

EXECUTIVE SUMMARY

I. INTRODUCTION

This text contains the Executive Summary of the Environmental Impact Assessment (EIA) for the Alto Maipo Hydroelectric Project (PHAM), owned by AES Gener S.A. The Project consists of a hydroelectric complex made up of two run-of-river power plants in a hydraulic series: the Alfalfal II and Las Lajas Power Plants. Works will be built almost entirely underground by means of pressure tunnels and powerhouse caverns as well as a piping network, mostly underground too. The project will be located south-southeast of the city of Santiago, in the commune of San José de Maipo, Cordillera Province, Metropolitan Region of Santiago (see Figure 1). The PHAM will have an installed power capacity of 531 MW and will on average generate 2350 Gwh per year, which will be supplied to the Central Power Grid (SIC) by means of a transmission line that is not part of the scope of this EIA.

It should be mentioned that the Project had been submitted earlier to the Environmental Impact Assessment System (SEIA); however, it was withdrawn so as to make adjustments and/or clarifications in connection with the design, location and timing of the works. A relevant aspect in that process was the Owner's early consultation of sensitive environmental issues with some Public Departments to have the project validated; equally important was the people's participation process, which helped identify some community concerns and build into the Project design measures to further safeguard environmental components. The foregoing fits in with AES Gener S.A.'s Policy on inserting the Project into the community.

II. PROJECT DESCRIPTION

II.1 General Background

The Project will be set in the upper basin of the Maipo River. The new "Alfalfal II" Power Plant will be located in the sub-basin of the Colorado River, downstream of the existing Alfalfal I Hydroelectric Power Plant, belonging to the Owner; the second, "Las Lajas" Power Plant, will be located on the south bank of the Colorado River, in the sector called El Sauce. The Alfalfal II Power Plant will use the waters from the upper part of El Volcán River and El Yeso River, 700 m downstream of the reservoir discharge, while Las Lajas Power Plant will use the waters from the discharge of Alfalfal I and II Power Plants, plus the flows from the intermediate basin of the Colorado River and sub-basin of the Aucayes Stream (see Figure 2).

Most of the works, including powerhouse caverns and piping, will be carried out underground. The main surface works and facilities will be the water intakes and access roads. Also envisaged is the construction of a power substation (which will be encapsulated), temporary worksite facilities, and temporary muck disposal and camp areas.

The estimated investment amount of the Project will be approximately US\$ 700 million. The current definition is the result of extensive technical and environmental studies that have allowed for adjusting the layout, location, and configuration of the works to minimize their impact on the environment.

The rationale for the Project is explained by the progressive increase in electric power demand in the country. In this regard, the Project will supply the SIC with an average 2,350 Gwh per year, with the added advantage of its close proximity to the system's peak demand

center. Thus, the Project will facilitate displacing the operation of new thermal plants. To this effect, given the nature of the Project, the Owner has envisaged implementing the Alto Maipo Hydroelectric Project (PHAM) under the Clean Development Mechanism (CDM) defined in Article 12 of the Kyoto Protocol.

INSERT FIGURE 1

II.2 Description of the Works

The Alto Maipo hydroelectric project consists of two run-of-river power plants in a hydraulic series in the upper Maipo River sector: Alfalfal II and Las Lajas.

Alfalfal II Power Plant: With a design flow rate of 27 m³/s, this plant will receive the water collected from streams in the upper part of El Volcán River and El Yeso River, 700 m downstream of the reservoir discharge. In the upper sector of El Volcán River, up to a maximum of 12.8 m³/s will be collected by means of four (4) water intakes that intercept the following streams: La Engorda, Colina, Las Placas and El Morado. The collected flow will be conveyed as far as El Volcán tunnel via a buried pipeline. The collected waters will be conveyed along this tunnel as far as the valley of El Yeso River, where the flow from the reservoir discharge will be received through a buried pipeline and an intake well.

The flow will then be conveyed along a pressure pipeline from the intake well to headrace tunnel of the Alfalfal II Power Plant. The surge shaft and loading chamber of this Plant will be placed at a short distance from the beginning of the penstock. Gross head is estimated at 1.146 m.

The powerhouse will be installed in a cavern excavated in the rock mass. Generation equipment consists of two Pelton turbines, each with a rated power of 136 MW.

The Alfalfal II Power Plant tailrace tunnel will deliver its flow to Las Lajas Power Plant headrace tunnel. The flow generated by the Alfalfal II Power Plant may be channeled to the powerhouse or else to the loading chamber of Las Lajas Power Plant, in either case via the abovementioned tunnel.

Las Lajas Power Plant: With a design flow rate of 65 m³/s, this plant will receive the waters from the Alfalfal and Alfalfal II Power Plants, in addition to the flows from the intermediate basin of the Colorado River, located between the water intakes of the Alfalfal Power Plant (Colorado and Olivares) and the current water intake of the Maitenes Power Plant. The flow from the Aucayes Ravine will be added to this.

Las Lajas Plant envisages a loading chamber located on the right bank of the Colorado River.

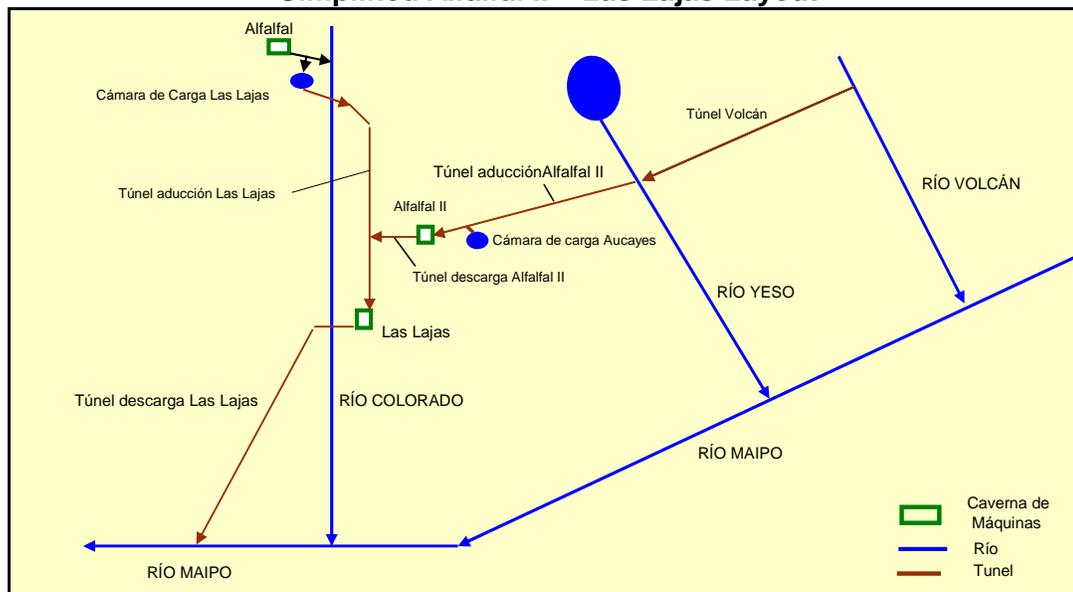
The waters collected at the Maitenes water intake will be conveyed along a channel located on the left bank of the Colorado River; both of these facilities already exist. The crossing to Las Lajas loading chamber is achieved via a siphon under the river.

The pipe system of Las Lajas Plant envisages a pipeline that crosses the Colorado River, by means of a siphon, and connects with Las Lajas tunnel. This tunnel will receive the flow from the Alfalfal II tailrace tunnel; additionally, this tunnel, which along its course will also receive the flow from the Aucayes Stream, envisages a surge shaft and will end up in a penstock that will feed the turbines. Gross head will be 485 m.

The powerhouse will be located on the left bank of the Colorado River, in a cavern excavated in the rock mass. Generation equipment will consist of two Pelton turbines, each with a rated power of 135 MW.

The tailrace tunnel of Las Lajas Plant will discharge its waters directly into the Maipo River, in the sector of Las Lajas.

Figure 2
Simplified Alfalfal II – Las Lajas Layout



II.3 Surface Area and Accesses

The area to be occupied by surface works will be 105 ha. Approximately 40% of this area will be occupied on a temporary basis and will be restored upon completion of the works.

Access to the various working faces will be through the use and upgrading of existing roads (see Table 1) and the construction of new ones (see Figure 3).

Table 1
Project Access Roads

Route	Sector
G – 25	Stretch running parallel to the Maipo River and subsequently to El Volcán River
G – 345	Stretch running parallel to the Colorado River
G – 455	Connects Route G-25 with El Yeso sector
G – 25	Connects Route G-25 with the Project area (Colina Bridge-Water Intakes private road).

