According to the Brazilian Institute of Geography and Statistics (IBGE), 17 species of mammal are threatened with extinction in the State of Santa Catarina. Of these, ten are in expected numbers in the region based on their natural characteristics.

For example, according to Chehébar (1990); Indrusiak and Eizirik (2003) apud Cherem (2005), the otter (Pteronura brasiliensis) is probably extinct in Santa Catarina and Rio Grande do Sul. There have also been no sightings of panthers in Santa Catarina (Indrusiak e Eizirik, 2003 apud Cherem, 2005).

Some groups of mastofauna are still found fairly frequently in isolated clumps of trees and larger remaining forests, but have suffered a rapid decline in population.

Avifauna

The **avifauna** of the region surveyed includes birds from the Seasonal Forests, birds from the Tropical Rain Forest and those strictly associated with Araucaria. In the undergrowth that grows in the shade of the araucarias it common to see groups of species from the families Thamnophilidae, such as White-backed Fire-eye (Pyriglena sp.) and Variable Antshrike (Thamnophilus sp.). Dendrocolaptidae, such as the Scaled Woodcreeper (Lepidocolaptes sp.); and Picidae, represented by the Little Woodpecker (Veniliornis passerinus), taking advantage of the great number of invertebrates that ants flush from the forest soil. Also seen are species such as the Bujarara, the White-browned Warbler, the Vinaceous Parrot (Amazona vinacea), the Red-breasted Toucan (Ramphastus dicolorus) and the Giant Antshrike. The blue-headed parrots and the parakeets seem to adapt perfectly to the araucarias.

Associated with different stages of regeneration we find the diademed tanager and the glaucous-blue grosbeak which can be observed in the forest or at the forest edge. The lemon-chested greenlet has been seen very frequently associated with mixed flocks in the treetops of araucaria copses.

Associated with the araucaria there is the marked presence of the azure jay (*Cyanocorax caeruleus*), considered a potential distributor of pine nuts.

In the riparian forest we found species associated with still water, such as kingfishers, which are seen all along the rivers where they find their food; egrets which build their nests in the vegetation; cormorants, the wood rail, the partner of some species of duck, also mix at these points, mainly in areas where the river waters are slow moving and near the banks the forest treetops on both banks almost meet, with beaches and richer micro-fauna at some sites.

Other characteristics of the avifauna of riparian forests: brown tinamou, blue-headed parrots, squirrel cuckoo, tropical screech owls, lineated woodpecker, long-tailed tyrant, blue-and-yellow tanager, ruby-crowned tanager, green-winged saltator and red-crested finch.

The avifauna associated with the fields in the south is very characteristic, such as the white monjita (*Xolmis dominicana*) that can be observed generally in isolated trees, where it sits, flying from its perch to catch insects in rapid flights. Another example of a characteristic bird of southern Brazil is the capped seedeater, which feeds on seeds from the sedges and grasses that make up the natural environment. The bat falcon (*Falco rufigulari*) can be commonly seen hunting bats in areas where there are rocky outcrops.

Areas with more accentuated slopes, when associated with rivers, produce waterfalls, which constitute habitats for species of swallow which are very common in the region. In the presence of bushes and low vegetation, these fields are visited by a series of species with the general name of elaenia.

The hawks found in open areas, such as the savanna hawk and common kites and harriers are the most easily seen carnivores in open field areas. They have the habit of following the frequent manmade fires in the local fields Southern lapwing and buff-necked ibis search this area for invertebrates The buff-necked ibis was seen during our stay in São Domingos, common in recently harvested fields (Figure 27).

Figure 27 – Buff-necked Ibis seen in São Domingos.

The species common to the fields can take advantage of vegetation clearing and pasture expansion in this region and have become characteristic in the local pastures.

Herpetofauna

Regarding **herpetofauna**, Schumacher and Hoppe (2001) state that in the forest regions, with vegetation density similar to Mixed Ombrophila and Seasonal Forest, the quantity of reptiles is low due to the abiotic conditions created by the density of the vegetation and by the large quantity of leaf mould and detritus.

However, the field region is suitable for reptiles. Santos *et al.* (2005) conducted a survey in field environments and found reptiles from various groups. Among the Testudines he found Orbigny's slider (*Trachemys dorbigni*); amongst the Sauria he found spectacled lizards (*Pantodactylus* sp. e *Mabuya* sp.), lizards (*Teiús oculatus* and *Tupinambis merianae*) and glass lizards (*Ophiodes* sp.).

The largest number of species were snakes. Some of the species found were lanceheads (*Bothrops* sp.), coral (*Micrurus* sp.), green racers (*Philodryas* sp.) etc.

The author states that some of them are not restricted to the field environment but can be found in forest and urban environments.

Even though there are no studies on amphibians in the indirect area of influence, we know of the presence of species such as *Hyla sp.* e *Bufo sp.*

Area of Direct Influence

Even though it is in a poor state of upkeep we have seen that this is an important part of the environment, permitting, for example, the passage of animals such as capybara (*Hydrochaeris hydrochaeris*). Feces of these animals were found at various points during on-site surveys.

There are also considerable fragments of native vegetation throughout the area of direct influence and these will be described later. Associated with these fragments, we found evidence of mastofauna and avifauna.

Section A

In the fields, we found evidence of mastofauna. The capybara (*Hydrochaeris hydrochaeris*) is an inhabitant of the area, indicated by the presence of mounds of typical feces, which can be seen in Figure 28.

Figure 28 – Evidence of the presence of Capybaras in region A.

We also observed the presence of armadillos (Dasypodidae Family) on site, finding typical burrows seen in Figure 29.

Figure 29 – Evidence of the presence of armadillos. Presence of burrows.

We also observed signs of predation on this section, near crops. The dead animal was a bird, therefore the hunter was probably a wild or domestic cat, (Family Felidae) (Figure 30).

Figure 30 – Evidence of bird predation, probably by a wild or domestic cat.

Among avifauna, we observed southern lapwings (*Vanelus chilensis*) whicha re associated with crops. We also saw other birds (Passeriformes) in the riparian forest.

Section B

Due to the size of the fragments, there is no habitat capable of sustaining animal populations. These fragments can only be used by mastofauna as a temporary home or hiding place during migration between one strip of vegetation and another.

Avifauna includes the saracura (Família Rallidae), due to the damp areas present. We also saw the gavião-caboclo (*Heterospizias meridionalis*) and the anu branco (Guira guira), as well as traditional avifauna represented by Passeriformes.

Section C

Being a well protected area, it is quite rich in fauna. From what we saw during a few hours of field study we could infer the results of a more detailed investigation.

Regarding mastofauna, we again found the presence of capybaras (*Hydrochaeris hydrochaeris*), through their characteristic feces. We also saw evidence of otters (*Lutra longicaudis*) and of raccoons (*Procyon cancrivorus*). We saw footprints of both at the mouth of Bonito river (Figures 31 and 32). The banks of shallow fast flowing rivers are a common habitat for these animals.

Figure 31 – Otter footprints, observed at the mouth of the river Bonito in C region.

Figure 32 - Raccoon footprints observed at the mouth of the Bonito river in C region.

We also saw feces containing fur, which indicates a predator, probably a feline such as a forest cat.

Among avifauna, we saw individuals of the families Accipitridae, Cuculidae, Fringellidae, Furnariidae, and Muscicapidae. The most common birds in the forest are Passeriformes.

Section D

In section D we again saw the presence of capybaras (*Hydrochaeris hydrochaeris*), this time from their footprints along the bank of the Chapecó river (Figure 33).

We saw avifauna of the families Furnariidae, of which we saw rufous horneiro (*Furnarius ruffus*); Tyranidae, of which we saw the great kiskadee (*Pitangus sulphuratus*); Turdidae, of which we saw the thrush (*Turdus rufiventris*); and Jacanidae, of which we obersved the wattled jacana (*Jacana jacana*).

Figure 33 – Capybara footprints (Hydrochaeris hydrochaeris).

Section E

In section E the only fauna we saw was avifauna, especially the families Furnariidae, of which we saw the rufous horneiro (*Furnarius ruffus*); Psittacidae, flock of monk parakeets (*Myiopsitta* sp.) and Ardeidae, specifically the snowy egret (*Egretta thula*).

Section F

In section F we saw birds, most commonly Passeriformes. We did not see any mastofauna, however the habitat is suitable for many animals listed as possible inhabitants in the area of indirect influence. Note that the region around the tributary of the river Chapecó (Figure 34) is the preferred habitat for animals such as the otter (*Lutra longicaudis*) and the raccoon (*Procyon cancrivorus*), evidence of which we found in the area of direct influence.

Figure 34 – Habitat suitable for otter (Lutra longicaudis) and raccoon (Procyon cancrivorus).

8.2.3. Aquatic Biota

The **icthyofauna** in the area of indirect influence is in an ecosystem of running fresh water. At the dam location, the river Chapecó is very shallow, but varies upstream from this point. The depth here is no more than 3m.

Therefore, this aquatic ecosystem is classified as a rapids zone (Odum, 1988), in which the bed is free from silt or other loose material, providing a firm substrate. The main limiting factor in the ecosystem is the current. There is an major exchange between ground and water, which results in a more open ecosystem. The riparian Forest is therefore extremely important as it absorbs the impact of rain on the soil and consequently on the lotic bodies of rapids.

Normally, the oxygen content is generally high and uniform in bodies with the these characteristics, with little or no thermal or chemical stratification.

In the following table, we present a list of species in the upper section of the Uruguay river basin, called the sub-basin of the Upper Uruguay where the Chapecó river is located. This list was obtained by merging on site data from LAPAD/UFSC in this section, as well as from information obtained from relevant literature. This list was presented by Andrade and Canellas (2004) in an Integrated Environmental Evaluation (AAI) for the hydro electrical plant built in the hydrographic basin of the river Uruguay by the THEMAG consortium.

Below are the order, family and species. The species marked with an asterisk are exotic (*).

Table 25 – Icthyofauna species in the area of indirect influence.

Species of Icthyofauna	
PERCIFORMES	ATHERINIFORMES
CICHLIDAE	ATHERINIDAE
Cichlasoma aff. *facetum* [6]	*Odontesthes* aff. *perugiae* [6]
Crenicichla celidochilus [6]	
Crenicichla gaucho [5]	CHARACIFORMES
Crenicichla igara [6]	ACESTRORHYNCHIDAE
Crenicichla jurubi [6]	*Acestrorhynchus pantaneiro* [6]
Crenicichla lepidota [4]	ANOSTOMIDAE
Crenicichla minuano [6]	*Leporellus vittatus* [6]
Crenicichla missioneira [6]	*Leporinus amae* [6]
Crenicichla prenda [5]	*Leporinus obtusidens* [6]
Crenicichla cf. *scottii* [1]	*Leporinus striatus* [6]
Crenicichla tendybaguassu [6]	*Schizodon nasutus* [6]
Crenicichla vittata [6]	CHARACIDAE
Geophagus brasiliensis [6]	*Astyanax alburnus* [1]
Gymnogeophagus gymnogenys [6]	*Astyanax eigenmanniorum* [1]
**Oreochromis niloticus* [6]	*Astyanax bimaculatus* [6]
CLARI I DAE	*Astyanax brachypterygium* [5]
Clarias gariepinus [6]	*Astyanax fasciatus* [6]
HEPTAPTERIDAE	*Astyanax* gr. *scabripinnis* [6]
Cetopsorhamdia aff. *iheringi* [6]	*Astyanax* sp. [1]
Heptapterus mustelinus [6]	*Bryconamericus iheringii* [6]
Imparfinis sp. [6]	*Bryconamericus stramineus* [6]
Pimelodella sp. [6]	*Brycon orbignyanus* [6]
Pimelodella australis [4]	*Charax leticiae* [6]
Rhamdella longiuscula [6]	*Charax stenopterus* [1]
Rhamdia quelen [6]	*Cynopotamus kincaidi* [6]
LORICARIIDAE	*Diapoma* aff. *speculiferum* [1]
Ancistrus sp. [6]	*Galeocharax humeralis* [6]
Ancistrus taunayi [6]	*Hypobrycon maromba* [5]
Eurycheilichthys pantherinus [4]	*Hyphessobrycon* sp. [6]
Hemiancistrus sp. [6]	*Hyphessobrycon bifasciatus* [1]
Hemiancistrus chlorostictus [5]	*Hyphessobrycon luetkeni* [1]
Hemipsilichthys vestigipinnis [5]	*Odontostilbe* sp. A [1]
Hemipsilichthys sp. [6]	*Odontostilbe* sp. B [1]
Hisonotus sp. [6]	*Oligosarcus brevioris* [6]
Hisonotus ringueleti [5]	*Oligosarcus jenynsii* [6]
Hypostomus commersoni [6]	*Moenkhausia* sp. [4]
Hypostomus isbrueckeri [6]	*Pygocentrus nattereri* [6]
Hypostomus luteus [6]	*Salminus brasiliensis* [6]
Hypostomus regani [6]	*Serrasalmus maculatus* [6]
Hypostomus roseopunctatus [6]	*Serrasalmus spilopleura* [1]
Hypostomus ternetzi [6]	CRENUCHIDAE
Hypostomus uruguayensis [6]	*Characidium* cf. *zebra* [6]
Hypostomus sp. [4]	*Characidium serrano* [6]
Loricariichthys anus [6]	*Characidium pterostictum* [1]

Loricariichthys sp. [6]	*Characidium* aff. *fasciatum* [1]
Loricariichthys maculatus [1]	*Characidium vestigipinne* [5]
Paraloricaria vetula [6]	CURIMATIDAE
Pogonopoma obscurum [5]	*Cyphocharax voga* [4]
Rineloricaria sp. [6]	*Cyphocharax saladensis* [1]
Rhinelepis sp. [4]	*Cyphocharax platanus* [4]
PI M ELOD I DAE	*Steindachnerina biornata* [6]
Iheringichthys labrosus [6]	*Steindachnerina brevipinna* [6]
Luciopimelodus pati [6]	*Steindachnerina stigmosa* [1]
Megalonema platanus [6]	CYNODONTI DAE
Parapimelodus valenciennis [6]	*Rhaphiodon vulpinus* [6]
Pimelodus absconditus [6]	ERYTH RI N I DAE
Pimelodus atrobrunneus [6]	*Hoplias lacerdae* A [1]
Pimelodus maculatus [6]	*Hoplias lacerdae* B [1]
Pseudoplatystoma corruscans [6]	*Hoplias malabaricus* [6]
Sorubim lima [6]	PARODONTIDAE
Steindachneridion punctatum [3]	*Apareiodon affinis* [6]
Steindachneridion scriptum [3]	PROCH I LONTI DAE
PSEUDOPI MELODIDAE	*Prochilodus lineatus* [6]
Microglanis eurystoma [6]	CYPRI N I FORM ES
Pseudopimelodus mangurus [6]	CYPRINIDAE
TRI CHOMYCTERI DAE	**Aristichthys nobilis* [6]
Paravandellia bertoni [6]	**Ctenopharingodon idellus* [6]
Tricomycterus sp. [6]	**Cyprinus carpio* [6]
Branchioica teaguei [4]	
	CYPRINODONTIFORMES
SYNBRANCHIFORMES	RIVULIDAE
SYNBRANCHIDAE	*Cynolebias periodicus* [5]
Synbranchus marmoratus [6]	POECI L I I DAE
	Phalloceros caudimaculatus [1]
SCIAEN I DAE	
Pachyurus bonariensis	GYMNOTIFORMES
	APTERONOTI DAE
SILURIFORMES	*Apteronotus* sp. [4]
ASPREDINIDAE	*Porotergus ellisi* [6]
Bunocephalus doriae [6]	*Sternacorhamphus hahni* [6]
AUCHENIPTERIDAE	GYMNOTIDAE
Auchenipterus sp. [1]	*Gymnotus carapo* [6]
Auchenipterus nigripinnis [4]	STERNOPYG I DAE
Auchenipterus osteomystax [4]	*Eigenmannia virescens* [6]
Parauchenipterus galeatus [6]	
Parauchenipterus teaguei [6]	
Tatia boemia [6]	
Tatia neivai [6]	
Trachelyopterus albicrux [4]	
CALLICHTHYIDAE	
Callichthys callichthys [6]	
Corydoras paleatus [6]	
CETOPSI DAE	
Pseudocetopsis gobioides [6]	

The authors mentioned below have been cited by Andrade and Canellas (2004) and serve as the source for this list.

[1] BERTOLETTI, J. J., C. A. S. LUCENA, Z. M. S. LUCENA, L. R. MALABARBA & R. E. REIS. (1989a).
BERTOLETTI, J. J., C. A. S. LUCENA, Z. M. S. LUCENA, L. R. MALABARBA & R. E. REIS. (1989b).
[2] BUCKUP, P.A. & HAHN, L. (2000).
[3] GARAVELLO, J.C. (2005).
[4] HAHN, L. (2000).
[5] MIQUELARENA, A.M.; LOPEZ, H.L. (2004).
[6] ZANIBONI FILHO, E.; MEURER, S.; SHIBATTA, O.A.; NUÑER, A.P.O. (2004).

This range of diversity may not exist around the Chapecó river, however there are no conclusive studies on the Icthyofauna here. Therefore, we will assume that this fauna populates the area of indirect influence.

Icthyofauna in the Direct Area of influence

In this diagnosis we did not collect primary data on Icthyofauna in the area of direct influence. To obtain the data presented here, we chose to interview the local inhabitants who often go fishing.

The interviewees stated that fish diversity is very low. They say this is caused by changes in water quality, specifically due pollution: effluent from a paper and cellulose plant, upstream from the study areas, and effluents from animal breeding, especially pig farms.

The fish that are currently caught on this section of the river Chapecó are those shown in Table 26.

Table 26 – Icthyofauna that, according to local people, are found in the river Chapecó, in the area of direct influence. The fish marked with an (*) are exotic.

Scientific name	Common name
Astyanax sp.	Lambaris
Geophagus brasiliensis	Cará
Rineloricaria sp.	Cascudo
Rhamdia sp.	Jundiá
Hoplias sp.	Traíra (*)
Cyprinus carpio	Carpa (*)
Tilapia rendalli	Tilápia

Sampling work, creating primary data, may find additional species.

8.2.4. Preservation Units

In the Chapecó river basin, the São Domingos municipal region – on the border with Paraná – one of the last refuges for araucarias in the West of the state of Santa Catarina, a farm was converted into the Santa Catarina State Forest Park – the first exclusively dedicated to araucaria forest.

Created by the Decree No. 293, dated 30th of May 2003, **The State Araucaria Park** is the first conservation unit for araucarias run by the State Government. The area covers 612 hectares and is covered solely by Mixed Ombrophila Forest, harboring two species threatened with extinction, the araucaria (*Araucaria angustifolia*) and ferns (*Dicksonia sellowiana*).

Inside the park there is the river Jacutinga, a tributary of the river Bonito. Not only is it an important tributary of the river Chapecó, it supplies water to the São Domingos municipal region.

The aim of this conservation unit is to help to maintain the araucaria forest, which currently occupies only 5% of their original area in the State of Santa Catarina.

The Santa Luzia SHS Project is located to the south of the State Araucaria Park. It does not affect this conservation area.

8.3. Socio-Economic Environment

8.3.1. Occupational History

According to published historical data, the forest domains on the slopes of the meridional high plains of Santa Catarina, where the municipal regions in this study are found, were inhabited by pre-Cabral indigenous groups, the Xokleng and Kaingang. These groups, according to CABRAL (1987), belonging to the linguistic group Jê, were called “Botocudos” by the cattle drivers who traveled on the road opened in 1728, cutting through the meridional high plain of Brazil to connecting São Paulo (Sorocaba) with Viamão (Porto Alegre).

This meant that dispersed support stations for the cattle drivers, called cattle ranches, were established along the trail and were run by Portuguese-Brazilians.

Up to the end of the XIX century, part of the meridional high plains, then called Campos de Palmas (Palm Fields) where the municipal regions being surveyed are located, were considered “no-man’s land”; it was used as a refuge for criminals and had a few sparsely spread cattle ranches, and was grounds for a dispute between Argentina and Brazil. However, in 1895, following a legal enquiry, President Cleveland of the USA decided that the contested region belonged to Brazil.

Incorporated into Brazil after a violent period called the War of Contestation, part of the so-called Palm Fields were divided between the States of Santa Catarina and Parana in 1916. This led to the formation of population centers, especially in Santa Catarina, where the municipal region of Chapecó was founded on the 25th of August 1917. This municipal region was populated with Brazilians of German and Italian descent in the 1930s, mainly the State of Rio Grande do Sul.

