ARCADIS Design & Consultancy for natural and built assets

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

Piauí Nickel Project

Volume III

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PIAUÍ NÍQUEL METAIS S.A

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6. Integrated Analysis

Integrated Analysis is an interdisciplinary exercise that seeks to assess the relationships, processes and dynamics existing between the relevant environmental, social and cultural attributes identified in the diagnostics of the physical, biotic, and socioeconomic environments, explaining the relationships of dependence and / or synergy between the environments , in order to understand the structure and environmental dynamics in the area of influence, offering subsidies to the following activities:

- More accurate assessment of the environmental and social impacts resulting from the implementation, operation and closing of the project, taking as a reference the weaknesses and potential identified in the Environmental and Social Diagnosis;
- Proposition and elaboration of Environmental and Social Programs, and Prognosis.

The Integrated Analysis was prepared for the limits of the Area of Direct Influence (ADI) of the Physical, Biotic, and Socioeconomic Environments, covering the structural aspects of this landscape: environmental attributes and the existing occupation, considering the following environmental themes:

- Physical Environment:
  - Susceptibility to processes of physical nature;
  - Surface and Underground Water Resources;
  - Air and Noise Quality;
  - Natural Caves.
- Biotic environment:
  - Protected Areas
  - Flora
  - Fauna community (terrestrial and aquatic).
- Socioeconomic Environment:
  - Occupation Process;
  - Infrastructure;
  - Population close to the project;
  - Cultural, Historical and Archaeological Heritage.

In view of this, inter-thematic considerations were outlined, highlighting the weaknesses and potentialities, and their relationships and / or synergies. Regarding the attributes of the physical environment referring to the themes of geology, geomorphology and pedology, the DAA's and the ADI's Potential Fragility Map synthesizes, from the interaction between the aforementioned disciplines, the terrains in levels of fragility and susceptibility to the processes of superficial dynamics (erosion).

According to the aforementioned mapping, it is possible to verify that the land in which the structures of the project are planned are divided as follows:

- 840 hectares (or approximately 72%) are composed of areas with low fragility;
- 37 hectares (or approximately 3%) for areas with medium to high fragility;
- 68 hectares (or approximately 6%) are highly fragile; and,
- 218 hectares (or approximately 19%) correspond to areas with very high fragility.

It is important to point out that the mining-industrial complex is based on land of very low fragility, with the exception of the nickel pit that will be implemented in the Brejo Seco hill, where land of very high fragility predominates where potentially mass movements and significant erosive processes can be triggered.

Another sector sensitive to the processes of surface dynamics, especially erosion processes, is the land near Chapadas do Mundão and São Domingos, located in the northern part of the AII / ADI where stretches of 'Medium' to 'High' fragility are notorious, where the implementation of the transmission line that will interconnect the Brejo Seco complex to the São João do Piauí substation. The ADI still has a small area of greater fragility of soils in the region of Serra da Garapa, where the access to the limestone deposit will pass.

In addition, the areas of fluvial plains must be highlighted, especially when associated with larger drainages since these areas have greater potential to silting and vulnerability to contamination of shallow aquifer systems, as in the case the Caraíbas stream and the Itaquatiara stream, crossed by the future access to the limestone mine.

The main water courses that drain the ADI and DAA are intermittent and are located on the right bank of the Piauí River, with emphasis on the Várzea stream, Gameleiras stream, São Domingos stream, Itaquatiara stream and the Caraíbas stream. The waters stored in ponds and dams in the region are intended for multiple purposes, such as human supply, domestic activities, bathing, recreation, fishing and animal drinking. The large regional source corresponds to the Jenipapo water Dam built by DNOCS on the Piauí River, with a capacity of 248 million m³.

The sampled water bodies already show signs of alteration in their quality, considering that some results were recorded in non-compliance with CONAMA Resolution No. 357/05 for class 2 waters. The parameters that stood out with results above the limits fixed by federal legislation were thermotolerant coliforms, BOD, oxygen, phosphorus, turbidity and some metals.

The tributaries of the Gameleira stream, such as the Várzea stream and the Itaquatiara stream are the ones most likely to suffer some kind of alteration in the quality of the water or in its configuration in the construction, operation and closure phases of the project, due to their location in relation to the main structures of the project (Umbuzeiro and Brejo Seco Mines), but other surface drains may also undergo some type of punctual intervention during the implementation of the transmission line and water pipeline.

With regard to hydrogeology, it is important to note that the most fragile area and the most vulnerable to groundwater contamination is the Umbuzeiro region, recognized as an area of occurrence of carbonate rocks, which constitutes a karst environment, which have high values of permeability, due to the fracturing of these rocks, as well as high water flow speeds, mainly because they are duct systems. The risk of possible groundwater contamination limestone mining will be addressed in the chapter on environmental impacts of this study.

As detailed in the Environmental and Social Diagnosis, the mining areas (nickel and limestone) are considered to be the most relevant for the propagation of vibration and noise, since in these areas the rock will be dismantled using explosives. It is important to highlight the existence of receivers close to these locations but outside the most critical areas and within the legal limits as shown in item 5.1.10 (Volume II). The closest communities to the two mining fronts where the explosives will be used correspond to the Brejo Seco community (720m from the nickel mine) and the Umbuzeiro community (1,724m from the limestone mine). For both calculations they indicate that the limit given by the current technical standard (134 dBL according to ABNT-9653/05,) will be respected.

Another highlight regarding the physical environment, corresponds to the characteristics of local air circulation combined with low rainfall and low humidity during most of the year, which favor the suspension of particulates in the atmosphere. This feature of the region will also receive contributions for mining activity considering the entire cycle of extraction and processing of ores during the life of the project, with the communities in the immediate vicinity corresponding (in principle) to the involuntary recipients of this material.

Regarding the Speleological Heritage, four environments with potential for the formation of natural underground cavities must be highlighted, they are:

- Carstified zone: region known as Umbuzeiro (future limestone pit);
- Talus zone: sectors of the Serras do Milhan and Aldeia close to the stretch of road connection between the Umbuzeiro region and Brejo Seco (future industrial complex);
- Lateritic canga zone: Brejo Seco hill (future nickel mining); and
- Sandstone escarpment zone: escarpment sectors associated with Chapadas do Mundão and São Domingos (future transmission line and pipeline).

After the execution of the speleological prospecting, it was concluded that only the sector of the 'Arenitic Escarpment Zone' close to the Chiqueirinho Community presents speleological features with some degree of importance and that potentially can be impacted by the present project, particularly by the structures of the water pipeline and Transmission Line. However, it is worth mentioning that according to the existing project, the pipeline must have its route defined in the region's valleys and plains, far from the slopes and escarpments. On the other hand, the construction of the TL, which can be carried out in any way regardless the relief, allow a high flexibility degree as to the places of effective impact on the region, and the distance between towers, the height of the LT and even the alignment between them, which can avoid any impact on any important geological and speleological features that are in their vicinity.

The surveys of regional and local flora did not indicate the presence of peculiar vegetation formations or with restricted occurrence in the region that basically corresponds to a continuum of caatinga in 3 phytophysiognomies (dense, open and sparse) that are distributed in the landscape according to the edaphic conditions and with the history of use, occupation and current and past disturbances.

Therefore, there is no stretch or fragment of native vegetation in the entire DAA and ADI of the project that requires special attention or the modification of its project to reduce the projected impact beyond the proposed control and mitigation measures.

It is worth highlighting the constant selective pressure on native vegetation exerted by free and intense grazing by animals raised extensively in the region whose traces and presence were found in all surveyed points. The predation of vegetation by domestic animals extends to a large number of plants considering that the different herds of cows, horses, donkeys and pigs have their particular preferences and a distinct ability to seek and reach portions of plants at different times. There are empirical indications that this intense grazing done mainly by goats, exerts a significant selection in the natural processes of succession and survival of local plant species, practically eliminating the natural regeneration of the most palatable plant species.

Regarding the results of the survey of the local fauna, they pointed out that it consists of species adapted to open areas as expected for an area planned in the caatinga biome, some of which are endemic to this biome.

Considering the relief and vegetation cover remaining in the region, it can be said that there are no significant barriers for the fauna's transit, and the surveys presented can be considered as representative and as good indicators of environmental quality that must be maintained if not improved with the insertion of the project as planned.

In terms of diversity, around 107 species of birds (none threatened with extinction) were identified, as well as 18 species of terrestrial mammals (with 5 threatened species), 6 species of bats (none threatened but with 3 dependent on karst environments), 14 species of amphibians (none threatened), 19 species of reptiles (none threatened) and 46 species of fish (none threatened but 9 endemic to the Parnaíba River Basin).

The results above demonstrate that the region still has a good diversity of animal species, but with a low occurrence of endangered species, some of which were recorded only through interviews as in the case of medium and large mammals. The exception is the Mocó (*Kerodon rupestris*) whose occurrence in the ADI was verified by direct sighting, which determines a point of attention for the analysis of the impacts of the project.

In relation to insects, the field survey focused on two groups considered as most important for their relationship with public health, acting as vectors of diseases. In this respect, the results registered the occurrence of 7 species of mosquitoes (anopheles) with epidemiological potential, as well as 2 species of kissing barbers (triatomids) known to transmit Chagas disease. These results must also be taken into account by the project when they are installed in the region, being reflected in their mitigating and compensatory measures aimed at educating the population regarding care to prevent the increase and spread of the population of these animals.

In addition to the study of the aforementioned groups, the characterization of hydrobiological communities was carried out, involving species of zooplankton, periphiton and benthic macroinvertebrates, as a way of assessing the ecological quality of local water bodies. The results in all groups show that during the study period, although organisms considered to be resistant to environmental changes and low water quality were found predominantly, the presence of some that develop mainly in oligotrophic environments was also noted, being very sensitive to changes of anthropic origin in the environment. However, it is worth noting that the natural low rainfall regime has a great impact on aquatic organisms regardless of whether or not the project is installed in the region. In this regard, the frequent interruption of water courses (lotic environments), concentration of nutrients and pollutants (with an important contribution from animal waste and even of anthropic origin) in reservoirs, weirs, lakes and ponds (lentic

environments) during the long dry season, already substantially alter all physical and even chemical parameters of water sources periodically throughout the year.

In relation to socioeconomics, the Piauí Nickel Project intends to settle in municipalities that have a history linked to the occupation of northeastern Brazil for livestock production, still in the 17th century, and which in a certain order still remains in the region.

Given the economic and productive characteristics, the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira and Dom Inocêncio, have a small population, the first two with less than 5,000 inhabitants, and the last with about 10,000 inhabitants, and have the largest portion of its residents (between 70% and 80%) living in rural areas. São João do Piauí, for being a local economic pole, aggregating activities of commerce and better developed services, has a relatively larger population, of about 20 thousand inhabitants, with 70% of the inhabitants living in urban areas.

With regard to the economy, it is observed that the smaller municipalities, Campo Alegre do Fidalgo, Capitão Gervásio Oliveira and Dom Inocêncio, are highly dependent on the public sector in the economy, both in the generation of formal jobs, since public administration in these municipalities account for the generation of about 90% of employees, as in value added (VA), in view that 70% in the VA correspond to public administration. It is worth noting that in these municipalities, although they have the majority of the population in rural areas, agricultural activities are of low value, accounting for about 10% of the VA.

In São João do Piauí, the greatest economic dynamics can be observed by the greater diversity in the composition of the VA and in the generation of formal jobs, since in this municipality the sectors of commerce and services are as relevant as that of public administration, about 45 % each.

Regarding public infrastructure and services, it is observed that there is a deficiency in the ADI municipalities in several aspects. In basic sanitation in general, the municipalities do not have a sewage collection or treatment system, the water supply network is non-existent or quite deficient, and garbage collection where existing does not have the correct destination, and open dumps are also used.

The education system in the municipalities of the ADI is basically formed by public schools, and in the municipalities with the largest rural population, it is difficult to move students, because, although public transportation is offered, the distance from schools makes the process extremely tiring for students in many cases.

The health service network in the municipalities of the ADI is basically composed of Health Centers / Basic Health Units or Health Posts in the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira and Dom Inocêncio. In São João do Piauí, in addition to the basic units, there are two hospitals that serve as a reference center for other municipalities in the region, including Campo Alegre do Fidalgo and Capitão Gervásio Oliveira. The health services offered at the ADI are deficient, especially with regard to specialized services, which are sent to the capital Teresina, which increases the spending of municipalities on patient transport.

In the area of insertion of the project, 15 surrounding communities were identified, eight in Capitão Gervásio Oliveira, two in Dom Inocêncio and five in São João do Piauí, which are likely to suffer direct impacts as a result of the Piauí Nickel Project. These communities are formed

by small rural properties used in subsistence agricultural production, especially with the creation of goats.

The breeding of animals takes place extensively, with the animals being free for movement in the region, since the confined breeding proves to be unfeasible given the low technological level and the long periods of drought, which makes the animals depend on themselves to feed from the caatinga vegetation, present throughout the region. Given the low productivity of these properties, as well as the weak local economy, the residents of these communities mostly have low socioeconomic conditions, being economically dependent on the Bolsa Família Program, having low educational levels, and being poorly served by public services, especially those of basic sanitation.

Given the rural characteristics, the communities present low circulation of people or vehicles, showing attributes of connection with the local landscape and very bucolic aspects.

Thus, it is observed that the Piauí Nickel Project insertion area, surrounding communities and ADI, present a very unfavorable socioeconomic situation with little diversified economic activities, showing great dependence on the public administration (both in generating jobs and providing income support for residents), the situation being relatively better in São João do Piauí. The low level of education of the residents, the low quality and the little offer of infrastructure and public services, such as health, sanitation and education, add up to the region's current conditions.

From the archaeological point of view, the project areas and it's surroundings were prospected for the diagnosis of the presence of sites. Not all areas of research have brought positive results, but according to the technical report presented, all remainings found in the researched areas have been properly recorded and collected. The report presents that the archaeological prospecting and rescue works have been satisfactorily completed, and the project now awaits for a positive manifestation from IPHAN for the award of the Project's Linceça Previa – LP from the competent environmental authority (SEMAR).

7. Identification and Assessment of Environmental and Social Impacts

7.1. Methodological Approach

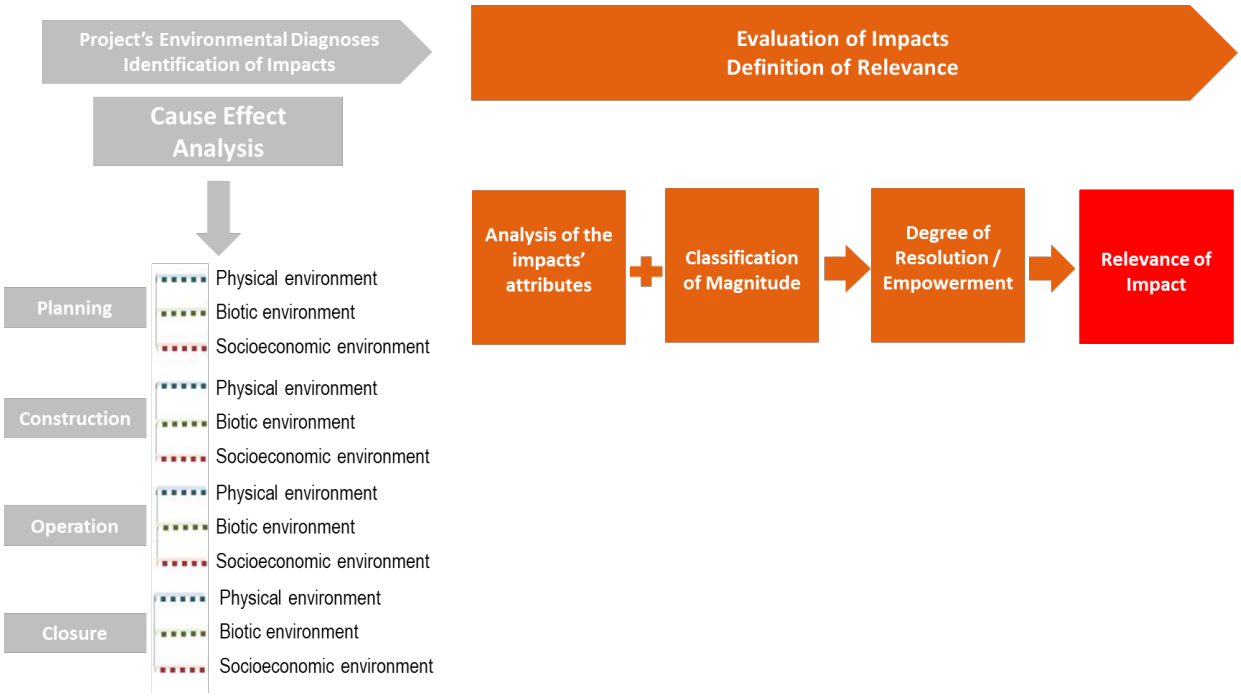
The methodology used to identify and assess the occurrence of environmental and social impacts, is based on the crossing of the impact generating actions (activities and aspects), identified in the Project Description chapter, with the environmental components (physical, biotic, socioeconomic and cultural environments), subject to change, depicted in the Environmental and Social Diagnosis.

First, in the identification stage, the crossing of activities and aspects was used, which will result in the initial list of environmental and social impacts (section 7.2).

Subsequently, an assessment of the impacts identified above was carried out, considering, according to Sánchez (2013), that evaluating impacts is a way of classifying them and separating the most important from the others.

In the evaluation stage, impacts are weighted according to attributes, such as Nature, Extent, Reversibility and Magnitude. The impacts are evaluated according to their intrinsic characteristics (attributes), a magnitude that, together with the degree of resolution of the proposed measures, end up revealing the degree of relevance (or significance) of the impacts (Figure 7.1-1).

Figure 7.1-1 – Impact Assessment.



Source: Arcadis, 2017.

The following is a summary of the elements to be used in the impact assessment: attributes; magnitude; measures; degrees of resolution and relevance to be considered and, subsequently, the tables Impact Attributes, Degree of Resolution and of Relevance (Table 7.1-1).

Table 7.1-1 – Impact Assessment elements.

Attributes	Magnitude	Measures	Degree of Resolution	Degree of Relevance
- Nature; - Occurance-Probability; - Occurance-Term; - Occurance-Spatiality; - Order; - Reversibility; - Form of interference - Duration;	- Small; - Medium; - Large	- Management; - Control and Monitoring; - Supervision; - Mitigation and Compensation; - Relationship	- Low; - Medium; - High	- Low; - Medium; - High

Source: Arcadis, 2017.

In Table 7.1-2 the criteria associated with the attributes are described.

Table 7.1-2 – Impact Attributes.

Impact Attributes	
Nature - positive (P) when it results in improving the quality of one or more environmental factors or parameters or; negative (N) when causing adverse effects on the quality of one or more environmental factors or parameters.	POSITIVE NEGATIVE
Probability - certain (C) with 100% probability of occurrence or; probable (P), associated with some degree of probability.	P - PROBABLE C - CERTAIN
Order - direct (D) when it results from a simple cause and effect relationship; indirect (I) resulting from a secondary relationship in relation to the action or when it is part of a chain of reactions.	D - DIRECT I - INDIRECT
Spatiality - localized, situated in a restricted space or; dispersed, comprising an extensive territorial distribution.	L - LOCALIZED D - DISPERSED
Term - the impact can be immediate, medium and long term. Immediate impacts are those that occur simultaneously with the action that generates them. Impacts in the medium or long term are those that occur with a certain lag in relation to the action that generates them; adopting an average term for the impacts that occur within 12 months after the start of the impacting action, and the long term, above one year (adapted from SANCHEZ, 2013).	C - IMMEDIATE M - MEDIUM L - LONG
Reversibility - reversible (R) when, once the action has ceased, the affected environmental factor or parameter returns to the original conditions or similar to that which would have been established if the impact had not occurred, or; irreversible (IR), when, once the action has ceased, the affected environmental factor or parameter does not	R - REVERSIBLE IR - IRREVERSIBLE

Impact Attributes	
return to the original conditions, thus characterizing non-mitigable impacts in whole or in part.	
Form of interference – in the sense of specifying whether the impact in the environment under analysis is caused by the project, or; on the contrary, an existing process, part of the regional dynamic, is intensified.	C - CAUSED I – INTENSIFIED F – NEW FACT
Duration - temporary are those that only manifest during one or more phases of the project and that cease when that phase ends, or cease when the action that caused them ends, permanent represent a definite change that has an indefinite duration, these impacts remain after the action that caused them ends (SANCHEZ, 2013).	P - PERMANENT T - TEMPORARY
Magnitude of Impact	
Largeness of an impact in absolute terms, which can be defined as the measure of change in the value of an environmental factor or parameter, in quantitative or qualitative terms, caused by an action. *Represents a definite change to a component of the environment or, for practical purposes, a change that has an indefinite duration.*	SMALL MEDIUM LARGE

Source: Arcadis, 2017.

In an associated way, it is possible, in this stage of the study, to previously indicate control, mitigating, compensating and monitoring measures for negative impacts, or potentializing measures to positive impacts.

Thus, depending on the effectiveness of the measures and those responsible for implementing them, a degree of resolution is associated (Table 7.1-3), as follows:

Table 7.1-3 – Degree of Resolution.

Degree of resolution: Attenuation power	
High resolution, in situations where it is possible to eliminate, significantly reduce the intensity of the impact or compensate for it, and even when the project is fully responsible for its implementation.	**Positive Impact** **Negative Impact**
Medium resolution, in situations in which it is possible to reduce the intensity, or when, although it is possible to significantly reduce the intensity of the impact, the project is co-responsible for its implementation, as also governmental or non-governmental institutional entities participate.	**Positive Impact** **Negative Impact**

Degree of resolution: Attenuation power	
Low resolution, the measure has no possibility of significantly reducing the impact, or even when the project is an articulator of other institutional entities that should implement the measure given their legal competence.	**Positive Impact** **Negative Impact**

Source: Arcadis, 2017.

With this set of characteristics, articulating the results to the attributes, the magnitude and the degree of resolution of the proposed measures, results in the Relevance Degree (or significance) of the impacts in the case of implementation of the proposed measures (Table 7.1-4). Without rigidity in its use, the following criteria can be oriented to situations of negative impacts (in the case of positive ones, the reverse interpretation is valid), without exhausting all possibilities.

Table 7.1-4 – Relevance Degree of the impact.

Relevance Degree*	
High relevance - impacts of large magnitude and medium to low degree of effectiveness of the proposed measures.	Positive Impact Negative Impact
Medium relevance - impacts of medium magnitude, combined with medium or small magnitude and medium to low effectiveness of the proposed measures.	Positive Impact Negative Impact
Low relevance - impacts of medium magnitude and medium to high effectiveness of the proposed measures.	Positive Impact Negative Impact

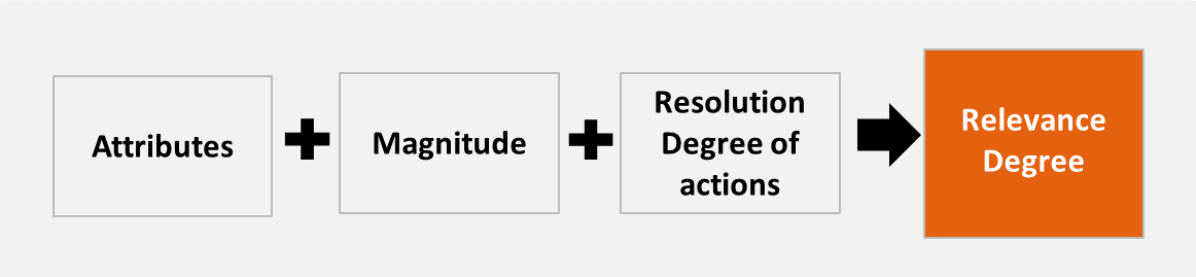
** Considering more relevant attributes: dispersed, irreversible, causative, permanent.*

Source: Arcadis, 2017.

It is also necessary to consider the extent of the measure in the target audience. In this resolution analysis, the magnitude of the impact should be considered in order to put its effectiveness into perspective. As an example, we can mention measures for training workers for reintegration into the labor market, whose implementation takes place through courses and training with limited vacancies, benefiting part of the population in a given area of influence and not guaranteeing its effectiveness (evidence thus the importance of quantifying whenever possible).

The summary of the procedures can be found in Figure 7.1-2.

Figure 7.1-2 – Procedures for analyzing impact resolution.



Source: Arcadis, 2017.

7.2. Identification of Environmental & Social Impacts

The impacts are classified according to the phase in which they occur, namely: planning, construction, operation and closure phase.