II.4 Project Time Limit

The construction stage will be approximately 5 years long, according to the following table:

Table 2
Project Time Limits

Works	Start Date	End Date
Preliminary Works	December 2008	May 2009
Works in El Volcán sector	June 2009	August 2013
Works in El Yeso sector	June 2009	November 2012
Works in the Aucayes-Alfalfal II sector	March 2009	September 2013
Works in Las Lajas sector	June 2009	December 2012

Estimated dates that will be adjusted pursuant to the obtainment of a favorable Environmental Approval Resolution and authorizations, concessions and permits required from other authorities and third parties.

A Project abandonment stage has not been considered; hence, it is possible to extend the project's effective life beyond a 50-year period through the preservation and modernization of equipment.

II.5 Labor

On a preliminary basis, five (5) camps including worksite facilities are envisaged. Each camp will be staffed with 200-400 workers, totaling an average of 2,000 people; hiring will peak at 2,500.

Total staffing for the operating stage is estimated at 50 people, required for maintaining and operating both hydroelectric plants.

II.6 Main Project Components

The project's surface and underground works are summarized in the following tables:

**Table 3
Project Surface Works**

Work	Main Characteristics
Collection Points	Two high-mountain water collection points in the upper basin of El Volcán River, with the following design flow rates: La Engorda (2.1 m ³ /s) and Las Placas (1 m ³ /s) Streams, and two lateral water intakes, Colina (6 m ³ /s) and El Morado (3.7m ³ /s). El Yeso collection point, near the reservoir discharge to El Yeso River (15 m ³ /s). Existing Maitenes Channel collection point (10 m ³ /s). Existing Aucayes Ravine collection point (2 m ³ /s). Existing Alfalfal Channel collection point (30 m ³ /s).
Buried Pipelines	El Volcán: 3.8 km long. Pipe to Intake Well: 1.35 km long. Intake Well to Alfalfa II Tunnel: 4.07 km long. Supply to Las Lajas Loading Chamber: 0.4 km long. Maitenes Channel 1 Diversion Pipeline: 0.15 km. Pipeline from Loading Chamber to Las Lajas Tunnel: 0.92 km.
Las Lajas Plant Loading Chamber	To be located in the Alfalfal sector, on the north bank of the Colorado River. It will have a storage volume of 300,000 m ³ .
Alfalfal II Loading Chamber	To be located in the Aucayes Alto sector, in a natural depression. It will have a storage volume of 45,080 m ³ .
Electric Substation	Located in El Sauce sector. It will be encapsulated and will have an approximate area of 0.1 ha.
Bridges and Other Minor Crossing Works	Four (4) bridges are envisaged: over the Colorado and El Yeso Rivers, and over the Aucayes and El Manzanito Streams. They will consist of a reinforced concrete slab over metal beams, which will be supported by abutments on each side of the river.
Siphons	El Morado Stream siphon, 70 m long. El Yeso River siphon, 130 m long. Colorado River – Las Lajas Tunnel siphon, 170 m long. Colorado River – Maitenes Channel siphon, 110 m long.
Access Roads	Approximately 31 km of new roads will be built.

Table 4
Project Underground Works

Work	Main Characteristics
Tunnels	<ul style="list-style-type: none"> - El Volcán Tunnel, 14 km long, begins at an approximate altitude of 2,500 m.a.s.l. and ends in the intake well in El Yeso River sector at an altitude of 2,470 m.a.s.l. This tunnel has no windows. - Alfalfal II Tunnel, approximately 15 km long, will convey the waters from the upper basin of El Volcán River and from the discharge of El Yeso Reservoir. It will have a construction access window located in the upper sector of the Aucayes Stream valley. - Las Lajas Tunnel, approximately 9.6 km long. It begins at the exit of the Loading Chamber and ends at the Penstock of Las Lajas Tunnel Power Plant. It will have two (2) construction access windows. - Alfalfal II Tailrace Tunnel, approximately 3.4 km long. It begins in the Alfalfal II powerhouse cavern and ends in Las Lajas Headrace Tunnel. This tunnel has no windows. - Las Lajas Tailrace Tunnel, approximately 13.4 km long. It begins in Las Lajas powerhouse cavern and ends at the discharge point into the Maipo River. This tunnel has one construction access window. - Alfalfal II Access Tunnel, approximately 2.4 km long. This tunnel has no windows. - Las Lajas Access Tunnel, approximately 1.9 km long. This tunnel has no windows.
Surge Shafts	Both power plants will feature surge shafts. In general, these are vertical or slanting shafts connected to the respective headrace tunnels.
Powerhouses	The powerhouses will be set up in caverns excavated in the rock mass, taking up a total area of approximately 1,500 m ² , in the case of Alfalfal II and 1,700 m ² in the case of Las Lajas. The powerhouses will have a reinforced concrete structure and their accesses will be through the above-mentioned respective tunnels, and will house the electromechanical equipment.
Tailrace Works	Waters from the Alfalfal II Power Plant may be discharged into the Headrace Tunnel of Las Lajas Power Plant to be conveyed to that power plant or to the Colorado River through the same tailrace tunnel. Las Lajas Plant, on the other hand, will discharge directly into the Maipo River at an elevation close to 820 m.a.s.l. Both discharges will have energy dissipation devices, and riverbed and riverbank safeguards.

INSERT FIGURE 3

II.7 Description of Project Stages

i) Information Gathering Stage

The project Owner has carried out the Project's technical, economic and environmental feasibility studies whose findings have been taken into account in the current definition of the works. That is the case with the decreasing or concentrating the Project's area requirements, temporary facility location criteria, and service road layouts, among others.

ii) Construction Stage

The following activities are worth noting at this stage (see Figure 3):

- Ground preparation: Cleaning and clearing prior to starting the implementation of preliminary works (camps, muck disposal sites, roads, and others).
- Implementation of five (5) camps for worker accommodation and seven (7) worksite facilities, five (5) of which will be adjacent to the respective camps, so only two (2) will be independent worksite facilities. Worksite facilities will be used for setting up offices, warehouses, storerooms, maintenance shops, etc. Camps will have drinking water supply and restrooms, parking lots, among other facilities, as well as such conveniences and services for personnel as required by the regulations and suitable for the weather in the high Andes.
- Implementation of new access roads totaling approximately 31 km will allow personnel, supplies and consumables to reach the working faces.
- Upgrading of Routes G-25 and G-455: these roads are in a deteriorated condition. In brief, upgrading will consist of replacing the granular surface from Pk 13.8 to Pk 20.0 on Route G-25 (considering as Pk0 the beginning of the dirt road on the bridge over El Yeso River) and from km 17.8 to km 18.3 on Route G-455; placement of road signage and safety barriers; construction of masonry or concrete structures; the application of annual bischofite spray as a dust suppressant, among other works and actions.
- Road maintenance, to last throughout the construction period, in the Colorado, Yeso and Volcán sectors.

- Implementation of 14 muck-disposal sites that will receive the material from tunnel excavations and surface works. The final location of these sites has taken into account the distance to population centers or dwellings serving as permanent or temporary habitation, low visual impact zones, next to natural elevations, areas of poor soil value, and sites with no botanic or cultural value. The final shape of each deposit has been adapted to the topography of the landscape. The project Owner has taken all the precautions in connection to site design and management in order to prevent landslides, rock fall hazards or erosion on account of rainfall.
- Works construction: The drill and blast method, which uses drill holes and blasting, will be used for underground works. Alternatively, the use of full section tunnel boring machines (TBM) is envisaged. Overall, around 1.7 million m³ of rock material will be moved and transported to a total of 14 stockpiling sites. This material will be transported on rail wagons, conveyor belts, and dump trucks. Surface works, on the other hand, envisage the construction of water intakes, pipelines, loading chambers, siphons and bridges.
- Use of borrow fills: The project does not envisage special areas for obtaining borrow fill or aggregates. In the sectors involving El Volcán, El Yeso and Colorado works, requirements of these materials will be covered by excavation surplus material from works existing in the Project's waterways, i.e., water intakes, siphons, bridge abutments, and rockfill protection works. In the works located in the Maipo River sector, aggregate requirements will be covered by authorized third parties located in the sector of La Obra.

iii) Operating Stage

The process of generating electricity will consist in the operation of hydraulic turbines that convert the potential energy of water into rotational mechanical energy. This mechanical energy is transformed into electric energy by means of a generator physically coupled to the same turbine shaft inside the powerhouse caverns.

