ANNEX 11
FLORA AND VEGETATION REPORT

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1 INTRODUCTION

This report presents the results of the Baseline study of flora and vegetation for the Project "Electricity Transmission Lines S/S Maitenes – S/S Alfalfal and Alfalfal II Power Plant – S/S Alfalfal," which is located in Cordillera Province, in the Metropolitan Region. The study analyzes and assesses the different vegetation systems found in the area of influence of the Project, including both typical vegetation and the flora that makes up these systems.

2 OBJECTIVES

2.1 General Objective

Characterize the vegetation systems, vegetation and flora currently found in the Project area.

2.2 Specific Objectives

In order to achieve the general objective, the following specific objectives are established:

2.2.1 Vegetation

Determine and characterize the biogeographic context of the vegetation present in the Project area.

Identify, delimit and characterize the vegetation formations that are currently found in the Project area.

Establish sites of vegetation singularity within the area of study.

2.2.2 Flora

Characterize the flora in the area of study

Identify and characterize the species that are considered endemic to the region and the country, and those in a conservation category at the national, regional or local level, as well as species of ecological and/or scientific importance for the sectors involved in the Project.

3 METHODOLOGY

The methodology used to collect and analyze information on the Flora and Vegetation component and fulfill the objectives and implement the activities established for this component, is described below.

The methodology was comprised of five elements:

Delimitation of the area of study

Collection and processing of information

Biogeographic context

Local vascular flora

Vegetation

Details of the work methodology used for each of the elements indicated above are presented below.

3.1 Delimitation of the area of study

In preparing the Baseline of the vegetation systems present in the sector studied, a strip 150 meters wide along each side of the transmission line was delimited both to study existing vegetation and survey associated flora.

3.2 Collection and Processing of Information

The fieldwork activities to collect the information required were carried out on March 3, 4, 11 and 12, 2008, and on November 16 and 17 of the same year. In accordance with the proposed objectives, the vegetation in the area was characterized based on the area and current distribution of vegetation formations within the area of influence of the Project, coverage of the different vegetation strata in each formation, and the relative participation of the dominant species in each of these. Flora present was detected by means of inventories in fixed areas located in the main vegetation formations present in the area of study, and characterized in terms of its conservation category, current level of distribution in the Project area, biogeographic origin and specific importance according to its level of endemism or scientific value.

3.3 Biogeographic Context

The biogeographic context of the Project area was analyzed on three levels: continental, national and regional. In carrying out this work, the works of Cabrera and Willink (1973)[1] were reviewed to obtain the continental context, and that of Gajardo (1983[2], 1994[3]) was reviewed for national and regional analyses.

This type of analysis is valuable for establishing a frame of reference for the current state of the vegetation, as it allows the information collected in the field to be compared with its potential natural state, as set out in the biogeographic context.

3.4 Local Vascular Flora

To assess the local flora, information was gathered through flora inventories conducted on fixed 100 m2 areas (Mueller-Dombois and Ellemberg, 1974)[4]. All species present were registered in order to establish the location, distribution, composition, diversity and relative abundance, specific frequency,

1 Cabrera, A. y Willink, A. 1973. Biogeografía de América Latina. Monografía Mº13, Serie Biológica, O.E.A. 120 p.

2 Gajardo, R. 1983. Sistema Básico de Clasificación de la Vegetación Nativa Chilena. U. de Chile – CONAF. Santiago de Chile. 319 p.

3 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Edit. Universitaria, Santiago. 166 p.

and representation of native flora in the area of study. To complement this work, samples were located in places outside of the floral plots and fragments were taken for later taxonomic identification in the laboratory.

To determine the conservation status of the flora identified, the catalogue containing the official listing was obtained (MINSEGPRES 2007[4], 2008a[5] and 2008b[6]) and other sources were reviewed for entities that do not appear in these documents. In the case of woody and non-cacti succulent species, Benoit (1989[7]) was consulted, for Pteridophytes (*Polypodiophyta*), Benoit (1989[8]) and Baeza *et al* (1998[9]) were consulted, while for bulbous species Benoit (1989[10]) and Ravenna *et al* (1998[11]) were consulted. Lastly, Benoit (1989[12]) and Belmonte *et al* (1998[13]) were consulted for cacti species. In each case, the source of the information was cited.

3.5 Vegetation

Vegetation was assessed by defining homogenous units within the area of study, based on the structural characteristics and dominant species present within those units. The delimitation of these units was made *a priori*, using photo-interpretation of units that were homogenous in regard to texture and color, using high-resolution images available on Google Earth. These were verified in the field in accordance with the "Land Occupation Maps" (LOM) methodology developed by the Louis Emberger phytoecology school (CEPE/CNRS[14]) of Montpellier, France, and adapted for the ecological conditions of Chile by Etienne and Contreras (1981[15]), and Etienne and Prado (1982[16]), based on the following assessment framework.

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4 Ministerio Secretaría General de la Presidencia (MINSEGPRES). 2007. D.S. Nº 151/2007. Oficializa primera clasificación de especies silvestres según estado de conservación. Diario oficial de la República de Chile. Publicado 24/03/2007.

5 Ministerio Secretaría General de la Presidencia (MINSEGPRES). 2008a. D.S. Nº 50/2008. Aprueba y oficializa nómina para el segundo proceso de clasificación de especies según estado de conservación. Diario oficial de la República de Chile. Publicado el 30/06/2008.

6 Ministerio Secretaría General de la Presidencia (MINSEGPRES). 2008b. D.S. Nº 51/2008. Aprueba y oficializa nómina para el tercer proceso de clasificación de especies según estado de conservación. Diario oficial de la República de Chile. Publicado el 30/06/2008.

7 Benoit, I. 1989 (Ed.). Libro rojo de la flora terrestre de Chile. CONAF, Santiago, Chile. 157 p.

8 Benoit, I. 1989. op. cit.

9 Baeza, M., E. Barrera, J. Flores, C. Ramirez y R. Rodríguez. 1998. Categorías de Conservación de Pteridophyta nativas de Chile. Boletín del Museo Nacional de Historia Natural 47: 23 - 46.

10 Benoit, I. 1989. op. cit.

11 Ravenna, P., S. Teiller, J. Macaya, R. Rodríguez y O. Zöllner. 1998. Categorías de Conservación de las plantas bulbosas nativas de Chile. Boletín del Museo Nacional de Historia Natural 47: 47 - 68.

12 Benoit, I. 1989. op. cit.

13 Belmonte, E., L. Faúndez, J. Flores, A. Hoffmann, M. Muñoz y S. Teiller. 1998. Categorías de Conservación de Cactáceas nativa s de Chile. Boletín del Museo Nacional de Historia Natural 47: 69 - 89.

14 Centre d'Etudes Phytosociologiques et Ecologiques Louis Emberger/Centre National de la Recherche Scientifique. FRANCE.

15 Etienne M y Contreras D. 1981. Cartografía de la Vegetación y sus aplicaciones en Chile. Bol. Téc. N°46. Fac. Cs. Agrarias y Forestales, Univ. Chile 27 p. 10 maps.

16 Etienne M. y Prado C. 1982. Descripción de la vegetación mediante la Carta de Ocupación de Tierras. Publicaciones Misceláneas Nº9. Fac. Cs. Agrarias y Forestales, U. de Chile.

Biological Type - Coverage Codes: Each of the cartographic units was described according to the following coverage ranges that were established for each biological type (Table 1).

Table 1 Biological types and degree of coverage using the LOM methodology

Symbol	Biological Type	Coverage Rating, n	Coverage (%)	Density
LA_n	Tall woody, with coverage n	1	1 – 5 %	Very scant
LB_n	Short woody, with coverage n	2	5 – 10 %	Scant
H_n	Herbaceous, with coverage n	3	10 – 25 %	Very clear
S_n	Succulent, with coverage n	4	25 – 50 %	Clear
		5	50 – 75 %	Somewhat dense
		6	75 – 90 %	Dense
		7	90 – 100 %	Very dense

Source: CEA Ltda.