Alongside exploration of forestry resources (extraction of timber and mate tea), these colonists used the São Paulo – Rio Grande railroad, built in the first decade of last century, to start exporting hogs and other merchandise to the Sao Paulo market. This started an economy based on corn and pork production. Consequently, new villages were established in the west of Santa Catarina, creating more than one hundred municipal regions, amongst them São Domingos e Ipuaçu.

The São Domingos municipal region, which gained independence on the 14th of December 1962 and was officially recognized on the 7th of April 1963, was originally a district of Chapeco created in 1937 and called Diogo Ribero. In 1942, it was given the name São Domingos, which came from the name of a farm belonging to Domingos Baldissera, who adopted the name of the Saint.

The Ipuaçu municipal region gained its independence on the 9th of January 1992. Building began in around 1940 when decedents of Italians, Germans and Poles from Rio Grande do Sul founded a small village to farm the Brazilian pine trees (Araucaria angustifolia). The name Ipuaçu comes from Tupi-Guarani and means “large paved floor” because of the physical characteristics of the Chapeco river bed. Today, Ipuaçu has a large indigenous population. Approximately 15,623 hectares of the municipal region are occupied by Kaingang and Guarani Indians representing 760 families, who live alongside the decedents of European colonizers. Both use the soil for agriculture and as the economic basis for local income.

8.3.2. Demographics

According to data published by the Brazilian Institute of Geography and Statistics (IBGE), following the Demographic Census in 2000, the municipal regions surveyed had a population of 15,661 people. Information related to the distribution of the rural and urban population from IBGE and the census show that in the area surveyed, about 70% of the total population resides in rural areas.

Taking the total area of the municipal regions, 661 km2, and the total population estimated by IBGE in 2000, 15,661 habitants, we obtain a demographic density of 23.7 habitants per Km2, a low population density and characterizing the study area as predominantly rural. In the study area, the use of the soil is mainly intensive and mechanized farming. (Pictures 35 and 36)

These characteristics are also related to animals farming, where the farmers form landowning groups and maintain cooperative production relationships with the industrial meat processing industry located in the eastern region of Santa Catarina.

Figure 35 – Predominant characteristic (land use) of the rural properties in the project's area of influence

Figure 36 – Predominant characteristic (land use) of the rural properties in the project's area of influence

São Domingos

Regarding the distribution of the rural and urban population, the São Domingos municipal region has a total of 2,580 homes, while the urban area has 1,509 homes, representing approximately 59% of the total population. In the rural area, there are 1,051 homes, where the rest (41%) of the population lives (Table 27).

Table 27 – Distribution of the population of the São Domingos municipal region

Municipal region	Total population	Men	Women	Urban Population	Rural Population
São Domingos	9.540	4.756	4.784	5.430	4.110

Source: Brazilian Institute of Geography and Statistics (IBGE). Demographic Census – 2000

It is worth mentioning the population's average geometric growth index. Over the last ten years, the municipal region presented negative population growth. In the demographic census from 1991, the IBGE counted a population of 10,764 inhabitants. In the 2000 census, the municipal region had a total of 9,540 inhabitants, the equivalent of an index of -1.3%.

Ipuaçu

According to data from IBGE (2000), about 83% of the total population in the municipal region lived in 1,254 homes situated in rural areas and the other 17% of the population in 257 homes located in the urban nucleus, totaling 1,511 homes (Table 28).

Table 28 – Distribution of the population of the São Domingos municipal region

Region	Total Population	Men	Women	Urban Population	Rural Population
Ipuaçu	6.122	3.079	3.043	967	5.154

Source: Brazilian Institute of Geography and Statistics (IBGE). Demographic Census – 2000

In the last ten years, contrary to the São Domingos municipal region, the average geometric growth index of the population of Ipuaçu, although not very expressive, has risen. Base on data from the Demographic Census for 1991 – IBGE, which showed a municipal region with a population of 5,823 inhabitants, compared with the data supplied by the 2000 demographic census, which registered 6,122 inhabitants, the municipal region grew 0.56%.

Such indexes are associated with internal migration between neighboring municipal regions in Santa Catarina and Parana, who have seen their tertiary sectors expand following the arrival of agro-industrial parks

8.3.3. Infrastructure

8.3.3.1. Water Supply

In the survey area, water is supplied in two ways – directly and indirectly. In the urban areas the supply comes from a distribution network of treatment plants managed by the private sector. In the rural areas, residents still draw water directly from wells, springs and streams.

According to data from CASAN, the company that supplies water to the municipal regions surveyed, in Ipuaçu the supply of treated water drawn from an artesian well called Toldo Velho has a flow of 116 cubic meters per day providing water to 100% of the urban population.

In the São Domingos municipal region the water drawn from the river Bonito by CASAN, after being treated, supplies up to 74% of the total population, based on a flow of 1,059m^3/per day.

In long periods of drought, there can be problems with regular supply of treated water in some urban areas, also affecting the water supplies in the rural zones. This problem is not linked to a scarcity of water but reflects the current supply infrastructure and the water sheds considered as class 1, which should be used for domestic supply, being contaminated with industrial effluents, agricultural pesticides, domestic waste and the effluent from pig farms.

The systems for drawing water and supplying it in both municipal regions are shown in Table 29.

Table 29 – Different kinds of water supply in the municipal regions in the project's area of influence.

Municipal	Permanent private homes	Water supply methods		
		General network	Well or spring	Others
Ipuaçu	1.511	528	951	32
São Domingos	2.580	1.502	1.042	36
Total	**4.091**	**2.030**	**1 .993**	**68**

Source: IBGE – Demographic Census 2000

8.3.3.2. Sanitary Depletion

The municipal regions do not have a network for sewage collection and a treatment station for domestic waste and few houses have their own septic tank, filter or leaching field.

According to data from the town halls in the municipal regions approached, although they exist, none of the sewage collection projects have been approved for the construction of sewage treatment systems. As an initial goal and with a view to initiating works on a sewage collection and treatment infrastructure, the municipal regions have had their rainwater drainage systems expanded in urban areas, which has reduced to some degree the appearance of sewage from the open air sewers and encouraged the illegal connection of rudimentary septic tanks to the network.

Another problem is the pollution of water sheds in the municipal regions, caused by direct disposal of waste from pig farms along the course of the river. This problem has been reduced through rural education programs, involving institutions that support agriculture and rural producers, building treatment systems for pig production waste converting it into organic fertilizers for crop improvement and fish farming.

In the rural environment of both municipal regions, projects carried out by both town halls have educated the rural famers and have resulted in the construction of home sanitation systems designed to minimize environmental problems and sewage treatment.

In Table 30 there is information on the types of system used for sewage treatment in the municipal regions surveyed.

Table 30 – Types of domestic discharge of the municipal regions in the project's area of influence.

Municipal regions	Number of homes with bath and sanitation	Type of sewage system						
		General sewage or rain network	Septic Tank	Rudimentary Septic Tank	Ditch	River	Others	No bathroom or sanitation
Ipuaçu	1.505	0	34	875	75	16	05	506
São Domingos	2.516	92	423	1.940	33	18	10	64
Total	**4.021**	**92**	**457**	**2.815**	**108**	**34**	**15**	**570**

Source: IBGE – Demographic Census 2000

8.3.3.3. Solid Waste Collection

Data supplied by IBGE from the Demographic Census in 2000 shows that of the 9,091 homes in the municipal regions of Ipuaçu and São Domingos, about 60% had refuse collection service.

In the Ipuaçu municipal region, refuse collection services reach only about 18.7% of the 1,511 homes. On average about 1 ton is collected per day, with 2 collections a week.

The refuse is tipped at an open-air dump. In the São Domingos municipal region refuse collection covers about 53% of the population of 2,580 homes, producing about 2 ton a day of refuse. This service is supplied by the town hall which runs a sanitary waste dump.

Today, even though selective waste collection has been adopted, using specific waste bins in some urban areas, the municipal regions do not have recycling and composting facilities. The recyclable materials are collected by self-employed recycling merchants from the public and residential refuse bins and also the open air municipal dump. The collection of "heavy refuse" occurs sporadically on specific days.

In the municipal regions, the rural areas have almost no refuse collection. The refuse produced in these areas is buried and/or incinerated on the property. In table 31 data on to the type of refuse disposal in the municipal regions surveyed is shown.

Table 31 – Destination of refuse produced in the municipal regions of the study area.

Municipal regions	No. of homes	Collection service – number of home served	Burned and/or buried on site	Thorn on empty land or public roads	Thrown into waterways	Other
Ipuaçu	1.511	282	1.113	109	06	01
São Domingos	2.580	1.391	1.052	106	05	26
Total	**4.091**	**1.673**	**2.165**	**215**	**11**	**27**

Source: IBGE – Demographic Census 2000

8.3.3.4. Electrical Power

In relation to electricity distribution in the municipal regions surveyed, São Domingos presents the greater deficit. According to data from CELESC, from 2005, of the 2,580 homes in the municipal region, only 1,105 were connected to the electricity network, or less than 50% of the total.

In the Ipuaçu municipal region this service is also lacking, mainly in the rural areas. The rural area represents about 60% of electrical energy consumption, because of the greater proportion of the total population. The rural population, which includes over 750 indigenous families, would like to see the electricity network reaching their homes.

Likewise, in the urban areas, there is not only a lack of public illumination but there are frequent power cuts and reductions in electrical supply. These oscillations and cuts cause disruptions and lead to insecurity in production sectors, inhibiting investment in potentially productive industries.

8.3.3.5. Communication

Practically all the homes located in the municipal region's urban areas have conventional fixed line phone systems, which allow direct dialing to the internet system. Broadband internet is still not available.

On some properties in rural areas the internet connection uses radio. In these areas the rural cell phone system predominates.

The reception of television channels covers practically all the homes in the municipal region. The signals from all the main channels are received (Globo, SBT, Record and Bandeirantes). All radio channels, frequencies and stations are available.

The main newspapers from Santa Catarina, Paraná and Rio Grande do Sul are regularly available as well as local and regional information bulletins.

8.3.3.6. Road System

The existing road system meets the demand for distributing farm production, circulation of goods and transport for the local population. The municipal regions surveyed have federal highways, access to inter-city and interstate roads, the interstate roads are all paved. Amongst the main roads which access the municipal regions are the BR 282, BR 470, BR 480, SC 467, SC 451 and the PRT 280. Among those mentioned, the most important for access to these cities are the BR 282 which crosses Santa Catarina from East to West, and the BR 480 with connects the East of Santa Catarina with the south region of the state of Paraná.

Table 32 shows the distances between the main cities in Santa Catarina with the municipal regions of Ipuaçu e São Domingos.

Table 32 – Road Distances (approximate) to the project surveyed.

Cities	Km
Abelardo Luz	48 km
Bom Jesus	27 km
Campos Novos	208 km
Chapecó	86 km
Curitibanos	276 km
Florianópolis	576 km
Ipuaçu	13 km
Joaçaba	165 km
Lages	353 km
Xanxerê	43 km
Xaxim	63 km

Source: DER/SC – Road Map 2005.

The municipal regions can also be reached from the airports located in Santa Catarina at Chapecó and Xanxerê, which are about 50Km from the city centers.

As well as the federal and state highways, the municipal regions also have their municipal road networks. The majority of these roads are unpaved.

8.3.4. Social Indicators

8.3.4.1 Education and Health

Alongside income, education and health development indicators are essential components when developing mathematical calculations to create indexes showing the level of human development of a particular society.

In the municipal regions surveyed, the literacy index reaches an average 85%, which is considered lower than average in Santa Catarina. According to estimated data from IBGE, in 2004, the literacy in Santa Catarina was over 94%.

The São Domingos municipal region lacks basic education facilities, forcing some of the students who are studying in junior school to go to schools in the Ipuaçu municipal region and to other neighboring municipal regions. Table 33 shows the type and number of schools in the study areas.

The health services offered in the study areas are still poor. The number of doctors and nurses is insufficient for the population, the public hospitals need modernizing and expanding as do the number of Outpatient Clinics, mainly in rural areas.

The town halls in the municipal regions, together with the state health organizations, are developing projects to expand the network of municipal Outpatient Clinics, to increase the basic services and develop actions pushing preventive and alternative medicine. In Table 34 we can see the number of hospitals and clinics available to the population of the study area.

Table 33 – Number of schools per municipal region in the area covered by the project in 2004.

Municipal Region	Number of Establishments				
	Pre-school	Basic school	High School	University	Total by city
Ipuaçu	06	12	02	00	20
*São Domingos	09	01	01	*01	12
Total	15	13	3	01	Total Number of Establishments
					32

Source: Ministry of Education – Educational Census 2004.
* The municipal region offers a degree course in Business Administration – an extension course from UNESCO in Xanxerê, which was implemented in 2005.

Table 34 – Hospitals and Outpatient Clinics in the study areas.

Municipal regions	Health centers		Number of beds	
	Public	Private	Total	Available to SUS
Ipuaçu	04	00	00	00
São Domingos	02	01	41	41
Total	**6**	**1**	**41**	**41**

Source: IBGE, 2002.

Even though lacking in municipal regions, in the AMAI (Association of the Municipal regions of High Irani) region covering the municipal regions being studies, the health sector has 11 hospitals with 411 beds for patients (one bed for each 332 habitants), 22 private clinics, 66 public outpatient clinics and 89 dentistry clinics.

These indexes, associated with other social factors, have contributed to an increase in the health indicators in Ipuaçu and São Domingos, which are based on mortality and birth rates and are expressed as life expectancy at birth, shown in Table 35.

Table 35 – Life expectancy at birth.

Municipal regions	Year	%	State Classification	State Index %	Brazilian index %
Ipuaçu	1991	66,65	257º	70,20	N/D
	2000	68,75	282º	73,70	67,70
São Domingos	1991	70,68	156º	70,20	N/D
	2000	72,40	202º	73,70	67,70

Source: IBGE, Demographic Census 1991 and 2000.

State standings, according to Table 35, have fallen.

Even though it has only recently been colonized (it was the last region of the state to be settled), the West High Plain of Santa Catarina has emerged as an agro-industrial center for the national economy, with an infrastructure that tries to improve the deficit in social well-being. This is probably the result of the economic production model based on small landowning groups, which tie the rural producer to agribusiness. In terms of the municipal regions studied here, it seems that this developed or maintained the social environment.

Tthere is a need to diversify production methods, mainly to add value to the agricultural products, by expanding and modernizing the secondary sector in these municipal regions.

8.3.4.2. Human Development Index - IDH

According to data from the Human Development Atlas/PNUD, 2000, the HDI in these regions was approximately 0.8 (HDI average). This index varies from 0.0 to 1.0, and is applied based on a series of social and economic criteria, attributing the following classifications of human development.

- Low Human Development – 0.0 to 0.5
- Average Human Development – 0.5 to 0.8
- High Human Development – 0.8 to 1.0

Adopting the Municipal Human Development Index –MHDI, which is based on data obtained from the simple mathematical average of three indexes related to longevity, education and income for each municipal region, the values obtained are also very close to those produced by the Human Development Atlas/PNUD, according to the following Table 36.

Table 36 – Social Development Index.

IDH	Municipal regions/Indices	
	Ipuaçu	São Domingos
Longevity	0,729	0,790
Education	0,812	0,862
Income	0,605	0,729
Municipal Human Development	0,715	0,794

Source: Human Development Report – The Institute of Applied Economic Research IPEA/2002.

As well as the cited indicators, the Secretary of State for Urban and Environmental Development – SDM for Santa Catarina, through its Urban Development Directors – DURB and to evaluate the level of development in Santa Catarina's municipal regions, developed an applied methodology, based on 17 indicators resulting from data based on municipal, social and economic means, the IDS – Social Development Index.

The municipal region with the highest socioeconomic development index was attributed a value of 1.0; it was qualified as providing a High Level of Efficiency. For the lowest index the value of 0.0 is equivalent to a Low Level of Efficiency. The other intermediate municipal regions, based on this methodology, were given values based on the following classification system.

- From 0.80 to 1.00 High Level of Efficiency
- From 0.65 to 0.79 Average to High Level of Efficiency
- From 0.65 to 0.64 Average Level of Efficiency

- From 0.65 to 0.49Average to Low Level of Efficiency
- From 0.65 to 0.29 Low Level of Efficiency

This methodology, when identifying the efficiency level of the Social Development Index, became a useful tool for planning socioeconomic and socio-environmental goals in Santa Catarina's municipal regions. Table 37 presents the SDI data for the municipal regions surveyed. São Domingos is shown as having an Average to High Level of Efficiency and Ipuaçu an Average to Low Level of Efficiency.

Table 37 – Social Development Index.

Municipal Region	IDS – Level of efficiency	State classification
Ipuaçu	0,44	250º
São Domingos	0,66	93º

Source: Source: Urban Development Directory – DURB / Secretary of State for Urban and Environmental Development SDM/SC/2000

8.3.5. Economic aspects

In the municipal regions being focused on and in practically the whole AMAI region, the main economic sector is the primary sector. It uses edaphic and forestry resources, soil for agriculture and forestry of exotic species for wood production.

For the Ipuaçu municipal region the total values of farming and industrial activities are practically the same in terms of municipal GDP. However, the added value of the secondary sector depends on and is the result of agricultural production, as shown in the following Table 38.

Table 28 – Composition of the municipal GP, value added by sector – 2002.

Municipal regions	Total Added Value (R$) 1 .000.00)	Agribusiness %	Industry %	Services %
Ipuaçu	70,636	28,954	29,438	12,244
São Domingos	61,777	32,342	8,200	21,235
Total	132,413	61,296	37,638	33,479

Source: IBGE, 2002.

One of the main characteristics in the AMAI is the area of land used for agricultural production. In this region most properties are plots, on average 20 hectares. They produce raw materials for processing industries. In the AMAI region there are over 400 industries, with the emphasis on production of mate tea, agricultural industries and lumber processing. They directly employ about 8,500 workers.

Table 39 shows specific and quantitative data on the main types of primary production in Ipuaçu and São Domingos. The secondary sector, in both municipal regions is represented by processing industries for the primary products. The main industries in the processing sector involve mate tea, wood and agro-industrial companies. Though mostly small scale, the area also includes furniture and clothing industries.

Table 39 – Specification and number of companies established in the study area in 2003.

Companies	Number of companies by region	
	Ipuaçu	São Domingos
Transformation industries	16	92
Electricity production and distribution:	01	01
Housing and food	13	29
Transport, storage and communication	11	53
Financial intermediation	00	02
Real estate and rental activities and services provided to companies	08	15
Other collective, social and personal services	76	96
Health and social services	00	11
Public administration, defense and social security	02	01
Mining industry	00	02
Construction	03	08
Education	04	02
Trade; (repairing cars, personal objects and home appliances)	50	242
Total	**184**	**554**

Source: IBGE, Profile of Brazilian Municipal regions – Public Management 2003.

Intended for the storage of agricultural production, AMAI has approximately 150 warehouses managed by agricultural cooperatives. Most can store approximately 2,000 tons of grain and farm produce.

The main agricultural products in the municipal regions surveyed are: perennial production of oranges, limes, grapes, peaches, pears and especially mate tea.

Seasonal production is large scale farming of soy and maize. On a lesser scale there is wheat, oats, rice, sugar cane, garlic, tobacco, peanuts, beans, potatoes, cassava, tomato and water melon. Of these products, soy and maize are cultivated intensively and are produced for agro-industrial sectors (Figure 37).

Figure 37 – Intensive use of the soil – soybean farming.

Also within the primary sector, another activity goring in importance is soybean planting for seed. This is marketed through cooperatives. Fish farming is another promising activity, which grows annually.

Cattle farming in the area is also important. According to the IBGE, in 2003, beef cattle in the municipal regions numbered 20,376 head. Hog farming in the same year produced 32,825 head. In aviculture, these regions raised 1,679,000 birds for meat and egg production.

Combined, primary and secondary sectors in the region supply the third sector, which includes trade and services. The largest proportion of agricultural production in the municipal regions supplies industries in other regions. Consequently, the service sector in the municipal regions does not grow.

8.3.6. Soil Use and Occupation

As a result of past extraction activities, involving fauna, forestry and edaphic resources which represent the majority of the morpho-climatic vegetation cover and Dense Mixed Ombrophila Forest, filled with adapted fauna species, the environmental activities of farmers in the Chapecó river basin, which is part of the AMAI area, are basically restricted to edaphic and water resources.