Given their condition as run-of-river power plants, the flows actually collected will depend on the hydrological conditions of the basin, with peak design flow rates of 27 m³/s for Alfalfal II and 65 m³/s for Las Lajas Power Plants. Likewise, the evaluation of water availability has considered maintaining the necessary ecological flows to preserve natural habitats and the environmental functions of waterways. In the case of El Yeso River, the flow delivered by the discharge from El Yeso Reservoir will be used on a stringent basis so as not to affect the reservoir's current operating criteria, in accordance with drinking water supply requirements of the city of Santiago and the reliability of supply.

On the other hand, it should be stressed that the Project will not affect water availability for water users in its area of influence. This stems from the fact that the PHAM envisages honoring all legally established third-party water rights; therefore, users of channels located between PHAM's water collection points and the return point will not have their rights breached. The remaining Maipo River users in the area of influence of the Project, whose water intakes are downstream of the delivery point of the Project waters (Las Lajas Power Plant), will not see any effect of the operation of the project on the natural regime of the Maipo River.

Finally, during the operation stage, civil works maintenance (inspections, cleaning, clearing and minor repairs in water intakes and hydraulic pipes) will be performed on electromechanical equipment and roads.

II.8 Consumables, Machinery and Service Requirements

The main consumables for the works will be: steel (4,800 ton), cement (86,000 ton), aggregates (105,000 ton), steel tubes (6000 ton), among others. The required machinery will consist of bulldozers, backhoes, front loaders, dump and tank-trucks, mixer trucks, jumbos, TBMs, drilling machines, compacting rolls, rail wagons, among others.

During the construction stage, electric power will be supplied through the 23 kV worksite line. Diesel oil and gasoline will be used as fuels, mainly at worksite and camp facilities. For the drinking water supply at camps and other workers facilities, the waters from the ravines existing in the lands where such facilities are to be located will be used, upon the respective owners' approval. With respect to sanitary facilities, a sequential sedimentation system connected to modular treatment plants will be implemented in each camp. Chemical toilets will be implemented at working faces.

II.9 Traffic Flow

With respect to incoming traffic flow from the Metropolitan area up to the various working faces and camp areas, three (3) trucks per hour for transportation of consumables are estimated, to be distributed among the seven (7) worksite facilities along Routes G-25, G-455 and G-345.

II.10 Emissions, Effluents and Waste

In general, generation of emissions, effluents and waste will take place during the construction stage of the Project. The Owner will set Contractors' contractual requirements in order to ensure an appropriate management and final disposal of solid waste. The following table summarizes the type of emission, effluent or waste and the management method provided.

Table 5
Type of Residues or Waste and Management Method

Type	Description of the Material and Management Method
Solid Waste	<ul style="list-style-type: none"> — Muck: inert material, wet crushed rock extracted from the tunnels. Disposal will take place at the project's stockpiling sites. Volume estimated at 1.7 M m³. — Construction waste: wood, pipe trimmings, debris, wires, packaging waste, metals, etc. will be reused or sold to third parties. Volume estimated at 30 to 40 m³/month. — Industrial waste: leftover oils and lubricant greases. Priority will be given to reusing and/or selling them to third parties. They may be stockpiled on a temporary basis in a specially implemented yard, to be later removed and disposed in authorized dumps, by companies authorized to transport this type of waste. — Domestic or domestic-assimilable waste: food waste from canteens, containers, papers, cartons, etc. Waste generation is estimated at a maximum of 2,500 kg /day at peak hiring time. Waste will be stored in containers and regularly removed by the contractor for final disposal at an authorized disposal site. — Vegetable waste: scrub trimmings, weeds and in a lesser proportion trees removed from the worksites, will be redistributed in the adjacent areas.
Liquid Waste	<p>Sewage, from toilets, showers, canteens, and other activities conducted at camp and worksite facilities. A maximum volume of 60 m³/day per camp is estimated. Sewage will be purified at modular treatment plants in each camp, until it reaches a quality suitable for disposal or reuse without being a hazard to human health and the environment. In this regard, during the winter period, treated waters will be discharged to surface watercourses in strict compliance with the maximum limits set forth in Supreme Decree (DS) No 90/2001 in Table No. 1, which sets the "Maximum permissible limits for liquid waste discharges into fluvial water bodies". In relation to sludge resulting from the treatment, they will be removed by the site contractor, to be transported and disposed at authorized sites (it is estimated that between two and three 6-m³ capacity pumper trucks will be required per camp per week).</p> <p>During the operation stage, on the other hand, the existing facilities at the Alfalfal and Maitenes Power Plants will be used.</p> <p>Industrial Waters and Effluents: Waters from construction activities such as concrete preparation, aggregate wash and preparation, truck body and tray wash, machine and tool wash and, finally, waters draining from tunnels during construction. The generation of this type of effluents will be restricted to worksite facilities only. On the other hand, no wastewater will be generated at camps as the activities carried out are limited to occupancy by personnel. Wastewater will be treated in a sequential sedimentation system, to be implemented at each worksite facility, consisting of a settling pond that will enable the separation of industrial liquid waste into clear water and settleable sludge. Clear water will be used in concrete preparation, surface moistening, vehicle wash, among others. Solid sedimentary material from the settling ponds will be disposed at the muck disposal sites as void fill material.</p>
Atmospheric Emissions	<p>Atmospheric emissions will consist of resuspended dust resulting from earthmoving activities (e.g. excavations, loading and unloading, etc.), and vehicle traffic on surface working faces. Emission control will be done by means of: i) upgrading existing roads currently used by mine trucks, ii) stabilizing new roads with granular surfaces and bischofite, iii) using canvas-covered hoppers, iv) performing mechanical maintenance on equipment, machinery and vehicles on a timely basis, v) surface moistening, vi) using wagons and conveyor belts for discharging muck from inside the tunnels, among others.</p>
Noise	<p>The locality of Alfalfal has been identified as a potential noise receiver. Noise generation sources will be: vehicles and machinery, and worksite facilities. Noise control will be done through periodic maintenance of machinery, the use of acoustic screens in El Alfalfal sector, minimizing the operation of heavy machinery and restriction of noisy activities on holidays and night shifts, among others.</p>

III. LEGAL FRAMEWORK

The main regulation of a general nature identified for the project is the Political Constitution of the Republic; Law 19,300, the General Framework Environmental Law; the Regulations of the Environmental Impact Assessment System; the General Ordinance on Urban Planning and Construction of the Ministry of Housing and Urban Planning (MINVU), and the General Law on Electric Services of the MINECOM (Statutory Decree No. 4/07), and the Regulations of the General Law on Electric Services of the Ministry of Mining (S.D. No. 327/97). The main specific environmental regulation applicable to the Project in its different stages and the method for complying with the same is summarized in Table 6.

Table 6
Summary of Plan for Complying with Specific Regulations

Regulation	Compliance Method or Action
DS 144 – DS 59 DS 75 – DS 4 DS 55	Air: Emission control will be done by means of: upgrading existing roads currently used by mine trucks, stabilizing new roads with granular surfaces and bischofite, using canvas-covered hoppers, surface moistening, vehicle wheel wash in the Colorado River sector, etc. Particulars of compliance actions are given in sections 2.5.3 of Chapter 2 and 6.4.1.1 of Chapter 6, and Appendix 4, 5, and 19 of the EIA.
DS 58	Air: According to the estimations made, project emissions of NO _x , HC and CO are considered irrelevant. In relation to project emissions of PM ₁₀ , as a compensation proposal, the project considers upgrading a stretch of Routes G-455 and G-25, which will result in a reduction in current emissions in the area from 1,672 ton/year to 502 ton/year, i.e., a reduction of 1,170 ton/year.
DS 146	Noise: In the Alfalfal sector, noise barriers and semi-enclosures for noisy machinery will be set up at the worksites; surface works will be priority given during daylight hours, and an information dissemination program geared to the likely affected population will be implemented (“Works Execution Work Schedule”). Notwithstanding the above, to verify the effectiveness of mitigation measures, noise monitoring will be conducted pursuant to the procedure set out in DS No. 146/97 of the MINSEGPRES. For noise impacts not regulated by DS 146/97, such as mobile source emissions and vibrations, the Owner has envisaged applying international regulations. Finally, the full assessment of noise and vibration emissions and the description of international regulations are set out in Appendix 30 “Noise Impact Survey”, attached to this EIA.
DS 735 – DS 446	Drinking Water: Water supplied to workers will comply with Chilean standard NCH 409, which sets down drinking water quality conditions.
DS 594, amended by DS 57	Drinking Water: Drinking water supply at least 200 L/day will be maintained, and will comply with Chilean standard NCH 409. Restrooms will conform to the provisions of this standard, particularly as relates to quantity and other specifications (hot water, showers, etc.). The Contractor will ensure the proper maintenance and operation of these services. Chemical toilets will be installed at working faces where workers are engaged on a temporary basis.
DFL 725	Sewage: Sewage will be treated at modular treatment plants that will have been approved by the respective sanitary authority.
DS 90 - DS 876, amended by Decree 105	Liquid Industrial Waste and Sewage: During construction, sewage and liquid industrial waste will be discharged into surface watercourses in compliance with the maximum limits set forth in DS No. 90/2001 in Table No. 1. Additionally, operating control of discharges will use as a reference Chilean standard NCh 1,333 “Water Quality Requirements for Different Uses”.
DFL 1,122	The project’s siphons and pipes will conform to the provisions of this Decree.
DFL 725	Waste: The Owner will set Contractor’s contractual requirements for the management and final disposal of muck, construction and industrial, domestic or domestic-assimilable waste and leftover vegetation.
Resolution No. 5,081	Waste: Each Contractor, in its capacity as a waste generator, shall file the industrial waste manifest tracking the destination of its waste.
DS 366	Flora: If any of the species mentioned in this Decree requires felling, the respective authorization requests shall be submitted.
DS 4,363 – DL 701 – D 82	Flora: The Project implies felling forest formations; to this end, the Forest Felling and Reforestation Management Plan, enclosed as Appendix 7 is being processed within the framework of the EIA.