Biological Types – Altitude Codes: Each of the cartographic units was described according to the altitude ranges established for each biological type (Table 2).

Table 2 Altitude codes for biological types, using the LOM methodology

Symbol	Height	Stratum	Symbol	Height	Stratum
Tall woody (LA)			**Short woody (LB)**		
$\overline{LA}$	< 2 m	Extremely short	$\overline{LB}$	< 5 cm	Extremely short
LA	2 – 4 m	Very short	LB	5 – 25 cm	Very short
$\underline{LA}$	4 – 8 m	Short	$\underline{LB}$	25 – 50 cm	Short
$\boxed{LA}$	8 – 16 m	Medium	$\boxed{LB}$	50 – 100 cm	Medium
$\textcircled{LA}$	16 – 32 m	Tall	$\textcircled{LB}$	100 – 200 cm	Tall
$\triangle LA$	> 32 m	Very tall	$\triangle LB$	> 200 cm	Very tall
Herbaceous (H)			**Succulent (S)**		
$\overline{H}$	< 5 cm	Extremely short	$\overline{S}$	< 5 cm	Extremely short
H	5 – 25 cm	Very short	S	5 – 25 cm	Very short
$\underline{H}$	25 – 50 cm	Short	$\underline{S}$	25 – 50 cm	Short
$\boxed{H}$	50 – 100 cm	Medium	$\boxed{S}$	50 – 100 cm	Medium
$\textcircled{H}$	100 – 200 cm	Tall	$\textcircled{S}$	100 – 200 cm	Tall
$\triangle H$	> 200 cm	Very tall	$\triangle S$	> 200 cm	Very tall

Source: CEA Ltda.

Areas without vegetation were also considered, including bare land and/or human settlements, and all those displaying some degree of alteration of, or intervention in, the vegetation system present in the sector.

This information, complemented by the documentary information compiled, makes up the Vegetation Map for the area of study. The map represents biological types (tall woody or trees, short woody or bushes, herbaceous and succulents) and the extent of their coverage of the area (%), as well as the dominant species present and the area that each of these takes up.

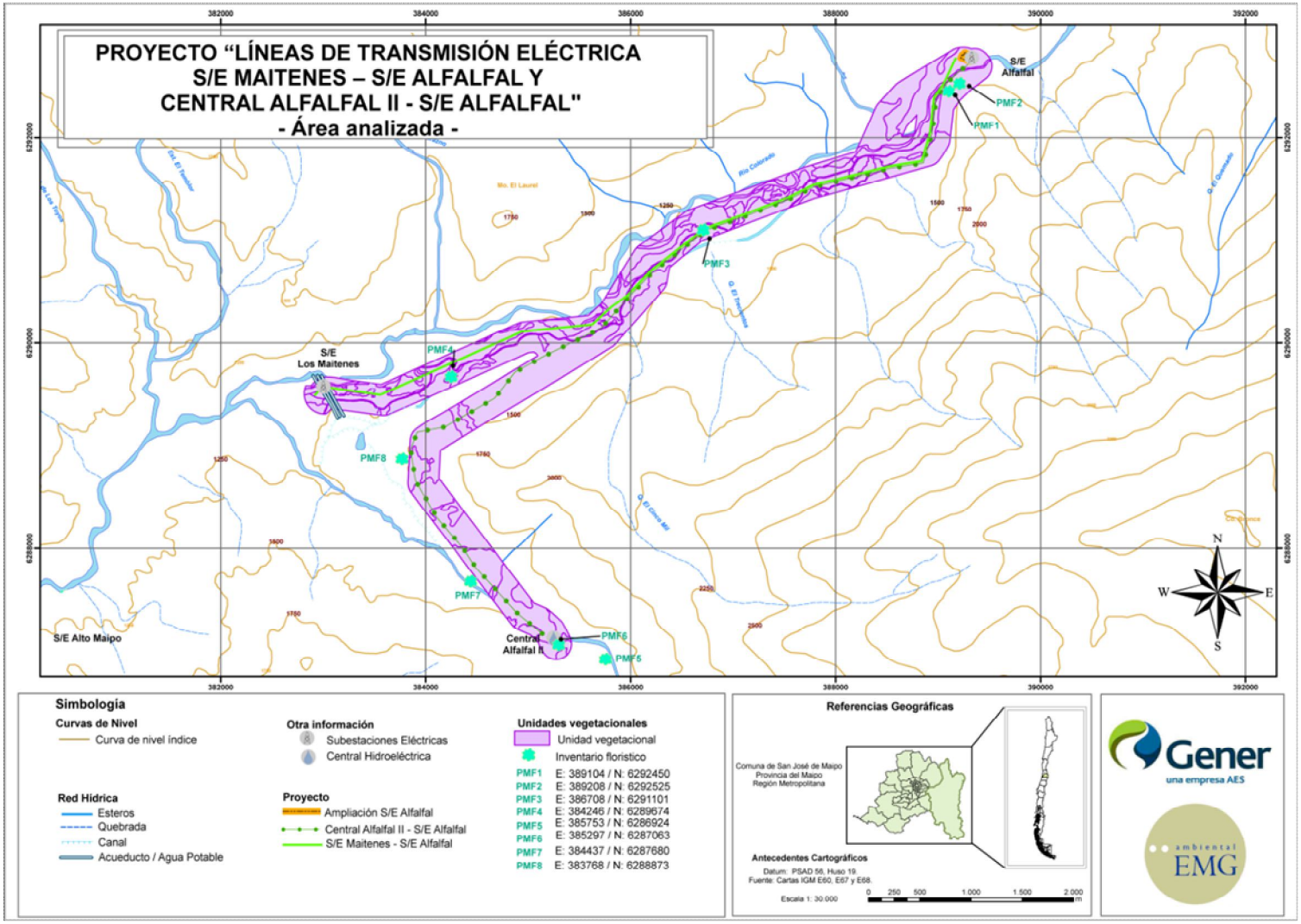
4 RESULTS

The results of the baseline information collected are presented below for the Flora and Vegetation environmental component of the Project.

4.1 Area of Study

As indicated, in preparing the Baseline of vegetation systems present in the area of study, the area of influence considered was a strip of land approximately 150 meters wide on either side of the transmission line route, both for the vegetation represented and for the survey of associated fauna.

Figure 1 General view of the Project Area



Source: Prepared by the authors, based on IGM maps E60, E67 and E68, 1:50,000 scale.

4.2 Biogeographic Context

Biogeographically, this sector is part of the Neotropical Region, Andean-Patagonia domain, Province of Central Chile. This region is characterized by the presence of species of very different origins and has a high degree of endemism, a bushy arborescent physiognomy, with Sclerophyllous foliar morphology (Cabrera and Willink, 1973[17]). It has recently been proposed that this area be excluded from Neotropical region and assigned to a new Austral region, which would include practically the entire country (Morrone, 2002[18]).

At the national level, the area of study lies mainly in the Sclerophyllous Scrubland and Forest region, the Sclerophyllous Forest formation of the Andean Foothills, which displays several floral associations on hillsides and alluvial terraces, where *Quillaja saponaria-Lithrea caustica*, *Quillaja saponaria-Colliguaja odorifera*, *Cryptocarya alba-Quillaja saponaria*, *Cryptocaria alba-Lithrea caustica*, and *Puya violácea-Colliguaja odorífera* formations have been recorded (Gajardo, 1994[19]).

A small segment of the transmission line route is located in the High Andean Steppe Region, in the Andean Sclerophyllous Scrubland Formation, which in a strict sense should be included in the Sclerophyllous Scrubland and Forest region but, owing to the great diversity of floristic elements, the author preferred to include it in the ecological region indicated (Gajardo, 1994[20]). In this formation, the following formations can be found: *Quillaja saponaria-Lithrea caustica*, *Quillaja saponaria-Colliguaja odorífera*, *Puya berteroana- Trichocereus chiloensis*, *Colliguaja integerrima-Tetraglochin alatum* and *Kageneckia angustifolia-Guindilia trinervis* (such as *Valenzuelia trinervis*), and, on the edges of the riverbanks, the association *Escallonia myrtoidea-Maytenus boaria*.

