CHAPTER 5 ENVIRONMENTAL IMPACT ASSESMENT AND FORECAST

CONTENT

1 INTRODUCTION

In this chapter the identification, analysis, value and description of the positive and negative impacts of significant character derived from the construction and operation stages of the Project are presented.

Forecast and assessment of the environmental impacts of the Project are materialized using the criteria defined in the Act N°19.300 of the Environmental General Basis and the Environmental Impact Assessment System Regulations (D.S. N° 30/97 and D.S. N° 95/01 of MINSEGPRES).

The applied methodology may be looked up in details in Annex 5, which includes identification of all the activities of the Project subject to cause environmental impacts and the components that might be affected by such activities. It also considers the potential positive effects the Project will generate over its surroundings.

2 ENVIRONMENTAL CHECK LIST ELABORATION

I.I Environmental Factors check list

In order to carry out the identification of the impacts, the methodology pointed out in Annex 5 was done, making a check list of the environmental components possible to be altered, together with the characterization of the influence area of the Project (Base line) presented in Chapter 4. These factors are breakdown for its later analysis in the different means and environmental components, presented in the next table.

Table 5-1 Environmental Factors check list

MEANS	COMPONENT
Physical means	Quality of Air
	Noise
	Geology and Geomorphology
	Use and quality of Air
	Hydrology and Hydrogeology
Biotic means	Flora and vegetation
	Vertebrates Fauna
Human means	Social means
	Cultural and Archaeological Heritage
	Landscape
	Tourism
Constructed means	Energy Infrastructure
	Roads

Source: Self Elaboration.

2.2 Project Activities check list

Based on the activities in the construction and operation stages pointed out in Chapter 1 the description of the Project presented in EIA, established the activities feasible to produce an environmental impact associated to them. These are listed in the following table:

Table 5-2 Project Activities Check List

CONSTRUCTION STAGE	OPERATION STAGE
■ Labor hiring ■Transport of the personnel and goods to and from the working faces, and wastes of the works installation areas. ■Operation of equipment, machineries and trucks. ■Personnel circulation in working faces. ■Reconsideration of structures of the line and foundations of S/S. ■Land clearance of the structure installations. ■Land movements. ■Construction of founding. ■Fillings. ■Assembly of structures of line and equipment of S/S. ■Provide the restrictive strip with forestry and pruning methods in the corresponding areas. ■Laying out and tightening of the conductors. ■ Tests and start ups. ■Demobilization and cleaning of the working faces. ■Equipment and machineries maintenance.	■Maintenance activities of the line and S/S (preventive, corrective program, failures and emergencies). ■Maintenance of the restrictive strip with forestry and pruning methods in the corresponding areas. ■Energizing of the lines.

3 IMPACT ASSESSMENT ON THE PHYSICAL MEANS

Next, the potential impact assessment of the physical means of the project, both in construction and operation stages are presented. This comprises the following components: Quality of air, Noise, Geology and Geomorphology, Use and quality of land, Hydrogeology, and Hydrology.

3.1 Quality of Air

3.1.1 Construction stage

i) Environmental impact analysis

The Project to be assessed comprises a number of activities tend to the construction of two electric transmission lines that will be established between S/S Maitenes and S/S Alfalfal, and between this last one and Alfalfal II Power Station; in this same fashion, the extension of S/S Alfafal is contemplated. From this agreement, the activity analysis presented in Chapter 1 of this EIA, it has been able to establish the impact of the air component that will be developed mainly during the construction stage and it is associated to the local deterioration, temporary and intermittent quality of air.

ii) Environmental impact synthesis

The environmental impact identified during this stage is valued and analyzed next.

Table 5-3 Impact qualification matrix. Quality of Air Component. Construction stage

MEANS: Physical		COMPONENT Quality of Air					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■ Excavations, fillings and land movement for the infrastructure installation. ■Dispersion of excavation materials not used for fillings ■Transport of the personnel and goods to and from the working faces and wastes of the areas of. works installation. ■Operation of equipment and machineries. ■Personnel circulation in working faces.	ICA1:Local temporary and intermittent deterioration of the quality of air	In areas of tower Installations and in access roads to the construction areas of the Project.	-	Rev	Tem	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

ICA1: Local, temporary and intermittent deterioration of the quality of air

The activities presented in Table 5-3 will have as consequences the particulate material (MP_{10}) lifting due to excavations and land movement in the working faces, dust lifting on the roads (although of low magnitude because all the roads are made of cement), as well as the generation of combustion gases (CO, NOx e HC) due to operations and transit of machineries and vehicles.

According to the backgrounds presented in Annex 6, the particulate material and gases generated by the Project comply with the compensation limits established by D.S. Nº 58/2003 of MINSEGPRES which reformulates and updates the Atmospheric Decontamination and Prevention Plan of the Metropolitan Region (PPDA). This intervention will be verified in terms of time and space, which allows establishing a *low* magnitude associated to this impact.

Similarly, emissions of particulate material and combustion gases have a *temporary* and *reversible* character, therefore, they will be shown over the air quality during the period where construction is developed (2 years approximately), going back after such period to its original condition. This impact has been considered as *direct* type because it is directly related to the activities required for the construction of the Project.

Based on the previously mentioned information, the impact can be assessed as local, temporary and intermittent, which according to the assessment methodology is classified as NEGATIVE MINOR.

3.1.2 Operation stage

It is important to record that during operation of the Project it has not been considered the relevant effects in this component, therefore atmospheric emissions will be reduced only to maintenance activities, associated to the eventual transit of machineries and vehicles.

3.2 Noise

3.2.1 Construction stage

i) Environmental impact analysis

Forecast of noise levels

The construction of high tension towers and expansion of S/S Alfalfal are presented in this stage.

The construction of the works starts with the revise of structures, continues with the land clearance and installation of them, followed by land movements, in order to later assemble the rebar and place the concrete for the founding within the excavation; later on, the molds will be taken out from the founding and the excavations will be filled with the same material of the excavation. After this, the structures are lifted, which will be pre-assembled in field. Once the structure is lifted, conductors are laid up and the equipment assembly in the substation starts, finalizing with the start up of the system.

The main equipment and machineries used in constructions of the lines will be trucks for transport of materials; backhoe loader, compressor and demolition hammer (if needed).

for excavations, concrete mixer and compressor for concrete, hoist and breaks (winches) for the conductors layup, frontal loader for movement of debris (within the proximities of the foundations) and finally, minor equipment such as shovels, picks, pulleys, portable hoists, and some minor tools.

The impacts in this stage are expected during construction of the foundations, especially, land movement, concrete mixer truck and frontal loader. The main equipment contemplated in construction and its reference levels at maximum power are the following:

Table 5-4 Equipment considered in construction of towers and noise Level in dB (A) at 15 m

Equipment or Machinery	NPSeq, dB(A)
Pump + concrete mixer truck	79
Demolition hammer	74
Backhoe loader	73
Frontal loader	79
Steer dumper	74
Total	**84**

Source: Self measurements, US Environmental Protection Agency (EPA), and background elaboration related to emission of noises generated by the construction activities (CONAMA, 2001).

For assessment effects, the most unfavorable scenario considers that the simultaneous operation of all sources, equivalent to a noise level of 84 dB (A) at 15 m distance.

This emission level is forecast to each receptive point considering, for such effects, the model established by the ISO 9613-2 standard " Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation".

The equation given by this standard is the following:

$$L_{ft}(DW) = L_W + D_C - A$$

L_{ft} = Power Level by octave band frequency dB.

D_C = Directivity index in dB.

A = Attenuation by octave band in dB.

Attenuation (A)

$$A = A_{div} + A_{atm} + A_{gr} + A_{bar} + A_{misc}$$

A_{div} = Attenuation by geometric divergence.

A_{atm} = Attenuation due to atmospheric absorption.

A_{gr} = Attenuation due to land effect.

A_{atm} = Attenuation due to barrier.

A_{am} = Attenuation due to other effects.

Attenuation by divergence (A_{div})

$$A_d = 20 \cdot \log \left(\frac{d}{d_0} \right) + 11\ dB$$

d = distance from source to receptor (in meters).

do = reference distance (= 1 m).

Atmospheric absorption (A_{atm})

^4„J_=ot,xd/1000

Table 5-5 Atmospheric attenuation coefficient

T°	H%	Atmospheric Attenuation coefficient, ⟨ dB/km							
		63	125	250	5000	1000	2000	4000	8000
10	70	0,1	0,4	1	1,9	3,7	9,7	32,8	117
20	70	0,1	0,3	1,1	2,8	5,0	9,0	22,9	76,6
30	70	0,1	0,3	1	3,1	7,4	12,7	23,1	59,3
15	20	0,3	0,6	1,2	2,7	8,2	28,2	88,8	202
15	50	0,1	0,5	1,2	2,2	4,2	10,8	36,2	129
15	80	0,1	0,3	1,1	2,4	4,1	8,3	23,7	82,8

Effect of land (Agr)

Agr = 4.8 – (2hm/d) (17 + (300/d))>0

The electricity lines and towers to be constructed will not touch in terms of civil works in field (see Figure 1-4 in Chapter 1); therefore, it will be taken for projection of noise levels, the distance from the electricity line and the tower closer to the sensitive receptors in each point of assessment.

For effects of calculation of the atmospheric absorption, the sound spectrum, proper from these works, will be used and it corresponds to the sum of all the sources indicated in Table 5-6.

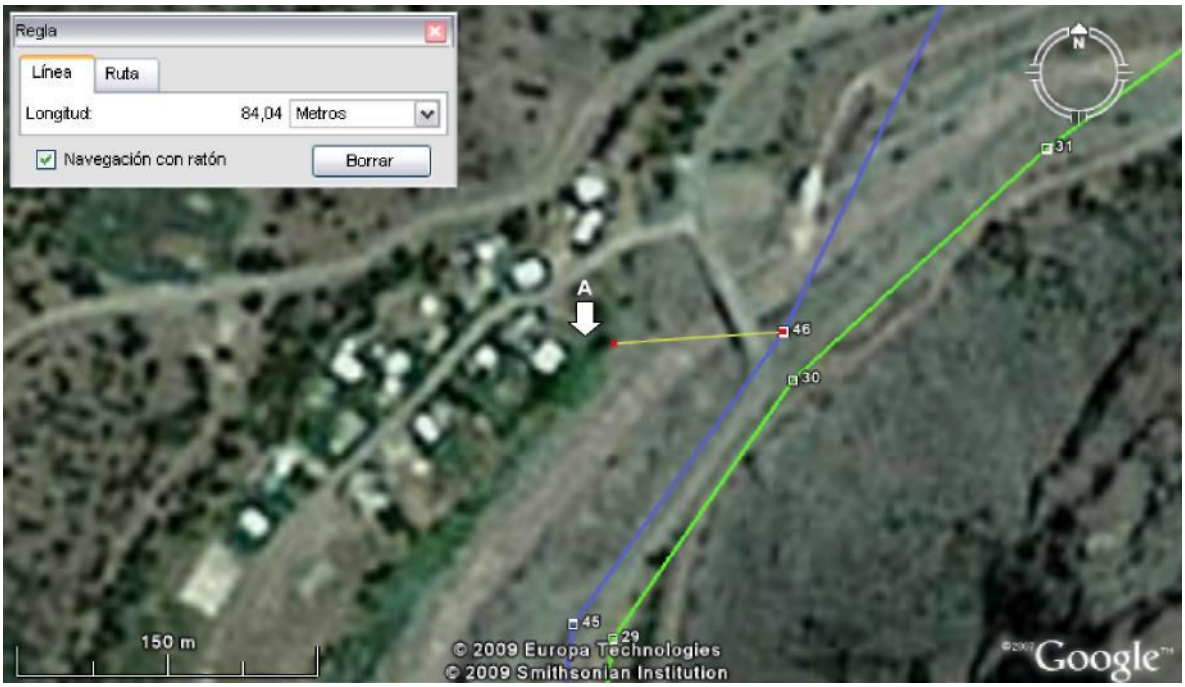
Table 5-6 Sound spectrum. Construction stage

Hertz frequency. dB(A) Levels								dB(A)
63	125	250	500	1000	2000	4000	8000	
80	81	81	77	77	77	77	73	84

Source: Self Elaboration.