Regulation	Compliance Method or Action
Law 19,473 - Exempt Decree 693	Fauna: Hunting or capturing animals will be prohibited by regulatory guidelines to be prepared based on this legal body.
Law 17,288 (Law 20,021) DS 484	Cultural Heritage: The Project will not affect any of the sites identified in the Baseline Survey. Notwithstanding the above, and as a protection, the Owner will make contractual requirements of the site contractor to implement risk prevention measures in relation to archaeological and paleontological heritage.
DS 298	Fuels: Fuel deliveries will be made by tanker trucks of distributing companies established in the Metropolitan Region.
DS 379	Fuels: Fuels will be stored in tanks and precincts fitted out in accordance with this Decree.
DS 400	Explosives: Before using explosives, the site contractor shall process the relevant permit applications through the Ministry of Defense or other competent agencies.
DS 77	Explosives: Transportation of explosives required at the various working faces, and storage in a powder magazine. Processing of this type of permit will be required by contract.
DFL 850	Roads: Project crossings or junctions with public roads will fully meet the requirements of the Highway Department, particularly with regards to regulation of intersections, signage and geometrical aspects.
DS 158 (D1910)	Roads: Vehicles shall carry a certificate of weight at point of origin. The Project Owner shall at all times supervise weight control so that weight does not exceed 45 ton as set forth in the DS.
Resolution No. 1	Roads: Trucks to be used shall conform to the truck dimension limits set forth in this regulation, and cannot exceed the dimensions stipulated therein.
Resolution 19 (D No. 1,665	Roads: In the event that shipment of construction stage supplies and equipment that, on account of their size and/or weight, implies exceeding the stipulated dimensions, the relevant authorization request shall be submitted to the Highway Department.
Exempt Decree No. 130	Roads: The trucks to be used shall conform to the restrictions imposed by this decree with regards to suspending circulation of trucks greater than four tons along Route G-25.
Exempt Resolution No.1,138	This EIA includes a prediction and assessment of the impact associated to the landscape and tourism, and specifies the proposed environmental management measures.

In the case of PHAM, the following sectorial environmental permits have been identified as mandatory; accordingly, technical and formal requirements to verify compliance therewith have been included in the EIA:

- Permit to transport radioactive material via any transportation mode, i.e. by land, water or air, insofar as such radioactive material does not form part of the means of transportation referred to in article 1 of DS 12/ 85, Ministry of Mining (Art. 83, DS No. 95/01, and Minsegres).
- Permit to build, modify and expand any public or private work designated for the discharge, treatment or final disposal of drainage and sewage pipes of any kind referred to in art. 71 letter b) of DFL 725, Sanitary Code (Art. 91/DS 95/01, Minsegres).
- Permit to build, modify and expand any plant for treating waste and refuse of any kind, or to install any facility meant for the storage, selection, industrialization, trade or final disposal of refuse and waste of any kind (Art. 93/DS 95/01, Minsegres).
- Permit to conduct such research fishing as may be required to track the conditions of hydrobiological species populations in the application of the Environmental Tracking Plan (Art. 95/DS 95/01, Minsegres).
- Permit to build the hydraulic works referred to in article 294 of the Water Code (Art. 101/DS 95/01, Minsegres).
- Permit to fell or exploit native forest, in any type of lands, or plantations in lands suitable for forestry (Art.102/DS 95/01, Minsegres).
- Permit to build natural watercourse normalization and defense works (Art. 106/DS 95/01, Minsegres).

IV. APPLICABILITY AND METHOD OF SUBMISSION TO THE SEIA

Pursuant to the provisions in articles 8 and 10, letter c) of Law 19,300, General Framework Environmental Law, and article 3, letter c) of DS 95/01, MINSEGPRES, the PHAM is required to be submitted to the SEIA given that it is an electric power generation project greater than 3 MW; accordingly, the eventual environment impacts thereof are assessed in this document.

The PHAM is submitted to the SEIA through this EIA given that during its execution it may generate or exhibit some of the effects, characteristics or circumstances referred to in letters b), d), e) and f) of article 11 of Law 19,300; therefore, its concretion will include a number of appropriate mitigation, compensation or repair measures to take responsibility for such effects.

V. BASELINE

The methodology of analysis for the environmental components included in this EIA Baseline included field information collection campaigns conducted in 2005, 2006, 2007 and 2008, and a thorough bibliographic compilation of specific studies and information about relevant environmental components. This background was supported by aerial photographs, theme charts and information generated by the Project engineering.

V.1 Physical Milieu

- Weather and Meteorology: According to the general classification, two weather types are distinguished in the Project area: “warm temperate with prolonged dry season” and “ice as a result of altitude”. Considering the information from available meteorological reports, the prevailing wind direction is NE; average annual temperature is 13°C; average annual rainfall reaches 600 mm and humidity exceeds 40% all year round; fog intensifies in wintertime and peak solar radiation values occur in the summer.
- Air Quality: San José de Maipo features a large rural area and population centers that are not relevant emission sources. However, industrial activities such as mining (extraction of non-metallic ores) and extraction of aggregates that eventually affect air quality are carried out near the project facilities (above 1,000 m.a.s.l.). In both activities, transportation of loose materials is the activity that generates the greatest amount of particulate material, in addition to truck traffic along unpaved roads. No air quality monitoring stations are in place near the worksites, as this is generally an uninhabited area.

- Noise: Base noise measurements were made pursuant to the regulations. Field determination of noise-sensitive receptors led to establishing eight measurement points in the area of influence of the PHAM, in sectors near future worksites (tunnel windows, camps), muck disposal sites, buried pipelines and main roads envisaged for vehicle traffic (Route G-25, G-345 and G-455). Current noise levels fall within two well-defined types based on location: in the sectors near the main vehicle traffic road, equivalent levels reached 72 dB(A), while in the remaining points they are below 54 dB(A) in daytime and 55 dB(A) at nighttime. Noise levels are predominantly the result of the presence of birds, nearby watercourses, tree foliage, community noise, and vehicle traffic.
- Soils: According to information from the Natural Resources Research Institute, given its topographic and geomorphological characteristics, the commune of San José de Maipo exhibits very poor soil quality, with prevailing dry, non-arable lands. Overall, soils in the area of direct influence range between land use capability classes VI and VII, i.e. poor quality soils that exhibit some sort of limitation due to factors such as topography, gradient and erosion.
- Water Resources: There are four large water systems in the Project area. The first, called Upper Sub-basin of the Maipo River, is characterized by a nival hydrological system and a mean annual flow of 77.8 m³/s (San Alfonso Station) and of 111 m³/s (El Manzano Station). The Maipo River receives the flow from three main tributaries with high headwater levels, which correspond to the remaining subsystems (basins of El Volcán, El Yeso and Colorado Rivers). Overall, both El Yeso and the Colorado Rivers have altered natural hydrological systems. The former due to the existence of El Yeso Reservoir, and the latter due to Los Maitenes and El Alfalfal hydroelectric power plants.