Today temporary or cyclical farming predominates in about 47% of the area that makes up the municipal regions in the AMAI, according to the distribution shown in Table 40.

Table 40 – Use and occupation of the soil - AMAL

Type of area	Relative Percentage
Permanent crops	1 .4%
Temporary crops (cyclical)	47.0%
Temporary crops at rest	4.7%
Pasture	15.2%
Natural pasture	14.4%
Woods and forests	15.3%
Productive and Unused Areas	2.0%

From maps on agricultural suitability for the region, the farming of Class 4 cyclical crops was considered a conflict of use, equivalent to a normal suitability for farming.

Present throughout the AMAI region, the greatest concentrations of soil with regular suitability (Class 4) and susceptible to erosion is in the municipal regions of Abelardo Luz, Ouro Verde, Faxinal dos Guedes, Xanxerê, Bom Jesus, Ipuaçu and São Domingos.

In these regions, the farmers use the topographically favorable areas located in the river flood basin for plantations and pastures (Figure 38).

Figure 38 – Flood plain (larger river bed) used for agriculture, inside the project's area of influence.

Consequently, when the reservoir is built, the Class 4 land of the nearby owners, currently used for pasture, cyclical or permanent crops, will be flooded.

The flooding area and the Project area are apparently lacking this type of resource. Current use is restricted to a small scale rock production which is crushed for gravel.

8.3.7. Leisure, Tourism and Culture

With intrinsic cultural characteristics due to the populating and colonization processes, the municipal regions of Ipuaçu e São Domingos have been included in the rural tourism and the traditional local celebration itineraries publicized by SANTUR, the official tourism agency in Santa Catarina.

There are still no official numbers available regarding the tourists who visit the municipal regions. However, during the main events (traditional celebrations) we find increased demand for activities related to rural tourism, including ecotourism, tourism contributes considerably to the income in the municipal regions.

According to data published by SANTUR, one of the biggest tourist attractions in the Ipuaçu municipal region is the Indian Outpost at Chapecó. Both the foreign and local tourists frequently visit the indigenous reserve to appreciate their customs and participate in their cultural demonstrations. The most popular being the Kiki, celebrated on the 19th of April, the Day of the Indian.

There are not only local celebrations. The tourists can visit parts of the Chapecó river and bathe at the freshwater beaches.

Figure 39 - Characteristics of areas for leisure (Despraiados) in the area under direct influence of the project.

However, the majority of these areas do not have appropriate infrastructure for tourism. In the area of direct influence we found piles of garbage and unstable constructions in the areas used for bathing and fishing (Figures 40 and 41).

Figure 40 – Garbage accumulating at the leisure area under direct project influence.

Figure 41 - Unstable constructions used by bathers in the area of direct project influence.

Likewise, the São Domingos municipal region also has a series of natural and cultural attractions. For those who like water sports and ecotourism, the municipal region offers a variety of attractions. It has great potential for ecotourism.

One of the natural tourist attractions of São Domingos that attracts the most visitors is Prainha (Little Beach), the main bathing area in the municipal region and the only one with a reasonable infrastructure that can offer services to tourists and locals. Prainha is located on the banks of the Chapecó river, at a shallow point where the river bed is made of rock (Figure 42). The location is used for leisure and relaxation, with an infrastructure made up of community barbecues, snack bar, toilets, restaurant and a camping site (Figure 43).

This area, which would be partially flooded by the project, is part of the infrastructure created as part of the proposed measures to use the SHS Quebra-Queixo surrounding area, built downstream.

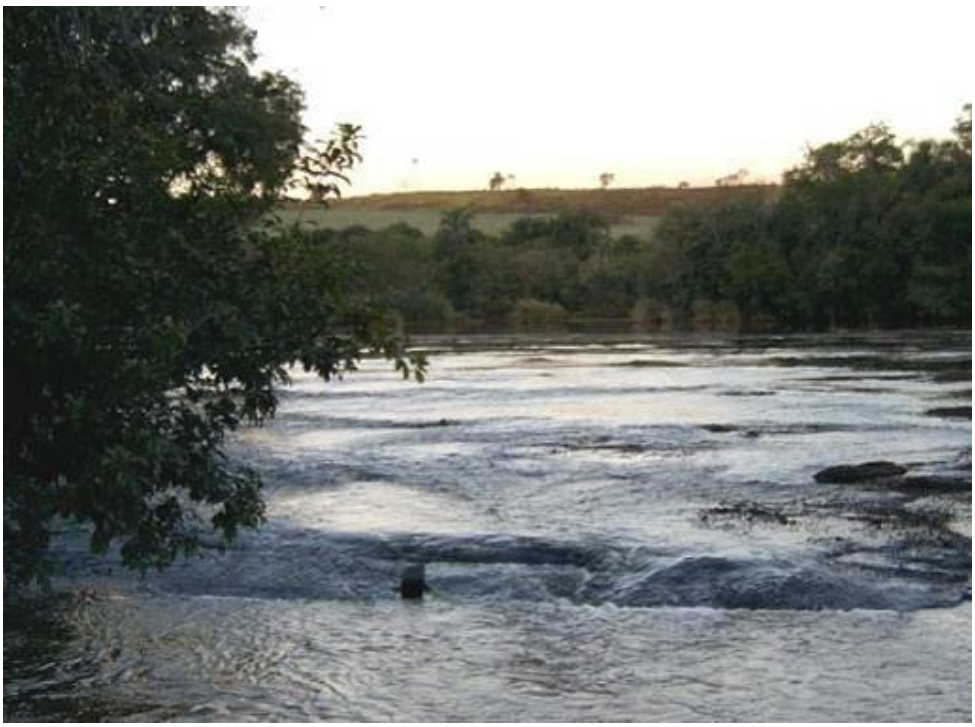

Figure 42 – Prainha area used for bathing.

São Domingos has a state environmental conservation unit – Araucaria Park – founded by decree No 293, of May 30, 2003. It covers an area of 612 hectares, covered with mixed ombrophila forest (FATMA 2006). It is about 12Km from the center of the municipal region. Part of it can be reached from the SC 480. Araucaria Park is cut by the Jacutinga river, a tributary of the Bonito river, which is the main source of water for the municipal region and the most important tributary of the Chapecó river.

Amongst the traditional celebrations promoted in the municipal region, the FASP "The Araucaria Country and Popular Festival" and the Colonist and Driver Festival, are the most popular, attracting tourists from all over the east of Santa Catarina.

In both municipal regions, tourism aims to promote a series of festive events associated with gastronomy, agricultural and industrial fairs and rural tourism based on the use of cultural traditions. Figure 43 - Camp site at Prainha.

Figure 43 – Prainha Camping Site.

Although just beginning to bring in income for these regions, the cultural attractions that make up the festivities, local agricultural production, the simple life and the warm welcome for visitors are becoming well known among those who enjoy rural and adventure tourism.

8.3.8. World Heritage, Cultural and Archeological Site

Due to historical occupation processes, population and colonization of the Brazilian meridional high plains, the municipal regions surveyed present intrinsic socio-cultural characteristics. These characteristics are expressed through historical testimony and demonstrations of the indigenous, Portuguese, German and Italian Brazilian cultures.

Related to testimony of the pre-colonial occupation period, information published by SCHMITZ (1957); SANTOS (1973); PIAZZA (1971); ROHR (1984), and other researchers who dedicated themselves to archeological investigations of the Brazilian meridional high plains, say that the region in the west of Santa Catarina was occupied during this period by groups of horticulturalist ceramicists of the Tupi-Guarani and Taquara/Itararé traditions.

The surveyed area, according to these authors, was part of the Guarani and Kaingang Indian territories which belong to the linguistic families of Tupi-Guarani and Macro-Jê, before the arrival of the first Europeans.

Following colonization of the meridional high plain, these indigenous groups were practically decimated. Excluded from their traditional territories, those that survived the frequent conflicts were forced to live in limited areas, the so-called indigenous reservations.

There is an indigenous population of 7,000 people in the State of Santa Catarina, based on the 2000 Demographic Census - IBGE. Of these about 60% are in the west region of Santa Catarina.

In the surveyed area, about 15,600 hectares of the Ipuaçu municipal region belong to the Chapecó Indian Post, which also covers lands in the municipal region of Abelardo Luz. The Post houses 760 Kaingang and Guarani Indian families who farm and survive by trading Indian craftwork which they sell to tourists visiting the municipal region.

The lands that cover these regions are managed by FUNAI, have no documented owners and are being contested in court. The flooding area, which will become the reservoir for the Santa Luzia Alto SHS, does not affect the land for the Indian Post or land that could potentially be used to preserve the indigenous culture.

Practically all the municipal regions that make up the AMAI area have museum collections that show pre-historical archeological findings from the river Uruguay, and also preserve utensils, photographs and documents from the periods of settlement and colonization of the west of Santa Catarina.

The cities with several museums that preserve regional artifacts are: Chapecó, Xanxerê, Concórdia and São Miguel d'Oeste. Likewise, these cities that were the initial centers for settlement and colonization in the area and have successfully preserved a large part of their historic architecture. Although they do not have significant architectural heritage from the time of settlement and colonization, the town halls in the regions of São Domingos e Ipuaçu have development and preservation departments for socio-cultural areas.

It is also worth emphasizing the work carried out by regional universities for the preservation of archeological, natural, artistic and cultural sites that reconstruct the processes of occupation, settlement and colonization, through anthropological university museums and extension programs and projects.

The region's museum collection, which is mainly anthropological, consists of a significant number of tools, funeral urns, decorations, etc. that have been saved from archeological sites. Objects from these sites in the west of Santa Catarina have been collected from the 1950's on.

This type of preservation activity, associated with archeological research required when building projects, mandated by the resolution from the National Advisory on the Environment - CONAMA No. 001 of 1986, setting rules for national heritage preservation, have saved a western Santa Catarina archeological site from intensive, mechanized agriculture, which is the main cause of archeological destruction.

In the area planned for Santa Luzia Alto SHS reservoir, the initial agricultural subsistence farming started by felling mixed Ombrophila forest, using the indigenous slash and burn technique and crop rotation, which is now carried out intensively and uses mechanized equipment.

Intensive farming started in the 90s, when mechanized agriculture arrived for large scale production of soy and maize, destroying possible archeological sites in the area. For example, the archeological research done by AMARAL & AMENOMORI (2003), for the construction of the LUDESA SHS, located upstream from the Santa Luzia project, stated that: *it is now not possible to find any archeological remains (ceramics and lytic artifacts) because the area where they were found has been intensively used. According to oral reports, the earth has been turned many times, ploughed with animals and tractors.*

There are no historic buildings in the project's direct area of influence. They are found in the municipal regions where they are a part of the cultural and natural heritage. The town halls in these regions have social and cultural support departments which also try to preserve the cultural remains of the Brazilian indigenous, Portuguese, German and Italian inheritance reflecting the periods of occupation, settlement and colonization.

8.3.8.1 Archeological Site Survey

This report presents the results of the *Archeological Sites Survey* on the banks of the river Chapecó, tributary of the river Uruguay, for the Santa Luzia Alto SHS, in the São Domingos and Ipuaçu municipal regions, state of Santa Catarina, in an area covering 558ha.

The archeological works started with bibliographic research and then a with a field study followed by an *Evaluation and Diagnosis* of the impacts from engineering works on the Archeological Heritage in the area that will directly affected.

The field study started after authorization was issued by IPHAN and confirmed data from archeological literature, confirming evidence of settlements formed by groups that inhabited the region before the Europeans and their descendents.

In the area affected by the Santa Luzia Alto SHS, information was collected on 5 (Five) archeological sites near the banks of the river Chapecó and in nearby areas. Of these we proved the existence of only 3 (three) sites, the others being considered "probable sites". The final survey report was delivered to IPHAN, Exhibit 15.

Introduction

The archeological research in the West region of Santa Catarina shows that the river Uruguay basin, in which the river Chapecó is situated, has been occupied by groups of humans since pre-history.

Regional settlement started approximately 8,600 years ago, when the first groups of hunter gatherers settled on the banks of the river Uruguay. These were followed by others with an economy based on hunting and gathering, but who were culturally different, related to the Umbu Traditions and Humaitá. Later, further groups arrived in the region brining a different type of economy – referred to by Traditional Archeology as Taquara/Itararé, who possibly already used an incipient type of agriculture. FOSSARI (2004) regards them as pre-Jê colonials, ancestors of the Jê groups that are historically known; and the Guarani, whose economy was based on agriculture.

At the time the Europeans arrived in the XVII century, there were three culturally different groups in the Western region of Santa Catarina: the Guarani occupied an area of subtropical jungle – which bordered the river Uruguay and its largest tributaries and the Kaingang in the areas with araucaria forests and intermediary fields. The Xokleng occupied the Campos de Lages, Curitibanos and Caçador and the araucaria forest to the east of them (D'ANGELIS, 1995).

From the XVII century to date, the Luso-Brazilians started occupying the region. This process intensified in the XIX century, profoundly changing the way of life of the native groups, the Kaingang and the Guaranis. Later, at the beginning of the XX century, the region received colonists descended from Italian and Polish immigrants who came mainly from Grande do Sul.

The municipal regions of São Domingos, Ipuaçu and Abelardo Luz are situated in the Midwest region of Santa Catarina, in the micro-region of the AMAI (Association of Municipal regions of High Irani). They are considered relatively recent, because they were only raised to the level of municipal regions from the 1950s on. Before this they were districts of the municipal regions of Xaxim and Xanxerê.

Before 1950, São Domingos was a district in the municipal region of Xaxim. Its total area is 384 Km^2, 635m above sea level. Amongst its larger rivers are the Martins, Saudades, Bonito and Chapecó. The river Chapecó cuts through the south of the region. (DIZ, 2002)

Archeological Research in the Chapecó River Basin

The archeological research in the west of the state of Santa Catarina started at the end of the 1950s. Later, various surveys were performed in this region, basically excavations and research on archeological sites.

However these surveys concentrated on the areas near the river Uruguay, while the Midwest of Santa Catarina – where the São Domingos and Ipuaçu municipal regions are located – were only recently the subject of archeological research.

AMARAL (2001) did some research on the banks of the river Irani recording 29 archeological sites in the municipal regions of Xanxerê, Xavantina, Faxinal dos Guedes, Xaxim and Arvoredo. The archeological sites recorded were identified as being from the Hunter gatherer groups of the Umbu Tradition and of Jê do Sul.

In 2002, there was archeological research on the banks of the river Chapecó. CALDARELLI *et al*. (2002) carried out the Archeological Recovery Project in the Directly Affected Area for the Quebra Queixo UHE on the river Chapecó, in the São Domingos and Ipuaçu municipal regions, recording 31 archeological sites in the areas of direct and indirect impact. According to the researcher, they are old Jê settlements, probably Kaingang, from the West of Santa Catarina.

Also in 2002, another area next to the river Chapecó was researched prior to construction of the "Small Hydroelectric Project São Domingos[2]", in the municipal regions of São Domingos, Ipuaçu and Abelardo Luz. Information was collected on the existence of 5 archeological sites on the banks of the river Chapecó and in the nearby area, of which 2 sites were proven to be from the Umbu Tradition and the others were considered "probable sites[3]" possibly related to the Jê do Sul groups. (AMARAL & AMENOMORI, 2003).

Later, AMARAL *et al.* (2005) carried out an additional report on the 2002 research, registering one more archeological site connected with the Jê do Sul groups and another characterized by the presence of lytic artifacts – a workshop site. According to the authors they were able to register 4 "probable sites" in the areas of direct and indirectly affected by the SHS.

> It can be said that the region covered by this research was inhabited by groups from the Umbu Tradition. This tradition is characterized by the tips of their projectiles. In the research conducted in 2002, two settlements were discovered of groups that were linked to this tradition, located in the area of direct impact created by the "São Domingos SHS". The horticultural groups of pre-colonial Jê also settled in the area and evidence is found in the lytic artifacts of "shaved hand" and ceramic fragments. The discovery of an archeological site with the presence of lytic artifacts can show that these are sites where these groups were active, as is shown in more recent surveys. (AMARAL *et al.*, 2005:27)

The last stage of this project researched the Workshop Site – characterized by the presence of sparse lytic artifacts (of stone) amongst many naturally rounded stones. "Due to the great anthropic disturbance to which the site is subject, the excavations did not continue. The research was carried out on the results of the survey and the collection of archeological material." (AMARAL & CASTELLANO, 2006:13)

To summarize: From the research carried out on the river Chapecó we can infer that the target region for this study is related to the pre-colonial settlement of groups of the Umbu and Jê do Sul Traditions.

2 However, during the archeological works the name of this SHS was changed to **SHS LUDESA.** During the archeological works referring to LI and LO stages, the researchers continued using the former name, according to the documentation sent to IPHAN.

3 "Probable archeological site" – This category was adapted from FOSSARI et al. (1992). According to Amaral "... we have included sites without apparent archeological material, but where archeological material was collected a few years ago, or even many years ago, when the land was ploughed, according to the owner, ." (AMARAL, 2001; AMARAL & AMENOMORI, 2003).

Pre-Colonial Umbu Tradition Groups

The groups related to this tradition settled in the three southern states of Brazil, south of São Paulo and in Argentina and Uruguay, generally close to streams, rivers, swamps, lakes and rarely close to the sea.

Their shelters were roofed or open, the sites are in the same landscapes "... on the borders of fields, the subtropical forest on the meridional border of the high plains or in copses and riparian forest in the more meridional landscapes." (SCHMITZ, 1984:15)

NOELLI (1999/2000:230) calls attention to the "... long persistence of technological standards, with artifacts manufactured with similar techniques and, basically, with the same raw materials, from at least 12,000 up to 1,000 years ago."

The most important items that form part off their cultural knowledge are the tips of projectiles (with a stalk and triangular or leaf-like fins), numerous chips, bifacial knives, scrapers, awls and small bifacial tools. The raw material used came from a great number of rocks: flint, chalcedony, basalts, arenite silicate, quartz and others.

They also made bone artifacts such as awls; double points; spatulas; hooks; needles; retouchers; scrapers and ornaments (perforated teeth). There is evidence of decoration with shells (perforated disks).

According to SCHMITZ (1984), the groups related to this tradition coexisted with those related to the Tupi-Guarani and Taquara/Itararé horticulturalist and ceramic traditions".

Based on dating for these groups, they still inhabited Santa Catarina up to a very recent period, between the IX and XIV centuries, according to PIAZZA (apud NOELLI, 1999/2000).

Jê do Sul Groups.

The history of the Jê do Sul peoples can be divided into: pre-colonial (before contact with the Europeans); and post-contact (from the XVII century on) which influenced and changed their traditional lifestyle.

In order to understand the history of these peoples in the south of Brazil, we rely on archeological, ethno-historical and ethnographic information.

Pre-Colonial Jê Populations

According to research, the Jê groups had a common origin in the central west of Brazil between the sources of the rivers São Francisco and Araguaia. Part of these groups migrated to the south of Brazil about 3,000 years ago, possibly arriving in the southern region about the time of the Christian era and occupying the best locations. (URBAN, 1992:90)

In the state of Santa Catarina, dating for the settlement of these groups is very recent, the oldest being 1,920 years ago, in the municipal region of São Joaquim. In the western region, near Irani, the only dating we have up to now is from 975 years ago at a settlement in the municipal region of Concórdia. (NOELLI, 1 999/2000).

These populations settled in the araucaria areas. They built “subterranean structures” – locations for living, storage and rituals, excavated from the compact ground or in rock undergoing decomposition. Some are connected to each other by galleries. Often they are associated with earthworks (a large mound of earth in a circular or ellipsoid shape possibly linked with burial grounds). (REIS, 1980)

According to the most recent archeological research, there is a historic continuity between the settlements of the Taquara/Itararé Tradition and the groups historically known as the Kaingang and Xokleng. (NOELLI, 2000)

Since the 1960s archeologists have noticed similarities between the ceramics collected at archeological sites of the Kaingang and Xokleng Indians and those in the Itararé, establishing associations between the Kaingang and their ancestors who made pottery in the style of the Taquara/Itararé and Casa de Pedra. (NOELLI, 2000)

For FOSSARI (2004:18) even if you count on the direct ancestral evidence of these known populations – starting from the contact with the European colonialists – with the populations identified as being of the Tradition Taquara/Itararé,

> “... it is not possible to ignore that they are populations separated by time (up to several hundred years). This fact itself only implies cultural differences resulting from the same cultural dynamics, whose resulting changes might, or might not, be perceptible through a temporal separation.”

