ENVIRONMENTAL AND SOCIAL STRATEGY

La Yesca Hydroelectric Project

MÉXICO

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>La Yesca Hydroelectric Project</th>
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<td>Project Number</td>
<td>ME-L1016</td>
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<td>Borrower/Sponsor</td>
<td>Under bidding by the Comisión Federal de Electricidad (CFE)</td>
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<td>Project cost:</td>
<td>Approximately US $ 832 million</td>
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<td>IDB Participation</td>
<td>Up to 25% of total Project costs in the aggregate (in the form of an IDB A-Loan and/or guarantee)</td>
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I. PROJECT DESCRIPTION

A. Overview

1.1 The La Yesca hydroelectric project contemplates the procurement, engineering, construction, transportation, installation of two turbines and ancillary facilities, and testing and start up of a 750-MW hydroelectric generating facility with an annual average output of 1,210-GWh (the “Project” or “La Yesca”). The Project is located on the Santiago River in the border between the states of Jalisco and Nayarit in the midwestern region of Mexico. The Project, located upstream of El Cajón Hydroelectric Project (“El Cajon”) is part of the Santiago River generation system. See Annex I for additional information on the proposed Project.

1.2 The Project is under public bidding by the Comisión Federal de Electricidad (“CFE”) under the Financed Public Works scheme (“Obra Pública Financiada” or “OPF”). The bids are expected to be submitted on July 31, 2007 with the contract award in September 2007. Under the OPF scheme, CFE awards a Mix Contract for Financed Public Works (“Contrato Mixto de Obra Pública Financiada, or the “Contract”), a construction contract to the winning consortia with the obligation to make payments for the full amount of the Project upon the Project’s provisional and final performance acceptance. Upon acceptance, the ownership and control of the Project is transferred to CFE, which then is responsible for the operation of the Project.

1.3 The proposed Bank participation is in the form of either an IDB A-B Loan and/or a guarantee with the aggregate amount of the Bank participation of up to 25% of the total Project cost.

B. Project Benefits

1.4 Increasing electricity supply and diversification of energy sources. Demand for electricity in Mexico has been expanding with annual growth estimated at 5% and
it is expected to continue growing at similar or higher levels for the coming years. As such, the Project will improve the diversification of energy sources reducing the dependency in thermal sources, increasing the reliability of electricity supply.

1.5 Reduction in the cost of electricity. The Project is consistent with CFE’s least-cost expansion plan, which calls for additional investments in the country’s total installed capacity for power generation to be undertaken by private companies to respond to continued growth in energy demand.

1.6 Support for Mexico’s promotion of renewable energy. The Government of Mexico promotes the development of power projects with renewable sources. In fact, the Energy Law specifically contemplates this type of initiative.

1.7 Carbon reduction emissions. The Project has the potential to qualify under the terms of the Kyoto Protocol.

C. Bank Participation

1.8 Financial additionality: closing the funding gap. Infrastructure projects, in particular hydroelectric generation plants such as the Project, have large capital costs that require financing from commercial banks. The viability of these projects relies critically on the availability of the entire financing at reasonable terms and conditions. As such, the Bank’s financing support in the form of an A-Loan and/or guarantee effectively contributes to closing the funding gap and mobilizing funding from commercial banks.

1.9 Catalytic demonstration effect. Bank participation in the Project will have an important demonstration effect for other project developers in Mexico, as well as private sources of finance/capital, of the viability of larger energy projects under the OPF scheme. This is especially important as Mexico has significant untapped large hydroelectric energy resources.

1.10 Environmental, Social, Health and Safety additionality. CFE is committed to develop the La Yesca Hydroelectric Project in a sustainable manner, with due respect of the environment and improving the standard of living of people living in the area of influence. Bank participation in the financing will help to ensure a positive environmental and social outcome, especially as a result of the Bank’s efforts to collaborate for developing with CFE and the constructor effective and efficient environmental, health and safety management systems and plans. In particular the Bank’s participation will help establish adequate compensation and resettlement programs.
II. ENVIRONMENTAL AND SOCIAL STRATEGY

A. Project Status and Compliance

2.1 CFE retained the University of Guadalajara to conduct the Project Environmental Impact Assessment Report (“EIA”). The EIA was prepared in accordance with the requirements for environmental impact assessments in Mexico, which requires a Regional Type EIA (“Manifestación de Impacto Ambiental Modalidad Regional”) for the proposed Project, as the Project area is more than 500 hectares (ha), will modify a hydrological watershed and will be located in a biological corridor. The EIA was submitted to the Ministry of the Environment and Natural Resources (“SEMARNAT”) on February 7, 2006. Additional information on the proposed Project was required to CFE by SEMARNAT, which was delivered on March 30 and June 20, 2006.

2.2 During the preparation of the EIA, CFE conducted consultation activities on the population of the five affected municipalities by means of questionnaires, interviews and workshops. During the workshops, the local population considered that the relevant topics were: cumulative impacts, social impacts (workers and women vulnerability), public security, compensation, and opportunities for development in the Municipalities.

2.3 On April 4, 2006 in response to a request for consultation and as per the environmental impact assessment requirements in Mexico, a public hearing was held in the city of Guadalajara, Jalisco. The key issues raised by the participants were concerns on potential social impacts and the desire from the communities to be provided with roads, water wells, etc. On July 10, 2006 SEMARNAT issued the environmental authorization for the construction and the operation of the Project. The authorization is subject to compliance with several terms and conditions, including the development of an Environmental Management Plan and specific programs for conservation of flora and fauna and the requirement to reach an agreement with the National Protected Areas Commission and to carry out a study on the biological corridor for promoting an protected natural area in the Project area, among other conditions. These plans and programs had been proposed by CFE in the EIA.

2.4 The construction contract requires compliance with environmental regulations, laws and permits, the obligations of the EIA authorization and the implantation of an environmental management system consistent with the International Standard Organization 14000 standard (“ISO 14000”). CFE’s Hydroelectrical Projects Coordination, which is the area of CFE responsible for the Project has an Environmental Management System (“EMS”) based on ISO 14000. CFE’s EMS

1 The ESS has been prepared based upon a preliminary review of the Project EIA. The Project team has not yet conducted a complete review of the EIA or other relevant Project-related documents, nor discussed findings of the EIA or any other reports with CFE, its environmental consultants or with any of the proposed bidders.
was certified on December 26, 2003. This system is used to manage environmental aspects on CFE projects.

B. Potential Impacts and Risks

2.5 The environmental and social impacts associated with the construction of La Yesca are those typically encountered at similar large-scale hydroelectric projects (see Annex I for a more complete summary of environmental and social aspects of the Project). However, given the characteristics of the canyon where the dam will be constructed (i.e. very steep), the direct impacts on the loss of 3,492 ha of land (34.5 km²) due to the creation of the reservoir is relatively limited in relation to the 750-MW generating capacity of the Project (e.g. 4.7ha/MW). The area to be flooded is isolated and agricultural and cattle grazing activities are low. The EIA indicates that of a total of the 3,492 ha to be flooded, only 34.27 ha (0.98 percent) were planted with crops, while 220 ha (6.3 percent) were pasture. The rest of the area is mainly Deciduous Tropical Forest vegetation 1,812 ha (51.9 percent) or areas with secondary vegetation 503 ha (14.40 percent). The creation of the reservoir will displace 64 people from two poor settlements; Mesa de Flores and Paso de La Yesca, which have a population of 41 and 23 inhabitants respectively. Mesa de Flores will be affected due to its proximity to the construction site, while Paso de La Yesca is located in an area to be flooded by the reservoir. The Project does not appear to significantly convert or degrade critical natural habitats or damage critical cultural sites. Natural habitats will be affected, but the directly affected area does not include any protected areas and these habitats are represented on areas which will not be flooded. No indigenous communities are located in the Project direct area and no potential direct and minor indirect negative impacts on indigenous peoples may occur. Social impacts in settlements and towns near the Project area are likely (such as increase in the demand of health services, public security and cost of living, etc.) due to the presence of more than 5,000 workers in a remote area, although, the constructor will supply health services, accommodations and other services for most of the workers. Other construction related impacts include temporary land use changes associated with the construction area, soil erosion, dust generation, management of petroleum products use during construction and associated wastes, storm water runoff, control of sanitary wastes, noise emissions from construction and blasting activities, and waste rock disposal. Health and safety issues and worker accidents due to the large scale of construction activities are also a potential impact/risk. Potential cumulative impacts include the continuous presence of a large number of workers in the area, as the recently concluded El Cajón project required a similar large number of workers in the area immediately downstream the Project. However, although these two projects are close to each other, the areas are practically incommunicated and thus cumulative impacts due to the presence of large number of workers in the area are expected to be insignificant.