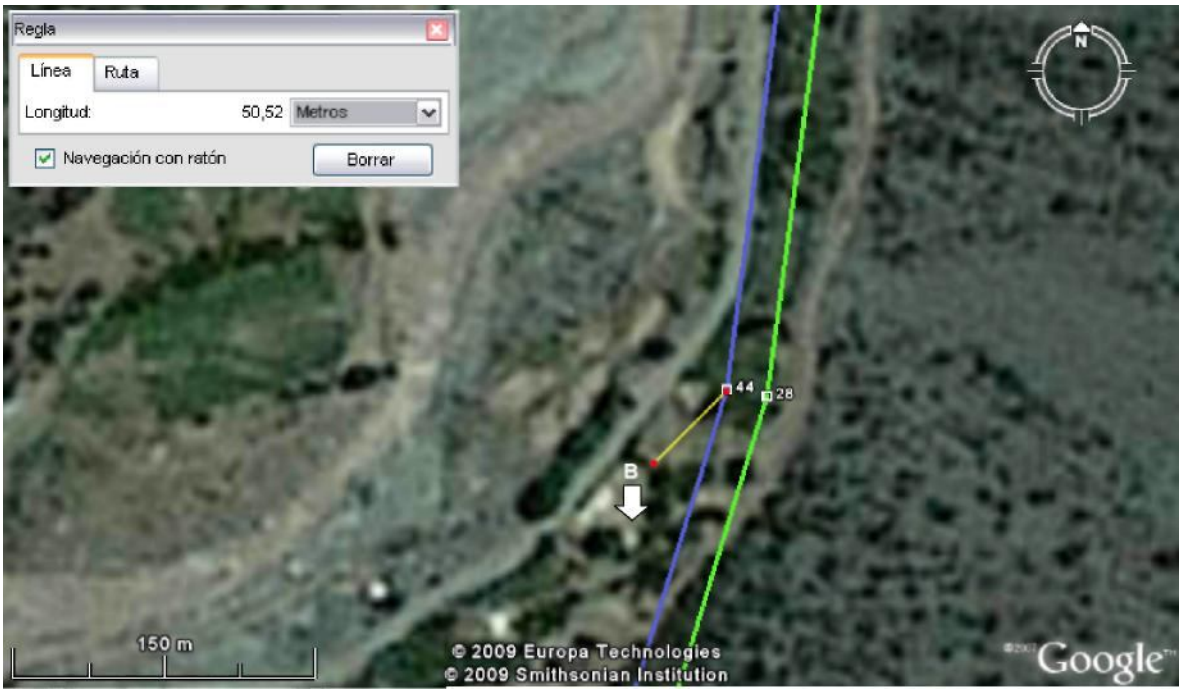
It considers a mid-temperature of 20° and 70° of humidity.

Figure 5-1 Distance between high tension tower - receptor. Assessment point A Scenario



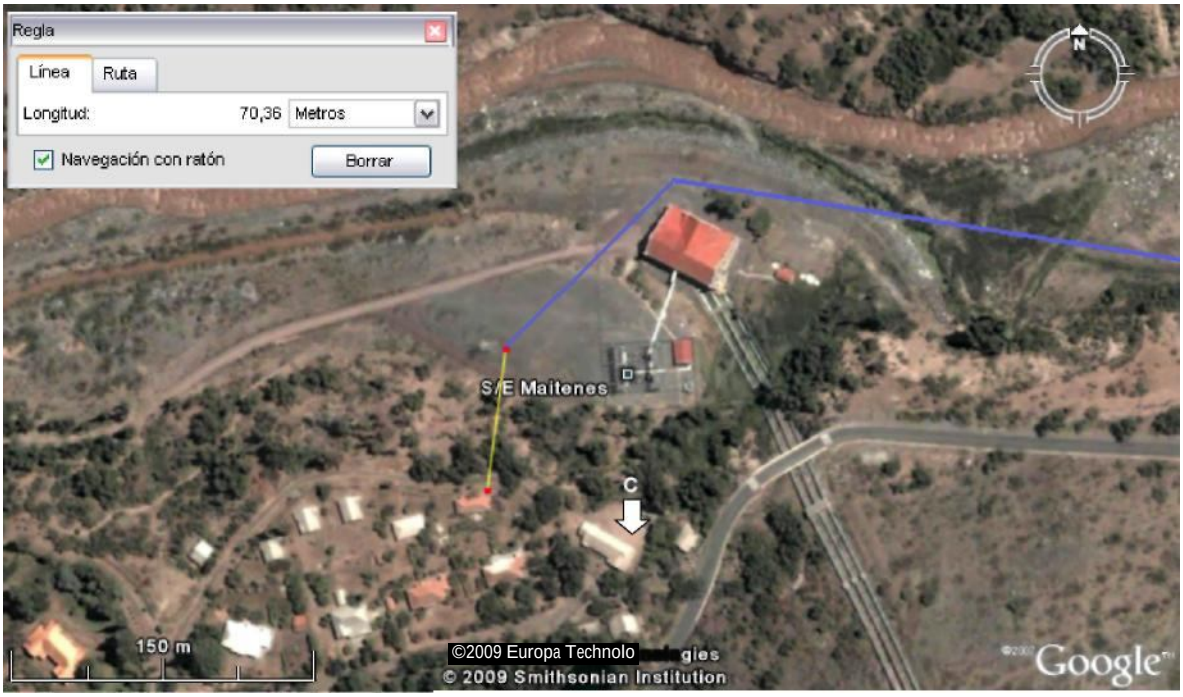
Source: Self elaboration over Google Earth base.

Figure 5-2 Distance between high tension tower - receptor. Assessment point B Scenario



Source: Self elaboration over Google Earth base.

Figure 5-3 Distance between high tension tower - receptor. Assessment point C Scenario



Source: Self elaboration over Google Earth base.

Noise levels estimated for each point assessed in the following table.

Table 5-7 NSeq projected. Construction stage

Point	Distance (meters)	Hm (m^2)	dB(A) Attenuations			NPSeq, dBA
			Adiv	Agr	Aatm	
A	80	120	15	40	2,2	63,3
B	50	75	10	3,4	0,5	69,7
C	70	105	13	3,9	1,1	65,7

Source: Self Elaboration.

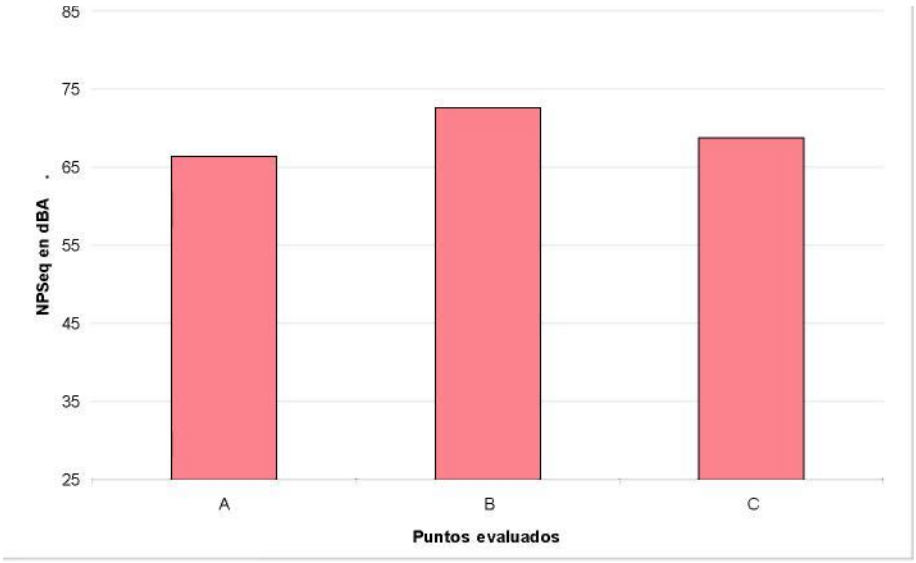
Due to the override of activities, it will be considered, for the worst cases, source duplication, this is 3 dB(A) over the assessed level, presented in the next table:

Table 5-8 NPSeq projected with override of activities. Construction stage

Point	NPSeq dB(A)
A	66,3
B	72,7
C	68,7

Source: Self Elaboration.

Figure 5-4 Noise levels forecast. Construction stage



Source: Self Elaboration.

The noise levels forecast over the receptors located in the surroundings of the layout vary between 66.3 and 72.7 dB(A).

The works to be carried out in S/S Alfalfal consist of extension of this one in three sections of 220 kV and another of 110 kV, including the installation of a 110/220 kV, 300 MVA transformer to allow the connection of two circuits from Alfalfal II Power Station and the circuit coming from S/S Maitenes.

Assessment related to D.S. Nº 146/97.

In order to assess the noise levels estimated for the Project it is required to know the land use defined for the territory regulation to standardize it with regards the zones established by D.S. Nº 146/97 of MINSEGPRES.

All the measuring points are located in rural zones, therefore, the maximum noise level will not pass the noise baseline level over 10 dB(A).

The construction works will be only carried out during daytime, so that period of time will be assessed with the measured baseline levels. In the following table, the forecast levels in construction stage and the maximum level established by D.S. Nº 146/97 for daytime is presented.

Table 5-9 Forecast levels assessment Construction stage - Daytime

Point	Forecast level (dBA)	Daytime limit D.S. Nº 146/97.	Excess (dBA)	Does it comply with the standard?
A	66,3	62	4,3	No
B	72,7	73	0	Yes
C	68,7	73	0	Yes

Source: Self Elaboration.

Points B and C comply with the maximum noise levels permitted. Point A presents a noise level exceeding the standard, that is why is presented in section 3 of Chapter 6 the environmental management measures to guarantee compliance with the standard (see details in Annex7).

ii) Environmental impact synthesis

Based on the background previously pointed out, the identification of the impact for the noise component due to the works on the construction stage is presented in the following table.

Table 5-10 Impact valuation matrix Noise Component. Construction stage

MEANS: Physical			COMPONENT Noise				
			VALUATION				
ACTIVITIES	IMPACT	LOCATION	Ca	Re	Te	Ti	Mg
Activities destined to construction of lines and S/S Project	IR1: Generation of noise over the receptors near	Point A	-	Rev	Tem	Dir	Me
		Point B	-	Rev	Tem	Dir	Ba
		Point C	-	Rev	Tem	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IR1: Noise generation over receptors near the Project

In order to establish the magnitude of the impact it is considered as criteria the following ratio:

Ba: noise level lower that the standard.

Me: noise level over the standard from 0.1 dB(A) up to 10.0 dB(A).

Al: noise level over the standard above 10.1 dB(A).

This is how it can be established that the expected impact of the construction of the Project will be *low* magnitude for points B and C, while it will be *medium* magnitude for point A, this because it is over 4.3 dB(A) according to the limits established by D.S. Nº 146/97 for such area.

Therefore, this impact has been assessed has MINOR NEGATIVE for points B and C, and MITIGATING NEGATIVE for point A. In this sense, a set of measurements to mitigate this impact is presented in section 3 of Chapter 6.

3.2.2 Operation stage

i) Environmental impact analysis

Forecast of noise levels

During this stage, the noise level perceptible corresponds to the one generated by ionization of air surrounding the conductors of high tension, which occurs when the electric gradient exceeds the

air dielectric rigidity and is presented as small sparks or discharges just few centimeters away from the cables, this known as corona discharge.

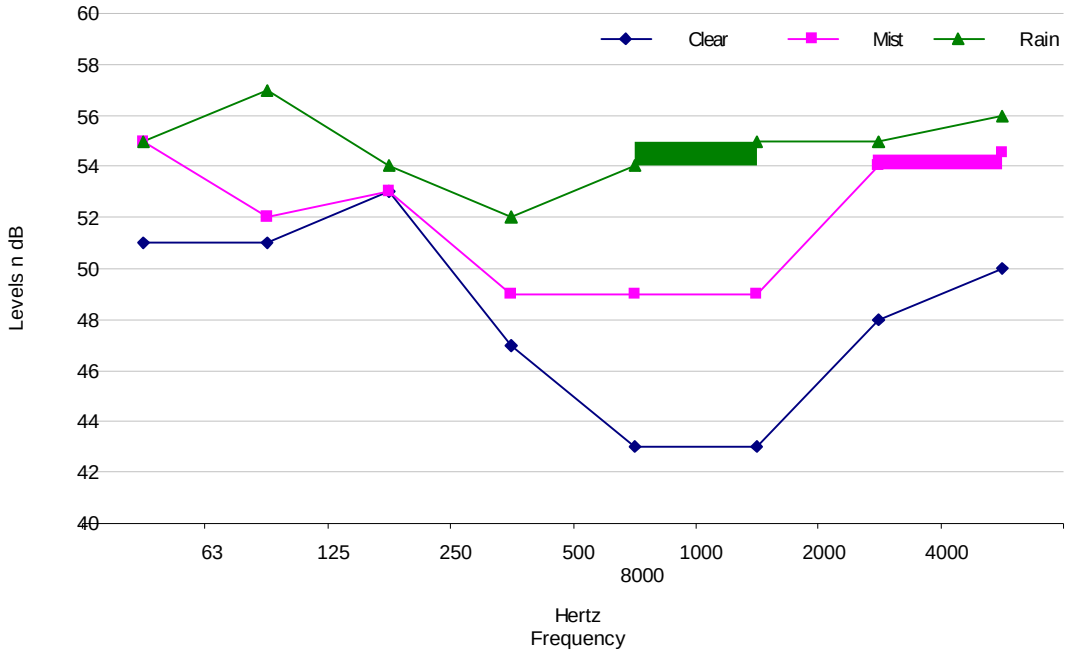
The degree or intensity of the corona and the hearing noise are conditioned by environmental factors, this are humidity, density, mist, wind, and water as showers.