The most important material evidence is the pottery, mainly small receptacles, sometimes with abstract designs and lytic artifacts, the most interesting of which are the pestles, polished or chipped axes, cutting blades and scrapers.

Jê Populations Post-Contact

When the Europeans landed on the Santa Catarina coast from the XVI century on, the Kaingang groups occupied the areas between what is now known as the states of São Paulo and Rio Grande do Sul – in the areas covered by araucaria forests and its interspersed fields. The Xokleng lived in the Atlantic Coastal Rainforest, located between the coastal strip and the abutments of the South Brazilian High Plain, also including areas of the High plain where araucaria grew.

The contact between the Kaingang and Xokleng with the surrounding colonial society, on the meridional high plain, started in the XVIII century and became much more common during the middle of the XIX century, when this region was colonized.

With the opening of the troop road, in the XVIII century, which connected Rio Grande do Sul to São Paulo and the founding of Lages – where cattle ranches were established and the sale and farming of mate tea and wood started – land invasions began in an are traditionally occupied by the Kaingang and Xokleng.

The original forest on these high plains was araucaria, a source of food for the Xokleng and Kaingang Indians during the winter months. The reduction of the pines areas threatened one of their main means of survival, as their society was one of hunters and gatherers. Conflict began between the whites and the Indians, and among the Indians, who fought for the land with untouched pines. (TOMMASINO & FERNANDES, 2004).

The fields, up to the middle of the XIX century, “were inflamed with militarized battles, promoted by white farmers who wanted to force the Kaingang from their ancestral lands. The reaction of the Kaingang was violent and warlike; they waged a war against the invaders of their territory for the most of the XIX century.” (MOTA, 2000:94)

Because they were on land that was being gradually invaded, from the XIX century on these groups were targets for great violence and suffered enormous difficulties (disease, lack of land, food and medication etc.) and almost became extinct.

The Kaingang Tribes

This name, Kaingang, started being used after a study by Tlêmaco Borba, in 1882, “... as a generic name for a large number of indigenous tribes that speak a dialect of the same language, related to the Jê main language, habitants of the states of São Paulo, Paraná, Santa Catarina and Rio Grande do Sul, in Brazil and the province of Missiones in Argentina.” (VEIGA, 1 995:261)

According to VEIGA (1992), the Kaingang tribes are organized in exogamous halves. Each half presents a distinctive painting style – round marks x long marks -, the first being related to dawn and the second to dusk. There are controversies regarding the quantity and names of the halves. The most common are Kamé and Kainhrukré. As for their lineage, they are part-linear; the individual belongs to the half to which his/her father belongs.

The political and religious power, according to research, shows that the Kaingang would have a chief, which could be a hereditary and lifetime position as long as he demonstrated specific qualities. They practiced different rituals and inside the group there were “people specialized in the function of praying, predicting the future and cures”. (VEIGA, 1992, 72).

When burying their dead they used a complex ritual, with pre-defined roles and behavior. The graves, according to NIMUENDAJÚ (1993: 63), vary from 1.70 to 1.80 in depth. For burial “they were at the bottom with coconut bowls surrounded with closely woven wattle and they lined the catacomb, covered with coconut shells, with ***heliconia*** leaves, so the earth does not touch the cadaver. Above they pile the earth in the form of a tomb up to 1 or 2 meters in height.”

One of their most important celebrations or rituals is the Kiki or Cult of the Dead. This occurs once a year, after the maize and pine nut harvest. The main drink was made from fermented maize (ZWETSCH, 1994).

The economy of the Kaingang tribes was based on agriculture and hunting and gathering. They planted maize, pumpkin, beans, peanuts and cassava – they used the slash and burn system. (ZWETSCH, 1994).

Other foods complemented their farming output; they collected tubers, wild fruit, medicinal herbs, heart of palm, honey and insect larva, but the pine nuts were the most important “... the pine nuts ripen at the beginning of autumn and produce, without any human effort, much greater harvests than the fields...” (SCHMITZ, 1 991:86).

The tribes met in the forests in the months of April and June for the harvest and had several processing and storage techniques. After the harvest they stored the produce in special locations; they also made flour, which could be preserved for longer periods. (ZWETSCH, 1 994).

They hunted anteater, wild boar, deer, birds, etc. This was easier during the ripening season of the pine nuts, which attracted animals and birds. They also fished in the rivers and caught freshwater mollusks. The fish were also stored for times of need.

The material culture is represented by artifacts made from plants, clay, stone, bone and metal – obtained from the surrounding society (the non-Indians).

Wood was used to make a series of artifacts: pots, pans, plates, bamboo tubes, cups, large troughs carved from the trunks of trees, sieves and utensils for eating – bowls and spoons; as well as artifacts for processing food: mortars and pestles. Most of their weapons were also made from wood, such as bows and arrows hardened in fire, clubs, lances and batons; they also made musical instruments, decorations and adornments. They also made textiles from fibers of nettles, bromeliad plumier stems, baskets from bamboo of various sizes, shapes and for diverse uses.

From clay they made small ceramics, plain or with abstract designs, but never painted. From stone they made axes, with or without a handle, later substituted by metal axes; chips to work wood and make arrows. These were also substituted by metal. From the bone of the brown howler monkey and deer they made arrows. Later they started to use metal obtained from the non-Indians.

These societies underwent great changes in their socio-cultural systems after the European conquest from the XVI century on. The current indigenous societies of Santa Catarina can not be compared with the pre-colonial societies, given the devastating effect of the European conquest, as a result of contagious disease, imprisonment or even ethnocide. (Cunha apud WÜST, 2000)

With the expropriation of the greater part of their territories, the Kaingang had to abandon most of their technologies which were slowly being substituted by products obtained directly from the market. Technologies that are still used are linked to basket making which, although changes have been made, is still a small scale activity, producing baskets for domestic use (sieves and baskets for storing food and collecting fish); and increasingly, baskets and sieves to sell on the regional market to generate income.

Today, in the west of Santa Catarina there are indigenous groups of Kaingang confined in three defined areas: Toldo Chimbangue Indigenous Reservation (Municipal region of Chapecó); Pinhal Indigenous Reservation (Municipal region of Seara) and Xapecó Indigenous Reservation (Municipal regions of Ipuaçu and Entre Rios).

Xapecó Indigenous Reservation

This indigenous reservation is located where the rivers Chapecó and Chapecozinho meet, on land in the Municipal regions of Ipuaçu and Entre Rios. This area is very close to the area that is being surveyed.

The reserve was created by decree in 1902, signed by the then President of the state of Paraná, because the land belongs to the state. Today, it covers 15,623 ha, and has approximately 4,500 inhabitants, distributed among 12 villages. Note that, there is a small Guarani population living on this land. (NÖTZOLD, 2003; 2004)

Field Research Project

The project was developed in two stages: the collection of oral information from the local population in the São Domingos and Ipuaçu municipal regions and the Archeological Prospection in the direct impact area for the Santa Luzia Alto SHS.

Oral Information

In the interviews we tried to contact all the inhabitants that would have their property directly affected by the hydroelectric project. This was to collect as much information as possible on archeological sites in the region. We also tried to describe the use of land by the current owner and when possible by the previous owners.

All the information collected on the area directly affected relating to archeological sites was checked to prove or disprove the information about any sites.

30 (thirty) interviews were held with local residents near the river Chapecó: 26 (twenty six) residents whose land will be affected by the project and 4 (four) farm laborers were interviewed.

These interviews helped us produce information on 5 (five) archeological sites. From this information the team confirmed the existence of 3 (three) archeological sites and of 2 (two) “probable sites”.

We include only interviews with the owners, because the other interviewees did not know of any archeological sites in the area (Table 41).

[4] See note 3.

Table 41 – Information on archeological sites in the area of the Santa Luzia Alto SHS.

Owner	bank	City/location	Archeological site	Procedures	UTM Coordinates	Oral information
Abílio Debortoli/ Avelino da Silva Sá	Right	São Domingos / Quebra-queixo	Sítio Arqueológico Debortoli	Caminhamento e Sondagem (S0 à S1 1)	22 J 346679.00 575.0 m 7056437.00	Há ± 25 anos encontrava frag. cerâmicos, até um pequeno pote c/ ± 20cm. A equipe de
Adilson de Carli	Left	Ipuaçu / Vila União	-	Caminhamento		
Alfeu Ferreira	Left	Ipuaçu / Vila União	-	Caminhamento		
Antonio Dallacorte	Right	São Domingos / Cascata	-	Caminhamento		
Antonio & Paulo Afonso Roani	Right	São Domingos / Quebra-queixo	“Probable Site” Roani	Caminhamento e Sondagem (S21 à S28)	22 J 346461 .00 569.0 m 7055909.00	Há muitos anos encontrava frag. cerâmicos. Doou 1 machado que achou na mesma
Antonio Vitório Cigel	Right		-	Caminhamento		
Arcilio Bigolin	Right	São Domingos / Santa Luzia	-	Caminhamento		
Corinda Migliavacca & Filhos	Right	São Domingos / Cascata	“Probable Site” Migliavacca	Caminhamento e Sondagem (S29 à S59)	22 J 346679.00 575.0 m 7056437.00	Encontraram há alguns anos fragmentos de cerâmica que se espalhava por toda a área.
Domingos Bigolin	Right	Quebra-queixo / São Domingos	-	Caminhamento		
Guerino Visoli	Left		-	Caminhamento		
Ivanildo Pedrassani	Left	Ipuaçu / Vila União	-	Caminhamento e Sondagem (S60 à S73)		
João F. de Oliveira	Right		-	Caminhamento		

Proprietário	Margem	Município/ local idade	Sítio Arqueológ ico	Procedimentos	Coordenadas UTM	Informação oral
José Mulinari	Right	São Domingos / Quebra-queixo	-	Caminhamento e Sondagem (S1 2 à S20)	22 J 348059.00 532m 7055374.00	O proprietário encontrou um sílex lascado na área.
Ladair Colpo	Left	Ipuaçu / Vila União	-	Caminhamento		
Maria Scheffer	Right	São Domingos / Cascata	-	Caminhamento		
Sadi Basso	Left	Ipuaçu / Vila União	-	Caminhamento		
Ceni Ferreira Santos	Right	São Domingos / Cascata	-	Caminhamento		
Severino Griss	Right	São Domingos / Cascata	-	Caminhamento		
Umberto Baldissera	Right	São Domingos / Cascata	-	Caminhamento		
Valdemar Rebelatto	Left	São Domingos / São Lourenço	Sítio Arqueológico Belão I	Caminhamento e Sondagem (S74 à S93)	22 J 347972.00 581 .0 m 7056949.00	A equipe encontrou um sílex lascado na área
Valdemir Anghinoni	Right	São Domingos	-	Caminhamento		
Valdir Bertan	Right	São Domingos / Quebra-queixo	-	Caminhamento		
Valério Mezzalira	Left	Ipuaçu / Vila União	-	Caminhamento		
José Mulinari	Right	São Domingos	Sítio Arqueológico Mulinari	Caminhamento e Sondagem (S94 à S95)	22 J 346826.00 578.0 m 7055244.00	Na área do conduto forçado. A equipe coletou frag. líticos e 1 pré-forma em arenito silicificado.

Archeological Prospection

This research was carried out in two stages: the first covered the areas which will be used for the infrastructure works and the second covered the flood areas (at an elevation of less than 635m) along the river Chapecó.

These two areas were searched from end to end to conduct a visual inspection of the land and apply a systematic prospection technique. Prospecting verifies the subsurface using the transect technique – imaginary lines, parallel and equidistant, at intervals of 100m x 100m and/or of 50m x 50m, together with soundings which were also taken at 100m x 100m and/or of 50m x 50m. These soundings were made using a hand-held metal auger (1.2m, approximately 20 cm in diameter).

All the locations identified as archeological sites and "probable sites" were covered by the systematic inspection and soundings at lesser intervals of 50 x 50m (Exhibit 16).

General information was gathered at each of the 3 (three) archeological sites and 2 (two) "probable sites" including the type of area and the type of evidence found, as follows:

Name: The name of the archeological sites and the "probable sites" were named after the location they were found. In some cases the name of the landowner was used, as in some cases the name of the location could be ambiguous, such as Quebra-Queixo, which has been used in research for the Quebra-Queixo UHE. (Caldarelli, 2002)

Type of Archeological Site: Impossible to specify because of the small number of artifacts found and their nature – chips of silicate, flint, quartz and silicate arenite, as well as an axe donated by one of the interviewees, could have been made by different cultures, demonstrated by archeological research carried out in the Midwest of Santa Catarina.

Location: The archeological sites are located in the Area of Direct Impact of the project: in an area that will be covered by the future lake and the Engineering Works (penstock).

Description of the Area: This refers to the slope of the land, because the sites are located on land that varies from flat to slightly sloping.

Oral Information: This is important because it shows the kind of evidence and provides locations.

Activities in the Area where the Archeological Sites are Located: This is to define the current activities in the area which could be damaging the site.

Archeological Evidence Found: The type of artifact found can define the type of group that produced it.

Origin of the Material: This defines whether the material was obtained by donation or collected on the surface. Bear in mind that the artifacts collected by the archeological team in this survey, or obtained by donation, constitute reliable proof of the existence or presence of archeological sites.

In cases where we only obtained oral information as evidence of the presence of archeological sites, these were considered “probable sites”.

State of Conservation: To analyze this variable, we used the Registry Sheet from the National Registry of Archeological Sites (CNSA) from IPHAN.

After researching the archeological sites, we found that they are:

Not in a Good State, with a degree of preservation lower than 25% - the site is in a ploughed field and has archeological material on the surface, which runs the risk of being totally destroyed;

Demolished – A site that presents no evidence of archeological material and is found in areas that for many years have been ploughed, but, according to the owner, there have been finds of material and these have been shown to the archeological team.

Later, the information on the 3 (three) archeological sites was registered on Registration Documents of the National Registry of Archeological Sites of IPHAN (National Institute of Historical and Artistic Heritage).

Infrastructure Works Area

In areas where infrastructure will be built, such as administration centers and accommodation; access and services roads, work site and support works and even leased areas (quarries, rock excavations. dumps and earthworks) and the areas around the tunnel, power station and the dam, were thoroughly inspected and soundings taken. In these areas, no archeological evidence of any kind was found, not even oral information that indicates the presence of archeological sites.

However, in the area where the pipe for the penstock will be installed we found stone fragments and a pre-form made of arenite silicate – Mulinari Archeological Site (Table 42 and Exhibit 17).

Flooded Areas

The areas along the river Chapecó were thoroughly searched. The prospection, at intervals of 100 x 100m, depended on the slope and vegetation cover in these areas because most of the time they were a limiting factor. In many areas with dense vegetation, the survey could not be conducted because access was impossible.

The locations were chosen because they presented appropriate characteristics for settlements and/or there were records of archeological material being found, or even surface evidence found during the survey. However, we did not find any remains in the subsurface, only on the surface, as well as some objects donated by the owners (Exhibit 17).

In these areas we recorded 2 (two) archeological sites: Belão Archaeological Site and Mulinari Archeological Site and 2 (two) “Probable Sites”: Roani “Probable Site” and Migliavacca “Probable Site”. (Table 42)

Table 42 – Location of archeological sites in the area of Direct Influence of the SHS.

Nº	Archeological site	Coordinates	Oral information	Material collected	State of Upkeep
1	Sítio Arqueológico Debortoli I	22 J 346679.00 575.0 m 7056437.00	Segundo o proprietário, há ± 25 anos foram encontrados fragmentos de cerâmica, entre estes um pequeno pote com ± 20cm.	Algumas lascas silicificadas.	Bem Comprometido
2	Sítio Arqueológico Belão	22 J 347972.00 581.0 m 7056949.00		Sílex lascado.	Bem Comprometido
3	Sítio Arqueológico Mulinari	22 J 346826.00 578.0 m 7055244.00		Fragmentos líticos e uma pré-forma em arenito sil icificado.	Bem Comprometido
4	"Provável Sítio" Roani I	22 J 346461 .00 569.0 m 7055909.00	Segundo o proprietário, há muitos anos encontrava frag. de cerâmica. Encontrou um machado na mesma área há alguns anos	Um machado foi coletado há muitos anos e o proprietário doou à equipe de Arqueologia.	Arrasado
5	"Provável Sítio" Migliavacca	22 J 346679.00 575.0 m 7056437.00	Encontraram há alguns anos fragmentos de cerâmica que se espalhava por toda a área.		Arrasado

Education on Local Heritage

The heritage education work is basically informal, involving the interviewees – the owners who will have their land affected in the São Domingos and Ipuaçu municipal regions and the farm laborers.

This work was started among local communities who were interviewed on the presence of archeological material and they were informed of the importance of this material for the local heritage. In doing this, we used publications with illustrations of lytic artifacts and the techniques that were used to make them. (Scatamacchia, 2000)

We obtained satisfactory results because not only did the inhabitants recognize similar artifacts, it made them reflect on the ways the past inhabitants made them.

Heritage Education involving the school community (teachers and students) will be the next stage, with the central theme being the destruction of "Archeological Heritage" in the São Domingos and Ipuaçu municipal regions.

Results

At the Santa Luzia Alto SHS, information was collected on the presence of 5 (five) archeological sites near the river Chapecó, in the area of direct impact.

Of these we proved the existence of only three archeological sites, the others being considered “probable sites”.

This research use the transects technique (walking along parallel and equidistant lines through the directly affected areas), alongside soundings to test the subsurface and interviews with local inhabitants.

The interviews did not produce satisfactory results as most of the local people did not know about any archeological sites in the region of the valley of Chapecó river. This information made it possible to register only 1 (one) archeological site and 2 (two) “probable sites”. However, the field research carried out by the archeological team in the affected areas registered 2 (two) archeological sites in the direct impact area.

In terms of the type of site, we were unable to define this from these initial studies, not being able to correlate the evidence with the groups of humans who inhabited the region in the past, as evidence found by the archeological team - chips of silicate, flint, quartz and silicate arenite, as well as an axe donated by one of the interviewees - could have been made by different cultures, as is shown in archeological research carried out in the Midwest of Santa Catarina.

Regarding location, all the sites and “probable sites” are located in the “area of direct impact” of the Santa Luzia Alto SHS: in the lake or Engineering Works (penstock) areas.

Description of the Area: from this survey we found that the settlements of pre-colonial groups were built on low hills which follow the drainage axis. According to soil studies in the areas affected by the hydroelectric power station, the soils are highly fertile. This must be one of the factors that attracted these groups to the region, because even today, these locations are good for mechanized crops, mainly soy, maize and wheat.

Activities Practiced in the Area where the Archeological Sites are Found: All the archeological sites are in ploughed areas which has damaged the sites.

Archeological Evidence Found and its Origins: of the 5 (five) archeological sites discovered in the “area of direct impact”, the team collected archeological evidence at 3 (three) sites; and 1 (one) donation. NOte that the team was given a broken artifact (axe), but the donator did not know exactly where it had been found.

At 3 (three) locations we were able to collect archeological evidence that confirmed them as settlement locations for past inhabitants, at the other locations registered as “probable archeological sites”, there was no evidence (artifacts) as they are no longer evident after intense agricultural use. From oral reports we found that before the 1960s it was common to find archeological artifacts when ploughing the fields with oxen, later, with use of mechanized farming, this evidence has disappeared and the earth has been turned by oxen and now by tractors for many years.

State of Conservation: We can say that these sites, located in farming areas, are seriously threatened and will soon vanish. This destruction process can lead to a total loss of archeological evidence. For this reason, we propose carrying out more research in those areas where archeological evidence does exist, so that part of the pre-colonial heritage of the west of Santa Catarina is not lost for ever.

Final Considerations

Research started with a bibliographic survey which held establish the type of occupation in the region surveyed and evaluate, in temporal and spatial terms, how such occupation occurred and the archeological potential of the area surveyed. This survey also served as a basis for field work strategies.

From the archeological studies already made along the Chapecó river, we can say that the region that includes the São Domingos and Ipuaçu municipal regions was inhabited by groups from the Umbu tradition. This tradition is characterized by the tips of their projectiles. The Jê do Sul groups also settled in the area, proven by the lytic articles, “pestle-hand” and ceramics with abstract decoration, typical of this tradition and found by researchers in previous surveys.

If, on one hand, the remains found by the archeological team during this survey (silicified chips of rock, silex, quartz and silicified arenite, as well as an axe donated by one of the interviewees) cannot be directly connected with the pre-colonial populations that inhabited the region, on the other hand, from studies carried out previously near the Chapecó river, we can infer that these are remains of the people of the Umbu and/or the Jê do Sul traditions.