7.2.1. Planning Phase

7.2.1.1. Socioeconomic Environment

A) Creating Positive Expactations

Activity and Aspect	
Activity	Disclosure of the project
Aspect	Availability and circulation of information

A socio-environmental perception survey and about the project was carried out with part of the population residing in the Surrounding Communities and with other social actors such as representatives of public institutions and social organizations located in the municipalities of the project's Area of Direct Influence (ADI).

As presented in the Environmental and Social Diagnosis section of this EIA, the interviews were conducted between October 31 and November 5, 2016. A semi-structured script was used as an instrument for conducting the interviews, applied by a trained multidisciplinary team, in order to ensure reliability information collected.

In general, the population tends to feed expectations based on speculation and inspired, in large part, by the local needs and the difficulties of the public authorities to fulfill them. In the case of the Piauí Nickel Project, about 90% of the interviewees reported that they knew about the possibility of implementing the project, but were unable to provide additional information, limiting themselves to indicating that they already knew about the project since Vale was the owner.

Among the interviewees, 33% evaluated the possibility of implementing the project as something excelent and 57% as good. The positive expectations are related to the benefits that the project will provide to the region, such as the generation of jobs, economy boost and increase in the local trade market.

a) Impact Assessment

The creation of positive expectations is a **positive** impact, as positive perspectives on employment and economic dynamism can stimulate the professional qualification of the population as well as expand investments in economic activities. This **impact** is indirect, as it does not result directly from an activity of the project, and is **reversible**, because with communication actions and good relations with local social actors, throughout the planning period this impact tends to be mitigated, since the population becomes aware of the real possibilities to be generated by the project, which is why it can also be said that it has a **temporary** duration. Analyzing the history of the project in the region, these expectations have always existed in the population, however, with the resumption of studies for the Piauí Nickel Project, these started to be renewed, thus being an **intensifying** impact.

It is a **likely** impact, and is manifested in the **short term**, linked to rumors and initial information about the project, in a phase that precedes the project construction. Its spatiality is **dispersed**, exceeding municipal limits, as its disclosure depends exclusively on the dissemination of information among the population. As this impact is likely to occur and has a reversible and temporary character, it was assessed as of **small magnitude**.

Attributes			
Nature	Positive	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

A transparent and efficient process for the dissemination of official information about the project and its implications, as well as clarification of doubts and discussion around the expectations and limits of the project's responsibilities, aimed at the different actors in the region is essential to adjust the expectations created to the reality to be provided by the Piauí Nickel Project, promoting an environment of harmony between the project and the local population. For this, it is necessary to put in place communication channels between the project, the outsourced companies that execute the construction works, the population of the ADI, and other institutions and entities of the public administration and of the organized civil society.

In this way, the questions presented must be worked together with the actors involved in the Piauí Nickel Project, in a clear way, taking technical information and clarifying the pertinent doubts.

Therefore, the elaboration and implementation of a Social Communication Program is of great importance, which promotes dialogue between all parties, through periodic communication

instruments. Having knowledge of all the information about the project, the actors will then be able to ponder and adjust their expectations, position themselves in relation to the project and prepare themselves to make the best use of the opportunities offered and promoted by the Piauí Nickel Project.

c) Degree of potentiation of the Measures and degree of relevance of the impact

Degree of Empowerment and Relevance	
Degree of Potentiation of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of potentiation and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

B) Creation of Negative Expectations

Activity and Aspect	
Activity	Disclosure of the project
Aspect	Availability and circulation of information

As well as the positive expectations highlighted in the previous impact, the survey on socio-environmental perception and the project also captured some negative expectations from the population heard, although in a much lower amount. Concerns related to the presence of strangers in the region have been reported, changing daily life and above all, in relation to the possible increase in crime levels in the region.

In two surrounding communities (Várzea and Veredas Settlements), given the proximity to the Brejo Seco hill area, where the main structures of the project will be installed, concerns were raised about the possibility of the project having to remove families from the place where they are living, as well as to know how the land negotiations that will eventually have to be used by the project will take place.

In addition to the concerns raised by the interviewees, it is common for the possibility of large-scale projects to settle in small municipalities, such as the Piauí Nickel Project, to generate concerns in part of the population related to the increase in the occurrence of STDs, cases of pregnancy in adolescence, increased demand for basic infrastructure, and public equipment and services.

a) Impact Assessment

The creation of negative expectations is a **negative** impact, since expectations are based on speculations generally not coincident with the facts that the project will actually promote, in addition to generating anxiety and insecurity in the population. This impact is **indirect**, as it does not result directly from an activity of the project, and is **reversible**, since communication and good relations with local social actors, during the planning period, tend to reduce this impact, reason for which is considered to be of **temporary** duration. Analyzing the history of the project in the region, these expectations have always existed in the population, however, with the resumption of studies for the Piauí Nickel Project, these started to be renewed, thus being an **intensifying** impact.

It is a **likely** impact, and is manifested in the **short term**, linked to rumors and initial information about the project, in a phase that precedes the construction works. Its spatiality is **local**, limited to the municipalities of the ADI and the Surrounding Communities. Considering that the impact is likely to occur and is reversible and temporary, it was assessed as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

As well as the impact of positive expectations and negative expectations, the main mitigation measures are the dissemination of official information about the project and its implications, as well as clarification of doubts and discussion about expectations, especially those that are already latent in the company. region.

In this case too, it is shown to be of great importance to the elaboration and implementation of a Social Communication Program, which promotes dialogue between all parties, through periodic communication instruments.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.2. Construction Phase

7.2.2.1. Physical Environment

A) Deterioration of Soil and Groundwater Quality

Due to the presence of contaminating substances

Activity and Aspect	
Activity	Vegetation supression Soil stripping and storage Earthworks and excavations Implementation of construction sites and accommodation Implementation and adaptation of access routes Implementation of operational structures Supply, maintenance and washing of machines and equipment Storage and / or use of general inputs and hazardous products
Aspect	Generation of liquid effluents Generation of solid waste Generation of surplus materials Soil exposure Leak of contaminating substances

The change in the quality of soils and groundwater in the construction stage may be due to the vegetation removal, the remodeling of the land and excavations for the activities and construction of support and operational structures, described as:

- Offices and construction sites;
- Provisional accommodation
- Communication system;
- Implementation and improvement of access routes;
- Preparation for supplying aggregates and concrete;
- Administrative buildings;
- Industrial sector;
- Transmission Line;
- Nickel and limestone pits;
- Waste deposit areas and ore stock areas;
- Heap Leaching Area; and,
- Waste deposits.

In order to carry out such activities, there will be intense circulation of vehicles (light and heavy), machines and equipment powered by combustion engines, subject to corrective maintenance, as well as the use of fuels and lubricating oils, representing risks of the occurrence of possible accidents / leaks of these products. This can result in the occasional change in the quality of soils and groundwater in these work fronts.

Thus, there are two fronts that increase the susceptibility of triggering deterioration of soil and groundwater: a greater exposure of these environments (due to vegetation clearance, earthworks, excavation, etc.) and the presence of chemical compounds necessary for the operation of the machinery used in construction.

It is important to note that the vulnerability of the aquifer, as described in the diagnosis, for the nickel pit area and industrial sector, is low. However, due to the karst environment in the limestone pit, the scenario is different, being a place with high vulnerability to contamination.

In general, the contamination of these environment is directly associated with localized and punctual events, such as fuel leaks, inadequate disposal of residues impregnated with oils and greases, oily effluents, among others.

In addition, soil and groundwater contamination can also be caused by sanitary / domestic and oily effluents, and solid waste generated at construction sites. It is important to highlight that the engineering project of this project comprises specific control systems for the management and control of the aspects mentioned, as shown in the table below.

Aspect	Proposed environmental control system
Generation of oily effluents	Use of containment boxes and impermeable floor around tanks and other fuel and lubricant storage devices. Waterproofing the floor of areas where maintenance and washing activities for equipment and parts will be carried out. Use of solids decanting boxes and water-oil separators (SAO).
Generation of sanitary / domestic effluents	In the initial installation phase of the construction site, the septic tank and anaerobic filter systems will be built, which will be used both in the construction phase of the project and in the operation phase. The final treated effluent will be released into the natural drainage, duly granted. Use of a fat box for effluents from the cafeteria.
Rainwater Drainage	Use of an efficient drainage system in the accesses and construction site. The drainage system must consist of adequate devices for collecting and disciplining rainwater until its final disposal in natural drains. In general, channels are built that will lead the flow of water to manholes and concrete water drops until their final disposal in the natural land in a controlled manner, without creating concentrated flows.
Solid residues	As a rule, segregation and temporary storage are foreseen taking into account the NBR Classification 10.004 / 2004 and respective characteristics according to the applicable legislation. Finally, the waste will be sent to licensed landfills / controlled companies.

a) Evaluation

The degradation of the soil and groundwater quality is a **negative** impact, as it changes and deteriorates the quality of these environments, **direct** and **likely to occur**. This impact should manifest itself in the **short term**, considering that it may occur soon after the execution of the triggering activities, it is **reversibl**e, since there is a way to return the natural conditions (or

similar) of the soil and groundwater if it occurs. It will occur in a **localized** manner, only at the DAA (construction sites, workshops, etc.). It is a **causative** impact, since it is the result of the implementation of the project, and **temporary** once the source of contamination ceases, the impact tends to be non-existent.

As this impact is likely to occur and is reversible and temporary, it was assessed as of **medium magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

Inspect and perform systematic maintenance:

- In the storage structures for lubricating oils, greases and / or chemical products of any nature, according to, minimally, the requirements of ABNT / NBR 14725-2 and ABNT / NBR 7505-1;
- In temporary and permanent drainage systems, as well as oil and grease separator boxes;
- In fluid containment systems (waterproofing, drainage, oil and grease separators, etc.); and
- In the segregation and temporary storage areas in accordance with the provisions of CONAMA Resolution No. 307 of 2002 and in line with the guidelines proposed in the Environmental Management Program.

- All machines, equipment and vehicles used in the implementation of the project must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential oil, grease and fuel leaks;
- Implementation of the Solid Waste Management Program;
- Implementation of the Effluent Monitoring Program; and,
- Implementation of the Groundwater Monitoring Program.

The proposed measures are detailed in the Groundwater Monitoring Program, Solid Waste Management Program and Effluent Monitoring Program. In the future, when developing the Risk Management Program and Emergency Response Plan, additional measures may be recommended.

In addition, a detailed geotechnical and geoenvironmental investigation is recommended in order to better recognize Umbuzeiro's karst structures aiming to ensure not only the protection of groundwater, but also the safety of those involved in the construction of the project.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

B) Soil Degredation

Due to the generation of surplus materials and promotion of erosion processes

Activity and Aspect	
Activity	Vegetation supression Soil stripping and storage Earthworks and excavations Implementation of construction sites and accommodation Implementation and adaptation of access routes Implementation of operational structures
Aspect	Generation of surplus materials Soil exposure Deflagration of erosive processes and mass movement

The construction phase of the project involves activities of vegetation removal, earthworks, reconformation of land, excavation and construction of permanent and temporary structures.

These activities encompass a set of actions which end up removing the protection and disaggregating the original soil structure, making it more susceptible to erosive factors such as wind, rain, water, etc. This exposure, together with erosive and anthropic agents, ends up resulting in the consequent pedological degradation of the area.

The deterioration of the soil can also correspond to its compaction, alteration of permeability, salinization and loss of material due to processes of surface dynamics (in particular mass movements and erosive processes).

The areas most susceptible to material loss are described in the diagnosis, and illustrated by the Map 5.1-12 of item 5.1.5, which describes the fragility of the areas in the face of superficial dynamic processes.

According to the map, it is possible to verify that the areas in which the structures of the project are envisaged are divided as follows:

- 840 hectares are composed of areas with low fragility;
- 37 hectares for areas with medium to high fragility;
- 68 hectares are highly fragile; and,
- 218 hectares correspond to areas with very high fragility.

It is worth noting, therefore, greater care with regard to the construction and operation of structures that are planned in areas of very high fragility, which include the nickel mining (pit), a small part of the transmission line and some access roads.

It should also be noted that due to the potentially more intense rainfall between the months of December to March, this period is more likely to trigger morphogenetic processes, especially in areas with greater fragility.

a) Evaluation

Soil degradation is a **negative** impact, as it changes and deteriorates the quality of the soil, **direct** and of a **certain occurrence**. This impact should manifest itself in the **short term**, considering that it may occur soon after the execution of the triggering activities, it **is reversible**, since there is a way to return the natural (or similar) conditions of the soil from a set of activities. It will occur in a **localized** way, once the processes referring to the deterioration of the soil, will occur in a general way inside the DAA. It is a **causative and intensifying** impact, since the outbreak of erosive processes is natural to the region, however the physical modifications of the soil (compaction, salinization, etc.) will be enhanced from the construction activities of the project. It is **permanent or temporary**, as its manifestation will occur during the entire life cycle of the project, and even after its complete decommissioning or be reverted soon after the use of a certain location, for example for the use of support areas such as construction sites works and temporary storage areas.

Due to the characteristics of the region and considering the extent of interventions that could promote the occurrence of degradation of the original soil conditions, even considering that most of this impact has a reversible character, it was evaluated as of **medium magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer e Intensifier
Occurance - Spatiality	Localized	**Duration**	Permanent/Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

- Management and storage of surplus material, including "top soil";
- Limit the removal of vegetation to the areas strictly necessary for the construction of the structures;
- Topographic and substrate reconformation of the affected areas and / or areas that are not in conformity (land instability processes);
- Earthmoving, execution of cuts, embankments in general must strictly follow the precepts of the engineering project and relevant Standards (such as NBR-11.682: 1991: slope stability and others);
- The schedule for the implementation of the project must be compatible with the recovery actions of the target areas of intervention, seeking to minimize exposure to exposed soil, exposure of slopes and others to erosive agents;
- The construction steps that involve the movement of masses must be planned to be carried out outside the rainy season in order to minimize any problems caused by water;
- Adoption of constructive techniques for soil protection (containment, drainage and other systems);
- Protect piles of excess material from erosive agents;
- Monitoring and controlling the processes of surface dynamics triggered in the area (especially erosive processes and mass movements);
- If necessary, carry out automated monitoring with relevant instruments (geotechnical monitoring).

The set of actions that encompass these aforementioned practices are found in: Degraded Areas Recovery Program (PRAD); Program for the Prevention and Control of Surface Dynamics and Silting of Water Bodies; and the Surface Water Quality Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **low relevance**.

C) Deterioration of Air Quality

Due to the resuspension of particulates and the emission of air pollutants

Activity and Aspect	
Activity	Land clearing and preparation Removal of vegetation Landscaping Implementation of support and operational structures Transport of personnel, supplies and equipment

Activity and Aspect	
Aspect	Generation of particulate material Burning fossil fuels

During the execution of the construction works for the construction of the mining complex, some activities may involve the emission of particulate material and pollutants, among which the following stand out: clearing and preparation of land, removal of vegetation, earthworks, implementation of support structures and operational, implementation of environmental control systems and transportation of personnel, supplies and equipment.

This increase in the emission of atmospheric pollutants will not occur continuously, varying according to the activities to be developed (material transport, excavation, etc.). The impact should be felt not only in the area of construction sites, but also in its surroundings, its extent depending on the location and type of activity.

The predominant component of the movement of earth and rock material is particulate material, characterized as resuspended dust, essentially earth and rock dust, which are inert. However, very small particles can penetrate the respiratory tract, reaching the pulmonary bronchi and alveoli and causing allergies and respiratory diseases (WHO, 2006). It is noteworthy that, in the incidence of strong winds, especially in the drier periods, the impacts caused by these emissions will be aggravated, due to the increased emission of particles by resuspension.

In addition to particulate material, there will be the impact caused by the generation of combustion gases during the construction and operation phases, resulting from the operation of light and heavy vehicles (automobiles, vans, pickup trucks, trucks, off-road, etc.), light equipment and heavy vehicles (compressors, tractors, loaders, etc.) that use engines based on burning fossil fuels as the driving force. Gaseous emissions will basically consist of gases such as carbon oxides (CO and CO_2), nitrogen oxides (NOx), sulfur oxides (SOx) and hydrocarbons.

The receivers closest to the project's structures (DAA) and which could potentially be more affected during the implementation stage are: Carnaíba Settlement (100m from the water pipeline); Várzea Settlement (50m from the pipeline), Veredas Settlement (350m from the pipeline), Brejo Seco Community (900m from the explosives warehouse), Várzea de Cima Community (350m from dike 2), Veredas Community (500m from the access road and 2 km from the Nickel Mine) and Umbuzeiro Community (1.4 km from the Limestone mine). Note that after the end of the construction, the communities that may still remain under the effect of this type of impact correspond to those located near the mining areas (Brejo Seco, Veredas and Umbuzeiro communities) and those located on the margin or close to the unpaved transport routes of ores and inputs.

a) Evaluation

It is a **negative, certain, dispersed** impact, since the impact can be felt beyond the immediate vicinity of the project, occurring in the **short term**, considering that it may occur soon after the execution of the activity that triggers it, **reversible** since the characteristics of the site may be recovered shortly after the completion of activities, **temporary**, as it will occur during the construction, **intensifier and causative** stage, understanding that the resuspension of particulate material is currently occurring, due to local characteristics, and the emission of gases is something new, as it is outside of an urban area and / or an area of intense vehicle circulation.

The impact in question is considered to be of **medium** magnitude, considering that the project is located outside the urban area but close to rural communities, however, because it is recurrent and due to local climatic conditions, the exposure and risks to existing recipients are increased.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier e Causer
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

- Establishment of vehicle speed limit, since the main factors that contribute to the increase in dust generation associated with vehicle traffic are weight and speed;
- Sprinkling water in the source areas with the greatest potential for generating particulate material and with the largest number of receivers;
- Prohibit the transport without packaging of materials that may provide the suspension of solid particles, in this way the loads and bodies of trucks must be properly covered / buffered in order to minimize the emission of particulates;
- Surface coverage of provisional stacks of unconsolidated materials;
- Vegetation cover of exposed areas as soon as they are released;
- Inspection and preventive maintenance of vehicles, machines and equipment, in order to detect any abnormalities in the regulation of the combustion engines and also to minimize the emission of gases and black smoke;
- Monitoring and apparent measurement of the smoke density emanating from vehicles, machines and equipment, using the Ringelmann scale;
- Use of new vehicles / equipment or in good condition, regulated according to the manufacturer's instructions and;
- Implementation of a Monitoring Plan of the Total Suspended Particulates (PTS) and inhalable particles in the construction phase.

Additionally, it is suggested that these controls be subsidized through the project's Environmental Management Program and the Air Quality Monitoring Program.

c) Degree of resolution of the measures and degree of relevance of the impact

Mitigating Measures and Degree of Relevance	
Degree of resolution of measures	Medium
Degree of relevance of the impact	Medium

It should be noted that the most effective measure for reducing the resuspension of particulates by truck traffic would be to spray water on unpaved roads. This measure, however, is difficult to apply in the region due to the scarcity of this resource. Thus, it is considered that any other measures to reduce this problem as palliative and less efficient, which led to the classification of the degree of resolution of the impact as medium.

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

D) Degradation of Speleological Heritage

Due to the modification of the original topography and other related aspects

Activity and Aspect	
Activity	Preliminary infrastructure services (vegetation removal, stripping and earthworks) Implementation of support structures (access roads and others) Implementation of operational structures (Transmission line and pipeline) Movement of vehicles, machines, equipment and workers
Aspect	Generation of liquid effluents Generation of solid waste Leak of contaminating substances Landscape changes, original land topography, land movement Intensification of erosive processes

The Piauí Nickel project intends to implement two linear structures in the Mundão / Chiqueirinho region, namely: water pipeline and power transmission line. As described in the Environmental and Social Diagnosis, item 5.1.11.Speleological Heritage, this region is made up of plateaus made up of sandstone rocks and slopes of an abrupt character where, in speleological prospecting work, features such as cavities and shelters within the 250 meter buffer were found from the project's DAA.

The implementation of the pipeline aims to meet the water demand of the industrial plant, thus interconnecting, through a piping system, the Jenipapo dam and the referred plant, and will require the occupation of about 33.52 linear km and construction of maintenance access roads. At this stage of the project, it is anticipated that the pipeline will be buried and a pipe offset of 8 m (4 m on each side of the axis) has been defined, considering 3 m of the pipe strip and 5 m of access and maintenance routes. It should be noted that along the route of the pipeline there are already existing access routes that will be used, thus reducing interventions. In addition, the preferred route of the pipeline will take place at the lowest levels of the land, crossing through valleys and plains, far from the areas most suitable for cavities.

With regard to the transmission line - LT, its implementation will take place parallel to the road that connects the municipalities of São João do Piauí to Campo Alegre do Fidalgo, with the exit point at the CHESF substation taking the direction of the industrial plant and ending in the porch of the Piauí Nickel Main Substation. The LT voltage will be 69 kV three-phase, with 103 towers in metallic structure, aluminum conductors with steel core. The implementation of the towers, along the 42.63 km of the LT, will require deforestation along its axis and the easement areas, in addition to the construction of the towers' bases and mechanical and electrical assembly. The easement area will occupy 11.26 ha and the towers 2.31 ha.

The construction phase is the most critical moment in relation to the potential for degradation of the speleological heritage, as it is where the preliminary infrastructure services (vegetation removal, soil stripping and earthworks) occur; construction of access roads; and of the aforementioned structures themselves. In addition, the expressive movement of teams and vehicles and machinery, and consequently the generation of liquid effluents and solid waste, should also be mentioned.

The sandstone slopes, where the speleological features identified are located, are sectors of significant fragility, however critical activities are not foreseen in the plateaus and escarpments themselves, which mitigates the potential for instabilities that may cause damage to the speleological features. It is worth mentioning that the area with the potential for forming speleological features associated with plateaus and sandstone slopes represents less than 2% (or 145.61 hectares) of the target area for speleological prospecting, thus representing a very small area.

In addition, the mentioned structures, LT and pipeline, present some flexibility as to the definition of the layout routes, so in the course of detailing the engineering project, these structures must be allocated so that interventions in speleological features do not occur.

a) Evaluation

In view of the above, the aforementioned socio-environmental impacts have a **negative** nature, of a **direct and irreversible** nature, due to the works to implement permanent structures. The impacts are also **short-term** and **permanent**, since the impacts will be perpetuated even after the complete decommissioning of the project. In turn, the punctuality of impacts qualifies the magnitude as **small**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Pouco Probable	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Permanent

Magnitude	
Qualitative	Small

b) Proposed Measures

- Technical supervision of a speleologist in the elaboration of the LT engineering project and pipeline to prevent and mitigate impacts on the sandstone and plateaus where speleological features appear;
- Technical supervision of a speleologist on the occasion of the construction of the TL and a pipeline to prevent and mitigate potential impacts on the sandstone and plateaus where speleological features appear;
- Install physical barriers (fences) along the construction areas in order to contain the installation and maintenance activities within the stipulated perimeter;
- Properly implement environmental education programs with employees and collaborators of the project on Speleological Heritage, its conservation and the importance of mitigation measures;
- Properly implement the management and control system for effluents and solid waste generated in accordance with the applicable legislation, avoiding any proximity to areas of occurrence of speleological formations of interest.

The actions described above are included in the Solid Waste Management Program; Effluent Monitoring Program; and Environmental Education Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution since even irreversible and permanent impacts can be avoided and mitigated. The impact was assessed as of small magnitude, it can be considered as of **low** relevance.

E) Deterioration of the Quality of Surface Water and Silting of the Drainage Network

Due to the generation and transport of sediments

Activity and Aspect	
Activity	Vegetation supression Soil stripping and storage Earthwork Opening of access routes Implementation of temporary and support structures Implementation of operational structures Deactivation of temporary structures
Aspect	Generation of surplus materials

Activity and Aspect	
	Soil exposure Deflagration of erosive processes and mass movement Alteration of the characteristics of water bodies

As described in the Environmental and Social Diagnosis, the Piauí Nickel project is planned in the Piauí River sub-basin.

In the construction phase of the project, activities related to the removal of vegetation, installation and operation of the construction site, earthwork services, the construction of industrial facilities, environmental control systems and the openings and access improvements may cause, directly or indirectly, the generation of unstable sediments or even uncovering significant portions of the land in the region.

Carrying these sediments into the watercourses may cause silting processes, with a decrease in the natural sections of the rivers and, consequently, interference in the flow capacity during the occurrence of floods. The fact is intensified in the short period of rains due to the concentration of significant volumes of water in a short space of time, forming fast and intense water currents, with great degrading capacity.

The flow of solids also promotes interferences in the quality of surface water, with increased levels of color, solids and turbidity, which can also lead to a higher concentration of metals typical of the regional geological matrix and also the transport of nutrients and animal waste accumulated in the water basin during the dry season. These components interfere with the aesthetic conditions of the waters and the biological productivity of the aquatic system, an impact that is enhanced in the rainy season.

