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HYDROELECTRIC POWER PLANT, CARILAFQUEN AND MALALCAHUELLO – CHILE

Figure 01: Pipe coming from one of the hydropower plants
Sources: provided by LAP – Latin America Power

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Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective project design or implementation.

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1. PROJECT DESCRIPTION & LOCATION

The hydroelectric power plant site is located 15 km southeast of the town of Melipeuco, in the triangular land area produced by the union of two rivers, covering about 5 km inland. The power plants are in early phase of construction (10%) and are located at a site that takes advantage of the geographical slopes to augment the overall performance of the power stations. In order to determine the feasibility of the site, a detailed description of the site and its surrounding areas was taken into account. The watershed of the Carilafquén River in the area studied has a flow regime with clear predominance in the summer period and a smaller magnitude in the winter. The Malalcahuello River has a similar flow regime, which means that in both cases there is a constant run of water throughout the year. Latin America Power (LAP) appointed the company Andritz Hydro to manufacture, transport, assemble and commission the electromechanical equipment for the Carilafquén-Malalcahuello project.

The approximated investment is estimated at US $54 million.LAP is the owner and manager of this project. LAP has chosen Peru and Chile as their development platform for renewable energy projects in Latin America. LAP's first investment in Chile was the purchase of 65% of the water rights at Carilafquén-Malalcahuello in the Araucanía region in order to develop these hydroelectric plants. The management structure of LAP consists of five stages: planning and control, technical feasibility, supplier management, construction and operation. The project has a timeline of three years.

The project is currently in the construction phase, which began in April 2014. The project plan, with a life expectancy of 50 years, has not covered deconstruction, as it allows for an upgrade of equipment to prolong its life. The study area is within the Altoandino deciduous forest. The regional landscape corresponds to a matrix that combines extensive grasslands associated with fragments of the native forest. The existing vegetation is associated with the humid climate that prevails at this latitude.

Melipeuco is one of 12 municipalities of the Province of Cautín, where the rural population is larger than the urban population. In the area where the project is located people have limited access to jobs; therefore the project can be one of the major sources of employment in the area. It is estimated that the project will employ about 100 people annually for a period of two years during construction. The hydroelectric power plants of Carilafquén and Malalcahuello are part of a larger network. The energy generated will be fed into the Central Interconnected System (SIC). The construction of a 110 kV line to connect to the Central Interconnected Central System is being considered as part of the project.

The power plant located in the Carilafquén River will generate an approximated output of 19.8 MW. The power plant located in the Malalcahuello River will generate approximately 9.2 MW. The project will be connected to the Interconnected Central System (SIC), the biggest electricity grid in the country. The project will deliver an average annual generation of 83,448 MWh and equate to approximately 56,136 tons of CO_2 emissions reductions per year. The implementation of the Carilafquen-Malalcahuello Hydroelectric Power Plant Project will displace the use of thermoelectric power plants currently operating in the SIC system and will deliver clean energy to the grid.

Chile's energy matrix is very low on renewable sources. The country has a large consumption of imported fossil fuels, such as natural gas and diesel. Chile currently has an installed capacity of approximately 16.2 GW, of which 66% is thermal energy. The relative amount of thermal energy has the effect of increasing energy prices in Chile due to its reliance on international markets. The remaining part is made up by hydroelectric power plants with

over 20 MW or about 31%, and non-conventional renewable energy projects, such as wind farms and biomass plants, which represent approximately 3% of the market.

The major source of emissions in this particular project is the construction phase due to truck traffic, the use of heavy machinery, and smaller vehicles for the transport of materials and personnel. The project is located outside of any urban area and far from population centers. All of these traits, combined with a high density of native vegetation, suggests emissions are considered relatively insignificant and temporary. During the operation stage there will be no emissions with the exception of the dust generated and occasional traffic on unpaved roads-. On a final note, it is important to mention that the project has a commitment to follow rules set by the Kyoto Protocol, and therefore it will be a Clean Development Mechanism for carbon credits.

2. APPLICATION OF THE ENVISION RATING SYSTEM

The Envision™ system is a set of guidelines that aid in optimizing the sustainability of an infrastructure project during the planning and preliminary design phases, as well as a means to quantify the relative sustainability of the project. In this case study, the infrastructure to be assessed is the hydroelectric plant from Carilafquen and Malalcahuello, Chile.

Envision consists of 60 credits grouped into five categories: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk. Each credit pertains to a specific indicator of sustainability such as reducing energy use, preserving natural habitat, or reducing greenhouse gas emissions. Those credits are rated on a five-point scale referred to as a 'level of achievement': 'improved', 'enhanced', 'superior', 'conserving', and 'restorative'. Evaluation criteria are provided to determine if the qualifications for each level of achievement have been met for a particular credit. In each of the five categories there is a specific credit called "Innovate or exceed credit requirements". This is an opportunity to reward exceptional performance that applies innovative methods within the subjects that Envision evaluates.

The criteria for the levels of achievement vary from credit to credit, but generally an 'improved' level of achievement is awarded for performance that slightly exceeds regulatory requirements. 'Enhanced' and 'superior' levels indicate additional gradual improvement, while 'conserving' often indicates performance that achieves a net-zero or neutral impact. 'Restorative' is the highest level and is typically reserved for projects that produce an overall net positive impact. The Envision system weighs the relative value of each credit and level of achievement by assigning points. Credit criteria are documented in the Envision Guidance Manual, which is available to the public on the ISI[1] and Zofnass Program[2] websites.

3. QUALITY OF LIFE CATEGORY

Envision's first category, Quality of Life, pertains to potential project impacts on surrounding communities and their respective wellbeing. More specifically, it distinguishes infrastructure projects that are in line with community goals, clearly established as parts of existing community networks, as well as consider the long-term community benefits and aspirations. Quality of Life incorporates guidance related to community capacity building and

[1] www.sustainableinfrastructure.org

[2] www.zofnass.org

promotes infrastructure users and local members as important stakeholders in the decision making process. The category is further divided into three sub-categories: Purpose, Wellbeing, and Community.

Purpose

The Purpose subcategory addresses the functional assets of communities such as growth, development, job creation, and the general improvement of quality of life. Positive results from infrastructure projects can include community education, outreach, knowledge creation, and worker training.

The Mapuche Community, project owners, and project team collaborated to ensure the efficient development of the hydroelectric power plant. The Community Relations Team (ERC) participated in a Mapuche ceremony, traditionally conducted to gain permission from the forces of nature. This aforementioned indigenous tradition is meant to develop a harmonizing environment with the natural spaces altered in Caren, Huechelepun and surrounding communities. This cultural practice is typical of the indigenous communities in this area and connects with their spiritual practices and rituals. The connection made by the project team to the indigenous communities demonstrates a deep involvement with the community while respecting the communities' beliefs and traditions.

Electric Caren agreed to fund a water supply project in the north of the Malalcahuello River, where the Huechelepun Community lives, directly affecting over 21 families. Caren trains employees on the necessary safety practices involved in each phase of the project. Training on rescue strategies such as immobilization in case of accidents is an important component of their health oversight.

The construction stage of the project will employ about 100 people annually for a period of two years. During the operation phase, an estimate of 15 permanent jobs will be created as well as 15 indirect jobs.

The collaborative approach of the project has allowed the community to provide feedback according to the project design. The location where the flow of the rivers will be restored was changed upon the request of the Mapuche community in order to prevent flooding in surrounding areas. As a result, minimal adverse impact is felt by the configuration of the pipelines. The visual qualities of the landscape will remain intact. In relation to these efforts there have been agreements and authorizations established between the current owners of the affected areas. Adjustments have been made in the engineering design to optimize the chosen path, taking into account the topographic configuration of the local area. These interventions serve as evidence of the collaborative work between the owners of the project and the community.

Llellipun is a ceremony celebrated through the indigenous communities with nature and that the project convened to make sure nature and the community members requested the appropriate permissions from forces of nature as well as appeased the communities. *Llellipun* means to pray or plea with the objective of asking for permission for a peaceful transition of nature with new construction. The ERC established a positive relationship with the Mapuche community. The relationship is established for a year in order to develop trust and mutual respect with Caren, LAP-ICAFAL and local community members that added up to 26 people and multiple actors for this ritual. The idea is to enhance a relationship with what indigenous communities call "gen" or the internal spirit, protectors of the natural space and/or the owners of the "gen" of the water flows, trees, vegetation, wind and all related winds or what one could call mother nature. Machinery, construction trucks, employees, implanting the available infrastructure in the natural habitat. The ceremony was seen as successful and effective.

The cultural needs in local communities were given priority. LAP-ICAFAL showed their support during the ceremonial preparations through the purchase Mapuche clothing, instruments and utensils for the ceremony itself. These procedures had the effect of establishing a cultural respect of the LAP workers with the cultural importance of having a relationship with nature.

Since neither NGOs nor the national government has given any type of financial or social resources for their religious activities, this kind gesture from the a private company is seen as especially symbolic and emblematic of creating a continuity between the hydroelectric plant, community and natures with its respective *gen*. The community Esteban Traipe celebrated what was called *gillatun* with the resources and help given through this outreach program.

Community

Community addresses issues related to comfort, health and mobility of local communities as well as project workers. Safety is an integral part of the planning process and promotes the expansion of alternative modes of transport.

Actions include the removal of external pipes from where their visibility would disrupt human passageways as well as cattle movements. The project also implemented routes for trucks and transportation that would least affect the community. Understanding that the project should not interfere with the cultural and territorial dynamics of the indigenous communities, the project implemented the construction of the plant with appropriate participatory information retrieved ahead of time.

The local community also greatly benefits from having 49% of people within a 15-km radius being employed in some capacity within the project. In terms of safety and noise, the project created contingency plans that followed best practices. Both the owner of the hydroelectric plant and the project team meet the safety protocols in the construction phases. As an example, road maintenance is being performed in each distinct phase of the project. In the winter, a series of transit signs are installed to warn about operations in the area. Following this train of thought, a contingency plan was developed to manage the imminent increase in traffic flow during the construction period.

The aim of this operation is to identify, qualify and register each of the routes that make up the network by making an inventory of road maintenance and then repairing the deteriorating areas. In addition, pedestrian access paths are created after the installation of the underground pipes and driving courses are offered for bus drivers responsible for transporting personnel.

A study was conducted to determine the acoustic impact on the area as a consequence of noise generated in both the construction and operation phases. This study considers the distances at which levels cannot exceed the permissible limits according to current legislation. It also implements general control measures in the event that the records obtained indicate a need to reduce noise levels during construction and operation of the project. Despite the acoustic studies conducted, the project did not take light pollution into account.

Wellbeing

The Wellbeing subcategory covers the visual and functional impacts of infrastructure projects on their immediate surroundings. Projects are encouraged to utilize innovative ways of integrating into the local community without perturbing its character and natural features.

The project is the second largest investment of its type (hydroelectric plant) where forests are the predominant vegetation. The surrounding vegetation is the reason for a large number of indigenous communities and therefore there are also many environmentalists; in addition, the Agreement [*Convenio*] 169 has not been put into action. These facts allowed for the community relations team to develop a pilot program aimed at forming positive relationships and diplomacy in order to achieve the successful construction of a hydroelectric plant in such a prime habitat with cultural significance. The purpose is to create a best practice model for private companies to develop in order to successfully create community relations that appease communities with different goals for their habitat than the national goals of creating more renewable energy.

The Chilean Environmental Evaluation modified the project design from that which was originally approved. In order to lessen the visual impact of the project, design considerations were taken into account to substitute open adduction channels with completely buried HDPE (High- Density Polyethylene) pipelines. With this alteration the bridges that were considered in an early design phase were eliminated, avoiding visible barriers to cattle and people and also avoiding potential risks with the pipes and these formations to the soil. Whenever any habitat is altered to include imposed infrastructure, naturally these new built structures disrupt the natural views of this remote and spectacular area in Chile. Another visual effect was on penstocks, where the visible pipes on the mountainside will be camouflaged with paint. One very impressive modification was the river where the waters would originally be reintegrated, Tranuan Alonso, was changed to appease the Mapuche community. The Malalcahuello and Carilafquen rivers were chosen instead to respect the indigenous community's request and avoid potential flooding that could emerge with the original design.

In addition, there was a series of archaeological inspections that took place at the site in order to determine the possible presence of historic objects. The plan consisted in implementing archaeological monitoring of all work that involves earthmoving, particularly excavations. Objects were rescued from potential damage and placed in the *Regional Museum Araucania.* This is another example of how the project reaches out to stakeholders to create relationships not only with the community and environmental activists but with museums that could benefit from the findings made before the construction phase.

4. LEADERSHIP CATEGORY

Leadership evaluates project team initiatives that establish communication and collaboration strategies early on, with the ultimate objective of achieving sustainable performance. Envision rewards stakeholder engagement as well as encompassing a holistic, long-term view of the project's life-cycle. Leadership is distributed into three sub-categories: Collaboration, Management, and Planning.

Collaboration

The Collaboration subcategory addresses the importance of including input from a wide variety of stakeholders to fully understand synergies, savings, and opportunities for innovation. This type of collaboration necessitates a new

kind of leadership and commitment from the project team as well as new ways of managing processes.

A favorable practice is exercised when the CAREN Electric Company' Environmental Impact Assessments are divided into stages with a list of activities to be carried out and their respective impact on their community. The project has a hierarchy chart, tackling communication with the community. The organizational structure is planned and operated with the CAREN Community Relations Team (CRT) with support from a consultancy and advisory management team. The project also completes detailed monitoring of social and environmental aspects that are part of the overall management system.

Latin America Power (LAP), in an effort to collaborate with the community, performed a phytosanitary treatment for the cattle in 3 sectors and 6 communities adjacent to the construction of the hydroelectric plant. This phytosanitary program where 95% of cattle was treated was valued as highly positive for the community..

Overall the project has an organized management system that facilitates the sustainable performance of the project. In addition, the Mapuche community requested to change the location of the restitution of river flows, in order to prevent flooding in surrounding areas, which project owner accepted. Adjustments have also been made in the engineering design to optimize the chosen path, taking into account the topographic configuration of the local area and to avoid disruption of the *Lleuque* tree species.

Stakeholders have maintained a strong level of involvement and engagement with the community. There is a strategic analysis of how to meet their goals, the extent to which the community or public services could help to legitimize the project, and an analysis of all the groups or communities affected by the the project. They have generated a program dedicated to receiving feedback from the community. The latter has allowed the project to meet the community needs balanced with the stakeholder's interests.

Management

The Management subcategory covers how a broader and more comprehensive understanding of the project can allow the team to see and pursue synergies between systems, either within the project or among larger infrastructure systems, leading to new ways of managing the project while increasing sustainability and useful life.

The management is established in such a way as to ensure horizontal and vertical management schemes and to offer the best solutions in developing strong communities, healthy living and working environments. This type of management is both siloed and integrated, which creates synergies and effective construction and operational phases. Management is pointed out as a strong component of the various processes involved in the different stages of implementation.

This project could improve their scores in the creation of by-product synergies. The project is located in the rural area of the Melipeuco commune, on the Araucanía region in Chile. This region does not have a considerable amount of infrastructure; as a consequence the hydroelectric power plants will not integrate with any existing infrastructure except the road system.

In fact, this credit is often difficult and arduous to assess, as it takes a whole-systems approach. it is important to mention the location of the project in a rural zone, with little infrastructure to create connections with in order to

develop synergies. However, by-product synergies could be achieved at the construction phase through sourcing and procurement practices that allow for materials transported throughout the region. This mentality is what Envision means when characterizing by-product synergies that could create linkages with parallel supply chains.

While the fact that this site is in a rural area makes it challenging to use unwanted by-products from other nearby facilities, the project can enhance these through the discovery of supply chains that are used at a regional scale.

Planning

The Planning subcategory considers how taking a long-term view of the project can greatly increase its sustainability. This approach necessitates the understanding of planning regulation to avoid pitfalls and plan effectively for its future.

Despite the fact that the project team has a structured leadership system indicating the people responsible for the monitoring and maintenance of the project, there is no proof that the team has developed a long-term monitoring plan or agenda. The required resources for maintenance have not been established yet. However, certain measures were adopted to counteract the direct impacts of the project from an ecological point of view, like the reforestation of the Lleuque species. It is important to mention that the survival and density of the tree species will be monitored for a period of 15 years once the project starts.

The project team also addressed regulations in relation to the indigenous communities affected by the project. With this in mind, they conducted a study to assess the indigenous communities and their relation to the project site. As a result, the project team initiated an engagement strategy. Since the project is located in a rural region, mostly inhabited by indigenous people, no policies that stall sustainable infrastructure implementation have been identified. On the contrary, there are laws and policies that protect the environment and equity through the protection of community interests.

5. RESOURCE ALLOCATION CATEGORY

Resource allocation deals with material, energy, and water requirements during the construction and operation phases of infrastructure projects. The quantity and source of these elements, as well as their impact on overall sustainability, is investigated throughout this section of the Envision rating system. Envision guides teams to choose less toxic materials and promotes renewable energy resources. Resource Allocation is divided into three subcategories: Materials, Energy, and Water.