Historical data shows that the Palm Fields (in which the municipal regions surveyed are located) are the traditional territory of the Kaingang groups belonging to the Jê do Sul. We also have descriptions from interviewees of ceramics they used to find, which seem to be, based on the abstract designs and the size of the jars, ceramics produced by the Jê do Sul groups.

From the Archeological Research carried out on the banks of the Chapecó river due to the construction of the Santa Luzia Alto SHS, we see the sad truth of the destruction of archeological heritage.

This destruction is directly related to the accelerated occupation started in the 1940s, following the appearance of agro-industries which later led to strong ties between family agricultural production and the industrial sector. In general, use of the land in the valley of the Chapecó river mostly involves intense mechanized farming and cattle breeding which destroys archeological sites.

Recommendations

The archeological heritage in Midwest Santa Catarina has suffered rapid destruction due to the intense mechanized farming that started in the 1940s. This is confirmed by prior research in the Chapecó river area.

- The 3 (three) archeological sites will be the subject of a survey, a more detailed study that will involve not only research of the landscape where the sites are located, but also a detailed study of each site, establishing its size and the types of evidence found. This is necessary because only after this survey will we be able to do the following:
- Evaluate the need for excavations, taking into account that some of the areas near the sites have dense vegetation or provide difficult access.
- And/or only “restore” the evidence that exists near the surface, so that part of the pre-colonial heritage of east Santa Catarina is not lost for ever.
- Heritage Education Projects involving the school community (teachers and students), as well as public institutions (town halls) focusing on the destruction of this heritage and its importance in Regional History.
- Monitor the initial works of the Santa Luzia Alto SHS, because in areas where the infrastructure will be built, no evidence of any archeological remains has been found. The area has therefore been authorized to start engineering works.
- In the area where the penstock will be erected a survey should be made of the Mulinari Archeological Site.
- Archeological Monitoring of the areas that are inaccessible due to the dense vegetation should be made when the vegetation is cleared.

8.3.9. Land Characteristics of Affected Properties

A total of 94 properties will be affected by Santa Luzia Alto SHS belonging to 47 owners.

Approvals from the owners were collected around the SHS and were attached to the process, and an ADA Agrarian Location Map is presented in Exhibit 18.

On the affected properties, and virtually throughout the city, land is mainly used for edaphic and forest resources, farming and stockbreeding activities and forestry of exotic species to produce timber. In terms of land usage, temporary or cyclical cultures are predominant in nearly 47% of the area.

Dominant crops are oranges, lemons, grapes, peaches, pears, and especially mate.

In cyclical farming, soy and corn crops are predominant and on a smaller scale there is wheat, oats, rice, sugar cane, garlic, onion, tobacco, peanut, beans, potatoes, cassava, tomato, and watermelon. Among the aforementioned

products, soy and corn are cultivated on an intensive basis, and sold to agro-industrial sectors.

From the farming maps for the region, farming of Class 4 cyclical crops of was considered a conflict of use, which corresponds to a normal suitability for agricultural use.

The farmers use the topographically more favorable areas located in the river flood basin for plantations and pastures.

Consequently, following construction of the reservoir, land qualified as Class 4 belonging to neighboring owners which is currently used for pasture, cyclical or permanent crops, will be flooded.

The flooded area, civil works sites and APP section represent the area to be indemnified alongside existing infra-structure. The Affected Properties Registration and Indemnity Program, to be adopted by the project developer, creates a communication, registration and indemnity system according to a methodology that takes into account market prices and specific features of each property.

Exhibit 18 presents the distribution of the affected properties around the future Santa Luzia Alto SHS reservoir, noting that more properties were identified on the river right bank, of a total of 94 affected properties.

On both the right and left bank, especially on the larger properties, the economy is predominantly based on cyclical plantations, such as corn, soy, and wheat, whereas on smaller properties, there are also the permanent plantations (citrus, mate) and cattle as the farmer's source of income, while sometimes part of the area is planted with cyclical crops.

One of the land issues that stands out in this analysis is the large number of property registrations in terms of owners, each owner owning several properties, which indicates a certain level of agrarian concentration. Note that a significant number of properties are owned by members of the same family, thus indicating agrarian fragmentation resulting from the hereditary process.

The large properties present a high level of mechanization and well-organized infra-structure, assuring a very satisfying life quality for the owners and their families. On the other hand, on the small properties, the difficulties are greater, however, they cannot be compared to the small rural producers on the coast, for instance, where a clear subsistence agrarian structure is observed. In this region, even those small owners have a quality of life higher than the small subsistence properties.

Some small properties, especially on the right bank, will be totally flooded by the reservoir construction, while others will be partially flooded. These properties will be the most affected, and certain compensation measures must be taken, defined in the details for the Basic Environmental Plan, upon the Affected Properties Registration and Indemnity program. The large properties, also covered by the Program, will experience less

flooding and will be able to maintain their ongoing activities, fitting into the layout areas for plantation.

The small properties that may lose areas and become financially unfeasible shall also be covered by the Program with full compensation, in order to move to another location where they can continue their activities.

On the other hand, please note that a significant number of properties that will be affected by the flooding will only lose unproductive areas, either because they are steep or they are in permanent conservation areas. However, with the introduction of the riparian range around the reservoir, in some cases this will cover productive areas, but they will be indemnified anyway.

9. INTEGRATED ANALYSIS

The chapter “Integrated Analysis” covers the interpretation of the environmental diagnosis and includes the relationships and interactions that exist between the physical, biotic and anthropic environments evaluated. It covers the impact of the construction and operation of the project in a way that the respective environments can be analyzed together, as a whole. This permits an evaluation of the whole environment and the different interactions that it is subject to.

Note that the analysis in this item is not a working method and although the research was conducted on the interaction of the environments studied, these environments have been separated, which is normal in environmental studies in Brazil.

This is important because it is important to understand that the most environmental impacts directly or indirectly affect the environment as whole and not in an isolated manner. Therefore, when a specific impact is produced, it can affect fauna, with some form of synergetic anthropic aspect, which in its turn can modify an aspect of the integrated environment, and so on. This can cause an extensive chain reaction and can affect many ecosystems in very different ways.

But, before we delve deeper into the analysis of the area, Notethe great contemporary scientific difficulties when studying and fully understanding the natural environment and its phenomenon. Within this context, the natural sciences are typical examples of the search for impartial knowledge. This issue essentially arises from a lack of integration, an ideological divergence and even the ruling corporativism in different scientific fields, as there is no mutual corroboration in the work done to understand nature in its totality. However, other sciences are also going through a similar crisis, when requiring collective thought for the greater good, “knowledge”, which is the case in physics and chemistry. However, these obstacles prove the indifference of science to its essential attribute, which is to provide human well being and evolution.

This type of environmental analysis, which is normally used in environmental studies, separates natural and anthropic elements to further scientific knowledge through analysis. This approach, paradoxically, is encouraged by the authors who support the total integration of environmental studies while emphasizing that separating natural aspects for study is only one method among many others of performing a more in-depth analysis mainly to focus on areas of special interest instead of global knowledge of the environment. An example of this is confirmed by Monteiro (1995), when he says “integration of natural and anthropic variables (the analysis stage), then pooling resources, uses and problems, creating (integration stage) homogenous units, which then take on a primordial role in the spatial structure (synthesis stage) which clarifies the true quality of the environment (application stage) during analysis”.

In Brazil, environmental studies are being steered towards an approach that separates natural elements in detriment to a more global understanding.

Therefore, the research adopted this approach, individually describing the physical, biotic and socioeconomic aspects of the project areas of influence, subsequently conducting an integrated analysis to highlight the environmental status of the area surveyed.

Within this context, in light of information from the impact study, we can conclude that the transforming processes and their results converge to create a scenario that is better than the current situation. This is confirmed by the current environmental characteristics in the areas of influence of the SHS, which has been substantially transformed by anthropization processes, especially land usage (intensive farming) making it very different from the original land..

This is evident when we superimpose different timescales on the same location, revealing the continuous transformations taking place. These are transformations in a space that has already been transformed, and will once again be re-transformed. The result of this process is the transformation of a natural space in an anthropic space, one that is not natural.

On the other hand, there will always be new impacts on these altered environments, albeit less intense.

From studies made in the analysis of the physical issues, we discovered that the land surveyed, from a geological and geomorphologic point of view, appears to be stable, as its structure of colluvial deposits and flat surfaces does not offer any risk for its intended usage. These physical characteristics, amongst others, drive the multiple uses of this space, ascertained from the historical occupation process locally and regionally, transforming it from a natural area to agricultural and pasture. The local flora and fauna reflect previous uses in small patches of remaining vegetation and forests.

As we can see, what we found in the areas of direct influence of the Santa Luzia Alto SHS, are spaces that have been profoundly transformed over the years. The biotic environment including the vegetation cover is limited to remaining forest isolated by areas of farmland. Likewise, the same degradation can be attributed to the physical components of soil erosion and the affects of hydro resources. These issues alone mean that all of the planned activities on site are sustainable provided that all of the environmental control activities are in place, especially offsetting the negative impacts of the site construction.

10. PROGNOSIS

10.1. Scenario Projection

The purpose of this analysis is to present a prognosis of the area surveyed with and without the project, in order to qualify and quantify the negative and positive aspects resulting from Santa Luzia Alto SHS construction between the São Domingos and Ipuaçu cities, in Mid-Western Santa Catarina.

Two scenarios will be defined and explained based on the studies produced for this EIA (Environmental Impact Study): the first scenario involves not building the project, leaving the area as it is, i.e. with no changes caused by the project; the second involves project construction and the consequences of the proposed intervention.

The Scenario Assessment is used to present evidence, based on the results from the environmental diagnosis in the EIA that show analysts the results from both scenarios, so they can make their own assessment, measuring the positive and negative aspects of each situation and reach a conclusion.

10.1.1. Scenario Trends

The area without the project is a regional socio-environmental area which is suffering from an energy shortfall and any future consequences and changes. The Santa Luzia Alto SHS location has been progressively and gradually undergoing changes, mostly illegal, and when these changes are legal, not always in synergy with the environment, with no guarantee that non-intervention (not building the SHS) will assure the current environmental status is upheld or improved.

In the current scenario, there is intensive farming with environmental problems resulting from the continuous misuse of natural resources, that over time have caused risks to the environment, some of which may be serious (riparian forest suppression; pollution from chemical products for agrarian use). The influence area of the SHS project is an environment that has been anthropized for a long time and whose resulting impacts are mostly irreversible, taking into account the fact that agricultural activity is, at least nowadays, irreplaceable in the local and regional socio-economic context.

In this scenario, the facts must be weighed in order to try and measure what is most environmentally valuable in the area of influence of the project in terms of the gain in financial resources for the region, for Santa Catarina, and Brazil. It follows that not building the SHS project would not necessarily lead to environmental improvement in the area influenced by the project, but it would certainly lead to further socio-economic losses,

if not directly in a local context, given the nature of the energy distribution in the system, but definitely at a regional level.

10.1.2. Target Scenario

In a realistic comparison of scenarios, we can see that the impacts caused by the project may bring benefits as well as harm to the local environment. Aware of those impacts, the project developer has based the project layout on a design that considers certain environmental restrictions. This way, technology and environmental alternatives were proposed in an attempt to try to mitigate the negative impacts that will arise, with a significant improvement in regional socio-economic perspectives.

In this second scenario, where the SHS project is built, one of the latent advantages is possibly greater reliability of the Brazilian electrical system, boosting the future development of the region and of Santa Catarina. Note also that the project is of public interest and is based on a modern design, aligned with contemporary social and environmental needs, in order to meet the restrictions of current environmental legislation.

The study proposes mitigating measures and environmental control programs to address the negative impacts arising from the project and comply with the local environmental restrictions.

As stated, all the works shall be planned to reduce, as much as possible, the negative impacts on the environment and on the way of life of the affected communities.

Finally, an analysis based on the facts shows that a decision not to build the project will not guarantee greater environmental stability. However, this project would improve the current situation, through measures for environmental compensation, especially in the socio-economic environment, will also contribute to the economic improvement in the surrounding area, generating taxes and income for the cities in the area of influence.

Thus, it is clear both from a community perspective and among relevant authorities, that the intended construction of Santa Luzia SHS will have a positive economic effect in the region in light of the current energy deficit in Brazil, while not having a significant environmental impact.

10.2. Environmental Impact Evaluation and Identification

An explanation of the project features, alongside a clearer understanding of the project's specific characteristics and the physical, biotic, and socio-economic environment around the project area of influences – analyzed above – helped us identify actions with possible consequences or potential impacts for the natural or man-made environment created by the Santa Luzia Alto SHS project.

The method adopted in the analyses and evaluation of the impact was based on activities that might potentially produce environmental changes following project construction and operation. This evaluation procedure helped us identify the actions and the resulting environmental impacts as they occur and the environments affected. 5 (five) actions that could potentially have an impact were defined by the technicians from the Planning, Installation, and Operation stages of the project. They are described below:

1) Planning:

- Studies and Projects

2) Installation:

- Construction of Basic Infrastructure;
- Construction of the main installations;
- Filling the reservoir.

3) Operation:

- Operating the Power Station

10.2.1. Planning Phase Impacts – Studies and Projects

In this stage we are considering the works involved in field studies and construction. The following environmental impacts are expected:

Socioeconomic:

- Expectations among the local population in terms of the Project;
- Increase in property speculation;
- More economic activity.

10.2.2. Construction Phase Impacts

This stage includes the construction of the SHS and involves actions that will generate an impact. Each activity will have its own environmental effects in its respective environment. Briefly, we can cite the actions related to the preliminary and complimentary services which include: construction of basic infrastructure, construction of the main works and filling of the reservoir. The actions referred to and the impacts identified in this phase will be later characterized and evaluated using the Leopold (LEOPOLD et. al.,1971) interaction matrix.

- Construction of the basic infrastructure.

This includes the expansion and improvement of the basic transport infrastructure, the premises for the main contractor and the allocation of workers, as well as the construction and operation of the works site, residential camp sites and administration.

Physical:

- Changes to the landscape
- Creation of degraded areas;
- Alteration in water quality.

- **Biotic:**

- Vegetation clearing;
- Interference in the terrestrial fauna;
- Fragmentation and reduction of habitats;
- Temporary removal of fauna;
- Modification of the composition and structure of aquatic fauna;

Socioeconomic:

- Loss of soil with agricultural potential;
- Reduced safety and pressure on local traffic during the works
- Change to the bathing possibilities in the river upstream from the Project;
- Interference in the day to day lives of the communities near the works;
- Expectations of the local population with regard to the Project;
- Increase in property speculation;
- Improvement of the Road system and of access to the site;
- Acoustic pollution;
- Production of solid and liquid waste;
- More economic activity;
- The creation of favorable environments for the proliferation and dispersion of vectors and endemics

- Construction of the main site

The main works include construction and operation of the works site, the excavation of the supply system, the construction of the waste dump and dam construction. In this phase we also include demobilization of workers.

Physical:

- Alteration of the landscape
- Alteration of the Quebra Queixo UEH Permanent Preservation Area;
- Creation of degraded areas;
- Changes in water quality.

Biotic:

- Changes in the composition and structure of the aquatic fauna;
- Interference in the terrestrial fauna;
- Fragmentation and reduction of habitats;
- Temporary removal of fauna;
- Clearing of vegetation;

Socioeconomic:

- More economic activity;
- Expectations of the local population with regard to the Project;
- Change to the bathing possibilities of the river upstream from the Project;
- Increase in property speculation;
- Interference in the day to day lives of the communities near the works;
- Production of solid and liquid waste;
- Loss of soil with agricultural potential;
- Acoustic pollution;
- Less safety and pressure on local traffic during the works
- The creation of favorable environments for the proliferation and dispersion of vectors and endemic diseases

- Filling the reservoir.

In this stage the reservoir is filled, forming the lake.
In this phase we also include demobilization of workers.

Physical:

- Alteration of the landscape
- Creation of degraded areas;
- Erosion of the banks of the reservoir;
- Change in water quality.

Biotic:

- Modification in the composition and structure of the aquatic fauna;
- Fragmentation and reduction of habitats;
- Temporary removal of fauna;
- Interference in the terrestrial fauna.

Socioeconomic:

- More dynamic economic activities;
- Expectations of the local population with regard to the Project;

- Loss of soil with agricultural potential;
- Change to the bathing facilities on the river upstream from the Project;
- Increase in value of land around the reservoir;
- Interference in the day to day lives of the communities near the works.

10.2.3. Operation Phase Impacts

This stage represents completion of the project in a regional context, from the moment the turbines start working.

- Operation of the Power Station

Although, we should consider the main, positive impacts in a local and regional socioeconomic context, with direct effects on the economy and improvement to the quality of life for the local and regional population, the negative impacts should also be clarified. In practical terms project operation will consist of tasks related to: the management of the river course between the water source with maintenance of the ecological flow; the power station and administration of the power plant, also including maintenance of the hydraulic structures and control of their activities.
Note that after conclusion of the project, some impacts that start appearing during this stage will be in a state of permanent evolution. Therefore, alterations in the quality of the water and the aquatic biome will continue to change in a process which will gradually become more stable. In basic terms, it will move towards to a dynamic equilibrium.

Physical:

- Alteration in the quality of the water;
- Erosion of the banks of the reservoir.

Biotic:

- Replanting of the permanent preservation area;
- Proliferation of macrophytes.

Socioeconomic:

- More dynamic economic activities;
- Increase in value of land around the reservoir;
- Change to the bathing facilities on the river upstream from the Project;
- Multiple uses of the reservoir and surrounding areas;
- Stimulus to local and regional tourism;
- Improvement of the Road system and of local access;
- Production of solid and liquid waste;
- Increase in the production of electricity.

10.3. Environmental Impact Evaluation and Characterization

The Project, which involves construction of the Santa Luzia Alto SHS, will supply the region with more electricity and is part of a series of priority infrastructure works for the development of the country. The project will guarantee a more reliable electrical system in the Mideast and eastern region of Santa Catarina, contributing to an increase in the dynamic regional economy. It will encourage increased investments in virtue of the greater availability of electricity.

Although the positive factors are manifestly in favor of the project, we must be cautious during its construction. The study is based on the principle that the project construction implies care being taken in the areas of direct and indirect influence, preventing the area from becoming an island. For this reason, the Simplified Environmental Report covers the entire area of influence of the project, thereby eliminating or mitigating misleading expectations regarding its effects.

We should also note other local plans and programs, as many of these projects now underway could possibly cause transformations as large as those in the project itself.

The environmental impacts resulting from the Identified Impact Actions above, are listed below according to the affected environments.

In this evaluation, the impacts have been evaluated to include the affected environments and the interaction of the impacts from all phases of the project. They also include the relevance of the impact in each environment. However, although they have been grouped according to the environment affected, the interaction between them has also been considered and presented in the impact action identification matrix (Table 71).

10.3.1. Physical Environment

Alteration to the landscape

The construction of the SHS, from the building stage to operation, will permanently change the landscape in the area, due to the changes in land usage. The biggest impact will occur in the physical, biotic and socioeconomic environments. Regarding physical issues, the modifications will start with the visual aspect of the landscape, resulting initially from the installation of the works site, access roads and the construction. Later, after the filling of the reservoir, substituting a river with a lake of large proportions, the water classification of the river in the area of direct influence will change from lotic to lentic.

The impact on the biotic area will mainly come from clearing vegetation in the area to be flooded, leaving the soil exposed. From a socioeconomic aspect, however, the local landscape has already been altered by agriculture. The project will substantially change the landscape, greatly influencing the activities on site.

Table 43 – Evaluation of the impact resulting from the alteration of the relief and landscape.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Develop the Degraded Area Restoration Program.
- Develop a Soil Conservation, Use and Occupation Around the Reservoir Master Plan;
- Encourage the Legal Reserve Registration on Bordering Properties;
- Develop a Program to Revegetate the Riparian Forest;
- Construction of the works site and access roads, carefully avoiding the clearing of vegetation and of other locations of value in the landscape.

- Creation of degraded areas.

The construction of the Santa Luzia Alto SHS will create areas with a certain degree of degradation, mainly following removal of vegetation and soil in order to open the access roads, construction of the cofferdams and dam, and utilization of the leased areas as well as other actions directly linked to the construction and relevant to the type of project surveyed.