According to J.J.M. Requena[12], every small discharge passing, where particles are suddenly ionized and violently impelled by the electrical field of the conductors, could be the origin of the crash of an acoustic wave, it could be proved with the effect of a dry crackling noise together with each discharge.

The noise level with showers or mist, and determined conditions, can reach 60 dB(A), nevertheless the characteristic noise varies between 35 and 50 dB(A).

The next figure presents the characteristic sound spectrum of noise by a high tension line in a sunny, cloudy or rainy weather, where is possible to warn an increase up to 10 dB when comparing the noise level between sunny and cloudy weather.

Figure 5-5 sound spectrum produced by high tension line



Source: Self Elaboration.

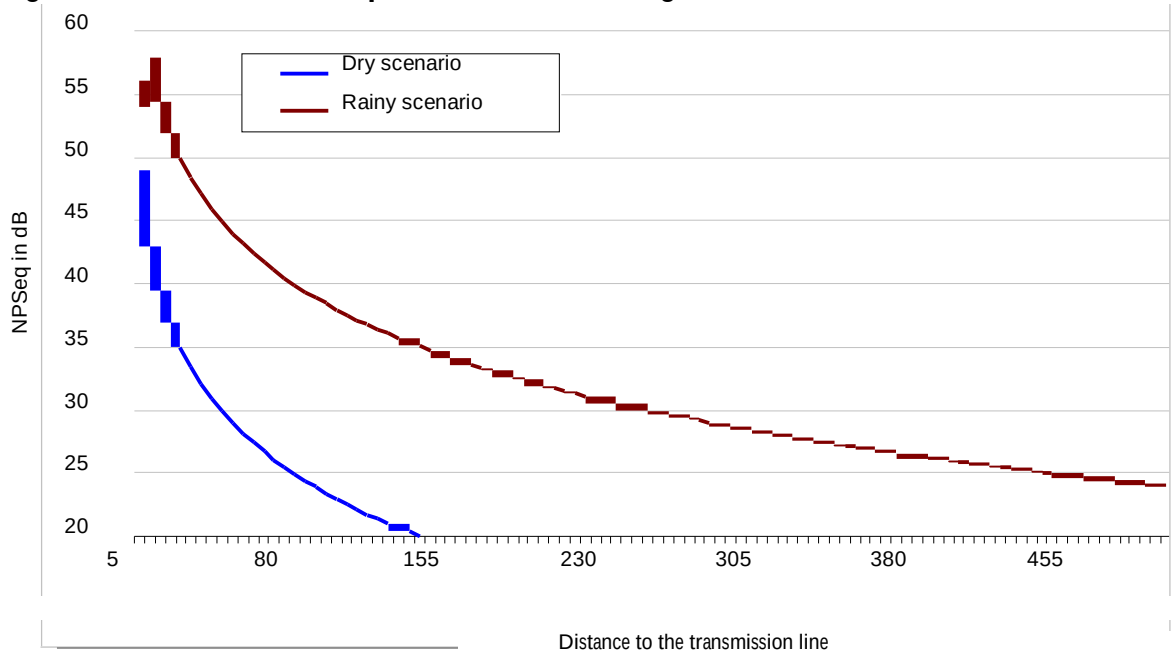
During showers, the main noise source is the raindrops which drive to different types of local discharges. Frost over the conductors is also a noise generation source.

For dry weather, the roughness existing over the cables surface such as scratches, deposits of industrial or vegetal pollution, sometimes small bugs, are the localized discharges places and constitute a noise source as well.

[12] Noise produced by high tension lines. National Acoustic Day Valencia 1994.

Considering an emission level of 35 dB(A) for a dry scenario and 50 dB(A) for another one with rain, and the transmission line located at 25 m high, the sound attenuation profile is the following:

Figure 5-6 Sound attenuation profile Construction stage



Source: Self Elaboration.

It is possible to warn that most of the noise levels are expected during shower conditions; therefore, for effects of assessing the most unfavorable scenario, the level of noise will be estimated in each point assessed in the base line considering this situation.

Figure 5-11 Noise level forecasts. Operation stage considering one line

Point	Distance (meters)	Estimated NPSeq (dBA)
A	80	33,5
B	50	37,6
C	70	34,7

Source: Self Elaboration.

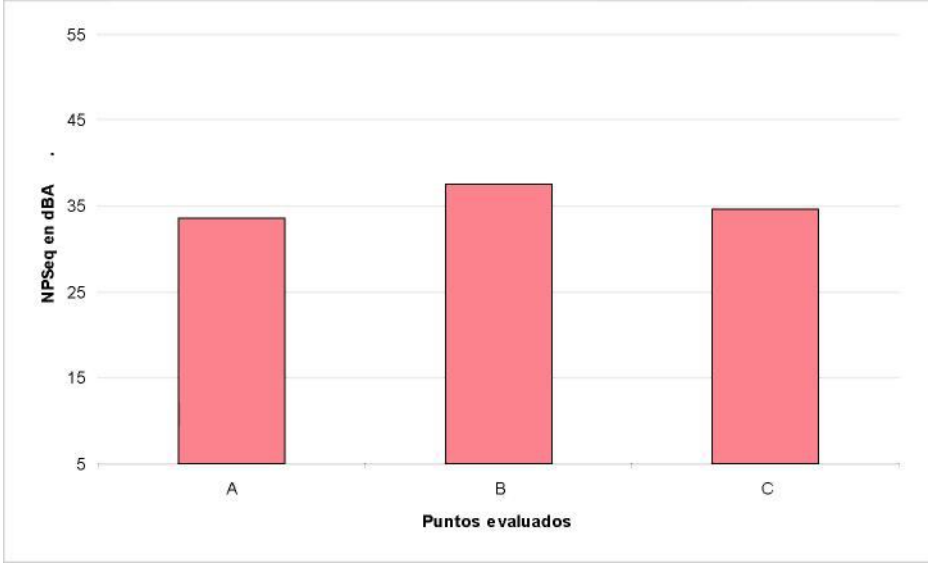
The previous table mentions the noise level forecast only for the nearest electricity line to the receptor in the assessed points. The actual scenario considers the two lines, where in worst case scenario, both lines will emit the NPSeq presented in the previous table in the receptors, therefore the noise level projected in the assessed points will be, as maximum, as indicated in the following table:

Figure 5-12 Noise level forecasts. Operation stage considering both lines

Point	Distance (meters)	Estimated NPSeq (dBA)
A	30	36,5
B	35	40,6
C	80	37,7

Source: Self Elaboration.

Figure 5-7 Noise levels forecast. Operation stage (worst case scenario: both lines functioning at same distance from receptor)



Source: Self Elaboration.

The noise level associated to the operation of both transmission lines in the assessed points vary between 37 and 41 dB(A).

Assessment related to D.S. Nº 146/97.

All the measuring points are located in rural zones, therefore, the maximum noise level will not pass the noise baseline level over 10 dB(A).

Because the operation of the line is continuous, the level of noise generated during day and night time has been considered, as it is presented in the following tables:

Table 5-13 Forecast levels assessment Construction stage - Daytime

Point	Forecast level (dBA)	Daytime limit D.S. Nº 146/97.	Excess (dBA)	Does it comply with the standard?
A	36,5	62	0	yes
B	40,6	68	0	Yes
C	37,7	56	0	yes

Source: Self Elaboration.

Table 5-14 Forecast levels assessment Construction stage - Night-time

Point	Forecast level (dBA)	Daytime limit D.S. Nº 146/97. (dBA)	Excess (dBA)	Does it comply with the standard?
A	36,5	62	0	yes
B	40,6	68	0	Yes
C	37,7	56	0	yes

Source: Self Elaboration.

The noise levels projected during the operation stage comply with the maximum level of day and night noise established by D.S. Nº 146/97 of MINSEGPRES.

ii) Environmental impact synthesis

According to the information previously presented, it has been identified as associated impact to this component, the generation of permanent noise over the receptors near the Project, due to energizing of the lines. The valuation of itself for operation stage is presented in the following table.

Table 5-15 Impact valuation matrix. Noise Component. Construction stage

MEANS: Physical		COMPONENT Noise					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■ Energizing of the lines during daytime.	IR2: Generation of permanent noise over receptors near the Project	Point A	-	Rec	Per	Dir	Ba
		Point B	-	Rec	Per	Dir	Ba
		Point C	-	Rec	Per	Dir	Ba
■Energizing of the lines during night-time.	IR2: Generation of permanent noise over receptors near the Project	Point A	-	Rec	Per	Dir	Ba
		Point B	-	Rec	Per	Dir	Ba
		Point C	-	Rec	Per	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IR2: Permanent noise generation over receptors near the Project

For the establishment of the impact magnitude it has been considered the same criteria pointed out for IR1.

Noise levels associated to the operation of the Project (corresponding to energizing of the lines) will not exceed day and night time noise limits established by D.S. Nº 146/97 in the assessed points, therefore, the impact magnitude is *low*; as consequence, this impact has been assessed as MINOR NEGATIVE.

3.3 Geology and Geomorphology

According to the features of the Project, the carry out area of itself, does not foresee the generation of significant effects on the Geology and Geomorphology components during the construction and operation stages. Technical information is presented next.

3.3.1 Construction stage

The works associated to the construction of the Project will not imply relevant effects in the Geology and Geomorphology components, this because the necessary works for construction of the foundations will be surveyed and will not compromise neither geology nor geomorphology units existing in such place.

In fact, the land movement necessary in this Project is related to the construction of foundations of the 61 structures to be assembled (considering both lines). In order to do this task, it will be necessary to move 1.300 m^3 of materials, out of which near 50% will be used as foundation filling, while, the rest of the material will be displaced near the foundations[13], taking care of keeping the original shape of the land, without generating topographic alterations.

Additionally, restoration measurements in order to leave the land in similar conditions to the original state are contemplated. When considering forestry measures for management of native vegetation existing in the restricted strip area, as well as other criteria presented in Annex 2, avoids leaving the land bared empty, minimizing the possibility of developing erosive processes associated to washing off it due to rains.

3.3.2 Operation stage

The operation of the Project does not contemplate activities that may directly alter the Geology and Geomorphology components of the area, because these will correspond, mainly, to maintenances of the structures.

3.4 Use and quality of land

3.4.1 Construction stage

i) Environmental impact analysis

Most of carry out area of the Project is located over lands with use capacity VI, VII y VIII, with low interest from the agriculture point of view, but where there is arborean and bush vegetation. This vegetation complies with a fundamental role to protect the existing land features, especially in the high slope sectors.

As it is considered in this Project, pruning according to its forestry criteria and, at the same time complying with the standard NSEG 5 En 71, it is avoid leaving the land bare, and in consequence, minimizing its deterioration associated to the weather elements, mainly showers.

A layer of approximately 10 cm thick of material will be placed in the carry out of the tower area, taking into consideration that every tower will use a surface of approximately 12*12 m.

ii) Environmental impact synthesis

According to the land resource features presented in the analyzed area (see point 2.4 of Chapter 4 and Appendix 9) and the description of the Project (Chapter 1), the impact generated over this component is related to the loss of land surface in the installation area of the towers foundations. Valuation and analysis of itself, is presented next.