Materials

The Materials subcategory looks for a reduction of the total amount of material used as a primary consideration for infrastructure projects. Minimizing material reduces the amount of natural resources that must be extracted and processed, as well as the energy involved in production and transportation.

The major materials for the construction of civil works, steel and concrete, come from regional plants that are close to the project area, Concepción and Temuco. The project team developed a management plan for the collection of excess excavation in the Huechelepún sector. The main goal for this study was to correctly deposit the

material surplus generated by the excavation in specific areas that could be benefit the project. The team selected Andritz as an equipment supplier for the hydroelectric plant; this decision was based on the fact that they have clear sustainability policies and good performance criteria in environmental governance and social sustainability.

They also utilized CAP Acero (Compañía de Aceros del Pacífico), a company that is committed to mitigating the impacts of their operations, as well as to promote environmental initiatives that bring value to the environment in which they operate. The company seeks to reuse as much of their waste as possible, transforming it into products that are sold or reused by the same company. The hydroelectric plant, with 50 years of life expectancy, has not covered deconstruction, as it allows for an upgrade of equipment, parts and accessories to prolong its life. For equipment and parts that need to be changed, material reuse is anticipated. It is important to mention that the project has devices that isolate water flows, which allows the replacement of equipment on specific areas, separating and making the process of recycling materials more manageable.

Energy

The Energy subcategory addresses the importance of reducing overall energy use - particularly from non-renewable fossil-fuel sources - which are already becoming scarce.

This hydroelectric power plant will deliver an average annual generation of 83,448 MWh. This project will be connected to the Interconnected Central System (SIC), the biggest electricity grid in Chile. According to the latest bulletin, around 35% of the grid's energy comes from renewable sources. Moreover, this project is identified as a net positive renewable energy generator due to the nature of the facility. Since reducing overall energy use is crucial, the project team contracted a third party, Agrosonda, that will monitor the equipment of the plant. They will be responsible for the services of "Operation and Maintenance" of the plant in three stages: transition, initial period of operation, and the long term monitoring plan. The scope of this contract includes the supply of all human organization and accessories that allow optimal operation and preventive and corrective maintenance that will allow this specific project to maximize profits. To achieve the objective outlined, Agrosonda will provide the hydroelectric plant with the resources to ensure maximum performance and availability of the Central or the lowest possible cost, maximizing the efficiency and minimizing the use of energy.

Water

The water subcategory aims to emphasize the importance of reducing overall water use, particularly potable water, amid the changing climate and increasing population that places future water security at risk. Long-term monitoring to study water availability as well as looking for alternative water resources are key aspects considered in this section.

The project team conducted a study of the estimation of available water resources and the average monthly flows in the areas where the water will be captured for the generation of energy in the hydroelectric plants. This leads to a reduction in the impact on the quality, quantity, and availability of fresh water in the Carilafquén and Malalcahuello rivers. The freshwater supplies that the project uses to generate energy for the hydroelectric plants are replenished at the source. Even though the project team has conducted extensive studies in the availability of water resources, there is no particular plan that monitors on a long-term basis the water system performance.

6. NATURAL WORLD CATEGORY

Natural World focuses on how infrastructure projects may impact natural systems and promotes opportunities for positive synergistic effects. Envision encourages strategies for conservation and distinguishes projects with a focus on enhancing surrounding natural systems. Natural World is further divided into three sub-categories: Siting, Land and Water, and Biodiversity.

Siting

The siting subcategory addresses the fact that infrastructure should be sited, when possible, to avoid direct and indirect impacts on important ecological areas. This hydroelectric plant is located in the Carilafquén and Malalcahuello rivers and includes floodgates as part of the overall design of the project, which responds to any potential flood impacts that might take place. These movable floodgates are commanded electromechanically to open when a heavy rainfall provokes a higher volume of river flow. The project team developed a report that aims to describe the actual situation of the elements that constitute the aquatic flora and fauna of the area that will be impacted by the project in an effort to maintain the aquatic habitat. This study was conducted in an effort to determine the influence of the project and how the project affects the ecological systems. The results of the study for Carilaquén and Malalcahuello were treated independently in order to explain more clearly the characteristics of each of the systems.

Land & water

The Land and Water subcategory seeks minimal impact on existing hydrologic and nutrient cycles, taking particular care to avoid the introduction of contaminants through stormwater runoff or pesticides and fertilizers.

The project team argued that this development does not employ the use of potentially polluting substances and therefore the water will not be contaminated. They did launch a monitoring program for water quality; the risk of spills was contemplated and they worked on the logistics of how to prevent them. The project team did not utilize strategies to manage the stormwater, but in order to minimize the impact of the infrastructure being built, it is important to take into consideration the stormwater flow and how the landscape will be modified post-construction.

Following this line of thought some measures may need to be implemented to prevent the sediment collapse. The hydroelectric plant is located in an area where pesticides or fertilizers are not required, as a result none of these methods were implemented in order to maintain the natural landscape of the site. In addition the project scope did not include the design of a new landscape with new plant species.

Biodiversity

This project has a strategy that focuses on mitigating adverse impacts the project might have in the natural habitat. The first step was to identify the habitat in the surroundings of the intervened area, in order to gain a better understanding of the overall land use. Part of the project is located within a native forest, which signified a

series of commitments and meticulous design decisions for its protection. Moreover, the character of buried pipes, versus the previous plan of open channels, represents a valuable contribution to connectivity for wildlife.

There was a plan developed for the recuperation of vegetation in the areas impacted by the project. In addition the plan considers reinforcing and extending some fragments of the native forest. The plan proposes to triple the amount of plants in the reforestation as well as the number of species to reforest. The project has the obligation to monitor the reforestation for up to 15 years to ensure the success of the measures implemented. The project team organized a study with detailed descriptions of the species in the area where three homogeneous vegetation units were identified: native forest, scrub and meadow. One of the positive aspects about the project is that it leaves the ground in the condition it was found, showing that the disturbed soils can be restored for any agricultural activity or vegetation to grow in that area. Also the project will maintain the hydrologic connection because the flow of water, after passing through the turbines in the powerhouse, will be returned to the river through drainage channels. These channels are completely underground and ensure the maintenance of the hydrologic ecosystem.

The project involves maintaining the ecological flow that relates to water rights granted by the *Direción General de Aguas* General Direction of Waters (DGA). According to this agency, the ecological flow must respond to the respective water rights that the Malalcahuello and Carilafquen rivers currently have. Thus these measures are intended to maintain the functioning of aquatic ecosystems and the goods and services they provide. The documents state that the water will be restored to each river in the same amount and quality of when being captured, a quality that is suitable for the development of aquatic life and the overall habitat. Finally the opening of the gates that are located in the intake permit allows sediment transport without disruption.

7. CLIMATE & RISK CATEGORY

Envision aims to promote infrastructure development that are sensitive to long-term climate disturbances. Climate and Risk focuses on avoiding direct and indirect contributions to greenhouse gas emissions, as well as promotes mitigation and adaptation actions to ensure short and long term resilience to hazards. Climate and Risk is further divided into two sub-categories: Emissions and Resilience.

Emissions

In the construction phase, dust was the biggest area of concern in terms of emissions. A mitigation plan was consistently applied to decrease the effect of dust on air quality. Meanwhile, the emissions overall were not deemed to be large enough according to the country's pollutant baseline scenarios. Since the project's emissions are lower than the country's pollutant maximum, the project did not have to mitigate these. In terms of greenhouse gas emissions (GHG), the project delivers 83,448 MWh of clean energy and reduces 56,136 tons of CO2 emissions per year. It will also replace thermoelectric plants that would otherwise emit greenhouse gas emissions. The hydroelectric plant effectively replaces the generation of fossil fuel combustion, and therefore score higher in this subcategory.

Resilence

The project's Resilience score was high for half the applicable subcategories, and half could be improved. The project team ensures long term health of tree species within a 20 meter radius from the site. The reforestation of the *Lleuque* species is to be monitored for 15 years once the operational phase of the project begins to ensure the

density of the trees.

The project recognized a need for flood prevention, which led to design changes in the site. However, the project also recognizes the need for electromechanical mechanisms in order to adapt to rain and snow.

The assessment to ensure durability of the materials, the use of water gates for flooding, and design changes that adapt to weather fluctuations are a few reasons the project scored highly. Long term adaptability scored extremely high due to the design of the plant, which considered creating flood gates using statistical evaluation of weather shifts and changes over 250 years. These response mechanisms ensure adaptability to climate conditions in the longer term, which explains the high score in this area. In terms of adapting to heat island effects, the project is in a greenfield, rural area, giving it little need to adapt to urban heat island effects.

8. SUMMARY AND CONCLUSION

The project scores high on quality of life in topics relating to the community, well-being and purpose. The main reason for these scores is the fact that the project worked closely with the community and the natural habitat, respecting the spatial cultural relevance within the rural population. The project links each goal with community members and the appropriate actors and stakeholders. One area in which they achieved a higher level of consciousness is with relation to community relations, whereby the connection to the Mapuche community, the Community Relations Team (ERC) and the employees integrated an all-encompassing desire to create equity and balance the needs of the natural habitat with the natural forces of nature.

Of course, these initiatives help Caren greatly benefit from this relationship. It is a well-known fact in Chile how infrastructure projects could potentially fail to be built without the community's buy-in. The Mapuche community with the Community Relations Team (ERC) together participated in a Mapuche ceremony to achieve the right design of the hydroplant, ultimately lessening the impact on pedestrian crossing the region, cattle going through and painted exterior steel pipes to camouflage infrastructure with the natural environment.

The project team took initiatives such as protecting the Lleuque tree species were protected with the use of high-pressure pipelines that alternatively conserve this specific type of species. In terms of archeological artifacts, these artifacts were carefully conserved and taken to the museum. The stakeholder engagement process involved many actors such as the Director of the Social Department and PRODESAL (Local Development Program), the National branch of tourism and the municipality of Melipueco. Interviews and surveys among these diverse stakeholders engaged them in just one area- archeological aspects of the site. Like this engagement process, the project manages similar engagement processes to tackle different goals, such as roadway development, ceremony engagement, and construction.

One initiative that is rather innovative is Carén's fundraising to support water supply around the Malalcahuello River, which ultimately directly helps the Huechelepún community where there are 21 families. The joint initiative brings the City of Melipueco to regularize the water to develop the area. Again, this last initiative helps create synergies within the neighboring communities. Another area that is rather stepping outside best practices is reforesting the Lleuque trees. These will be monitored for 15 years to ensure successful reforestation measures were taken.

While the project did create some interesting and innovative changes, one area that needs to be improved are the bikes and pedestrian roads seem like a very ad-hoc measure of improving or helping employees get to work. If bicycles are the main forms of transport, a bike subsidy to employees or programs implemented in similar conditions through corporate social responsibility programs can be put in place to innovate on this topic. Sustainable rewards programs given to employees is one way, although the count of these bicyclists can be negligible. This segment seemed very ad-hoc and with relatively little help to the community. Although, minibuses were contracted to help employees living at a longer distance.

In the Envision Leadership Category, the project also scores high due to its commitments in establishing sustainability policies through contracting the right companies. For example, CAP Acero was procured for its steel, and it was chosen based on their commitment to mitigate the greenhouse gas (GHG) emissions their operations produce. While this specific procurement decision is under resource allocation, it also shows committed leadership in engaging with procurement processes that follow better than best practice sustainability measures. The team also contracted Andritz as the plant's principal equipment supplier due to their environmental practices and sustainability policies. The project team's developed very concise sustainability policy analyses of each company contracted for the project, ensuring that a triple bottom line mentality is achieved. The regional plants were chosen based on their proximity to the project site. With regard to stakeholder engagement, interviews were conducted with the key actors when delivering the architectural artifacts found onsite. This is one example where outreach was successful while being significantly different from the indigenous community outreach. It shows their commitment to create links and connections with every party involved or potentially affected by the new infrastructure.

Resource allocation scored an average score, however, the project is noted for securing the procurement of materials and resources that best accomplishes sustainability goals for the hydroplant. One key area that would resolve issues in different categories is conducting a life-cycle analysis. The project achieves an overview of material from resource extraction to waste and back to reuse through a life cycle analysis. Also, in several of the subcategories in this section included creating an inventory of the amount of material used with percentages of recycled materials. Also this category looks at waste which is also part of a full life-cycle assessment. The project reuses materials with CAP Acero while they source locally by contracting civil works, concrete and steel with regional plants such as Planta *Ready Mix Concepción Plantas de Hormigón, Planta Ready Mix Temuco Plantas de Hormigón.* Concrete iron and the HDPE have been mentioned on several occasions throughout this assessment as being an area that allowed the project to score high on several overlapping categories where local economy, environment and equity are taken into account.

The purpose of using local sources is to minimize costs and environmental impacts, which on many occasions is due to the transport of these materials and their respective GHG emissions. The project followed best-practices when it came to hazardous waste, but still contracted the aforementioned waste to the most effective contractor-DISAL Chile, a leader in environmental services such as water treatment and integrated waste management. In terms of reducing energy, the project must analyze the project life cycle to assess ways to improve this subcategory. In terms of maintenance, Agrosonda was chosen to oversee "Operation and Maintenance" of the plant, and the in three stages: transition period, initial period of operation, and the long term monitoring plan.

In terms of water resources, the project owners measure monthly flows of water captured to reduce its impact on water quality or fresh water availability in the Carilafquén and Malalcahuello rivers. This last specific resource is replenished to ensure the communities' water sources are top quality.

The Natural World had also a combination of no score and very high scores. One area that should be highlighted is the Natural World where the project examined the Altoandino Deciduous Forest, southeast of the town of Melipeuco, considered important to Chile because of its scenic beauty. This project mitigates the potential hard done on the natural habitat, where the predominant landscape is a greenfield. The project team studied the surrounding area in a detailed manner, proposing to mitigate the harm by tripling the vegetation around the site with reforestation efforts, monitored for 15 years. In addition, design changes within the triangular land area produced by the union of the two rivers and covering about 5 km inland, the project decided to bury the pipes, instead of open channels to ensure little barriers, which avoids the disruption of cattle and human movement. The latter is considered to score very high in ensuring. This biodiversity subcategory scored very high, which was a positive project characteristic and one that was skillfully planned within a larger ecological perspective.

In the water category, this project presents punctual works of construction in capturing and restoring water from and to the rivers. The geology was specifically studied and also scored fairly average, yet still made a significant understanding of the groundwater, geo mechanical properties, and the definition of soil type according to the Chilean seismic code. In previous section, the addition of flood gates allowed the project to score high, which helped bolster the score in Natural World category. A recommendation is noted for stormwater management where the landscape can be modified in order to manage storm water within the built structures.

In Climate and Risk category, the project performs quite well on half of the sub-categories. Mainly, it delivers a resilient infrastructure plan with greenhouse gas emissions mitigation. The project overall attempts to use scientific statistics to ensure the water gates can be opened in 500 years' time with a plan for 250 years from now. The fact that the project team uses science to develop a plan for its infrastructure is true resiliency. However, in terms of adaptability to weather, the project does not address how the materials were tested for quality assurance while keeping an inventory of how these materials and construction of these can maintain well in the case of extreme climate change other than floods. Heat, drought, or any other set of conditions can also create problems with the durability of the materials chosen. While maintenance will be conducted, there is little mention on how and to what extent these materials have been tested for secure durability.

In terms of greenhouse gas emissions, the project team does ensure and quantify the amount of greenhouse gas emissions it will avoid being used once the project is implemented. This is a highly sought after credit for renewable energy projects. Only heat island effects were not scored due to the obvious reasons-- little heat island effect is created in a project that is in a rural area with little surface area that can produce deleterious effects on their surroundings. Overall, climate and risk is impressive and caters to short term as well as long term hazards. Particularly impressive is the reforestation of the *Lleuque* species in the outlines area around the site. Reforestation is an ecological characteristic that should bid well in preventing other catastrophic climate change hazards to the area, unless of course fires and extreme heat becomes an issue in this geographic area of Chile. The team, however, studies the geology of the area sufficiently and has detected flooding as being the main predictable hazard to be contained, and plans to mitigate this are effectively put into action in the operational phase.

The project effectively targets improvement in all categories and has an eye for innovation in terms of social while balancing environmental issues. The project's infrastructure design is also very poignant at mixing well with its natural habitat and delivering a service to Chileans without compromising the indigenous community's relationship with natures *gen*, neither the natural habitats scenic beauty. Their eye for procuring companies with sustainability goals and ecological perspective is also a defining characteristic. The project can be a leader is establishing positive relationships in very rural areas with deep forests, virgin vegetation and indigenous groups.

Carilafquén-Malalcahuello hydropower plant, Chile

This report evaluates the sustainability performance of the Carilafquen-Malalcahuello hydropower plant project in Chile according to the Envision™ Rating System. The report identifies areas in which the project scored highly, as well as low-scoring areas that represent opportunities for which the project team can learn and improve on in future projects, as they strive to achieve sustainable project design and construction methodologies.