2 The global average for all large hydroelectric dams constructed to date is about 60 ha/MW.
Operational impacts will include: (i) overall changes in the characteristics of the existing water body (i.e., riverine to reservoir); (ii) further deterioration of water quality in the Santiago River and its tributaries (which currently present good water quality) due to the decomposition of vegetation to be inundated which can result in the death of certain fish and other aquatic organisms; and (iii) potential generation of greenhouse gasses such as methane and carbon dioxide due to the oxidation of organic material, albeit likely small due to reservoir shape and characteristics. Potential risks include the deterioration of water quality due to the failure of mining tails ponds located in the upper areas of the Bolaños River. Potential cumulative impacts include minor seismic activity in the area of the Project, especially since the region may already suffer from the cumulative effects of Aguamilpa and El Cajon and overall changes on the hydrology of the Santiago River, as the Project will be the fifth large hydroelectric station in the Santiago River in a segment of 300 km.

Positive impacts include increased commercial and services activities in the two affected States to meet the market demands of the construction of the Project and the workforce attracted to the area, employment opportunities during construction and operation phases.

C. Environmental and Social Due Diligence Strategy

The Project team proposes to classify the Project as Category “A” in accordance with the IDB Environmental and Safeguards Compliance Policy, as large hydroelectric projects have the potential to cause significant negative environmental and associated social impacts. However, considering the environmental and social conditions of the area where the Project will be constructed, the environmental and social impact assessment concluded that the Project will not cause any significant negative social or environmental impact.

CFE is planning on implementing environmental and social monitoring and verification programs. The Bank will build upon CFE efforts, contributing with its experience to the improvements of these activities. The Bank, as part of its due diligence process and in coordination with CFE will conduct the following activities:
(a) Assessment of compliance status with the applicable Mexican environmental, social, health and safety, and labor legal requirements (e.g., laws, regulations, standards, permits, authorizations, applicable international treaties/conventions, etc.), in particular the Mexican EIA requirements; Project-specific legal requirements (e.g. contract, etc.); applicable IDB Bank environmental and social policies (including specifically the Environmental and Safeguard Compliance Policy, Indigenous Peoples Policy, Disclosure of Information Policy, and Involuntary Resettlement Policy), and any applicable International Conventions (e.g., CITES)3.

3. CFE and IDB agree that the development of the project in first instance must comply with
(b) Evaluation to confirm that the Project’s direct, indirect and cumulative negative environmental and social impacts have been properly identified and evaluated, in particular any impact on: water quality impacts in the Santiago River and its tributaries impacts from the generation of greenhouse gasses, social impacts in settlements and towns near the Project area, any potential impacts on the Agave Landscape and Ancient Industrial Facilities of Tequila area proclaimed by the World Heritage Committee (UNESCO) as World Heritage Area health and safety issues and worker accidents due to the large scale of construction activities, indirect negative impacts on indigenous peoples and cumulative negative impacts including the continuous presence of a large number of workers in the area, long-term socio-economic impacts as what will happen to temporally workers after construction, seismic activity and overall changes on the hydrology of the Santiago River, as the Project will be the fifth large hydroelectric station in the Santiago River in a segment of 300 km;

(c) Assess the information included in the EIA on Green House Gases (GHG) to confirm whether there is enough and reliable data to confirm if there will be a positive impact on GHG;

(d) Attempt to assess whether the dam design takes into account rainfall pattern data that is based on future rainfall estimates, or is based solely on past rainfall data so that potential climate change implications are accounted for in the design and that proper mitigation measures are in place;

(e) Confirmation that environmental and social management plans and procedures and monitoring programs will be established and implemented for the Project in order to adequately prevent, mitigate or control the significant environmental and social impacts and address the environmental and associated social risks. In particular, this will include: the resettlement and compensation procedures and process for the acquisition of the access road and transmission line right-of-way; measures to properly deal with construction workers and the potential associated impacts in local communities and waste and water disposal from the construction camps;

(f) Confirmation that health and safety plans and procedures will be established and implemented by the winning consortia of the Contract and its subcontractors to adequately address potential worker health and safety risks associated to the magnitude of the construction activities of the Project;

(g) Confirmation that contingency plans and procedures will be established and implemented by the winning consortia of the Contract and its subcontractors to adequately address potential Project-related environmental events (i.e., overtopping of the cofferdam and dam, explosions, fires, etc.);

Mexican legal requirements (e.g., laws, regulations, standards, permits, authorizations, applicable international treaties/conventions, etc.).
(h) Evaluation of Project-related information disclosure and public consultation activities that have been performed including confirmation that the participation processes of stakeholders has been adequately conducted and that the proposed future actions to provide adequate ongoing information disclosure and public consultation with the local population, is in compliance with IDB policies. This will include confirmation of adequate stakeholder engagement, that the communities have participated meaningfully in pertinent decisions that affect them throughout the Project cycle (i.e. location of infrastructure and access roads, compensation agreement, etc.), other information disclosure and public consultation activities, during both construction and operation of the Project; and

(i) Assessment of the winning consortia of the Contract and CFE capacity to properly mitigate and monitor environmental, social, health and safety and labor aspects under their respective responsibility.

2.10 CFE and IDB will promote an evaluation of El Cajón Hydrolectric project in terms of potential lessons to improve the practices to be implemented in La Yesca.

2.11 The Project team will attempt to collaborate with the Project Company and the participating lending institutions to adopt a single environmental assessment process and unify documentation, consultation and disclosure requirements consistent with the requirements of the different lending institutions.

2.12 As part of the Bank’s environmental and social due-diligence, the Bank will prepare an Environmental and Social Management Report (“ESMR”) in coordination with CFE for consideration by the Bank’s Committee on Environmental and Social Impact (“CESI”). The ESMR will provide a synthesis of the relevant environmental and social aspects related to the Project and the proposed Bank recommendations in terms of project-specific environmental and social requirements.
ANNEX I
ENVIRONMENTAL AND SOCIAL
I. TECHNICAL DESCRIPTION

A. Location

1.1 La Yesca will be located on the Santiago River, which is the border between the States of Nayarit and Jalisco (See Figure 1). The dam axis will be constructed in a deep canyon between these two states. The dam and associated facilities will be located at approximately 6 km downstream from the point where the Bolaños and Santiago rivers merge. The site where the dam will be located is 105 km by road (90 km straight line distance) northwest from the city of Guadalajara, the capital of the State of Jalisco, and 62 km upstream of the El Cajón hydroelectric project, currently under construction, whose reservoir will define the tailwater elevation at La Yesca. The reservoir will flood areas in four municipalities in the State of Jalisco and one municipality in the State of Nayarit. The dam, powerhouse and overall works will occupy an area of approximately 200 ha in the municipality of Hostotipaquillo in Jalisco. The Municipal seat is the town of Hostotipaquillo, which is located 27 km from this site, whereas the closest settlements are Mesa de Flores and Paso de La Yesca at 6 and 9 km respectively (See Figure 2). The geographic coordinates of the site for the dam are latitude 21°11’49” North and longitude 104°06’21” West. The dam and the reservoir will be sited within a deep river canyon with very steep slopes.