Table 5-16 Impact valuation matrix Use and quality of land component Construction stage

MEANS: Physical		COMPONENT Use and quality of lands					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
Land movements. Construction of foundations.	IS1: Clearance and surface loss of land in the carry out area of the foundations.	Carry out area of the foundations of the towers of the Project	-	Irr	Per	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IS1: Clearance and loss of land surface on the carry out area of the towers

According to the information presented in Annex 9, about 3 kilometers of the line to be established between Alfalfal II Power Station and S/S Alfalfal, will be located near Aucayes stream, where the land resource is characterized by be comprised of a low evolved rocky matrix; there it is possible to differentiate an early stratum of land not going further than 3 cm thickness. From the analyzed resource point of view, due to the virtually no existence of land with agricultural purposes in this area, it has been decided to exclude this area to assess the effects of this impact.

As consequence, the clearance impact and loss of surface of land associated to construction of foundations of the towers (from the land movement) will have a greater expression in zones preferably flat, where if there is minor evolution of land resource and it is possible to find a stratum with a greater thickness (up to 15 cm). Nevertheless, in these areas the capacity of the use of land reaches, in the best cases, to VI type being feasible to use, although with limitations, for forestry and grazing.

Without prejudice of the above, it is important to mention that the Project contemplates the limitation of the areas where the foundations will be built, in order to narrow down the surface of intervention, and avoiding the unnecessary lessening of this resource, as well as the present vegetation in its surroundings. These interventions will be specific and will affect the approximate total surface of 0,9 ha considering the establishment of 61 towers[14].

[14] According to the information presented in Chapter 1, each tower will use an approximately surface 12*12 m, nevertheless, the effective surface that the four foundations will use per tower is lower than: 13 m^2 (considering four foundations of 1,8*1,8 m, corresponding to the anchored blocks which will be established in the line between Alfalfal II Power Station and la S/S Alfalfal).

As consequence, it has been considered that the impact will be of *negative* character because there will be an effective loss of this resource; *irreversible* and *permanent* due to once the land movements and the construction of the foundation is done, land will be lost; of *direct* type and *low* magnitude due to the land surface to be lost is specific and small in terms of extension.

It is important to point out that it has not been considered the surfaces associated to S/S Alfalfal, because this area is already intervened (current cemented surface).

As summary, this impact has been classed as MINOR NEGATIVE.

3.4.2 Operation stage

The operations of the project contemplate, among other activities, the periodic development of pruning in the restricted tripe sector, which its objective is the compliance of the electricity standard without damaging vegetation existing in that area. According to the information presented in Annex2, this activity will be done in determined areas under the forestry criteria, whose objective is to avoid cutting vegetable species presented in the restricted strip, and even incline to improve the vigor of them.

When considering the permanent existence of a vegetation cover on the carry out area of the Project (pruning is to be done), avoids the exposure of this land to erosive agents, so it will not lose quality, therefore, the operation of the Project should not take alterations in the capacities of the originally identified uses (see Annex 9). From that point of view, the operation of the Project has been considered not to have significant effects over this resource.

As summary, it has not been identified any impacts over the land resource in operation stage.

3.5 Hydrology and Hydrogeology

The works contemplated by the Project during construction and operation will not have significant effects over this environmental component, therefore, will not modified the existing hydrology and hydrogeology characteristics in this sector. The analysis performed is presented in the following paragraphs.

3.5.1 Construction stage

The analyzed Project does not contemplate the establishment of structures nor installations in the river courses or ravines existing in the area, or the discharge of waters to them.

When considering vegetation pruning in the restricted strip under the forestry criteria (and not logging), avoids:

- direct exposure to the ground to the erosive action of rain, with the consequent washing off of itself, and
- increase of surface run-off towards the existing courses.

With regards this aspects, the works of the Project will not constitute relevant effects on the hydrology component, therefore will not affect the features of the river courses or streams of

ravines present in the area, neither will generate pollution to the superficial waters, nor will underground, because discharged of solids or liquids, or of any nature, not be done.

On the other hand, it is important to register that in the carry out area of the Project there is a predominance of superficial rock units with almost no characteristics of permeability (practically permeable). The only activity to analyze for the component here studied is associated to the foundations construction in an anchored block, which would be 3 to 6 meters depth and precisely, due to the conditions of exposed permeability, there are no impacts associated. In the case of river terrace deposits generated from Colorado river and Aucayes stream, at underground water level is over 10 meters depth, there are no impacts related to the hydrology component as well.

3.5.2 Operation stage

Due to the characteristics of the Project, intervention of the pouring of waters to the existing river courses in the area is not contemplated; this is why impacts associated to these environmental components have not been identified.

4 IMPACT ASSESSMENT ON BIOTIC MEANS

In this section, the impact assessments on biotic Means which will be generated in the construction and operation stages of the Project are presented. The assessment is performed over the flora and vegetation components, such as vertebrate fauna.

4.1 Flora and vegetation

4.1.1 Operation stage

i) Environmental impact analysis

For the environmental impact assessment in the study area, it has been considered the geographic zone corresponding to the influence area of the Project (see figure 1 of Annex 11, figure 4-20 and 4-21 in Chapter 4), as well as identified species in such area.

The local flora is comprised by a total of 144 species of vascular flora belonging to 106 genres in 49 families. This entities area divided in 115 indigenous species and 29 allochtonous species according to their geographic origin. Four species (4) with conservation problems were detected: one suculenta Rara (*Austrocactus spiniflorus*) and three (3) vulnerable, out of which are less frequents *Kageneckia angustifolia* (Franjel), which is only located in an inventory (in PMF8, see Annex 11), mainly due to the location of the layout out of the preferential distribution area of this specie which is slightly superior in terms of altitude; *Puya berteroana* (chagual) registered in three inventories, given its preferable distribution in rocky areas of warm exposition (see components north and west; PMF 2, PMF 4 and PMF 7; see Annex 11). The rest of the species currently classified as vulnerable (*Pyrrhocactus curvispinus*: Quisquito) is a frequent entity, which should not have problems avoiding its damage in particular.

The Project contemplates pruning of vegetation which is in the restricted strip areas presented in Chapter 1; this activity, together with the foundations construction, will be carried out in such a way to prevent cut, elimination, destruction or grubbing-up of the native species which are presented in a conservation category.

It is important to add that the layout design and carry out area of towers has had a series of adjustments, in order to avoid native tree logging that is not part of the conservation category. Nevertheless, in case of not being possible to re allocate the foundation of the towers, the individual rescue will proceed, which it is specified in Annex 2, in order to prevent impact on this one. It is important to clarify that this activity will not affect, under any circumstances, native species on conservation category.

ii) Environmental impact synthesis

The impact pointed out is associated to the decrease of vegetative coverage. Valuation and assessment of this impact is presented next.

Table 5-17 Impact valuation matrix. Flora and vegetation component Construction and operation stage

MEANS: Biotic		COMPONENT Flora and vegetation					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■Enabling and maintenance of the restricted strip with agricultural, livestock and forestry and pruning methods only in areas to be	IFV1: Decrease of arborean foliage cover	protected strip	-	Rec	Tem	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IFV1: Decrease of arborean foliage cover

This impact refers to the decrease of the arborean foliage cover associated to pruning of trees present in the protected strip, in order to comply with the electricity standard.

This impact has been qualified as *negative* because there would be a decrease in the vegetation cover, altering the condition that is currently present in the area; *recoverable* as long as the complementation of a procedure for pruning although reducing the tree foliage, is prone to have a better development of them; *direct* and *low* magnitude due to the restriction strip considers a total surface lower than 60 ha, out of which is needed pruning to an even lower surface, considering the areas without vegetation, or individuals with altitudes lower to the limits established by the electricity standard (see map and logging surface in Annex 2).

As synthesis, this impact has been assessed as MINOR NEGATIVE; nevertheless, the environmental management measures presented in section 3 of Chapter 6 are incorporated.

4.2 Vertebrate fauna

4.2.1 Construction stage

i) Environmental impact analysis

For identification and assessment of the impacts, the same geographic area identified as Flora and vegetation component has been considered.

In the area of study at least 27 species have been sighted, out of which 20 are birds, 5 are reptiles, and 2 are mammals, not been registered amphibians (although it is possible to have their presence). Out of the total amount of species, seven (this is 25.9%): 5 lizards, the Condor, and one mammal (the Culpeo fox) there are some of 5 "conservation states" defined by SAG (2006), being considered as vulnerable 5 species, 4 lizards: *Liolaemus lemniscatus*, *L. nigroviridis*, *L. monticola* and *L tenuis*, and the cóndor (*Vultur gryphus*), while it is considered as inappropriately known specie: the culpeo fox (*Pseudalopex culapaeus*), and one specie catalogued as non-endangered: *Liolaemus fuscus*.

ii) Environmental impact synthesis

Given the attributes of the present fauna in the direct influence area of the Project, the impact identified will be developed, mainly, during the construction stage. Identification and valuation of it is presented in the following table.

Table 5-18 Impact valuation matrix. Fauna Component. Construction stage

MEANS: Biotic		COMPONENT: Vertebrates fauna					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
■Transport of the personnel and goods to and from the working faces and wastes to the installation works area. ■ Operation of trucks, equipment and machineries. ■Land clearance of structure constructions. □ Land movements. □ Construction of foundations. ■Fillings. ■Land clearance of structure constructions. ■Assembly of the structures and equipment of the S/S.	IF1:Alteration of the quality of Habitat	Installation of towers area	Ca	Re	Te	Ti	Mg
			-	Irr	Pe	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IF1: Alteration of the quality of Habitat

By virtue of the results presented and the characteristics of the Project, it can be concluded that the activities carried out during the construction stage will have a *low* magnitude for the directly affected vertebrates fauna, so the effective altered area does not exceeds 0,9 ha total; *non recoverable* due to this areas will not return to its natural state and *permanent* in time. The group with highest risk assessed corresponds to reptiles, all of them considered as endangered and of low mobility.

According to the information previously stated, this impact has been assessed as MINOR NEGATIVE. Nevertheless, with the goal of mitigating the loss of the areas directly affected, in section 3 of Chapter 6, the corresponding measures of environmental management are presented.

4.2.2 Operation Stage

In the study area at least 27 species where seen, out of which 20 are birds, 5 are reptiles and 2 are mammals, not registering amphibians (although their presence might be possible) Out of the recognized birds, one of them is in the conservation category, specifically vulnerable, and it corresponds to the cóndor (*Vultur gryphus*).

i) Environmental impact synthesis

Given the attributes of the present fauna component in the direct influence area of the Project, an impact has been identified which will be developed, during the operation stage. Valuation of it is presented in the following table.

Table 5-19 Impact valuation matrix. Fauna Component. Operation stage

MEANS: Biotic		COMPONENT Fauna					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■Existence of new lines.	IF2: Possible bids collisions with new lines	Mainly in rivers crossings	-	Irr	Per	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IF2: Possible bird collisions with new lines

By virtue of the characteristics of the Project and the raising of the base line, it is possible to establish that its operations should have an impact of *low* magnitude in the vertebrates' fauna of the area, especially in birds' life, because there is the possibility that this may collision with new lines.

It is important to mention that the risk of electrocution of birds in the transmission lines of 45 kV, or more, is unlikely, given the gap between the conductors.

As consequence, this impact has been assessed as MINOR NEGATIVE.

5 IMPACT ASSESSMENT ON HUMAN MEANS

In the following pages the potential impact assessment of the human means of the project, both in construction and operation stages is presented. This comprises the following components: Social Means, Cultural and Archaeological Heritage, Landscape and Tourism.

5.1 Social means

5.1.1 Construction stage

i) Environmental impact analysis

The project will not alter the constituent characteristics of human groups present in its surrounding, considering the direct and indirect influence area pointed out in Chapter 4. The analysis of each one of the dimensions considered to assess the potential impacts was done according to the Criteria Guidelines for Assessing the Significant Alteration of Life and Costumes of Human Groups System in SEIA.

With regards the geographic/demographic Dimension, the Project will not alter in a significant way, the organization of human group spaces, or the communicational and transports flows. In fact, the high tension line is a transparent infrastructure, to a large extent, allowing the communications and transport flow in a totally fluent fashion. It is important to set down that the lines will not cross the existing villages (Los Maitenes and El Alfalfal).

Regarding the demographic Dimension, the Project assumes employment limits the amount of labor (145 workers/month maximum) during a relatively short period of time (two years approximately) which it does not mean an alteration of the demographic conditions on the carry out area of it, especially when the implementation of camp sites is not set out.

In terms of the anthropological Dimension it can be stated that the Project in all of its activities will not consider the loss of local cultural/subcultural components, nor an alteration in the traditional communication system, neither a social and community organization loss or from the sense of root to the territory. In fact, the Project, due to its features, will not intervene in any special demonstration of local culture/subculture or the built or natural means of the area that might produce a lessening on this field.