APPENDIX:
APPENDIX A: PROJECT PICTURES AND DRAWINGS

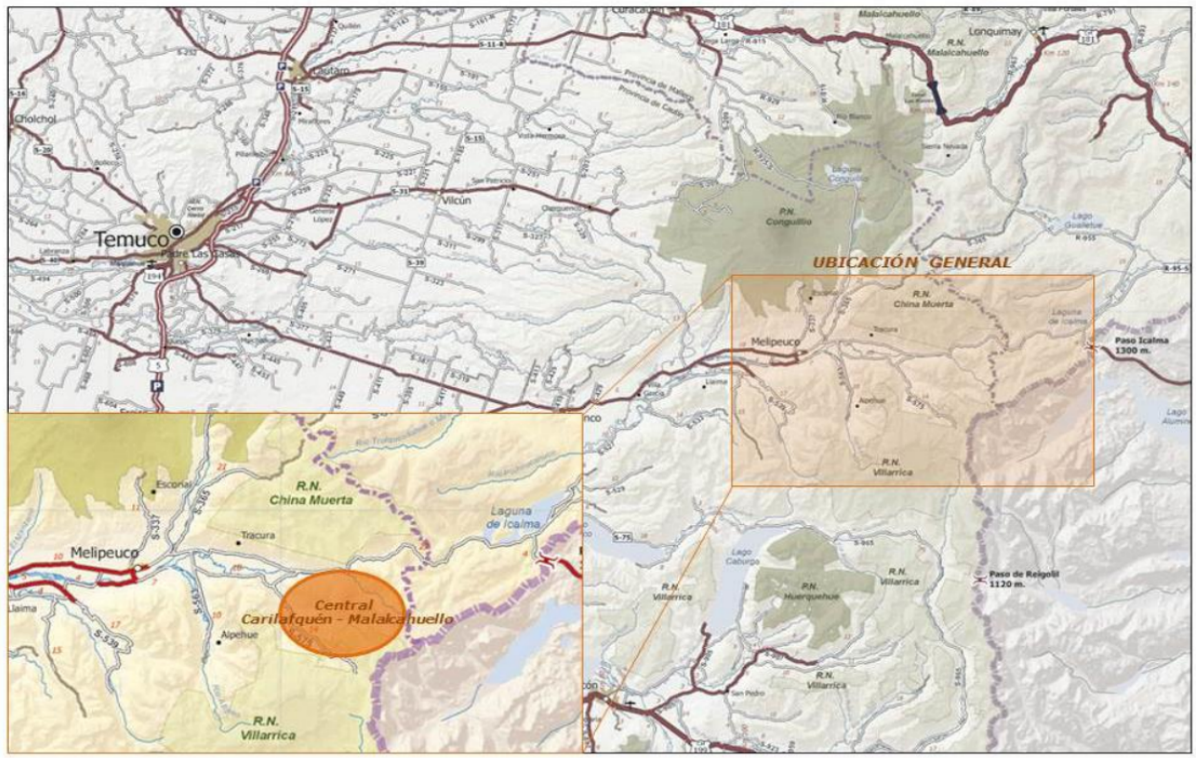

Figure 02: Location map
Sources: Environmental impact assessment _ Modification central de pasada Carilafquen-Malalcahuello page 11

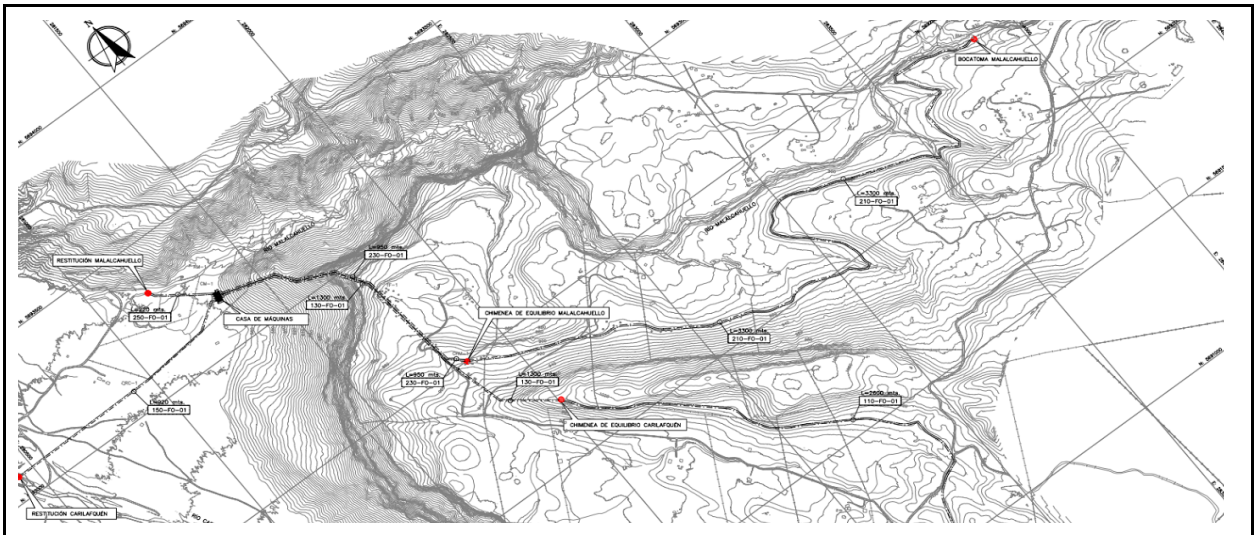

Figure 03: Location map.
Sources: CAREN-01-000-ELE-PL-008_0.pdf

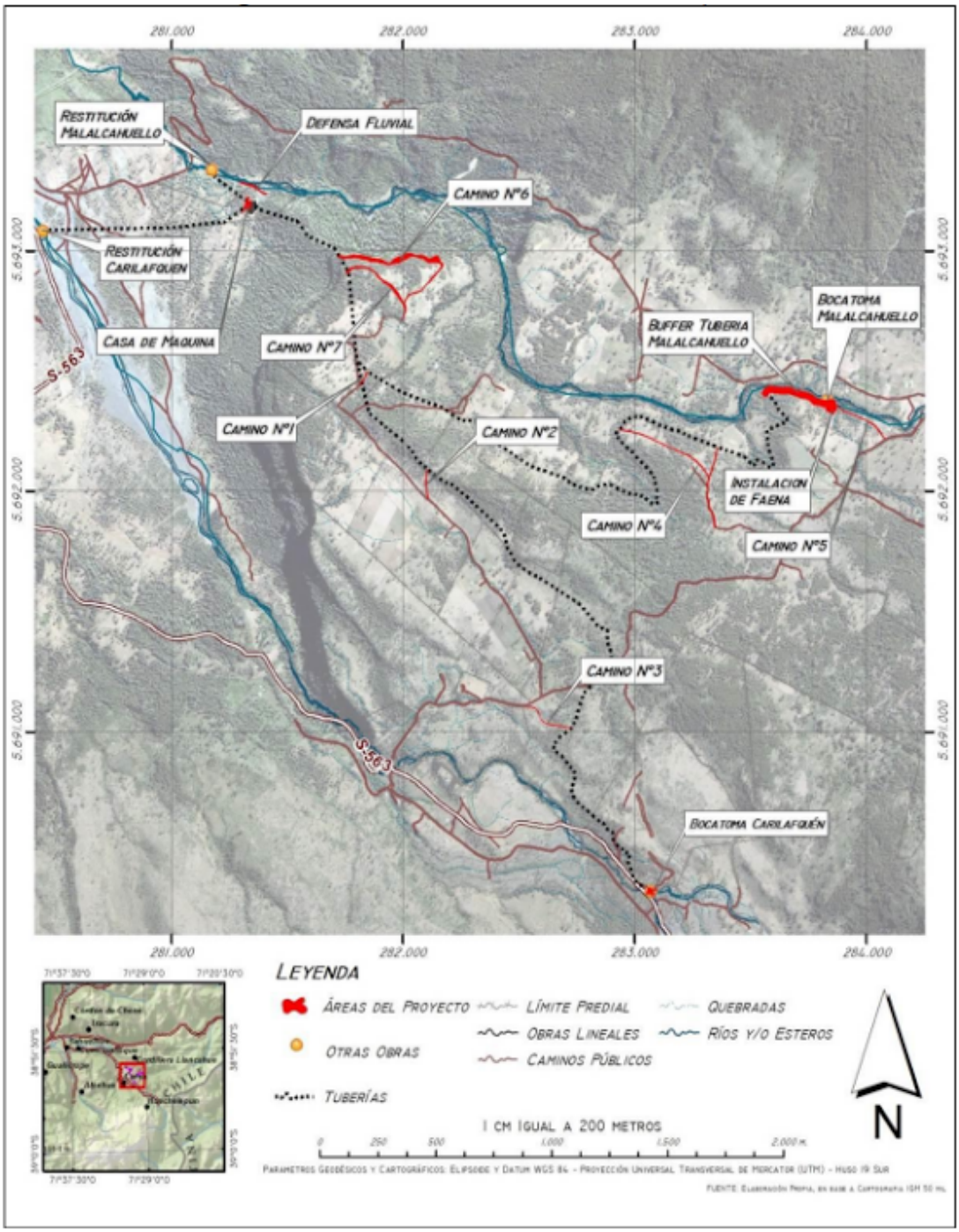

Figure 04: Location of the construction work
Sources: Adenda N°1: Modificacion central de pasada Carilafquen- Malacahuello, page 22

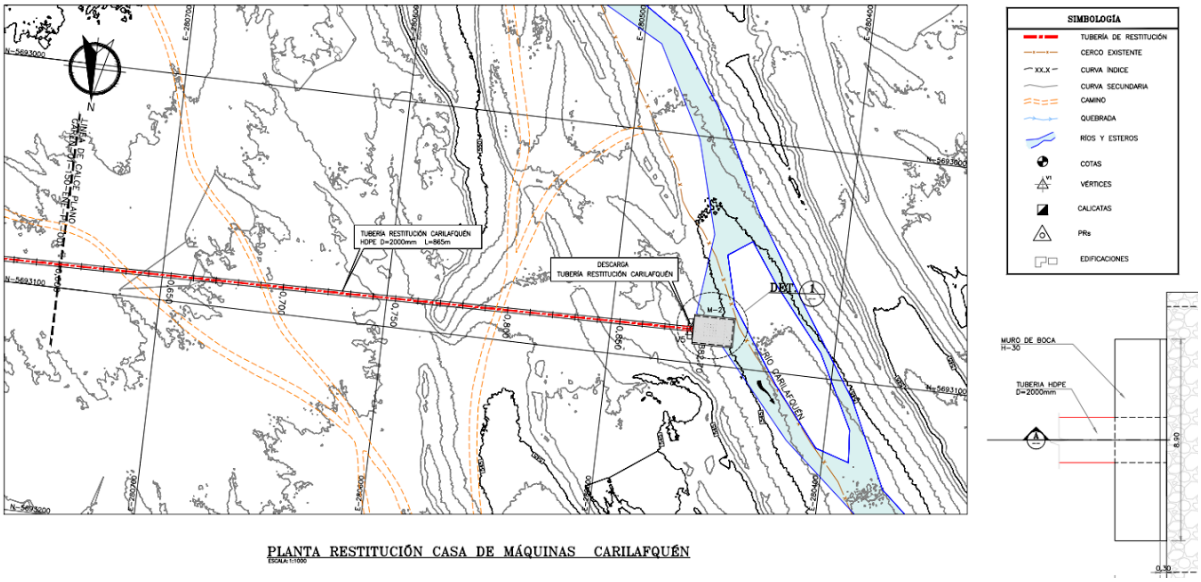

Figure 05: Location map.
Sources: CAREN-01-150-ENE-PL-002-0.pdf

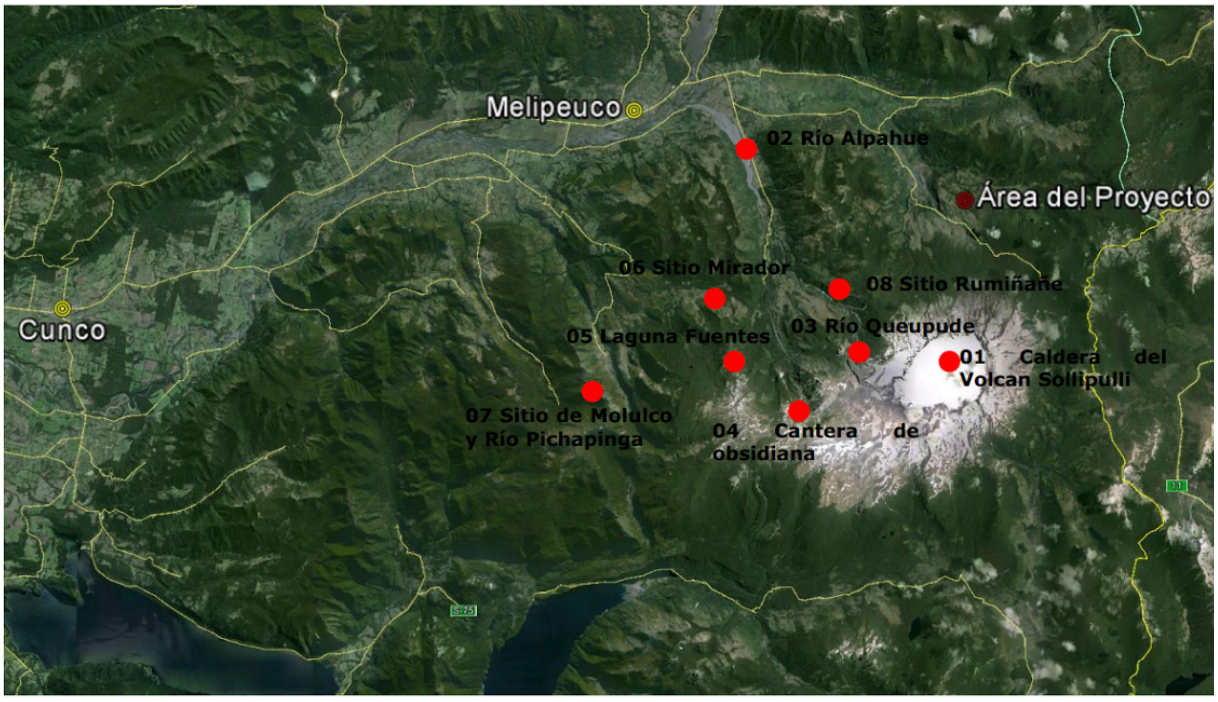

Figure 06: Location of the sites with evidence of historical presence indigenous groups
Sources: Caracterización Ambiental: Medio Humano DIA "Modificación Central de Pasada Carilafquén Malalcahuello" page 11

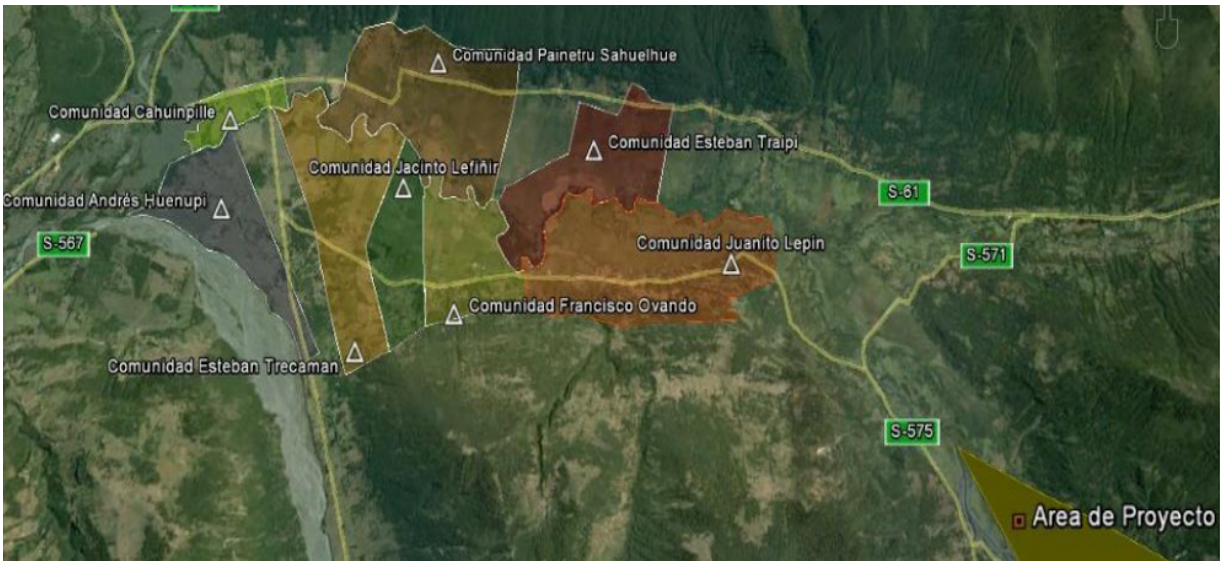

Figure 07: Location of the sites with evidence of historical presence indigenous groups
Sources: Caracterización Ambiental: Medio Humano DIA "Modificación Central de Pasada Carilafquén Malalcahuello" page 17