The different vegetation formations display a marked seasonality in which summer aridity and drought provoke the recess of most of the species accompanying the dominant ones. This recess continues until winter, when the lower temperatures limit growth. In fact, it is in spring that these systems develop most.

Nevertheless, this vegetation, originally arborescent scrubland with a predominance of Sclerophyllous tree species (Litre, Quillay, Bollen) and bush species (Colliguay, Bio-bio), with succulents in more arid sectors (Quisco and Chagual), is currently intensely intervened, especially in areas that are flat and/or have deep soil. In these areas, agriculture has completely transformed the landscape and the attributes of the original inhabitants, communities and ecosystems.

This transformation continues today, though perhaps less intensely than during the agricultural phase, with urbanization and unregulated tourism activities that have continued to modify the natural attributes of the area.

The section below presents the results obtained from the study of the Project's area of influence. In order to determine the environmental sensitivity of the vegetation, the assessors walked the route

17 Cabrera, A. y Willink ,A. 1973. Biogeografía de América Latina. Monografía N°13, Serie Biología, O.E.A. 120 p.

18 Morrone J. 2002. Biogeographical regions under track and cladistic scrutiny. Journal of Biogeography 29:149-152.

19 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago. 166 p.

20 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago. 166 p.

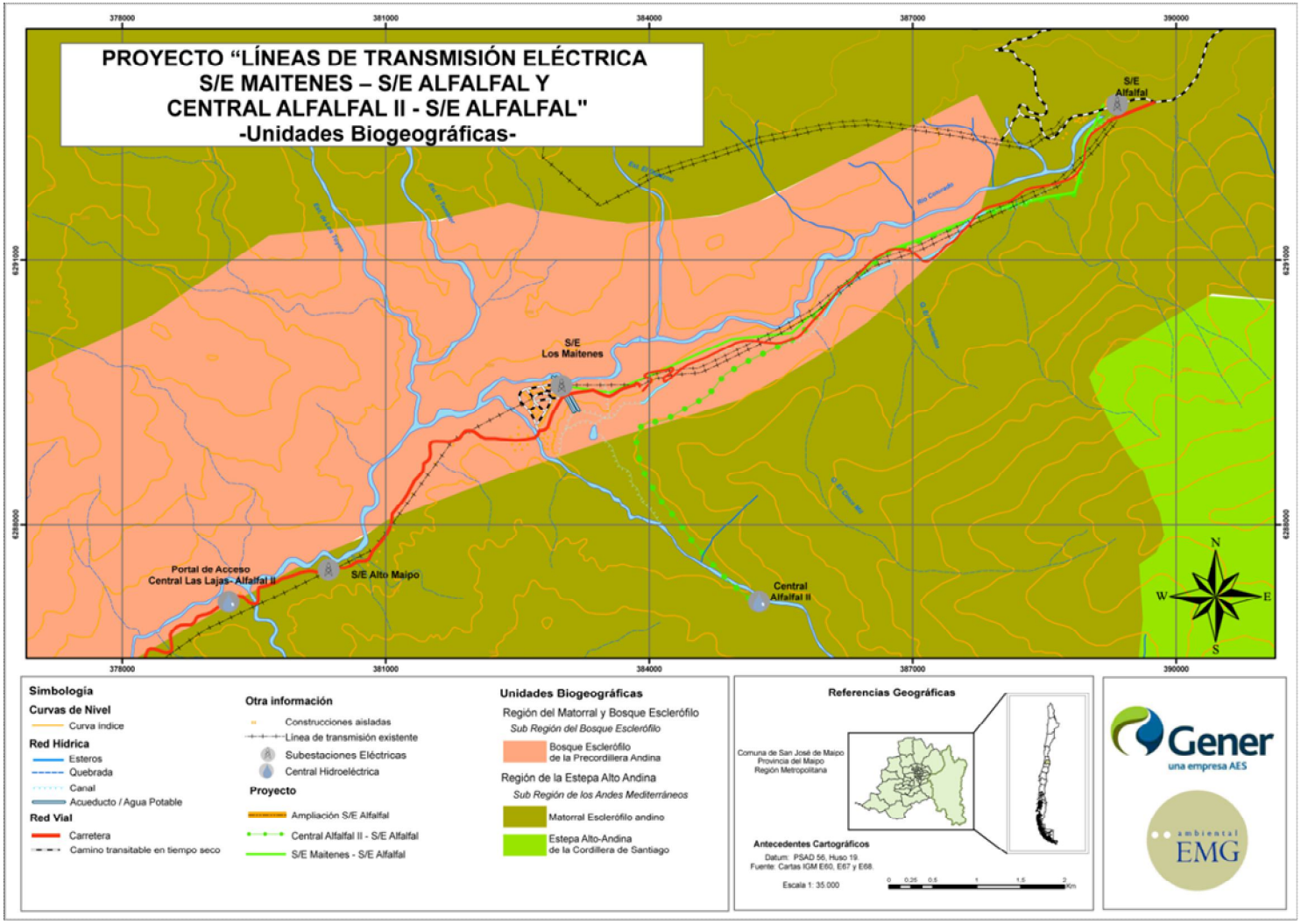
of the transmission line, identifying the different vegetation formations present, determining their degree of naturalness and detecting species with known conservation concerns.

The figure below displays the biogeographic context at the regional and local levels for the Project area (Gajardo, 1983[21] and 1994[22]).

21 Gajardo, R. 1983. Sistema Básico de Clasificación de la Vegetación Nativa Chilena. U. de Chile – CONAF. Santiago de Chile. 319 p. 14 maps.

22 Gajardo, R. 1994. La Vegetación Natural de Chile: clasificación y distribución geográfica. Ed. Universitaria, Santiago. 166 p.

Figure 2: Regional Biogeographic Context of the Project



Source: Prepared by the authors based on IGM maps E60, E67 and E68, 1:50,000 scale.

4.3 Local Vascular Flora

4.3.1 Richness of species and most important groups

The local vascular flora was assessed through 8 inventories of different representative vegetation formations that comprise the natural vegetation system of the area of study. The taxonomic summary of the area is presented in Table 3. A total of 144 vascular plant species were detected overall, which corresponds to 2.8% of all national flora species. The list of species detected in the area of study is provided in Appendix A, which also provides the taxonomic information for each species, its conservation status, geographic origin, and common name.

Taxonomically, local flora includes the divisions Magnoliophyta, Polypodiophyta y Pinophyta; the first is most significant in terms of the number of species detected in the sector, with a total of 136 entities, equal to 2.7% of all flora species in this division found nationwide. The second, Polypodiophyta, is represented locally by a total of seven species, which at the national level represents 4.7% of the total. The third group, Pinophyta, has only one species, which accounts for 6.7% of the group's national total.

Among the Magnoliophyta are the taxonomic classes Liliopsida (monocotyledons) and Magnoliopsida (Dicotylodonates), the former represented by a total of 19 species, most notably the family Poaceae (Graminaea), with 15 species. The second class presents a total of 117 species, especially the families Asteraceae, Scrophulariaceae, Fabaceae and Rosaceae, with 31, 9, 8 and 7 species, respectively. Table 3 below presents a taxonomic summary of the local vascular flora in each of the taxonomic groups registered in the area of study.