As the rivers that drain the project's areas of influence are generally small to medium-sized and intermittent, there will be a significant impact on the water bodies resulting from the carrying of solids if adequate mitigating measures are not adopted during the construction works, especially in stretches without riparian vegetation.

On the other hand, in addition to land with predominantly flat characteristics, the data on land fragility presented in the Environmental and Social Diagnosis show that in Brejo Seco Mine, Umbuzeiro Mine, in the pipeline, transmission line and new access routes, the largest part of the structures will be installed in an area of low fragility, which means that there is low susceptibility to erosion and, consequently, the chances of sediments being carried to the nearest water courses are lower. In addition, the areas of intervention in APP will be insignificant when considering the total amount of APP in the ADI, and considering that they will represent about 11.35% of the total ADI's APPs.

However, as already highlighted in the chapter on land fragility, the project as a whole intercepts some sections considered to be of high fragility. These lands correspond to stretches of mountain range (especially in the nickel pit area itself) and crossing of some water courses where the works of construction of the mining complex, of its accesses, electric network and pipeline can cause problems in the conservation of the soil if they are done without proper care.

On the other hand, it must also be considered that the project already includes numerous actions aimed at minimizing the carrying of sediments to water courses, among which the following stand out:

- Perform edaphic practices (such as “top soil” storage);
- Limit the removal of vegetation to the areas necessary for the construction of the structures;
- Management and storage of surplus material;
- Earthmoving, execution of cuts, embankments in general must strictly follow the precepts of the engineering project and relevant Standards (such as NBR-11.682: 1991: slope stability and others);
- The schedule for the implementation of the project must be made compatible with the recovery actions of the target areas of intervention, seeking to minimize exposure to exposed soils, exposure of slopes and others to erosive agents and also with the drought period, avoiding any mass movement during the short rainy season;

It is noteworthy that the rivers in the region are all intermittent, spending most of the year dry, with its exposed bed and accessible to livestock herds that roam throughout the area. In this respect, the quality of local surface waters varies greatly depending on the time of year when samples are collected, and the diagnosis of surface waters in the region pointed out that they currently show some changes in their quality. In some samples, high results of turbidity, low oxygenation, presence of metals, organic matter and nutrients were found in levels that do not comply with the legislation, in addition to bacteria of fecal origin.

a) Evaluation

The silting up of watercourses and the deterioration of the quality of surface water by the supply of diffuse loads is a **negative, probable** impact, occurring in the **short term**, considering that it may occur soon after the execution of the activity that triggers it. This is a **reversible** impact, since, in addition to preventive mechanisms, there are usual corrective methods, such as mechanical removal of sediment banks and control of sediment input, allowing the water body to return to conditions similar to the original ones.

It is considered an **intensifying** impact by the project, since this process already occurs naturally, although in a slower and more **dispersed** way, as it may exceed the limit of the ADI. Silting up is also considered **temporary**, tending to be softened or stopped with the consolidation of the embankment areas and with the end of the project's implementation activities.

Bearing in mind that the ADI water bodies are intermittent and small to medium-sized, the carrying of solids for them favors the silting processes and changes the quality of the water. It must also be considered that all drainages that will be directly influenced by the future project are tributaries of the Piauí River, that is, the latter may accumulate the interventions that occurred in the tributaries. However, as the intervention in APP areas will be low and most of the project's structures are located in an area with low susceptibility to erosion, a large amount of sediment is not expected to enter the nearest water bodies. Therefore, this impact is considered to be of **medium magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

The mitigating measures to be adopted to reduce this impact include, in addition to those already provided for in the Project Description chapter:

- Topographic and substrate reconformation of affected areas and / or areas that are in non-compliance;
- Promote systematic preventive and corrective actions in order to minimize possible environmental degradation due to the intensification of superficial dynamic processes;
- When necessary, carry out automated monitoring with relevant instruments (geotechnical monitoring);
- Adoption of constructive soil protection techniques (containment, drainage and other systems);
- Protect piles of excess material from erosive agents;
- Monitoring and controlling the processes of surface dynamics triggered in the area (especially erosive processes and mass movements);
- Conducting periodic visual inspections and maintenance of the rain drainage system, in addition to systematic observations on the general appearance of the water bodies, registering eventual presence of debris and concentration of solids;
- Implementation of sediment containment dikes downstream of the areas of the mineral complex of this project precisely to avoid carrying solids to the water courses;

The set of actions that encompass these abovementioned practices is found in: Recovery of Degraded Areas Program, and Program for the Prevention and Control of Surface Dynamics and Silting of Water Bodies.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **low relevance**.

F) Deterioration of Surface Water Quality by Effluents and Solid Waste

Due to the generation of liquid and oily effluents and solid waste

Activity and Aspect	
Activity	Supply of machinery and equipment Maintenance of machinery and equipment Vegetation supression Soil stripping and storage Opening of access routes Machine shop operation and equipment washing Movement of vehicles Implementation of temporary and support structures Implementation of operational structures Closure of temporary structures
Aspect	Generation of solid waste Generation of liquid and oily effluents Leak of contaminating substances Alteration of the characteristics of water bodies

During the implementation of the Piauí Nickel project, there will be the generation of one-off charges represented by the disposal of solid waste, oily effluents and liquid effluents of sanitary and pluvial origin.

The solid residues will come mainly from the activities of civil works, the construction site, the cafeteria, the toilets, the ambulatory, the deforestation activities, among others.

The oily effluents will originate at the construction site, at the equipment repair and maintenance workshops and at the fuel supply locations. Such effluents are rich in oils, surfactants and solids, in addition to hydrocarbons.

The liquid effluents of pluvial origin will be basically composed of water and sediments from the disintegration of soils where there is an impact of rain on unprotected surfaces such as roads, accesses, embankments and other areas without vegetation cover, causing the sediment to be carried by surface runoff to the bottoms of valleys where water bodies are found.

Regarding sanitary liquid effluents, considering the presence of approximately 1,875 employees at the peak of the construction works, a generation of 131.25 m³ / day of liquid sanitary effluents (0.07 m³ / person / day, according to ABNT / NBR 13969: 1997), in addition to the material collected from the chemical toilets to be distributed on the work fronts. Sanitary effluents are characterized by a high content of nutrients, organic matter and high densities of bacteria of fecal origin.

As adequate measures for the collection, storage, treatment and proper disposal of effluents and solid waste are described below, these punctual loads have a low probability of reaching water resources in the Piauí River sub-basin and causing changes in the quality of their waters.

Among the possible changes in water quality, the following stand out: reduced levels of dissolved oxygen, increased concentration of organic matter and nutrients, especially phosphorus and nitrogen, and increased density of fecal bacteria, intensifying eutrophication processes, with reflexes to aquatic biota.

The engineering of this project comprises the following specific control systems for the management and control of the aspects mentioned.

Aspect	Proposed environmental control system
Generation of oily effluents	Use of containment boxes and impermeable floor around tanks and other fuel and lubricant storage devices. Waterproofing the floor of areas where maintenance and washing activities for equipment and parts will be carried out. Use of solids decanting boxes and water-oil separators (SAO).
Generation of sanitary / domestic effluents	In the initial installation phase of the construction site, the septic tank and anaerobic filter systems will be built, which will be used both in the project's construction phase and in the operation phase. The final treated effluent will be released into the natural drainage, duly granted. Use of a fat box for effluents from the cafeteria.
Rainwater Drainage	Use of an efficient drainage system in the accesses and construction site. The drainage system must consist of adequate devices for collecting and disciplining rainwater until its final disposal in natural drains. In general, channels are built that will lead the flow of water to manholes and concrete water drops until their final disposal in the natural land in a controlled manner, without creating concentrated flows.
Solid residues	As a rule, segregation and temporary storage are foreseen taking into account the NBR Classification 10.004 / 2004 and respective characteristics according to the applicable legislation. Finally, the waste will be sent to licensed landfills / controlled companies.

a) Evaluation

The change in the quality of surface water due to the contribution of punctual loads generated in the construction phase is a **negative, direct, probable** impact, occurring in the **short term**. It is a **dispersed, reversible** impact, a **new fact** for the project and **temporary**, since once the polluting source is controlled, the quality of surface water tends to re-establish itself to current standards.

This impact is considered to be of **small magnitude**, since the implementation of the project under analysis will imply the generation of point loads, but with efficient control systems.

Attributes			
Nature	Negative	**Order**	Direct

Attributes			
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	New fact
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Proposed Measures

The mitigating measures to be adopted to reduce this impact include, in addition to the actions already foreseen by the project and mentioned in the discussion of the impact, the following activities:

- Inspect and carry out systematic maintenance of the storage structures for lubricating oils, greases and / or chemicals of any nature;
- The area used as a construction site must be waterproofed and equipped with the necessary control systems;
- All machines, equipment and vehicles used in the mine's implementation must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential leaks of oils, greases and fuels. In this sense, workshops and maintenance places must be equipped with environmental control devices.

The set of actions that encompass these abovementioned practices is found in: the Liquid Effluent Management Program and the Solid Waste Management Program, in order to minimize the generation of waste and adapt it to segregation, packaging, identification, collection and external transport, and final disposal, providing the generated waste and effluents with a final route in accordance with current environmental legislation and standards, in accordance with the guidelines of the National Solid Waste Policy; and the Surface Water Quality Monitoring Program, which will allow monitoring systematic analysis of the environmental control parameters of the aquatic ecosystem.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

G) Alteration of the Water Network Configuration

Due to the implementation of project structures

Activity and Aspect	
Activity	Implementation of temporary and support structures Implementation of operational structures Movement of vehicles and machines Opening of access routes
Aspect	Deflagration of erosive processes and modification of river dynamics / flow regime

The main structures planned for the implementation of the Piauí Nickel Project are located close to water courses, all belonging to the Piauí River sub-basin.

According to the projection of the structures of the project on the drainage network, direct intervention and / or transposition on the São Domingos, Itaquatiara, Várzea and Caraíbas streams is noted, as well as some watercourses with no defined nomenclature, all of which intermittent character. It is worth mentioning that the structures of the project that most overlaps the drainage network are the fines containment dikes (which are necessarily constructed in thalwegs) and the limestone pit (the allocation of which depends directly on the occurrence of ore and thus presents some locational rigidity).

The total extent of interventions in the water network is considered small when compared to the total extent of drainage existing in the ADI. The intervention is planned for approximately 3,980 meters in the drainages for the implementation of the project, which corresponds to 1.98% of the drainage network existing in the ADI.

Some interventions may result in a change in the surface runoff regime of watercourses, but as they are intermittent and dry for most of the year, this condition will be evident in periods of rain.

a) Evaluation

Interference with the natural drainage network is a **negative, permanent, probable** impact. It is also **direct, irreversible, localized** and a **new fact**.

Depending on the number of drainages planned near the main structures and in view of the control measures to be adopted, the impact will be of **small** magnitude.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	New fact
Occurance - Spatiality	Localized	**Duration**	Permanent

Attributes	
Magnitude	
Qualitative	Small

b) Proposed Measures

Mitigating measures to be taken to reduce this impact include:

- Adoption of intrinsic control measures indicated in the Environmental Works Control Program;
- When drainage is intercepted, rainwater conduction devices should be provided, considering the region's rainfall regime, in places where there is interference by the project;
- Adoption of construction techniques appropriate to each water body, in order to cause the least possible environmental impact;
- Avoid intervention in riparian forests and the triggering of erosive processes on the margins;
- Recovery of degraded areas.

The actions described above are included in the: Recovery of Degraded Areas Program; Program for the Prevention and Control of Surface Dynamics and Silting of Water Bodies.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

H) Environmental Discomfort – Sound Overpressure

Due to mobile and fixed equipment

In the construction phase, the main environmental discomforts caused to the surrounding population caused by noise emissions will be due to the activities involved in the construction of the mining complex structures, described as:

- Offices and construction sites;
- Provisional accommodations;
- Communication system;
- Implementation and improvement of access routes;
- Preparation for supplying aggregates and concrete;
- Administrative buildings;
- Industrial sector;
- Transmission Line;
- Nickel and limestone pits;

- Waste deposit areas and ore stock areas;
- Heap Leaching Area; and,
- Waste deposits.

In order to carry out such activities, there will be an intense circulation of vehicles (light and heavy), machines and equipment powered by combustion engines, which consequently will generate environmental discomfort due to the increase in the level of environmental noise.

The noise of excavation, material and construction machinery varies widely depending on the type and condition of operation.

As a maximum value, it can be considered, based on previous experiences with similar equipment, that these equipment will not emit noise at levels above 90 dB (A), measured at 7 meters from the source.

Applying the logarithmic decay curve at this maximum level, the result shown in Data Table 7.2-1, which indicates the expected sound level, depending on the distance of the works.

Data Table 7.2-1 – Expected Sound Level and Distance of Works.

Distance (m)	Noise Level (dB(A))
7	90
10	87
20	81
30	77
40	75
50	73
100	67
150	63
200	61
300	57
400	55
500	53
750	49
1000	47
1250	45
1500	43

According to NBR 1015, the acoustic comfort limits considered are shown in the figure below:

Limites de Ruído conforme NBR 10.151

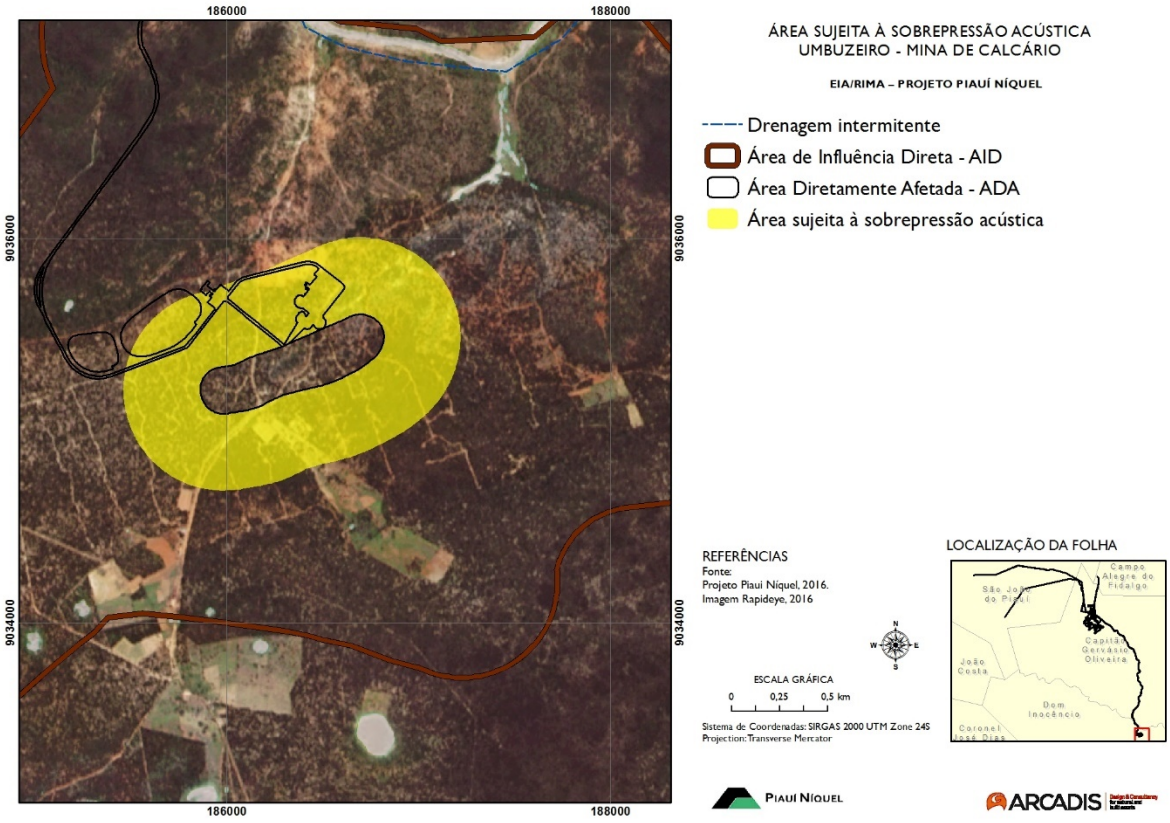
Uso e Ocupação do Solo	Diurno	Noturno
Áreas de sítios e fazendas	40	35
Área estritamente residencial urbana ou de hospitais ou de escolas	50	45
Área mista, predominantemente residencial	55	50
Área mista, com vocação comercial e administrativa	60	55
Área mista, com vocação recreacional	65	55
Área predominantemente industrial	70	60

Obs.: Caso o nível de ruído preexistente no local seja superior aos relacionados nesta tabela, então este será o limite.

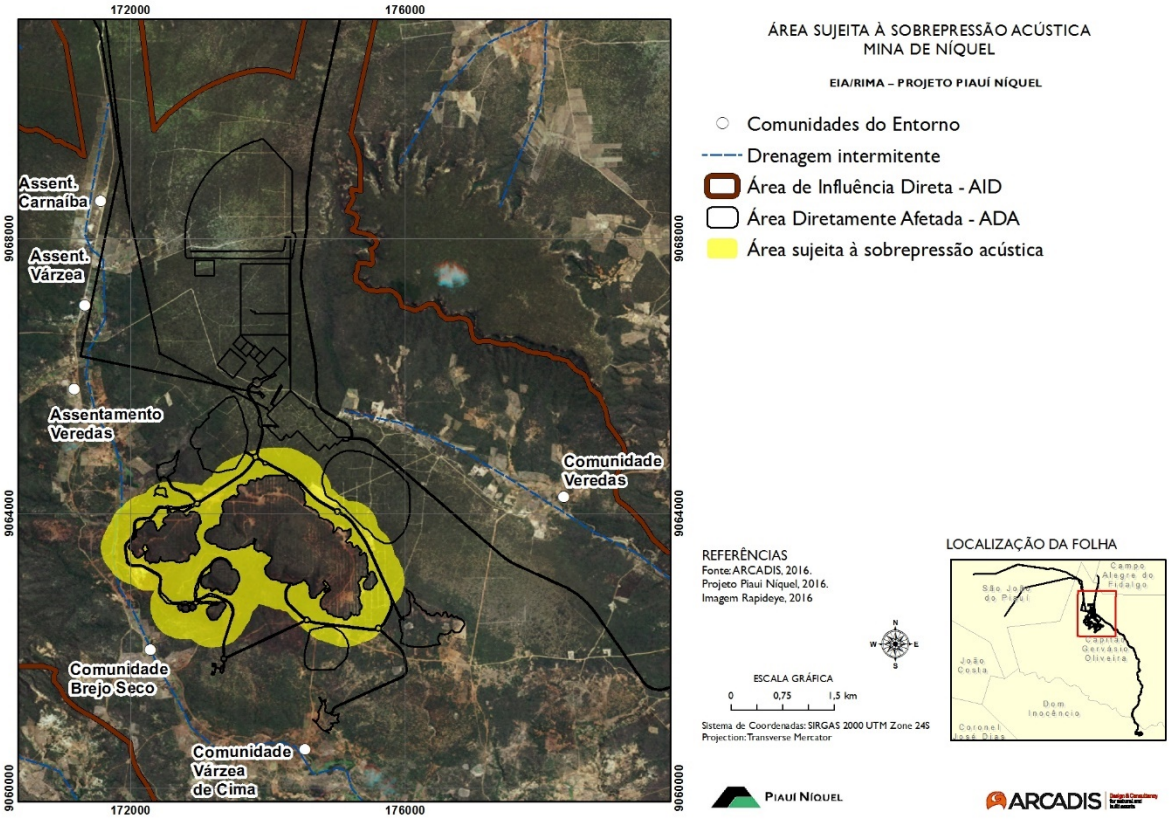
The communities surrounding the mining and processing areas (main sources of noise generation) are considered to be mixed areas with residential predominance. Thus, according to the standard, a noise of 55 dB (A) during the day and 50 dB (A) at night is recommended.

Therefore, according to the data in the table, it is observed that up to a distance of 400 m, during the day, and 700 m at night, the operation of machinery and equipment on the construction site may impair acoustic comfort conditions. In view of the above and the distance from the communities surrounding the project in relation to DAA and noise sources (over 400 meters as Map 7.2-1 and Map 7.2-2) the local population is not expected to be disturbed.

Map 7.2-1 – Area Subject to Umbuzeiro Acoustic Overpressure - Limestone Mine



Map 7.2-2 – Area Subject to Acoustic Overpressure - Nickel Mine.



a) Evaluation

The environmental discomfort resulting from the increase in the level of environmental noise is a **negative** impact, since it generates discomfort to the receivers, **direct** and **likely to occur**. This impact will manifest itself in the **short term**, considering that it will occur soon after the start of the triggering activities, it is **reversible**, insofar as, when the project ends, the noise levels return to the same as before the mining complex, as well how it is possible to adopt mitigating measures. It is **dispersed**, since it should cover a significant area of territory. It is a **causative** impact, since it is the result of mining, and **permanent**, as it will occur both in the implementation and throughout the project's useful life, albeit at different levels and periods.

As this impact is likely to occur, permanent, but of a reversible nature, it was assessed as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Dispersed	**Duration**	Temporary

Attributes	
Magnitude	
Qualitative	Small

b) Control Measure

The noise control measures are mainly aimed at the workers involved in the implementation of the project, since the other possible recipients that would be the surrounding communities would not suffer any inconvenience that requires the adoption of control and / or mitigation measures.

Thus, the measures below must be applied on the construction sites and follow the regulations related to the exposure of workers to noise. Recommended:

- Minimize the time of use of machines / activities that generate higher levels of exposure to noise and vibration of workers, such as, for example, through rotation of workers, and implementation of the use of personal protective equipment (anti-vibrating gloves, safety boots). safety, hearing protectors);
- Carry out systematic preventive and corrective maintenance on vehicles, machinery and equipment in general;
- Create a communication channel with the surrounding communities to systematically check requests and complaints involving issues of vibration and noise; and
- Properly implement the Noise and Vibration Monitoring Program in the construction phase, if non-conformities are identified, these must be corrected by adopting specific techniques to mitigate any diagnosed impacts.

The actions described above are included in the Noise and Vibration Monitoring Program and the Social Communication Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.2.2. Biotic Environment

A) Loss of habitats

Activity and Aspect	
Activity	Opening of access roads; Removal of vegetation
Aspect	Interference on vegetation cover

For the construction of the industrial complex, the transmission line and the pipeline, removal of 1,121.33 ha of native vegetation is planned, whose interference will occur outside and inside the permanent preservation areas (APP).

The vegetation, by providing three-dimensionality to the environment, plays a structuring role in habitats, as well as a source of trophic resources for fauna. Thus, associated with the removal of vegetation is the disappearance of habitats to which animal species are associated.

In addition, when in highly fragile terrain such as steep slopes, springs and river banks, it plays an important role in protecting the terrestrial and aquatic environment, being considered as permanent preservation (APP). In the latter case, they provide shelter, food and breeding areas for various aquatic species.

Each species responds differently to the changes caused, according to the respective specializations, foraging pattern, adaptability of the diet and physiological sensitivity to environmental and microclimate changes.

Even though opportunistic and generalist species prevail, which preferentially use open environments, it should be taken into account that the strips without vegetation cover represent areas whose animals are subject to a greater risk of predation. Thus, changes in the environment and changes in the structure of habitats tend to affect the composition and organization of fauna, which take refuge and promote changes in interactions between species. It is worth noting, however, that the vegetation removal for the construction of the structures corresponds to 5% of all native vegetation existing in the ADI, which has already been partially altered by anthropic factors (mainly by grazing caused by domestic animals). In addition, it is planned to store the organic soil layer for later use in areas to be recovered.

The implementation of the transmission line and the pipeline will promote the reduction of small extensions of the vegetation cover of the ADI along a stretch already fragmented by the PI-465 highway, therefore, habitat fragmentation is not foreseen, given the permeability of the environment, since the rupture or reduction of continuity in the caatinga environments by the installation of linear undertakings is not decisive for the movement of species.

a) Evaluation of Impact

The impact of habitat loss is considered **negative** and **certain**, since part of the space where animals thrive in the natural environment will be suppressed. It should take place in the **short term**, as soon as the removal activities start, and in a **localized** manner, since stretches of previously delimited native vegetation will be removed. It is **direct** and **intensifying**, since there are signs of illegal extraction of native vegetation. It can be considered **permanent**, but **partially reversible**, if programs for the recovery of degraded areas are considered after the project is deactivated.