The degraded areas, as well as representing a highly negative landscape, may form points of erosion or create areas suitable for the propagation of pathogens, creating an area favorable for the reproduction of carriers of disease (isolated trenches, inadequate and abandoned accumulations of rubble and various types of waste etc.).

Table 44 – Evaluation of the effects from the creation of degraded areas.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		

Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magnitude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Adequate planning of activities of greater impact in relation to the creation of degraded areas.
- Adoption of preventive measures to control creation of points of erosion and soil erosion;
- Encourage the Legal Reserve Registration on Bordering Properties;
- Develop the Degraded Area Restoration Program.
- Develop the Replanting Program for the Riparian Forest. **–**

Alteration of water quality.

With the construction of the Santa Luzia Alto SHS the water system of the Chapecó river will be altered on the section where the reservoir will be created, changing from a lotic to a lentic water system.

Water quality could change during the construction of the works and/or during the operation phase. In the construction phase, the building of the cofferdams and the dam, the use of leased areas and the diversion of the river could result in sediments being carried to the bodies of water, increasing turbidity and modifying physiographic characteristics of the river due to the sedimentation. In the operating phase, with the formation of the reservoir and the consequent change of the lotic environment to lentic, there could be a reduction in the oxygen dissolved (DO) in the water, affecting the self-purification of various pollutants. This reduction of the DO could worsen with the increase of the biochemical demand for oxygen due to the large quantity of organic material resulting from the flooding of the vegetable biomass and by the contamination by effluents and domestic residuals produced by the installation of the works site.

Downstream from the dam, we believe that there will be no great change to the quality of the water, due to the low permanence time in the reservoir. We can add to this the incorporation of oxygen in the turbine water, which will be returned to the Chapecó downstream for the power station, producing an increase in dissolved oxygen.

Table 45 – Evaluation of the impact resulting in the alteration of water quality.

Característica	**Classificação do Impacto**			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireto (1)	**Direta (2)**		
Característica espacial	**Local (1)**	**Regional (2)**	Estratégico (4)	

Característica de magn itude	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Develop the Limnological Monitoring and the Water Quality Program;
- Develop the Vegetation Clearing Program and Cleanup of the Flooded Area, removing the vegetation cover from the area to be flooded, maintain stability of the banks during the filling;
- Develop the Environmental Management Program of Solid and Liquid Effluents with the adoption of measures for sanitary control and production of pathogenic environments;
- Developing a Riparian Forest Revegetation Program;
- Develop the Sediment Monitoring Program;
- Develop the Degraded Area Restoration Program.

- **– Erosion on the reservoir banks.**

After filling the reservoir there may be bank washout, due to the wave systems and the raising and lowering of the water level caused by the power station. Likewise downstream of the dam, with a sediment imbalance due to the retention of material in suspension by the dam, the water body tends to procure a new sedimentary balance through erosion of the river banks, which according to CARVALHO 1,990, occurs until the body of water is saturated.

Table 46 – Evaluation of the impact resulting from the erosion of the reservoir banks.

Característica	**Classificação do Impacto**			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireto (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Develop the Degraded Area Restoration Program.
- Developing a Soil Conservation, Use and Occupation Around the Reservoir Master Plan;
- Encourage Registration of Legal Reserves at Bordering Properties;
- Developing a Riparian Forest Revegetation Program;
- Develop the Sediment Monitoring Program together with stability control for embankments during the operation of the SHS.

Alteration of the Permanent Preservation Area of the Quebra Queixo UEH.

The construction of the power station at the Santa Luzia Alto SHS will encroach onto the Permanent Preservation Area of the UEH. However, this area should be incorporated into the area of permanent preservation at the Santa Luzia Alto SHS, with the transfer of the final section of the riparian forest from the UEH. The area covers 15.9188 hectares and is managed by the Chapecó Energy Company – CEC.

Table 47 – Evaluation of the impact resulting from the alteration of the permanent preservation area of .

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireto (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- The area should be included in the permanent preservation area of Santa Luzia Alto SHS, under the responsibility of Lourenco Gomes Construction Company, project manager at Santa Luzia Alto.

10.3.2. Biotic Environment

- Change in the aquatic fauna composition and structure

In the area of direct influence, the watercourses are lotic and there are fauna and flora associated with this ecosystem and landscape. Among the fauna, some fish species are found in Chapecó river, such as the cascudo (*Hypostomus regain)*, are totally adapted to the currents and shallows (Koch *et al.,*2000), and mammalian fauna animals, such as mãopelada (*Procyon cancrivorus*) also registered in this survey, which inhabit shallows and currents looking for food with the hands in these shallows (Silva, 1994). Lotic

water streams, according to Odum (1988), have a current which is a limiting factor on species that can live in these ecosystems and the oxygen tension is high, with little or no thermal or chemical stratification.

The Santa Luzia Alto SHS project creates changes in the water course dynamics, which will change the ecosystem type. Thus, depending on the tolerance limit of animal and vegetal species, nature will not be able to recover its stability using resilience mechanisms (Odum, 1988), and another community will be created.

This impact begins in the project stage, and will end only when the ecosystem reaches homeostasis again, with the replacement of populations that occupy the same ecological niches.

Table 48 – Evaluation of the impact resulting from the alterations in the aquatic fauna with the changes to the hydro system.

Característica	**Classificação do Impacto**			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magnitude	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	**Compensável (3)**	Potencializável (4)

Recommended measures:

- Although the change in water regime and change to the ecosystem is unavoidable, it is possible to offset this damage through conservation of similar ecosystems in other locations;
- Rescue fish fauna on reduced flow sections;
- Ban on fishing activity in the reservoir until the balance of the fish fauna community is reached, with monitoring by the Environmental Police.
- Develop an Environmental Education and Social Communication Program, teaching the population about the improper collection of fish fauna stuck in the puddles formed during the reduction of flow and the river diversion, allowing fish fauna rescue to progress;
- Flooded Area Deforestation and Clearing Program
- Develop the Flora Rescue and Management Program and the Fauna Rescue and Management Program;
- Develop the Degraded Area Recovery Program and the Riparian Forest Revegetation Program;
- Develop an Icthyofauna Rescue and Management Program.

- Vegetation Suppression

The area of direct influence, as presented in this diagnosis, has been changed by use of land for agriculture. It is mostly a widely anthropized location. However, there are three forest fragments that are partially affected by the project, in addition to the riparian vegetation. Because it is narrow, the latter will completely disappear after the reservoir is filled.

Note that in the remaining forest we found some species currently threatened with extinction, such as araucaria (*Araucaria angustifolia*), xaxim (*Dicsonia sellowiana*), canela imbuia (*Ocotea porosa*) and canela-sassafráz (*Ocotea pretiosa*)

Santa Luzia Alto SHS project will reduce the remaining forest habitats and riparian forest due to the suppression of native vegetation in areas that will be submerged after the reservoir is filled.
Nevertheless, we know that these fragments are likely to gradually disappear if they are not registered as legal reserves. Therefore, it is worthwhile offsetting this possible impact, which will occur in the project stage, through the programs proposed below.

Table 49 – Evaluation of the impact resulting from the suppression of vegetation.

Característica	**Classificação do Impacto**			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	**Regional (2)**	Estratégico (4)	
Característica de magnitude	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	**Compensável (3)**	Potencializável (4)

Recommended measures:

- Develop a Degraded Area Recovery Program;
- Choose places for the construction of the work site, access ways, and places for waste disposal and leasing;
- Develop a Riparian Forest Revegetation Program;
- Encourage Registration of Legal Reserves at Bordering Properties;
- Develop a Program to Create or Revitalize Conservation Units;
- Develop a Soil Conservation, Use and Occupation Around the Reservoir Master Plan;
- Develop a Flora Rescue and Management Program.

- Fragmentation and reduction of habitats;

Some activities in the project stage, such as vegetation suppression, ground leveling, installation of work sites and the operation of machines and equipment can lead to the alteration of several amphibian, reptile, fowl, and mammal species' habitats.

The vegetation removal, even if it is small scale, leads to a reduction in the area available for several forest species, leaving several animals exposed to unfavorable environmental conditions (increase of luminosity, increased temperature, reduction of humidity, increase of border effect), making it easier to hunt as well as interfering in processes like reproduction (population isolation and loss of genetic variability) and food acquisition.

In addition, vegetation removal promotes the arrival of typical species from open environments, some of them exotic in Atlantic Forest. This impact can be mitigated through the connection of forest fragments using forest corridors, especially along water courses.

Table 50 – Evaluation of the impact resulting from the destruction, fragmentation and reduction of habitats.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magnitude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	Mitigável (2)	**Compensável (3)**	Potencializável (4)

Recommended measures:

- Develop the Fauna Rescue and Management Program and the Flora Rescue and Management Program;
- Develop the Degraded Area Recovery Program and the Riparian Forest Revegetation Program;
- Develop a Program to Create or Revitalize Conservation Units;
- Encourage Legal Reserve Regulation on Bordering Properties;
- Develop the Flooded Area Deforestation and Clearing Program
- Implement the Soil Conservation, Use and Occupation Around the Reservoir Master Plan;

- Fauna temporary displacement

During the project stage, activities such as the operation of machines and equipment, the increased noise and the mobilization of workers can scare away several species. The vegetation removal and the consequent reduction in food can lead some species to move to other locations seeking resources or they may invade neighboring areas, such as plantations and residential areas. However, after the project activities cease, fauna will gradually return to their old habitats, recovering the degraded areas.

Table 51 – Evaluation of the impact resulting from the temporary removal of fauna.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magnitude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	Mitigável (2)	**Compensável (3)**	Potencializável (4)

Recommended measures:

- Develop the Fauna Rescue and Management Program and the Flora Rescue and Management Program;
- Develop the Degraded Area Recovery Program and the Riparian Forest Revegetation Program;
- Program to Create or Revitalize Conservation Units;
- Develop the Flooded Area Deforestation and Clearing Program
- Perform the Soil Conservation, Use and Occupation Around the Reservoir Master Plan;

- Revegetation of the permanent conservation area

In parallel with vegetation logging in the area of the aforementioned SHS, the developer is obliged to revegetate the areas adjacent to the water intake. These Permanent Preservation Areas, by Law, will be a minimum 30 meters in length and will be the responsibility of the developer, thus providing an important location for development and protection of local fauna and flora.

Table 52 – Evaluation of the impact resulting from replanting the APP areas.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	Indireta (1)	**Direta (2)**		

Característica espacial	Local (1)	Regional (2)	**Estratégico (4)**	
Característica de magnitude	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- Perform revegetation with native species, prioritizing rare species as well as those under the threat of extinction;
- Encourage Legal Reserve Registration at Bordering Properties;
- Develop the Flora Rescue and Management Program;
- Implement the Soil Conservation, Use and Occupation Around the Reservoir Master Plan;

- Interference of terrestrial fauna

In the area of direct influence from the project, terrestrial fauna is associated with forest remnants including the riparian forest**.** Based on the observations made in this diagnosis, there are at least four medium-sized species of mammalian fauna here: capybaras, crab-eating raccoons, otters and pampas foxes. The presence of these animals is an indication that there is a relevant fauna community, because the maintenance of populations of these species requires a complex food chain, especially when considering that the pampas fox is a tertiary consumer, at a high level in the food chain.

Construction of Santa Luzia Alto SHS may result in the increased death of the terrestrial fauna, either killed by inhabitants, or due to the increase in vehicles traffic and noise in the construction phase.

These impacts can be mitigated. As the fauna is restricted to the few forest fragments that remain, it is relatively easy planning an efficient fauna rescue program. In addition, the intervention area for construction of the dam may be controlled through measures to be proposed.

Table 53 – Evaluation of the impact resulting from the increased mortality of terrestrial fauna.

Característica	**Classificação do Impacto**			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Develop the Fauna Rescue and Management Program and the Flora Rescue and Management Program;
- Develop the Environmental Education and Social Communication Program involving two target groups: the local population workers and collaborators involved in the enterprise. It will guide people on legal issues related to killing fauna and the requirement not to prey on animals;
- Develop the Degraded Area Recovery Program and the Riparian Forest Revegetation Program;
- Develop a Program to Creation or Revitalize Conservation Units;
- Develop the Flooded Area Deforestation and Clearing Program
- Perform the Soil Conservation, Use and Occupation Around the Reservoir Master Plan;

- Proliferation of macrophytes

The reservoir and consequent increase of depth and volume of liquid mass in the environment will lead to retention of nutrients and sediments, generating a situation very different situation from the current situation on river Chapecó in the flooded area, which may influence the dam's downstream area as well as the reservoir itself, through alterations in water quality, due to a significant increase of the habitat, especially macrophyte plants, resulting in great proliferation of the respective species associated with this flora. Such aspects must be monitored according to the recommendations contained in specific environmental programs.

Algae will also proliferate due to the increased habitat (surface area with a photic zone), and availability of leached nutrients of the downstream agricultural zone. Although positive for the phytoplankton, this impact may lead to eutrophyzation with undesirable consequences, therefore requiring control and monitoring actions.

Table 54 – Evaluation of the impact resulting from the proliferation of macrophytes.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	**Indireta (1)**	Direta (2)		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3**)	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measure:

- Develop the Limnological Monitoring Program and Water Quality Program with monitoring of macrophyte proliferation.

10.3.3. Socio-Economic Environment

- Local population's expectations regarding the enterprise

The population in benefitting municipal regions will be informed of project construction based on socio-environmental studies, where the community will also be made aware of the SHS implantation. However, for the population located in the area of influence, more significant impacts are related to the expectations generated – both negative and positive – by the project. For the population, expectations are based on the way and form in which information is interpreted and presented, especially information on job creation and indemnification for lands used by the project.

Owners of land located in the area of influence and subject to interference will also be informed of the need for the project due to the current energy situation in Brazil, as well as legal indemnities.

Table 55 - Evaluation of the impact resulting from the expectations of the local population in relation to the project.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measure:

- Develop the Environmental Education and Social Communication Program;
- Encourage hiring of local workers;
- Develop the Program for Registration and Indemnification of Affected Properties, containing well defined criteria as well as discussion with the directly affected population.

- Interference affecting the routines in communities near the site

The construction of energy projects, even small ones such as the SHS, will cause some temporary discomfort to the population residing near the works.

These disturbances are related to the increasing vehicle flows in these locations (including heavy vehicles), noise on the construction site and vegetation suppression in the future reservoir area, temporary increase of local demographic density, the possible appearance of viruses or other exogenous diseases in the local community and the possible overload of the local health system. In addition, there may be inconvenience caused by the animal displacement, especially during vegetation suppression stages and reservoir filling.

Table 56 - Evaluation of the impact resulting from the disturbance of the day to day life of the communities near to the works.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Publicly disclose the developer's intentions through an Environmental Education and Social Communication Program, providing all explanations necessary so the population fully understands the benefits of the project;
- Guidance for workers, through the Environmental Education and Social Communication Program for workers and creation of a Code of Conduct, and deployment of the Environmental Procedures Manual on the habits of the local population in order to avoid possible conflict situations;
- Plan the of hours of most noise for personnel, materials and equipment transportation, avoiding peak and night periods, in order not to disturb the affected communities;
- Train technicians who will be in touch with the population on their approach to the owners (be polite and patient), in order to avoid possible conflicts;
- Reinforce signage of highways, especially near schools, churches, hospitals and health centers.

- Insecurity and pressure on local traffic during the works

The insecurity generated among drivers by the traffic diversions and interruptions is caused mainly by increased heavy vehicle during the SHS construction.

Table 57 - Evaluation of the impact resulting from the lack of traffic safety during the works.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Característica de importância	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Características de intervenção	**Evitável (1)**	Mitigável (2)	Compensável (3)	Potencializável (4)

Recommended measures:

- The engineering company responsible for the project will draw up a detailed plan of the procedures related to the flow of site vehicles in the area, establishing a schedule to rationally deal with these vehicles;
- Carry out the procedures involving signage on site, insulation, safety devices and also the disclosure of the activities which may interfere with traffic locally;
- Comply with weight restrictions on highways, transporting loads with compatible weight as often as possible;
- Apply the Environmental Education and Social Communication Program in the community and among workers.

- Improvements in the road system

According to the guidelines presented in this study, it is in the developer's interest to maximize use of the existing road structure for access to locations at the Construction Site, dam, power station and other activities required on site. For partial or total use of existing roads and access ways, any improvement required will be provided so these roads and access provide permanent access, including grade alterations, platform configuration and drainage works.

The local population will benefit from improvements to the road system that accompany the project, either because they facilitate access to properties or make it easier to transport goods.

Table 58 - Evaluation of the impact resulting from improvement of the road system.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	**Indireta (1)**	Direta (2)		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- Agreement with local government for maintenance of roads and access ways;
- In case new routes are required, define layouts which cause as little environmental impact as possible;
- Control soil erosion.

– Increasing economic activity

The strength of the economy may be affected through some economic variables related to activities in all stages of the project (planning, construction and operation) such as changes in the market for goods and services, increased local and regional revenue, municipal levies, increase in demand for equipment and social services and, especially, job creation.

This type of development tends to positively affect the local economy. Therefore greater economic changes may be caused by these projects, especially during operational phases. Works planning can generate positive results from the activities indirectly related to the site and during operation, creating a favorable situation which attracts or generates interest in new projects and developments.
When building begins, the demand for service and goods in the area of influence will change substantially. This demand is differentiated, because the assets and services required by the development during the construction phase will be different from those required in the operational phase.

This increased demand will lead to new commercial establishments (of all types). These, in turn, will set off new demands and consequently the appearance of other activities. Although the construction of Santa Luzia Alto SHS will have negative impacts on the biotic and physical environments, it is especially positive in terms of the quality of life for human populations.

In the planning and mobilization phase of the site infrastructure, this brings job and revenue creation with

increased financial resources for the local economy. Consequently, the development will generate employment directly and indirectly. Direct jobs based on the SHS construction and operation phases, through the immediate absorption of labor and indirect jobs based on the increased purchasing power and consequent rise in consumption of goods and services, promoting the local and regional economy.

In addition to the development itself, the resulting economic activities will significantly increase municipal or state taxes as economic activity increases.

Table 59 - Evaluation of the impact resulting from more dynamic economic activity.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	**Direta (1)**	**Indireta (1)**		
Característica espacial	**Local (1)**	**Regional (2)**	Estratégico (4)	
Característica de magn itude	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- Seek technical alternatives in order to improve the quality of energy currently supplied to the municipal regions of Ipuaçu and São Domingos;
- Prioritize tax spending from energy production on projects which benefit the municipal region;
- Prioritize purchase of local and regional goods and services, boosting the local and regional economy, maintaining job growth created by the development;
- Develop the Social Communication and Environmental Education Program which provides the quantity, profile and qualification of the labor hired for SHS construction;
- Encourage hiring of local labor;
- Priority hiring of local labor, seeking to keep jobs created within the community;
- In order to avoid an uncontrolled flow of people seeking work, the regional population should be informed and aware of the fact that the development will prioritize local hiring and the local supply of good and services;
- Survey existing regional public and private institutions and establish ways of operating and means of communication aimed at informing the population about the development's characteristics.

- Creation of environments favorable to the proliferation of vectors and endemic diseases

Different situations may create conditions suitable for vectors which transmit diseases and may affect public health. Stagnant bodies of water or the presence of organic material, such as food remains, favor the development of micro and macro vectors, as might “pools” in leased areas and construction material, obstacles in undersized or badly located gullies or deposits of solid waste and useless material. In the former situation the drainage systems for surface waters may prevent stagnant surface water.

Table 60 - Evaluation of the impact resulting from the creation of environments for the proliferation of vectors and endemic diseases.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	**Evitável (1)**	Mitigável (2)	Compensável (3)	Potencializável (4)

Recommended measures:

- Drainage of surface waters;
- Work place cleaning;

- Implement the Environmental Management Program for Solid Waste and Liquid Effluents;
- Develop the Social Communication and Environmental Education Programs with the Environmental Procedures Manual.

- Increase in property speculation

The construction of projects in the energy sector, especially to generate electricity, stimulate the property market and increase property values in rural and urban areas in the municipal regions located near to these projects. The experience gained from construction of the UHEs in Machadinho, Campos Novos and mainly Quebra Queixo which are nearby the Project, and others, confirm this trend because compensation may be paid. However, although the Santa Luzia Alto SHS is a small scale Project, there is a trend towards an increase in the property prices in the areas located close to the project, inflating prices in neighboring areas. The survey of these properties shows that the ADA of the SHS will cover 11 properties. With this, at least some of these properties will be acquired by the construction company and this will certainly push up the prices of local properties and subsequently those of other similar properties in the same region.