The basin of El Volcán River is divided into two main upper sub-basins (La Engorda Stream and El Volcán River) that give rise to El Volcán River. The area of interest for the PHAM is formed by the sub-basin of La Engorda Stream system, which corresponds to El Morado Canyon, Las Placas Ravine, Colina Stream and La Engorda Stream as such. This area has a hydrological system of nival-glacial origin covering approximately 36 km² of glaciers. This implies that the largest mean annual flows of each of these sub-basins, under natural conditions, occur between November and March due to the increase in temperatures, while they decrease markedly during the winter months.

El Yeso River system has significant water mirrors: Negra Lagoon, Lo Encañado Lagoon and El Yeso Reservoir. Lo Encañado Lagoon exhibits a nival hydrological behavior with peak discharge flows in November, which results in a mean annual flow, under natural conditions, of 0.76 m³/sec. The Negra Lagoon, with a similar hydrological behavior, exhibits a volume of approximately 600 M m³ and flows into Lo Encañado Lagoon, mainly by infiltration. The basin that controls El Yeso Reservoir is fed by a nival-glacial system; El Yeso River exhibits a flow increase between November and March and a flow decrease during the winter months, with a mean annual flow of 8.4 (m³/s). The three water bodies described above are considered to be Santiago's drinking water reserve, managed by Aguas Andinas.

The feeding basin of the Colorado River originates in the high peaks of the Tupungato Volcano, and receives the waters from the Olivares River, its main affluent. The basin of the Colorado River has the following sections: the sub-basin of the Olivares River, with a mean annual flow of 10.1 m³/s; the basin of the Colorado River before it meets the Olivares River, with a mean annual flow of 17.6 m³/s; and the basin of the Colorado River before it meets the Maipo River, with a mean annual flow of 32.7 m³/s.

With regard to current usage and requirements, these relate to irrigation activities in the lower valley sectors, to hydroelectric power generation, and to water requirements associated to mining activity and drinking water.

- Water Quality: The PHAM area exhibits varying anthropic intervention conditions. The most heavily intervened systems are the Maipo, Colorado, El Yeso Rivers and the Aucayes Stream; on the contrary, the least intervened systems are El Volcán River and the Colina, La Engorda and El Morado Streams, probably because of their distance from human settlements and because of the lesser agricultural activity. Except for the suspended particle load, which notably increases during the thawing season, there is a favorable water quality condition for the development of aquatic biota in all watercourses in the study area. In all sectors and sampling points, dissolved oxygen, pH, alkalinity and specific conductivity values attested meet the standards applied to irrigation uses and aquatic life.
- Hydrogeology: In general, the groundwater tables fed by surface flows, thawing and direct rainwater infiltration are not limited to riverbeds, but take up large nonconsolidated Quaternary fill sectors of the depression. Water table runoff basically occurs concurrently with surface runoff, from the Andes to the sea.

The valleys of the Colorado, El Yeso and El Volcán Rivers exhibit a type of primary permeability of high significance in terms of availability. The occurrence of groundwater is associated to unconsolidated fill deposits formed by fluvial, glacial, alluvial, lacustrine, and wind sediments. In general, these water tables are either free or semi-confined, with varying permeability.

Multiple thermal water streams associated to the recent Tupungato – San José volcanic activity crop up in the study area. The main sources are: Colina Hot Springs, Morales Hot Springs, Tupungato Hot Springs, Salinilla Hot Springs, Azules Hot Springs, and Piuquenes Springs.

- **Geology and Geomorphology:** Geologically, the Project area features outcroppings consisting mainly of stratified sequences of continental and marine volcanic and sedimentary rock, intruded by abundant veins, mantles, laccolites, dykes and stocks. The sequences present in the study area are stratified sections dating back from the Upper Jurassic to the Upper Tertiary: seven units or lithostratigraphic formations crop up stripwise, from north to south: Colina River, Damas River, Lo Valdés, Colimapu, Abanico, Farellones and Colorado – La Parva.

In relation to geomorphology, two morphogenetic domains were identified: high and medium mountain areas. In the former, erosive processes predominate, with slopes wearing away and materials carried down (Upper Volcán River, Yeso and Lo Encañado). The latter (Colorado River, El Manzano and Las Lajas areas) is a more stable environment with more significant pedogenetic processes forming soil over the slopes; these are areas with a continuous vegetation cover and consequently greater biological activity in the soils.

V.2 Biotic Milieu

- **Flora and Vegetation:** The characterization of this component was based on visits to the area in different seasons, on specialized bibliography, and on aerial photographs. Sample specimens were collected, herborized and analyzed in desktop studies. For vegetation, the Land Occupation Maps (COT, as per its acronym in Spanish) methodology was used.

With regards to flora, the survey carried out accounted for a total of 258 species in the area of influence of the PHAM. Below 1,700 m.a.s.l. forest formations (trees) predominate, while above 2,000 m.a.s.l. low bushes not higher than 50 cm predominate; these alternate with grasses in thickets, with hard leaves. In humid zones, on the other hand, perennial herbs predominate. Native species, with the presence of wild, allochthonous species, predominate mainly on sites already altered by human activities, in particular below 2,000 m.a.s.l.. It is worth noting that 40 % of the species recorded in the Colorado River sector are wild, allochthonous species, which is explained by the anthropic alteration of this sector. Endemic species decrease with altitude and reach greater numbers in sclerophyllous forest environments (43 %), diminishing in higher areas (15 % in El Yeso and La Engorda). On the other hand, most of the allochthonous species in the Colorado-El Alfalfal sector are annual herbs, although in the Andean areas perennial herbs, mostly found in moisture zones, and even shrubs and trees are also found. A total of six (6) threatened species was recognized. Four of them were found in the Colorado River-El Alfalfal sector, i.e. frangel, *Kageneckia angustifolia*, chagual, *Puya berteroniana* (*P. alpestris*), quisquito, *Eriosyce curvispina* (*Neoporteria curvispina*) and peumo, *Cryptocarya alba*, and two (2) in the Andean highland (El Volcán River) sector, i.e. llareta de Santiago, *Laretia acaulis* and Inca lily, *Alstroemeria exerens*.

With regards to vegetation, following Gajardo's (1994) proposal, the El Colorado-El Alfalfal sector would be set in an Andean Sclerophyllous Forest environment (upper limit 1300-1800 m.a.s.l.), while higher altitude sectors would be characterized by the presence of Andean Schlerophyllous Scrubland. On the other hand, the Andean highland sectors (El Volcán, El Yeso Rivers and Aucayes Alto Stream) would be characterized by the Andean highland Steppe of the Cordillera de Santiago, whose distribution range lies above 2,000 m of altitude. Above the vegetation formations of conservation interest, in the Colorado River area the presence of frangel (*Kageneckia angustifolia*) forests, particularly between 1300 and 1700 m of altitude, and quillay (*Quillaja saponaria*) populations is worth noting, as well as the meadow sectors in El Yeso River, areas with a high degree of intervention due to grazing. The "meadows" in La Engorda sector consist of shub-like scrubland with a particularly abundant herbaceous stratum, with the presence of moisture species such as *Juncus arcticus*. True meadows with prevailing grasslands only occur along watercourses and in the lower sector of La Engorda Canyon; these meadows have a seasonal character, as they tend to disappear at the end of the summer and autumn due to the reduced seasonal water flows and excessive grazing.

- Fauna: Fauna characterization was based on field campaigns and bibliographic information to estimate the richness and abundance of amphibian, reptile, bird, and mammal species.

In this area, a total of 86 species was recorded: three amphibians, nine reptiles, 70 bird species out of which nine are predatory birds, 10 waterfowls and 51 non-predatory birds; four species are mammals.

Of these 86 species, in the sectors of the Colorado River, La Engorda Canyon, El Morado Stream, Lo Encañado Lagoon, El Manzanito Stream, El Yeso Reservoir and River, and Aucayes Stream, 16 species with a conservation status were recorded, most of them belonging to the reptile class, followed by amphibians, mammals, and birds. Only two of them are rated as Endangered (cururo and the four-eyed frog), eight as Vulnerable (two amphibians, four reptiles, one predatory bird and one non-predatory bird), four as Rare (three reptiles and one predatory bird), one as Insufficiently Known (the culpeo fox) and one as Out of Danger (the brown tree iguana).

- Limnology: Two field campaigns were conducted (April 2005, November 2006) whereby representative sampling points were identified; sampling followed customary methodological procedures, both regarding sample collection and maintenance. With regards to richness and abundance of aquatic flora, the comprehensive analysis performed based on the richness of phytobenthos and zoobenthos revealed that El Manzanito Stream and Maipo River exhibited the greatest richness of phytobenthonic taxa in the study area, whereas the remaining systems exhibited lower richness of taxa; this points to the fact that these systems are more favorable habitats for fish populations; on the other hand, the lesser abundance of benthos in the Colorado River and the Aucayes, Colina and El Morado Streams would point to less favorable habitats for ichthyofauna. The remaining systems exhibit intermediate abundance values.