1.2 There are other existing hydroelectric power projects and existing hydroelectric plants on the Santiago River near to the proposed Project. The Santa Rosa 61-MW hydroelectric plant is located approximately 70 km upstream of the site of the proposed Project. The Santa Rosa reservoir collects wastewater flows from the Guadalajara city suburbs. The Santa Rosa hydroelectric power plant regulates much of the flow of the Santiago River. Closer to the Project, at approximately 62 km downstream the 750-MW El Cajon project is in its final stage of commissioning. The El Cajon reservoir started its filling on July 14, 2006. Further downstream, the 960-MW Aguamilpa hydroelectric plant has been in operation since 1994 (See Figure 3). There are other hydroelectric power projects that are at the planning stage, as only 32% of the 4,300 MW hydroelectric potential of the Santiago River has been developed.

B. Project Components and Facilities

1.3 The Project will have a total nominal capacity of 750 MW, provided by two Francis-type generating units to generate an estimated annual average total output of 1,210 GWh.
1.4 Diversion. La Yesca will have an in-stream diversion scheme. The river will be diverted from its bed through two 14-m x 14-m tunnels to be located in the left margin of the mountain side (left bank) to discharge further downstream back in its riverbed. The two tunnels will be partially lined with concrete, with lengths of 693.3 m and 750.6 m. A 227,000 m$^3$ earthfill upstream pre-cofferdam will withstand the low river flows of the dry season. A 78-m high concrete faced rockfill cofferdam (hereinafter called the “integrated cofferdam”) will be built downstream of the pre-cofferdam, in order to withstand the probable maximum flood (PMF) of 8,653 m$^3$/sec established for the construction stage. This PMF corresponds to a return period of 200 years. The integrated cofferdam, along with a 77,000 m$^3$ earthfill downstream cofferdam, will become part of the main dam.

1.5 Spillway, Penstocks and Powerhouse. The spillway will be located on the left bank of the river and will include six 12 x 19 m hydraulically operated radial gates. Each of the intake structure for the two units will have a trashrack and hydraulically operated, flat, wagon-type gate. Two 7.95-m diameter x 194-m long penstocks will be concrete lined in the upper part and steel lined in the lower part only. An underground powerhouse will accommodate the two generating units.

1.6 Transmission Lines and Switchyards. A 32-km 115 kV transmission line will be erected to provide electric power to auxiliary facilities during construction of the Project. For the operation of the Project, a 400 kV transmission line will be built including a substation. This 400 kV transmission line will be awarded or constructed by CFE as a separate work from the Project.

1.7 Dam. The main dam is 210.5-m high (579 masl) and 610-m long at the crest and will be a rock-filled gravity dam, which will require a volume of 11.9 million m$^3$ of fill material. The dam will be the highest concrete faced rock-fill dam in the world. The upstream face will be covered with a waterproof concrete surface between the plinth and the top of the dam.

1.8 Reservoir. When the reservoir is filled, the maximum normal headwater elevation will be 575 meters above sea level (masl) and the minimum 518 masl. At 575 masl the reservoir will cover an area of approximately 34.92 km$^2$, of which 3.21 km$^2$ correspond to the existing bed of the river, resulting in an area to be affected by flooding of less than 35 km$^2$. The total volume of the reservoir is $5,283 \times 10^6$ m$^3$. The 34.92 km$^2$ reservoir is relatively small in size compared to the size of reservoirs of hydroelectric projects with similar generating capacity. Although the reservoir is deep, its surface area is less than 35 km$^2$ and provides minimal usage storage (approximately $1,392 \times 10^6$ m$^3$) for flow regulations between elevations of 575 and 518 masl. The average river flow is 118.7 m$^3$/s and the average hydraulic residence time is seven (7) months. The estimated time to fill the reservoir is approximately one year. Due to the topography, the reservoir will have an elongated shape, reaching as far as 54.8 km from the dam in the Santiago River and an additional 23.5 km in the Bolaños River. The reservoir will flood areas of
the municipalities of Hostotipaquillo, Tequila, Magdalena and San Martin de Bolaños in the State of Jalisco and La Yesca in the State of Nayarit.

1.9 The overall construction site is very steep and hilly. All temporary and concrete structures such as spillway, powerhouse, diversion tunnels, concrete plant, camps etc. are to be located on the left bank of the river.

1.10 **Project Roads.** The Project will require the construction of a 23-km access road from Hostotipaquillo to the site.

1.11 **Construction Materials** The borrow areas for the rock have been found to contain rock adequate to support the construction of the dam. Some borrow areas have material that will not be completely used, such as in the spillway where only a 50% utilization of the excavated rock is expected to be used for the construction of the main dam.

1.12 **Water Supply System** Wells will be drilled to supply water for construction activities. Potable water will be transported from the town of Hostotipaquillo.

1.13 **Wastewater Treatment Plant.** A wastewater treatment plant will be constructed with a capacity to treat as much as 600 m³ per day (during the peak of construction) of domestic sewage from workers camps, restaurants, bathrooms, etc.

1.14 **Waste Management.** There are no municipal landfills near the construction site and thus a new landfill will be constructed for the domestic waste to be generated by the Project. Hazardous waste will be stored temporarily at the site while it is sent to final disposal. Both landfill and temporarily hazardous waste storage areas will be designed, constructed and operated in accordance with applicable Mexican regulations.

C. **Schedule, Project Workforce and Cost**

1.15 The construction is scheduled to require 55.5 months from mid-November 2007 to project completion at the end of June 2011. The primary construction activities include the civil, electromechanical, and associated works.

1.16 The first critical path in the construction sequence starts with the works for diversion of the river including the excavation and concrete lining of one of the diversion tunnels. The most important contract dates for this project are:

- Scheduled start date November 13, 2007
- River diversion through tunnel No. 1 November 1, 2007
- Final river closure for filling of reservoir June 2, 2010
- Provisional Acceptance 1st Unit February 1, 2011
- Provisional Acceptance 2nd Unit May 2, 2011
- Project finish date June 30, 2011
1.17 After the Project is constructed and upon reaching Project Completion, CFE, the Mexican utility, will take possession of the plant.

1.18 Workforce requirements are expected to reach approximately 5,100 workers during the peak of construction (2009-2010). The EIA reports that approximately 70% of the workers will be accommodated in camps at the Project site.

1.19 The Project contract price is estimated at approximately US $832 million including the related financing costs.

D. Project Alternative Analysis

1.20 The Santiago River basin has been widely studied by CFE. The site for the Project was first studied in 1957. Later, during the 80’s, the site was studied in more detailed by CFE’s North Pacific Zone Survey Management office and the Coordination of Hydroelectric Project office. The basic studies at the site proved the feasibility of the project and led to the performance of specific studies in order to specify topographic, geologic, geotechnical, social and environmental knowledge of the area.

1.21 The environmental and social criteria used to select the site for La Yesca included:
   - Low ratio of inundated area per electricity produced;
   - Low population density to reduce resettlement of population;
   - Avoid the presence of indigenous peoples;
   - On-site availability for construction materials; and
   - Adequate geologic characteristics to support the construction of the dam.

1.22 The site for the dam was determined through the analysis of five possible designs and alternative sites. A feasibility study was completed in August 1991. In 2004, CFE conducted a detailed geological and topographic survey from which La Yesca was selected over other sites.