Table 61 – Evaluation of the impact resulting from the increase in property speculation.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	**Indireta (1)**	Direta (2)		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Característica de importância	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Características de intervenção	**Evitável (1)**	Mitigável (2)	Compensável (3)	Potencializável (4)

Recommended measures:

- The Social Communication and Environmental Education Program includes information for the local and regional community to reduce expectations and speculation;
- Development of the Registry and Compensation Program for the affected properties, including physical registration of the affected properties, to accurately quantify the land and improvements that receive compensation, according to ABNT evaluation standards and normal market conditions.

- Increase in the energy supply

The construction of the Santa Luzia Alto SHS will contribute to the Integrated Brazilian System, increasing energy supplies for the nearby regions of Western Santa Catarina and the rest of the state.

The improvement in supplies to the system as a whole is necessary based on increasing demand for electricity nationwide. This is caused by an increase in domestic consumption and the need for expansion in the industrial sector. This improvement will contribute to regional development, strengthening the tertiary sector, attracting industries to create and increase income for the population.

Table 62 - Evaluation of the impact resulting from the increase in energy.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	Local (1)	**Regional (2)**	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- .Develop material on the SHS, promoting its importance and social benefits in the Social Communication and Environmental Education Program

- Loss of infrastructure and soils with potential for agriculture

The Basic Project for the Santa Luzia Alto SHS includes the formation of a reservoir covering approximately 709 hectares (including flooded area and permanent preservation strip of 30 meters, varying by up to 1.00 meter), covering 11 rural properties. As a result, land suitable for 1ABC agriculture containing FLUVIAL NEOSOILS and therefore having a high rating for agriculture, will be flooded. The economic impact is attenuated by the fact that this use of these areas is preferentially alluvial forests and pastures, this land is being underused. The lack of use could be associated with the fact that the fields are generally located in a Permanent Preservation Area (APP), with makes their use illegal.

Table 63 - Evaluation of the impact resulting from the loss of infrastructure and soils with agricultural potential.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		

Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magnitude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	Mitigável (2)	**Compensável (3)**	Potencializável (4)

Recommended measures:

- Survey the properties affected by the project;
- Include information in the Social Communication and Environmental Education Program for the local community with a view to diminishing expectations and speculation.
- Develop the Registry and Compensation Program of the affected properties, including physical registration of the affected properties, quantifying the land and accurately specifying the value of the agricultural area, based on normal market conditions.

- Change in the bathing facilities on the river upstream from the project.

There is a latent concern among the local population regarding loss of the leisure area represented mainly by the “Camp site, Little Beach” (Prainha), which is a strategic area for regional tourism. Note that this area is part of the infrastructure built downstream by the Plan for Usage of the Surrounding Area at the Quebra-Queixo SHS. It is well frequented area in the summer and will be partly flooded. From a geographic viewpoint, the location called “Prainha” is characterized by the base rock slab swept by a sheet of water from the river Chapecó which will disappear with construction of the SHS.

Leisure areas are located on both banks of the river Chapecó near the mouth of the river Bonito, and are used by the local population. This area is called “Barrinha – Little Barrier” and which will be flooded by the project. It is an area frequented in summer. The most popular bank is on the left of the river (Ipuaçu municipal region) has 13 shacks in precarious conditions, while on the right bank there is no infrastructure and there are sanitary problems.

With construction of the Project these areas will be damaged. The local population uses the rocky river bed and rapids for leisure purposes. These areas will probably be flooded and the rapids will become a lake.

Table 64 - Evaluation of the impact resulting from the change in bathing facilities on the river upstream from the project.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	Local (1)	**Regional (2)**	Estratégico (4)	
Característica de magn itude	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	**Compensável (3)**	Potencializável (4)

Recommended measures:

- Inclusion of the Water and Limnological Quality Program;
- Promote the benefits of the Project based on improvement to the leisure facilities in the affected locations through the Social Communication Program;
- Deploy the Director Plan for Conservation, Use and Occupation of the Land Around the Reservoir of the Santa Luzia Alto SHS, informing the community and the local government of locations that are appropriate of the construction of new leisure areas.

- Noise Pollution

The perception and the physiological changes caused by noise and vibration affect each individual in different intensities and manners. The mitigating measures are varied and may require more or less investment.

Possible negative impacts include the increase in noise during the operation of services and equipment used at the Santa Luzia Alto SHS. This negative impact will have a localized effect in the areas surrounding the construction. These will be caused by service trucks, the works site and dumps, as well as movement of earthmoving equipment, paving, drainage, tunnel excavations and dynamiting.

The noise pollution significantly contributes to a temporary reduction in fauna. This reduces their mortality when clearing the vegetation. However, noise pollution should be avoided and minimized.

Table 65 - Evaluation of the impact resulting from noise pollution.

Característica	Classificação do Impacto			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		

Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	**Desprezível (1)**	Pequena (2)	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Advanced planning of the materials and equipment transport;
- Use of safety equipment by the construction workers;
- Maintenance and conservation of vehicles used on site, to reduce noise at source;
- Establish day shifts for the works;
- Use nose reducing equipment on site and on noisy machinery;

- Production of Solid Waste and Liquid Effluents

The production of solid and liquid waste is inevitable in a Project of this type. It is produced by the works site and construction activities.

The solid waste should be adequately handled by type, separating dangerous waste (class 1, NBR 1 0004, 2004), non-inert waste (class 2A, NBR 10004, 2004) and inert wastes (Class 2B, NBR 10004, 2004). When badly managed this waste can produce a temporary loss in environmental quality in locations near the project.

To mitigate this impact, a service supply contract should be signed with a company licensed to collect waste produced during the construction of the SHS and by building treatment systems for liquid effluents according to their individual characteristics.

Table 66 - Evaluation of the impact resulting from the production of solid waste and effluents.

Característica	**Classificação do Impacto**			
Característica de valor	Positivo (+)	**Negativo (-)**		
Característica de ordem	Indireta (1)	**Direta (2)**		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	**Mitigável (2)**	Compensável (3)	Potencializável (4)

Recommended measures:

- Implement the Environmental Management Program for Solid Waste and Liquid Effluents;
- Complete the project and construction of treatment systems for liquid effluents;
- Contract a service supply company licensed to remove the waste produced during construction of the SHS;
- Follow the instructions in regulations on storage, transport and disposal of the different types of wastes produced during the works, especially that of CONAMA 307/02, which refers to waste produced by civil construction.

- Increase in the value of land around the reservoir

One of the most notorious impacts of the Project is the increase in land prices around the reservoir. This is mainly caused by speculation on possible bathing areas around the reservoir for leisure use. This impact, shown in Table 67, is a positive factor for the construction of the project.

Table 67 - Evaluation of the impact resulting from the increase in value of the land around the reservoir.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	**Indireta (1)**	Direta (2)		
Característica espacial	**Local (1)**	Regional (2)	Estratégico (4)	
Característica de magnitude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- Deploy the Director Plan for Conservation and Use of Land Around the Reservoir with directives and management that preserves the landscape and the sustainable use of the location.

- Multiple uses for the reservoir and surrounding area

When a project of this nature is designed we should draw up a list of negative impacts that will occur mainly in the construction phase. However, based on this conservationist attitude towards the environment, we often omit relevant and positive effects of projects of this type, for example, the multiple uses that the reservoir offers when completed. Amongst these uses, we can list:

the use for aquaculture by traditional communities; availability of water for irrigation of agricultural areas; the creation of bathing areas for leisure and aquatic sports.

This impact certainly contributes to an improvement in the quality of life for the population in the municipal regions affected and the nearby region.

Table 68 - Evaluation of the impact resulting from the increase in value of the land around the reservoir.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	**Indireta (1)**	Direta (2)		
Característica espacial	Local (1)	**Regional (2)**	Estratégico (4)	
Característica de magn itude	Desprezível (1)	**Pequena (2)**	Média (3)	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- Deploy the Director Plan for Conservation and Use of Land Around the Reservoir with directives and management that preserves the landscape and the sustainable use of the location.

- Stimulus to local and regional tourism

In this scenario, the project will stimulate local and regional tourism in virtue of the reservoir. This will offer new leisure and recreation options for the local and regional population.

This impact certainly contributes to an improvement in the quality of life of the population in the municipal regions affected and the nearby region.

Table 69 - Evaluation of the impact resulting from the increase in value of the land around the reservoir.

Característica	Classificação do Impacto			
Característica de valor	**Positivo (+)**	Negativo (-)		
Característica de ordem	**Indireta (1)**	Direta (2)		
Característica espacial	Local (1)	Regional (2)	**Estratégico (4)**	
Característica de magnitude	Desprezível (1)	Pequena (2)	**Média (3)**	Alta (4)
Característica de importância	Desprezível (1)	Pequena (2)	Média (3)	**Alta (4)**
Características de intervenção	Evitável (1)	Mitigável (2)	Compensável (3)	**Potencializável (4)**

Recommended measures:

- . Deploy the Director Plan for Conservation and Use of Land Around the Reservoir including directives and management that preserves the landscape and the sustainable use of the location.

Table 70 – Matrix for the identification of impacting actions.

	Componentes Ambientais Passíveis de Impactação								
	Meio Fí sico			**Mei o Biótico**			**Meio Soci oeconômico**		
.									
Ações impactantes decorrentes do Planejamento									
Estudos e Projetos								**X**	**X**
Ações impactantes decorrentes da Implantação									
Implantação da Infra-estrutura Básica	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Implantação de obras principais	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Enchimento do Reservatório	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Ações impactantes decorrentes da operação									
Operação da Usina		**X**				**X**	**X**	**X**	

Tabela 71 - Avaliação do impacto resultante do planejamento, implantação e operação do empreendimento.

COMPONENTES SOCIOAMBIENTAL IMPACTADOS	AÇÕES IMPACTANTES	ETAPAS	1 - Planejamento	2 - Implantação			3 - Operação	Valoração da relevância do
			Estudos e Projetos				Operação da Usina	
Meio Físico	Alteração na paisagem			X	X	X		- 10
	Formação de áreas degradadas			X	X	X		- 10
	Alteração na Área de Preservação Permanente da UEH Quebra Queixo				X			- 08
	Alteração na qualidade da água			X	X	X	X	- 13
	Erosão das margens do reservatório					X	X	- 09
Meio Biótico	Modificação na composição e estrutura da fauna aquática			X	X	X		- 13
	Interferência na fauna terrestre			X	X	X		- 11
	Fragmentação e redução de habitats			X	X	X		- 10
	Deslocamento temporário da fauna			X	X	X		- 10
	Revegetação da Área de Preservação Permanente						X	+ 17
	Proliferação de macrófitas						X	- 08
	Supressão da vegetação			X	X			- 15
Meio Socioeconômico	Expectativas da população local em relação ao empreendimento		X	X	X	X		- 10
	Interferências com o cotidiano das comunidades próximas as obras			X	X	X		- 08
	Insegurança e pressão do tráfego local durante as obras			X	X			- 06
	Melhorias no sistema viário			X			X	+ 11
	Geração de resíduos sólidos e efluentes líquidos			X	X		X	- 10
	Valorização das terras do entorno do reservatório					X	X	+ 11
	Usos múltiplos do reservatório e entorno						X	+ 13

	Impulso ao turismo local e regional					X	+ 16
	Poluição sonora		X	X			- 08
	Dinamização das atividades econômicas	X	X	X	X	X	+ 16
	Formação de ambientes favoráveis à proliferação de vetores e endemias		X	X			- 10
	Aumento na especulação imobiliária	X	X	X			- 05
	Aumento da oferta de energia elétrica na região					X	+ 14
	Perda da infra-estrutura e de solos com potencial agropecuário		X	X	X		- 1 1
	Alteração da balneabilidade do rio a montante do empreendimento		X	X	X	X	- 15

10.4. Conclusive Impact Analysis

According to the methodology proposed, the analysis of the environmental impacts resulted in an interactive evaluation matrix. Through this interaction we saw the impact resulting from the stages and the actions involved in the project. The evaluation provides measurements of the impacts according to their environmental relevance.

67 interactions were registered in the three stages of the Project. These are described below:

The activities in stage 1 (Project studies) will have three impacts in the socioeconomic environment.

The activities in stage 2 for construction of the basic infrastructure, have 19 (nineteen) impacts on the environmental components (physical, biotic and socioeconomic). The construction of the main works has 19 (nineteen) impacts and the filling of the reservoir has 14 (fourteen) impacts in the three environmental components.

The activities in stage 3 involve operation of the power station and generate 12 (twelve) impacts.

We notice from the matrix that the most affected socio-environmental components were those in the socioeconomic environment with a total of fifteen impacts, followed by the biotic environment with seven impacts and the physical environment with five.

In the quantitative evaluation, impacts that are considered irrelevant were not included in the environmental analysis. It is worth noting that although qualified as irrelevant, all the environmental control measures should also be implemented to reduce and offset these impacts not described here.

The impacts considered relevant according to the values obtained: increase in property speculation reached the value of (-05), and the lack of safety and pressure on traffic during the works (-06), alteration in the Permanent Preservation Area of the UEH Quebra Queixo (-08), proliferation of macrophytes (-08), interference in the day to day routine of the communities near the works (-08), noise pollution (-08), erosion of the banks of the reservoir (-09), alteration of the landscape (-10), recovery of degraded areas (-10), fragmentation and reduction of habitats (-10), temporary removal of fauna (-10), expectations of the local population in regard to the project (-10), production of solid and liquid effluent wastes (-10) and the formation of environments favorable to the proliferation of vectors and endemic diseases (-10).

The impacts considered most relevant from an environmental point of view in order of importance were: interference with the terrestrial fauna (-11), increase in value of land around the reservoir (+11), improvement to the road system (+11), loss of soil infrastructure and of soil with agricultural potential (-11), alteration of the water quality (-13), modification of the composition and structure of the aquatic fauna (-1 3), multiple uses of the reservoir and its surroundings (+13), increase in the supply of electricity in the region (+14), vegetation clearing (-15) changing the bathing environment on the river upstream from the project (-1 5).

Only three impacts were considered to be extremely relevant: Increasing the dynamism of economic activities (+16), stimulation of local and regional tourism (+16) and replanting of the Permanent Preservation Area (+1 7).

Regarding the relevance of the impacts in relation to each socio-environmental component, the analysis demonstrates that the positive impacts are of great importance for the projects and justify the construction of the project. Amongst the positive impacts, based on the characteristics of the project, we can highlight the stimulus to economic activities, the stimulus to local and regional tourism, the replanting of the Permanent Preservation Area, the increased availability of electricity in the region and the multiple uses of the reservoir and its surroundings. The negative impacts that are worth emphasizing and will have environmental control measures are: reallocation of existing infrastructures, changes in the bathing facilities on the river upstream from the project, modification of the composition and structure of aquatic fauna, alteration in the water quality and clearing of vegetation.

10.5. Program Control and Environmental Monitoring

The execution of the Environmental Programs will be the basis for the Environmental Control Measures suggested in the EIA for the Santa Luzia Alto SHS. The programs aim to eliminate, compensate and minimize the impacts caused by the project, respecting the legal principles established by legislation and the developer will be solely liable for implementation, subject to verification by government departments responsible.

Based on the research and evaluation of the impacts and environmental liabilities we present the Environmental Programs including the environmental control measures for the negative impacts in order to minimize them, offsetting them or eliminating them.

The Environmental Programs presented below include the environmental areas being affected, their preventive or corrective approach and effectiveness, the party implementing them, as well as their responsibilities and the duration of the impact.

These are presented in Table 72 as follows:

Table 72 - Presentation of the mitigating and compensation measures.

Componente Ambiental	Meio Físico	Meio Biótico	Meio sócio-Econômico
Caráter/Eficácia	Preventivo	Corretivo	
Agente Executor	Empreiteira	Consultora	Poder Público
Duração	Temporário	Permanente	

- Environmental Management Program

According to the directives from the Ministry of the Environment – MMA, Management of Natural Resources (2000), Environmental Management is a group of principles, strategies and directives, defined to protect the physical and biotic environment, supporting socioeconomic development.

Therefore, an Environmental Management Program - PGA should establish norms and procedures to frequently monitor the activities that can result in environmental impacts. These procedures not only verify the extent of the predicted impacts, they identify environmental incompatibilities, evaluating the measures to be adopted. At the same time, they can guide and justify new mitigating and compensatory measures, initially proposed by the environmental programs during environmental licensing.

In this manner, the Environmental Management of the activities at the Santa Luzia Alto SHS will involve supervision and management of the integrated plans and other programs to be adopted.

With the execution and application of this program, we expect to achieve the performance indices, based on environmental control indices identified. We expect that the results will not only contribute to socioeconomic development and environmental quality but also achieve the proposed Sustainable Development, which aims to ensure rational use of natural resources, which will then be available to society.

Table 73 – Environmental Management Program.

Componente Ambiental	**Meio Físico**	**Meio Biótico**	**Meio sócio-Econômico**
Caráter/Eficácia	**Preventivo**	**Corretivo**	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	**Temporário**	Permanente	

Lists of the Programs proposed and managed by the Environmental Management Program.

Lists of the Programs proposed and managed by the Environmental Management Program.

- **Environmental Education and Social Communication Program;**
- **Registration for Indemnity of Affected Properties Program;**
- **Encourage hiring of local workers.**
- **Encourage the Legalization of the Legal Reserve on Neighboring Properties;**
- **Liminological Monitoring and Water Quality Program;**
- **Sediment Monitoring Program;**
- **Environmental Management Program for Solid Waste and Liquid Effluents**
- **Fauna Management and Rescue Program;**
- **Icthyofauna Management and Rescue Program:**
- **Flora Management and Rescue Program;**
- **Restoration of Degraded Areas Program:**
- **Flooded Area Deforestation and Clearing Program**
- **Replanting of the Riparian Area Program;**

- **Program to Create or Revitalize Conservation Units;**
- **Director Plan for Conservation, Use and Occupation of the Soil around the Reservoir.**

- Environmental Education and Social Communication Program

The objective of an environmental education and social communication program allied with project construction is to permit environmental supervision plans to operate as sources of information and examples which will help create conservation awareness and social development.

This will target two distinct groups: the collaborators at the Santa Luzia Alto SHS and the local community.

The theme of the program should cover the following topics: solid waste, sewage collection, local flora and fauna. A special topic will be the fauna that has been expelled from the area of direct influence.

The surrounding population and the collaborators at the SHS should be instructed not to hunt the relocating animals and what to do when finding animals that need help. This same guidance is used for the workers involved in clearing the vegetation.

There will be a need for meetings with the surrounding community. These can be by invitation to a meeting (or small meetings) or involve visiting homes. For any of the options adopted, explanatory material should be prepared, such as pamphlets, which will serve to help people understand the issues.

Also, the community should be informed of a possible increase in accidents with poisonous animals. We should therefore supply information on the basic procedures in case of accidents.

Therefore, contact with the community should cover and ensure the following points are understood:

- The Project;
- The fauna rescue methodology and its consequences;
- Correct procedures when finding migrating or wounded animals;
- Adequate procedures in the case of accidents with poisonous animals.

The installation of a Community Social Program is important in events of this magnitude. The population as a whole is involved with the works, and requires clear and objective information on forecast activities and how they will interfere in the daily activities at that location.

Objectives:

- Explain the importance of all aspects of the works;
- Clarify which procedures and techniques will be employed during the construction phase and the traffic diversions which will occur, through regional media;

- Listen to, record and analyze the complaints and suggestions of the population;
- Inform the forecast timetable for the different phases of the works.

This Environmental Education and Social Communication Program should start simultaneously with the construction works and last until it finishes.

Table 74 – Environmental Education and Social Communication Program.

Componente Ambiental	**Meio Físico**	**Meio Biótico**	**Meio sócio-Econômico**
Caráter/Eficácia	**Preventivo**	Corretivo	
Agente Executor	**Empreiteira**	**Consultora**	**Poder Público**
Duração	**Temporário**	Permanente	

- Registry and Compensation of Affected Properties Program

The area affected by the projects, in other words, the reservoir, the location around the civil works and the strip of APP are part of the land and improvements whose owners will receive compensation. The objective of the program is to create a communication and compensation system based on a methodology that takes into account market prices and the individual characteristics of each property.

Table 75 – Registry and Compensation of Affected Properties Program;

Componente Ambiental	Meio Físico	Meio Biótico	**Meio sócio-Econômico**
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	**Empreiteira**	Consultora	Poder Público
Duração	**Temporário**	Permanente	

- Encourage Hiring of local workers

During construction of the Santa Luzia Alto SHS workers will be contracted according to the needs of the companies involved with the works.