With regards to ichthyofauna, the presence of fish in the study area was irrespective of food supply, as it was not detected in watercourses with greater food supply, such as the Maipo River and La Engorda Stream, but in sectors where food was less available, such

as the Colorado River and the Aucayes Stream. These findings suggest that the presence of fish would be due to factors alternative to low food availability, such as a greater load of suspended particles.

The introduction of highly invasive and aggressive ichthic species in relation to native species has had historical and current adverse effects on native fish assemblages in the country. These species have caused a high intervention condition in the area; therefore, from the point of view of biological conservation, the study area may be given a low environmental value. These findings lead to the conclusion that biological assemblages in the study area have been frequently disturbed by natural and anthropic conditions mainly associated to irrigation, electric power generation, and recreation activities.

V.3 Human and Social Milieu

A characterization was made both at the commune (San José de Maipo) level and on a local scale, considering the localities existing in the area of influence of the PHAM; for both scales, the geographic, demographic, anthropologic, socioeconomic and basic well-being dimensions were studied. The area of influence of the PHAM features sparsely populated localities, with a predominance of rural entities. The sectors located in the high cordillera have been used since long ago by local mule drivers as a grazing area, an activity that has declined while the use of these lands for mountaineering and tourism has increased, so local mule drivers offer their guide services, horses and mules. Also worth noting is the sale of cottage industry dairy products. Each locality has basic, in some cases rudimentary, facilities, and some of them operate as microcenters. All of the localities have access to the natural milieu, despite the scarcity of pedestrian pathways, with the respective associated tourist infrastructure.

V.4 Built Milieu

Over 84% of the dwellings in the area of direct influence of the PHAM are connected to the sewage system; otherwise, septic tanks, pits or other solutions have been implemented. Drinking water supply comes from the connection to the public network (over 70 %), while the remaining dwellings collect their water from highland streams and springs. The main drinking water provider in the area is Aguas Andinas, which has water collection works in the Maipo, El Yeso and El Volcán Rivers. Only 5.5% of the dwellings lack public lighting.

With regards to economic and production activities, the economic foundation of the commune of San José de Maipo is agriculture and livestock farming, mainly carried out in the valleys of the Maipo and Colorado Rivers. Also worth noting is extraction of aggregates and non-metallic mining, as well as electric power generation and drinking and irrigation water production. Livestock grazing activities are determined by the traditional land use by families in the various localities. The presence of livestock activity in different areas may be attested according to the season of the year (summer vs. winter grazing areas).

Road infrastructure is rather undeveloped, and consists of a structuring spine (G-25) that connects and provides access to all the populated localities, and secondary roads G-455 and G-345; there are scarcely any roads inside each locality. There is only one public transportation (Metrobus) route apart from three collective taxi lines. With regards to facilities, these exhibit clearly rural characteristics, with limited services and education, sports, and public recreation facilities.

With regards to tourism, there is considerable seasonal activity between September and March, as the conduct of tourist activities is strongly conditioned by weather conditions during the remainder of the year.

V.5 Land Use and Planning Instruments

The main land uses acknowledged in the area of direct influence of the PHAM are residential uses (clustered and isolated); mining (gypsum and limestone in the upper basin of El Volcán, Yeso and Colorado Rivers) and aggregate extraction; agriculture and livestock (Los Maitenes, El Alfalfal, San Gabriel, El Manzano) and summer grazing areas (meadows associated to El Yeso Reservoir and Lo Encañado Lagoon, and El Morado, Las Placas, La Engorda and Colina Streams); power generation (Los Maitenes, El Alfalfal, Queltehues and El Volcán); commercial (both sides of Route G-25); services and facilities (basic community services and facilities in each locality), and tourism and recreation.

With regards to planning instruments, the commune of San José de Maipo has no Communal Master Map; it only has Urban Limits in force for the localities of San Alfonso, La Obra, San José de Maipo, El Melocotón, San Gabriel and Las Vertientes. According to the Metropolitan Master Plan for Santiago (PRMS), part of the PHAM is situated in an Ecological Preservation Area meant to be maintained in a natural state to ensure and contribute to environmental balance and quality and to preserve the landscape heritage. Overlapping the above are Priority Site areas for the conservation of biodiversity, which have similar protection and conservation purposes.

V.6 Cultural Heritage

Three zones with resources of cultural interest were identified in the area of indirect influence of the Project, i.e. Las Morrenas and Camino del Inka (Inca Road) sites in Lo Encañado Lagoon sector, and the site called Aucayes 1 in the Colorado River – Aucayes Stream sector. “Las Morrenas” site is in a very good state of preservation, while the “Camino del Inka” site exhibits significant interventions as a result of the construction of an aqueduct, currently in disuse. The Aucayes 1 site, on the other hand, apparently does not exhibit either anthropic or natural alteration. In the Upper Volcán sector, sites have been detected where very old fossils or paleontological material may be found. A large part of this material has been ravaged by tourists and residents of nearby areas (according to information made available by the Chilean Paleontological Society (SPACH)). The PHAM works will not generate direct intervention.

V.7 Landscape and Aesthetics

Work focused on the characterization and assessment of visibility, visual quality and visual fragility of the landscape by means of field work, analysis of topographic maps, aerial photographs, area photographs, and indirect valuation methods. The PHAM is situated in a mountain landscape domain with morphological features of valleys, marked abiotic features on the slopes and biotic features restricted to valley bottoms and half-way up the slopes, with vegetation that exhibits vegetation layers depending on the altitude. Seven (7) landscape units were identified where visual quality (aesthetic characteristics) and visual fragility (visual absorption capability in relation to elements foreign to the landscape) were specified, namely, Upper Volcán River, El Yeso River Valley, Lo Encañado, Lower Section of the Colorado River Valley, El Manzano Ravine in the sector of Route G-25, Aucayes Stream Canyon and Maipo River Valley in Las Lajas sector. Visual quality ratings ranges from medium to high, while visual fragility ratings range from medium to high-medium. By combining both characteristics (aesthetic value and susceptibility to deterioration), the most sensitive unit is the lower stretch of the Colorado River, followed by the Upper Volcán River and El Yeso River Valley units.

V.8 Risk Areas

The determination of risk areas was made by means of field visits, bibliographic information, and aerial photographs. Considering the location and the geological and geomorphological characteristics of the area where the PHAM is situated, Risks were acknowledged due to mass wasting, landslides or snow avalanches, earthquakes, volcanic activity and lahars, overflowing and flooding. The most recurring feature is the presence of mass wasting processes in the high mountain domain.

VI. ENVIRONMENTAL ASSESSMENT

Environmental impact prediction and assessment were made by contrasting each of the environmental elements with its potential transformations as a result of executing the PHAM works and/or activities. Impact ratings have taken into account the environmental control measures built into the engineering and those arising from the EIA. The following table specifies the hierarchy of the anticipated impacts:

Table 7
Hierarchization of Environmental Impacts

Elements or Variables	Impact	Rating
Construction Stage		
Air Quality	Alteration of air quality as a result of earthmoving associated to construction works and excavations, equipment and vehicle traffic, and transportation of materials along unpaved roads. Additionally, minor CO, HC and NOx emissions will be released as a result of the operation of equipment and machinery motors.	Negative; medium relevance
Noise	Increase in sound pressure level resulting from scattered sources at each working face, the operation of concrete plants located in worksite facilities, and truck traffic between working faces and muck disposal areas.	Negative; low relevance
Water	Temporary modification of waterways and/or water quality during the implementation of works; treated sewage points and subsequent water return into the original waterway.	Negative; low relevance
Vegetation	Vegetation intervention due to ground requirements for building service roads, siphons, collection works, buried pipelines, windows, loading chambers,	Negative; medium