Figure 08: Mapuche ceremony
Sources: Report of Mapuche ceremony conducted on Saturday March 29, 2014

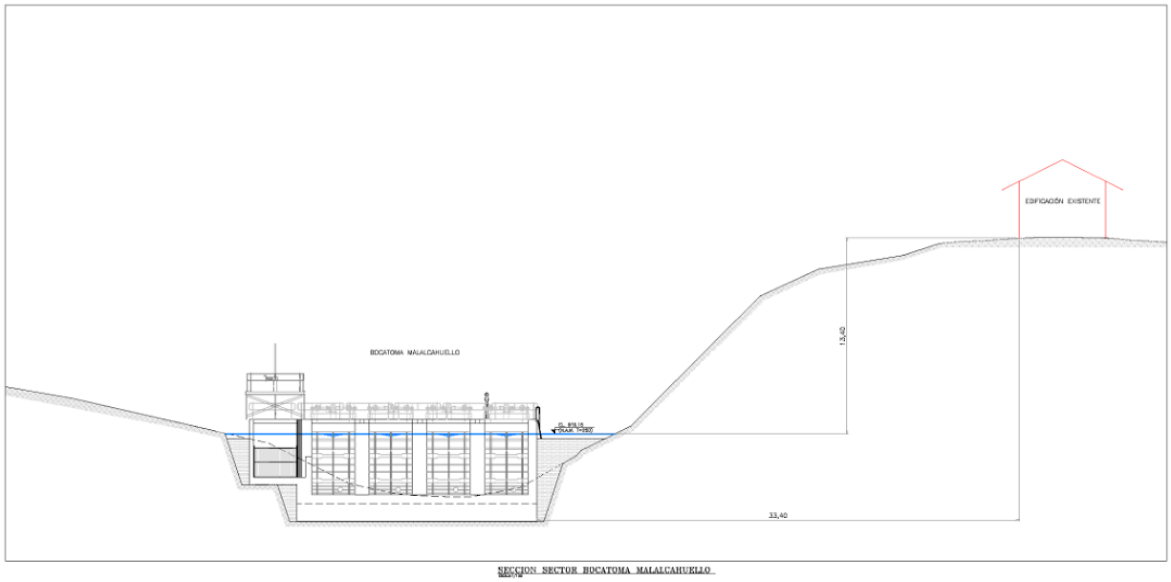

Figure 09: Obras Bocatoma y Casa más cercana
Sources: Adenda N°1: Modificación central de pasada Carilafquén- Malalcahuello, page 3

Figure 10: Defense fluvial unconsolidated rock type
Sources: Adenda N°1: Modificación central de pasada Carilafquén-Malalcahuello, page 10

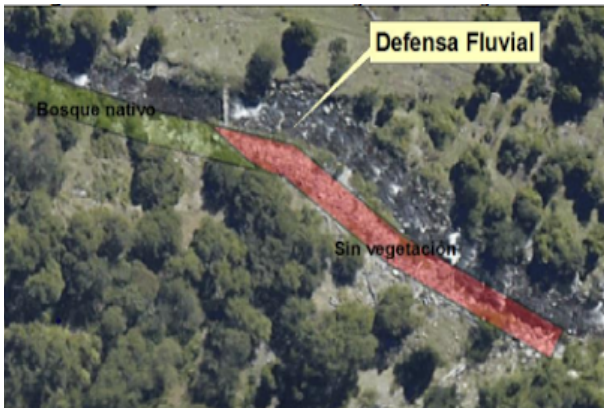

Figure 11: Homogenous vegetation units for fluvial defense
Sources: Adenda N°1: Modificación central de pasada Carilafquén-Malalcahuello, page 10

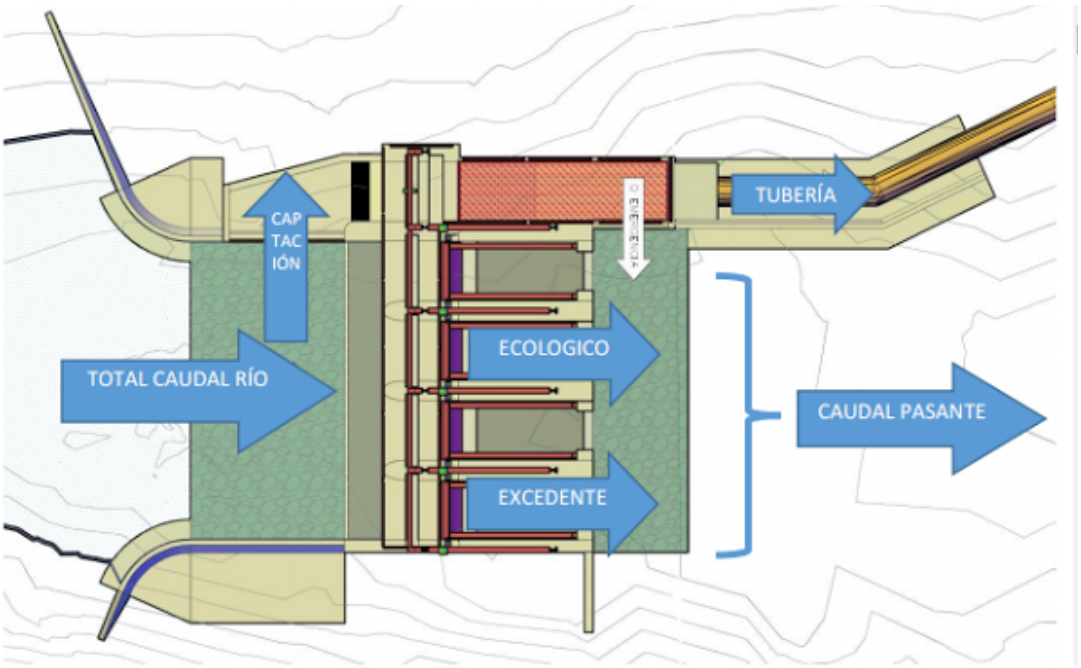

Figure 12:Passing mechanism through the flow gates
Sources: Adenda N°1: Modificación central de pasada Carilafquén- Malalcahuello, page 34

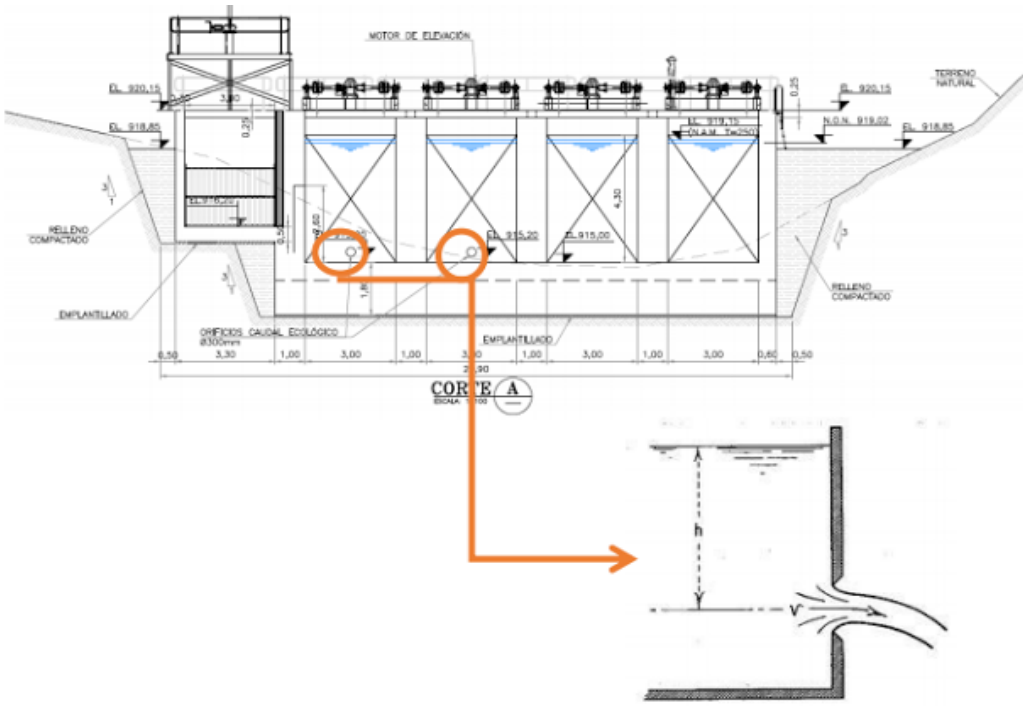

Figure 13: Flow gate detail.
Sources: Adenda N°1: Modificación central de pasada Carilafquén- Malalcahuello, page 33

Figure 14: Construction process
Sources: Pictures provided by LAP

Figure 15: Construction process
Sources: Pictures provided by LAP

Figure 16: Construction process
Sources: Pictures provided by LAP

Figure 17: Construction process
Sources: Pictures provided by LAP

Figure 18: Construction process
Sources: Pictures provided by LAP

Figure 19: Construction process
Sources: Pictures provided by LAP

Figure 20: View of the surroundings of the project
Sources: Caracterización Ambiental: Medio Físico DIA "Proyecto Modificación Central de Pasada Carilafquén – Malalcahuello" , page 6

Figure 21: View of the surroundings of the project
Sources: Caracterización Ambiental: Flora y Vegetación Terrestre DIA "Modificación Central de Pasada Carilafquén-Malalcahuello" p.20

Figure 22: View of the surroundings of the project
Sources: Caracterización Ambiental: Flora y Vegetación Terrestre DIA "Modificación Central de Pasada Carilafquén-Malalcahuello" p.30

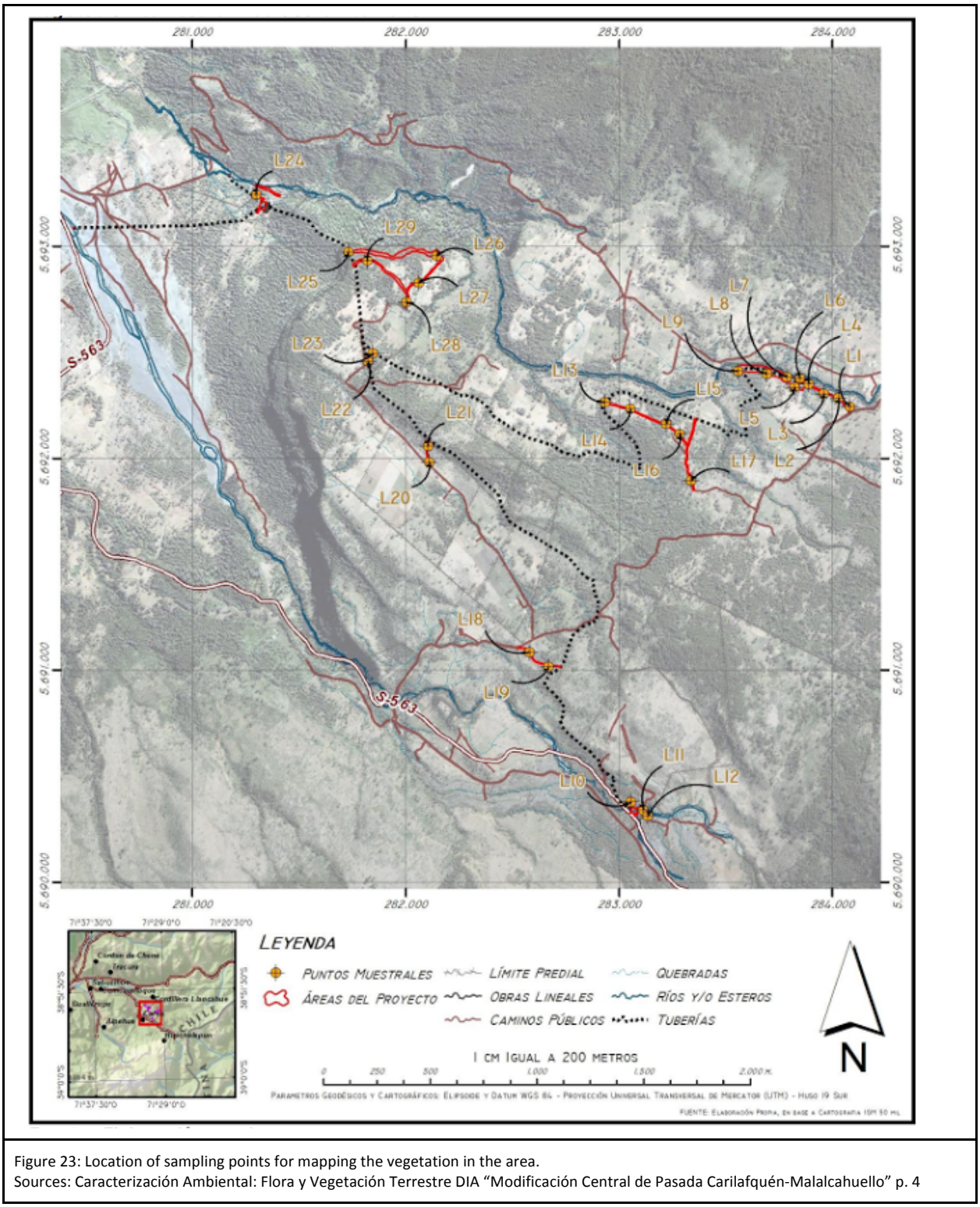

Figure 23: Location of sampling points for mapping the vegetation in the area.
Sources: Caracterización Ambiental: Flora y Vegetación Terrestre DIA "Modificación Central de Pasada Carilafquén-Malalcahuello" p. 4

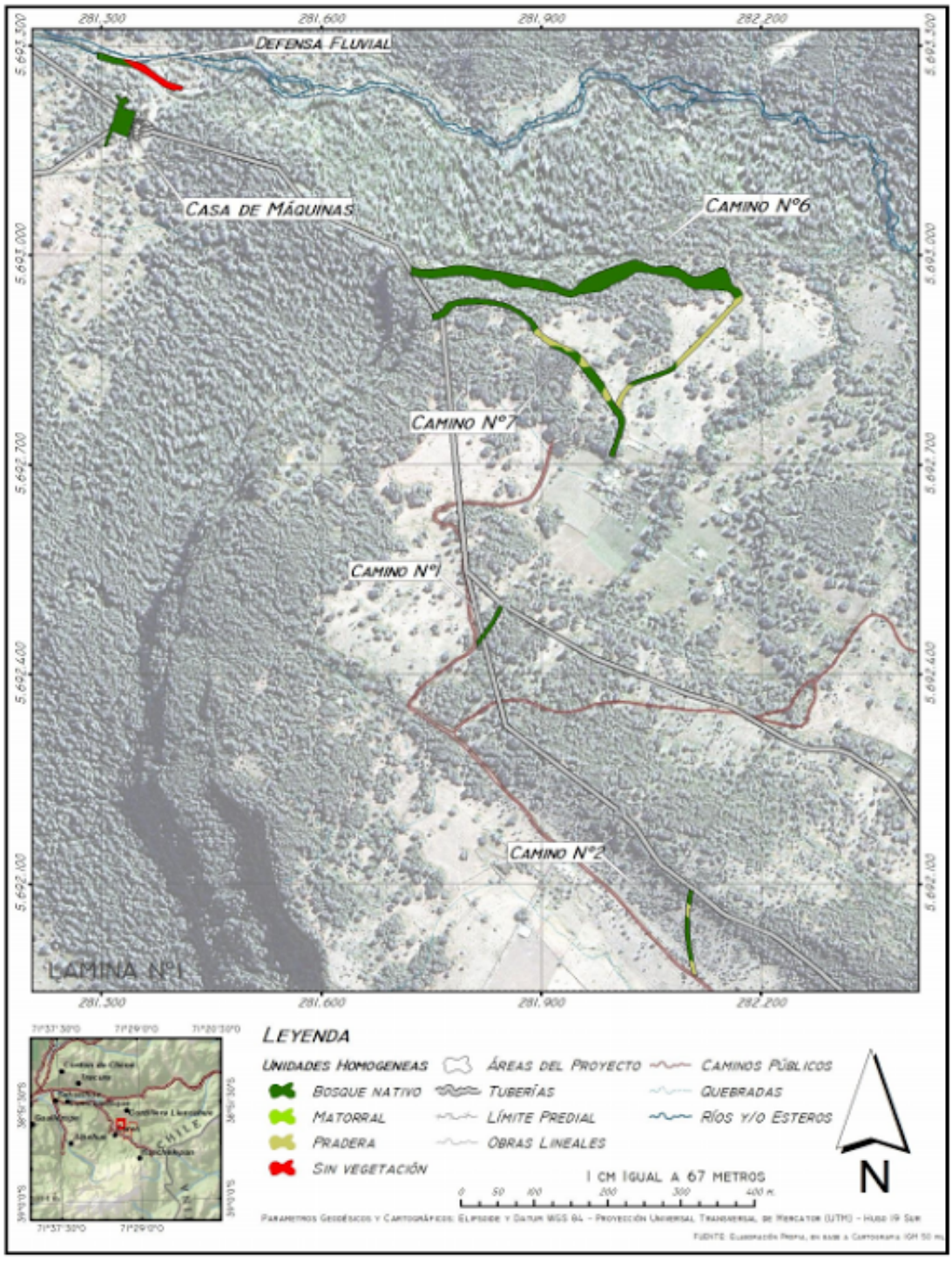

Figure 24: Homogeneous vegetation units present in the works: Defense Fluvial, Powerhouse, Road No. 1, No. 2 Road, Road No. 6 and No. 7 Road.
Sources: Caracterización Ambiental: Flora y Vegetación Terrestre DIA "Modificación Central de Pasada Carilafquén-Malalcahuello" p.13