Table 3: Taxonomic summary of vascular flora present in the area of influence of the Project and its representativeness (number of families, genera and species) in the national flora. Metropolitan Region, March and November 2008

DIVISION	FAMILIES			GENERA			SPECIES		
CLASS	Loc.	Chile	%	Loc.	Chile	%	Loc.	Chile	%
Polypodiophyta									
Polypodiopsida	1	22	4.5	2	46	4.3	7	137	5,1
Sphenopsida	0	1	0.0	0	1	0.0	0	2	0,0
Lycopsida	0	3	0.0	0	4	0.0	0	9	0,0
Psilotopsida	0	1	0.0	0	1	0.0	0	1	0,0
Division Total	**1**	**27**	**3.7**	**2**	**52**	**3.8**	**7**	**149**	**4.7**
Pinophyta									
Pinopsida	0	3	0.0	0	8	0.0	0	8	0,0
Gnetopsida	1	1	100.0	1	1	100.0	1	7	14,3
Division Total	**1**	**4**	**25.0**	**1**	**9**	**11.1**	**1**	**15**	**6.7**
Magnoliophyta									

DIVISION	FAMILIES			GENERA			SPECIES		
CLASS	Loc.	Chile	%	Loc.	Chile	%	Loc.	Chile	%
Liliopsida	5	30	16.7	14	214	6.5	19	1069	1.8
Magnoliopsida	42	132	31.8	89	743	12.0	117	3906	3.0
Division Total	**47**	**162**	**29.0**	**103**	**957**	**10.8**	**136**	**4975**	**2.7**
Total	**49**	**193**	**25.4**	**106**	**1018**	**10.4**	**144**	**5139**	**2.8**

Source: CEA Ltda.

4.3.2 Origin, Conservation Status and Degree of singularity of Local Flora

By biogeographic origin, among the species detected in the area there are 29 allochthonous species and 115 autochthonous species; there is a higher number of autochthonous species in the area of study, owing to the fact that the samplings and localization of flora inventories are usually focused on obtaining information about native flora units and often ignore those sectors with a high degree of human intervention, where allochthonous species predominate.

In regard to the presence of species in a conservation category, one succulent species was registered that is in the Rare category (*Austrocactus spiniflorus*). This was a very small individual detected in a rock fissure in the Aucayes Stream, at a point near the water intake canal of the Maitenes Power Plant (floristic inventory 6: PMF6). Another three species are classified as vulnerable: one tree species (currently arborescent) *Kageneckia angustifolia* (Franjel) (one individual, PMF 8) and two succulents, *Puya berteroana* (chagual) (PMF 2, 4 and 7) and *Pyrrhocactus curvispinus* (Quisquito) (PMF 2, 4, and 6). The summary of species in a conservation status for the area is presented in Table 4.

Table 4: Conservation status of local flora associated with the area of influence of the Project. March and November 2008.

Conservation Status	Origen	Total species
Vulnerable	Autochthonous	3
Rare	Autochthonous	1
No information	Autochthonous	52
No problems	Autochthonous	59
Not applicable	Allochthonous	29
Overall Total		**144**

Source: Prepared by the authors.

In regard to the singularity of flora, no singular local or regional endemic species were detected; the majority of species found were typical of the Sclerophyllous formations of Central Chile.

4.3.3 Vegetation

The vegetation of the area of study was assessed by defining 107 polygons that represented different states of the horizontal or vertical structure and composition of the dominant species. This mapping is presented in figures 3 and 4; Appendix B contains the descriptions corresponding to each unit of that map.

Table 5 provides a summary of the area covered by different categories of vegetation into which the vegetation units present in the area of study are grouped.

As the table shows, the largest part of the area related to the Project corresponds to scrubland, with 307.89 ha of area assessed. Within this type of land use, in the area of influence sectors defined as scrubland with trees and succulents are important in terms of the area occupied, with 137.88 ha en total. These areas combine autochthonous woody species, remnants of the original vegetation, which denotes the vegetation's high degree of alteration. It is important to note the absence of vegetation that can be classified under Forests, as while they correspond to Tall Scrubland, and in some cases are quite dense, they have a stratum of trees (tall woody species) with less than 25% coverage, which reflects the high degree of alteration of the area in general.

In general, taller structures and high percentages of coverage are associated with the lower parts of steep slopes with little solar exposure, characteristics that provide better conditions for biological development on the one hand, and on the other present limitations to agricultural and livestock uses.

Table 5: Summary of area covered by vegetation categories (land use) of the units detected in the area of influence of the Project. March and November 2008

	Land Use	Area	Nº polygons
Natural vegetation	Arborescent scrubland with succulents	13.97	5
	Scrubland with trees and succulents	137.88	22
	Riparian scrubland	19.41	8
	Prairie-scrubland	37.75	8
	Scrubland with succulents	98.88	17
	Total Natural Vegetation	**307.89**	**60**
Non-vegetation use	Residential	1.34	1
	Bare Land	53.49	29
	Industrial Zone	23.62	4
	Agriculture	16.19	3
	Water body	15.65	10
	Total non-vegetation use	**110.29**	**47**
Overall Total		**418,18**	**107**

Source: CEA Ltda.

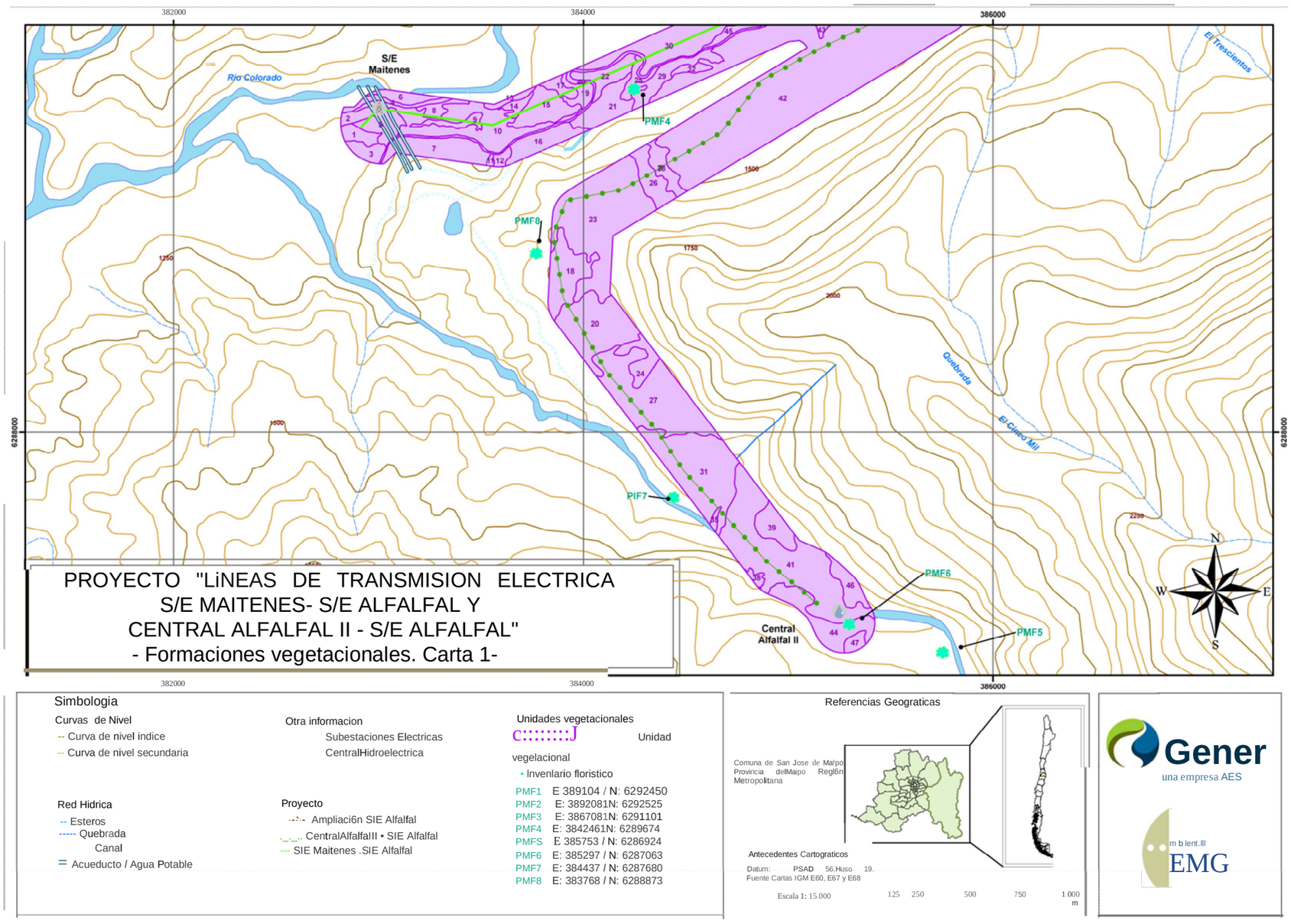
Another fact worth noting is the great diversity of dominant species registered, with four tall woody autochthonous species and one wild allochthonous species, which seems to indicate that propensity of the area to forest, while only four dominant species are short woody species, which reaffirms the vegetation's greater vertical structures. Lastly, among the dominant herbaceous species of the 9 species detected, four correspond to introduced species and one of them even is a ruderal species. The dominant species registered and their mapping codes are presented in Table 6, organized by biological type.