Considering the indicated attributes, the total hectares foreseen for removal and its percentage in relation to the ADI, this impact is evaluated as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Permanent
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

As a way of mitigating the impact:

- Avoid removing unnecessary areas;
- Promote, whenever possible, the collection of plant material of species for use in the recomposition of areas;
- Carry out revegetation or compensatory actions determined in accordance with current environmental legislation and by SEMAR;
- Establish legal reserve areas for properties owned by the project.

These measures will be adopted in the Flora Removal and Rescue Control Program and in the APPs Intervention Compensation Program.

As a form of mitigation, storage of the soil's organic layer is foreseen, whenever possible, for later use in areas to be recovered. These measures will be included in the Recovery of Degraded Areas Program (PRAD).

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

B) Loss of specimens from the native flora

Activity and Aspect

Activity	Opening of access roads; Removal of vegetation
Aspect	Interference on vegetation cover

The vegetation represents an environmental factor in that it is composed of a floristic group, whose species are represented by populations with different densities and different forms of distribution, which varies according to the type of soil, water availability and incidence of degradation factors, as seen in the results of the phytosociological studies conducted. Depending on the type of species suppressed, there may be a trigger to a greater or lesser degree of scarcity of resources, such as shelter and food, causing damage to the survival of natural populations.

The species that stand out for their high density, that is, the highest number of individuals per hectare, are canela-de-velho *(Cenostigma macrophyllum*), angico-de-bezerra (*Piptadenia obliqua*) e marmeleiro (*Croton sonderianus*).

On the other hand, larger species, such as amburana de cambão (*Bursera leptophoeus*), occur in low abundance.

Finally, many species occur sparingly and are therefore rare in phytosociological sampling, for example, cacti such as the facheiro (*Cephalocereus Piauíhensis*), the mandacaru (*Cereus jamacaru*) and the xique-xique (*Cephalocereus gounelei*). Also noteworthy in the region is the presence of an endangered species, the ipê-cascudo, *Handroanthus spongiosus*.

The removal of these individuals implies a reduction in populations adapted to the environmental conditions of the biome (lack of humidity and high temperatures), which structure the habitats and provide resources to the associated animals. It is worth mentioning, however, that the vegetation in the area of the project is already undergoing intense anthropization with the incidence of several degradation factors, of which the cutting of the vegetation and the extensive grazing of several species of domestic animals deserve to be highlighted, important factors of structural changes in the caatinga in the project's ADI.

a) Evaluation of Impact

This impact has a **negative** nature, of **certain** occurrence and in a **localized** way restricted to the DAA. It qualifies as **reversible**, **short-term**. It corresponds to an **intensification** of a fact that already exists in the region, characterized by altered caatinga areas. This impact is **direct** and **permanent**. Given the amount of native vegetation that will be suppressed and the presence of an endangered species, this impact is considered to be of **small** magnitude.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Permanent

Magnitude	
Qualitative	Small

b) Management Measures and Environmental and Social Programs

As vegetation is a renewable natural resource, the adoption of measures that make it possible to rescue propagules and to revegetate areas mitigates, to a large extent, these losses. This genetic material, used in vegetation recovery actions, allows the maintenance of species richness and genetic variability.

As a way of mitigating the impact, the project must:

- Avoid removing unnecessary areas;
- Promote, whenever possible, the collection of plant material of species for use in the recomposition of areas;
- Carry out revegetation or compensatory actions determined in accordance with current environmental legislation and by SEMAR;
- Establish legal reserve areas for properties owned by the project.

These measures will be adopted in the Flora Removal and Rescue Control Program and the APPs Intervention Compensation Program.

As a form of mitigation, storage of the soil's organic layer is provided, whenever possible, for later use in areas to be recovered. These measures will be included in the Recovery of Degraded Areas Program (PRAD).

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low** relevance.

C) Dispersion and loss of terrestrial fauna specimens

Activity and Aspect	
Activity	Construction of buildings; Construction of operational structures; Compressor operation; Removal of Vegetation; Construction of access roads; Operation of machinery and equipment; Movement of vehicles and people; Mobilization of labor; Assembly of towers; Cable release.
Aspect	Noise generation; Generation of terrain vibrations; Running over of fauna; Increased hunting pressure; Collision of fauna with structures of the project.

During the project construction, the loss of fauna specimens will occur mainly during the vegetation removal stages.

It is during the process of removal of native vegetation, that loss or injury of fauna specimens occurs, especially representatives of the herpetofauna with low escape capacity due to morphological characteristics, such as reduced or absent locomotor members, who end up being run over during the operation of tractors and vehicle circulation. This loss can be aggravated if removal occurs during periods of reproduction, when there are young in burrows and nests.

Other semi-arboreal species are also at risk of being killed by being run over, as they usually take refuge in shrub-tree vegetation when chased away due to the emission of high intensity noise. It is also noteworthy that domesticated species, especially goats and sheep, are also at risk of death by being run over, given the intense grazing, crossing of roads and circulation through the lanes themselves.

In this respect, the running over of animals is another critical point that determines the loss of fauna.

During the construction of buildings and operational structures, in addition to the intense traffic of machines and equipment, noise is generated that disperses to adjacent areas and changes the behavior pattern of the fauna specimens.

Behavioral changes can generate aggressive interactions between animals, as well as increase levels of competition as populations migrate to other territories. Noises and vibrations can also compromise species that depend, especially, on sound communication to reproduce. It is worth mentioning, however, that during the construction phase of the project, new equipment should be used and periodic maintenance of the equipment should be carried out, in order to mitigate the noise and vibrations arising from the movement of vehicles. Therefore, despite the possibility of disorderly dispersion of wild fauna, the isolation of populations in remnants of caatinga is not foreseen, given the maintenance of the shrub-tree matrix.

The anthropization process, already existing in the region, will tend to intensify in the project's construction phase, due to the presence of workers and the consequent increase in the circulation of people in the ADI. In this phase, an estimated contingent of 1875 workers is expected. This increase in the number of people can lead to an increase in the pressure of illegal hunting on the fauna, directed mainly to species of greater human value, such as the armadillo (*Tolypeutes tricinctus*) and the parrot (*Amazona aestiva*). This pressure on fauna for illegal breeding or commercialization is increased when the species are threatened, as is the case of the armadillo (*T.tricinctus*).

There is also a strong anthropic pressure on species of snakes that, regardless of the species, are popularly considered to be poisonous and dangerous and, for this reason, are often killed when found.

a) Evaluation of Impact

This impact is **negative** and **certain to occur**; the impact should manifest itself in the **short term**, as soon as the first activities start. Its spatiality is **dispersed** since it occurs throughout the entire implementation of the project. This impact is intensifying, given the human pressure existing in the region, and **direct**, as it results from the movement of people and machinery, as well as the installation of physical barriers in the landscape. The dispersion and loss of fauna individuals can be considered **permanent** and **irreversible**.

The impact is considered of **medium** magnitude, considering also the registration of only one threatened species in the project's ADI, and the majority of the community is composed of species considered common and less sensitive to environmental changes, in addition to occurring in low population densities.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Permanent
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

In order to minimize the occurrence of this impact due to trampling and removal of vegetation, the following are proposed:

- Chace away and translocation of fauna specimens, concomitant with the operation of the machines and equipment used during the cutting and removal of vegetation, in order to avoid death by being run over (Fauna Chase Away and Management Program).
- Actions to control the speed of vehicles and equipment through signaling on site (Environmental Management Program);
- Guidance for drivers and pedestrians regarding the necessary precautions for safe traffic (Environmental Education Program);

It is not possible to eliminate noise and vibrations during the project implementation, however, some measures are planned to mitigate the noise and vibrations in this phase such as:

- Use of new equipment;
- Periodic maintenance of equipment and vehicles.

Through the Environmental Education Program, it is proposed to:

- Guide hired workers on the prohibition on hunting wild animals, emphasizing their importance in the maintenance and sustainability of natural environments.
- Demystify issues related to snakes and other wild animals, guiding workers on ways to avoid encountering potentially dangerous species and enabling them to take the right actions in the event of chance encounters.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **low relevance**.

D) Deterioration of the quality of aquatic habitats

Due to the generation and transport of sediments

Activity and Aspect	
Activity	Vegetation supression Soil stripping and storage Earthwork Opening of access routes Implementation of construction sites
Aspect	Generation of surplus materials Soil exposure Deflagration of erosive processes and mass movement Alteration of the characteristics of water bodies

During the construction phase of the Piauí Nickel Project, there may be changes in water quality due to the inflow of diffuse loads, especially solids, generated from activities such as removal of vegetation, implementation and operation of the construction site, construction of support facilities, adjustments and opening of accesses, among others. The increase in the carrying of solids into the bodies of water will occur, especially in the rainy season, causing or intensifying the carrying of sediments to the adjacent water bodies.

This transport may change the water quality, mainly due to the increase in solids, turbidity, nutrients and metals, such as iron and manganese, which are characteristic of the regional geological matrix. In addition, it can cause a decrease in the natural sections of the drainages and a reduction in their flow speed, which in turn can lead to changes in the aquatic biota,

especially in the ADI water courses (belonging to the Piauí River sub-basin), irreversibly affecting aquatic communities.

The high turbidity and large amount of suspended solids, for example, interfere with the photosynthetic processes of primary producers (phytoplankton), as they make it difficult for light to enter the aquatic system and reduce temporary niches. Since primary producers are affected in the ecosystem, by a direct relationship, zooplankton and all other links in the food chain are affected.

The carrying of sediments can also cause the silting up of water courses, with repercussions mainly on benthic organisms, that is, those that live in the beds of water bodies. Changes in water bodies directly affect the aquatic habitats available to the benthic community, as the progressive accumulation of sediments in the bed can promote uniformity of the bottom by filling in the recesses and also by the loss of differentiation between backwater and current areas (EGLER, 2002 apud QUEIROZ et al, 2008). Thinner solids content (<2 mm) can also affect the feeding and breathing activities of benthic beings due to the deposition of particles in the respiratory organs and in the larvae filtration structures of some insects such as tricopterans and diptera (WOOD & ARMITAGE, 1997).

Suspended sediments can also carry nutrients and toxic substances obstructing the gills of the fish, until they interfere with their breathing and their ability to feed and defend themselves against their predators. The suspended particles can also absorb additional heat from sunlight, increasing the temperature of the surface water layer (UFRRJ s/d), influencing the reproduction of fish species (Chacon, 1988).

Although most of the year, the majority of the ADI water courses are dry, in the case of high intensity rainfall events, which are infrequent in the region, even if the planned control measures are applied, obstruction of the control devices may occur and the efficiency of removing solids from the rain drainage system can be compromised. In addition, rainfall can also intensify erosion in areas not directly controlled.

On the other hand, in addition to land with predominantly flat characteristics, the data on land fragility presented in the Environmental and Social Diagnosis show that at Brejo Seco Mine, Umbuzeiro Mine, in the pipeline layout, transmission line and new accesses, the largest part of the structures will be installed in an area of low fragility, which means that there is low susceptibility to erosion and, consequently, the chances of sediments being carried to the nearest water courses are lower. The only point that deserves mention because it is located in a very high susceptibility to erosion area is the one located in the nickel pit area. In addition, the areas of intervention in APPs will be insignificant when considering the total amount of APP in the ADI, and considering that they represent about 7% of the total ADI's APPs.

Another important point to be highlighted is the low diversity of fish species found in the ADI that already receives a natural impact due to the variation in the levels of water bodies in the region (mostly temporary), added to the degree of anthropization of the existing landscape, which is considerably higher than any impact that may be caused by the implementation of the project.

Finally, it must also be considered that the project already includes numerous actions aimed at minimizing the carrying of sediments to watercourses, among which the following stand out:

- Implementation of sediment containment dikes downstream of the areas of the mineral complex of this project precisely to avoid carrying solids to the water courses;
- Perform edaphic practices (such as “top soil” storage);
- Limit the removal of vegetation to the areas necessary for the construction of the structures;
- Management and storage of surplus material;
- Earthmoving, execution of cuts, embankments in general must strictly follow the precepts of the engineering project and relevant Standards (such as NBR-11.682: 1991: slope stability and others);
- The schedule for the implementation of the project must be made compatible with the recovery actions of the target areas of intervention, seeking to minimize exposure to exposed soils, exposure of slopes and others to erosive agents.

a) Evaluation of Impact

The loss of individuals from the aquatic biota due to the diffuse load is a **negative** impact, **unlikely** due to the considerations made above, occurring in the **short term**, considering that it may occur soon after the execution of the activity that triggers it. It is a **reversible** impact (since aquatic communities can recover) and **temporary** even if there is a loss of wealth and abundance of species considering the construction phase.

It is considered a **dispersed** and **intensified** impact by the project, since this process already occurs naturally, albeit more slowly.

Bearing in mind that ADI water bodies are intermittent and small to medium-sized and already have water quality impairment, that the region is characterized by long periods of drought, that most of the land that will suffer interference is of low susceptibility to erosive processes, and that the project already foresees the construction of sediment containment dykes downstream of the main structures and interventions to be carried out during the construction phase, a large amount of sediment transport is not expected into the bodies 'closer water with consequent death of aquatic biota, so that this impact is evaluated as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Permanent
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

The same actions defined within the scope of the impacts caused on the surface water quality described above are valid, noting, in addition to those already foreseen by the project:

- Topographic and substrate reconformation of affected areas and / or areas that are in non-compliance;
- Promote systematic preventive and corrective actions in order to minimize possible environmental degradation due to the intensification of superficial dynamic processes;
- If necessary, carry out automated monitoring with relevant instruments (geotechnical monitoring);
- Adoption of constructive soil protection techniques (containment, drainage and other systems);
- Protect piles of excess material from erosive agents;
- Monitoring and controlling the processes of surface dynamics triggered in the area (especially erosive processes and mass movements);
- Conducting periodic visual inspections and maintenance of the rain drainage system, in addition to systematic observations on the general appearance of the water bodies, registering eventual presence of debris and concentration of solids;
- Implementation of the Surface Water Quality Monitoring Program, in order to systematically monitor the environmental control parameters of the aquatic ecosystems potentially affected by the construction works, allowing preventive and corrective actions to be taken throughout the implementation phase.

The set of actions that encompass these aforementioned practices is found in: Recovery of Degraded Areas Program (PRAD); Program for the Prevention and Control of Surface Dynamics and Silting of Water Bodies; and Monitoring Surface Water Quality Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

E) Deterioration of the quality of aquatic habitats

Due to the generation of liquid and oily effluents and solid waste

Activity and Aspect	
Activity	Implementation and operation of the construction site Supply of machinery and equipment Maintenance of machinery and equipment Vegetation removal Machine shop operation and equipment washing

Activity and Aspect	
	Movement of vehicles Construction of the project's infrastructure
Aspect	Generation of solid waste Generation of liquid and oily effluents Leak of contaminating substances Alteration of the characteristics of water bodies

During the implementation of the Piauí Nickel Project, there will be generation and disposal of solid waste, oily effluents and liquid effluents of sanitary and pluvial origin.

As adequate measures for the collection, storage, treatment and proper disposal of effluents and solid waste are planned, as described below, these punctual polluntant loads have a low probability of reaching water resources in the Piauí River sub-basin and causing changes in the quality of their water and, consequently, to cause contamination of habitats in aquatic and associated environments, which could result in the loss of individuals from the aquatic biota.

The eventual contamination of water by oils and greases, for example, causes the death of the planktonic community, as these substances destroy the cell membrane of organisms. In benthic organisms, oils and greases can cause toxicological and metabolic effects and, consequently, the death of these animals, as these substances are accumulated inside their bodies (ITOPFL, 2004 *apud* SECRON *et al,* 2010). Oils and greases can also create an oily film on the water surface, making it difficult for gas exchange between the atmosphere and the water body. Surfactants can also be present in the above mentioned effluents and have a toxic effect on aquatic organisms.

Domestic liquid effluents, generated in the administrative and support areas, are mainly characterized by a high concentration of organic matter and bacteria of fecal origin and, if they reach water resources, they can increase the nutrient content in the water. Certain levels of nutrients, such as phosphorus and nitrogen, are limiting for the development of some classes of phytoplankton, especially for Cyanophyceae. The increase in the concentration of nutrients in the water, therefore, reduces the development of some species and favors the development of others, resulting in the decrease of aquatic biological diversity.

Organic materials generated by domestic sewage and solid waste can also reduce the dissolved oxygen levels present in the water, reaching even the deepest layers inhabited by benthic invertebrates, selecting organisms that are more resistant to pollution, such as chironomids and oligochaetes.

As already widely discussed previously, it is not expected to have significant impacts on the region's water bodies during the construction phase, nor during the project's operation phase, mainly due to the intermittent characteristics of the majority of the local hydrographic network combined with the control and mitigation measures to be adopted by the project.

The engineering of this project already provides for the following specific control systems for the management and control of the aspects mentioned.

Aspect	Proposed environmental control system
Generation of oily effluents	Use of containment boxes and impermeable floor around tanks and other fuel and lubricant storage devices. Waterproofing the floor of areas where maintenance and washing activities for equipment and parts will be carried out. Use of solids decanting boxes and water-oil separators (SAO).
Generation of sanitary / domestic effluents	In the initial installation phase of the construction site, the septic tank and anaerobic filter systems will be built, which will be used both in the construction phase of the project and in the operation phase. The final treated effluent will be released into the natural drainage, duly granted. Use of a fat box for effluents from the cafeteria.
Rain drainage	Use of an efficient drainage system in the accesses and construction site. The drainage system must consist of adequate devices for collecting and disciplining rainwater until its final disposal in natural drains. In general, channels are built that will lead the flow of water to manholes and concrete water drops until its final disposal in the natural land in a controlled manner, without creating concentrated flows.
Solid waste	As a rule, segregation and temporary storage are foreseen taking into account the NBR Classification 10.004 / 2004 and respective characteristics according to the applicable legislation. Finally, the waste will be sent to licensed landfills / controlled companies.

As presented in the Environmental and Social Diagnosis, the results of surface water quality analyzes prior to the implementation of this project already indicate that they were free from contamination by oils and greases, but showed some specific detectable results of MBAS (surfactants) in the third sampling campaign, after a rainy period. Some points also showed low oxygenation and a high amount of nutrients. The thermotolerant coliforms exceeded the maximum value allowed by CONAMA Resolution No. 357/05 in some samples analyzed, mainly in the Itaquatiara River microbasin, where the highest results were recorded. It is also worth noting that the densities of cyanobacteria, including some with potential for toxin production, showed high results in some watercourses, at densities higher than those allowed by federal legislation.

a) Evaluation of Impact

The impact of loss of individuals due to contamination by solid waste and effluents is **negative**, **indirect, probable**, occurring in the short term. It is **irreversible**, as it reduces the richness and abundance of species, a **new fact** for the project and **permanent**.

This impact is considered to be of **small magnitude**, since the implementation of the project under analysis will involve the generation of ponctual effluents and waste loads.

Attributes			
Nature	Negative	**Order**	Indirect

Attributes			
Occurance - Probability	Probable	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	New fact
Occurance - Spatiality	Dispersed	**Duration**	Permanent
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

The mitigating measures to be adopted to reduce this impact include, in addition to the actions already foreseen by the project and mentioned in the discussion of the impact, the following activities:

- Inspect and carry out systematic maintenance of the storage structures for lubricating oils, greases and / or chemical products of any nature;
- The area used as a construction site must be waterproofed and equipped with the necessary control systems;
- All machines, equipment and vehicles used in the mine's construction must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential oil, grease and fuel leaks. In this sense, workshops and maintenance places must be equipped with environmental control devices;

The set of actions that encompass these abovementioned practices is found in: the Liquid Effluent Management Program; the Solid Waste Management Program; and the Surface Water Quality Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.2.3. Socioeconomic Environment

A) Increase in economic activity

Activity and Aspect	
Activity	Acquisition of goods, supplies and services; construction of the project and its structures.
Aspect	Demand for goods and services; Job creation

Economic sectors cannot be isolated, since there is an interrelated relationship between them. When producing a service or final good, the sectors that produce the inputs will also be encouraged to increase their production, motivating the entire production chain. Thus, the increase in the number of direct jobs in an economic sector stimulates the increase in production and the generation of additional jobs in other sectors where there is a relationship in the production chain.

The workers to be hired for the construction of the Piauí Nickel Project, will spend part of their wages in the purchase of goods and services, causing an increase in the income generation of the local and regional economy. Hiring workers from other locations may still increase the economy due to the demand for hosting services.

Likewise, in addition to the workers, the outsourced construction company (ies) must demand different types of inputs and services necessary for the construction process, all contributing to the increase of the local and regional economy. In this case, given the characteristics of the ADI municipalities, it is likely that a considerable part of these inputs will also increase the economy of the AII, since it presents greater economic dynamism.

Although it is not possible to accurately quantify this increase in the economy, it is certain that it will exist in an expressive magnitude considering that the construction period will hire about 1,875 direct workers (at the peak of the works) and that the planned investments are some US$ 520 million.

a) Evaluation of Impact

The impact of increased economic activity is **positive**, of **certai**n occurrence, in the **medium term**, as it is related to the two-year period of works and the gradual mobilization of labor. It is of **dispersed** spatiality, although it will occur mainly in the municipalities of the ADI and AII, as it is based not only on the transformation of workers' wages into local consumption, but in the other productive sectors related to local and regional civil construction. It is **reversible**, as it is directly associated with the deployment phase (mobilization followed by demobilization), and so it is also an **intensifying** impact, since the economies involved have a current dynamic. It is **direct**, since it is the result of the acquisition of inputs, goods and services and the generation of jobs by the Piauí Nickel Project.

Given the highlighted attributes and above all the number of jobs and the investment value involved, the magnitude of this impact is considered to be **large**.

Attributes			
Nature	Positive	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

It is necessary to adopt measures that encourage the hiring of suppliers of local and regional goods and services, through actions of the Local Suppliers Development Program. Through partnerships and agreements with institutions for research, development and strengthening of productive activities such as, for example, SENAC, SENAI, SEBRAE, IFPI, the program should diagnose the situation of companies and businesses in the ADI municipalities and promote actions and events that aim at the regularization and development of local projects / traders, making it possible to use them as part of the suppliers of inputs and services for the implementation of the Piauí Nickel Project.

Thus, it is expected that in project construction, the project will be able to use suppliers from the municipalities of the ADI and AII to provide inputs, even the simplest ones, for the civil construction process. Actions to publicize opportunities should also be provided for, through the Social Communication Program.

c) Degree of potentiation of the measures and degree of relevance of the impact

Degree of Empowerment and Relevance	
Degree of Potentiation of Measures	**High**
Relevance Degree of the Impact	**High**

The proposed measures have a high degree of potentiation and as the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

B) Increase in the demand for housing and prices' elevation

Activity and Aspect	
Activity	Implementation of the project and its structures.
Aspect	Attraction of people

As presented in Project Description section, it is estimated that the works of the construction phase of the Piauí Nickel Project will be carried out in 24 months, with 1,875 workers expected at the peak of the work. The hiring will be directed primarily to workers with fixed residence in

the municipalities of the ADI (Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio and São João do Piauí).

Even though priority is given to hiring local labor, it is likely that workers in these locations are not sufficient to meet the specific qualification demands of the project during the implementation phase, requiring the hiring of professionals from other locations. Thus, as shown in the Project Description, it is estimated that the local contingent of workers should be 30% of the total demanded.

Thus, the remaining 70% of workers required for the implementation of the project must come from other locations. During the elaboration of the detailed engineering of the Piauí Nickel Project, the project will jointly assess with the public authorities of the ADI municipalities the need to implement housing for part of the workers, which on the one hand would reduce the pressure for housing, but on the other hand, would decrease the benefits in the accommodation and property rental sector. This assessment will serve to identify what is most beneficial for the impacted municipalities.

Even if lodgings are built on the construction site, a portion of these workers, especially those with higher qualifications, should settle in the headquarters of the municipalities of the ADI, mainly in São João do Piauí in view of their greater economic and infrastructure size, and Capitão Gervásio Oliveira due to the proximity to the project.

It is also considered that the increase in urban activities caused by the implementation of the project should attract a population indirectly associated with it, due to the increase in the region's economic dynamics.

Thus, the population increase in the municipalities of the ADI, especially in São João do Piauí and Capitão Gervásio Oliveira, resulting both from the hiring of workers to implement the project and from migration due to the increase in the local economic dynamics, should be reflected in the increase the demand for housing in its different modalities, highlighting the demand for social housing by segments of the low and very low income population, with the risk of the appearance or expansion of irregular occupations in inadequate areas.

As a result of this increase in the demand for housing, there may be an increase in the price of real estate and rents, a fact that should negatively affect families that live in the condition of tenants and positively in those who own properties, expanding possible existing social inequalities.

a) Evaluation of Impact

The increase in the demand for housing is a **negative** impact, since it can result in the emergence or expansion of irregular occupations, and increase the expenses of families that pay rent.