II. INSTITUTIONAL AND LEGAL FRAMEWORK

A. Institutional

2.1 The Secretariat of Environment and Natural Resources (Secretaría del Medio Ambiente y Recursos Naturales, SEMARNAT) is a government agency whose main purpose is to oversees compliance with legislation on environment and natural resources, including the environmental impact assessment process. Through this process, SEMARNAT approves environmental impact assessment reports (EIA) and establishes the conditions to carry out the works and activities
that may cause ecological imbalances or surpass the limits and conditions established in the applicable provisions to protect the environment.

2.2 The environmental impact assessment process includes the disclosure of information to interested parties and the review of EIAs. SEMARNAT publishes the request for authorization of EIA in its Ecological Gazette while the promoter publishes a summary of a proposed project in a newspaper of broad circulation in the state involved within five days following the date on which the EIA is submitted to SEMARNAT. The Secretariat, at the request of any person or company of the community in question, may conduct a public consultation under the following conditions:

- Any citizen, within ten days following the publication of the project summary under the above terms, may request to the Secretariat to make the EIA available for the public in the state involved;
- In case of works or activities that may cause significant ecological imbalances or damage to the public health or ecosystems pursuant to the provisions established in the regulations of the law, the Secretariat, in coordination with local authorities, may arrange a public information meeting in which the promoter shall explain the environmental technical matters of the work or activity involved;
- Any interested party, within twenty days following the date on which the Secretariat discloses the EIA to the public, may suggest the implementation of additional prevention and mitigation measures;
- The Secretariat shall add the remarks of the interested parties to the corresponding file and record within the resolution it may issue the process of public consultation conducted and the results of the remarks and proposals prepared in writing are filed by project proponents.

2.3 Having evaluated the EIA, the Secretariat shall issue a resolution in which it may authorize the execution of the work or activity involved under the terms requested or authorize the work or activity involved, but being conditioned to the change of project or the establishment of additional preventive and mitigating measures in order to avoid, decrease or compensate the adverse environmental impacts that may be caused due to the construction, normal operation and in case of accident. In case of conditioned authorizations, the Secretariat shall determine the requirements to be observed in the execution of the work or activity involved.

B. Project Compliance Status

2.4 The environmental licensing process was initiated by CFE. An EIA was completed by the University of Guadalajara in early 2006. The University of Guadalajara integrated a multi-interdisciplinary team to support the preparation of the EIA. The EIA was prepared in accordance with the requirements for environmental impact assessment in Mexico, which requires a Regional Type EIA for the proposed Project, as the Project area is more than 500 hectares (ha), it will modify a hydrological basin and it will be located in a biological corridor.
The EIA did not include certain infrastructure associated with the construction of the Project such as the access road, a landfill, a transmission line and three (3) wastewater treatment systems, as the specific characteristics (i.e. design) of these components are to be decided by the winner of the bid. However, this associated infrastructure is not relevant for determining the environmental feasibility of the Project. The EIA was submitted to SEMARNAT on February 7, 2006. Additional information on the proposed Project was required to CFE by SEMARNAT, which was delivered on March 30 and June 20, 2006.

2.5 In the case of the access road, after submitting the EIA, CFE decided to request as part of the EIA licensing the inclusion of the expansion and modernization of a 25.5 km existing road. CFE provided additional information on the proposed expansion of the existing road, which included an assessment of impacts and proposed mitigation measures. After evaluating the information, SEMARNAT concluded that the expansion of the road would not generate significant environmental impacts and considering that it was an existing road, the road was included as a component approved in the EIA environmental authorization.

2.6 On April 4, 2006 in response to a request for consultation and as per the environmental impact assessment requirements in Mexico, a public hearing was held in the city of Guadalajara, Jalisco. On July 10, 2006 SEMARNAT issued the environmental authorization for the construction and the operation of the Project. The authorization is conditioned to comply with several terms and conditions, including the development of an Environmental Management Plan and specific programs for conservation of flora and fauna, soil, etc, the requirement to reach an agreement with the National Protected Areas Commission and to carry out a study on the biological corridor in the area of the Project, among other conditions. All these programs had been considered in the EIA statement submitted by CFE. The authorization is valid for a period of 4 years for the construction and 50 years for the operation of the Project. These periods can be extended by the authority.

2.7 SEMARNAT’s authorization does not include a landfill, a transmission line and three (3) wastewater treatment systems, infrastructure that are required for construction and which will need to be permitted by the bidder of the concession. In addition, SEMARNAT’s authorization does not include the 400 kV transmission line required to connect the Project to the existing grid upon the start of operations. The corresponding municipalities or State governments will require either Environmental Impact Statements or Environmental Impacts Assessment Reports based on the characteristics of the components and in accordance with the state environmental legislation.

III. ENVIRONMENTAL AND SOCIAL CONDITIONS
La Yesca will be located on the Santiago River in the boundaries of the states of Nayarit and Jalisco, in the Sierra Madre Occidental Mountainous Range in Western Mexico. The topography is characterized by deep ravines and canyons. Canyons are normally 700 m deep, although there are areas with 1,500 m of elevation difference. The Project dam and the reservoir are to be located in a very steep canyon.

The EIA completed for CFE by the University of Guadalajara defines the area of influence of the Project as an area of approximately 65,000 ha along the canyons where the Santiago and the Bolaños River runs and the more open valleys found in the upper areas, from the existing Santa Rosa hydroelectric power station to 5 km downstream where La Yesca dam will be constructed. The area to be affected directly by the Project encompasses 3,692 ha (3,492 ha for the reservoir and 200 ha of access roads, and construction site), which represents 5.37% of the environmental system where the Project will be located.

A. Environmental

Hydrology. The Lerma-Santiago River is Mexico’s longest river with a length of 2,600 km in west-central Mexico. The Lerma-Santiago River begins in Mexico's central plateau at an altitude over 3,000 masl, and ends where it pours into the giant Lake Chapala (at 1,510 masl), near Guadalajara, Jalisco.

The Santiago River is 443 km long and continues from Lake Chapala. The Santiago flows generally northward and westward through the Sierra Madre Occidental Mountainous Range, receiving the Verde, Juchipila, Bolaños, and other tributaries. It descends to the coastal lowlands and empties into the Pacific Ocean. The Santiago's course is marked by rapids and falls and is therefore no navigable, especially in mid elevations as where the Project will be located. The Santiago River fertile valley (upstream of the Project site) is of great economic importance.

The basin of the Lerma-Chapala-Santiago system covers a surface of 125,555 km², of which 30 per cent belong to the Lerma river, 8 percent to the Chapala lake and 62 per cent to the Santiago river, this represents 6.4 per cent of the national territory. The mountain system of the area turns the Santiago river into the depositary of all the water that flows from the Sierra, which albeit is used for agricultural and urban purposes, is enough to generate electric power.

The Project area watershed is 62 km², as the existing Santa Rosa hydropower station located 70 km upstream regulates much of the flow of the Santiago River. The average long-term mean flow was estimated at 3,088.19 million m³/year at the site where the dam will be constructed. The average flow at the site of the dam is reported to be 118.7 m³/s and is composed of the flow of the Santiago River (92.19 m³/s) and the flow from the Bolaños River (26.39 m³/s).
3.7 **Water quality** The EIA reports that the Rio Santiago has very poor water quality. The poor water quality is influenced by wastewater discharges from the city of Guadalajara and some industrial discharges from the area of Tequila, where the liquor industry is intense. The EIA reports exceedances of the limits established in the Mexican standards for lead, aluminum, chromium and manganese, in limits commensurable to the nature of the industrial water being discharged. The city of Guadalajara has specific plans to treat all discharges to the river and treatment plants are scheduled to become operational before the conclusion of the construction of the Project. Some tributaries as the Bolaños River present good water quality, which support a high diversity of fish.