Table 6: Dominant species in the vegetation map generated for the area of influence of the Project. March and November 2008

	Dominant species code	Species
Tall woody species	AC	Acacia caven
	CM	Crataegus monogyna
	LC	Lithrea caustica
	QS	Quillaja saponaria
	SP	Schinus polygamus
Short woody species	Bs	Baccharis salicifolia
	Cp	Cestrum parqui
	Gi	Gymnophyton isatidicarpon
	Hu	Haplopappus uncinatus
Herbaceous species	bp	Baccharis pingraea
	cm	Centaurea melitensis
	cp	Carduus picnocephalus
	cr	Cortaderia rudiuscula
	cv	Chenopododium ambrosioides
	ha	Helenium aromaticum
	hi	Hirshfeldia incana
	ta	Tessaria absinthioides
	vm	Vulpia megalura
Succulents	tC	Trichocereus chiloensis

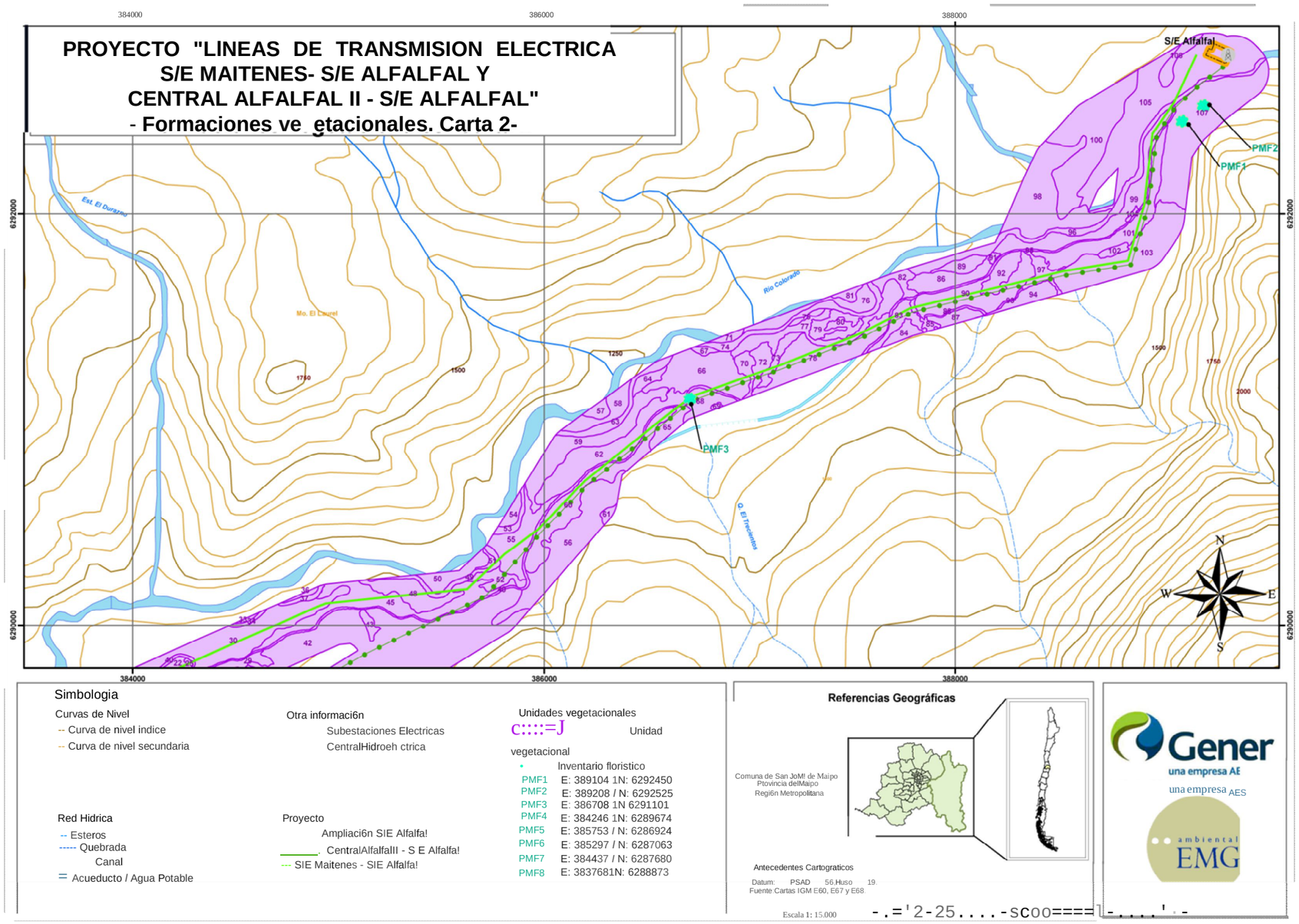
Source: CEA Ltda.

Figure 3: Vegetation Formations in the Project Area. Map 1.



Source: CEA Ltda.

Figure 4: Vegetation Formations in the Project Area. Map 2.



Source: CEA Ltda.

5 IDENTIFICATON AND ASSESSMENT OF IMPACTS

5.1 Construction and Operational Phases

5.1.1 Analysis of environmental impact

In the analysis of the environmental impact of the area of study, the geographic zone corresponding to the Project's area of influence has been considered, as well as the species identified within it.

The local flora is composed of a total of 144 species of vascular flora belonging to 106 genera in 49 families. In terms of geographic origin, these entities are distributed as follows: 115 autochthonous species and 29 allochthonous species. Four species were detected in a conservation category- one succulent classed as Rare (*Austrocactus spiniflorus*) and 3 as vulnerable: the least common, *Kageneckia angustifolia* (Franjel), was located in a single inventory (in PMF8), mainly because the route of the transmission line is outside of the preferential area of distribution of this species, which is slightly higher in altitude; and *Puya berteroana* (chagual), registered in three inventories, and commonly found in warm, exposed rocky places (with north and west components, namely PMF2, PMF 4 and PMF 7). The remaining species is classified as vulnerable (*Pyrrhocactus curvispinus*: Quisquito) is commonly found and therefore it should be possible to void damaging it in particular.

The Project includes pruning of the vegetation that is found inside the buffer strip indicated in Chapter 1; this activity, and the construction of the tower foundations, will be carried out in a way that avoids the cutting, elimination, destruction and/or uprooting of native species that are in a conversation category.

It is important to add that the design of the transmission line route and the tower sites had been adjusted in order to prevent cutting of native trees that are not in a conservation category. Nevertheless, where it is not been possible to re-site a given tower, individual trees will be rescued according to the procedure specified in Annex 2, in order to prevent any impacts. It is important to clarify that under no circumstance will this activity affect native species in a conservation category.

5.1.2 Summary of environmental impact

The impact identified is associated with the reduction of plant coverage. The valuation and assessment of that impact is presented below.

Table 7: Impact Assessment Matrix. Flora and Vegetation Component. Construction and Operational Phases.

ENVIRONMENT: Biotic		COMPONENT: Flora and vegetation					
ASSESSMENT ACTIVITIES	IMPACT	LOCATION	Ca	Re	Te	Ti	Mg
▪ Clearing and maintenance of the buffer strip with forestry measures and pruning only where required.	IFV1: Reduction in tree foliage coverage	Buffer strip	-	Rec	Tem	Dir	Ba

ASSESSMENT CRIERTIA: Ca= Character [Positive (+), Negative (-)]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), Unrecoverable (Irr)]; Te= Timeframe [Temporary (Te), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergistic (Sin), Cumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)].