APPENDIX B: ENVISION POINTS TABLE

APENDICE B: TABLAS DE PUNTUACION ENVISION

CREDIT SCORING

				IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve community quality of life	2	5	10	**20**	**25**
2			QL1.2 Stimulate sustainable growth and development	1	2	5	13	**16**
3			QL1.3 Develop local skills and capabilities	1	2	5	12	**15**
4		COMMUNITY	QL2.1 Enhance public health and safety	2			**16**	
5			QL2.2 Minimize noise and vibration	1			8	**11**
6			QL2.3 Minimize light pollution	1	2	4	8	**11**
7			QL2.4 Improve community mobility and access	1	4	7	**14**	
8			QL2.5 Encourage alternative modes of transportation	1	3	6	12	**15**
9			QL2.6 Improve site accessibility, safety and wayfinding		3	6	12	**15**
10		WELLBEING	QL3.1 Preserve historic and cultural resources	1		7	**13**	**16**
11			QL3.2 Preserve views and local character	1	3	6	11	**14**
12			QL3.3 Enhance public space	1	3	6	11	**13**
						Maximum points possible:		**181**
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	2	4	9	**17**	
14			LD1.2 Establish a sustainability management system	1	4	7	**14**	
15			LD1.3 Foster collaboration and teamwork	1	4	8	**15**	
16			LD1.4 Provide for stakeholder involvement	1	5	9	**14**	
17		MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	3	6	12	**15**
18			LD2.2 Improve infrastructure integration	1	3	7	13	**16**
19		PLANNING	LD3.1 Plan for long-term monitoring and maintenance	1	3		**10**	
20			LD3.2 Address conflicting regulations and policies	1	2	4	**8**	
21			LD3.3 Extend useful life	1	3	6	**12**	
						Maximum points possible:		**121**
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce net embodied energy	2	6	12	**18**	
23			RA1.2 Support sustainable procurement practices	2	3	6	**9**	
24			RA1.3 Use recycled materials	2	5	11	**14**	
25			RA1.4 Use regional materials	3	6	9	**10**	
26			RA1.5 Divert waste from landfills	3	6	8	**11**	
27			RA1.6 Reduce excavated materials taken off site	2	4	5	**6**	
28			RA1.7 Provide for deconstruction and recycling	1	4	8	**12**	
29		ENERGY	RA2.1 Reduce energy consumption	3	7	12	**18**	
30			RA2.2 Use renewable energy	4	6	13	16	**20**
31			RA2.3 Commission and monitor energy systems		3		**11**	
32		WATER	RA3.1 Protect fresh water availability	2	4	9	17	**21**
33			RA3.2 Reduce potable water consumption	4	9	13	17	**21**
34			RA3.3 Monitor water systems	1	3	6	**11**	
						Maximum points possible:		**182**
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat			9	14	**18**
36			NW1.2 Protect wetlands and surface water	1	4	9	14	**18**
37			NW1.3 Preserve prime farmland			6	12	**15**
38			NW1.4 Avoid adverse geology	1	2	3	**5**	
39			NW1.5 Preserve floodplain functions	2	5	8	**14**	
40			NW1.6 Avoid unsuitable development on steep slopes	1		4	**6**	
41			NW1.7 Preserve greenfields	3	6	10	15	**23**
42		LAND & WATER	NW2.1 Manage stormwater		4	9	17	**21**
43			NW2.2 Reduce pesticide and fertilizer impacts	1	2	5	**9**	
44			NW2.3 Prevent surface and groundwater contamination	1	4	9	14	**18**
45		BIODIVERSITY	NW3.1 Preserve species biodiversity	2			13	**16**
46			NW3.2 Control invasive species			5	9	**11**
47			NW3.3 Restore disturbed soils				8	**10**
48			NW3.4 Maintain wetland and surface water functions	3	6	9	15	**19**
						Maximum points possible:		**203**
49	CLIMATE & RISK	EMISSIONS	CR1.1 Reduce greenhouse gas emissions	4	7	13	18	**25**
50			CR1.2 Reduce air pollutant emissions	2	6		12	**15**
51		RESILIENCE	CR2.1 Assess climate threat				**15**	
52			CR2.2 Avoid traps and vulnerabilities	2	6	12	16	**20**
53			CR2.3 Prepare for long-term adaptability				16	**20**
54			CR2.4 Prepare for short-term hazards	3		10	17	**21**
55			CR2.5 Manage heat islands effects	1	2	4	**6**	
						Maximum points possible:		**116**
								803