The Project will not affect the socio-economic Dimension while it will be established in non-populated areas and belonging to National Property. Additionally, the high tension lines are compatible with the development of the forestry, farming and forestry, farming and livestock works. By its part, the extension of S/S Alfalfal will be done in the premises of the already mentioned S/S, so it will not generate modifications on the land uses of such place.

The Project, due to its dimensions and features, will not mean a relevant impact on factors associated to social well-being Dimension of the adjacent village.

ii) Environmental impact synthesis

In function of the information previously stated, as well as the features of the Project, it has been determined that the impacts on this component will only occur during the construction stage, and they are directly related to the labor contracting. It is important to register that for the social Means impact assessment has not been considered those contemplated in other components such as use of land, roads and noise, which are registered in the corresponding paragraphs.

In this way, the impact identified during the construction stage is identified and valued in the following table.

Table 5-20 Impact valuation matrix. Social means component Construction stage
■ Labor hiring.

MEANS: Human		COMPONENT Social means					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■ Labor hiring.	IMS1: Generation of direct jobs	Province of Santiago and Cordillera	+	Rev	Te	Di	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IMH1: Generation of direct jobs

During the construction stage, the Project will require qualified and non-qualified labor. Because of operational and economic reasons, it is very likely that big part of the hired labor will come from the provinces of Santiago and/or Cordillera. It is calculated 115 workers, as medium amount, during the approximate 24 months of construction of the Project, with a peak of 145 workers/month.

The impact is qualified as *positive* and *temporary* given its effects are restricted to the period of construction stage. It is considered a *direct* type of impact in which the jobs generated by the Project such as (jobs that will be managed under contractors mode) and *low* magnitude due to the low number of jobs generated with regards the population of the provinces mentioned.

As consequence, this impact has been assessed as MINOR POSITIVE.

5.1.2 Operation stage

With regards the geographic/demographic Dimension, the Project will not alter the organization of human group spaces, nor the communicational and transports flows.

Maintenances will be occasional and performed by the personnel who currently execute these activities in the rest of the lines and substations in AES Gener S.A., therefore new workers related to the operation of this Project will not be hired. Similarly, in S/S Alfalfal will not require additional workers for the extension operations, due to this task will be taken by the personnel of this one.

The operation of the Project does not consider alterations in the anthropological Dimension because it contemplates the loss of local culture/subculture components, nor alterations in the traditional communications system, nor a loss in the social and community organization or the sense of root to the territory. In fact, the Project will not intervene in any special demonstration of local culture/subculture nor the built means or natural of the area that might produce a lessening on this field.

The Project will not affect the socio-economic Dimension because there will not be alterations in the economic activities developed in that area.

The Project, due to its dimensions and features, will not mean a relevant impact on factors associated to the social well-being Dimension of the adjacent village.

5.2 Archaeological and Cultural Heritage

5.2.1 Operation and construction stage

In the base line study of the Archaeological and Cultural Heritage has been determined the absence of elements of archaeological, paleontological, historic and/or anthropological character in the area to be carried out the Project (see section 6 of Chapter 4 and Annex 14).

Nevertheless, as preventive measure in front of an eventual finding of these type of remains during the land movement activities (excavations), an archaeological monitoring is contemplated, which will be extended during the whole period where this activity is developed during construction stage (see measure in section 4 of Chapter 6).

In case of finding any site or archaeological remain during the construction stage in the carry out area of the Project, works will be stopped and the fact will be reported to the competent authority, the Provincial Governor, which will order Carabineros to guard the location until the National Monuments Council takes charge of it, as it is established in article 23 of the Law Regulations N° 17.288.

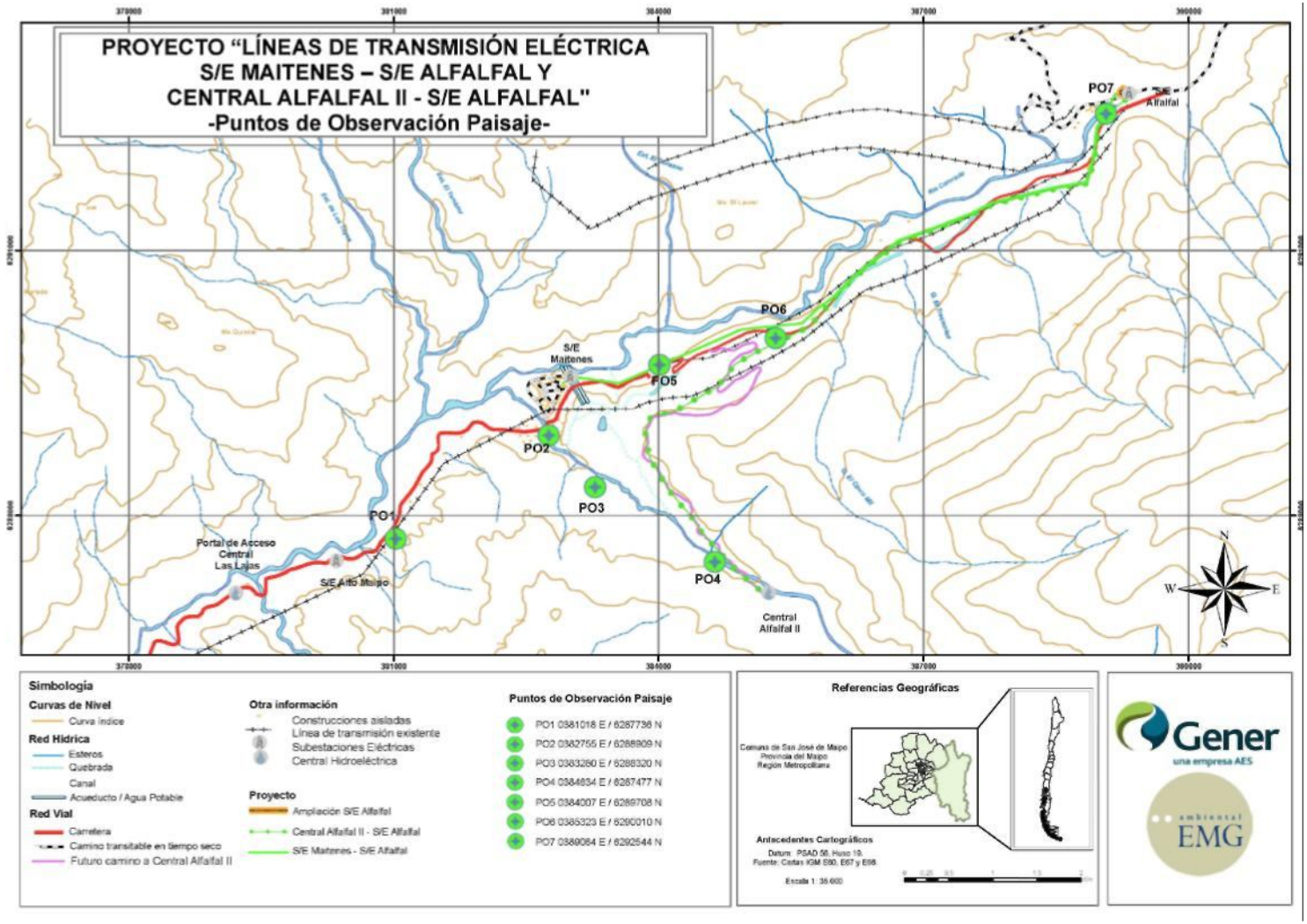
5.3 Landscape

5.3.1 Construction stage

i) Environmental impact analysis

For the impact identification and assessment, the carry out area of the Project was visualized from determined observation points in land, from visual access, as building areas with interest potential where the forecast installations could be observed (see Figure 5-8). In this way, the possible impacts that might affect the component in construction and operation stage were identified.

Figure 5-8 Landscape observation points



Source: Self elaboration based on IGM E60, E67 and E68 letters scale 1:50.000.

ii) Environmental impact synthesis

During the construction stage is foreseen the generation of impacts on the landscape component associated to the alteration of visual quality in UP1 (Colorado River Canyon), UP2 (Mountain chain) and UP3 (Aucayes Stream); similarly, it has been considered that singular areas and/or landscape areas will be altered. Valuation and analysis of the impacts before mentioned are described next.

Table 5-21 Impact valuation matrix Landscape Component. Construction stage

MEANS: Human		COMPONENT Landscape					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■Assembly of the structures and equipment of S/S. ■Enabling of the restricted strip with forestry and pruning methods only in areas to be corresponded. ■Lay up and tightening of the conductors.	IP1: Alteration of the visual quality of the landscape	UP1: Colorado river Canyon	-	Irr	Per	Dir	Ba
		UP2: Mountain Chain	-	Irr	Per	Dir	Ba
		UP3: Aucayes Stream	-	Irr	Per	Dir	Me
	IP2: Alteration of the views to singular and/or landscape interest areas	UP1: Colorado river Canyon	-	Irr	Per	Ind	Ba
		UP2: Mountain Chain	-	Irr	Per	Ind	Ba
		UP3: Aucayes Stream	-	Irr	Per	Ind	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IP1: Alteration of the visual quality of the landscape

The alteration of the quality of the landscape is an impact defined by the modification of some of its components; this is morphology, vegetation, fauna, water, anthropic action, scenic fond and singularity or rareness. If any of these components may be affected, directly decreases the visual quality of the analyzed landscape.

From this point of view, UPI (Colorado river Canyon) is currently intervened with small villages and isolated houses, besides crops (especially forage and fruits), diverse industrial facilities (Rio Colorado Mine and existing substations) and cables, where works associated to the construction of Alfalfal II Power Station and Las Lajas (Access entrance to Las Lajas Power Station and duct intake and discharge works of Alfalfal II Power Station); this last element will modify the baseline situation registered in this EIA at the moment of starting construction of the Project.

The new elements to be incorporated to the landscape because of the construction of the Project will be permanent (S/S Alfalfal extension, cables and towers) and temporary (working faces, with vehicles and corresponding machineries), enabling a restrictive strip in

sectors determined in the layout including, if necessary, pruning of trees as well. Taking into consideration the features of the Project, the main component affected by UP1 is the anthropic action, in spite of the above; the works associated to the Project will have a minor relevance, considering the amount of existing works that at same time have high presence in the analyzed areas.

A similar situation occurs in UP2 (Mountain chain), where the current scenic quality is affected by non-harmonious modifications, mainly the existence of some electricity transmission lines, with its corresponding towers, which can be seen form the shady and sun trap hillsides of the mountain chain which is presented around the Colorado river. Also in this area, the Route G-345 is located, frequently used by trucks from Rio Colorado mine. In this sense, the incorporation of new structures of the Project will present a negative alteration, but of low magnitude, due to this type of elements are not alien to the current situation exhibited in this Unit.

In UP3 (Aucayes Stream) part, there are no great anthropic interventions at the moment, therefore the incorporation of new permanent elements (cables and towers), as well as enabling the restrictive strip, could generate a mid to high magnitude impact. This assessment is basically done for the carry out of new structures, which in relation to the landscape and potential of observation, are highly visible, as well as the variation in the original architecture of the vegetation species. Never mind the above, and as how has been stated in this study, to the execution date of the works, it is foreseen that this sector will already have some alterations associated to Alto Maipo Hydroelectric Project (due to the constructions of a cement road of 10 m width approximately and near to the works associated to Alfalfal II Power Station), being the reason of alterations on the basal quality registered in the area.

As result of the above, it has been considered that the IP1 impact will be of *negative* impact, *irrecoverable, permanent* and *low* magnitude and for UP1 as well as UP2, due to the carry out area has anthropic alterations and its type of landscape is type III[15]. As consequence the impact has been assessed as MINOR NEGATIVE.

In the case of UP3 part, this impact has been qualified as *negative*, *irrecoverable, permanent* and magnitude *medium*, because although the area will be altered at the moment of starting the works of the Project, this presents a landscape class type II[16], where the development of activities is much more restrictive with regards the other units analyzed. Therefore the impact has been assessed as MITIGATING NEGATIVE and it will be object of environmental management. The corresponding measures are presented in section 3 of Chapter 6.

[15] Landscape Class III: Visual quality Zones and variable Visual Fragility that might be incorporated to the previous category when the circumstances suggest it, that is, if any element assessed require protection due to its individual value. Its degree of variable restriction allows a greater level of pressure over the landscape, but does not accept strong landscape impacts (for instance: residential areas, civil works of low impact, etc.).