Source: Prepared by the authors.

IFV1: Reduction in tree foliage coverage

This impact refers to the decrease in tree foliage coverage resulting from the pruning of trees within the buffer strip in order to meet the regulatory requirements for electricity installations.

This impact has been classified as *negative* as it will reduce the plant coverage and alter the current condition of this sector; *recoverable* to the extent that the pruning procedure will foster better development of the trees, even though it will reduce their foliage; *direct* and of *low* magnitude, because the buffer strip will affect a total area of 60 ha and the area that requires pruning will be even less, as there are some areas without vegetation, and some trees that are lower than the limit established by the electricity regulations.

In summary, this impact as been assessed as MINOR NEGATIVE.

6 PLANNED MITIGATION, REPAIR/RESTORATION, AND COMPENSATION MEASURES

In order to mitigate the IFV1 impact the following measures have been developed:

Educate Project workers about the need to learn about and protect the flora and vegetation that exists in this place.

Prohibit workers from cutting and collecting wood in the area.

Additionally, this Project will include a program to disseminate the environmental protection actions pledged as part of the Alto Maipo Hydroelectric Project. This Program will include the installation of signs on roadways with images of species under conservation in the zone and information about the ban on cutting trees. This signage will be installed in places where tourist and other visitors congregate.

7 CONCLUSIONS

Based on the results obtained in the Baseline study of the Project, it can be concluded that:

The flora in the area is composed of a total of 144 species of vascular flora vascular belonging to 106 genera in 49 families. Depending on their geographic origin, these entities can be divided as follows: 115 autochthonous species and 29 allochthonous species. Four species were detected in a conservation category- one succulent classed as Rare (*Austrocactus spiniflorus*) and 3 as vulnerable: the least common, *Kageneckia angustifolia* (Franjel), was located in a single inventory, mainly because the route of the transmission line is outside of the preferential area of distribution of this species, which is slightly higher in altitude and *Puya berteroana* (chagual), registered in three inventories, and commonly found in warm, exposed rocky places (with north and west components). The remaining species is classified as vulnerable (*Pyrrhocactus curvispinus*: Quisquito) is commonly found and therefore it should be possible to avoid damaging this species in particular.

Local vegetation was delimited and characterized through 107 polygons grouped into 10 types of land use, or vegetation types falling within two types of land use—natural vegetation and non-vegetation uses.

The units with natural vegetation cover a total area of 307.89 hectares in the area evaluated (418.18), while those with non-vegetation uses, which include the waterway, industrial zones and bare land, as well as residential areas, cover a total of 110.29 ha.

Assessing the structures of this vegetation and the composition of dominant species, a high degree of alteration was noted, due to both the land's tendency to forest structures and the composition of dominant species, which includes a large proportion of tall woody species, probably remnants of the original vegetation, and a high proportion of ruderal allochthonous herbaceous species.

APPPENDIX A
TAXONOMIC LIST OF VASCULAR FLORA SPECIES DETECTED IN THE AREA OF STUDY. MARCH AND NOVEMBER 2008

Division / Class / Family / Species	Common name	Origin	Conservation Status	Life form
Magnoliophyta				
Liliopsida				
Alliaceae				
Leucocoryne ixioides (Hook.) Lindl.	Huilli	Autoch.	No information	Perennial herb
Alstroemeriaceae				
Alstroemeria pallida Graham	Lirio del campo	Autoch.	No problems	Perennial herb
Bromeliaceae				
Puya berteroana Mez	Chagual	Autoch.	Vulnerable	Succulent
Iridaceae				
Sisyrinchium arenarium Poepp.	Maicillo	Autoch.	No information	Perennial herb
Poaceae				
Avena barbata Pott ex Link	Teatina	Allochth.	Not Applicable	Annual herb
Bromus berteroanus Colla	Pasto largo	Autoch.	No information	Annual herb
Bromus catharticus Vahl	Pasto del perro	Autoch.	No information	Perennial herb
Festuca tunicata Desv.	----	Autoch.	No information	Perennial herb
Hordeum chilense Roem. & Schult.	Cebadilla	Autoch.	No information	Perennial herb
Hordeum comosum J. Presl	Cebadilla	Autoch.	No information	Perennial herb
Hordeum murinum L.	Cola de raton	Allochth.	Not Applicable	Annual herb
Melica laxiflora Cav.	Pega-pega	Autoch.	No information	Perennial herb
Nassella chilensis (Trin.) Desv.	Nudillo	Autoch.	No information	Perennial herb
Poa bonariensis (Lam.) Kunth	----	Autoch.	No information	Perennial herb
Schismus sp.	----	Allochth.	Not Applicable	Annual herb
Stipa sp.	Champa	Autoch.	No information	Perennial herb
Stipa speciosa Trin. et Rupr.	Coiron amargo	Autoch.	No information	Perennial herb
Vulpia bromoides (L.) S.F. Gray	----	Allochth.	Not Applicable	Annual herb
Vulpia megalura (Nutt.) Rydb.	----	Allochth.	Not Applicable	Annual herb
Magnoliopsida				
Anacardiaceae				
Lithrea caustica (Mol.) H. et A.	Litre	Autoch.	No problems	Tree
Schinus montanus (Phil.) Engler	Moy	Autoch.	No problems	Bush

Division / Class / Family / Species	Common Name	Origin	Conservation Status	Life form
Schinus polygamus (Cav.) Cabr.	Huingán	Autoch.	No problems	Bush
Apiaceae				
Anthriscus caucalis Bieb.	Anisillo	Allochth.	Not Applicable	Annual herb
Gymnophyton isatidicarpum (K. Presl ex DC.) Math. et Const.	Bío-bío	Autoch.	No information	Bush
Mulinum spinosum (Cav.) Pers.	Panza	Autoctona	No problems	Bush
Torilis nodosa (L.) Gaertn.	----	Allochth.	Not Applicable	Annual herb
Asteraceae				
Baccharis linearis (R. et P.) Pers.	Romerillo	Autoch.	No problems	Bush
Baccharis paniculata DC.	Pulpio	Autoch.	No problems	Bush
Baccharis pingraea DC.	Chilquilla	Autoch.	No problems	Perennial herb
Baccharis rhomboidalis Remy	Bautro	Autoch.	No problems	Bush
Baccharis salicifolia (R. et P.) Pers.	Chilca	Autoch.	No problems	Bush
Centaurea melitensis L.	Abrepuño	Allochth.	Not Applicable	Annual herb
Chaetanthera moenchioides Less.	Rosita	Autoch.	No information	Annual herb
Cirsium vulgare (Savi) Ten.	Cardo negro	Allochth.	Not Applicable	Biennial herb
Conyza sp.	Huilmo	Autoch.	No information	Biennial herb
Gamochaeta chamissonis (DC.) Cabr.	Hierba de la perdiz	Autoch.	No information	Perennial herb
Gnaphalium philippii Cabr.	----	Autoch.	No information	Perennial herb
Haplopappus multifolius Phil. ex Reiche	Bailahuen	Autoch.	No problems	Bush
Haplopappus uncinatus Phil.	Crespilla	Autoch.	No problems	Bush
Haplopappus velutinus Remy	Crespilla	Autoch.	No problems	Bush
Helenium aromaticum (Hook.) Bailey	Manzanilla del campo	Autoch.	No information	Annual herb
Hypochaeris berteroi Colla	Serraja	Autoch.	No information	Perennial herb
Lactuca serriola L.	Lechuguilla	Allochth.	Not Applicable	Annual herb
Lactuca virosa L.	Lechuguilla	Allochth.	Not Applicable	Annual herb
Leucheria glandulosa D. Don	Rosita	Autoch.	No information	Perennial herb
Leucheria tenuis Less.	Rosita	Autoch.	No information	Annual herb
Madia chilensis (Nutt.) Reiche	Melosa	Autoch.	No information	Annual herb
Madia sativa Mol.	Melosa	Autoch.	No information	Annual herb
Moscharia pinnatifida R. et P.	Almizcle	Autoch.	No information	Annual herb
Mutisia ilicifolia Cav.	Clavel del campo	Autoch.	No problems	Vine
Mutisia latifolia D. Don	Clavel del campo	Autoch.	No problems	Vine