It is an impact of **certain** occurrence, and it manifests itself in the **medium term**, linked to the beginning of the works to implement the project. Its spatiality is **local,** limited to the headquarters of the municipalities of the ADI. This impact is **indirect**, as it is associated with an unplanned population increase, and **reversible**, once the construction activities have ceased, there should be a population influx, which is why it is considered a **temporary** and a **causing** impact.

Considering the number of workers and the population potential to be attracted and that the impact is certain to occur and has a reversible and temporary character, this was assessed as of **medium magnitude**.

Attributes			
Nature	Negative	**Order**	Indirect
Occurence - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurence - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

Although the responsibility for the provision of housing and urban infrastructure rests with the public authority, it will be up to the project to assist in the planning and implementation of equipment that corresponds to the additional demand to be generated by the population attracted and directly associated with the project, represented by the contracted workers and their families.

With regard to the increase in demand for housing due to migration resulting from the attraction to the region expected to be generated by the project, due to the increase in the dynamism of the economy, the project must identify and provide technical and institutional support to the initiatives of the responsible public bodies.

Although the rental price is defined by market rules, such as the principle of supply and demand, the project will be able to assist families living in rental housing that find themselves in difficult negotiation situations, offering the support of a team that indicates appropriate measures to contain possible abuses by property owners.

These actions should be part of the Interference Monitoring and Support to Public Services Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Low**
Relevance Degree of the Impact	**Medium**

The proposed measures represent a great effort on the part of the project to adapt the project's insertion in the region in order to cause the least possible negative social impact. However, given its interface with the public authorities, the measures may not achieve the expected degree of success and for this reason, conservatively, it was decided to keep them as of low

resolution and, as the impact was assessed as of medium magnitude, this can be considered as of **medium relevance**.

C) Increase in the demand for public services

Activity and Aspect	
Activity	Construction of the project and its structures.
Aspect	Attraction of people

As shown in the previous impact, the duration of the works for the construction phase of the Piauí Nickel Project is expected to be 24 months, with a total of 1,875 workers at the peak of the works. Hiring should be aimed primarily at workers with fixed residency in the ADI municipalities, however it is estimated that around 70% should be hired from other locations. In addition to the direct workers of the project, the increase in the dynamism of the ADI economy is expected to attract more migrants from other locations to the ADI municipalities.

Thus, in view of this scenario, there may be an increase in demand for public services and equipment, notably in the areas of health and education, in addition to other services of a public nature, due to the percentage of migrants who may be attracted by job and business opportunities.

In relation to health, according to the Environmental and Social Diagnosis, the municipalities of the ADI have Health Centers / Basic Health Units in an adequate amount for their respective populations, however there is a low number of doctors and only the municipality of São João do Piauí has hospitals. The hospitalization beds present in the service network of São João do Piauí are less than needed in the region, given that the municipality is a reference for other municipalities such as Campo Alegre do Fidalgo and Capitão Gervásio Oliveira.

In their physical educational structure, the municipalities of the ADI have public establishments that meet the levels of early childhood education, elementary and high school. The municipality of São João do Piauí has the best service network, including higher education, through the IFPI. Given the rural characteristics of the municipalities, it was observed, through the interviewees' report in the socio-environmental perception survey, that the difficulties encountered are mainly due to the displacement of students from rural areas. According to the interviews carried out, the municipal education service is considered regular for 67% of the interviewees, being poor for 11% and terrible for 22%.

In this context, with the possible increase in population, an increase in pressure on public equipment and services is expected, which may worsen a situation that is in a state of less than ideal.

a) Evaluation of Impact

Due to its characteristics, this impact is qualified as **negative** and **certain**, since part of the hired workers must be from locations outside the municipalities of the ADI and, of **localized** occurrence and in the **medium-term**, as it will reach the infrastructure and public services of the municipalities of the ADI from the beginning of the construction works. **Temporary**, as it is related to the population increase only in this phase and **reversible** with the end of the works. The impact is considered **indirect**, since, if it occurs, it will result from the possible arrival of

migrants in search of work, and as a **cause** given the relative stability in the demands for public services.

Considering that there will be the hiring of about 1300 workers from outside the municipalities of ADI and that they will be able to take family members with them and that the dynamism of the local economy can further increase this contingent, this impact is qualified as of **large magnitude**.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

It is recommended the implementation of a Program for Monitoring Interference and Support to Public Services, in which the monitoring of public service attendance indicators is carried out, in order to establish the relationship between the increased demand on infrastructure and services in the municipality and the project.

If a direct relationship is found between the increase in demand for such infrastructure and public services and the project, measures should be verified together with public agencies that reduce this impact.

Also related to this impact are the actions foreseen in the Social Communication Program, and in the Labor Management Program, mainly in relation to the prioritization of hiring local labor.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**High**

The proposed measures have a medium degree of resolution and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

D) Increase in prostitution / sexual exploitation

Activity and Aspect	
Activity	Implementation of the project and its structures

Activity and Aspect	
Aspect	Attraction of people

A significant part of the Brazilian population is exposed to problems of early pregnancy and prostitution, including children and adolescents. These social and public health problems tend to be aggravated in the regions that host projects that attract a population, even if not directly linked to them, but which is also attracted by the trend of greater economic dynamics and job opportunities in the region.

Even considering that 30% of the workers hired for the construction works for the Piauí Nickel Project will be from the ADI municipalities, it is estimated that approximately 1300 workers will come from other municipalities. In addition to the direct workers of the project, the increase in the dynamism of the ADI economy is expected to attract more migrants from other locations to the ADI municipalities. These migrant workers, given the characteristics of civil construction activities, are mostly male, between the ages of 20 and 40, and in most cases move unaccompanied by their families.

Workers with this profile, to the extent that they establish social relationships with the local population and seek leisure options at work, may negatively impact the ADI municipalities with sexual activity practices, incurring an increase in cases of prostitution, early pregnancy and sexual exploitation of children and adolescents[1].

a) Evaluation of Impact

The impact can be classified as **negative** and **likely** to occur and **located** in the ADI, with an emphasis on the Surrounding Communities. It is **medium term**, therefore, it can last throughout the construction phase. It is considered an **indirect, intensifying, reversible** impact, as soon as the contracted labor outside the ADI returns to its regions of origin, this situation tends to stabilize and, for this reason, it can be considered a **temporary** impact.

Considering that there will be the hiring of about 1300 workers from outside the municipalities of the ADI and that the dynamization of the local economy can further increase this contingent and that the area covered are municipalities and small communities, this impact is qualified as of **large magnitude**.

[1] On the topic see the research "The men behind the great works of Brazil", carried out by psychologists from the Federal University of Sergipe and the Federal University of Rio Grande do Sul, in partnership with Childhood Brasil (Instituto WCF), who heard 288 men working in the construction of mega- infrastructure projects in the states of Santa Catarina, São Paulo, Minas Gerais, Goiás and Rondônia. The study points out that 97.2% of the interviewees say that their work colleagues use the services of prostitutes, only 56.7% admit to having done the same, yet, 66.9% affirm that the partners go out with girls under 18 years old, 25.4% acknowledge having acted in the same way. More than half of the interviewees, 57.3%, witness or have witnessed the sexual exploitation of children and adolescents. Available at: http://www.childhood.org.br/wp-content/uploads/2014/03/Homens-por-tras-das-grandes-obras.pdf. Accessed on: January 2017.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

The measures to mitigate this impact are of a preventive nature, taking place through the implementation of educational and awareness actions focusing on themes related to sex education, sexually transmitted diseases and, mainly, prevention and combating the sexual exploitation of children and adolescents and will be part of joint actions of the Social Communication and Environmental Education Programs.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**High**

The proposed measures have a medium degree of resolution and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

E) Increase in government budget revenues

Activity and Aspect	
Activity	Acquisition of goods, supplies and services; Implementation of the project and its structures.
Aspect	Generation of taxes (taxes, fees, contributions, royalties).

Considering the national tax characteristics, it is observed that during the period of implementation of the Piauí Nickel Project, the significant impact on budget revenues will occur mainly in the municipalities of the ADI.

During the construction phase of the project, the increase in revenue in the municipalities of the ADI that may assume some expression is that resulting from the increase in the collection of the Tax on Services of Any Nature (ISSQN).

Therefore, it is considered that the engineering services and others associated with the construction of the structures should be collected in the municipalities where the works will be

located, that is, those that make up the ADI (Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio and São João do Piauí). In this sense, it is important to emphasize that this increase should be more intense in the municipalities of Capitão Gervásio Oliveira, where most of the works will be concentrated, and São João do Piauí, which in addition to the works in its territory may also provide other types of complementary services.

At the state level, the acquisition of the necessary inputs for the construction of the project should increase the collection of the Tax on Circulation of Goods and Services (ICMS), although given the size of the state budget it should not be a significant impact.

It is important to highlight that, as presented in the Environmental and Social Diagnosis, the municipalities of the ADI have low capacity for their own collection, with a high dependence on federal transfers, especially from the Municipality Participation Fund, except for São João do Piauí, which presents a greater diversity of revenues.

a) Evaluation of Impact

The increase in municipal revenues, resulting from the ISSQN withholding to be paid, is a **positive** impact, will represent a significant increase in budgetary resources, reducing the municipal dependence on state or federal current transfers during the construction period, generating greater revenue autonomy for the ADI municipalities, especially, Capitão Gervásio Oliveira.

This impact is **certain**, as it will derive from a tax obligation. **Located**, because it is a collection of municipal competence, and as this collection will cover the entire construction phase, it will be in effect in the **medium term**. It will be a **reversible** impact, since, after the implementation phase, the collection of ISSQN will cease. **Direct**, since it will derive from the contracting of construction services and other services necessary for the installation works, and so in a **causative** way. **Temporary**, manifesting only during the duration of the project implementation.

The magnitude of this impact is therefore **large**, considering the high significance of increase in municipal revenue.

Attributes			
Nature	Positive	**Order**	Direct
Occurence - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurence - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

Provision of training for employees of the municipalities of the ADI in relation to public management in order to improve the collection and use of public resources. This control measure has a medium degree of potentiation as it does not depend exclusively on the project, and must be part of the Interference Monitoring and Support to Public Services Program.

c) Degree of Potentiation of Measures and degree of relevance of the impact

Degree of Empowerment and Relevance	
Degree of Potentiation of Measures	**Medium**
Relevance Degree of the Impact	**High**

The proposed measures have a medium degree of potentiation and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

F) Increase in social conflicts

Activity and Aspect	
Activity	Circulation of vehicles (cargo, passengers, etc.); Demobilization of labor; Implementation of the project and its structures; Negotiation for land acquisition.
Aspect	Traffic generation; Generation of unemployment; Attraction of people; Interference with other economic activities; Availability and circulation of information

As already highlighted in previous impacts, the implementation of the Piauí Nickel Project will require the hiring of around 1300 workers from outside the ADI. In addition to the direct workers of the project, the increase in the dynamism of the ADI economy is expected to attract more migrants from other locations to the ADI municipalities. These migrant workers, given the characteristics of civil construction activities, are mostly male, between the ages of 20 and 40, and in most cases move unaccompanied by their families.

The agglomeration of this “outsider” population, both in homes and in workplaces, may favor the emergence of disputes, which may result in conflicts. Here we mention some elements that can contribute to the emergence and / or potentiation of conflicts, such as deficiency and lack of adequacy of the local infrastructure to shelter migrants, deficiencies in fighting crime, great distances from workers' homes and the absence of their families, in addition to everyday relationships, which can culminate in violence, such as disputes over job opportunities, romantic relationships, disagreements between colleagues, drug use and alcohol abuse.

The possibility of abusive use of alcoholic beverages and drugs are factors that can favor the onset of these situations. Other situations of friction and violence may occur due to the demand and use of public services such as transportation, health, education.

The project's need to acquire land for the project's facilities, changing their uses, as well as the development of the works themselves can also lead to conflicts with residents of the Surrounding Communities.

a) Evaluation of Impact

The increase in social conflicts is a **negative**, **probable** impact, which was considered to be **short-term** and **indirect**, mainly due to the migration of workers. It must be a **localized** phenomenon, especially in the municipal offices of the ADI and in the surrounding communities. **Temporary**, with improvement after the return of the migrant population to the places of origin, being, therefore, **reversible**. It is considered an **intensifying** impact, adding to existing conflict situations in society.

According to the attributes presented, as well as the characteristics of the localities, this impact is considered to be of **medium** magnitude.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Mreasures and Environmental and Social Programs

The main measures proposed to mitigate this impact are the hiring of the greatest possible number of local labor and the diffusion of lectures, events, campaigns and training focused on the theme. Actions and content related to the Social Communication Program, the Workforce Management Program and the Environmental Education Program should include the issue of coexistence between people "from different cultures", as well as respect for local customs and habits.

In addition, ensuring a healthy work environment, which highlights the benefits of teamwork to achieve goals, often generates a sense of "belonging" that indirectly influences individual behavior.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

G) Increase in discomfort to the population

Activity and Aspect	
Activity	Circulation of vehicles (cargo, passengers, etc.); Construction of buildings; Construction of the project's infrastructure; Demobilization of the construction site; Orderly distribution of tubes; Execution of Foundations; Exploration of cut/fill areas; Implementation of construction sites; Pipeline construction; Maintenance of machines / equipment; Assembly of the towers; Operation of machines / equipment; Operation of the construction site; Operation of the machinery yard; Earthwork, Storage of hazardous and polluting substances.
Aspect	Generation of particulate material; Odor generation; Generation of gaseous pollutants; Noise generation; Traffic generation (vehicles / machines); Generation of terrain vibrations; Attraction of people

This impact is associated with the civil works activities related to the implementation of the Piauí Nickel Project, which will require great movement of people, machinery, equipment and vehicles and explosions to assist in the implementation of the pits, as described in the Project Description chapter, which it may generate changes in noise, vibration and air quality levels (suspension of particulate matter - dust) around the works, resulting in inconvenience to residents of the surrounding communities.

The use of machinery and equipment, the transport of material and construction workers, as well as the use of explosives, should cause noise and vibration impacts in the areas closest to the emitting sources. These actions and their consequences are detailed in the impacts of the construction phase "Environmental discomfort - Acoustic Overpressure", previously presented.

Regarding air quality, the predominant component, under these conditions, is particulate material, essentially from soil movement and vehicle circulation. It should be noted that the area where the project is located has aggravating factors for this problem, due to the low humidity of the air, with long periods of drought, and the strong winds that reach the location, so these factors can intensify both the production of particulate material and expand its dispersion, which would further affect the Surrounding Communities. Further details are presented in the impact of “Deterioration of air quality” in the implementation phase.

The inconveniences to the population should be concentrated in the communities closest to the structures of the project (DAA), namely: Carnaíba Settlement (100m from the pipeline); Várzea Settlement (50m from the pipeline), Veredas Settlement (350m from the pipeline), Brejo Seco Community (900m from the explosives warehouse), Várzea de Cima Community (350m dike 2), Veredas Community (500m from the access road and 2 km from the Nickel Mine) and Umbuzeiro Community (1.4 km from the Limestone Plant).

Considering the number of families estimated in the Surrounding Communities most impacted, Carnaíba Settlement (13); Várzea Settlement (16), Veredas Settlement (18), Brejo Seco Community (no estimate), Várzea de Cima Community (10), Veredas Community (50) and Umbuzeiro Community (8), it is estimated that the main discomfort impacts to population can reach up to 115 families, or about 400 people.

Finally, it is important to remember that the Piauí Nickel Project already foresees the construction of an independent and exclusive road for the use of the project, located far from these surrounding communities precisely to reduce the use of pre-existing roads to the maximum and consequently minimize this impact on the closest receivers.

a) Evaluation of Impact

The impact is **negative**, it has a **certain** occurrence, because the works and the transport of cargo are fundamental for the implementation of the Piauí Nickel Project, and it should manifest itself in the **short term**. The spatiality of this impact is **localized**, as it is concentrated in the area of the project and its surroundings (roads; area of noise propagation and, eventually, vibration; portion of the aerial basin affected by the dispersion of dust and gases and area of action of vectors).

The inconveniences generated to the population during the construction phase are **reversibl**e and **direct**, as they are directly linked to the period of works and the logistics needs of the project.

This impact has a **temporary** duration, returning to the previous situation when the activities of this phase cease. It is considered an **intensifying** interference, because although it is a change that will only happen with the implementation of the project, the pilot plant is already in operation.

According to the attributes presented, as well as the characteristics of the project and the impacted locations, this impact is considered to be of **large** magnitude.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

Some measures must be taken such as:

- Assess and identify sources of noise, requiring mitigating measures to contain and minimize these impacts. It is recommended to place sidings with height determined according to the height of the equipment (noise sources) to be used. It would also be important to schedule the noisiest activities for the day, leaving the night activities with less noise and vibrations;
- Inform the local residents in advance when the most disturbing activities occur. This measure should be part of the Social Communication Program;

To reduce the levels of noise and dust emitted by the traffic of heavy and light vehicles, it is recommended:

- Proper maintenance and conservation of roads;
- Establishment of ideal speed for vehicles, that is, that produces the lowest level of noise and dust;
- Sprinkling water on the unpaved roads to be used, in order to reduce the suspension of particulate matter;
- Traffic planning for heavy vehicles, avoiding the night shift.

The actions related to vehicle traffic may be included in the Environmental Management Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**High**

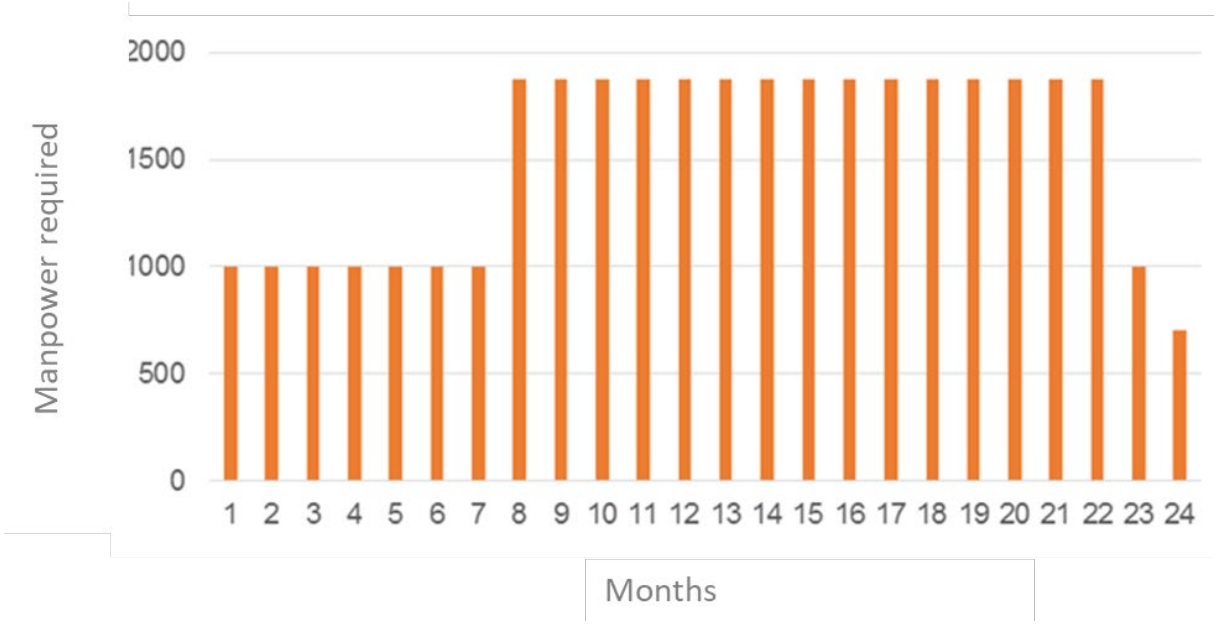
The proposed measures have a medium degree of resolution and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

H) Increase in the number of employed workers and the population's income

Activity and Aspect	
Activity	Acquisition of goods, supplies and services; Implementation of the project and its structures; Mobilization of labour;
Aspect	Job creation; Changing local or regional economic dynamics

During the implementation of the project, at the peak of the works, approximately 1,875 new direct jobs will be generated. This demand is expected to happen over the 8th and 22nd month of construction, as shown in the graph below.

Graph 7.2-1 – Histogram of Labor Occupation, in the Implementation Phase.



Considering the estimated hiring of 30% of local workers (ADI residents), at the peak of the works there will be about 560 employees directly spending a large part of their remuneration in the ADI municipalities, in addition to the portion to be spent by the other contracted workers.

Investments that generate direct jobs also have an effect on other activities and consequently also generate more jobs. The jobs generated as a result of investing in other areas are called indirect, which refer to the effect that this investment will have within the other activities of the productive chain of this sector, and of income effect, linked to the consumption that direct and indirect employees will realize from the perceived income.

For estimating indirect and income-effect jobs, data from the Employment Generation Model (Najberg and Ikeda 1999)[2] can be used as the calculation basis. According to this methodology, investments in civil construction generate for each direct job 0.6 indirect and 3.35 of income effect.

Applying these factors to the total amount of labor (at the peak of works) of the project, which will be 1,875 direct employees, the estimated value of 1,125 indirect jobs and 6,281 of income effect generated on account of investments of the Piauí Nickel Project. It is important to note that these indirect and income-effect jobs will not be given exclusively in the municipalities of the ADI, but will be dispersed throughout all locations that have a connection with the productive network that encompasses the region.

[2] Najberg, S .; Ikeda, M. Job creation model: methodology and results. Rio de Janeiro: BNDES, 1999. (Text for Discussion, n. 32). Available in: http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/conhecimento/efetividade/relatorio_efetividade_2007_2014.pdf. Accessed in December 2016.

The jobs generated in this phase will have a significant and positive impact, since, according to the data presented in the Environmental and Social Diagnosis, about 90% of the offer of formal jobs in the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira and Dom Inocêncio came from the public administration, which indicates the low dynamism of the economies of these municipalities. São João do Piauí, as already mentioned, has a more developed economy, not showing much dependence on public administration, with this being responsible for 48% of formal jobs in the municipality.

It is important to highlight that only the direct jobs of the Piauí Nickel Project that are expected to generate for the residents of the municipalities of the ADI, 560 during the implementation, represent about 25% of all formal jobs existing in these municipalities (2,275).

a) Evaluation of Impact

The increase in the number of workers and local income will be a **positive** impact, of **certain** occurrence, since the project will open new jobs, generating an increase in employment and local income and, therefore, it is **dispersed**, as it may be extend beyond the ADI to reach the AII and other municipalities in the region, due to indirect and income-effect jobs.

As this impact will affect the entire construction phase of the project, it will be in effect in the **short term**, since, in the first hirings, it will take effect, although taking into account the gradual mobilization of the workforce, it should present greater intensity between the 8th and 22nd months of the project construction. And, thus, it will be a **reversible** impact, since it occurs only during the works. This is a **causative** and **direct** impact, since it will directly result from the **temporary** labor contracting aspect, manifesting itself only during the implementation of the project.

The magnitude of this impact is **large**, as, as shown, only the direct jobs expected for the ADI municipalities correspond to about 25% of formal workers in these municipalities.

Attributes			
Nature	Positive	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

The measures that can enhance the positive effects of the impact in this construction phase are:

- Hiring as many of local workers as possible, considering the municipalities of the ADI;

- Training of workers hired, aiming at their future employability, above all enabling hiring during the operation phase, as well as expanding the future matrix of local specialized labor. This measure should be part of the Labor Management Program;
- Establishment of frequent communication channels that provide official information on the demand and qualification required for hiring labor, in accordance with the actions provided for in the Social Communication Program;
- Dissemination of information to the population explaining how the recruitment and selection of labor activities will take place, in accordance with actions planned and provided for in the Labor Management Program.

c) Degree of potentiation of the Measures and degree of relevance of the impact

Degree of Empowerment and Relevance	
Degree of Potentiation of Measures	**High**
Relevance Degree of the Impact	**High**

The proposed measures have a high degree of potentiation and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

I) Decrease in jobs, income and economic activity (demobilization)

Activity and Aspect	
Activity	Demobilization of labour
Aspect	Exodus of people and workers; Reduced traffic generation(vehicles / machines)

The economic sectors must be analyzed as integrated and interdependent, thus, in a productive chain, the fall in economic activity in one determines a certain impact in another, as a consequence of the lower allocation of resources directed to the demand for productive inputs or, simply, due to the lower consumption resulting of the lowest family income in circulation, thus there is a drop in local economic activity.

Despite being an expected and predicted impact due to the characteristics of the engineering works, the decrease in employment, and the consequent decrease in income and economic activity, after the completion of the works is a negative fact.