3.8 Water from springs and wells located in the surroundings of the area to be flooded reports the presence of natural groundwater pollutants that arise in the Mesa de Flores area. The presence of pollutants is associated with hydrothermal geologic zones, many of them which have been used by mining companies for the extraction of gold, silver, copper, lead and zinc. The EIA reports seven springs in the Mesa de Flores area. Most of these springs do not meet the Mexican standard for drinking water, although in general, water is deemed appropriate for domestic and agricultural use.

3.9 **Geology and Geomorphology.** Mountainous zones comprise most of the study area. The elevation ranges from 200 m in the lower areas of the Santiago River to 2,800 in the mountains (Tequila Mountain), but in general the elevation ranges from 500 to 2,400 masl. The Project will be located at areas of around 600 masl and the dam will be constructed in a very step canyon. Refer to Figure 4 for a representative view of the steepness of the canyon.

3.10 **Climate.** The temperature and humidity in the studied area are a function of the altitude. The climate is extreme, with high temperatures prevailing most of the year which usually reach 40°C, specially during the summer and the dry season which extends for as long as 8 months. The hot months are from March to July. The rain from July to October can often be accompanied by strong winds and hail. The average annual rainfall is 1,500 millimeters, but it is not uncommon to have prolonged drought.

3.11 **Main Ecosystems.** The canyon to be affected is composed mainly of Deciduous Tropical Forest. Four environmental units were identified in the 65,000 ha studied area, which consist of mountain, ravines, riparian and aquatic areas. It should be noted that both the riparian and the aquatic ecosystems present certain degrees of affectation. The riparian ecosystems have been affected by the changes in river flow as a result of the operation of the Santa Rosa hydroelectric project located upstream of the study area. In the case of the aquatic ecosystem, the poor water quality of the Santiago River has limited the diversity and abundance of the ichtyofuana.
Natural Resources. While there is limited use of natural resources in the study area, its have vast forest and mineral resources, as well as pastures for extensive cattle rising.

Flora. Deep valleys with pronounced and steep slopes characterize the landscape of the region and particularly of the canyon where the reservoir will be created. Due to the fact that the canyon is relatively inaccessible, it presents a relatively high level of conservation. In most of the canyon, the steep-sided ravines support mainly Deciduous Tropical Forest vegetation, which is very common in Mexico (in Jalisco State this type of vegetation covers 24% of the state territory). The Deciduous Tropical Forest is characterized for having a great diversity of species. The EIA reports 6 classes, 120 families encompassing 786 species of vegetation in the Project area, most of which have a wide distribution in the States of Jalisco and Nayarit. According to Mexican regulations, of the 786 species of vegetation identified in the EIA, four are threatened and there is no endangered species. The threatened species include the large shrubs *Tabebuia chrysantha*, pink trumpet tree *Tabebuia palmeri*, the caracolillo *Masticodendron capiri* and the bush *Dasylirion acotriche*. These species are distributed in areas which will not be flooded.

Fauna. Field studies were conducted in the four main environmental units (mountain, ravines, riparian and aquatic). The EIA reports 195 species of vertebrates of which 6.67% are fish, 11.28% are amphibians and reptiles, 62.56% are birds and 19.49% are mammals. The surveys were tailored to each specie and focused on endemic and native species. In general, the wild fauna is composed of deer, jaguar, small rodents, eagles, and many different reptiles. The EIA reports the presence in the 65,000 ha studied area of some endangered and threatened species in accordance with both Mexican regulations and international classifications, specifically the International Union for the Conservation of Nature and Natural Resources (UICN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As the area is well preserved, the following paragraphs describe in more detail the fauna in the 65,000 ha studied area.

Fish. The EIA reports the presence of 13 species of fish grouped in 6 families. Two of these species are also registered in the Aguamilpa hydroelectric power station, located downstream of the proposed Project. These species are *Dorosoma*

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CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES does not take the place of national laws but rather provides a framework to be respected by each adhered country, which has to adopt its own domestic legislation to ensure that CITES is implemented at the national level. The species covered by CITES are listed in 3 Appendices, according to the degree of protection they need. Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.
smithi and Lepomis macrochirus. The more abundant family are the Poeciliidae with three species followed by Cyprinidae, Cichlidae and Centrarchidae with two species each. The area with more abundant species was in the Bolaños River, where fishing activities were reported. Fishermen who say that catches in the lower areas of the Bolaños River frequently between 300 and 500 kilograms every three days. The fish is commercialized in the nearby communities local markets. The less abundant area for fishing is reported to be in the Santa Rosa reservoir, located upstream the proposed Project. Two of the thirteen species are listed as threatened in the Mexican Official Standard NOM-SEMARNAT-059-2001. None of the identified species are listed by UICN nor CITES. The information suggests a low level of diversity of ichthyofauna in the study area, probably as a result of the poor water quality of the Santiago River.

3.16 Amphibians and Reptiles The EIA reports four species of amphibians and 18 of reptiles, mainly small lizards and snakes. Five of these species are endemic to Mexico; two lizards, two snakes and one turtle. Eight are under a protection regime as per the NOM-SEMARNAT-059-2001. These eight species are distributed widely in the canyon of the Santiago River.

3.17 Birds The avifauna of the area is diverse and abundant. The EIA reports 122 species of birds, with a big concentration of different species of birds in the ravines of the Bolaños River. Ten species are endemic to Mexico, being the most relevant Glaucidium palmarum colemense, Vireo hypochryseus, Calocitta colliae and Turdus ryfopallitus. The EIA identifies one specie, the military macaw (Ara militaris) as endangered and the Colima Warbler (Vermivora crissalis) as Especially Protected under the NOM-SEMARNAT-059-2001. Two species are listed by IUCN, one as vulnerable (Ara militaris) and one as semi-threatened (Vermivora crissalis). In the case of CITES, one specie is included in Appendix I and 16 in Appendix II. Feeding and nesting areas of A. militaris will not be flooded and V. crissalis is distributed on all the area of influence.

3.18 Mammals The fauna is composed of 38 species of mammals distributed in 16 families. Among the most common species which were registered in the three terrestrial environmental units are the possum (Didelphis virginiana), the nine-banded armadillo (Dasypus novemcintus), the ring tailed cat (Bassariscus astutus) and the hooded skunk (Mephitis macroura) as well as three species of bats (Pteronotus parnelli, Desmodus rotundus y Artibeus jamaicensis) and the Zacatecan Rock Mouse (Peromyscus difficilis). Two threatened species are reported in the EIA; the jaguarundi cat (Herpailurus yagouaroundi) and the neotropical river otter (Lontra longicaudis) while the ocelot is reported as endangered. Five species are listed by IUCN and CITES. IUCN list the mouse opossum (Marmosa canescens) while CITES lists three felines in its Annex I and one other feline in its Annex II. These species can be found in all the canyon of Santiago River and at present CFE in collaboration with University of Guadalajara is developing a program for protecting crocodile and river otter.
3.19 **Seismicity.** There are no active or major faults in the Project area. The most relevant seismic event in a radius of 100 km from the Project site occurred in 1875 with an estimated magnitude of 7.5 degrees. Since 1987 CFE implemented a seismic monitoring network, which covers the area from the Santa Rosa to the Aguamilpa hydroelectric power stations, which includes the area for La Yesca. The site-specific seismic information is limited to the past 9 years during which no seismic event has been detected.