**The five innovation credits are bonus points and not included in total point tallies*

APPENDIX C: GRAPHS

APENDICE C: GRAFICOS

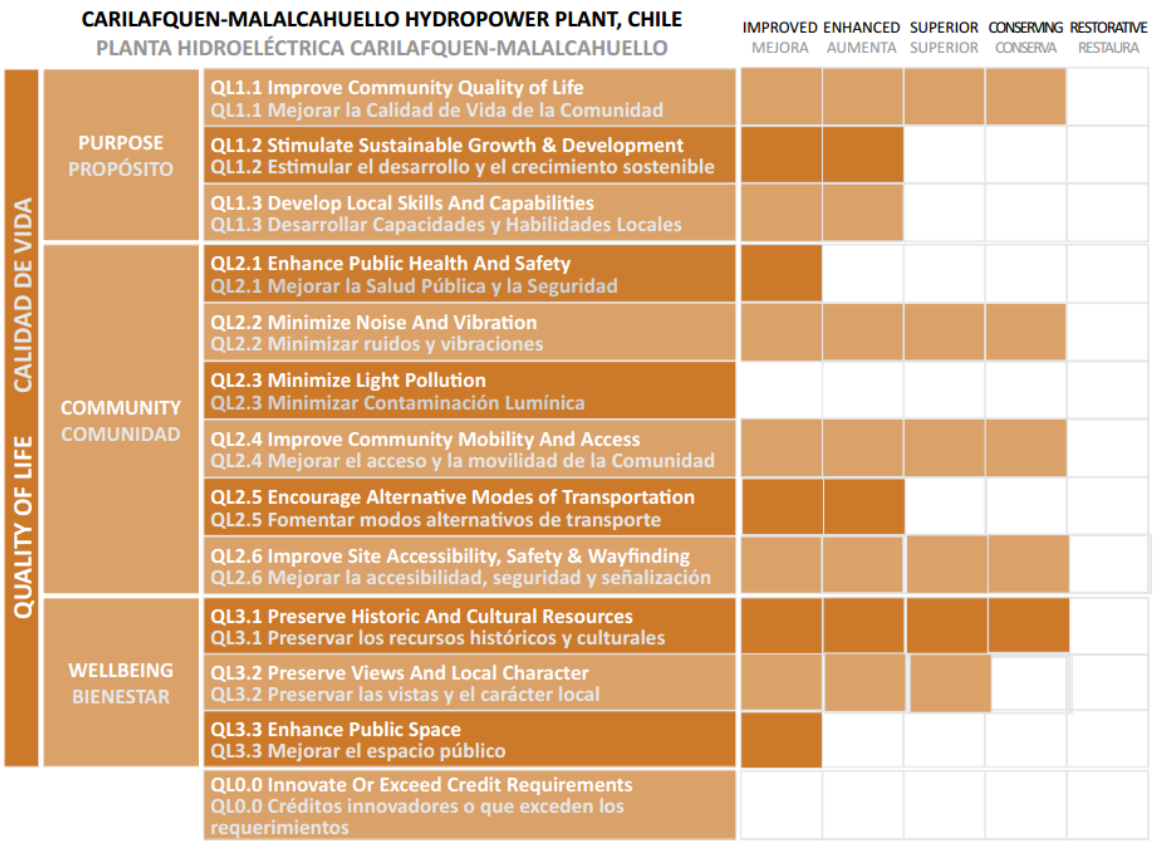

Figure 25: Quality of Life category_ Summary of results

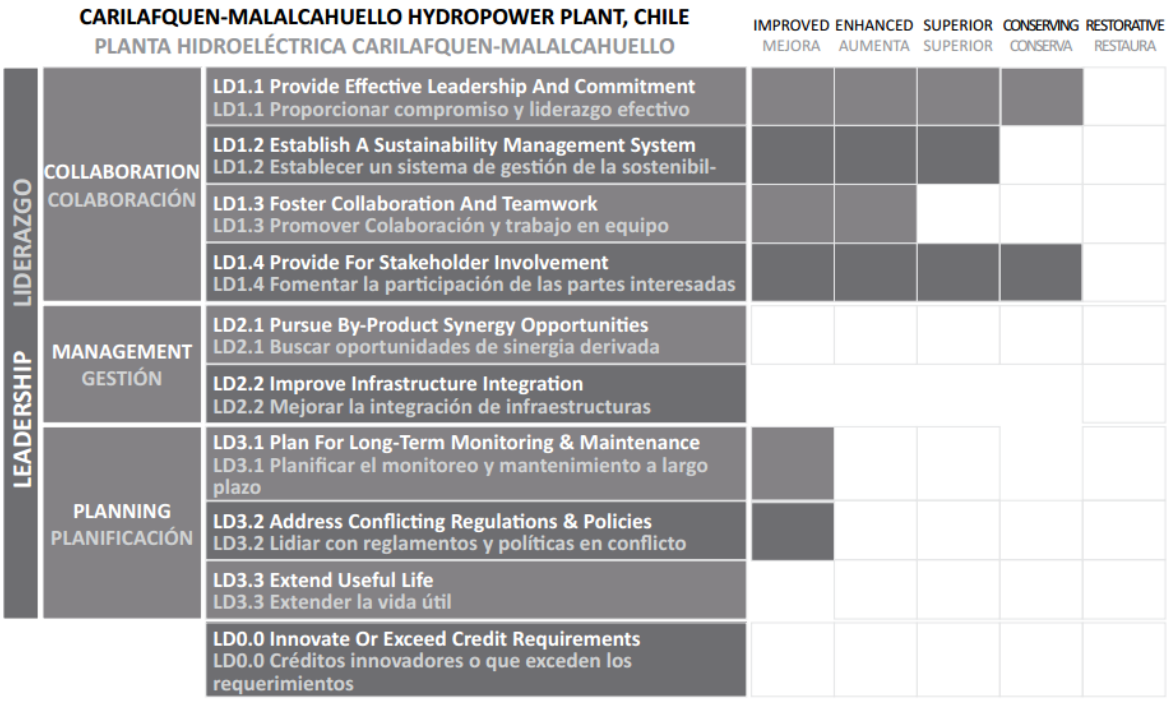

Figure 26: Leadership category_ Summary of results

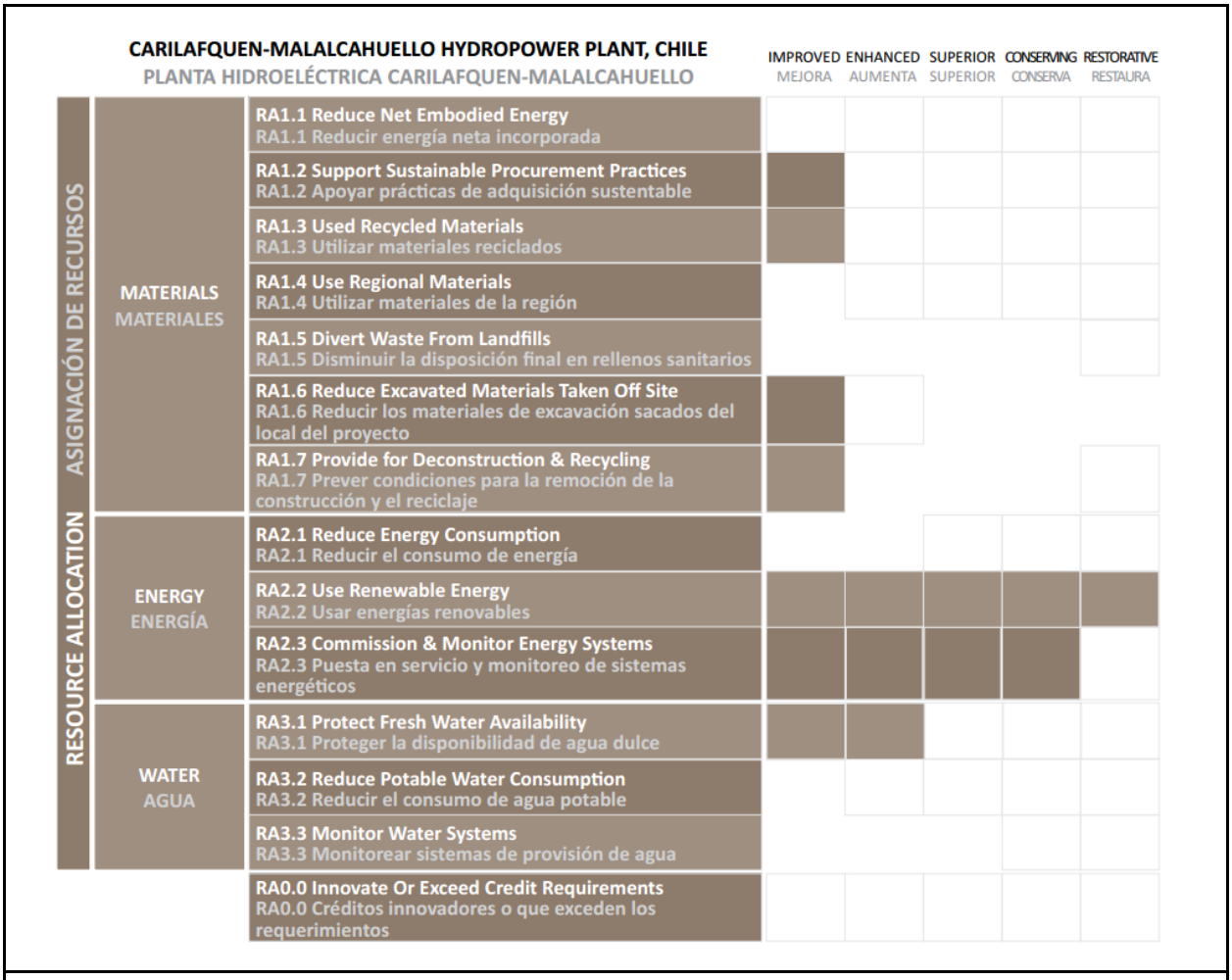

Figure27: Resource Allocation category_ Summary of results

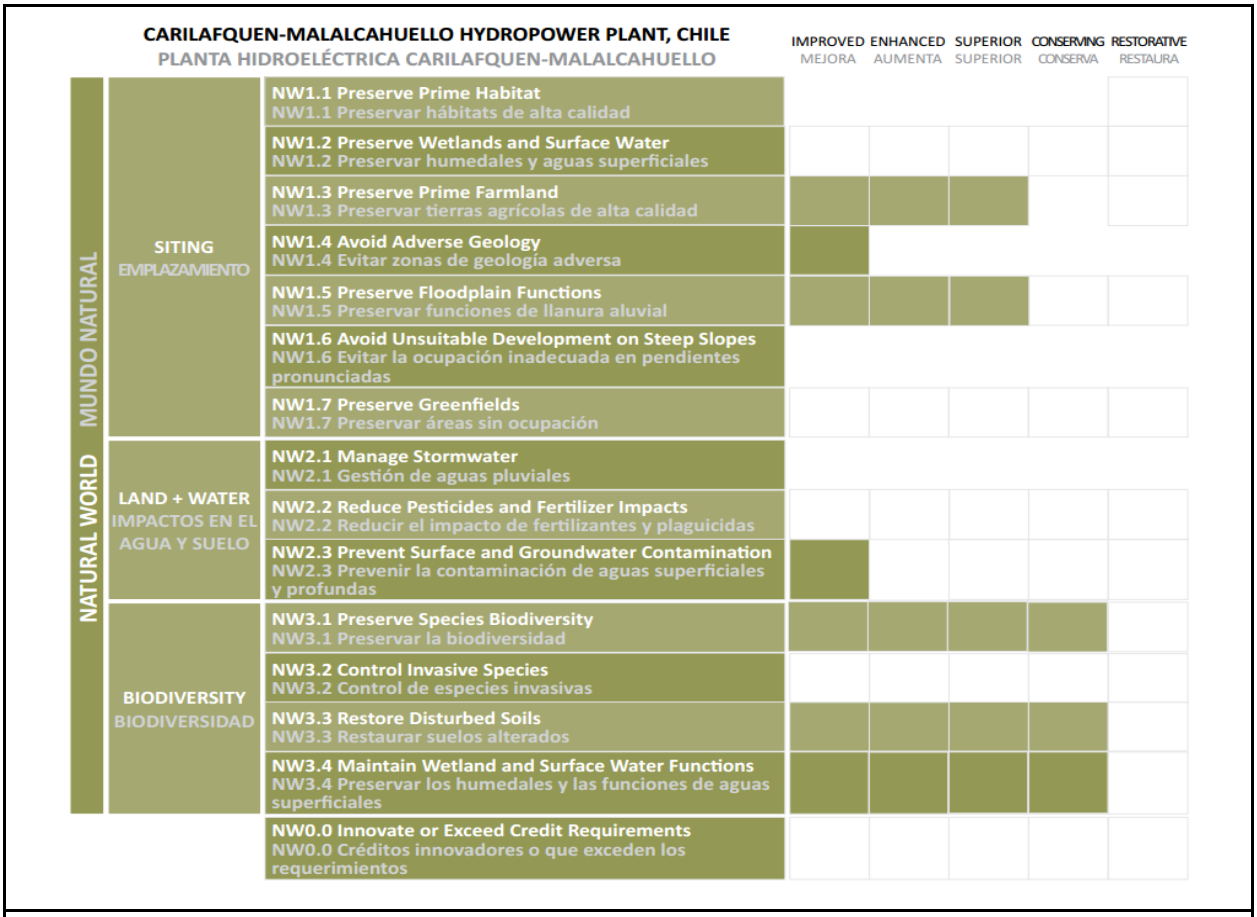

Figure 28: Natural World category_ Summary of results

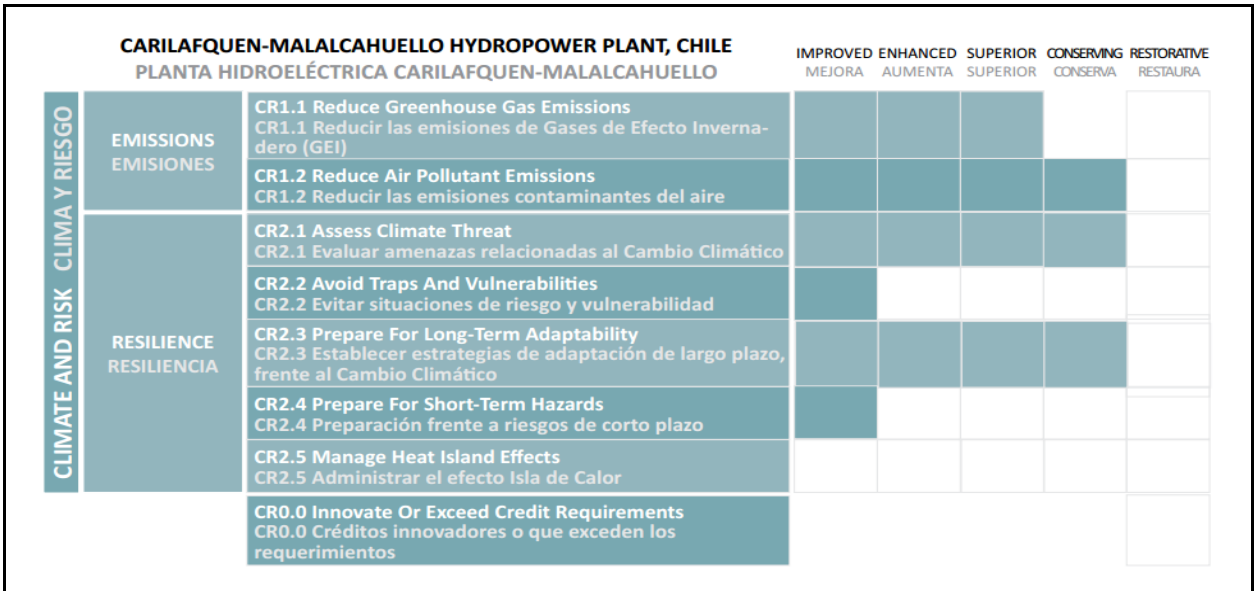

Figure 29: Climate & Risk category_ Summary of results

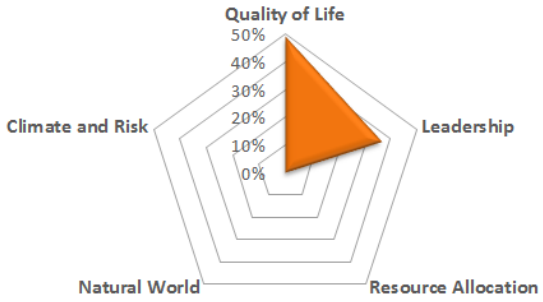

Figure 30: People & Leadership award Summary of results

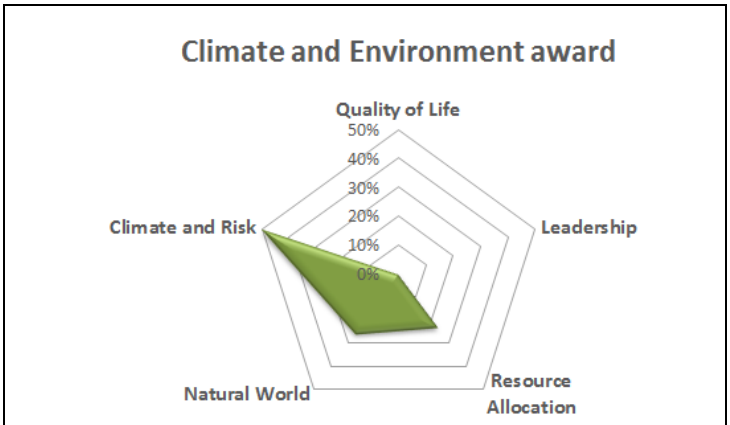

Figure 31: Climate & Environment award Summary of results

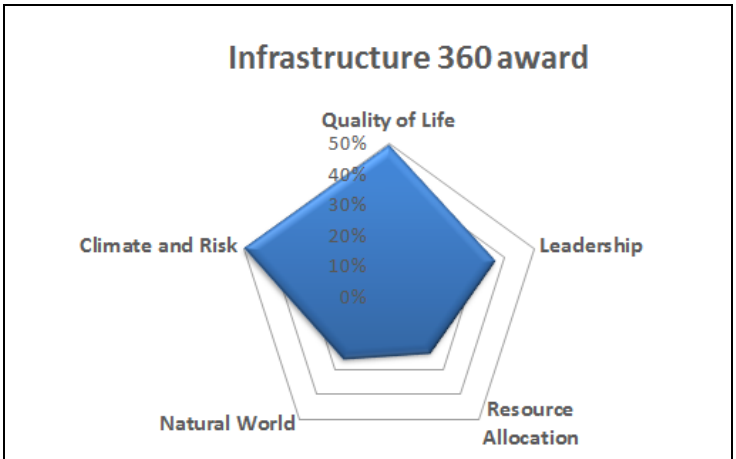

Figure 32: Infrastructure 360 award Summary of results

			CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE	PT.	Performance
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve Community Quality of Life	20	Conserving
2			QL1.2 Stimulate Sustainable Growth & Development	2	Enhanced
3			QL1.3 Develop Local Skills And Capabilities	2	Enhanced
4		COMMUNITY	QL2.1 Enhance Public Health And Safety	2	Improved
5			QL2.2 Minimize Noise And Vibration	11	Conserving
6			QL2.3 Minimize Light Pollution	0	No score
7			QL2.4 Improve Community Mobility And Access	14	Conserving
8			QL2.5 Encourage Alternative Modes of Transportation	3	Enhanced
9			QL2.6 Improve Site Accessibility, Safety & Wayfinding	12	Conserving
10		WELLBEING	QL3.1 Preserve Historic And Cultural Resources	16	Conserving
11			QL3.2 Preserve Views And Local Character	6	Superior
12			QL3.3 Enhance Public Space	1	Improved
			QL0.0 Innovate Or Exceed Credit Requirements	0	N/A
			QL	89	

			CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE	PT.	Performance
13	LEADERSHIP	COLLABORATION	LD1.1 Provide Effective Leadership And Commitment	17	Conserving
14			LD1.2 Establish A Sustainability Management System	7	Superior
15			LD1.3 Foster Collaboration And Teamwork	4	Enhanced
16			LD1.4 Provide For Stakeholder Involvement	14	Conserving
17		MNGMT.	LD2.1 Pursue By-Product Synergy Opportunities	0	No score
18			LD2.2 Improve Infrastructure Integration	0	No score
19		PLANNING	LD3.1 Plan For Long-Term Monitoring & Maintenance	1	Improved
20			LD3.2 Address Conflicting Regulations & Policies	1	Improved
21			LD3.3 Extend Useful Life	0	No score
			LD0.0 Innovate Or Exceed Credit Requirements	0	N/A
			LD	44	

			CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE	PT.	Performance
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce Net Embodied Energy	0	No score
23			RA1.2 Support Sustainable Procurement Practices	2	Improved
24			RA1.3 Used Recycled Materials	2	Improved
25			RA1.4 Use Regional Materials	0	No score
26			RA1.5 Divert Waste From Landfills	0	No score
27			RA1.6 Reduce Excavated Materials Taken Off Site	2	Improved
28			RA1.7 Provide for Deconstruction & Recycling	1	Improved
29		ENERGY	RA2.1 Reduce Energy Consumption	0	No score
30			RA2.2 Reduce Pesticide and Fertilizer Impacts	20	Restorative
31			RA2.3 Commission & Monitor Energy Systems	11	Conserving
32		WATER	RA3.1 Protect Fresh Water Availability	4	Enhanced
33			RA3.2 Reduce Potable Water Consumption	0	No score
34			RA3.3 Monitor Water Systems	0	No score
			RA0.0 Innovate Or Exceed Credit Requirements	0	N/A
			RA	**42**	

			CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE	PT.	Performance
35	NATURAL WORLD	SITING	NW1.1 Preserve Prime Habitat	0	No score
36			NW1.2 Preserve Wetlands and Surface Water	0	No score
37			NW1.3 Preserve Prime Farmland	6	Superior
38			NW1.4 Avoid Adverse Geology	1	Improved
39			NW1.5 Preserve Floodplain Functions	8	Superior
40			NW1.6 Avoid Unsuitable Development on Steep Slopes	0	No score
41			NW1.7 Preserve Greenfields	0	No score
42		L & W	NW2.1 Manage Stormwater	0	No score
43			NW2.2 Reduce Pesticides and Fertilizer Impacts	0	No score
44			NW2.3 Prevent Surface and Groundwater Contamination	1	Improved
45		BIODIVERSITY	NW3.1 Preserve Species Biodiversity	13	Conserving
46			NW3.2 Control Invasive Species	0	No score
47			NW3.3 Restore Disturbed Soils	8	Conserving
48			NW3.4 Maintain Wetland and Surface Water Functions	15	Conserving
			NW0.0 Innovate or Exceed Credit Requirements	0	N/A
			NW	52	

			CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE	PT.	Performance
49	CLIMATE	EMISSION	CR1.1 Reduce Greenhouse Gas Emissions	13	Superior
50			CR1.2 Reduce Air Pollutant Emissions	12	Conserving
51		RESILENCE	CR2.1 Assess Climate Threat	15	Conserving
52			CR2.2 Avoid Traps And Vulnerabilities	2	Improved
53			CR2.3 Prepare For Long-Term Adaptability	16	Conserving
54			CR2.4 Prepare For Short-Term Hazards	3	Improved
55			CR2.5 Manage Heat Island Effects	0	No score
			CR0.0 Innovate Or Exceed Credit Requirements	0	N/A
			CR	61	

Total points	**288**	**0**

APPENDIX D: CREDIT DETAIL

CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT: CREDIT SPREADSHEET WITH DETAILS		
CATEGORY I, PEOPLE AND LEADERSHIP		
SUB CATEGORY: QUALITY OF LIFE		
	Score	**CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE**
QL1.1 Improve Community Quality of Life	**20**	**Conserving** There were a series of considerations taken into account in the development process for the hydroelectric power plants, which produced some design iterations that were adopted to mitigate negative impacts on the communities. The location where the flow of the rivers will be restored was changed by request of the Mapuche community in order to prevent flooding in surrounding areas. As a result minimal adverse impact is felt by the configuration of the pipelines. The visual qualities of the landscape will remain intact. In relation to these efforts there have been agreements and authorizations established between the current owners of the affected areas. Adjustments have been made in the engineering design to optimize the chosen path, taking into account the topographic configuration of the local area. The Community Relations Team (ERC) participated in a Mapuche ceremony that was held in order to request authorization from the forces of nature, since the natural spaces will be altered in Caren, Huechelepún and surrounding communities. This cultural practice is typical of many native people and religions. These interventions serve as evidence of the collaborative work between the owners of the project and the community. *Source:* *06_Respuesta Pertinencia Nº109_2013.pdf* *06_Informe LLellipun CMA 29-03-2014.pdf* *RECOMMENDATIONS* In order to reach a higher level there needs to be evidence that this project improved or rehabilitated the quality of life of the community.
QL1.2 Stimulate Sustainable Growth & Development	**2**	**Enhanced** The construction stage of the project will employ about 100 people annually for a period of two years. For the operation phase an estimate of 15 permanent jobs will be created as well as 15 indirect jobs. It is important to mention the agreement reached between the project owner and the community, where Eléctrica Carén will support and fund the development of a water supply project for the northern section of the Malalcahuello River, where the Huechelepún community lives, including 21 families. This is a joint initiative wherein the community or the City of Melipeuco offers a regularized source of water, which encourages the growth and development of that area. *Source:* *06_Declaracion_de_Impacto_Ambiental.pdf* *06_Personal Obra Central Carilafquén.pd* *RECOMMENDATIONS* To reach a higher level there needs to be evidence that shows that the delivered infrastructure will attract business and people and enhance cultural and recreational assets.
QL1.3 Develop Local Skills and Capabilities	**2**	**Enhanced** Caren ensures that their employees are trained to perform the services required. These and other more precise specifications are part of the contract. There is also a series of lectures and training sessions for the specific jobs to be implemented in each phase for the project. All personnel are trained to use basic immobilization strategies in case of accidents as well as rescue strategies that will promote future capacity building.

		Source: *06_Personal Obra Central Carilafquén.pdf* *06_Proveerdor Local 1.pdf* *06_Fotografía Capacitación.jpg*
		RECOMMENDATIONS The company could go further by implementing educational programs that both identify the community needs and at the same time improve the skill level of the workers.
QL2.1 Enhance Public Health And Safety	**2**	**Improved**
		There are a series of reports that take into account the observations and security inspections that need to be carried out on the project. Some deal with the inspection of the roads and how road maintenance is performed in each distinct phase of the project. A series of transit signals will be installed as a warning about operations in the area. Pedestrian access paths are created after the installation of the underground pipes. Driving courses are offered for bus drivers responsible for transporting personnel. In summary, the owner as well as the project team was able to meet the safety protocols in the construction phases of the project. However, the project did not employ the use of new technologies or materials beyond what was already required to enhance public health or safety.
		Source: *Sources: 06_FO-059 Formato Informe mes AGOSTO.pdf*
		RECOMMENDATIONS The project should employ the use of new methodologies or technologies that are innovative, to go beyond what is expected in relation to how they impact public health or safety.
QL2.2 Minimize Noise And Vibration	**11**	**Conserving**
		A study was conducted to determine the probable acoustic impact on sectors potentially affected as a result of noise generated in both the construction and operation processes. It considers the distances in which levels cannot exceed the permissible limits according to current legislation. It also implements general control measures in the event that the records obtained point to the need to reduce noise levels during construction and operation of the project. The study is divided into separate sections that target specific areas, but when combined form an extensive and comprehensive study.
		Source: *06_Estudio_de_Impacto _Acustico.pdf*
		RECOMMENDATIONS
QL2.3 Minimize Light Pollution	**0**	**No score**
		After examining the documents provided, it has been determined that there is not enough information related to this credit. A study was not conducted for this project.
		Source: *N/A*
		RECOMMENDATIONS It is recommended to conduct baseline studies of light pollution in the areas affected by the project in order to have enough criteria to evaluate the project.
QL2.4 Improve Community Mobility And Access	**14**	**Conserving**
		The project team took into consideration all possible routes to the site and implemented modifications that will reduce the negative impacts on the community, understanding that the project should not interfere with the cultural and territorial dynamics of the indigenous communities. Some of these modifications include removing soil that obstructs the road, maintaining clean pits, and conserving the sewer system. In addition, strategies like retrofitting gravel driveways and natural soils, repairing superstructures, and cleaning signs are part of the extensive plan to improve mobility and access during the construction phase. The documents presented include evidence of the community's approval for these interventions. They also include a contingency plan that manages the imminent increase in traffic flow during the construction period.
		Source:

		06_CAREN-01-COR-INF-0002-0 12.12.pdf *06_Autoriza Plan de Uso de Caminos.pdf* *06_Aprobación Vialidad_Caminos y Puentes.pdf* *06_Prevención Comunidades.pdf*
		RECOMMENDATIONS
QL2.5 Encourage Alternative Modes of Transportation	**3**	**Enhanced**
		Most of the workers walk or bike in order to get to the site. The transportation options are limited because the site is located in a very rural area. However, there are initiatives to reshape the platforms of dirt and gravel roads, including the street gutters. This plan was designed to provide the best possible traffic conditions for the workers and the community. There is no documentation provided or evidence of public transportation enhancement for the community.
		Source: *06_CAREN-01-COR-INF-0002-0 12.12.pdf*
		RECOMMENDATIONS The project could provide drawings that show the trails that connect workers with the construction sites and provide evidence of alternative modes of transportations for the workers.
QL2.6 Improve Site Accessibility, Safety & Wayfinding	**12**	**Conserving**
		The accessibility of the roads that lead to the site and surrounding areas was upgraded by the repairs made to the available infrastructure, mostly bridges. The aim of this operation is to identify, qualify and register each of the roads that make up the network by making an inventory of road maintenance and then repairing the deteriorating areas to make them safer. Cleaning safety signs form part of the extensive plan to upgrade the wayfinding and access during the project construction phase.
		Source: *06_CAREN-01-COR-INF-0002-0 12.12.pdf* *06_Prevención Comunidades.pd*
		RECOMMENDATIONS Provide design documents and plans that prove that these observations were implemented how the community benefited from them.
QL3.1 Preserve Historic and Cultural Resources	**16**	**Conserving**
		There were a series of archaeological inspection activities that took place at the site in order to determine the possible presence of historic objects. The study also proposes basic environmental management measures for the protection of archaeological sites that could be found in the project area. In the event that archaeological or paleontological objects appear during the execution of the project, the project owner shall give notice to the approporiate authorities. The plan considers implementing archaeological monitoring of all work that involve earthmoving, particularly excavations. A professional archaeologist will conduct this process. Additionally, interviews were conducted with key members of the Municipality of Melipeuco, such as the Director of the Social Department and members of PRODESAL (Local Development Program), officials of the National Branch as the manager of tourism, and the person responsible for community relations.
		Source: *06_Caracterización Ambiental Patrimonio Cultural.pdf* *06_Caracterización Ambiental Medio Humano.pdf* *06_Informe Ejecutivo Caren Alto 1.pdf* *06_Carta autorización sondeos CMN.pdf*
		RECOMMENDATIONS
QL3.2 Preserve Views and Local	**6**	**Superior**
		In order to lessen the visual impact of the project, design considerations were taken into

Character		account to substitute open adduction channels with completely buried HDPE (High- Density Polyethylene) pipelines. With this alteration the bridges will be eliminated and there will be a reduction of both the visual impact and the effect of a barrier to the movement of people and animals on the premises of the project. As a result the risks of accidents is considerably reduced. Additionally, the project owners are considering an optimization of the path that respects the topographic configuration of the site area. The layout of high-pressure pipelines was designed to prevent the impact on the Lleuque tree species. Steel pipes will be painted so they blend in with the surroundings and reduce visual impact. Certain measures were adopted to counteract the direct effects on the ecosystem, like the reforestation of Lleuque trees.
		Source: *06_Respuesta Pertinencia Nº109_2013.pdf* *06_R F N 422-2013 CP Carilafquen-Malalcahuello.pdf*
		RECOMMENDATIONS The project should try to aid local communities in developing new policies and regulations to preserve the local character of the community.
QL3.3 Enhance Public Space	**1**	**Improved**
		The project focuses on having a very low impact on the community's resources. Therefore the operation of the project will not have adverse effects on water resources or public space. Given the fact that this project is located in a rural area, where there is no clear evidence of any public or recreational facility, it cannot take advantage of or improve spaces that are not developed. There is no additional evidence related to this credit.
		Source:
		RECOMMENDATIONS The project should try to contribute in the creation of public space for the community.
QL0.0 Innovate Or Exceed Credit Requirements		*N/A*
	89	

SUB CATEGORY: LEADERSHIP		
	Score	**CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE**
LD1.1 Provide Effective Leadership And Commitment	**17**	**Conserving**
		One of the documents examined was the Latin America Power (LAP) sustainability policy, which includes a series of statements on sustainability and the commitment of the company to develop their project while addressing environmental and social issues. As further proof of the sustainability commitment, an auditor's report was issued by external auditors and the result of the evaluation indicates that all LAP processes demonstrate the preparation of monthly reports to systematize the information and results. In addition to this, LAP performed a phytosanitary treatment in 3 sectors and 6 communities adjacent to the construction of the hydroelectric plant. This action was well received by the community and they were thankful for the action, since 95% of their cattle benefited.
		Source: *06_Politica de Gestión Integrada.pdf* *06_LAP-SUS Política de Sustentabilidad rev00 PT.pdf* *06_Reporte de auditoría combinada.pdf* *06_INFORME Tratamiento Sanitario Ganadero.pdf*
		RECOMMENDATIONS N/A
LD1.2 Establish A Sustainability Management	**7**	**Superior**
		The project has a hierarchy chart establishing a structured system in a communication, territorial and environmental level. The organizational structure is planned and operated with

System		the CAREN Community Relations Team with support from a consultancy and advisory management team, and the engineering team is composed of a construction and sustainability branch. Certificate of safety management system and occupational health and a certificate of environmental management system. The project also completes detailed monitoring of social and environmental aspects that are part of the overall management system. The CAREN Electric Company also has a set of Environmental Aspects and Impacts, divided by stages, in which they list the activities to be carried out and their impact on the community. There is also a set of operating controls that seek to mitigate the environmental impacts caused. Overall the project has an organized management system that guarantees the sustainable performance of the project.
		Source: *06_Estrategia Comunicación Social.pdf* *06_Organigrama 2014.pdf* *06_Certificados ISO esp.pdf* *06_FO-037 HAIA Consolidado CMA.pdf*
		RECOMMENDATIONS The project sustainability management system should be strong enough to guarantee that in case of large changes in the design variables, it can still perform as efficiently in sustainable terms.
LD1.3 Foster Collaboration And Teamwork	**4**	**Enhanced**
		There are three main examples that serve as evidence of the collaboration and teamwork in this project. The first is that the design considerations were taken into account to substitute open adduction channels with completely buried HDPE (High- Density Polyethylene) pipelines. Thus the need for bridges for crossing from one point to another was eliminated, resulting in a reduction of the visual impact and the barrier to the movement of people and animals on the premises of the project. The second example of collaborative work is the restitution of the river flows (Carilafquén and Malalcahuello). In this case the owner of the project acquiesced to the request made by the Mapuche community to change the location of restitution of the river flows, in order to prevent flooding in areas near the project. The third one is the adjustments that have been made in the engineering design to optimize the chosen path, taking into account the topographic configuration of the local area and to avoid impacts on the Lleuque tree species. The project receives input from the communities and socio-environmental authorities, and then it is transferred to the technical area of the work, where they deliver solutions that improve the performance of the overall scheme. No specific information about the delivery process or evidence of the risk/reward sharing is part of the owner´s contract with the design team.
		Source: *06_Respuesta Carta de Pertinencia N°109_2013.pdf*
		RECOMMENDATIONS The collective approach described above should be implemented from the design phase by including it into the project delivery process.
LD1.4 Provide For Stakeholder Involvement	**14**	**Conserving**
		The documents provided reveal numerous strategies established by the stakeholders in order to maintain a strong level of involvement and engagement with the community. There is also a series of observations of concerns about the project and the community's perception of the company. They also have a strategic analysis of how to meet the goals, the extent to which the community or public services could help to legitimize the project, and stakeholder analysis of all the groups or communities that in some way are affected or benefit from the development of the project. They have generated a program dedicated to getting feedback from the community and trying to maintain a balance between what the stakeholders want and what the community needs. This feedback is then taken into account in the design of the project. The documents presented serve as a guarantee that the project team is actively involved in the

		search for decisions that benefit both parties.
		Source: *06_Mapeo de Grupos de Interés y lineamientos estratégicos LAP.ppt* *06_Estrategia Comunicación Social.pdf* *06_Negociaciones Faja Norte 15m Zona Arqueológica.* *06_Asistencia Manual de Crisis.pdf*
		RECOMMENDATIONS N/A
LD2.1 Pursue By-Product Synergy Opportunities	**0**	**No score**
		There is no documentation that proves that the project takes advantage of the usage of discarded materials or unwanted by-products.
		Source:
		RECOMMENDATIONS The project should seek to identify whether they can benefit from product synergy opportunities by making use of unwanted by-products, possibly from nearby facilities, even though the project is not located in an urban context.
LD2.2 Improve Infrastructure Integration	**0**	**No score**
		The project is located in the rural area of the Melipeuco commune, on the Araucanía region in Chile. This region does not have a considerable amount of infrastructure; as a consequence the delivered works of the hydroelectric power plants will not integrate with any existent infrastructure system except for the road system.
		Source: *N/A*
		RECOMMENDATIONS N/A
LD3.1 Plan For Long-Term Monitoring & Maintenance	**1**	**Improved**
		Despite the fact that they have a structured leadership system indicating the people responsible for the monitoring and maintenance of the project, there are no documents that serve as evidence that the team developed a long-term monitoring plan or agenda. The required resources for the maintenance has not been established. However, certain measures were adopted to counteract the direct impacts of the project from an ecological point of view, like the reforestation of the Lleuque tree species. It is important to mention that the survival and density of the tree species will be monitored for a period of 15 years once the project starts.
		Source: *06_Organigrama 2014.pd* *06_R F N 422-2013 CP Carilafquen-Malalcahuello.pdf*
		RECOMMENDATIONS Develop a monitoring plan for the constructed works and above all ensure that ecological protection, mitigation and enhancement measures are incorporated.
LD3.2 Address Conflicting Regulations & Policies	**1**	**Improved**
		The project did not address potentially conflicting regulations or policies regarding sustainability. However, they do address regulations in relation to the indigenous communities affected by the project. The purpose of the study was to assess the indigenous communities and their significance to the project site, and a strategy of engagement was adopted afterwards. The project is located in a rural region, mostly inhabited by indigenous people, so policies that create barriers to the implementation of sustainable infrastructure have not been identified. On the contrary, there are laws that protect the environment, especially the interests of the community.
		Source: *06_TECO_LAP_INFORME FINAL_REV B.pdf*
		RECOMMENDATIONS

		N/A
LD3.3 Extend Useful Life	**0**	**No score**
		There is no evidence to suggest that the project's useful life was extended by utilizing design as the major tool for durability
		Source: *N/A*
		RECOMMENDATIONS *The project could provide documentation that shows the specific design of the project and how it may achieve long term durability.*
LD0.0 Innovate Or Exceed Credit Requirements		*N/A*
	44	

CATEGORY II: CLIMATE AND ENVIRONMENT		
RESOURCE ALLOCATION		
	Score	**CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE**
RA1.1 Reduce Net Embodied Energy	**0**	**No score**
		The project team did not provide enough information to prove that they assessed the net embodied energy of the project materials.
		Source: *N/A*
		RECOMMENDATIONS Conduct a study that accounts for the net embodied energy of the project materials and the percentage of reduction over industry norms as well as the result of a life cycle energy assessment performed in accordance with recognized and accepted methodologies.
RA1.2 Support Sustainable Procurement Practices	**2**	**Improved**
		The team selected Andritz as a supplier of main equipment for the hydroelectric plant, this decision was based from the fact that Andritz has clear sustainability policies and a good performance criteria in environmental governance and social sustainability. In Andritz's corporate policy, they mention that sustainability has always been an integrated element and it is reflected in the management principles and business processes implemented within the group.
		Source: *http://www.andritz.com/group/gr-about-us/gr-sustainability.htm*
		RECOMMENDATIONS Provide evidence that the project established a procurement program to identify and obtain materials, as well as equipment, from the best possible supplier who implements sustainable practices.
RA1.3 Used Recycled Materials	**2**	**Improved**
		The project team utilized CAP Acero (Compañía de Aceros del Pacífico) a company that is committed to mitigating the impacts of their operations as well as promoting environmental initiatives that bring value to the environment in which they operate. The company seeks to use as much of their waste as they can, transforming them into products that are sold or reused by the same company.
		Source: *http://www.cap.cl/wp-content/uploads/2014/04/cap_rs_2013_cap_acero.pdf (pág. 11)*
		RECOMMENDATIONS Provide evidence that an inventory of materials that could be reused is taken into account, this includes materials that have recycled content. This inventory avoids sending useful materials to landfills and taking advantage of what is already there. That way it is easier to keep track of the quantity of reused structures or materials.
RA1.4 Use Regional	**0**	**No score**

Materials		The main materials for the construction of civil works, steel and concrete come from regional plants that are close to the project area, Concepcion and Temuco (Planta Ready Mix Concepción Plantas de Hormigón, Planta Ready Mix Temuco Plantas de Hormigón). According to the project team there is a big volume of material that comes from local sources, specially concrete, iron and HDPE pipes, but no information has been provided to prove this statement. As specified only the electromechanical equipment comes from Europe.
		Source: *http://www.cbb.cl/cementos/centroContacto.aspx?Id=2&ZonaId=5*
		RECOMMENDATIONS The applicant should provide documentation that proves the extent in which the project team utilized local sources (materials, aggregates and soils) to minimize costs and impacts. It will be helpful to provide an inventory of the materials adjacent to the site that were used.
RA1.5 Divert Waste From Landfills	**0**	**No score**
		Good disposal/treatment processes of waste generated in the work was implemented (household waste, recyclable waste, wood waste, oils and fats, excess excavation). The plan conveys that all waste will be removed, transported and disposed by a certified company so that it fully meets the environmental standards and regulations. Stones, sand, and the soil that will come from the works of rockfill and trenching will be reused in the same work. Throughout the project waste will be segregated into drums of colors. Nonhazardous solid waste is collected by DISAL Chile, a leader in environmental services such as water treatment and integrated waste management. Even though the project has implemented the previously mentioned measures, there is no evidence or any kind of calculation of the volume that the project is recycling and reusing in terms of its percentage. To achieve the minimum score in this credit a plant to divert at least 25% of waste from landfills should be proven.
		Source: *06_FO-059 Formato Informe mes AGOSTO.pdf pag.13*
		RECOMMENDATIONS Provide the waste management plan to decrease waste during operation, and at the same time maximize the possibility of recycling and reusing waste. It is important to mention that methods that decrease the quantity of waste may increase its toxicity so the project team should take into account three variables: the amount of waste generated, its recyclability, and its toxicity.
RA1.6 Reduce Excavated Materials Taken Off Site	**2**	**Improved**
		The project team developed a management plan for the collection of excess excavation in the Huechelepún sector. The main goal for this study was to correctly deposit the material surplus generated by the excavation in specific areas that could be beneficial for the project. What constitutes a suitable area to generate a collection of surplus excavated material is one that has no tree cover, gentle slopes, and has no streams. In order to prevent negative impacts on the intervened land, the area will be revegetated and / or reforested with native species growing in the sector.
		Source: *06_Plan de Acopio Excedentes.pdf (pág. 7, 10)*
		RECOMMENDATIONS Documentation that shows estimations of how the design of the project balances the cut and fill of the site to maximize performance.
RA1.7 Provide for Deconstruction & Recycling	**1**	**Improved**
		Credit detail The project plan, with 50 years of life expectancy, has not covered deconstruction, as it allows for an upgrade of equipment, parts and accessories to prolong its life. For equipment and parts that need to be changed a reuse of materials is anticipated. The primary material for the construction of the project is steel, a material that judging by its properties can be easily recycled. On the other hand the project utilizes reinforced concrete, which is also subjected to extraction of iron for recycling. It is important to mention that the project has devices that isolate water flows which allows the replacement of equipment on specific areas,

		separating and making the process of recycling materials more manageable.
		Source: *06_RCA 77_2014.pdf (punto 3.1 ; pág 4)*
		RECOMMENDATIONS In the case that the project team has developed a plan of reusing or recycling materials once the project reaches the end of its useful life, some documentation needs to evidence this endeavour. An inventory of the materials that were considered since the initial phases of design that retain value for future use.
RA2.1 Reduce Energy Consumption	**0**	**No score**
		There was not enough documentation provided by the team project to prove that this credit was completed in a successful way.
		Source: *N/A*
		RECOMMENDATIONS Conduct analysis that produces evidence how the project team used energy reduction strategies for the operation and maintenance during the project life cycle.
RA2.2 Use Renewable Energy	**20**	**Restorative**
		This project is linked to the regional electricity distribution that forms part of the national system network, it can be stated that according to the latest bulletin of the in Chile, around 35% of the energy comes from renewable sources. Moreover this project is identified as a net positive renewable energy generator due to the nature of the facility. This power plant, located in the Carilafquén river will generate an approximated output of 19.8 MW of renewable energy.
		Source: *06_Boletín Septiembre 2014 (pág.5)*
		RECOMMENDATIONS Calculation of the use of renewable sources, not just during operation (once that the plant is in use), but also during the construction phase would increase this project's score. Calculation of the use of renewable sources, not just during operation (once that the plant is in use), but also during the construction phase would increase this project's score.
RA 2.3 Commission & Monitor Energy Systems	**11**	**Conserving**
		The third party that will monitor the equipment of this hydroelectric plant is called Agrosonda and they will be responsible for the services of "Operation and Maintenance" of the plant in three stages: transition period, initial period of operation, and the long term monitoring plan. The scope of this contract includes the supply of all human organization and accessories that allow Optimal Operation and Preventive and Corrective Maintenance that will allow this specific project to maximize their profits. To achieve the objective outlined, Agrosonda will provide the hydroelectric plant with the resources to ensure maximum performance and availability of the Central or the lowest possible cost, maximizing the efficiency and minimizing the use of energy.
		Source: *06_LAP-1069-CARMAL-OM-COT Rev A.pdf*
		RECOMMENDATIONS *N/A*
RA3.1 Protect Fresh Water Availability	**4**	**Enhanced**
		The project team conducted a study of the estimation of available water resources and the average monthly flows in the areas where the water will be captured for the project. This leads to a reduction in the impact on the quality, quantity, and availability of fresh water in the Carilafquén and Malalcahuello rivers. The freshwater supplies that the project uses to generate energy for the hydroelectric plants are replenished at source.
		Source: *06_Anexo_8.5_Estudio_de_disponibilidad_de_recursos_hidricos.pdf*
		RECOMMENDATIONS

