
STAGES TO BE IMPLEMENTED							
PRE-OPERATION							
Pre-construction		**Construction**	**x**	**Operation and maintenance**		**Dismantlement and abandonment**	
TYPE OF MEASUREMENT							
Prevention	**X**		**Correction**		**X**		
Mitigation	**X**		**Compensation**				
ACTIONS TO BE TAKEN							

- Document the Safety and Health at Work Management System
- Prepare the risk matrix
- Conduct field verification that all safety standards are functioning and otherwise intervene to rectify
- Together with production hold toolbox safety meetings
- Establish training schedule; training is area inspections.
- Prepare monthly Safety and Health at Work reports and those contractually required.
- Attend meetings with internal auditing and SST associated
- Keep project management and SST corporate management updated with results of accidents and statistics.

And any other deemed necessary by the employer.

IMPLEMENTATION SITE

The road corridor and associated infrastructure of the Rumichaca Pasto dual carriageway road project

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector
- Coordinator / Resident / Safety and Health Inspector-SST
- Head of section / Resident / supervisor / inspector work

RESPONSIBLE FOR EXECUTION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
100% induction of personnel involved in the project	(Number of people who have received induction / Number of personnel employed) * 100	100%	Monthly	- SST Report - Photographic record - Attendance list
100% training of workers in safety and health at work	(Number of trainings held / Number of trainings scheduled) * 100	100%	Monthly	- SST Report - Photographic record

				- Attendance list
Keep statistics on accidents	(Number of labor accidents / Number of workers) * 100	100%	Monthly	- SST Report - Photographic record

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	267	27	28	29	10
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Costs for handling explosives are covered within the overall project costs.

- ***Signage Management Program***

Table 11.1.1.2 Signage

ABIOTIC ENVIRONMENT	
MS-1	**SIGNAGE MANAGEMENT**
OBJECTIVE	
The fundamental objective is for traffic through or on the border of the area of the works is safe and expeditious with the least possible disruption of normal traffic, while ensuring the safety of workers and tasks; This requires that signs and measures used regulate circulation, warn of dangers, properly guide drivers through the work area and protecting them and the workers.	
GOAL	
– 100% implementation of signage management measures in work fronts and work sites	
IMPACTS TO MANAGE	

Activity	Impact
All project activities	

STAGES TO BE IMPLEMENTED							
PRE-OPERATION							
Pre-construction		**Construction**	**x**	**Operation and maintenance**		**Dismantlement and abandonment**	

TYPE OF MEASUREMENT			
Prevention	**X**	**Correction**	**X**
Mitigation	**X**	**Compensation**	

ACTIONS TO BE TAKEN

1. TRAFFIC MANAGEMENT PLAN

The fundamental objective is to mitigate the impact caused by the works taking place on the road and in the surrounding areas in order to provide a safe, orderly, agile and comfortable environment for drivers, passengers, cyclists, pedestrians, work personnel and neighbors.

SPECIFIC OBJECTIVES.

- Ensure the security and integrity of users, pedestrians, workers, work teams and the work itself.
- Avoid restricting or observation of vehicle and pedestrian flows, including properties and commercial activities adjacent to the construction area.
- Design, program and implement coherently alternative routes and / or detours required for execution of the works, affecting as little as possible public and private transportation.
- Select and quantify necessary devices during development of the works.
- Define areas where work will be allowed, storage of materials and work equipment for each stage of the work.
- Identify inspection programming and documentation methodology to report the results thereof.
- Establish criteria to maintain the surrounding areas in good housekeeping conditions.
- Establish requirements to mobilize machinery inside and outside the work areas.

IMPLEMENTATION SITE

Road corridor and associated infrastructure Rumichaca Pasto dual carriageway road project

PERSONNEL REQUIRED

- Coordinator / Resident / Environmental Inspector

- Coordinator / Resident / Safety and Health Inspector-SST
- Head of section / Resident / supervisor / inspector work

RESPONSIBLE FOR COMPLETION

The Concesionaria Vial, Unión del Sur S.A.S will be responsible for execution and performance of this program by its contractors throughout project development.

FOLLOW UP AND MONITORING INDICATORS

GOAL	INDICATOR	COMPLIANCE	FREQUENCY	RECORD
100% implementation of signage management measures in work fronts and work sites	(Number of sites with signs / Number of sites requiring signs) * 100	100%	Monthly	- Photographic record - Checklist installed signs

IMPLEMENTATION SCHEDULE

STAGE	TIME (years)																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	267	27	28	29	10
PRE-CONSTRUCTION																														
CONSTRUCTION																														
OPERATION AND MAINTENANCE																														
DISMANTLING AND ABANDONMENT																														

COSTS

Costs for handling explosives are covered within the overall project costs.