Division / Class / Family / Species	Common Name	Origin	Conservation Status	Life form
Mutisia rosea Poepp. ex Less.	Clavel del campo	Autoch.	No problems	Vine
Podanthus mitiqui Lindl.	Mitique	Autoch.	No problems	Bush
Proustia cuneifolia D. Don	Huañil	Autoch.	No problems	Bush
Senecio micropifolius DC.	----	Autoch.	No problems	Bush
Senecio sp.	----	Autoch.	No problems	Bush
Triptilion capillatum (D. Don) DC.	Siempre viva del cerro	Autoch.	No information	Annual herb
Berberidaceae				
Berberis chilensis Gill. ex Hook.	Michay	Autoch.	No problems	Bush
Bignoniaceae				
Eccremocarpus scaber R. et P.	Chupa-chupa	Autoch.	Not Applicable	Perennial herb
Boraginaceae				
Cryptantha sp.	----	Autoch.	No information	Annual herb
Cynoglossum creticum Mill.	----	Allochth.	Not Applicable	Annual herb
Brassicaceae				
Hirschfeldia incana (L.) Lagrése - Fossat	Mostacilla	Allochth.	Not Applicable	Annual herb
Sisymbrium irio L.	Mostacilla	Allochth.	Not Applicable	Annual herb
Cactaceae				
Austrocactus spiniflorus	----	(blank)	Rare	Succulent
Pyrrhocactus curvispinus (Bertero ex Colla) A. Berger	Quisquito	Autoch.	Vulnerable	Succulent
Trichocereus chiloensis (Colla) Britton et Rose	Quisco	Autoch.	No problems	Succulent
Calyceraceae				
Calycera sessiliflora Phil.	----	Autoch.	No information	Annual herb
Caryophyllaceae				
Cerastium fontanum Baumg. ssp. vulgare (Hartm) Greuter et. Burdet	----	Allochth.	Not Applicable	Annual herb
Stellaria abortiva Naud.	Quilloy-quilloy	Autoch.	No information	Annual herb
Celastraceae				
Maytenus boaria Mol.	Maitén	Autoch.	No problems	Tree
Chenopodiaceae				
Chenopodium ambrosioides L. var. andicola (Phil.) Aellen	Paico	Autoch.	No information	Perennial herb
Elaeocarpaceae				

Division / Class / Family / Species	Common Name	Origin	Conservation Status	Life Form
Aristotelia chilensis (Mol.) Stuntz	Maqui	Autoch.	No problems	Bush
Euphorbiaceae				
Colliguaja integerrima Gill. et Hook.	Colliguay, Duraznillo	Autoch.	No problems	Bush
Colliguaja odorifera Mol.	Colliguay	Autoch.	No problems	Bush
Colliguaja salicifolia Gill. et Hook.	Colliguay	Autoch.	No problems	Bush
Fabaceae				
Acacia caven (Molina) Molina	Espino	Autoch.	No problems	Tree
Adesmia confusa Ulibarri	Espinillo	Autoch.	No problems	Bush
Adesmia radicifolia Clos	Lentejilla	Autoch.	No information	Perennial herb
Lotus subpinnatus Lag.	Arvejilla	Allochth.	No information	Annual herb
Lupinus microcarpus Sims	Hierba del traro	Autoch.	No information	Annual herb
Medicago polymorpha L.	Hualputra	Allochth.	No information	Annual herb
Medicago sativa L.	Alfalfa	Allochth.	Not Applicable	Perennial herb
Melilotus alba Desr.	Trebillo blanco	Allochth.	Not Applicable	Biennial herb
Flacourtiaceae				
Azara petiolaris (D. Don) Johnst.	Corcolén	Autoch.	No problems	Tree
Geraniaceae				
Erodium cicutarium (L.) L'Hérit. ex Aiton	Relojito	Allochth.	Not Applicable	Annual herb
Geranium berteroanum Colla ex Savi	Core-core	Autoch.	No information	Perennial herb
Hydrophyllaceae				
Phacelia brachyantha Benth.	Flor de la cuncuna	Autoch.	No information	Annual herb
Lamiaceae				
Marrubium vulgare L.	Toronjil cuyano	Allochth.	Not Applicable	Perennial herb
Stachys grandidentata	Hierba Santa	Autoch.	No information	Perennial herb
Loasaceae				
Scyphanthus elegans D. Don	Monjita	Autoch.	No information	Perennial herb
Loranthaceae				
Tristerix verticillatus (R. et P.) Barlow et Wiens	Quintral del molle	Autoch.	No information	Parasite
Lythraceae				
Pleurophora pungens D. Don	Pico de gallina	Autoch.	No problems	Bush
Malesherbiaceae				
Malesherbia linearifolia (Cav.) Pers.	----	Autoch.	No information	Perennial herb

Division / Class / Family / Species	Common Name	Origin	Conservation Status	Life form
Malvaceae				
Sphaeralcea obtusiloba (Hook.) G. Don	Malva del Cerro	Autoch.	No problems	Bush
Onagraceae				
Clarkia tenella (Cav.) Lewis et Lewis	Huasita	Autoch.	No information	Annual herb
Oenothera sp.	Don Diego	Autoch.	No information	Perennial herb
Oxalidaceae				
Oxalis hypsophila Phil.	Vinagrillo	Autoch.	No information	Perennial herb
Oxalis megalorriza Jacq.	Vinagrillo	Autoch.	No information	Perennial herb
Papaveraceae				
Eschscholzia californica Cham.	Dedal de oro	Allochth.	Not Applicable	Perennial herb
Polemoniaceae				
Polemonium micranthum Benth.	----	Autoch.	No information	Annual herb
Polygalaceae				
Monnina sp.	----	Autoch.	No problems	Bush
Polygonaceae				
Muehlenbeckia hastulata (J.E. Sm.) Johnst.	Quilo, Voqui quilo	Autoch.	No problems	Bush
Portulacaceae				
Calandrinia capitata H. et A.	Pasto de perdiz	Autoch.	No information	Annual herb
Calandrinia grandiflora Lindl.	Pata de guanaco	Autoch.	No information	Perennial herb
Rhamnaceae				
Colletia hystrix Clos	Crucero	Autoch.	No problems	Bush
Trevoa quinquenervia Gill. et Hook.	Talhuen	Autoch.	No problems	Bush
Rosaceae				
Acaena pinnatifida R. et P.	Pimpinella	Autoch.	No information	Perennial herb
Crataegus monogyna	Peumo extranjero	Allochth.	Not Applicable	Tree
Kageneckia angustifolia D. Don	Frangel	Autoch.	Vulnerable	Tree
Kageneckia oblonga R. et P.	Bollén	Autoch.	No problems	Tree
Quillaja saponaria Mol.	Quillay	Autoch.	No problems	Tree
Rosa canina L.	Rosa Mosqueta	Autoch..	Not Applicable	Bush
Tetraglochin alatum (Gill. ex H. et A.) O.K.	Horizonte	Autoch.	No problems	Bush
Rubiaceae				
Galium aparine L.	Lengua de gato	Allochth.	Not Applicable	Annual herb