3.20 **Protected Areas.** The Project area is not located within any natural protected area defined by the National System of Protected Areas in Mexico. The closest natural protected areas to the Project are the *El Bosque La Primavera* which is located 80 km from the site of the Project, in the limits of the Municipalities of Zapopan, Tlajomulco de Zuñiga, Tala y El Arenal, Jalisco; as well as the Municipal Area of Hydrologic Protection Santiago River Ravine (Barranca del Río Santiago) which is located in the Municipality of Zapopan, Jalisco. None of these two areas will be affected by the Project.

3.21 **Cultural Resources** The Agave Landscape and Ancient Industrial Facilities of Tequila in the Municipality of Tequila has been proclaimed by the World Heritage Committee (UNESCO) as World Heritage Area. The Agave Landscape and Ancient Industrial Facilities of Tequila area is composed of 34,658 ha area, stretching between the foothills of the Tequila Volcano and the deep valley of the Rio Grande River. This Tequila area is inscribed on the UNESCO World Heritage List as “part of an expansive landscape of blue agave, shaped by the culture of the plant which has been used since the 16th century to produce tequila spirit and over at least 2,000 years to make fermented drinks and cloth”. Within the landscape are working distilleries reflecting the growth in the international consumption of tequila in the 19th and 20th centuries. The World Heritage site is not affected by the creation of the reservoir.

B. **Socio-economic**

3.22 The Project’s reservoir will flood areas of the municipalities of Hostotipaquillo, Tequila, Magdalena and San Martin de Bolaños in the State of Jalisco and La Yesca in the State of Nayarit. These five municipalities encompass an area of 14,741 km² with a population of 92,323 inhabitants living in 737 towns and

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5 A UNESCO World Heritage Site is a specific site (such as a forest, mountain, lake, desert, monument, building, completes or city) that has been nominated and confirmed for inclusion on the list maintained by the international World Heritage Programme. The programme aims to catalogue, name, and preserve sites of outstanding cultural or natural importance to the common heritage of humankind. The programme was adopted by UNESCO in 1972. Since then, over 180 State Parties have ratified the convention. As of 2006, a total of 830 sites are listed: 644 cultural, 162 natural, and 24 mixed properties, in 138 States Parties. Each World Heritage Site is the property of the country on whose territory the site is located, but it is considered in the interest of the international community to preserve each site for future generations of humankind. The protection and conservation of these sites are a concern of all the World Heritage countries.
communities. The area at and around the reservoir to be created is scarcely populated due to the steepness of the valley and the poor quality of the soils.

3.23 The dam, powerhouse and overall works will be occupy an area of approximately 200 ha in the municipality of Hostotipaquillo. The Municipal seat is the town of Hostotipaquillo, which is located 27 km from this site, whereas the closest settlements are Mesa de Flores and Paso de La Yesca at 6 and 9 km respectively.

3.24 **Land Use.** The area to be affected by the flooding of the reservoir is over 35 km² (3,492 ha excluding the 321 ha of the existing riverbed). The EIA refers that of a total of the 3,492 ha to be flooded, only 34.27 ha (0.98 percent) were planted with crops, while 220 ha (6.3 percent) were pasture. The rest of the area is mainly Deciduous Tropical Forest vegetation 1,812 ha (51.9 percent) or areas with secondary vegetation 503 ha (14.40 percent).

3.25 **Land Tenure.** Most of the land to be affected by the Project is private property. The Project will affect 66 properties in the Municipalities of Tequila and Hostotipaquillo in the State of Jalisco and La Yesca in the State of Nayarit.

3.26 **Economic Activities.** With the exception of the Municipality of Tequila and Magdalena, the rest of the municipalities in the study area have a very low contribution to the economy of Jalisco and Nayarit. The economic activities in La Yesca and Hostotipaquillo are mainly subsistence farming and cattle ranching. There is a trend for the population of these two Municipalities to migrate to areas more economically developed, mainly to the United Sates of America and the capitals of their respective states.

3.27 **Indigenous Peoples.** The EIA reports the presence of 3,558 indigenous peoples living in the five affected Municipalities. The information provided in the EIA is based on the 2000 Population Census and identifies La Yesca as the affected Municipality with the most indigenous population (3,366 individuals).

IV. ENVIRONMENTAL AND SOCIAL IMPACTS

4.1 According to the EIA prepared by the University of Guadalajara, the Project will not cause any adverse and significant environmental or social impact. The Environmental authority considered that some of the relevant impacts included in the EIA could be significant.

4.2 During the construction of La Yesca, the principal negative environmental impacts will be experienced mostly at the construction of the dam site, power station and associated facilities. The principal environmental and social impacts associated with the construction and operation of La Yesca are those typically encountered at similar large-scale hydroelectric projects. However, given the characteristics of the canyon where the dam will be constructed, the direct impacts on the loss of 3,492 ha of land (34.5 km²) due to the creation of the
reservoir is relatively limited in relation to the 750 MW generating capacity of the Project. Due to the topography of the area, which limits the access to the canyons and the limited areas for agricultural or cattle ranching activities, the area of the Project is somehow isolated and scarcely populated. The creation of the reservoir will displace 64 people. As such the relation of both land area flooded (3,492ha) and people displaced (64 people) per the 750 MW installed capacity indexes (4.65 and 0.085 respectively) are very favorable when compared with other large hydroelectric projects worldwide.\(^6\) The site selected for the development of the Project does not appear to pose a risk to critical natural habitats and should not threaten the survivor of protected species, given that the Santiago, Bolaños and other rivers present the same type of vegetation and habitats in similar conditions or better conserved. The Project will not damage critical cultural sites. The directly affected area does not include any protected areas. No indigenous communities are located in the Project direct area and minor potential direct or indirect negative impacts are anticipated on indigenous peoples.

A. Construction

Environmental Impacts

4.3 Construction related impacts are those typically generated at similar large-scale hydroelectric projects. These potential impacts will include erosion, sedimentation and the clearing of vegetation associated with the construction of more than 20 km of internal roads required to provide access to the riverbed and areas where diversion tunnels, dam and power facilities will be constructed (which activities have the potential to affect the ravines that constitute well preserved habitats of birds and mammals), modification of the natural water drainage paths and of the existing topography and possible landslides and contamination of soil, by disposal of cut materials and the likelihood of fuel spills, the generation of waste, dust and noise, the deterioration of air quality resulting principally from crushing operations and from concrete, and asphalt plants and from other large construction related activities such as the emission of air pollutants from vehicles and machinery. To a lesser degree environmental impacts will be experienced during the construction of the access road and the transmission line.

4.4 Soil Erosion. Among the principal impacts during construction is soil erosion. Rock quarry and borrow area mining activities, access road opening and superficial soil removal required for construction infrastructure, offices, lodging facilities, assembling patios, etc will create the potential for erosion in selected

\(^6\) The global average for all large hydroelectric dams constructed to date is about 60 ha/MW. Ledec George, Qintero Juan David, Good Dams and Bad Dams; Environmental Criteria for Site Selection of Hydroelectric Projects, The World Bank, Environmentally and Socially Sustainable Development Department (LCSES), 2003.
areas. Exposed soils in some areas could create the potential for triggering small-scale landslides or falling rocks.

4.5 **Impact on Water Quality from Diversion of the River.** During the construction of the Project, the natural flow of the Santiago River will be altered by the diversion of water through the two diversion tunnels immediately ahead of the cofferdam. However, this diversion will have minimal impacts on the water quality, since the diversion is not very extensive and thus there is a minimal risk of potential increase in mineral salt content from the interaction of the deviated water with the native rocks in the tunnel.