[16] Landscape Class II: High Visual Quality and mid or low Visual Fragility Zones, suitable for the promotion of activities that require landscape quality and might cause impacts of low entity in its landscape. Its restriction degree of use is high (for instance: general tourism, low impact projects or that may add landscape value, etc.)

IP2: Alteration of the views towards singular and/or landscape interest areas

According to the lifting of the base line, the study area in its three units present minor milestones and interest zones, specifically waterfalls and rocky burst, where color and texture of the rocks constitute a visual traction.

It is foreseen that the existence of the Project could alter the perception towards singular and/or landscape interest areas due to the installation of towers and lay up, that may obstruct the views towards these areas.

Taking into account the above, this impact has been valued as *negative* and *permanent* because the structures will be established in this area during the lifespan of the Project; *indirect* due to the perception of the singular and/or landscape interest areas depending on the observation site and of the person contemplating at them; and magnitude *low* magnitude because the works of the Project, if obstructing the views, will be just partially, besides, the general area analyzed currently presents this type of infrastructure. Due to the above, this impact has been assessed as MINOR NEGATIVE.

5.3.2 Operation stage

i) Environmental impact analysis

The operation of the Project will take periodic maintenance activities, both for structures as the restrictive strip. Considering these aspects, together with the quality and visual fragility of the landscape units analyzed, it has been considered including an impact over this environmental component during the operation stage.

ii) Environmental impact synthesis

During the operation stage the impacts indicated in the following table are considered.

Table 5-22 Impact qualification matrix. Landscape Component. Operation stage

MEANS: Human		COMPONENT Landscape					
ACTIVITIES	IMPACT	LOCATION	VALUATION				
			Ca	Re	Te	Ti	Mg
■Maintenance of the restricted strip with forestry and pruning methods only in areas to be corresponded. ■Existence of lines and structures.	IP1: Alteration of visual quality of the landscape	UP1: Colorado river Canyon	-	Irr	Per	Dir	Ba
		UP2: Mountain Chain	-	Irr	Per	Dir	Ba
		UP3: Aucayes Stream	-	Irr	Per	Dir	Ba
	IP2: Alteration of the views towards singular and/or landscape interest areas	UP1: Colorado river Canyon	-	Irr	Per	Dir	Ba
		UP2: Mountain Chain	-	Irr	Per	Dir	Ba
		UP3: Aucayes Stream	-	Irr	Per	Dir	Ba

VALUATION CRITERIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), non-recoverable (Irr)]; Te= Temporariness [Temporary (Tem), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergy (Sin), Accumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Self Elaboration.

IP1: Alteration of visual quality of the landscape and IP2 Alteration of the views towards singular and/or landscape interest

According to the backgrounds, it is foreseen that the greatest impact in terms of landscape will occur during the construction stage, because it is the first moment where its original condition (baseline quality) will be altered through the establishment of new permanent and temporary elements.

In this stage, the maintenance tasks (mainly the pruning in the restrictive zone) will have a variable effect according to the behavior of the vegetation facing this management, which would be appreciated with greater clarity right after pruning, which will decrease gradually according time passes up to the next maintenance.

In consideration to these aspects, the impact has been catalogued as *negative*, *irrecoverable* and *permanent* due to safety reasons it requires to periodically do some pruning during the whole lifespan of the Project; *direct* and *low* magnitude because the area is already been intervened, and maintenance of the restrictive strip constitute a minor area within the landscape units considered for the analysis; in the same way, the elements comprising the landscape, such as vegetation, will suffer from a partial alteration and not a loss of its main attributes. This is the reason why the impact has been qualified as MINOR NEGATIVE.

5.4 Tourism

5.4.1 Construction and operation stage

The area of study corresponds to the Colorado River sector, within San José de Maipo municipality, which has been declared as ZOIT by SERNATUR according to R.E. N° 1130/01

November 2001. According to this resolution, San José de Maipo municipality, Metropolitan Region:

- Counts with tourism attractive of hierarchy, of permanent character, suitable to sustain an intensive tourism development.
- Allows the development of tourism activities, leisure and/or cultural along related to tourism resources supplied, therefore the area counts with special aptitudes for development of current and potential tourist products.
- It presents conditions proper for capturing the current and potential tourist demand.
- It has conditions of current and potential accessibility.
- When facing an intensification of demand, it presents conditions of vulnerability of its resources[17], due to the lack of proper receptive conditions, being necessary to have preservation and/or value measures.
- Lacks of an instrument of physical planning (territory) according to the aptitude and tourism vocation identified for such area.
- It requires coordination measures for provisioning infrastructure and basic utilities focused on the tourism activities of the area.
- It was considered by the National Tourism Service as priority for tourist development of the region.

Particularly, the area of influence of the Project, this is the Colorado river Canyon and Aucayes stream, the existence of two tourist attractions were identified according to Sernatur Land Registry (2007)[18]. The first one, of folk character, deals with Los Maitenes location identified mainly with Los Maitenes Power Plant, dated from 1923; the second one associated to Alfalfal. Both locations are related to the existing power facilities, and constitute an attraction that has to do with them. The Colorado River is the scenario of tourist activities that are still incipient and informal, such as horse riding, climbing, trekking, etc. It has been identified specific activities of mountaineering, which is developed in the upper part of the mentioned river, and horse rides in some specific areas through informal operators carried out in Alfalfal area. From the tourist scheme view, the influence area only counts with one hostel in Los Maitenes town (see details in Annex 16).

In the Communal Development Plan (PLADECO)[19], the Colorado Canyon is defined as tourist attraction zone, highlighting the current activities developed and stimulating its projecting towards the future. This Plan shows that the zone has a scarce tourist development but a great potential to improve its levels of progress.

[17] It is understood as "tourist resource" the existence of tourist attractions that will motivate trips to this area. Sernatur (2008) Tourism Glossary Technical bulletin N°1/2008. Department of Planning.

[18] National Tourist Service (2007). Communal tourist attraction land registry 2007, SERNATUR. Chile, Santiago.

[19] Urquieta y Domínguez Consultants(2004). Communal development Plan of San José de Maipo, Illustrious Municipality of San José de Maipo. Santiago, Chile, 7 v.

As synthesis, the result of the base line gives us as main feature the scarce tourist supply (in relation to attractions, activities and tourist scheme), the growing demand and the potential growth, expansion and consolidation of some initiatives.

From this perspective, the Project does not produce alterations of existing tourist activities in the Colorado river area due to the works will be concordant to the existing power facilities. It is worth to mention that the facilities of the Project will be part of the landscape of the municipality, which currently has hydroelectric power plants and transmission lines, which are part of the surroundings from the first half of the XX century.

In Aucayes stream area the construction of an access road of the Alto Maipo Hydroelectric Project is projected, already environmentally assessed, whose layout is used for the construction of the high tension lines. In this context, the tourist development of the Aucayes stream area is boosted with such road infrastructure availability. This means that, although the tourist potential of the zone was visualized for development of tourist activities according to the non-intervened natural attractive, the presence of this road will modify this situation repositioning it to the activities that would use the access towards this area and its surroundings. It considers its potential activities such as visits to the stream, picnic, walks, trekking and excursions, associated to non-specialized tourism.

In this sense, it is foreseen that the construction of the Project, specially the construction of the high tension towers at the edge of the road, would affect in a negative way the landscape, factors that has been already assessed in IP1 (see page 5-28).

In synthesis, the activities and works associated to the Project should not generate impacts on the tourist activity of the zone.

6 IMPACT ASSESSMENT ON THE CONSTRUCTED MEANS

In this section the assessment of the potential impacts of the Project on the constructed Means, that is to say, over the energy and road infrastructure, both in the construction as in operation stages.

6.1 energy infrastructure

6.1.1 Operation and construction stage

The Project contemplates the construction of two new energy transmission lines and the extension of S/S Alfalfal, this with the goal of transmit the energy generated by the future power plants Alfalfal II and Las Lajas, which at the same time area part of Alto Maipo Hydroelectric Project. From this point of view, the Project here analyzed (Electric Transmission Lines Maitenes S/S - Alfalfal S/S and Alfalfal II Power Plant - Alfalfal S/S) will not alter the normal functioning of the existing power plants, substations and transmission lines, because these will continue generating and transporting energy from the power plants which are currently operating in the location (Los Maitenes and Alfalfal).

From this point of view, impacts associated to this component during the construction and operation stage of this Project are not foreseen.

6.2 Roads

6.2.1 Construction stage

i) Potential impact to be assess analysis

In order to determine the roads impact degree that the Project might generate over the identified roads in its direct influence area (see Annex 17), the service level of the road infrastructure existent (Current Situation) was analyzed, considering the normal transit demand in the periods where transport associated to the Project will effectively be done.

Then the Base Situation was determined, including the vehicle flows of normal transit on routes G-25 and G-345 forecast for the year 2011 together with the Alto Maipo Hydroelectric Project (PHAM), already environmentally assessed.

Finally the new flow associated to the construction stage of the Project are added to the flows of the Base Situation, determining the service levels for the "Situation With Project", which allows to review the differences between both scenarios and identify the magnitude of the road impact produced (low, moderate, severe) It is considered as "low impact" when there are no level changes; "moderate impact" when the change is produce at one level, and "severe impact" when the change is are at more than one level.

Analysis Periods

The schedule periods considered correspond to those where the flows of the Project will effectively use the mentioned roads, is worth to say, between 07:00 and 08:00 hours for entry to work and between 18:00 and 19:00 hours for coming back to Santiago, considering that

these will always be developed in circumstances when in La Florida Avenue has a transit towards the opposite direction.

Project Traffic Generation

In Table 5-23 y Table 5-24 details of the requirements of transport, for loads on trucks, people in buses and light weight vehicles towards the working faces, it is considered the maximum flow foreseen, fundamentally delimited by transport of elements comprising the high tension towers structures and the conductors.

Transit under the prior assumption that all the carry of the structures will be done at once, form San Antonio Port up to the storage area of the works (Maitenes Power Plant), which it represents the maximum flow generated by the Project.

For the structures and conductors transportation, trucks of semi-trailer type of 28 tons capacity of load will be used, while for the carry of personnel, buses with 40 seated people will be used.

Buses will leave every morning from Macul Station of Metro de Santiago, located at the intersection of La Florida Av. with Américo Vespucio Av. and will stay, as well as trucks, in the works facilities during the day of work; therefore they will do one daily trip in the morning and one to return in the afternoon.

It is worth to mention that the qualified and non-qualified labor require for construction of the line corresponds to an average of 80 people, reaching a maximum of 95 people working together in the different stages of the construction phase. The greatest amount of labor will be hired for the execution effects of the structures, organized in teams and comprising of a maximum of 11 people. In relation to the extension of the substation Alfalfal, it is estimated that it will require a maximum amount of 50 workers/day, which is translated into a mid-daily amount of 35 workers. This means a maximum of 145 people, which will be transported in four buses.

Table 5-23 Trucks flow generated by structures and conductors transportation

Type		Amount	weight (Kg)	Total(Kg)	TRK/DAY	TRK/HOUR
Structures	Maitenes - Alfalfal					
	Anchorage	15	7.800	117.000	4.2	0.42
	Suspensions	14	5.200	72.800	2.6	0.26
		Total		189.800	6.8	0.68
	Alfalfal P.P. II - Alfalfal					
	Anchorage	19	9.600	182.400	6.5	0.65
	Suspensions	13	6.300	81.900	2.9	0.29
		Total		264.300	9.4	0.94
	Structures total weight			446.300	16.2	1.6
				ROUND OFF	**17**	**2**
Conductors	Maitenes - Alfalfal			51.000		

Type		amount	weight (Kg)	Total (kg)	TRK/DAY	TRK/HOUR
	Alfalfal 2 - Alfalfal			57,400		
	OPGW (guard cable)			10,100		
	Conductors total weight			118,500	4.2	0.4
				ROUND OFF	**5**	**1**
Total					**22**	**3**

Source: Ambitrans Ingenieros Consultores Ltda.

Table 5-24 Project flow in routes G-25 and G-345. Critical day* (one direction traffic)

Type of vehicle		Daily flow	Time flow	Time flow approximated to whole
Trucks	Structures and conductors**	22	2,2	3
	Goods (concrete truck)	1	0,1	1
	Moisture	1	0,1	1
Buses***		4	4	4
Pick-up		4	4	4

Note: * Critical Day corresponds to that one done (at once) the whole transport of structures and connectors from San Antonio port up to the stock yard of Alfalfal Power Plant.