Thus, if at the peak of the works, in the implementation phase, about 1,875 direct workers will be mobilized and, due to their remuneration, they will start to consume in commerce and hire local services, at the end of this same phase, with the gradual demobilization of the labor force and the consequent reduction in family income in the local economy, it will present a drop in marginal demand for each worker who fails to receive his salary.

Likewise, all services and supplies that will be demanded in the 24 months of the project's implementation will no longer be activated, that is, they will also cause a drop in the economic dynamics of the ADI. Thus, from the simplest consumer goods to the most specialized service that will be demanded during the implementation phase, they will no longer be demanded at the end of this phase, causing a drop in economic activity.

a) Evaluation of Impact

If the impact of a positive increase in employment and the local economy, which will last throughout the implementation phase, was assessed as significant, the present reverse impact cannot be considered negligible. In other words, the deactivation of the construction period and the demobilization of labor, will generate a **negative** and not negligible impact on the economy of the ADI.

This impact has **short-term** characteristics, as, in addition to the fact that household consumption does not change in the short term, there are medium and long-term effects derived from that first activation impact on the local economy, which will mitigate the negative effect. It is **certain** because there will be the demobilization of workers, and so it is also **direct**. The effects of the impact will be **localized**; as most demobilized workers will be ADI residents.

Considering that even the operation of the project is expected to have minor effects on the local economy, the impact is assessed as **permanent**. It is also an **intensifying** impact, given the low economic dynamics of the ADI, before the works of the project.

Bearing in mind that the region's economic and social development driven by the implementation of the project may have some of its lasting effects, in certain irreversible aspects, the magnitude of the impact resulting from the deactivation of the implementation period will be less than the economic acceleration resulting from its activation and duration over two years, so the impact is rated as of **medium** magnitude.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Permanent
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

It is necessary to adopt actions that encourage the hiring of suppliers of local and regional goods and services throughout the implementation phase, according to the measures proposed for the positive impact of increased economic activity, described for the beginning of this phase. These actions should be part of the Local Suppliers Development Program.

Considering that the demobilization of labor is gradual, a measure that can mitigate the impact on the ADI municipalities is that preference is given so that local workers are kept in their jobs as long as possible.

It is still necessary to train directly hired workers, as indicated in the positive impact of increasing the number of workers, aiming at their future employability, above all enabling hiring during the operation phase and expanding the future matrix of local specialized labor. These measures should be part of the Workeforce Management Program.

In addition, as a means of long-term mitigation, during the operation phase, actions will be proposed to promote activities that can raise the level of socioeconomic development of the ADI communities. Actions will be presented that encourage the emergence and / or expansion of self-sustainable economic activities, that is, that do not depend on the Piauí Nickel Project to develop. These actions will be part of the Local Communities' Self-Sustainable Development Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

J) Increase in the incidence of diseases (by vectors, endemic, STD / AIDs, cardiovascular, respiratory, etc.)

Activity and Aspect	
Activity	Circulation of vehicles (cargo, passengers, etc.); Construction of buildings; Construction of the project's infrastructure; Demolition and disinfection; Orderly distribution of tubes; Exploration of cut/fill areas; Implementation of construction sites; Implementation of the project and its structures; Operation of machines / equipment; Operation of the construction site; Removal of Vegetation
Aspect	Attraction of people; Generation of particulate material; Generation of solid waste; Noise generation; Proliferation of disease vectors.

According to the Project Description chapter, it is estimated that the works of the project's construction phase should generate, at the peak of the works, about 1,875 direct jobs. The hiring will be directed primarily to the ADI workers, however it will be necessary to hire around 1300 professionals from other locations.

Thus, the increase in the circulation of people in the municipalities and the characteristics of this population, especially the age group between 20 and 40 years old and male, are factors that can lead to an increase in the occurrence of sexually transmitted diseases - STDs, including the HIV, in addition to the possibility of increased reporting of injuries due to injuries from external causes, such as occasional accidents or violent acts.

It is also added that, with the arrival of workers from other places added to the attracted population not directly associated with the project, there may be an increase in the number of people per household or collective housing, generating the possibility of degradation of sanitary

and hygiene conditions , impacting the health of these people, through the acquisition of infectious and / or parasitic diseases. Thus, greater care should be taken with the monitoring of diseases such as wounds and leprosy, endemic in the region. Similarly, other non-endemic diseases in the region can be brought about through the migration of these people.

The possible worsening of air quality, especially through the generation of particulate material, essentially from soil movement and vehicle circulation, can also cause an increase in diseases of the respiratory system, especially in people from the highest risk groups such as children, the elderly, and people with chronic illnesses (such as asthma or allergic rhinitis). It is important to mention that, as highlighted in the Environmental and Social Diagnosis, diseases of the respiratory system are one of the main causes of morbidity in the ADI.

The possible increase in diseases of the respiratory system, if it occurs, should be restricted to the Surrounding Communities, especially those with greater proximity to the areas with the greatest concentration of the project's structures (Carnaíba, Várzea and Veredas settlements, and Brejo Seco, Várzea de Cima, Veredas and Umbuzeiro).

a) Evaluation of Impact

Regardless of the generating aspect, the impact is **negative**, **likely** to occur. As for the order, this impact is considered directly associated with the activities related to the works of the project, but indirectly associated with the other aspects. Therefore, this aspect is considered **indirect**. This is considered a **medium term** and **reversible** impact. Considering that the conditions mentioned for the increase in the incidence of diseases will be new in the region, the impact is in a **causative** way. Because the impact is limited to the ADI municipalities and surrounding communities, spatiality is **localized**.

The magnitude of this impact is associated with the volume of people to be attracted to the region, as well as the fact that it is likely and indirect, thus, the magnitude is considered **medium**.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

The following actions are planned:

- Maintain adequate sanitary conditions at the construction site;

- Strengthening of the sex education policy, health promotion and STD / AIDS prevention for construction workers and for the population of the ADI municipalities, with an emphasis on residents of the Surrounding Communities, through educational campaigns;
- Perform air quality control and monitoring actions.

These actions should be part of the Social Communication and Environmental Education Programs.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Low**
Relevance Degree of the Impact	**Medium**

The proposed measures have a low degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of medium relevance.

K) Loss of productive areas (farming)

Activity and Aspect	
Activity	Implementation of the project and its structures
Aspect	Change in land use and occupation

The region in which the project is located is predominantly rural, characterized by the predominance of caatinga vegetation, with few areas used in agricultural and livestock production. With the advent of activities related to the construction of the project, the use and occupation of the soil should be significantly altered since the native vegetation and current anthropic uses should, in part, give way to the facilities of the Piauí Nickel Project.

With regard to the productive areas directly impacted by the project, it is noteworthy that only 59.76 hectares are currently composed of areas used in agriculture and livestock, representing only 1.8% of the areas used in the ADI agriculture for land use. These areas of agricultural production are distributed over some rural properties, including part of the Várzea Settlement.

It should be noted that in addition to the areas mapped as agricultural and livestock, livestock production given its characteristic in the region, extensive and loose (including without physical barriers between most of the properties), ends up using the caatinga areas as the main source of food for the animals.

a) Evaluation of Impact

This is a **negative** impact, since the implementation of the project will introduce activities and structures to replace existing agricultural activities. It is an impact of **certain** probability, since the change in the use and occupation of the land is inseparable from the very existence of the project, and is manifested in the **short term**. It is also a **localized** impact, as it will occur on the spot, not extrapolating the project's DAA. In the **causitivity** of the interference, it will be a **direct** and interference impact, given that it will result from the activities for the implementation of the

project. This impact **is irreversible**, since after the construction phase there will be mining activity, **permanently** changing the use and occupation of the soil.

Although the changes in land use and occupation are significant, due to the fact that the project changes only a small area currently used in productive activities, this impact is considered to be of **small** magnitude.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Irreversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Permanent
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

In order to guarantee the maintenance or improvement of the levels of economic activity and the quality of life of families that have their properties impacted by the project, the following actions will be taken:

- Execution of the Socioeconomic Register for purposes of identification, quantification, qualification and public registration of the affected population;
- Holding of a negotiation meeting between the project and the affected families;
- Preparation of Physical-Territorial Register of affected properties;
- Preparation of appraisal reports for the affected properties / improvements;
- Negotiation for the acquisition of land based on the report of each property, with the objective of amicable negotiation;
- If it is necessary to provide technical support to families in need of relocation, in order to guarantee maintenance or improvement in quality of life.

In the case of the need to acquire the lands of the Várzea Settlement, a survey should be carried out with the residents' association to assess the best way to proceed with collective bargaining. These actions, among others, will be part of the Land Negotiation Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.3. Operation Phase

7.2.3.1. Physical Environment

A) Environmental Discomfort – Topographic Change

Due to the change in the original land topography

Activity and Aspect	
Activity	Preliminary infrastructure services Implementation of support structures Implementation of operational structures Mining of nickel and limestone pits
Aspect	Alteration of the original land topography Insertion in the landscape of the structures of the project

The construction phase of the project, in addition to involving topographic reconformation activities in areas where structures of the mining complex will be installed, will include the beginning of the open pit excavation of rock material in the mining areas, in order to begin exploration of the nickel ore and limestone.

The nickel deposit corresponds to an elevation in the form of a plateau, where the weathered and mineralized nickel portion will be mined, up to the level close to that of the surrounding topography. In this way, mining in the pit consists of removing the upper portion of the elevation (hill) that constitutes the nickel deposit, so that, at the end of its useful life, there will be few sites left in the form of the pit itself.

The mining of the limestone deposit will take place through the excavation and deepening of the local level, generating a topographic depression in the area, with approximately 60 meters.

Therefore, in addition to the more subtle modification of areas, for the construction of the Project's structures, there will be a great impact on the natural landscape due to mineral exploration (mainly nickel), through the local topographic remodeling engendering a new landscape configuration of the area.

a) Evaluation of Impact

The landscape change is a **negative** impact, as it alters the local topographic dynamics, **direct** and of a **certain occurrence**. This impact should manifest itself in the medium term, as soon as the first excavation activities begin, it is **irreversible**, since there is no way to return to the natural geomorphological conditions. It will occur in a **localized** manner, only in the mining areas of the project. It is a **causative** impact, since it is the result of mining activity, and **permanent**, as it will manifest itself throughout the life cycle of the project and even after its complete decommissioning.

As this impact is of a certain occurrence and has an irreversible and permanent character, it was evaluated as of **medium magnitude** because the hill where the nickel deposit is located does not constitute a relevant landmark of the regional landscape and neither has cultural or tourist importance, the elevation is not observable from the access road to the municipality.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Irreversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Permanent
Magnitude			
Qualitative	Medium		

b) Proposed Measures

The strategy of the Preliminary Closure Plan is for the future recovery of the project area - mine, waste deposits and industrial area - for the economical exploitation of pastures and managed reforestation, to be implemented from the beginning of the mine's operation, leading to the effective decommissioning at the end of activities of the mining project.

The objectives of the closure plan are to protect human health and the environment, by maintaining physical and chemical stability; enable the reuse of land, once mining operations are completed, and provide an adequate response of social and economic reaction by deactivating the project.

The measures proposed here and other details are included in the Preliminary Mine Closure Plan, as well as in the Degraded Areas Recovery Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Low**
Relevance Degree of the Impact	**Medium**

The proposed measures have a low degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

B) Deterioration of Soil and Groundwater Quality

Due to the deposition of dry residues and ore processing, and the presence of contaminating substances

Activity and Aspect	
Activity	Ore beneficiation process Deposition of solid process waste Supply and maintenance of machinery and equipment Storage and / or use of general inputs and hazardous products Machine and equipment washing Mining complex operation
Aspect	Acid effluent generation Generation of liquid and oily effluents Generation of solid waste Generation of surplus materials Leak of contaminating substances

The change in the quality of soil and groundwater, during operation, may be due to:

- Processing and dry waste deposit;
- Generation of solid waste within the mining complex; and,
- Generation of sanitary and industrial effluents.

The ore beneficiation process relies on leaching using sulfuric acid. In this operation, the crushed or agglomerated ore will be stacked and irrigated with an aqueous solution of sulfuric acid. Sulfuric acid percolates by gravity from the top to the bottom of the heap, reacting with the ore and leaching (solubilizing) the metals present in the ore, including nickel, the metal of interest.

During this stage, a large amount of acid solution is available (about 250 kg of acid for each ton of ore - 750,000 t / year), which, if not handled with special care, may end up percolating over the surface of the area and reaching groundwater, resulting in the deterioration of its quality.

As for the process residues, according to the PAE (Vale, 2013), the IFC represents the residues formed from the filtration of the “liquor” with the addition of limestone, obtaining a nickel-free mass with the presence of limestone and neutralized sulfuric acid. This rock also contains impurities such as Fe and Al in addition to the high concentration of these two reagents already mentioned.

The present project has as premise the complete waterproofing (lining) of the process residue storage areas, solution ponds and ore heaps. These structures will be located on compacted soil and double lined (geomembrane on clay). In addition, it is planned to recirculate acid solutions remaining from the production processes and structures, given that sulfuric acid is a primordial product to the beneficiation process. Thus, the project does not provide for the loss of the aforementioned product.

The generation of solid waste will occur through daily activities (cafeterias, bathrooms, offices, etc.). In addition to those mentioned, the formation of liquid and oily effluent is also due to the use of fuels and lubricating oils in the machinery of the mine, representing risks of the occurrence of eventual accidents / leaks of these products. It is important to highlight that the engineering project of this project comprises specific control systems for the management and control of the mentioned aspects, as shown in the table below.

Aspect	Proposed environmental control system
Generation of oily effluents	The machines will be subjected to mechanical maintenance only on waterproofed floor and side channel system for collection. From this floor, the area will be drained into a system of oil and water separating boxes, where they will be concentrated in the boxes and, as they are filled, will be stored in sealed drums, for soon after being marketed to the recycling industry or others. uses, evidently for customers who have an environmental license. Eventual oil leaks from the machines outside the workshop area must be contained in an oil drum that will be available in the workshops. Use of fuel and lubricant containment basins for protection in case of accidental leakage. Adoption of a preventive overhaul program on the machines, in order to prevent leaks. In the event of leaks, the affected points will be isolated and treated using sand and sawdust so that the excess oil can be removed, avoiding carrying the contaminant to the natural drains. This contaminated material, after scraping, will be collected and temporarily disposed in waterproofed areas, for later final destination in licensed landfills.
Generation of sanitary / domestic effluents	Domestic sewage from bathrooms will be treated at the project's WWTP, with the final effluent being discharged into the natural drainage. Use of a fat box in the cafeteria.
Rain drainage	Use of efficient drainage systems. Vegetation recovery of exposed areas. Controlled deforestation of the areas following the plans for sequencing the mine and stockpile and waste stockpiles. Water can be incorporated into the industrial process without being discharged into the environment or, if discarded, it must pass through a control system such as containment dikes, for example. The water percolated in the tailings and collected in the waterproofing mat will be directed to a containment pond and later reused as process water or planned for a duly licensed landfill.

Aspect	Proposed environmental control system
	Periodic monitoring of groundwater through installed wells, in order to ensure that there are no effluents and liquids infiltrating the soil or groundwater.
Solid residues	As a rule, segregation and temporary storage are foreseen taking into account the NBR Classification 10.004 / 2004 and respective characteristics according to the applicable legislation. Finally, the waste will be sent to licensed landfills / controlled companies.

In addition, it should be noted the high vulnerability to groundwater contamination in the Umbuzeiro region due to the presence of a karst aquifer, requiring a hydrogeological and geotechnical study when detailing the engineering project for operational control systems and measures.

a) Evaluation

The degradation of the quality of soil and groundwater is a negative impact, as it changes and deteriorates the quality of these environments, **direct** and **likely to occur**. This impact should manifest itself in the **short term**, considering that it may occur soon after the execution of the triggering activities, it is **reversible**, since there is a way to return the natural conditions (or similar) of the soil and groundwater if it occurs. It will occur in a **localized** manner, only at the DAA (construction sites, workshops, etc.). It is a causative impact, since it is the result of the operation of the project, and **temporary** once the source of contamination ceases, the impact tends to exist.

As this impact is likely to occur and is reversible and temporary, it was assessed as of **medium magnitude.**

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	High		

b) Proposed Measures

- Disposal of rock waste and the dry process waste (spent ore and IFC) according to applicable standards, such as NRM 19 of the National Department of Mineral Production - DNPM and ABNT NBR 13029: 2006;
- Inspect and carry out systematic maintenance of the storage structures for lubricating oils, greases and / or chemical products of any nature, according to, at least, the requirements of ABNT / NBR 14725-2 and ABNT / NBR 7505-1;
- All machines, equipment and vehicles used in the project must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential oil, grease and fuel leaks;
- Conducting periodic monitoring of waste and waste, in accordance with Standard NBR 10.004 / 04;
- Implementation of the Solid Waste Management Program;
- Implementation of the Effluent Monitoring Program;
- Implementation of the Groundwater Monitoring Program;
- Implementation of the Degraded Areas Recovery Program.

The proposed measures are detailed in the Programs mentioned above. In the future, when the Risk Management Program, Emergency Response Plan is drafted, new measures may be incorporated into the environmental management of this project.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Medium**

The proposed measures have a high degree of resolution and, since the impact was assessed as being of high magnitude, it can be considered as of **medium relevance**.

C) Deterioration in Air Quality

Due to the resuspension of particulates and the emission of air pollutants

Activity and Aspect	
Activity	Extraction of ores (Nickel and Limestone) Improvement of Nickel and Limestone Operation of industrial plants (Nickel and Sulfuric Acid) Transport of personnel, supplies, ore and equipment Operation of ore stockpile structures, leaching, waste dump and others
Aspect	Generation of particulate material Burning fossil fuels Generation of air pollutants caused by the sulfuric acid plant, mines and others

During the operation of the mining complex, some activities may involve the emission of particulate matter and pollutants, among which the following stand out: extraction of ores (Nickel and Limestone); processing of Nickel and Limestone; operation of industrial plants (Nickel and Sulfuric Acid); transportation of personnel, inputs, ore and equipment; operation of the structures related to ore stockpiles, heap leaching, waste dump; and others.

Among the activities that generate particulate material, the operational activities of limestone extraction and crushing in the Umbuzeiro region should be highlighted, as well as the transportation of the material to the nickel plant, estimated at 25 trips / day (during the dry period - 9 months of the year) through a dirt road.

The increase in the emission of atmospheric pollutants will not occur continuously, varying according to the activities to be developed. The impact should be felt not only in the DAA, but also in its surroundings, its extent depending on the location and type of activity.

The predominant component of most activities is particulate material, characterized as resuspended dust, essentially solid particles such as: rock powder, earthy material and other inert materials. However, very small particles can penetrate the respiratory tract, reaching the bronchi and pulmonary alveoli and causing allergies and respiratory diseases (WHO, 2006). It is noteworthy that, in the incidence of strong winds, especially in the drier periods, the impacts caused by these emissions will be aggravated, due to the increased emission of particles by resuspension.

In addition to the particulate, there will be the impact caused by the generation of combustion gases during the operation stage, due to the operation of light and heavy vehicles (automobiles, vans, pickups, trucks, off-road, etc.), light and heavy equipment (compressors, tractors, loaders, etc.) that use engines based on the burning of fossil fuels as the driving force. Gaseous emissions will basically consist of gases such as carbon oxides (CO and CO2), nitrogen oxides (NOx), sulfur oxides (SOx) and hydrocarbons.

It is worth mentioning that the present project has as premise the construction of a new road connecting the Industrial Plant with the state highway PI-465 for the exclusive use of the project and far from the existing communities and receivers, for the flow of labor, transportation of inputs and equipment, and product outlets. This new connection route will be paved to increase operational safety, reduce the risk of accidents, in addition to avoiding the dispersion of dust and particulates with the flow of input and product trucks. It is important to note that this route was planned precisely to prevent the flow of vehicles from the project on the pre-existing local roads, and to stay away from the communities and settlements surrounding the nickel mining area and the mining-industrial complex, in order to reduce discomfort.

According to Data Table 7.2-2, results of the dispersion modeling of atmospheric pollutants obtained by the USEPA ISCST3 model allowed observing concentrations below the primary standards defined by CONAMA Resolution 003/90 for sulfur dioxide (SO_2) both for the maximum concentration of 24 hours and for the annual average for both urban centers and surrounding communities.

Data Table 7.2-2 – Results of the Dispersion Modeling of Air Pollutants – Sulfur (SO_2).

City / Town	Coordinates		Spindle	Maximum Concentration SO_2 – 24 hs	Average Concentration Anual SO_2
	UTM-E	UTM-N		($\mu g/m^3$)	($\mu g/m^3$)
Campo Alegre do Fidalgo					
Urban Area	187.839	9.073.022	--	3,24	0,02
Capitão Gervásio Oliveira					
Urban Area	191.536	9.054.850	--	2,17	0,04
Settlement Bravo	171.563	9.068.549	24S	0	0
Settlement Carnaíba	827.939	9.076.210	23 S	4	6
Settlement Várzea	171.335	9.067.022	24S	2	8
Settlement Veredas	171.175	9.065.805	24S	2	2
Community Brejo Seco	172.286	9.062.005	24S	0	0
Community Carnaíba	182.688	9.061.569	24S	0	0
Community Várzea de Cima	174.540	9.060.560	24S	0	0
Community Veredas	178.311	9.064.233	24S	2	0
Community Umbuzeiro*	186.140	9.037.243	24S	0	0
São João do Piauí					
Urban Area	142.325	9.074.920	--	2,09	0,38
Settlement Eugênio	187.351	9.048.235	24S	0	0
Settlement São José	813.555	9.076.904	23 S	0	0
Community Cabeça	819.964	9.079.578	23 S	0	0
Community Chiqueirinho	168.585	9.074.191	24S	0	0
Population Grajaú	823.133	9.077.172	23 S	0	0

** Located on the border of the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio.*

Sulphur Dioxide (So_2) 24 H [(1)] – Primary Standard 365 ($\mu g/m3$); Secondary Standard 100 ($\mu g/m3$) –
[(1)] It should not be exceeded more than once a year;
Sulphur Dioxide (So_2) MAA [(3)] – Primary Standard 80 ($\mu g/m3$); Secondary Standard 40 ($\mu g/m3$) –
[(3)] Annual Arithmatic Mean (MAA).
Adapted from: EIA/RIMA - Arcadis Tetraplan, 2008.

Regarding the concentrations of sulfuric acid mist arising from the operation of the industrial acid plant, as shown in Data Table 7.2-3, all calculated receiving points are within the occupational limit defined by the ACGIH (*American Conference of Industrial Hygienists*).

Data Table 7.2-3 – Results of the Dispersion Modeling of Air Pollutants – Sulfuric Acid (H_2SO_4),

Locality	Coordinates		Spindle	Maximum Concentration H_2SO_4 – 8H
	UTM-E	UTM-N		(µg/m³)
Campo Alegre do Fidalgo				
Urban Area	187.839	9.073.022	--	0,36
Capitão Gervásio Oliveira				
Urban Area	191.536	9.054.850	--	0,23
Settlement Bravo	171.563	9.068.549	24S	0
Settlement Carnaíba	827.939	9.076.210	23S	1,5
Settlement Várzea	171.335	9.067.022	24S	1,5
Settlement Veredas	171.175	9.065.805	24S	1,5
Community Brejo Seco	172.286	9.062.005	24S	0
Community Carnaíba	182.688	9.061.569	24S	0
Community Várzea de Cima	174.540	9.060.560	24S	0
Community Veredas	178.311	9.064.233	24S	1,5
Community Umbuzeiro*	186.140	9.037.243	24S	0
São João do Piauí				
Urban Area	142.325	9.074.920	--	0,2
Settlement Eugênio	187.351	9.048.235	24S	0
Settlement São José	813.555	9.076.904	23 S	0
Community Cabeça	819.964	9.079.578	23 S	0
Community Chiqueirinho	168.585	9.074.191	24S	0
Population Grajaú	823.133	9.077.172	23 S	0

** Located on the border of the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio.*

Sulphuric acid fumes (H_2SO_4) the occupational limit defined by the ACGIH (America Conference of Industrial Hygienists) was used for the year 2007, in 0,2 mg/m³ (defined for the thoracic fraction) to a time-weighted average of 8 hours (reference value).

Adapted from: EIA/RIMA - Arcadis Tetraplan, 2008.

a) Evaluation

It is a **negative, certain, dispersed** impact, since the impact can be felt beyond the immediate vicinity of the project, occurring in the **short term**, considering that it may occur soon after the execution of the activity that triggers it, **reversible** since the characteristics of the site may be recovered shortly after the completion of activities, **temporary**, as it will occur during the operation of the project, **intensifier and causer**, it being understood that the resuspension of

particulate material is currently occurring, due to the typology of the site, and the emission of gases is something new, since it is outside of an urban area and / or vehicle circulation area.