4.6 **Waste.** Other principal impacts during construction will be the generation of a wide range of waste, including construction waste such as wasted lubricants and oil as a result of the in-house maintenance activities, sludge from grease collectors from maintenance areas, fuel storage facilities and vehicles cleaning areas, generation of used solvents and paint residues, metal scraps and containers impregnated with oil are generated on-site and sent for its reuse and/or final disposal through authorized companies. An important amount of domestic solid waste, such as general office and domestic refuse, cafeteria waste and sludge from the wastewater treatment plant will also be produced at the site as a result of the presence of more than 5,000 construction workers during the peak of construction. The solid and dangerous waste will be handled according to the regulations. A landfill will be constructed for disposing domestic waste.

4.7 **Landscape.** The construction of the Project will permanently change the natural characteristics of the area. During construction, removal of vegetation, diversion of the river, and the large-scale rock mining activities will scar the landscape. These changes, however, are temporary and will be covered by water once the reservoir is filled and the surrounding land is flooded.

**Social Impacts**

4.8 The construction of the Project will affect the settlements of Mesa de Flores and Paso de La Yesca, which have a population of 41 and 23 inhabitants respectively. The former will be affected due to its proximity to the construction site while Paso de La Yesca is located in an area to be flooded by the reservoir. The population of both communities will be resettled. Other than the residents of these two communities, there are no inhabitants living in the immediate vicinity of the construction site.

4.9 The presence of up to 5,100 workers for the construction of the Project and the generation of a similar number of indirect jobs are likely to increase the population in nearby towns as well as to generate some social impacts such as an increase in the demand of health services, public security and cost of living, especially in La Yesca and Hostotipaulllo. In addition, construction activities are
likely to attract a significant number of migrants looking for employment opportunities, which eventually might not all be employed. This increased population will result in additional pressure on the public services and infrastructure in the La Yesca and Hostotipaquillo. Most of the worker will stay at the project site where the constructor will supply all needed services.

4.10 **Infrastructure.** Other infrastructure that will be lost by the reservoir includes a bridge across the Santiago River and its access roads. This bridge communicates some farms and the community of San Pedro Analco. The bridge provides a shorter route (by crossing the Santiago river) between the Municipal seats of Hostotipaquillo and Magdalena, but is not the only route. The EIA includes as a compensation measure the reposition of the bridge.

4.11 **Cultural Resources** The upper reaches of the reservoir will flood land in the Municipality of Tequila. The EIA reports that the Agave Landscape and Ancient Industrial Facilities of Tequila proclaimed by the World Heritage Committee (UNESCO) as World Heritage Area will not be affected.

4.12 **Cumulative Impacts** Potential cumulative impacts include the continuous presence of a large number of workers in the area, as the recently concluded El Cajón project required a similar large number of workers in the area immediately downstream the Project. The construction of a new project on a river where at present there are other three dams, can have cumulative impacts on the water quality and availability, although the EIA reports that this effect will not be significant.

**Health and Safety**

4.13 **Given the magnitude of the civil works and associated activities,** the construction of la Yesca involves considerable health and safety risks. Permanent heavy traffic in very steep roads poses a risk of vehicles overturning. Past tunneling work has involved the use of explosives, excavators, lift trucks and dumpers. Blasting is required in the authorized quarry used to supply construction material. The construction of the powerhouse and hydraulic circuit requires the erection of very tall scaffolds, the operation of cranes and the continuous use of energized tools.

**B. Filling of the Reservoir**

4.14 **Deterioration of Water Quality in the Reservoir.** The decomposition of organic matter from soil and vegetation to be inundated during the filling of the reservoir will lower the levels of dissolved oxygen, at levels well below saturation, especially at the bottom areas of the reservoir. In addition, thermal stratification is expected to occur within the water column in the reservoir. Given that the reservoir will be relatively deep, stratification is anticipated within the water column, colder water temperatures will likely occur within the hypolimnion of the reservoir. During this period, death of fish and other aquatic organisms could
potentially occur due to the change in the physico-chemical characteristics of the original ecosystem. In addition, a change in the ichthyofauna can be expected in the area of the reservoir. Fish that thrive in the river system will be replaced by those that prefer the lake-like conditions of the reservoir.

4.15 Deterioration of Water Quality in the Rio Chico and Bolaños Rivers The impacts on water quality are more significant in the tributaries such as the Rio Chico and Bolaños Rivers that currently present good water quality and which will deteriorate with the mixing of the water of the Santiago River and overall from the reservoir.

4.16 Deterioration of Water Quality – Cross Contamination. Another potential impact would be the contamination of water and groundwater by naturally occurring elements and compounds that may exist in the native soils and rocks. If high concentrations of certain naturally occurring elements and compounds that exist in the unsaturated portion of the soil profile came in contact with the groundwater, it could become contaminated. The area is rich in minerals and mining is a common activity. Naturally occurring elements or compounds that could negatively impact the groundwater include heavy metals and sulfates. However, considering the quantity of water that flow along the river and the fact that the rock is not pulverized, the impact of cross contamination is not considered as a relevant risk.

4.17 Loss of Land, Flora and Fauna. The filling of the reservoir will result in the loss of over of 3,492 ha of land (34.5 km²). This area is composed mainly by Deciduous Tropical Forest in more than 50%, which will be submerged by the filling of the reservoir. The anticipated impacts on the local wildlife that currently survive in the area will be of minor significance, as it has been anticipated that there is a good forest’s carrying capacity in the rest of the well conserved canyon and nearby areas. During the filed investigation and surveys on the 65,000 ha of the studied area, only one threatened specie, a rattlesnake (Crotalus basiliscus) was identified in the area to be flooded. The rest of the threatened, endangered and protected species were identified in the 65,000 ha studied areas (See Figure 5). The EIA concludes that threatened species of fish and birds will not be impacted by the creation of the reservoir, as these will move easily to other areas. The loss of terrestrial wildlife to drowning during reservoir filling is a likely impact to be experienced as a consequence of the flooding of terrestrial natural habitats.

4.18 Suppression of downstream flow. The suppression of flow upon the closing of the diversion tunnels during the filling of the reservoir could pose downriver hydrological changes on the riparian ecosystems dependent on the natural flow of the Santiago River. The riparian ecosystem is currently affected by the variations of the Santiago River flow resulting from the operation of the Santa Rosa hydroelectric plant. The EIA has considered that this impact will be low and temporal as El Cajon reservoir is extend up to La Yescas dam.
C. Operation

4.19 Generation of Greenhouse Gases (GHG): Methane and Carbon Dioxide. Carbon dioxide and methane are mostly produced from organic matter decomposition under anaerobic conditions. Given the depth of the reservoir, the characteristics of the impoundment and the accumulation of sediments due to the change from a fluvial environment to a lacustrine one and to the amount of vegetation that will be flooded, it is anticipated that the bottom of the reservoir will be subject to anaerobic conditions, which will foster the generation of methane. On the other hand, in areas of the reservoir with submerged vegetation and with water having oxygen, principally in superficial areas, it is anticipated that the organic material will be oxidized resulting in the generation of carbon dioxide. The EIA includes an estimation of the GHG based on the areas of the ravines to be submerged estimated in 3,350 ha, a vegetative biomass density of 3,378 kg/h, surface area of the reservoir 3,014.75 ha at a normal operation level of 560 masl and the total volume of water estimated at 2,020 million cubic meters. Based on two different equations, it is estimated that 0.27 kg of methane will be produced by kilogram of reduced biomass and 0.73 kg of carbon dioxide by kilogram of reduced biomass. This results in a total production 2,077 tons of methane and 11,878 tons of carbon dioxide. The impact from the generation of GHG is not significant its cumulative effects are considered to be minor.

4.20 Seismicity. The filling of the reservoir may lead to minor seismicity in the area of the Project, especially since the region may already suffer from the cumulative effects of Ahuamilpa and El Cajon. Seismic events would normally occur only during the filling of the reservoir and for one to three years following the filling of the reservoir. These events could cause the destabilization of the steep margins leading to localized landslides. After some years, subsurface structures are expected to stabilize and become stable under the newly created conditions (i.e. the weight of the water column and other effects on the geology eventually reach an equilibrium soon after the creation of the reservoir).