** Semi trailers of 28 tons capacity of load for transport of structures and conductors.

*** As buses and pick-up trucks stay in the facilities during the working day, therefore they do just one trip in the morning and another one in the afternoon.

Source: Ambitrans Ingenieros Consultores Ltda.

Levels of service estimation

The categories of service levels are defined in the following fashion:

- Service level A: It represents the free flow condition, with low levels of transit and high speeds to be chosen by the driver, being the only restriction of the legal limitations imposed by the physical conditions of the road.
- Service level B: It represents the stable flow condition with speeds of operation a bit restricted by the transit conditions.
- Service level C: It still represents a stable flow condition, but speeds and the maneuverability are closely controlled by the high volumes of transit
- Service level D: Marks the beginning of an unstable flow.
- Service level E: It cannot be described just by speed, but it represents operation conditions at even lower speeds that in service level D, with volumes representing almost the capacity of the road.

- Service level F: Describes the forced flow at low speeds and with volumes greater than the capacity of the truck. These conditions come generally from creation of long lines of vehicles due to some restriction in the road.

For rural tranches, the Volume 6 Methodology of the Roads Manual, allowing estimation of capacities and service levels in prevailing conditions, obtaining real numbers, based on values of ideal capacities, which are affected by physical reductions and operations on the road, such as the presence of heavy vehicles, carriageway width, side frictions, type of roads, tranches with adequate visibility, etc.

For the urban case and the main interurban intersections analyzed, the service level can be obtained from the estimation of the saturation (X) degree, which is an index of strictness of congestion, equal to the ratio between the demand (flow of vehicles) and the road supply (capacity). Congestion will be produced as long as X tends 1.

Nevertheless, usually for values of saturation degrees over 0.8, congestion starts to demonstrate itself as unstable in conditions of traffic on the roads and intersections, through speed reductions, difficulty to maneuver, etc.

According to Rahmi Akcelik "Calibrating SIDRA" publication from Australian Road Research Report Nº 180 de 1990, the service level according to the saturation degree, could be assesses with regards the following ranks:

Service level	Saturation degree (X)
A	$X \leq 0{,}60$
B	$0{,}60 < X \leq 0{,}75$
C	$0{,}75 < X \leq 0{,}90$
D	$0{,}90 < X \leq 0{,}95$
E	$0{,}95 < X \leq 1{,}00$
F	$1{,}00 < X$

Source: Ambitrans Ingenieros Consultores Ltda.

A summary, for the intersections involved in this study the analysis will be focused on determining if the eventual reduction of the capacity and the vehicle flow increase associated to the Project, leads to a drop in the current service level. For such effect, the SIDRA Traffic simulation model is used, which allows to simulate the operation of traffic in isolated intersections, delivering congestion indexes, such as saturation degree and impacts, delays, and increase on the length of the queue.

Capacity and service level in road tranches calculation

To calculate the capacity and service level of the rural road trenches, such as Route G-25 and Route G-345, the levels of service are analyzed using as base the Methodology proposed in Volume 6 of the Highways Manuel by the Ministry of Public Works (Chapter 6.803), whose method allows estimating the capacity of the routes in the prevailing conditions.

For these effects, the volumes of transit registered in the hours coincident with the transport associated to the Project, that is to say, between 7:00 and 8:00 in the morning (going) and between 18:00 and 19:00 hours (return), coming back at 18:00 hours from the works.

It is excluded from this analysis the tranche of Route G-25between Departamental and Eyzaguirre, because the calculation of its capacities does not correspond to this Methodology, but to a simulation of intersections with Sidra.

The tranches to be analyzed are the following:

- Tranche 1: Route G-25 between Eyzaguirre and Access to Route G-421 (Las Vertientes).
- Tranche 2: Route G-25 between Access to Route G-421 and Route G-345 (Access to Los Maitenes).
- Tranche 3: Route G-345 between Route G-25 and El Alfalfal.

Out of this tranche is necessary to subdivide Tranche 1 in the sub-tranches (1a and 1b), due to the difference in the width of the road. Therefore, Tranche 1a (double road) is extended between Eyzaguirre and La Obra, and Tranche 1b (simple road) between La Obra and access to Route G-421 in Las Vertientes.

Each defined tranche is analyzed according to its current geometric and operation conditions, considering three situations of different tranches, allowing determining the effect of commercial vehicles over the capacity of a road. These are:

- Flat land: is that one whose horizontal and vertical alignment allows the commercial vehicles to keep operational speeds similar to those in passenger's vehicles.
- Uneven Land: is that one whose horizontal and vertical alignment compels commercial vehicles to keep, in some sectors, reduced speeds, lower than passenger's vehicles. Trucks can reach operate at regimen speeds in short sectors.
- Mountain Land: It is that one whose horizontal and vertical alignment compels commercial vehicles to operate at regimen speeds in a continuous way. At the same time, the horizontal alignment imposes restrictions such as passengers vehicles are obliged to reduce its speeds due to this fact.

General features of the roads (design parameters)

The design parameters and relevant features used as input for application of the methodology before mentioned, are those detailed next.

Table 5-26 General road features

Parameter	Description as per tranche			
	Tranche 1a: Route G-25 between Eyzaguirre and La Obra	**Tranche 1b:Route G-25 between La Obra and Las Vertientes**	**Tranche 2: Route G-25 between Las Vertientes and Route G-345**	**Tranche 3: Route G-345 access to El Alfalfal**
Type of road	By-directional road double	By-directional road simple	By-directional road simple	By-directional road simple
Amount of lanes per direction	2	1	1	1
Lane width	3.5 m	3.0 m	3.0 m	3 m
Hard shoulder	3 m to both sides (average width)	0.5 m to both sides (average width)	0.5 m to both sides (average width)	0.5 m to both sides
Distance to side obstacles	1.8 m	1.2 m	1.2 m	1 m (average)
Conditions of overtaking	100% adequate	60% adequate	60% adequate	60% adequate
Average speed (VPC)[20]	110 K.P.H.	96 K.P.H.	96 K.P.H.	72 K.P.H.
Type of land	Flat	Uneven	Uneven	Uneven

Source: Ambitrans Ingenieros Consultores Ltda.

Capacity calculation and service level of the road

The following tables show the hours flow considered for the calculation of capacity and service levels in each tranche and scenario analyzed. The methodological detail is presented in Annex 17.

[20] Average speed of the road (VPC), corresponds to the weighted average of design speeds of the different elements comprising the road (curves and straight tranches).

Table 5-27 Vehicle flows (veh/hr) in both transit directions and percentage distributions per type of vehicle (Current year 2009)

Current situation 2009 DEPARTURE (07:00-08:00)							Current situation 2009 RETURN (18:00-19:00)						
Tranche N°1-a Route G-25 (2 lanes per direction), between Eyzaguirre and La Obra													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2009	1408	82	21	1511	vl:	93%	2009	1807	81	33	1921	vl:	94%
					Trk:	5%						trk:	4%
					bus:	1%						bus:	2%
Tranche N°1-b Route G-25 (one lane per direction), between La Obra and Access to Route G-421 (Las Vertientes)													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2009	297	55	24	376	vl:	79%	2009	224	27	18	269	vl:	83%
					trk:	15%						trk:	10%
					bus:	6%						bus:	7%
Tranche N°2 Route G-25, between Access to Route G-421 and Route G-345													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2009	203	29	24	255	vl:	79%	2009	171	18	17	205	vl:	83%
					trk:	11%						trk:	9%
					bus:	9%						bus:	8%
Tranche N°3 Route G-345 between Route G-25 and El Alfalfal.													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2009	24	12	9	45	vl:	53%	2009	33	4	1	38	vl:	87%
					trk:	27%						trk:	11%
					bus:	20%						bus:	3%

Source: Ambitrans Ingenieros Consultores Ltda.

Table 5-28 Vehicle flows (veh/hr) in both transit directions and percentage distributions per type of vehicle (Base year 2011)

Base situation 2011 DEPARTURE (07:00/08:00)							Base situation 2011 RETURN (18:00/19:00)						
Tranche N°1-to Route G-25 (2 lanes per direction), between Eyzaguirre and La Obra													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	1537	87	41	1665	vl:	92%	2011	1696	86	54	2109	vl:	93%
					trk:	5%						Trk:	4%
					bus:	2%						bus:	3%
Tranche N°1-b Route G-25 (one lane per direction), between La Obra and Access to Route G-421 (Las Vertientes)													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	336	65	44	445	vl:	76%	2011	256	36	38	330	vl:	78%
					trk:	15%						trk:	11%
					bus:	10%						bus:	12%
Tranche N°2 Route G-25, between Access to Route G-421 and Route G-345													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	233	37	44	313	vl:	74%	2011	199	26	36	260	vl:	76%
					trk:	12%						trk:	10%
					bus:	14%						bus:	14%
Tranche N°3 Route G-345 between Route G-25 and El Alfalfal.													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	35	16	21	72	vl:	49%	2011	44	8	13	65	vl:	68%
					trk:	22%						trk:	12%
					bus:	29%						bus:	20%

Source: Ambitrans Ingenieros Consultores Ltda.

Table 5-29 Vehicle flows (veh/hr) in both transit directions and percentage distributions per type of vehicle (With Project year 2011)

Situation With Project 2011 DEPARTURE (07:00 - 08:00)							Situation With Project 2011 RETURN (18:00- 19:00)						
Tranche N°1-a Route G-25 (2 lanes per direction), between Eyzaguirre and La Obra													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	1541	92	45	1678	vl:	92%	2011	1973	91	58	2122	vl:	93%
					trk:	5%						trk:	4%
					bus:	3%						bus:	3%
Tranche N°1-b Route G-25 (one lane per direction), between La Obra and Access to Route G-421 (Las Vertientes)													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	340	70	48	458	vl:	74%	2011	260	41	42	343	vl:	76%
					trk	15%						trk:	12%
					bus:	10%						bus:	12%
Tranche N°2 Route G-25, between Access to Route G-421 and Route G-345													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	237	42	48	326	vl:	73%	2011	203	31	40	273	vl:	74%
					trk:	13%						trk:	11%
					bus:	15%						bus:	14%
Tranche N°3 Route G-345 between Route G-25 and El Alfalfal.													
Year	VL	TRK	BUS	TOTAL			Year	VL	TRK	BUS	TOTAL		
2011	39	21	25	85	vl:	46%	2011	48	13	17	78	vl:	62%
					trk:	25%						trk:	17%
					bus:	29%						bus:	22%

Source: Ambitrans Ingenieros Consultores Ltda.

In the following table the summary of the capacities and service levels obtained in the analyzed tranches are presented.

Table 5-30 Summary of flow, capacity and service level

Scenario		Current 2009			Base 2011			With Project 2011		
Tranche	Direction / hour	Flow veh / hr	C veh / hr	Service level	Flow veh / hr	C veh / hr	Service level	Flow veh / hr	C veh / hr	Service level
1-a	DEPAR / 07:00-08:00	1511	3488	B	1665	3461	C	1678	3441	C
	RETURN / 18:00-19:00	1921	3536	C	2109	3514	C	2122	3497	C
1-b	DEPAR / 07:00-08:00	376	1125	C	445	1090	C	458	1075	C
	RETURN / 18:00-19:00	269	1189	B	330	1125	C	343	1103	C
2	DEPAR / 07:00-08:00	255	786	C	313	702	C	326	672	C
	VUELTA / 18:00-19:00	205	870	B	260	740	C	273	700	C
3	DEPAR / 07:00-08:00	45	423	C	72	395	C	85	374	C
	RETURN / 18:00-19:00	38	913	C	65	586	C	78	508	C

Note: C=Capacity

Tranche 1-a: Route G-25 (2 lanes per direction), between Eyzaguirre and La Obra

Tranche 1-b: Route G-25 (one lane per direction), between La Obra and Access to Route G-421 (Las Vertientes)

Tranche 2: Route G-25 between Access to Route G-421 (Las Vertientes) and Route G-345 (Los Maitenes).

Tranche 2: Route G-345 between Route G-25 and Working Faces.

Source: Ambitrans Ingenieros Consultores Ltda.

Modeling of isolated intersections

Modeling of the intersections was done for the following scenarios:

- Current Situation year 2009.
- Base Situation year 2011.
- Situation with Project year 2011.

The following tables show the capacity, service levels and saturation degrees obtained in each one of the analyzed intersections, both for the trajectory of departing and returning from the works.