		N/A
RA3.2 Reduce Potable Water Consumption	**0**	**No score**
		There was not enough documentation provided by the team project to prove that this credit was completed in a successful way.
		Source: *N/A*
		RECOMMENDATIONS Calculate the estimated annual water consumption and encourage the use of greywater to reduce the amount of potable water utilized in the project.
RA3.3 Monitor Water Systems	**0**	**No score**
		Even though the project team has conducted extensive studies in the availability of water resources, there is no particular plan that monitors on a long-term basis the water system performance.
		Source:
		RECOMMENDATIONS Provide monitoring activities and integrate them with the operation of the project.
RA 0.0 Innovate Or Exceed Credit Requirements		*N/A*
	42	

NATURAL WORLD		
	Score	**CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE**
NW1.1 Preserve Prime Habitat	**0**	**No score**
		The study area is located within the Altoandino Deciduous Forest, what could be considered a prime habitat. The hydroelectric plant is located within the area that presents homogeneous characteristics in relation to its unique landscape and scenic beauty. The project is located southeast of the town of Melipeuco, in the triangular land area produced by the union of the two rivers, and covering about 5 km inland. In the study area three homogeneous vegetation units were identified: native forest, scrub and meadow. The presence of native forest is dominant covering almost 74% of the analyzed surface, followed by the prairie unit with 21%, and finally the scrub with 2%. p. 4-5
		Source: *06_Anexo 2.1 Caracterización Medio Físico.pdf* *06_ Anexo 2.2 Caracterización Calidad del Agua.rar* *06_Anexo 2.3 Caracterización Flora y vegetación.pdf* *06_Anexo 2.4 Caracterización Fauna.pdf* *06_Anexo 2.5 Caracterización Flora Acuática.rar* *06_R F N 422-2013 CP Carilafquen-Malalcahuello.pdf (punto 8) p. 4-5*
		RECOMMENDATIONS N/A
NW1.2 Preserve Wetlands and Surface Water	**0**	**No score**
		The development of this project is directly located and uses the river flows of the Carilafqén and Malalcahuello rivers. However, it is important to mention that this project presents punctual works of construction in capturing and restoring water from and to the rivers. Looking at the way in which the placement of the constructed works deal with the river, no buffer zone can be established from wetlands, shorelines, or water bodies; therefore this credit will not apply.
		Source: *06_R F N 422-2013 CP Carilafquen-Malalcahuello.pdf*
		RECOMMENDATIONS N/A
NW1.3 Preserve Prime Farmland	**6**	**Superior**
		In order to preserve agricultural and pastoral activities that might develop in the site,

		meaningful design considerations were made to substitute open adduction channels to completely buried HDPE (High- Density Polyethylene) pipe lines. This design consideration eliminates the barrier effect to the movement of people and animals on the premises of the project, as well as the protection of areas that can be potentially used as farmlands.
		Source: *06_Respuesta Carta de Pertinencia N°109_2013.pdf ; Punto 2.2 Cambio de Canales Abiertos de Aducción por tuberías, pág.2 y punto 4.2, pág. 5*
		RECOMMENDATIONS In an ideal scenario, the areas designated as prime farmlands will remain untouched as to avoid any kind of development in these areas would be exceptional.
NW1.4 Avoid Adverse Geology	**1**	**Improved**
		An intricate study of soil mechanics to further investigate the composition of the site was developed in the process of investigating the site, and as a result, the project has avoided development in areas of high risk. The location relative to these features was taken into consideration for the ultimate location of the project. The study presented in this report includes the results of subsurface exploration conducted in the field, from which one can obtain the following results: subsurface stratigraphy, the presence of groundwater, geo mechanical properties, and the definition of soil type according to the Chilean seismic code. Other specifications arise from this study, such as the minimum depth for a foundation and general constructive recommendations.
		Source: *06_MECÁNICA DE SUELOS.pdf*
		RECOMMENDATIONS N/A
NW1.5 Preserve Floodplain Functions	**8**	**Superior**
		This Hydroelectric plant includes floodgates as part of the overall design of the project, this responds to any potential flood impacts that might take place. These movable flood gates are commanded electromechanically to open when a heavy rainfall provokes the growth of the river flow. The project team developed a report that aims to describe the actual situation of the elements that constitute the aquatic flora and fauna of the area that will be impacted by the project in an effort to maintain the aquatic habitat to protect the species. This study was conducted in an effort to determine the influence of the project and how the project affects the ecological flow. The results of the study for Carilaquénn and Malalcahuello were treated independently in order to explain more clearly the characteristics of each of the systems.
		Source: *06_Anexo N°2 OPERACIÓN COMPUERTAS.pdf* *06_Anexo Nº 5 Complemento Medio Acuatico.pdf* *06_ADENDA Nº 1 LAP.pdf (Respuesta 3, pág. 8)*
		RECOMMENDATIONS N/A
NW1.6 Avoid Unsuitable Development on Steep Slopes	**0**	**No score**
		There was not enough documentation provided by the project team to prove that this credit was completed in a successful way.
		Source: *N/A*
		RECOMMENDATIONS Disturbance of areas with slopes must be reduced to the minimum, even if those that are not steep.
NW1.7 Preserve Greenfields	**0**	**No score**
		There is no information provided to prove that this credit was completed in a successful way. Since the development of this hydroelectric plant is in a rural area, the areas targeted by the project are not classified as greenfields or brownfields.
		Source: *N/A*

		RECOMMENDATIONS N/A
NW2.1 Manage Stormwater	**0**	**No score** To minimize the impact of the infrastructure being built, it is important to take into consideration the storm water flow and how the landscape will be modified post-construction. During the construction phase, some measures may need to be implemented to prevent the sediment collapse. No information has been provided to prove that similar strategies were implemented. *Source:* *N/A* *RECOMMENDATIONS* Take advantage of the possibilities of implementing strategies that manage stormwater and use this water in other part of the project. Also it is crucial to try to minimize the impact of stormwater runoff.
NW2.2 Reduce Pesticides and Fertilizer Impacts	**0**	**No score** The project does not use pesticides or fertilizers. The hydroelectric plant is located in a rural area and none of these methods has to be implemented in order to maintain the natural landscape of the site. The project team did not produce designed a new landscape with new plant species, they just tried to minimize the impact in the one that already existed. *Source:* *RECOMMENDATIONS* In the case that later on the project team decides to introduce plant species in the design of the landscape they should take into account the importance of reducing pesticides and fertilizers on site.
NW2.3 Prevent Surface and Groundwater Contamination	**1**	**Improved** The project team argues that this project does not employ the use of potentially polluting substances and therefore the water will not be contaminated. However, they did launch a monitoring program for water quality; the risk of spills was contemplated and they worked on the logistics of how to prevent them. *Source:* *06_Anexo II Manejo ambiental CMA 2014.pdf (pág.11 y pág.17)* *RECOMMENDATIONS* Develop a long-term surface and groundwater monitoring program to make sure that the constructed work cannot have an impact on receiving waters.
NW3.1 Preserve Species Biodiversity	**13**	**Conserving** This project has a stratagem that focuses on mitigating adverse impacts the project might have in the natural habitat. The first step was to identify the habitat inside and in the surroundings of the intervened area, this lead to a better understanding of the overall land use. Part of the project is located within a native forest which signified a series of commitments and meticulous design decisions for its protection. Moreover, the character of buried pipes, versus the previous methodology of open channels that was going to be implemented, represents a valuable contribution to connectivity for wildlife movement. There was a plan developed for the recuperation of vegetation in the areas impacted by the project. In addition the plan considers reinforcing and extending some fragments of the native forest. The plan proposes to triple the amount of plants in the reforestation as well as the number of species to reforest. Also they have the obligation to monitor the reforestation for up to 15 years to ensure the success of the measures implemented. After an intricate evaluation of the land scenario the project team came to the conclusion that only in the case that part of an ecosystem would be affected by the constructed works, a complete restoration of the latter would be implemented. *Source:* *06_DIA_LAP.pdf* *06_Anexo 2.5 Caracterización Flora Acuática.rar* *06_Anexo 2.4 Caracterización Fauna.pdf* *06_Anexo 2.3 Caracterización Flora y vegetación.pdf* *06_Anexo 2.1 Caracterización Medio Físico.pdf*

		RECOMMENDATIONS N/A
NW 3.2 Control Invasive Species	**0**	**No score** The scope of the project does not deal with the control of invasive species. However it is important to mention that the project team organized a study with detailed descriptions of the species in the area. In the study area three homogeneous vegetation units were identified: native forest, scrub and meadow. The presence of native forest is dominant covering almost 74% of the analyzed surface, followed by the prairie unit with 21%, and finally the scrub with 2%. In the area of project 70 species of flora were identified, of which 57 are native (10 of them endemic), and 13 were foreign. *Source:* *06_Anexo 2.3 Caracterización Flora y vegetación.pdf (p.2-4)* *RECOMMENDATIONS* Identify any noxious plants that might exist in that area and develop a comprehensive management plan for the removal of these invasive specie.
NW3.3 Restore Disturbed Soils	**8**	**Conserving** The project leaves the ground in the condition it was found, showing that the disturbed soils can be restored for any agricultural activity or vegetation to grow in that area. *Source:* *06_Respuesta Carta de Pertinencia N°109_2013.pdf ; Punto 2.2 Cambio de Canales Abiertos de Aducción por tuberías, pág.2 y punto 4.2, pág. 5* *RECOMMENDATIONS* N/A
NW3.4 Maintain wetland and surface water functions.	**15**	**Conserving** The documentation provided serves as evidence that the project will maintain the hydrologic connection because the flow of water, after passing through the turbines in the powerhouse, will be returned to the river through drainage channels. These channels are completely underground and ensure the maintenance of the hydrologic ecosystem. The project involves maintaining the ecological flow that relates to water rights granted by the Direción General de Aguas General Direction of Waters (DGA). According to this agency, it is determined that the ecological flow must respond to the respective water rights and the Malalcahuello and Carilafquen rivers currently have. Thus these measures are intended to maintain the functioning of aquatic ecosystems and the goods and services they provide. The documents state that the water be restored to each river in the same amount and quality of when being captured, a quality that is suitable for the development of aquatic life and the overall habitat. The opening of the gates that are located in the intake permit the sediment transport without disruption. *Source:* *06_ADENDA Nº 1 LAP p.8* *06_RCA 77_2014.pdf p.29* *06_Anexo N°2 OPERACIÓN COMPUERTAS.pdf (punto 5.3)* *RECOMMENDATIONS* N/A
NW 0.0 Innovate Or Exceed Credit Requirements		*N/A*
	52	

CLIMATE AND RISK		
	Score	**CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE**
CR1.1 Reduce Greenhouse Gas Emissions	**13**	**Superior** The project will be connected to the Interconnected Central System (SIC), the biggest electricity grid in the country, and is estimated that the project deliver an average annual generation of

		83,448 MWh and generate a total amount of 56,136 tCO2 emission reductions per year approximately. The implementation of Carilafquen-Malalcahuello Hydroelectric Power Plant Project will displace the dispatch of thermoelectric power plants currently operating in the SIC system and will contribute with the greenhouse gases (GHG) emission reductions, delivering clean energy to the grid that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, and specifically by avoiding the emission of CO2 produced by the combustion of fossil fuels, considered the main source of GHG.
		Source: *06_Anexo 2.1 Caracterización Medio Físico.pdf* *06_ Anexo 2.2 Caracterización Calidad del Agua.rar* *06_Anexo 2.3 Caracterización Flora y vegetación.pdf* *06_Anexo 2.4 Caracterización Fauna.pdf* *06_Anexo 2.5 Caracterización Flora Acuática.rar* *06_R F N 422-2013 CP Carilafquen-Malalcahuello.pdf (punto 8) p. 4-5*
		RECOMMENDATIONS N/A
CR1.2 Reduce Air Pollutant Emissions	**12**	**Conserving**
		The project does not follow the California Ambient Air Quality Standards, but other set of rules have been implemented into the project. According to the national standards, there are certain zones in Chile with height pollution indexes. In these areas, it is compulsory to account for the emissions generated. This is not the case of this project because the emissions are not significant so they are quantified by domestic rules of pollutant control blocks, mainly those from sources of combustion engines. The project developed plans of mitigation of dust during the construction stage where these potential emissions are most likely to occur. However the emissions generated during the project are negligible.
		Source: *06_RCA 77_2014.pdf (punto 3.8.2)* *06_Emisiones_Atmosfericas.pdf*
		RECOMMENDATIONS N/A
CR2.1 Assess Climate Threat	**15**	**Conserving**
		This project is linked with the construction of the necessary infrastructure for a hydroelectric plant. Therefore the management of water becomes the biggest factor that could have potential impacts in a climatic perspective. Recognizing this the design of the project responds and recognizes the seasonal climate fluctuations, to allow for a better understanding for the design variables that the project should incorporate. Some of these include managing floods, incorporating electromechanical mechanisms that will allow the infrastructure to respond to weather conditions such as rain, snow or snow melts. The water gates, incorporated in the intakes of the project, serve as an example of the adaptation plan to respond to these climates threats and achieve the best performance.
		Source: *06_Anexo N°2 OPERACIÓN COMPUERTAS.pdf (punto 5.3)* *06_Proyecto Central Carilafquen.pdf* *06_Proyecto Central Malalcahuello.pdf*
		RECOMMENDATIONS N/A
CR2.2 Avoid Traps And Vulnerabilities	**2**	**Improved**
		The assessment of potential vulnerabilities that were considered in this project can be summarized with the incorporation of water gates. This design variable helps regulate possible vulnerabilities that the community might face when the water level rises or decreases significantly.
		Source:

		06_Anexo N°2 OPERACIÓN COMPUERTAS.pdf (punto 5.3)
		RECOMMENDATIONS Establish broader considerations that take into account potential traps in relation with design variables and operational costs.
CR2.3 Prepare For Long-Term Adaptability	**16**	**Conserving**
		In the process of design of the hydroelectric plants, various items were considered including a hydrologic study that summarizes the water flow rates generated from climatic variations. The hydraulic aspects considered in the design of the flood gates takes into account the consequences of long term climatic change. These simulations are made for statistical evaluations of exceptional weather phenomena that could occur in periods of 250 years and also taking into consideration a 500 year gap. The operating conditions of the infrastructure contemplates three open gates for the flow of 250 years period, while it predicts that all four gates will be open in a period of 500 years. The flood gates works as a design feature that will increase the the alternatives of how the project will adapt to respond to these climate conditions.
		Source: *06_Diseño Largo Plazo Carilafquen.pdf (pág. 6)* *06_Diseño Largo Plazo Malalcahuello (pág. 7)*
		RECOMMENDATIONS N/A
CR2.4 Prepare For Short-Term Hazards	**3**	**Improved**
		The project team developed an evaluation of the scenario of indirect effects that will occur by the cutting and restoration of vegetation, in particular the Lleuque species. The plan is to monitor the survival and density of the tree species located 20 meters inland from the fragments from the new edges that will be generated by the project. The monitoring will be constant during a period of 15 years after the project starts its operation.
		Source: *06_R F N 422-2013 CP Carilafquen-Malalcahuello.pdf (p. 7)*
		RECOMMENDATIONS
CR2.5 Manage Heat Island Effects	**0**	**No score**
		The project team did not consider reducing or minimizing localized heat accumulation in surfaces by incorporating in them a high solar reflectance index (SRI).
		Source: *N/A*
		RECOMMENDATIONS The project should take into account the fact that hard surfaces can absorb large percentages of incident solar radiation and in consequence the surfaces could heat and so will the air what will cause an alteration in the climate around them.
CR0.0 Innovate Or Exceed Credit Requirements		*N/A*
	61	
OVERALL:	**288**	**CARILAFQUEN-MALALCAHUELLO HYDROPOWER PLANT, CHILE**