4.21 Downstream hydrological changes. The operation of the Project will not cause any downstream hydrological changes, as the water from the Project reservoir will flow to the El Cajon reservoir, that will be filled by the time La Yesca start operations.

4.22 Visual Impacts. La Yesca will operate as much as 10 hours daily during the rainy season (July to October) and approximately 4 hours daily during the dry season (November to June). The operational variations will result in a maximum fluctuation of 20 meters in the level of the reservoir. This 20 meters band will be completely eroded and will lack from vegetation. By the other hand, the reservoir will be an attraction to visit this areas of high scenic value and where presently these areas are not accessible.
4.23 **Sedimentation.** The rate of deposition of sediments into the reservoir has been calculated in 1.59 Million m³/year. The EIA concluded that there is a low risk of impacts from sedimentation (in terms of reduction of live storage and power generation) as the sediments deposition rate is low and that the existing Santa Rosa hydroelectric power station collects and serves as a barrier for additional sediments from the upper basin.

4.24 **Potential environmental risks. Deterioration of Water Quality – Risks from mining tails.** A potential risk exists for additional deterioration of water quality during the operation of the Project and is associated with the failure of mining tails ponds located in the upper areas of the Bolaños River. In the past, some of the ponds have failed and the release of the mining tails has negatively impacted water quality resulting in the mortality of fishes.

D. **Cumulative Impacts**

4.25 Potential cumulative impacts include overall changes on the hydrology of the Santiago River, as the Project will be the 5th large hydroelectric station in the Santiago River in a segment of 300 km. Other cumulative impacts identified in the EIA are (i) increase of water loss due to evaporation and (iii) the retention of sediment in the various reservoirs.

E. **Positive Impacts**

4.26 The principal positive environmental impact is the use of natural sources of inputs (water and gravity) to produce energy, which would otherwise have to be generated by conventional fuels. At the local level, positive impacts include increased commercial and services activities in the two affected States to meet the market demands of the construction of the Project and the workforce attracted to the area, employment opportunities during construction and operation phases.

V. **ENVIRONMENTAL, SOCIAL AND HEALTH AND SAFETY MANAGEMENT**

5.1 In La Yesca, CFE is retaining full responsibility of the control, mitigation and compensation of the environmental and social impacts of the Project, as the current Project development scheme is based on awarding a construction contract rather than a Built-Operate-Transfer (BOT) concession, common with other large infrastructure projects. As such, CFE will not transfer any environmental permits to a third party and remains highly involved in the development of the Project. CFE designed and defined the technical specifications, selected the site for the construction of the dam and commissioned the various environmental and social studies. While the Project will be constructed by a consortium assigned through a bidding process, CFE will strongly supervise all Project construction related works and will take over the operation of the Project at project completion date.
A. **Environmental and Social Management**

5.2 CFE’s Hydroelectrical Projects Coordination has an Environmental Management System (SAA) based on the International Standard Organization 14000 standard (ISO 14000). The SAA was certified on December 26, 2003. This system is used to manage environmental aspects of CFE projects. One of the main objectives of the SAA is continuous improvement, which contributes to permanently increasing their environmental performance. CFE requires their contractors and subcontractors to develop similar systems.

5.3 CFE awarded the construction of El Cajón to one of the consortiums that are bidding for the construction of La Yesca. La Yesca is very similar to the El Cajón project, the hydroelectric reservoir immediately downstream of the Project dam, which has been under construction for the past five years and is now in its commissioning phase. In the El Cajón project, CFE assigned a team of specialists on socio-environmental issues to supervise and monitor the contractor and subcontractors’ activities, as well as to fulfill the conditions set forth by the authorities.

B. **Environmental and Social Mitigation Measures**

5.4 The EIA includes a series of preventive, control, mitigation, rehabilitation and compensation measures both for the direct area to be impacted by the Project (construction site, reservoir, access roads, borrow pits, etc) and the area of influence upstream and downstream the reservoir. These measures are classified in whether the proposed measure is strictly environmental related, is associated with design and or construction specifications which will result in the minimization of potential impacts, whether they are required by the applicable laws or regulations as well as per internal regulations or codes, social programs and additional studies. Finally guidance is provided on whether the implementation of measures is contained to specific areas, of general application (in areas greater than 1 ha) or of general application (applied throughout construction fronts or other impacted areas). Basically these mitigation measures are based on standard mitigation measures and good construction practices.

5.5 The EIA also includes a series of proposed programs to further mitigate more specific and broader impacts. The following are the programs proposed in the EIA:

- Project to provide a new road connection between the settlements of Santo Domingo de Guzmán and Pueblo Viejo;
- Project to implement a nursery for revegetation;
- Program to mitigate and compensate the increase in the demand of water for human consumption;
- Program to prevent and control eutrophication in the reservoir;
• Environmental Assessment- Program for the Hydrologic Uses of the Santiago River;
• Domestic Waste Management Program;
• Wastewater Management Program;
• Hazardous Waste Management Program;
• Emissions Control Program;
• Reforestation Program;
• Erosion Control Program;
• Fauna Rescue and Relocation Program;
• Forestry Fire Protection and Control Program;
• Social Program; and
• Rehabilitation of construction related affected areas Program.

5.6 The environmental authorization requires CFE to provide a detailed Environmental Management Plan (EMP) at the latest 6 months after the issuance of the EIA authorization dated July 10, 2006 or six months prior to the start of construction activities for approval by the environmental agency. The required EMP is consistent with international best practices for this type of document and specifically requires a detailed description of all necessary environmental mitigation measures and monitoring activities, which shall be, at a minimum, those measures and monitoring activities defined in the EIA and its complementary information and the authorization; a statement of the estimated cost and a time schedule for implementing each mitigation measure and monitoring activity; Project supervision methods and reporting actions within and between Environmental Parties.

VI. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

6.1 During the preparation of the EIA, CFE conducted consultation activities on the population of the five affected municipalities by means of questionnaires, interviews and workshops. The relevant topics considered during the workshops were: environmental impact, job opportunities, social impacts (workers and women vulnerability), public security, compensation, and opportunities for development in the Municipalities.

6.2 On April 4, 2006 in response to a request for consultation and as per the environmental impact assessment requirements in Mexico, a public hearing was held in the city of Guadalajara, Jalisco. More than 300 individuals attended the hearing led by SEMARNAT.

6.3 The Municipal President of La Yesca required federal support for the municipality, including new roads and to extend the coverage in the supply of electricity while a community delegate of Michel (small settlement near the Project) asked for the construction of water wells, water reservoirs, the improvement of roads and sport recreational areas.
6.4 The principal concerns expressed by various NGOs were that the evaluation of the Project was not conducted in the context of the whole watershed, in particular for cumulative and synergic impacts. As a result of these comments, SEMARNAT requested CFE to provide additional information on the Project considering a watershed approach (Lerma River-Santiago River system) considering the integrity of the system and the hydrological balance as well as an analysis of cumulative and synergic impacts. The additional information provided by CFE was assessed by SEMARNAT for the authorization of the Project.

6.5 Finally the general public and some landowners expressed claims against the process conducted for the acquisition of land and the resettlement program of the El Cajón hydroelectric project. Landowners were also interested in the criteria for compensation for their land, timing for receiving compensation and the terms of payment. The environmental authority commented that the hearing was limited to the discussion of La Yesca project and to matters included in the environmental laws and regulations, which do not consider acquisition of land and resettlement. In any case, comments on El Cajón and acquisition of land were incorporated by SEMARNAT into the Project file.