Table 5-31 Capacity, saturation degrees and service levels in intersections (DEPARTURE trajectory)

INTERSECTION	RANGE					Current Situation 2009.							
		Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS
Nº 1: Av. La Florida / Av. Departamental	Av. La Florida (S)	2.635	1.757	1501,0	F	2.846	0,002	1617,0	F	2.846	0,002	1617,0	F
	Av. Departamental (E)	2.678	2.659	1796,0	F	2.882	2.645	2076,0	F	2.882	2.645	2076,0	F
	Av. La Florida (N)	856	1.061	0,807	D	955	1.056	0,913	E	968	1.052	0,931	E
	Av. Departamental (W)	784	2.902	0,312	B	841	2.928	0,331	B	841	2.928	0,331	B
	INTERSECTION	6.953	8.379	1796,0	F	7.524	8.389	2076,0	F	7.537	8.385	2076,0	F
Nº 2: Av. La Florida / Rojas Magallanes	Av. La Florida (S)	2.909	3.053	0,953	D	3.143	2.995	1050,0	F	3.143	2.995	1050,0	F
	Rojas Magallanes (E)	618	1.492	0,414	C	668	1.516	0,441	C	668	1.516	0,441	C
	Av. La Florida (N)	1.268	3.748	0,393	B	1.402	3.644	0,451	B	1.415	3.627	0,456	B
	Rojas Magallanes (W)	583	813	0,948	E	628	830	1039,0	F	628	830	1039,0	F
	INTERSECTION	5.378	9.106	0,953	C	5.841	8,985	1050,0	F	5.854	8.968	1050,0	F
Nº 3 Av. La Florida / Trinidad Oriente	Av. La Florida (S)	2.827	3.271	0,888	C	3.053	3,276	0,937	D	3.053	3.276	0,937	D
	Trinidad Oriente (E)	606	637	0,952	E	655	636	1030,0	F	655	636	1030,0	F
	Av. La Florida (N)	1.721	3.219	0,554	B	1.891	3.197	0,614	B	1.904	3.185	0,622	B
	Trinidad Oriente (W)	241	674	1849,0	F	259	669	2175,0	F	259	669	2175,0	F
	INTERSECTION	5.395	7.801	1849,0	E	5.858	7.778	2175,0	F	5.871	7.766	2175,0	F
Nº 4: Av. La Florida / San José de la Estrella	Av. La Florida (S)	2.422	2.778	0,929	C	2.614	2.784	1001,0	E	2.614	2.784	1001,0	E
	Av. La Florida (N)	1.807	3.738	0,485	A	1.984	3.713	0,534	A	1.997	3.698	0,541	A
	San José de La Estrella (W)	349	711	0,495	C	376	712	0,533	C	376	712	0,533	C
	INTERSECTION	4.578	7.227	0,929	B	4.974	7.209	1001,0	D	4.987	7.194	1001,0	D
Nº 5: Av. Camilo Henríquez / Av. Diego Portales	Av. Camilo Henríquez (S)	1.587	3.458	0,550	B	1.712	3.469	0,593	B	1.712	3.469	0,593	B
	Av. Diego Portales (E)	956	677	1412,0	F	1.033	678	1525,0	F	1.033	678	1525,0	F
	Av. La Florida (N)	1.934	0,004	0,621	B	2.121	3.521	0,688	B	2.134	3.511	0,694	B
	Av. Diego Portales (W)	510	642	0,795	C	551	643	0,859	D	551	643	0,859	D

INTERSECTION	RANGE	Current Situation 2009.				Base Situation 2011				Situation With Project 2011.			
		Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS
	INTERSECTION	4,987	8,317	1412,0	F	5,417	8,311	1525,0	F	5,43	8,301	1525,0	F
Nº 6: Av. Camilo Henríquez / El Peñón	Av. Camilo Henríquez (S)	1,191	3,307	0,984	B	1,284	3,256	1000,0	B	1,284	3,256	1000,0	B
	Av. Camilo Henríquez (N)	880	2,611	0,382	B	983	2,524	0,419	B	996	2,507	0,419	B
	El Peñón (W)	605	1,073	0,943	E	651	1,119	0,975	E	651	1,119	0,975	E
	INTERSECTION	2,676	6,991	0,984	C	2,918	6,899	1000,0	C	2,931	6,882	1000,0	C
Nº 7: Av. Camilo Henríquez / Eyzaguirre	Route G-25 (E)	620	3,391	0,261	A	668	0.003	1280,0	A	668	0.003	1280,0	A
	Av. Camilo Henríquez (NW)	766	3,419	0,224	A	860	3,367	0,255	A	873	0.003	0,261	A
	Eyzaguirre (SW)	736	869	1630,0	F	793	758	2160,0	F	793	747	2197,0	F
	INTERSECTION	2,122	7,679	1630,0	F	2,321	7,525	2160,0	F	2,334	7,487	2197,0	F
Nº 8: Route G-25 / Access to Route G-421	Access to Route G-421 (S)	56	618	0,091	A	60	575	0,105	A	60	566	0,106	A
	Route G-25 (E)	218	1,588	0,138	A	235	1,587	0,148	A	235	1,585	0,148	A
	Route G-25 (W)	123	1,487	0,083	A	172	1,389	0,124	A	185	1,364	0,136	A
	INTERSECTION	397	3,693	0,138	A	467	3,551	0,148	A	480	3,515	0,148	A
Nº 9: Route G-25 / Route G-345	Route G-25 (E)	99	3,179	0,059	A	106	0.003	0,063	A	106	0.003	0,063	A
	Route G-345 (N)	16	0.002	0,011	A	17	1,759	0,012	A	17	1,747	0,012	A
	Route G-25 (W)	75	2,491	0,038	A	117	2,425	0,052	A	130	2,425	0,056	A
	INTERSECTION	190	7,48	0,059	A	240	7,384	0,063	A	253	7,372	0,063	A

Note: C=Capacity

Source: Ambitrans Ingenieros Consultores Ltda.

Table 5-32 Capacity, saturation degrees and service levels in intersections (RETURN trajectory)

INTERSECTION	RANGE	Current Situation 2009.				Base Situation 2011.				Situation With Project 2011.			
		Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS
Nº 1: Av. La Florida / Av. Departamental	Av. La Florida (S)	1.508	1.973	0,764	C	1.662	1.958	0,849	D	1.675	1.949	0,859	D
	Av. Departamental (E)	1.416	2.542	1596,0	F	1.524	0,003	2036,0	F	1.524	0,003	2036,0	F
	Av. La Florida (N)	1.845	1.234	1513,0	F	1.992	1.182	1686,0	F	1.992	0,001	1688,0	F
	Av. Departamental (W)	1.359	2.308	0,702	B	1.467	2.301	0,763	B	1.467	2.301	0,763	B
	INTERSECTION	6.128	8.057	1596,0	F	6.645	7.971	2036,0	F	6.658	7.96	2036,0	F
Nº 2: Av. La Florida / Rojas Magallanes	Av. La Florida (S)	1.326	2.747	0,483	B	1.465	2.659	0,551	B	1.478	2.646	0,559	B
	Rojas Magallanes (E)	589	0,002	0,517	C	637	1.654	0,582	C	637	1.654	0,582	C
	Av. La Florida (N)	2.005	3.454	0,687	B	2.163	3.389	0,757	B	2.163	3.389	0,757	B
	Rojas Magallanes (W)	595	974	0,670	C	642	990	0,737	C	642	990	0,737	C
	INTERSECTION	4.515	8.795	0,687	B	4.907	8.692	0,757	B	4.92	8.679	0,757	B
Nº 3 Av. La Florida / Trinidad Oriente	Av. La Florida (S)	1.459	3.778	0,569	B	0,002	3.742	0,614	B	1.623	3.724	0,614	B
	Trinidad Oriente (E)	139	320	0,434	C	150	291	0,516	C	150	291	0,516	C
	Av. La Florida (N)	2.379	3.766	0,646	B	2.567	3.772	0,698	B	2.567	3.772	0,698	B
	Trinidad Oriente (W)	458	753	0,608	C	495	728	0,680	C	495	728	0,680	C
	INTERSECTION	4.435	8.617	0,646	B	4.822	8.533	0,698	B	4.835	8.515	0,698	B
Nº 4: Av. La Florida / San José de la Estrella	Av. La Florida (S)	1.315	2.617	0,661	B	1.454	0,003	0,716	B	1.467	2.576	0,716	B
	Av. La Florida (N)	2.315	3.564	0,650	B	2.499	3.571	0,700	B	2.499	3.571	0,700	B
	San José de La Estrella (W)	462	812	0,660	C	499	812	0,711	C	499	812	0,711	C
	INTERSECTION	4.092	6.993	0,661	B	4.452	6.973	0,716	B	4.465	6.959	0,716	B
Nº 5: Av. Camilo Henríquez / Av. Diego Portales	Av. Camilo Henríquez (S)	874	3.439	0,296	B	976	0,003	0,337	B	989	3.378	0,345	B
	Av. Diego Portales (E)	438	656	0,668	C	471	657	0,717	C	471	657	0,717	C
	Av. La Florida (N)	2.489	3.552	0,822	B	2.687	3.558	0,886	C	2.687	3.558	0,886	C
	Av. Diego Portales (W)	531	644	0,825	C	574	644	0,891	D	574	644	0,891	D

INTERSECTION	RANGE	Current Situation 2009				Base Situation 2011				Situation With Project 2011			
		Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS	Total flow (veh/h)	C (veh/hr)	GS	NS
	INTERSECTION	4,332	8,291	0,825	B	4,708	8,259	0,891	C	4,721	8,237	0,891	C
Nº 6: Av. Camilo Henríquez / El Peñón	Av. Camilo Henríquez (S)	594	3,122	0,324	B	673	3,075	0,348	B	686	3,049	0,348	B
	Av. Camilo Henríquez (N)	974	2,424	0,626	B	1,047	2,435	0,670	B	1,047	2,435	0,670	B
	El Peñón (W)	388	994	0,606	C	418	998	0,651	C	418	998	0,651	C
	INTERSECTION	1,956	6,54	0,626	B	2,138	6,508	0,670	B	2,151	6,482	0,670	B
Nº 7: Av. Camilo Henríquez / Eyzaguirre	Route G-25 (E)	503	3,177	0,208	A	574	0.003	0,222	A	587	3,092	0,222	A
	Av. Camilo Henríquez (NW)	1,598	3,516	0,455	A	1,689	3,519	0,480	A	1,725	3,523	0,490	A
	Eyzaguirre (SW)	587	360	3133,0	F	633	331	3375,0	F	633	326	3375,0	F
	INTERSECTION	2,688	7,053	3133,0	F	2,896	6,97	3375,0	F	2,945	6,941	3375,0	F
Nº 8: Route G-25 / Access to Route G-421	Access to Route G-421 (S)	27	720	0,038	A	29	679	0,043	A	29	668	0,043	A
	Route G-25 (E)	109	1,476	0,074	A	158	1,368	0,116	A	171	1,343	0,127	A
	Route G-25 (W)	147	1,618	0,091	A	158	1,624	0,097	A	158	1,624	0,097	A
	INTERSECTION	283	3,814	0,091	A	345	3,671	0,116	A	358	3,635	0,127	A
Nº 9: Route G-25 / Route G-345	Route G-25 (E)	94	3,125	0,056	A	113	3,056	0,071	A	113	3,056	0,071	A
	Route G-345 (N)	18	1,815	0,014	A	44	0.002	0,031	A	57	0.002	0,043	A
	Route G-25 (W)	81	2,705	0,039	A	88	0.003	0,043	A	88	0.003	0,043	A
	INTERSECTION	193	7,645	0,056	A	245	7,506	0,071	A	258	7,506	0,071	A

Note: C=Capacity

Source: Ambitrans Ingenieros Consultores Ltda.

According Table 5-30, is possible to establish the following:

- Current situation year 2009. In a working day, the current service levels vary between B and C, which represent a stable operation and without congestion problems.
- Base Situation year 2011: B service levels change into C due to the vegetative growth of normal traffic in the analyzed routes and those in C stay the same.
- Situation with Project year 2011: There are no changes in the service levels with regards the Base Situation of 2011, which indicates a low incidence in the flow of the Project.

In terms of capacities of the road tranches, these area always greater in the afternoon, due to the strain produced in the traffic flows.

ii) Environmental assessment synthesis

Taking into consideration the information presented, it is possible to establish that the Project will not generate changes at the service levels of the analyzed roads with regards the base situation analyzed for the year 2011.

6.2.2 Operation stage

Due to maintenances of the lines will be periodically activated, and will be performed by personnel that usually develops this activity in the area, it is not foreseen the generation of impacts in the service levels of the used roads.