Elements or Variables	Impact	Rating
	implementation of worksites and muck disposal sites.	relevance
Land Fauna	Movement or displacement of local fauna specimens, mainly reptiles and amphibians, due to changes in their natural habitat conditions and/or because they are chased away by human presence. Eventually, the loss of some specimens with lesser mobility or due to the destruction of burrows might occur.	Negative; medium relevance
Ichthyofauna	Alteration of some ichthyofauna specimens due to a temporary alteration in water quality due to earth removal during excavations and other construction works such as diversion works, collection points, etc.	Negative; low relevance
Population	Job and new income creation. Labor required is estimated at an average of 2,000 direct jobs, distributed across the various working faces.	Positive: high relevance
Population	Interference with tourism; specific, road-related aspect that would result in inconvenience for visitors, who might experience increased travel times or, specifically, longer waiting time at intersections.	Negative; low relevance
Landscape	Landscape alteration due to machinery and vehicle movements, worksite and camp implementation operations.	Negative; medium relevance
Infrastructure	Road impact associated to vehicle movement, mainly related to transportation of supplies and equipment to the worksites, transportation of excavation material to stockpiling sites and, to a lesser degree, personnel transportation to the working faces.	Negative; low relevance
Cultural Heritage	In the area of indirect influence of the Project, three areas with resources of archaeological interest and one of paleontological interest were identified. Expert advice will be available in the field on a permanent basis to prevent affecting these areas or to minimize impacts thereto.	Negative; low relevance

Elements or Variables	Impact	Rating
Operating Stage		
Water	Flow reduction in certain stretches of the river and streams flowing into the Maipo River will have an effect on the sediment entrainment regime.	Negative; low relevance
Ichthyofauna	Alteration of some ichthyofauna specimens due to a modification in the natural runoff regime (flow reduction).	Negative; low relevance
Population	Job and new income creation, associated to personnel required for power plants' maintenance and operation tasks.	Positive: low relevance
Landscape	Landscape alteration due to the implementation of muck disposal areas, which will be revegetated, and roads. Added to this are some smaller-sized works, i.e. water intakes, and tunnel windows and exits, at specific locations. Additionally, flow reductions are envisaged in waterways where water will be collected for the operation of the project.	Negative; low relevance

VII. ENVIRONMENTAL MANAGEMENT MEASURES

VII.1 Main Environmental Management Measures for the Construction Stage

- Minimize effects on air quality: A compensation proposal consisting in upgrading part of Route G-455 and Route G -25 as established in Appendix 4 of EIA, “Emission Compensation Program”, is submitted. The implementation of this measure will have immediate effect on the total emissions generated by this emission source. As per the estimates (see Appendix 5), the planned upgrading will help reduce current emissions from 1,672 ton/year to 502 ton/year in the area, which involves a reduction of 1,170 ton/year. This amount accounts for over 150% of the emissions generated by the project, thus complying with the PPDA. Other environmental management measures are specified in Chapter 6 of the EIA.
- Minimize the increase in sound pressure level: In the Alfalfal sector, noise barriers and semi-enclosures for noisy machinery will be used at the worksites; prioritize surface works during daylight hours. An information dissemination program geared to the population located near the works is also envisaged to communicate the occurrence of occasional noisy sources.
- Minimize the vibration effect: The site Contractor will give instructions on the sensitivity to be shown towards receivers’ attitudes. In this sense, and prior to executing these works, nearby owners will be advised in writing of the need to perform such works, the duration thereof, and the works execution schedule. In addition, a monitoring program will be established for blasting-related noise and vibration.
- Minimize the temporary modification of waterways and/or water quality: The placement of bridges will be carried out minimizing waterway intervention. The project has defined the optimal crossing section in relation to bridge width. Priority will be given to carrying out waterway works in late summer and early autumn. Treated wastewater will be disposed in wintertime into streams located in the project’s area of influence in accordance with the parameters specified in Table 1 of S.D. 90/2001. It should be noted that PHAM works will not affect or compromise Aguas Andinas’ facilities.
- Minimize/restore vegetation intervention: Build into the final project design, works that prevent disrupting surface runoff of anastomosed courses in La Engorda summer grazing area; locate water intakes in Alto Volcán sector at the lowest possible elevation to minimize intervention in the summer grazing area; train staff in the identification and preservation value of vegetation; in-situ demarcation of a perimeter for protection of the species *Eriosyce curvispina* (quisquito); restore the vegetation in areas to be cleared off for work installation (camps, worksite facilities and muck disposal sites).

In addition, take a small walkthrough prior to work commencement; establish restriction areas; train workers in the protection of summer grazing areas; remove and replace the original soil layer at the worksite in the Alto Volcán summer grazing area; dispose the vegetation leftover from clearing Andean highland areas in surrounding areas featuring null or very low vegetation cover.

Finally, reforesting 36 hectares in total is envisaged, by taking all the necessary measures, such as regular irrigation, installation of individual guards, control of lagomorphs (hares and rabbits), fertilization and regular assessment of plantation condition to establish the relevant corrective actions.

- Minimize/compensate local displacement of fauna species: Planned measures will consist in maintaining an ecological flow; minimizing the intervention of riverbank and Andean scrublands in summer grazing areas (establishment of restriction areas); ensuring adequate contractor behavior through training and contractual requirements; restoring habitats; relocating and monitoring species, and providing on-site supervision by a fauna expert. Additionally, and prior to work commencement, conducting a study of the population and habitat conditions for the frog *Alsodes nodosus*, the cururo *Spalacopus cyanus*, and the torrent duck *Merganetta armata*.
- Minimize the project's effects on ichthyofauna: The measures specified for the "temporary modification of waterways and/or water quality" impact are valid.
- Strengthen the effect of job and new income creation: To strengthen this impact, priority will be given to hiring local labor through direct incentives to construction contractors.
- Minimize/compensate interference with tourist activity: Vehicle traffic restrictions will be established for trucks on holidays and weekends; a plan for promoting tourism, particularly ecotourism, will be implemented; Routes G-345 and G 25 will be upgraded; and actions will be taken to promote the commune's tourist attributes, such as: training tourist guides in local educational establishments, designing and publishing a Communal Tourist Promotion Guide, and building and designing a Web site showcasing all the commune's tourist attractions and offerings.
- Minimize/restore landscape alteration: The location of works and facilities has tried to use areas without the presence of high Andean scrubland formations and mature forests of sclerophyllous flora and with less visual accessibility. The location of muck disposal sites shall meet the requirements established by the Regional Highway Department. The filling of muck disposal sites will follow the morphological conformation of the area, so as to favor their insertion in the general relief of each sector. Likewise, upon the closure these sites, slopes will be profiled and revegetated.

The project's power substation will be encapsulated, and 25% of its surface area will be planted with native species.

Other supplementary measures will be the topographic recovery and revegetation of sectors intervened by provisional works and, particularly for the summer grazing areas in the Alto Volcán sector, the minimization of vegetation intervention.

- Minimize road impact: To minimize the use of public roads, approximately 31 Km of service roads will be built. Routes G-25 and G-455 will be upgraded by installing safety barriers and signage, and applying bischofite as dust suppressor, among others. On the other hand, compliance with all Highway Department's provisions will be strictly controlled. Heavy truck traffic will be suspended on Routes G-25 and G-421 on holidays and weekends.
- Minimize effects on traditional activities: The project will instruct its site supervisors to minimize any interference with the passage of herdsmen to the upper part of summer grazing areas; use protecting fencing to prevent animals from falling onto excavation sites; and conduct a Social Indicator Monitoring (SIM), as described in Chapter 8 and Appendix 39.

VII.2 Environmental Management Measures for the Operation Stage

- Minimize vegetation intervention: The project envisages maintaining ecological flows in intervened watercourses. Workers will be trained in special preventive actions concerning circulation in and maintenance of the facilities in La Engorda summer grazing area, so as to minimize vegetation alteration and/or prevent any type of interference with local users (minor grazing). The foreseen effects will be checked by monitoring vegetation during the construction stage and the first five years of project's operation.
- Minimize the project's effects on ichthyofauna: The project shall maintain the ecological flow defined by the Water Department (DGA) in each of the intervened natural courses. Environmental tracking programs will also be developed to check on the assessment of ichthyofauna species.
- Strengthen the job creation effect: Priority will be given to hiring local labor.
- Minimize landscape alteration: A Revegetation Plan shall be developed for temporary works such as camps, muck disposal sites, and worksite facilities. A multiple-purpose ecological flow shall be maintained to minimize the landscaping effect associated to flow reduction, mainly in sectors with higher visual accessibility.
- Strengthen the effects on people development: Establishment of a ten-year US\$ 200,000 annual fund starting in 2010, through Fundación Maitenes, to favor local entrepreneurs submitting local tourist development projects, education projects for local employability improvement, and projects of social interest for the commune that are within I. Municipality of San José de Maipo program. The Owner proposes supporting the development of such comprehensive studies as determined by the competent authority, and as necessary for the integral management of sedimentological resources and erosion-sedimentation balance of the Maipo River, provided they are developed jointly with all the stakeholders involved in the use of the Maipo River resources.