It is important to hire as many workers as possible living in the municipal regions of the Area of Direct Influence (AID) of the Project and/or neighboring locations. This encourages socioeconomic development in the region, through the creation of Jobs for members of the neighboring communities as well as improving the image of the Project within the community, obtaining more support for the construction company during construction of the Santa Luzia Alto SHS alongside the other social economic and environmental projects aimed at the affected municipal regions.

Generally, highly specialized workers are not usually found in the regions where this kind of project is built, as in this project. Specialized employees will have to be brought from outside in most cases.

With the focus on hiring local labor, there is less need for accommodation and areas for leisure to accommodate workers being brought from other regions. There is also a reduction in the production of sewage, solid waste, and a larger contribution to minimizing the negative socioeconomic impacts on the communities involved.

Table 76 – Program to encourage hiring of local workers.

Componente Ambiental	Meio Físico	Meio Biótico	**Meio sócio-Econômico**
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	**Empreiteira**	Consultora	Poder Público
Duração	**Temporário**	Permanente	

- Encouraging the Legalization of the Legal Reserve of Neighboring Properties

In addition to restoring the riparian forest around the reservoir, important in that it provides more environmental quality to reservoir water, benefitting the aquatic flora and fauna and reducing the deposit of sediments, as well as reducing erosion and silting, encouraging local biodiversity, it is worthwhile encouraging land owners, neighboring the riparian forest around the reservoir, to plant and legalize their areas in the Legal Reserve adjacent to the riparian forest, which will increase the vegetation and preserve the flora, especially species threatened by extinction, and native fauna.

This program requires a lot of work on environmental education, to convince the neighboring landowners to legalize their areas in the legal reserve in the area adjacent to the riparian forest, creating awareness and attitudes among the population, generally a long term process. Also, legalization of the legal reserve of neighboring properties is not directly or legally connected with the construction company.

Table 77 – Program to Encourage the Legalization of the Legal Reserve in the Neighboring Property;

Componente Ambiental	**Meio Físico**	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	**Empreiteira**	**Consultora**	**Poder Público**
Duração	Temporário	**Permanente**	

- Liminological and Water Quality Monitoring Program

Before the reservoir is filled, a diagnosis of the quality of the water from the river Chapecó in the area of direct influence should be made. After starting the works, a permanent **Liminological and Water Quality Monitoring Program** should be implemented.

As this is a preventive program, during the works, all the procedures needed to maintain water quality must be carried out by installing environmental control measures and conducting periodic water analyses.

The change in lotic to lentic flow and the quantity of organic matter in the dammed water will reduce water quality in the artificial lakes. This effect can be lessened through monitoring and the adequate application of other environmental programs related to the reservoir.

Reservoir monitoring is necessary to avoid any significant reduction in the quality of the water resources. This could even harm energy production as well as the survival of the aquatic fauna living in or near the reservoir.

Table 78 - Liminological Monitoring and Water Quality Program;

Componente Ambiental	**Meio Físico**	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	**Preventivo**	**Corretivo**	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	Temporário	**Permanente**	

- Sediment Monitoring Program

The construction of a dam and the formation of its reservoir normally modify the natural conditions of the water course. Regarding sediment, the dams cause a reduction in current speed, provoking the gradual deposit of sediments carried by the water course, causing silting, gradually diminishing the storage capacity of the reservoir and even suspending power plant operation, as well as causing various environmental problems.

As the presence of solid sediments is directly related to the erosion and sedimentation process, this Project should be started alongside the other environmental programs related to the reservoir, which aim to control these undesirable impacts, impeding or eliminating the degradation of areas used by the works and areas surrounding the reservoir.

As a main goal this project will identify and quantify the environmental situation upstream and downstream of the reservoir. Three different periods will be covered by the survey: before, during and after the construction of the dam, also including its operation

Table 79 - Sediment Monitoring Program;

Componente Ambiental	**Meio Físico**	Meio Biótico	Meio sócio-Econômico
Caráter/Eficácia	**Preventivo**	**Corretivo**	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	Temporário	**Permanente**	

- Environmental Management Program for Solid Waste and Liquid Effluents

Santa Luzia Alto presents preventative measures to be adopted from the beginning of the works, to avoid or reduce the processes of degradation and contributing to maintain a high level of environmental quality on site.

The Project will implement environmental control systems and measures on the works site, to avoid the site operation impacting or contaminating the environment in the directly affected area or its surroundings. Therefore, a project will be developed encompassing the entire site.

With regard to the solid waste produced on the works site, this should go through stages of separation, following the Management Program for Solid Waste and also fulfilling the requirements in CONAMA Resolution 307/02, wish establishes directives, criteria and procedures for the management of civil construction waste.

In the same way, the sewage from the site workers' accommodation should be disposed of using an adequate treatment system, with physical-chemical analysis of the effluent. - Fauna Rescue and Management Program

Table 80 - Environmental Management of Solid and Liquid Effluent Waste Program.

Componente Ambiental	**Meio Físico**	Meio Biótico	Meio sócio-Econômico
Caráter/Eficácia	**Preventivo**	Corretivo	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	Temporário	**Permanente**	

- The Fauna Rescue and Management Program

The Fauna Rescue and Management Program aims to preserve the existing fauna in the area surrounding the project, more specifically in the areas that will be affected by construction of the project and within the area that will be flooded, preventing animals from being hurt, or at least minimizing the effects, protecting the works from the occurrence of environmental problems involving wild animals.

The rescue of local fauna should occur at the same time as the clearing of vegetation and filling of the reservoir. This is a critical moment and should be a gradual process, not carried out in the spring, when many species are breeding. The rescue planning can use the relief and the remains of the forest as strategic points for rescuing fauna.

The rescued species should be sent to pre-established areas, preferably to nearby forest remains. This can repopulate the permanent preservation area surrounding the reservoir, guaranteeing population maintenance.

The fact that the animals will then live in protected areas will certainly contribute towards an increase in the populations and create territories. Different to the situation faced in the current project area, the animals can rely on a more stable situation.

The rescue should be accompanied by educational activities, with a view to learning about the local fauna, by registering species found, collecting data such as weights, size, age etc. Therefore, this program will increase knowledge of local fauna, based on a biometric survey which will include the availability of animals in order to collect scientific information, incrementing the existing scientific bases.

Signs and traffic signposts should be installed, alerting to the presence of wild animals on the roads which lead to the works site. The employees and even the local inhabitants will receive instructions via the Environmental Education Program, a fact that will help reduce fauna mortality.

Table 81 - Fauna Rescue and Management Program;

Componente Ambiental	Meio Físico	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	**Temporário**	Permanente	

- Icthyofauna Rescue and Management Program

The construction of a hydroelectric power station cause modifications in the aquatic environment and in the communities present (SALE 1985). It causes alterations to the hydro system of a given section of a river where it is built, resulting in modifications in the aquatic ecosystem in function of the transformation of a lotic environment into a lentic.

The new environment, formed after the damming, will present different characteristics from the original and the communities significantly differ from those which occur on original lotic sections or those that remain. Therefore the result of this project, in regard to aquatic fauna, is the alteration in the abundance and richness of species, with proliferation of some and the reduction of others (AGOSTINHO 1994).

The Icthyofauna Rescue and Management Program aims to ensure better understanding of the local Icthyofauna, using the management and rescue program to mitigate, in the most efficient form possible, environmental damage caused by the project in this ecosystem, and save the fish imprisoned on site.

Table 82 - Icthyofauna Management and Rescue Program:

Componente Ambiental	Meio Físico	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	**Temporário**	Permanente	

- Management and Rescue of Flora Program

This program aims to learn about, rescue and preserve in other locations, such as the riparian forest and legal reserve area, samples of the main plant species in the areas to be flooded by the reservoirs at the Santa Luzia Alto SHS, in the works site and especially the species threatened with extinction.

One of the first things to be done to determine monitoring areas is a study of the vegetation coverage map, as well as forestry and fauna inventories, identifying important corridors for the natural movement of the fauna and the characteristic species in this region. This program should be closely associated with the other programs, mainly the Environmental Education Program, which should interact with the population in the area of influence, informing them of the importance of the studies being carried out, also stimulating awareness of the project in the region and the efforts that are being made for environmental conservation.

The rescued species, especially those threatened with extinction, should be kept in conditions so that they can be reinserted into the environment at a later date, either in the riparian forest or during recovery of degraded areas in general. For this the Management and Rescue of Flora Program needs a basic operational infrastructure composed of a nursery for cuttings, as well as support from scientific institutions for the use of the botanic material rescued.

Table 83 - Flora Management and Rescue Program;

Componente Ambiental	Meio Físico	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	**Temporário**	Permanente	

- Recuperation of Degraded Areas Program

This program should be implemented from the start of the construction works and over the first two years of the operation of the power station. This is to ensure the preservation of the local natural resources over the lifetime of the project. The program will not only accompany the development of possible erosion processes, containment work for these processes, especially the drainage system and the replanting of all the areas occupied by the project and the riparian forest. It will also promote the reintegration of the landscape of these areas and also guarantee the integrity of the project.

The construction of the Santa Luzia Alto SHS requires construction of works sites and accommodation, the use of construction materials, the availability of dumps and the opening of service roads, which due to their nature; include earthmoving operations, excavations and the creation of new slopes, embankments and landfills. All these disturbances of a natural resource (the soil) tend to trigger or accelerate erosion when already present. This will harm the natural vegetation, the associated fauna, agricultural pasture and forestry production, social and economic activities and the drainage channels, and may even silt up the reservoir.

This program aims to preserve the water resources, the landscape and the banks as a support for the natural vegetation. These objective turn into actions on two main fronts: in the areas affected by the construction works of the SHS – works sites, accommodation, service roads, siphon box and others, and the areas surrounding the future reservoir.

All the possible interference involving the soil, resulting from the construction of the Santa Luzia Alto SHS, justify the prevention and mitigation projects. In brief, the measures grouped in this program, starting with the maintenance or recuperation of the soil quality, and the substrate, support replanting of original plant species or the restarting agriculture, forestry and pasture in the areas degraded during the project construction, reintegrating them with the local landscape.

The plant cover in these areas, whether natural or agricultural, plays an important role in the soil stability, avoiding the production of sediments in the drainage system and also contributing to the preservation of the regional fauna and flora.

The areas will have specific procedures, according to their use before the project. In the areas that will suffer temporary alteration of use, such as works sites, dumps, leased areas and some of the service roads, recovery will be total and they will return to their original condition.

The areas that will suffer permanent change of use, such as some of the water channel and some of the service roads, will be subject to specific projects involving tree planting, while the new banks and part of the siphon boxes should be reintegrated through the forest replanting program. For the planting of native species of flora, the possibility of re-introducing species that have disappeared from the region should be considered.

This program should also include and stimulate conservation activities in the neighboring areas around future reservoir, using the physical and technical apparatus that has been defines by the Project, distributing saplings and other plants and providing guidance on their planting and management.

All the areas that are specifically degraded due to the construction project are the responsibility of the construction company.

Table 84 - Restoration of Degraded Areas Program:

Componente Ambiental	**Meio Físico**	**Meio Biótico**	**Meio sócio-Econômico**
Caráter/Eficácia	**Preventivo**	**Corretivo**	
Agente Executor	**Empreiteira**	**Consultora**	Poder Público
Duração	**Temporário**	Permanente	

- Clearing of Vegetation and Cleanup of Flooded Area Project

The Vegetation Clearing and Reservoir Cleanup consists of a group of activities which comply with environmental law and also fulfill technical and operational requirements.

In legal terms, compliance with the conditions of the Installation License, as well as all current environmental legislation for the environment, avoid environmental damage after flooding of the vegetation, such as the proliferation of macrophytes and changes in the quality of the water; other effects of a technical and operational character, avoiding damage to the structure of the dam or the equipment (turbines, tubing of the sanitary discharge) hit by branches or trunks brought in by the water flow.

This program presents the procedures for the removal of vegetation, solid waste and other materials that could contaminate the water or float during the flooding of the reservoir. These actions will be supported by removal, rescue and use of flora, as well as fauna rescued from the works site and its access roads and the banks and surrounding areas of the river bed which will be flooded when filling of the reservoir.

Even though this program aims to save the flora, the strategy adopted attempts to integrate vegetation clearing with fauna monitoring, providing for more sensible natural migration, in an ordered and gradual manner, which is referred to as indirect management.

Table 85 - Vegetation Clearing and Cleanup of Flooded Area Program;

Componente Ambiental	Meio Físico	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	**Preventivo**	Corretivo	
Agente Executor	Empreiteira	**Consultora**	Poder Público
Duração	**Temporário**	Permanente	

- Replanting of Vegetation in the Riparian Forest

This program, in addition to other important items, focuses on replanting the area around the reservoir of the Santa Luzia Alto SHS, and will comply with Resolution CONAMA nº 302, of 20th of March 2002, article 3, in which it refers to the Permanent Preservation Areas around reservoirs.

The actions related to this project are mainly permanent activities and are integrated with other projects such as the Recuperation of Degraded Areas Program and the Management and Rescue of Flora Program, as well as with other diverse environmental programs.

The restoration of the riparian vegetation cover, planting early, secondary and late secondary bush and tree species, applying the principle of permaculture, which establishes a balanced system, integrating components with different functions, belonging to the ecosystem surveyed, using natural techniques. This is one of the most efficient processes to recover the soil bio-structure, where the roots of the plants retain part of the rainwater and the nutrients essential for their development. The shoots and foliage protect the soil from the sun's rays and serve as a shield from the impact of the rain drops which provoke erosion of the soil, with subsequent surface erosion.

The replanting process should use the greatest possible variety of species that are found around the project as long as they are able to recover. Also important are natural seed dispersal mechanisms, therefore the following basic directives should be followed:

- Only use pioneering species, for naked soil and early secondary and late secondary species in areas covered with initial stage vegetation;
- Consider that many species established above the dam, in remaining areas, will have their fruit and seeds transported to the banks of the lake. Therefore, a small strip, just above the flood line, should be left for natural repopulation based on fruit and seeds transported by the currents and waves;
- Emphasize planting of rare plants and species threatened with extinction. **Table 86** - Replanting of the Riparian Area Program;

Componente Ambiental	Meio Físico	**Meio Biótico**	Meio sócio-Econômico
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	**Empreiteira**	**Consultora**	Poder Público
Duração	Temporário	**Permanente**	

- Creation or Stimulation of Conservation Units Program

Article 36 of Law n^{o} 9,985, dated 18 July 2000 which created the National System of Units of Conservation in Nature - SNUC, determines that in environmental licensing of projects with a significant environmental impact, the construction company is obliged to support the project and maintain a conservation unit of the Integral Protection Group.

The value of environmental compensation, based on resolution CONAMA n^{o} 371, dated 5th of April 2006, is fixed at half a percent of the predicted costs for the construction of the project until the environmental authority establishes and publishes methodology defining the level of environmental impact.

The installation of the Conservation Unit - UC and the maintenance of the Permanent Preservation Areas – APPs and the Legal Reserve protect the banks of the reservoir, maintaining the more representative areas of the local ecosystems, promoting the social benefits that river and lake bank forests offer, involving the health and leisure of the local populations, associated with the esthetic composition of the landscape that was changed by the construction of the SHS.

Table 87 - Creation or Stimulation of Conservation Units Program;

Componente Ambiental	**Meio Físico**	**Meio Biótico**	**Meio sócio-Econômico**
Caráter/Eficácia	Preventivo	**Corretivo**	
Agente Executor	**Empreiteira**	**Consultora**	**Poder Público**
Duração	Temporário	**Permanente**	

- The Director Plan for Conservation and Use of Land Around the Reservoir

One of the main contributions of the Plan for Conservation, Use and Occupation of Land Around the Reservoir is the protection of its banks. This will contribute above all else to its conservation, and consequently towards restructuring the ecosystems, as well as improving the quality of life of the population and indirectly improving the quality of the surrounding landscape.

It will also restore all of the areas directly affected by the works, including those that correspond initially to the protected areas around the reservoir, justifying the actions proposed in this plan to improve environmental quality.

This plan aims to establish and implement a zoning area which simultaneously complies with legal requirements, respects the capacity of environmental support for the area and the value the landscape has in the local community and also the possible uses of the reservoir and its surrounding areas. These include activities involving preservation, leisure, fishing and irrigation.

The target group for the plan is the entire population of the municipal regions of Ipuaçu and São Domingos, who will benefit directly, as well as the populations of other municipal regions, mainly those living not far away, who can come and benefit from yet another leisure area.

In the development of the plan, which is mainly based on socio-environmental sustainability, we should consider two areas of interest: focus on environmental quality and focus on mass population involvement.

- Focus on the environmental quality.

This focus mainly involves the analysis, measurement and promotion of improvements to current environmental conditions. This involves three phases: analysis, planning and deployment, if the community and the local government shows interest, it can later incorporate an evaluation phase.

The analysis covers the internal and external issues, the environmental potentials and the risks. It also has a political-institutional profile and the contributions and expectations of the social agents. The planning starts then creating the Plan: the main issues are the zoning for conservation use and occupation of the soil around the reservoir. The project involves implementing the Plan and should occur as described therein.

- Focus on the participation of the local population.

As the main basis of the plan is sustainability with democracy as one of the main pillars of sustainable development, also considering the legal aspects which guarantee the involvement of the public, the Plan should be the result of a process that involves government institutions, the construction company and the community.

To reach this goal, the Plan should propose a systematic structure, with a view to progressive engagement, in a way that the level of involvement of the community in the zoning project will lead to effective participation.

This should involve joint creation of mechanisms to transfer knowledge by the construction company and the local municipal government, based on technical meetings (meetings and talks), in order to inform, communicate and (re)educate the population, to establish the goals and stages of the development of the Plan.

The socio-environmental zoning of the study area shall be defined from the Environmental Units, previously defined. This will be the basis for creating the Plan to Conserve, Use and Occupy the Land Around the Reservoir, comprising the rules defining the use and occupation of the land and the conditions for the use of natural resources.

The policy adopted for zoning is to optimize resources and adapt the planning and the project of the actions that aim for sustainable development in the region, including the creating of areas for leisure and tourism.

After this is discussed, reviewed and approved, the Plan should be executed, always with the participation of the local population.

All the activities to be developed in the Plan, are directly or indirectly associated with the activities of different programs and projects that will be executed during the project.

Table 88 - Director Plan of Conservation, Use and Occupation of the Soil Around the Reservoir of Santa Luzia Alto SHS.

Componente Ambiental	**Meio Físico**	**Meio Biótico**	**Meio sócio-Econômico**
Caráter/Eficácia	**Preventivo**	**Corretivo**	
Agente Executor	**Empreiteira**	**Consultora**	**Poder Público**
Duração	**Temporário**	Permanente	

Table 89 – Spreadsheet of the Environmental Control Measures.

IMPACTOS AMBIENTAIS											
	Alteração na paisagem		X							X	X
	Formação de áreas degradadas		X							X	
	Alteração na qualidade da água		X						X		
	Erosão das margens do reservatório		X						X		
	Alteração na fauna aquática com a mudança do regime hídrico		X								
	Supressão da vegetação		X							X	
	Aumento da mortandade da fauna terrestre		X	X	X						
	Proliferação de macrófitas		X								
	Insegurança e expectativas da população local em relação ao empreendimento		X	X	X						
	Interferências com o cotidiano das comunidades próximas às obras		X	X	X						
	Insegurança do tráfego local durante as obras		X	X							
	Melhorias no sistema viário	X									
	Remanejamento da infra-estrutura existente		X	X	X	X					
	Dinamização das atividades econômicas	X		X	X						

	Formação de áreas favoráveis a proliferação de vetores e endemias		X								
	Aumento da especulação mobiliária			X	X	X					
	Aumento na oferta de energia elétrica	X		X	X						
	Perda na infra-estrutura e de solos com potencial agropecuário			X	X	X					
	Alteração da balneabilidade do rio a montante do empreendimento		X	X	X	X					X

10.6. Project Deactivation

In virtue of the nature of the project it is not appropriate to establish a deadline for deactivation even though a Small Hydro-electric Power Station - SHS fits into a series of operational, location, economic, characteristics that override the rules for more common projects such as industries, landfills, etc. It is therefore difficult to carry this out with little basis to establish recovery measures for deactivation of the SHS.

11. TECHNICAL TEAM

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13. EXHIBITS

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13.3. General Management of Works

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