Division / Class / Family / Species	Common Name	Origin	Conservation Status	Life form
Galium eriocarpum Bartl. ex DC.	Relbún	Autoch.	No information	Perennial herb
Galium suffruticosum H. et A.	Relbún	Autoch.	No information	Perennial herb
Santalaceae				
Quinchamalium chilense Mol.	Quinchamalí	Autoch.	No problems	Perennial herb
Sapindaceae				
Guindilia trinervis Gill. ex H. et A.	Guindilla	Autoch.	No problems	Bush
Saxifragaceae				
Escallonia myrtoidea Bert. ex DC.	Lun	Autoch.	No problems	Tree
Scrophulariaceae				
Calceolaria corymbosa R. et P.	Capachito	Autoch.	No problems	Perennial herb
Calceolaria hypericina Poepp. ex DC.	Topa-Topa	Autoch.	No problems	Bush
Calceolaria polyfolia Hook.	Topa-Topa	Autoch.	No problems	Bush
Calceolaria purpurea Graham	Capachito morado	Autoch.	No information	Perennial herb
Calceolaria thyrsiflora Graham	Hierba dulce	Autoch.	No problems	Bush
Mimulus parviflorus Lindl.	Trebillo amarillo	Allochth.	Not Applicable	Annual herb
Verbascum thapsus L.	Hierba del paño	Allochth.	Not Applicable	Biennial herb
Verbascum virgatum Stockes	Mitrún	Allochth.	Not Applicable	Biennial herb
Veronica anagallis-aquatica L.	Berro dulce	Allochth.	Not Applicable	Perennial herb
Solanaceae				
Cestrum parqui L'Hérit.	Palqui	Autoch.	No problems	Bush
Lycium chilense Miers. ex A. DC.	Coralito	Autoch.	No problems	Bush
Salpiglossis sinuata R. et P.	Terciopelo	Autoch.	No information	Perennial herb
Solanum crispum R. et P.	Natre	Autoch.	No problems	Bush
Valerianaceae				
Valeriana papilla Bert. ex DC.	Papilla	Autoch.	No information	Perennial herb
Valeriana stricta Clos	----	Autoch.	No problems	Bush
Verbenaceae				
Phyla nodiflora (L.) Greene	Hierba de San José	Autoch.	No information	Perennial herb
Vivianiaceae				
Viviania marifolia Cav.	Té de burro	Autoch.	No problems	Bush
Pinophyta				
Gnetopsida				
Ephedraceae				

Division / Class / Family / Species	Common Name	Origin	Conservation Status	Life form
Ephedra chilensis C. Presl	Pingo-Pingo	Autoch.	No problems	Bush
Polypodiophyta				
Polypodiopsida				
Adiantaceae				
Adiantum chilense Kaulf.	Palito Negro, Culantrillo	Autoch.	No problems	Perennial herb
Adiantum chilense Kaulf. var. hirsutum Hook. et Grev.	Palito Negro, Culantrillo	Autoch.	No problems	Perennial herb
Adiantum excisum Kunze	Palito Negro, Culantrillo	Autoch.	No problems	Perennial herb
Adiantum scabrum Kaulf.	Palito Negro, Culantrillo	Autoch.	No problems	Perennial herb
Adiantum sulphureum Kaulf.	Palito Negro, Culantrillo	Autoch.	No problems	Perennial herb
Cheilanthes glauca (Cav.) Mett.	Doradilla	Autoch.	No problems	Perennial herb
Cheilanthes mollis (Kze) Presl	Doradilla	Autoch.	No problems	Perennial herb

Source: CEA Ltda.

APPENDIX B

NUMBER OF MAPPING UNIT, VEGETATION FORMATION, DOMINANT SPECIES T AREA OF POLYGONS DELIMITED IN THE VEGETATION MAP. MARCH AND NOVEMBER 2008

Note: see code for vegetation formation and coverage index methodology. Dominant species code in Table 6 (p. 15).

Unit Code	Vegetation Formation	Dominant Species	Area (ha)
1	$\underline{LA}_2\ LA_3\ (LB)_3\ [LB]_4\ H_2\ (S)_1$	QS, QS AC, AC LC, SP, Cp, cm vm ha, tC	1.23
2	ZD		0.99
3	ZU		1.34
4	CA		1.13
5	ZI		2.39
6	$[LB]_3\ \underline{LB}_3\ [H]_2\ \underline{H}_3$	Bs AC, Bs, cr, ta	1.36
7	$LA_1\ [LB]_4\ (S)_2$	QS, Gi, tC	4.88
8	ZD		0.95
9	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	1.01
10	$\underline{LA}_2\ [LB]_3\ \underline{H}_4\ H_2$	QS, AC, hi, cv	8.6
11	ZD		0.17
12	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	0.53
13	CA		0.64
14	ZD		0.8
15	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	3.66
16	$LA_1\ [LB]_4\ (S)_2$	QS, Gi, tC	3.17
17	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	0.93
18	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	5.2
19	ZD		1.32
20	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	8.73
21	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	3.65
22	$\underline{LA}_2\ [LB]_3\ \underline{H}_4\ H_2$	QS, AC, hi, cv	2.423
23	$LA_1\ [LB]_4\ (S)_2$	QS, Gi, tC	17.25
24	$LA_1\ [LB]_4\ (S)_2$	QS, Gi, tC	2.18
25	ZD		1.27
26	$LA_3\ [LB]_4\ \underline{LB}_1\ H_2\ (S)_1$	QS CM, SP, Hu, cp bp, tC	2.79
27	$LA_2\ [LB]_4\ (S)_2$	QS, Gi, tC	13.11

Unit Code	Vegetation Formation	Dominant Species	Area (ha)
28	LA_1 LB_4 S_2	QS, Gi, tC	2.02
29	LA_1 LB_4 S_2	QS, Gi, tC	2.92
30	LA_1 LB_4 S_2	QS, Gi, tC	10.21
31	LA_1 LB_4 S_2	QS, Gi, tC	12.2
32	ZD		0.66
33	ZD		0.15
34	CA		0.29
35	LA_2 LB_3 H_4 H_2	QS, AC, hi, cv	0.29
36	ZD		0.27
37	CA		0.48
38	LA_1 LB_4 S_2	QS, Gi, tC	0.41
39	LA_1 LB_4 S_2	QS, Gi, tC	2.57
40	ZD		5.22
41	LA_2 LB_3 H_4 H_2	QS, AC, hi, cv	17.7
42	LA_3 LB_4 LB_1 H_2 S_1	QS CM, SP, Hu, cp bp, tC	56.07
43	ZD		0.62
44	LA_1 LB_4 S_2	QS, Gi, tC	5.07
45	LA_3 LB_4 LB_1 H_2 S_1	QS CM, SP, Hu, cp bp, tC	8.25
46	LA_1 LB_4 S_2	QS, Gi, tC	2.04
47	LA_2 LB_3 H_4 H_2	QS, AC, hi, cv	0.78
48	LA_1 LB_4 S_2	QS, Gi, tC	3.46
49	CA		1.53
50	LB_3 LB_3 H_2 H_3	Bs AC, Bs, cr, ta	2.2
51	ZD		0.28
52	ZD		1.46
53	CA		0.74
54	LB_3 LB_3 H_2 H_3	Bs AC, Bs, cr, ta	0.85
55	LA_2 LA_3 LB_3 LB_4 H_2 S_1	QS, QS AC, AC LC, SP, Cp, cm vm ha, tC	4.56
56	LA_1 LB_4 S_2	QS, Gi, tC	9.98
57	LB_3 LB_3 H_2 H_3	Bs AC, Bs, cr, ta	0.75
58	ZD		2.36

Unit Code	Vegetation Formation	Dominant Species	Area (ha)
89	CA		1.24
90	LA_3 LB_4 LB_1 H_2 S_1	QS CM, SP, Hu, cp bp, tC	6.18
91	ZD		0.19
92	ZI		2.03
93	ZD		0.13
94	LA_3 LB_4 LB_1 H_2 S_1	QS CM, SP, Hu, cp bp, tC	1.78
95	ZD		2
96	CA		4.73
97	ZD		1.41
98	ZD		10.47
99	LA_1 LB_4 S_2	QS, Gi, tC	6.39
100	LB_3 LB_3 H_2 H_3	Bs AC, Bs, cr, ta	11.85
101	LA_2 LB_3 H_4 H_2	QS, AC, hi, cv	6.08
102	ZD		0.55
103	LA_3 LB_4 LB_1 H_2 S_1	QS CM, SP, Hu, cp bp, tC	10.23
104	LA_3 LB_4 LB_1 H_2 S_1	QS CM, SP, Hu, cp bp, tC	0.15
105	ZI		19.08
106	LB_3 LB_3 H_2 H_3	Bs AC, Bs, cr, ta	1.38
107	ZD		13.79

Source: CEA Ltda.