VII.3 Environmental Risk Prevention Plan

Natural risk in the Project area is represented by avalanches, landslides, lahars, flooding, and earthquake risk. Anthropogenic risk refers to incidental events resulting from human activities. The following risks are identified in the case of PHAM: fire, traffic accidents, hazardous substance spills, and incidental interference with sites of cultural value, production of drainages from stockpiles and tunnels, and effect on the water table.

As part of the general risk prevention strategy, the project has considered the following:

- Environmental measures built into the engineering design, such as criteria for location, works design and travel distance minimization, among others.
- Systematic check on compliance with applicable regulations through strict contractual requirements for site contractors.
- Establishment of restriction areas of natural or archaeological value or protected by a regulatory instrument.
- Baseline expansion in cases of work design adjustments.
- Expert supervision by an archaeologist during construction.
- The Owner shall require its contractors to have Internal Order, Hygiene and Safety Regulations in accordance with current regulations.
- Contractors shall have an emergency plan and sufficient equipment and infrastructure at all their facilities to deal with potential emergencies.
- A communication plan will be established, which will operate throughout the project construction stage in accordance with the guidelines of the Risk Prevention and Contingency Plan attached to the EIA.
- Camps will be fitted with all necessary conveniences and resources to address the isolation conditions arising from extreme weather events that may interrupt access roads for several days.
-

Other specific risk prevention and environmental contingency control measures are specified in Chapter 7.

VIII. ENVIRONMENTAL TRACKING

This plan comprises the monitoring and/or tracking programs that will watch over the behavior of environmental components and variables established according to the types of foreseen impacts (see Table 8).

Additionally, the Owner plans to conduct an independent environmental audit during the project's construction phase, managed along with the Authority, particularly for scope definition and external auditor selection.

Table 8
Environmental Tracking Plan

Tracking Description	Frequency and Duration/Site	Reporting Frequency/Report Receiving Authority
Program to monitor particulate matter emission control measures in the construction stage.	Working faces will be inspected on a weekly basis to check on compliance with emission control measures.	ITO will prepare a quarterly report for submission to CONAMA Metropolitan Region and the Health Service, describing the activities and results of the monitoring period.
Noise monitoring program in the construction stage.	Noise measurements will be made for four successive days, during the first two months following work commencement in each of the sectors involved. Thereafter, measurements will be made every six months throughout the work construction stage in the Alfalfal sector, Sauce sector housing, and specific points along Routes G-25 and G-455.	Monitoring reports will be included in a consolidated report to be submitted to the Regional Health Service and CONAMA on a half-yearly basis.
Blasting vibration monitoring program in the construction stage.	On a quarterly basis for the first 100 m of progress in early tunnel opening work. Monitoring will be conducted at the eight points identified as sensitive to blasting noise.	Monitoring reports will be included in a consolidated report to be submitted to the Regional Health Service and CONAMA on a half-yearly basis.
Water quality monitoring program in the construction stage (T°C, pH, CE, OD, Nitrite, Nitrate, Ammonium, Nitrogen, Nitrate, Ammonium, Orthophosphate, Phosphorous, SST and SSD, Alkalinity, Phenolphthalein, Sulphate, metal elements, DBO5).	On a monthly basis throughout the construction period, in each of the waterways, since the inception of activities. Measurements will be made 100 m upstream and 100 m downstream of the work construction areas in Colina, La Engorda, El Morado, and Las Placas Streams, El Yeso River, and Las Lajas discharge.	The results of these analyses will be included in a technical report to be submitted to the Water Department and CONAMA Metropolitan Region on a half-yearly basis.

Tracking Description	Frequency and Duration/Site	Reporting Frequency/Report Receiving Authority
Wastewater discharge monitoring program in the construction stage (parameters set forth in DS 90)	<p>El Morado, and Aucayes Streams (downstream of the existing Maitenes drinking water collection point). El Yeso, Colorado, and Maipo Rivers.</p> <p>Only in winter, as wastewater will be used as part of the construction process during the rest of the year.</p>	The results of these analyses will be included in a technical report to be submitted to the Health Authority on a half-yearly basis.
Limnological monitoring in the operation stage (fish and benthonic macro invertebrate fauna, benthonic microalgae and macrophyte flora, chlorophyll, and MO and OD).	<p>To be implemented in waterways downstream of the works planned in the Colorado and El Yeso Rivers and the Aucayes Stream.</p> <p>Monitoring will be conducted every two months for the first six months of the Project's full operation. Thereafter, monitoring will continue for one year on a quarterly basis.</p>	The results of these analyses will be included in a technical report to be submitted to the Office of the Under-Secretary of Fishing, the Fishing Department, and CONAMA Metropolitan Region.
Ecological flow monitoring program in the operation stage.	<p>Hydrometric stations will be set up in El Yeso River, where the planned bridge will be located, and in La Engorda Stream upstream of the confluence with El Volcán River. Measurements will be made on a monthly basis for a 12-month period, once the relevant rain gage station has been put into operation.</p>	The results of these analyses will be included in a technical report to be submitted to the Water Department and CONAMA every two months during the first six months of the project's full operation. Thereafter, monitoring will continue for one year on a quarterly basis.
Social indicator monitoring program in the operation stage.	<p>This program will be carried out in the localities of Alfalfal, Los Maitenes, El Manzano, El Canelo, Baños Morales, Lo Valdés, El Volcán, El Romeral, El Yeso River Road Sector, and San Gabriel.</p> <p>It will have an annual frequency for the first five years of the operation stage.</p>	A half-yearly report of the results obtained will be prepared, by using charts showing the comparative parameter trend from one campaign to the next. This document will be submitted to CONAMA.
Road monitoring program in the construction stage.	<p>Measurement points will be located on Routes G-25, G-345, G-421, and G-455, and will be consistent with the points determined by the National Census Plan.</p> <p>Monitoring will take place during the first three consecutive business days of each month for a six-month period. Thereafter, it will take place every four months, during a similar period, for the first three years of project construction.</p>	The results of these analysis will be included in a technical report to be submitted to the Highway Department of the Ministry of Public Works (MOP) and CONAMA on a half-yearly basis.
Vegetation monitoring in La Engorda summer grazing area in the construction stage and part of the operation stage.	<p>Sector of meadows and scrubland on both sides of the conveying channel, taking the vegetation upstream of the channel as control.</p> <p>Monitoring will take place on a yearly basis for five years, in the summer period, preferably between December and February.</p>	An annual report will be prepared with the results of each campaign, compared with those of previous campaigns, to identify any changes in vegetation composition and abundance. The reports will be submitted to the Agricultural and Livestock Service (SAG) and CONAMA.

IX. INFORMATION AND PEOPLE'S PARTICIPATION

The Owner acknowledges the relevance of people's participation as a two-way communication process among bidder, community and authorities, which enables individuals and legal entities to have the necessary information on a project and its potential impacts, so that they may have an informed opinion thereon. Thus, throughout the environmental consultation process for the PHAM submitted to the SEIA earlier on and initiated with the environmental prefeasibility studies in 2005, the Owner has introduced a number of adjustments and/or clarifications concerning the design, location and timing of the works, so as to ensure that the Project will minimize its environmental impacts and facilitate the obtainment of environmental permits from the relevant authorities. A relevant aspect in such process was the Owner's validation or early consultation of sensitive environmental issues with some Public Departments, as well as the people's participation process, which at that time helped identify some community concerns and build into the Project some design measures to further safeguard the environmental components. The foregoing fits in with AES Gener S.A.'s Policy on inserting the Project into the community.

In the case of PHAM, during the People's Early Participation process for the EIA submitted earlier, the Owner held a number of meetings with the various community stakeholders, represented by different authorities and members of the local community. The methodology used involves exposing the project and receiving attendees' concerns and comments.

In general, the community's and authorities' concerns have been included in the engineering of the current Project and in the design of environmental management measures. The Owner also puts forward the future commitments to be undertaken with the community in terms of employability, tourism, and the relationship and applicability of the current Fundación Maitenes funds. The EIA includes a consolidated report on emerging issues collected during the meetings held with the community under the previous EIA preparation and assessment process.

Additionally, under Title V of SEIA Regulations, the Owner will carry out the following activities or actions during the environmental impact assessment process for the project:

- Publish an excerpt of the project in the Official Gazette and in a regional newspaper.
- Affix the excerpt at public access places in the offices of the Municipality of San José de Maipo and in the commune's social clubs.
- Meet with CONAMA to agree on people's participation activities to be held during the 60 business day period established by law.
- Attend meetings or other people's participation activities as jointly defined with the authority.