The impact in question is considered to be of **medium** magnitude, because although located essentially in rural areas, due to the constant truck traffic between the Brejo Seco mining complex and the limestone deposit in Umbuzeiro associated with local climatic conditions, the exposure is increased suspended particulate matter and possible damage to existing receivers.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier and Causer
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

- Establishment of vehicle speed limit, since the main factors that contribute to the increase in dust generation associated with vehicle traffic are weight and speed;
- Sprinkling water in the source areas with the greatest potential for generating particulate material and with the largest number of receivers;
- It is forbidden to transport without packaging materials that may provide the suspension of solid particles, thus the loads and bodies of trucks must be properly covered / buffered in order to minimize the emission of particulates;
- Adoption of control systems in industrial areas aiming at minimizing atmospheric emissions according to the future details of the engineering project, as well as applying systematic maintenance (preventive and corrective) in the adopted systems;
- Inspection, as well as preventive and corrective maintenance of vehicles, machines and equipment, to reduce the emission of gases and black smoke to a minimum;
- Monitoring and apparent measurement of the smoke density emanating from vehicles, machines and equipment, using the Ringelmann scale;
- Use of new vehicles / equipment or in good condition, regulated according to the manufacturer's instructions; and,
- Air Quality Monitoring (sulfur dioxide, particulate - PTS and inhalable particles, sulfuric acid mist, SOx and other relevant pollutants if applicable).

Additionally, it is suggested that these controls be subsidized through the project's Environmental Management Plan and the Air Quality Monitoring Program.

c) Degree of resolution of the measures and degree of relevance of the impact

Mitigating Measures and Degree of Relevance	
Degree of resolution of measures	**Medium**
Degree of relevance of the impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

D) Change in Underground Water Availability

Due to the collection of groundwater for the implementation of the project and the lowering of the water table in the Umbuzeiro area.

Activity and Aspect	
Activity	Exploitation of underground water resources Lowering the limestone pit water table
Aspect	Generation of groundwater lowering funnel

During the stage of operation of the project, the supply of water for human consumption in the office and in the other structures of the project will be carried out by capturing two drilled wells that currently serve the pilot plant. The licenses for the use of these wells authorize flows of 2.5 m³/h and 2.0 m³/h and are valid until March 2019. If necessary, other wells may also be used, once their grants and / or external supply.

In addition, limestone mining is planned in the region called Umbuzeiro with a depth around 60 meters. This area, as it is located in a region with a lower topography, will possibly have the surface water table intercepted and, therefore, may require its lowering for mineral exploration.

In addition, the exploitation and lowering of the water table may lead to a reduction in the availability of underground water resources in other catchment areas and also a reduction or even temporary extinction of the nearest springs and drains.

a) Evaluation

The change in water availability is a **negative** impact, as it causes a drop in the disposition of the resource, **direct** and **likely** to occur. This impact should manifest itself in the **medium term**, considering that it may not occur immediately after the execution of the triggering activities, it is **reversible** either by restoring the natural balance or by applying engineering techniques. It will occur in a **localized** manner, and should have its impact in areas restricted to the ADI. It is a **causative** impact, since it comes from the project's implementation and operation activities, and **temporary** once the need to lower the groundwater level has ceased.

It is an impact of probable occurrence and reversible, however, due to some uncertainties of the real impact, it was classified as of **medium magnitude.**

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

If there is groundwater interception and in there is need to lower the water table level, a Groundwater Monitoring Program should be formulated and implemented containing:

- Monitoring and integrated management of water resources (surface and underground) through continuous monitoring, geological and hydrological studies, as well as detailing the relationship between the lowering of the water table and aspects of groundwater dynamics with the dynamics of surface waters.

The set of actions that encompass these practices mentioned above are found in the Groundwater Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Low**
Relevance Degree of the Impact	**Medium**

The proposed measures have a low degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

E) Environmental Discomfort – Vibration Level

Due to the vibration level generated by rock dismantling by explosives

Activity and Aspect	
Activity	Rock blasting Use of heavy machinery Intense circulation of vehicles
Aspect	Increased vibration and noise

The excavation operations at the mine and the loading of the material resulting from the dismantling will be carried out with hydraulic excavators, which will load dump trucks. These will

transport the respective destinations: primary crushing, limestone and nickel pit, marginal ore stockpile or waste disposal stockpiles.

In addition, at some points it will be necessary to use explosives to dismantle the massif, and it is necessary to estimate the levels of terrain vibration and acoustic pressure resulting from the rock dismantling by explosives expected in receivers located in the nearest communities as shown below.

For the nickel mine area (Brejo Seco), estimates of vibration and sound pressure levels to be generated by rock dismantling by explosives at different distances from the mining area were made considering maximum waiting loads of 30 kg, 50 kg and 100 kg. For this purpose, load-distance equations obtained in bibliography for basalt and sandstone were used, since the local geology is characterized by the predominant occurrence of ultra-basic and sedimentary rocks.

In addition, for the area planned to be the limestone mine (Umbuzeiro), estimates of vibration and sound pressure levels to be generated at different distances from the mining area were also carried out considering maximum waiting loads of 50 kg, 100 kg and 150 kg by means of of load-distance equations obtained in bibliography for limestone.

The results of the estimates of vibration levels for rock dismantling in the nickel mine presented in Tables 5.1-35 to 5.1-37 (Volume II of the EIA) reveal particle speeds below 15 mm / s, the most restrictive limit defined by the NBR standard 10,151 / 2005 for the frequency of 4 Hz, from 200 m away, considering a maximum load per wait of 100 kg.

The results presented in Tables 5.1-38 to 6.1-40 (Volume II of the EIA), containing the estimates of vibration levels for rock dismounts in the limestone mine, indicate particle speeds below 15 mm / s from 400 m distance, considering a maximum waiting load of 150 kg.

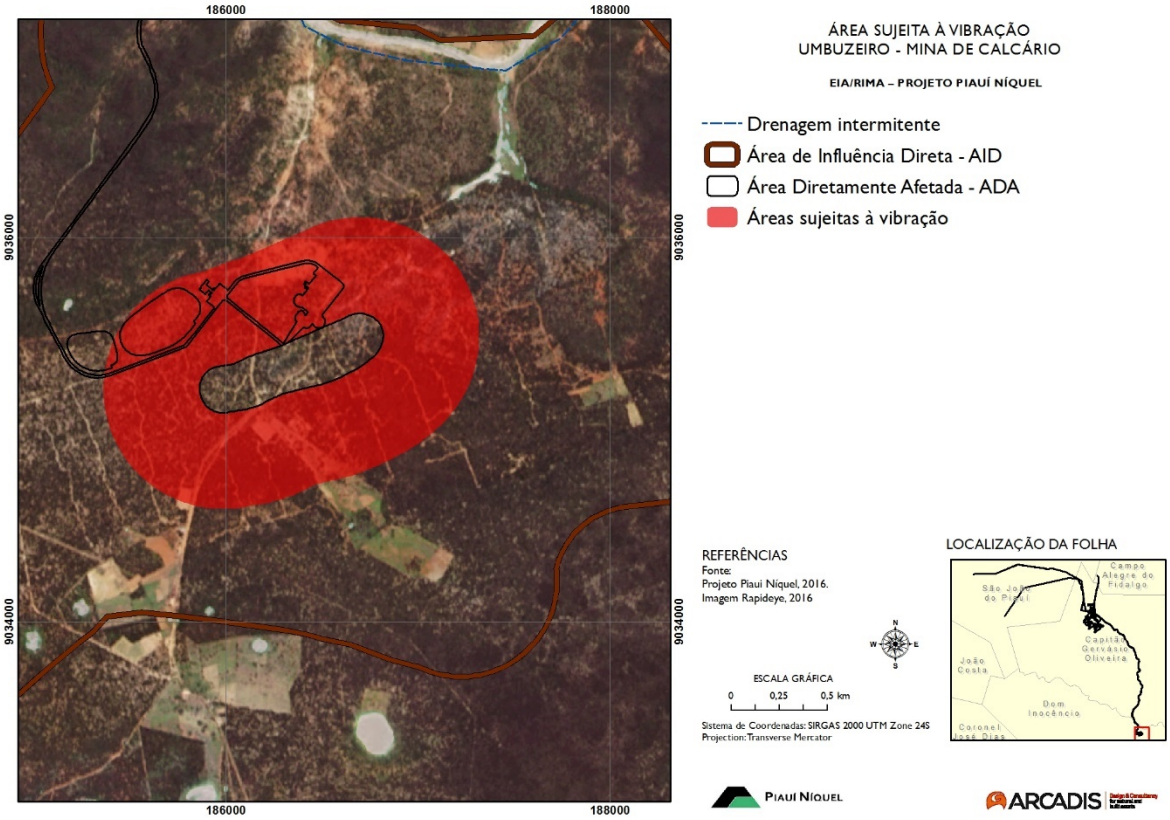
According to Tables 5.1-41 to 5.1-44 (Volume II of the EIA), sound pressure levels lower than 134 dBL are estimated from 200 m away from the disassembled bench, both for the nickel mine and for the limestone mine.

The acid plant of the project under study is located approximately 1.1 km from the limit of the final mining area planned for the nickel mine. The contractors' accommodation is approximately 7 km from the nickel mine and approximately 26 km from the limestone mine. Capitão Gervásio Oliveira, the municipality closest to the mining areas, is located 16 km away from the nickel mine (Brejo Seco) and 25 km away from the limestone mine (Umbuzeiro).

It is concluded, therefore, that the levels of vibration and acoustic pressure, using a fire plan similar to that presented in item 2 - Description of the Project (Volume I of the EIA), should not exceed the limits defined by the NBR standards 9653/05 for particle speed and sound pressure over distances greater than 500 m from mining areas.

According to the field work carried out in 2016, it is important to note the existence of several communities in the vicinity of this project, in particular the Brejo Seco Community, located at a distance of 720 meters from the future Nickel mine. The Map 7.2-3 presents the areas subject to vibration (500 meters from the surrounding fields) for the Limestone Mine and the Map 7.2-4 shows the areas subject to vibration and the location of the communities surrounding the Nickel Mine (the distances between the communities and the mine are detailed in the Table 7.2-1).

Map 7.2-3 – Area Subject to Vibration from Explosions at the Limestone Mine.



Map 7.2-4 – Area subject to Explosion Vibration at the Nickel Mine.

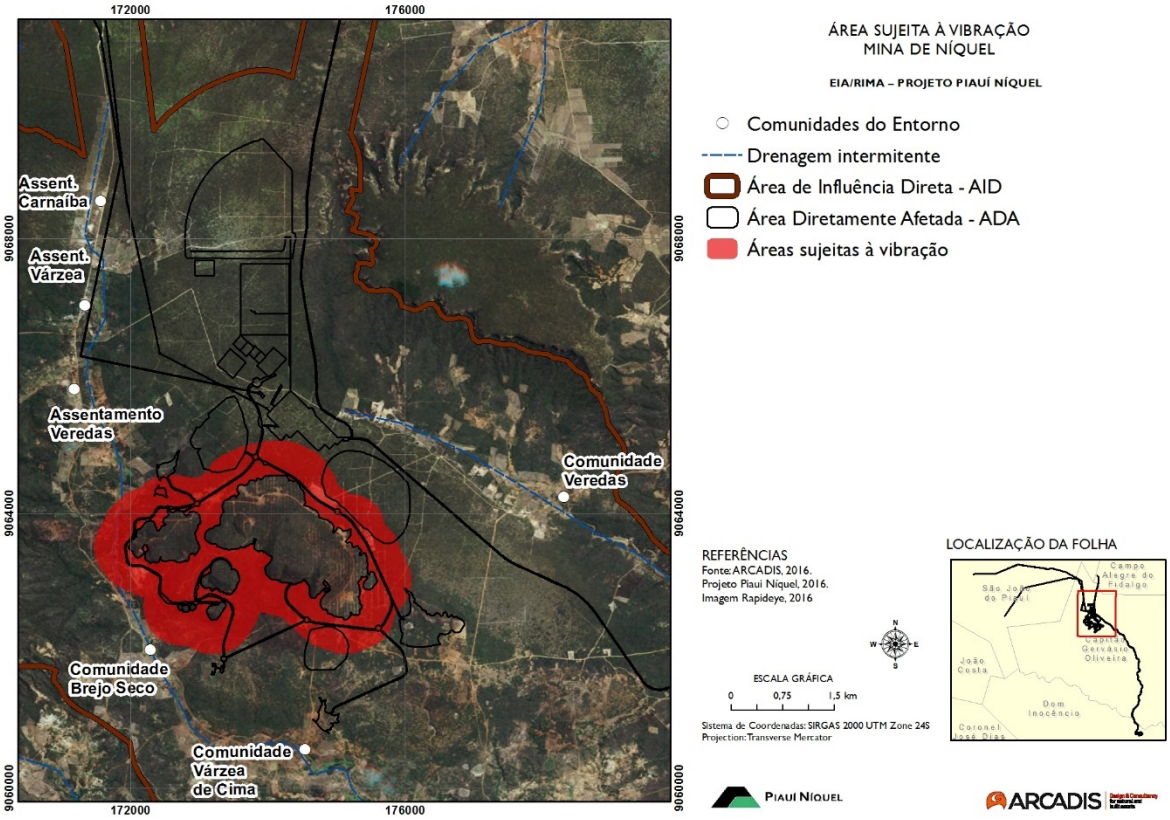


Table 7.2-1 – Distance between Surrounding Communities and Areas Subject to Vibration - Nickel Mine (buffer 500m).

Community	Distance (m) from Areas Subject to Vibration
Settlement Carnaíba	6,755
Settlement Várzea	2,712
Settlement Veredas	1,693
Community Brejo Seco	220
Community Várzea de Cima	1,465
Community Veredas	2,493

Source: Arcadis, 2017.

Thus, according to the simulations carried out and considering that there are no receivers in the areas subject to vibration, the operation of the project should not cause discomfort to the populations surrounding the project, providing insignificant particle vibration speed values for these locations. , as well as low levels of sound pressure.

However, the simulations performed are based on data from the specialized bibliography, without taking into account specificities of rock masses in the mining areas and other local information that can directly influence the results of sound pressure and vibration, so further

studies should be carried out at the time of the survey. details of the engineering project and environmental studies to request the Installation License.

a) Evaluation

The increase in the levels of sound pressure and vibration is a **negative** impact, as it generates discomfort to the receivers, **direct** and of a **certain occurrence**. This impact will manifest itself in the **short term**, considering that it will occur soon after the start of the triggering activities, it is **reversible**, since, when the project ends, the noise and vibration levels will be the same as before the mining complex. It is **dispersed**, since it should cover a significant area of territory. It is a **causative** impact, since it is the result of mining, and **temporary**, as it should occur until the final shaping of the mines.

As this impact is of a certain occurrence, permanent, but of a reversible character, it was evaluated as of **medium magnitude**, having seen the existence of communities close to the areas subject to vibration (500 meters from the surrounding of the mines).

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

- Detonations must be previously communicated and signaled through sound mechanisms (such as sirens) to the closest receivers (PNM itself and adjacent communities). Explosions should only occur at certain times, not occurring outside of these times;
- Minimize the time of use of machines / activities that generate higher levels of exposure to noise and vibration of workers, such as, for example, through rotation of workers, and implementation of the use of personal protective equipment (anti-vibrating gloves, safety boots). safety, hearing protectors);
- Carry out systematic preventive and corrective maintenance on vehicles, machinery and equipment in general;
- Create a communication channel with the surrounding communities to systematically check requests and complaints involving issues of vibration and noise;
- Carry out precautionary inspections on real estate and improvements located in areas with a greater likelihood of vibrations before the start of the operation in order to obtain assessments on their status, allowing for future comparisons either in the construction phase or in the operation of the project itself; and

Properly implement the Noise and Vibration Monitoring Program in the operation phase, if non-conformities are identified, these must be corrected by adopting specific techniques to mitigate any diagnosed impacts.

The actions described above are included in the Noise and Vibration Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of **medium relevance**.

F) Environmental Discomfort – Acoustic Overpressure

Due to mobile and fixed equipment

In the operation phase, the main environmental and social discomforts caused to the surrounding population from noise emissions will be due to the activities involved in the operation of the structures of the mining complex, described as:

- Operation of industrial plants;
- Operation of the processing systems;
- Operational activities of waste deposits and ore stocks;
- Leaching cell operational activities; and,
- Operational activities of tailings deposits.

In order to carry out such activities, there will be an intense circulation of vehicles (light and heavy), machines and equipment powered by combustion engines, which consequently will generate environmental discomfort due to the increase in the level of environmental noise.

The noise of excavation, material and construction machinery varies widely depending on the type and condition of operation.

As a maximum value, it can be considered, based on previous experiences with similar equipment, that these equipment will not emit noise at levels above 90 dB (A), measured at 7 meters from the source.

Applying the logarithmic decay curve at this maximum level, the result shown in Data Table 7.2-4, which indicates the expected sound level, depending on the distance of the works.

Data Table 7.2-4 – Expected sound level and distance from works.

Distance (m)	Noise Level (dB(A))
7	90
10	87
20	81
30	77
40	75
50	73
100	67
150	63
200	61
300	57
400	55
500	53
750	49
1000	47
1250	45
1500	43

As already demonstrated in the same impact during the construction phase of the project, the noise of the operation has as main receptors the workers of the mining complex. The surrounding communities should not suffer any discomfort due to sound pressures during the operations of the complexes.

Further details on the analysis of this impact should be noted in the construction phase of the project.

a) Evaluation

The environmental discomfort resulting from the increase in the level of environmental noise, is a **negative** impact, since it generates discomfort to the receivers, direct and of a **certain occurrence**. This impact will manifest itself in the **short term**, considering that it will occur soon after the start of the triggering activities, it is **reversible**, insofar as, when the project ends, the noise levels return to the same as before the mining complex, as well how it is possible to adopt mitigating measures. It is **dispersed**, since it should cover a significant area of territory. It is a **causative** impact, since it is the result of mining, and **permanent**, as it will occur for the entire useful life of the project.

As this impact is likely to occur, permanent, but of a reversible character, it was assessed as of **medium magnitude**, considering workers as recipients of this impact.

Attributes			
Nature	Negative	**Order**	Direct
Occurence - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurence - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

- Detonations must be previously communicated and signaled through sound mechanisms (such as sirens) to the closest receivers (PNM itself and adjacent communities). Explosions should only occur at certain times, not occurring outside of these times;
- Minimize the time of use of machines / activities that generate higher levels of exposure to noise and vibration of workers, such as, for example, through rotation of workers, and implementation of the use of personal protective equipment (anti-vibrating gloves, safety boots). safety, hearing protectors);
- Carry out systematic preventive and corrective maintenance on vehicles, machinery and equipment in general;
- Create a communication channel with the surrounding communities to systematically check requests and complaints involving issues of vibration and noise;
- Properly implement the Noise and Vibration Monitoring Program in the operation phase, if non-conformities are identified, these must be corrected by adopting specific techniques to mitigate any diagnosed impacts.

The actions described above are included in the Noise and Vibration Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution (with the use of PPE's) and, since the impact was assessed as medium in magnitude, it can be considered as of **low relevance** for the workers of the complex and of little significance for the surrounding communities.

G) Soil Degradation

Due to the generation of surplus materials and promotion of erosion processes

Activity and Aspect	
Activity	Mine operation and mineral extraction Operation of beneficiation systems Operational activities of waste deposits and ore stocks; Operational activities of the leach cells; and, Operational activity of tailings deposits.
Aspect	Generation of surplus materials Soil exposure Deflagration of erosive processes and mass movement

The project's operation stage involves the operation of mines and mineral extraction, as well as operational activities in the waste deposits and ore stocks; heap leaching, tailings deposits, as well as general maintenance of various structures and access routes.

These activities include a set of actions which end up generating surplus material (rocks, soil, aggregates, etc.) and consequent exposure of a greater contact surface of massifs and soil masses. This exposure, together with erosive and anthropic agents, ends up resulting in the consequent pedological degradation of the area.

The deterioration of the soil can be described by its compaction, alteration of permeability, salinization and loss of material due to processes of surface dynamics (in particular mass movements and erosive processes).

a) Evaluation

Soil degradation is a **negative** impact, as it changes and deteriorates the quality of the soil, **direct** and of a **certain occurrence**. This impact should manifest itself in the **short term**, considering that it may occur soon after the execution of the triggering activities, it is **reversible**, since there is a way to return the natural (or similar) conditions of the soil from a set of activities. It will occur in a loc**alized** way, once the processes referring to the deterioration of the soil, will occur in a general way inside the DAA. It is a **causative and intensifying** impact, since the outbreak of erosive processes is natural to the region, however the physical modifications of the soil (compaction, salinization, etc.) will be enhanced from the activities of construction of the project. It is **permanent**, as its manifestation will occur during the entire life cycle of the project, and even after its complete decommissioning.

Due to the characteristics of the region and how this impact is reversible, it was assessed as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible

Occurance - Term	Short	**Form of interference**	Causer and Intensifier
Occurance - Spatiality	Localized	**Duration**	Permanent
Magnitude			
Qualitative	Small		

b) Proposed Measures

- Topographic and substrate reconformation of areas that are not in conformity;
- Earthmoving, execution of cuts, embankments in general must strictly follow the precepts of the engineering project and relevant Standards (such as NBR-11.682: 1991: slope stability and others);
- Promote systematic preventive and corrective actions in order to minimize possible environmental degradation as a result of the intensification of superficial dynamic processes;
- When necessary, carry out automated monitoring with relevant instruments (geotechnical monitoring);
- Adoption of constructive techniques for soil protection (containment, drainage and other systems);
- Protect piles of excess material from erosive agents;
- Maintenance of drainage systems and accessory structures; and,
- Monitoring and controlling the processes of surface dynamics triggered in the area (especially erosive processes and mass movements).

The set of actions that encompass these practices mentioned above are found in the: Degraded Areas Recovery Program; Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; and Surface Water Quality Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

H) Deterioration of Surface Water Quality and Silting of the Drainage Network

Due to the generation and transport of sediments

Activity and Aspect	
Activity	Project operation (including mining areas, stockpiles, storage areas, etc.) Vehicle handling
Aspect	Generation of surplus materials Soil exposure Deflagration of erosive processes and mass movement Alteration of the characteristics of water bodies

During the project's operation phase, some activities may cause, directly or indirectly, the generation and consequent transport of sediments to the nearest water bodies, causing the drainage network to silt up. The most critical points at which sediment generation may occur during the project's operation phase are mainly associated with the following areas: nickel mining, waste dump and stockpile in the Brejo Seco Mine area and in the limestone mine and waste deposit in the Umbuzeiro Mine area.

The sediments generated in these activities can be carried to the adjacent watercourses, especially in the rainy season, tending to accumulate in the streams. In the region, the rains have a concentrated, torrential rainfall regime. These waters can cause the breakdown of the exposed soil particles, resulting in smaller and loose particles, which are removed and transported by the laminar or concentrated surface runoff, forming erosive grooves on the surface of the land.

During the operation phase, activities that generate and manipulate unconsolidated sediments may contribute to the silting process in the Brejo Seco Mine area, mainly in the Várzea stream and its tributaries and in the tributaries of the Itaquatiara stream in the Umbuzeiro Mine area.

As a consequence, the receiving water bodies will tend to suffer a drop in quality standards, with an increase in particulate material, nutrients, turbidity and will be subject to a greater degree of silting.

It should be noted that nickel and limestone mining will be carried out using the open bench method. The stripping of the mining front will promote the exposure of the soil to the action of rain and winds, thus making the area more susceptible to the occurrence of erosive processes, especially in the nickel mining area of the Brejo Seco Mine where the susceptibility land erosion is higher. In the other areas, however, the susceptibility to erosion is predominantly low, which reduces the probability of carrying sediment into the nearest watercourses. The low sediment transport is also favored by the local topography, which has flatter characteristics.

According to the information presented in the Project Description chapter, the structures will be equipped with rainwater drainage control devices. In addition, it is important to consider that downstream of the stockpiles and mining area in the Brejo Seco Mine, the construction of dykes is planned, which will have the role of containing fine sediments before the waters are directed to river drains. Provisional and permanent drainage systems will also be implemented in order to drain rainwater flows in an appropriate and safe way to the drainage points / dikes.

a) Evaluation

The silting up of watercourses and the deterioration of the quality of surface water by the supply of diffuse loads is a **negative**, **probable** impact, occurring in the **short term**, considering that it may occur soon after the execution of the activity that triggers it. It is a **reversible** impact with the use of an efficient drainage system, the practice of controlled and periodic dredging and the application of preventive and corrective control measures.

It is considered an impact **intensified** by the project, since this process already occurs naturally, although in a slower and more **dispersed** way, as it will be felt mainly in the ADI, although it can also reach water courses in AII. Silting up is also considered **temporary**, with duration expected for the stage of operation of the project.

Because some of the project's operational structures are close to some natural drains in the Piauí River sub-basin and activities related to these structures cause sediment transport to water bodies, especially in the rainy season, this impact is considered of **medium magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

The mitigating measures to be adopted to reduce this impact include, in addition to those already foreseen in the project:

- Recover and monitor the altered and exposed areas, mainly adjacent to the operational structures of the Brejo Seco Mine and the Umbuzeiro Mine;
- Punctual application of mitigation methods in order to reduce the processes of erosion and landslide in areas accidentally collapsed or eroded;
- Implementation of smaller solids retention devices, such as decantation boxes;
- Cleaning and maintenance of the drainage system, removing the sediment accumulated in the decantation boxes, clearing channels, ditches and manholes, possibly silted;
- The products must be transported in trucks covered with tarpaulins, avoiding the falling and spreading of particulate material;
- Surface protection of soils to prevent the occurrence of erosion and the revegetation of areas with exposed soils through the Recovery of Degraded Areas Program (PRAD);
- Periodic removal of material accumulated in the fines containment dikes located downstream of the Brejo Seco Mine stockpiles and pit;

- Continuation of the Surface Water Quality Monitoring Program, which will allow preventive and corrective actions to be taken throughout the project's operation and decommissioning phase.

The set of actions that encompass these abovementioned practices is found in the: Degraded Area Recovery Program, Erosive Process Control and Monitoring Program and Surface Water Quality Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **low relevance**.

I) Deterioration of Surface Water Quality by Effluents and Solid Waste

Due to the generation of liquid and oily effluents and solid waste

Activity and Aspect	
Activity	Operation of the project, including mining areas, stockpiles and deposits Operation of the administrative area (offices, surveillance service, concierge, security center, ambulatory, cafeteria, laboratory, etc.) Production of limestone, lime and sulfuric acid Supply of machinery and equipment Maintenance of machinery and equipment Machine shop operation and equipment washing Movement of vehicles
Aspect	Generation of solid waste Generation of liquid and oily effluents Leak of contaminating substances Alteration of the characteristics of water bodies

During the operation phase of the project, the impact related to the deterioration of the quality of surface water may occur due to the generation of punctual loads represented by liquid effluents (rainwater drainage, sanitary effluents and industrial effluents) and oily and solid waste originating from industrial processes and supporting infrastructure.

As for solid waste, it will be generated during the waste operation phase, tailings, ore leftovers, scrap, oily waste, metal drums, plastics, glass, rubber, organic waste, household waste, batteries, PPE, explosive packaging, oil kitchen, organic waste, health service waste, among others, detailed in the Project Description chapter, where the characterization of each one is also presented.

The sources of generation of effluents of domestic origin are associated with the sanitary facilities and cafeteria. 46.76 m³ / day of domestic liquid effluents will be generated in the

operation phase (0.07 m³ / person / day, according to ABNT / NBR 13969: 1997), considering that the operational number will be 668 employees.

The oily effluents will be generated, mainly, in the vehicle and equipment maintenance workshop where there will be activities such as oil change, maintenance and washing of vehicles and equipment. There are also effluents composed of fuels and lubricants from the supply facility subject to the risk of eventual leakage.

The rainwater effluent in the operation stage is water and sediments from the disintegration of soils where there is an impact of rain on unprotected surfaces such as roads, accesses, embankments and areas without vegetation cover or areas with exposed ore, carrying sediment via surface runoff. for valley areas and coming from the inner area of the pit due to rainfall.

It is important to highlight that the engineering project of this project comprises specific control systems for the management and control of the mentioned aspects, as shown in the table below.

Aspect	Proposed environmental control system
Generation of oily effluents	he machines will be subjected to mechanical maintenance only on waterproofed floor and side channel system for collection. From this floor, the area will be drained into a system of oil and water separating boxes, where they will be concentrated in the boxes and, as they are filled, will be stored in sealed drums, for soon after being marketed to the recycling industry or others. uses, evidently for customers who have an environmental license. Eventual oil leaks from the machines outside the workshop area must be contained in an oil drum that will be available in the workshops. Use of fuel and lubricant containment basins for protection in case of accidental leakage. Adoption of a preventive overhaul program on the machines, in order to prevent leaks. In the event of leaks, the affected points will be isolated and treated using sand and sawdust so that the excess oil can be removed, avoiding carrying the contaminant to the natural drains. This contaminated material, after scraping, will be collected and temporarily disposed in waterproofed areas, for later final destination in licensed landfills.
Generation of sanitary / domestic effluents	Domestic sewage from bathrooms will be treated at the project's WWTP, with the final effluent being discharged into the natural drainage. Use of a fat box in the cafeteria.

Aspect	Proposed environmental control system
Rainwater drainage	Use of efficient drainage systems. Vegetation recovery of exposed areas. Controlled deforestation of the areas following the plans for sequencing the mine and stockpile and waste stockpiles. Water can be incorporated into the industrial process without being discharged into the environment or, if discarded, it must pass through a control system such as containment dikes, for example. The water percolated in the tailings and collected in the waterproofing mat will be directed to a containment pond and later reused as process water or planned for a duly licensed landfill. Periodic monitoring of groundwater through installed wells, in order to ensure that there are no effluents and liquids infiltrating the soil or groundwater.
Solid residues	As a rule, segregation and temporary storage are foreseen taking into account the NBR Classification 10.004 / 2004 and respective characteristics according to the applicable legislation. Finally, the waste will be sent to licensed landfills / controlled companies.

It should also be noted that during the project's operation phase there will be production of limestone and lime at the Umbuzeiro Mine and the production and use of sulfuric acid, one of the main inputs of the Brejo Seco Mine process.

Sulfuric acid will be produced at the Sulfuric Acid Plant, to be built next to the Brejo Seco Industrial Plant, from elemental sulfur imported and transported to the site by road.

The industrial liquid effluents resulting from the manufacture of sulfuric acid and the precipitation of nickel will be generated in large quantities. They are characterized by the high potential for pollution and water contamination, which can cause serious damage to aquatic biota and human health.

The process waste deposit, however, has impermeable soil and the percolated rainwater will be sent to the containment pond to be treated or reused in the process.

Although the operation of the project foresees the total recirculation of effluents in a closed-circuit system so that no discharges occur in the environment, there is the possibility of some trace of sulfuric acid reaching the rain drainage during periods of rain and, consequently, reaching the streams of water, especially the Várzea stream and its tributaries. However, it is noteworthy that an analysis of this rainwater effluent will be foreseen before its release into water courses and it will be released into the water course if it is in compliance with the guidelines provided for in CONAMA Resolutions 357/05 and 430/11.

As control systems and mitigating measures are foreseen, the chances of punctual loads generated in the aforementioned activities being introduced in the water courses of the Piauí

River sub-basin are small, with a low probability of changes in water quality, with an increase the amount of organic matter and contamination by chemical compounds.

Eventual occurrences of accidents must be included in the Risk Management Program, comprising the appropriate contingency and emergency measures, which must be prepared for the next stage of environmental licensing, when obtaining the Project Installation License.

a) Evaluation

The deterioration of water quality due to the supply of punctual loads generated in the operation phase is a **negative**, **direct**, **probable**, short-term impact. This is a **dispersed** impact, as the point loads may go beyond the limit of the ADI, which is **reversible**, a new fact for the project and **temporary**, since once the polluting source is controlled, the quality of surface water tends to re-establish itself to current standards. This impact is considered to be of **medium magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	New fact
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Proposed Measures

The mitigating measures to be adopted to reduce this impact include, in addition to the actions already foreseen by the project:

- Water can be incorporated into the industrial process without being discharged into the environment or, if discarded, it must pass through a control system such as sediment decantation box, for example;
- All machines, equipment and vehicles used in the mine's implementation must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential leaks of oils, greases and fuels. In this sense, workshops and maintenance places must be equipped with environmental control devices;
- Use of containment boxes and impermeable floor around tanks and other fuel and lubricant storage devices.

The mitigating measures to be adopted also include the elaboration and execution of the Solid Waste Management Program, the Liquid Effluent Management Program and the Surface Water

Quality Monitoring Program, which will allow preventive and corrective actions to be taken. throughout the project's operational phase.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of medium magnitude, it can be considered as of **low relevance**.

J) Alteration of Surface Water Availability

Due to water consumption

Activity and Aspect	
Activity	Project operation Operation of the administrative area
Aspect	Water consumption

In the operation phase of the Piauí Nickel Project, a daily water consumption of about 460 m^3/h of surface water is foreseen, directed to human, sanitary, sulfuric acid plant and fire fighting.

The water intake will take place at the Jenipapo Dam, located on the Piauí River, and will be conducted to the industrial area by means of a pipeline. The water will be treated by reverse osmosis and distributed according to the needs of each area.

a) Evaluation

The change in surface water availability in the operation stage is a **negative**, **certain**, **short-term** impact. This is a **localized**, **reversible** impact, a **new fact** for the project and **temporary**, ending with the end of the project's operation.

This impact is considered to be of **small** magnitude during the operation phase, because although the Jenipapo dam has multiple uses, the amount to be extracted for the Piauí Nickel Project is not significant when compared to the total volume of water from the dam (248,000,000 m^3) and the average affluent volume of the reservoir (5.6 m^3/s or 20,160 m^3/h) (BVP Engenharia, 2008). In addition, as there is already a grant authorizing the withdrawal of water for the new project, it is understood that a specific study has already been carried out that indicates that the other uses of water in this reservoir and the downstream uses will not be compromised with the withdrawal of 460 m^3/h of water for the project. It should be noted that the grant was obtained in 2014 and is expected to be valid until 2024.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	New fact
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Proposed Measures

Mitigating measures to be taken to reduce this impact include:

- The project will maintain measuring equipment to monitor the flow captured, always seeking efficiency in the use of water; and
- In view of Federal Law 9433/97, there is a possibility of suspension of the grant in situations of calamity, such as severe droughts or the need for water to meet uses of collective interest for which alternative sources are not available, and knowing that the region under study presents problems of public supply, the project should prepare a study of alternative water collection for the operation stage of the project, in order to guarantee the operation of the Piauí Nickel Project operations in case of grant suspension.

The actions described above are included in the Surface Water Quality Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Low**

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.3.2. Biotic Environment

A) Deterioration of the quality of acquatic habitats

Due to the generation and transport of sediments

Activity and Aspect	
Activity	Project operation (including mining areas, stockpiles, storage areas, etc.) Vehicle handling

Activity and Aspect	
Aspect	Generation of surplus materials Soil exposure Deflagration of erosive processes and mass movement Alteration of the characteristics of water bodies

Several activities in the operation phase of the project may generate sediments that, if they reach the water bodies, will affect the water quality and, consequently, the aquatic ecosystem, especially phytoplankton, zooplankton, benthic macroinvertebrates and fish. The main bodies of water affected by the generation of sediments by the Piauí Nickel Project are the tributaries of the Itaquatiara stream and the Várzea stream, belonging to the Piauí River sub-basin.

The damages that the sediment transport into the water bodies are the same as those presented in the impacts of the construction phase, with the probable final consequence of the loss of individuals from the aquatic biota, that is, reduction of the communities' wealth and abundance, especially of species considered more sensitive to human intervention.

As already mentioned, the susceptibility to erosion in the DAA is predominantly low, which reduces the probability of carrying sediment into the nearest watercourses. The low sediment transport is also favored by the local topography, which has flatter characteristics.

In addition, according to the characteristics presented in the Project Description chapter, the structures of the Brejo Seco and Umbuzeiro mines will be equipped with rainwater drainage control devices. In addition, it is important to consider that downstream of the stockpiles and mining area in the Brejo Seco Mine, the construction of dykes is planned, which will have the role of containing fine sediment before the waters are directed to river drains. Provisional and permanent drainage systems will also be implemented in order to drain rainwater flows in an appropriate and safe way to the drainage points / dikes.

a) Evaluation of Impact

The deterioration in the quality of aquatic habitats due to the supply of diffuse loads is a **probable negative** impact, occurring in the **short term**, considering that it may occur soon after the execution of the activity that triggers it. This is a **reversible and temporary** impact if there is a loss of wealth and abundance of species.

It is considered a **dispersed** and **intensified** impact by the project, since this process already occurs naturally, albeit more slowly. This impact was considered of **small** magnitude, due to the activities to be carried out that will cause the generation of inexpressive volumes of sediments and the characteristics of the water courses in the region.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier

Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

The mitigating measures to be adopted to reduce this impact include, in addition to those already foreseen in the project:

- Recover and monitor the altered and exposed areas, mainly adjacent to the operational structures of the Brejo Seco Mine and the Umbuzeiro Mine;
- Punctual application of mitigation methods in order to reduce the processes of erosion and landslide in areas accidentally collapsed or eroded;
- Implementation of smaller solids retention devices, such as decantation boxes;
- Cleaning and maintenance of the drainage system, removing the sediment accumulated in the decantation boxes, clearing channels, ditches and manholes, possibly silted;
- The products must be transported in trucks covered with tarpaulins, avoiding the falling and spreading of particulate material;
- Surface protection of soils to prevent the occurrence of erosion and the revegetation of areas with exposed soils through the Recovery of Degraded Areas Program (PRAD);
- Periodic removal of material accumulated in the fines containment dikes located downstream of the Brejo Seco Mine stockpiles and pit;
- Continuation of the Surface Water Quality Monitoring Program, which will allow preventive and corrective actions to be taken throughout the project's operation and decommissioning phase.

The set of actions that encompass these practices is found in: Program for the Recovery of Degraded Areas, Program for Control and Monitoring of Erosive Processes and Program for Monitoring Surface Water Quality.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

B) Deteriortation of the quality of acquatic habitats

Due to the generation of liquid and oily effluents and solid waste

Activity and Aspect	
Activity	Project operation

Activity and Aspect	
	Operation of the administrative area Production of limestone, lime and sulfuric acid Supply of machinery and equipment Maintenance of machinery and equipment Machine shop operation and equipment washing Movement of vehicles
Aspect	Generation of solid waste Generation of liquid and oily effluents Leak of contaminating substances Alteration of the characteristics of water bodies

In the operation phase, the discharges are likely to occur due to the generation of liquid (industrial and sanitary) and oily effluents and solid waste. The water bodies that may be contaminated by effluents and solid waste are mainly those directly affected by the structures, such as the Várzea stream and the tributaries of the Itaquatiara stream.

As mentioned in the impacts of the construction phase, liquid and oily effluents and the generation of solid residues, if they reach the water bodies, may harm aquatic communities, as they are rich in organic matter, fecal bacteria, surfactants, oils and greases and other contaminants. These contaminants can cause the death of some organisms or favor the occurrence / dominance of more tolerant species, creating an unbalanced environment.

The engineering project of this project, however, comprises specific control systems for the management and control of the aforementioned aspects as shown in the table below.

Aspect	Proposed environmental control system
Generation of oily effluents	The machines will be subjected to mechanical maintenance only on waterproofed floor and side channel system for collection. From this floor, the area will be drained into a system of oil and water separating boxes, where they will be concentrated in the boxes and, as they are filled, will be stored in sealed drums, for soon after being marketed to the recycling industry or others. uses, evidently for customers who have an environmental license. Eventual oil leaks from the machines outside the workshop area must be contained in an oil drum that will be available in the workshops. Use of fuel and lubricant containment basins for protection in case of accidental leakage. Adoption of a preventive overhaul program on the machines, in order to prevent leaks. In the event of leaks, the affected points will be isolated and treated using sand and sawdust so that the excess oil can be removed, avoiding carrying the

Aspect	Proposed environmental control system
	contaminant to the natural drains. This contaminated material, after scraping, will be collected and temporarily disposed in waterproofed areas, for later final destination in licensed landfills.
Generation of sanitary / domestic effluents	Domestic sewage from bathrooms will be treated at the project's WWTP, with the final effluent being discharged into the natural drainage. Use of a fat box in the cafeteria.
Rainwater drainage	Use of efficient drainage systems. Vegetation recovery of exposed areas. Controlled deforestation of the areas following the plans for sequencing the mine and stockpile and waste stockpiles. Water can be incorporated into the industrial process without being discharged into the environment or, if discarded, it must pass through a control system such as containment dikes, for example. The water percolated in the tailings and collected in the waterproofing mat will be directed to a containment pond and later reused as process water or planned for a duly licensed landfill. Periodic monitoring of groundwater through installed wells, in order to ensure that there are no effluents and liquids infiltrating the soil or groundwater.
Solid residues	As a rule, segregation and temporary storage are foreseen taking into account the NBR Classification 10.004 / 2004 and respective characteristics according to the applicable legislation. Finally, the waste will be sent to licensed landfills / controlled companies.

In the operation phase there are also industrial effluents that contain highly toxic substances that are harmful to aquatic biota, such as sulfuric acid that will be manufactured and used in the production process at Brejo Seco Mine. Although the operation of the project foresees the total recirculation of effluents in a closed-circuit system so that no discharges occur in the environment, there is the possibility of some trace of sulfuric acid reaching the rain drainage during periods of rain and, consequently, reaching the water streams, especially the Várzea stream and its tributaries. However, it is noteworthy that an analysis of this rainwater effluent will be foreseen before it is released into watercourses and it will be released into the watercourse if it is in compliance with the guidelines provided for in CONAMA Resolutions 357/05 and 430/11.

As control systems and mitigating measures are foreseen, the chances of punctual loads generated in the activities mentioned above being introduced in the water courses of the Piauí River sub-basin are small, with low probability of changes in water quality and, consequently , in the aquatic biota.

Eventual occurrences of accidents must be included in the Risk Management Program, comprising the appropriate contingency and emergency measures that must be prepared for the next stage of environmental licensing, when obtaining the Project Installation License.

a) Evaluation of Impact

The impact of loss of individuals due to contamination by solid waste and effluents is **negative**, **indirect**, **probable**, occurring in the short term. It is **reversible**, as it reduces species richness and abundance, a **new fact** for the project and **temporary**. This impact is considered to be of **small** magnitude.

Attributes			
Nature	Negative	**Order**	Indirect
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	New fact
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

The mitigating measures to be adopted to reduce this impact include, in addition to the actions already foreseen by the project:

- Water can be incorporated into the industrial process without being discharged into the environment or, if discarded, it must pass through a control system such as sediment decantation box, for example;
- All machines, equipment and vehicles used in the mine's implementation must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential leaks of oils, greases and fuels. In this sense, workshops and maintenance places must be equipped with environmental control devices;
- Use of containment boxes and impermeable floor around tanks and other fuel and lubricant storage devices.

The following programs will also be maintained: Surface Water Quality Monitoring Program, Solid Waste Management Program and Liquid Effluent Management Program, which will allow the provision of subsidies for the indication of possible mitigation measures.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

C) Loss and disturbance of fauna

Activity and Aspect	
Activity	Operation of machinery and equipment; Mine front opening; Ore extraction; Operation of the belt, pumps and crusher; Rock drilling and dismantling (explosives and mechanical excavation); Detonation by explosives of intermittent occurrence.
Aspect	Noise generation; Generation of terrain vibrations

The most important aspect to be mentioned in relation to the loss of fauna individuals refers to the possibility of an increase in running over type accidents due to the increase in traffic on the roads in the region. In this respect, the trampling of domestic fauna is much more worrying than that of the wild, since these animals, some of which are large, are raised freely throughout the region and since they are already used to the human presence, they are not easily frightened by the arrival vehicles, favoring the occurrence of claims.

Due to excavations and the use of explosives on mining fronts in addition to truck traffic on the roads, the generation of noise and vibration causes the dispersion of fauna individuals, compromising their behavioral patterns necessary for survival such as foraging and feeding, also affecting species that depend on sound communication to reproduce. Simulation studies of noise and vibration propagation carried out in the diagnostic stage, however, indicated their propagation up to 400 and 500 m from the emission point (mine - where there will be dismounting with explosives), respectively. Thus, the impact must reach adjacent areas contiguous to the shrub-tree matrix, and fauna individuals tend to flee to remaining and preserved areas of caatinga, with no consequences such as population isolation and loss of genetic variability. In addition, during the operation stage of the project, new equipment must be used and periodic maintenance must be carried out, in order to mitigate the noise and vibrations arising from the movement of vehicles.

a) Evaluation of Impact

This impact is negative and of certain occurrence, since noises and vibrations are also manifested in the entire useful life of the project; the impact should manifest itself in the **short term**, from the stage of implementation of the project. Its spatiality is **dispersed**, since the noise can reach high levels of power, increasing the potential for disturbance of the fauna. This impact is **direct**, as it results from the movement of people and machinery, as well as activities that will enhance the vibration of the terrain. The project is the **cause** of this impact. It can be considered **reversible** and **temporary**, while the project's activities last.

In view of the attributes indicated, this impact is assessed as of **medium** magnitude due to the expected increase in the run over of the fauna.

The impact of noise and vibration is assessed to be of **small** magnitude.

Attributes			
Nature	Negative	**Order**	Direct

Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Dispersa	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

It is not possible to eliminate noise and vibrations, nor the flow of vehicles through roads during the project's operation, however, some measures are foreseen in the Environmental Management Program aiming to mitigate the impacts in this phase of the project, such as:

- Use of new equipment;
- Periodic maintenance of equipment and vehicles.

In relation to pedestrians, it is recommended to adopt the following measures:

- Increased signaling regarding the care of crossing animals on open roads;
- Installation of speed reducers at the most critical points;
- Environmental education and defensive driving training for workers;
- Enclosure of roads as far as possible to avoid the invasion of the carriageways by animals (mainly large domestic animals);
- Assess the need for a program to monitor the running over of fauna.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

In relation to the trampling of the fauna, the mitigating measures have a medium degree of resolution for this impact evaluated as of medium magnitude. Thus, in this aspect, the impact can be considered as of medium relevance.

7.2.3.3. Socioeconomic Environment

A) Increase in jobs, income and economic activity

Activity and Aspect	
Activity	Acquisition of goods, supplies and services; Operation of the project and its structures.
Aspect	Consumption of inputs and natural resources; Demand for goods and services; Generation of taxes (taxes, fees, contributions, royalties); Changing local or regional economic dynamics

Although at the end of the construction phase there will be a reduction in jobs, the workers needed for the operation of the Piauí Nickel Project, who will preferably be hired in the ADI, should partially compensate for the adverse effects of the process of reducing the workforce used.

These hired workers, as well as part of the indirect and income-effect workers, will spend part of their wages on the purchase of goods and services, causing an increase in income generation for the local and regional economy.

According to the Project Description chapter, 668 workers will be required for the operation of the project, distributed as shown in the table below.

Table 7.2-2 – Project workforce by department.

Department	Workers
Nickel Mine	268
Limestone Mine	61
Process Plant	207
Sulfuric Acid Plant	21
Management	2
Health, Safety, Environment and Social	26
Engineering	20
Finance department	10
Human Resources and Administration dept.	27
Logistics department	26
Total	**668**

Source: PNM, 2016.

As already mentioned, for the estimation of indirect and income-effect jobs, data from the Job Generation Model can be used as the calculation basis (Najberg and Ikeda 1999). According to this methodology, investments in mining activities generate 1.05 indirect jobs and 3.44 income effects for each direct job.

Applying these factors to the total number of workers needed for the operation of the Piauí Nickel Project, one finds the estimated value of 705 indirect jobs and 2,300 of income effect generated by the operation of the project. It is important to point out that these indirect and income-effect jobs will not occur exclusively in the municipalities of the ADI, but will be dispersed throughout all locations that have a connection with the productive network that covers the region.

In addition to the jobs and consumption generated from the workers' income, the Piauí Nickel Project itself should demand different types of inputs and services necessary to maintain the operation, as far as possible, these should be purchased from the ADI suppliers, from way that they can contribute to the increase of jobs and the local economy.

a) Evaluation of Impact

The impact of increased economic activity is **positive**, of **certain** occurrence, in the **short term**, as it is related to the entire period of operation. It has a **dispersed** spatiality, although it will happen mainly in the municipalities of the ADI, as it is based not only on the transformation of workers' wages into local consumption, but in the other productive sectors related to local and regional mining activity. It is **reversible**, as it is directly associated with the operation of the project. It is **direct**, since it is the result of the acquisition of inputs, goods and services and the generation of jobs by the Piauí Nickel Project.

Although it is not possible to accurately quantify this increase in the economy, it is certain that it will exist in a significant magnitude considering that the number of direct (668), indirect (705) and income-effect workers (2,300), thus the magnitude of this impact is considered **large**.

Attributes			
Nature	Positive	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

The measures that can enhance the positive effects of the impact in this phase of operation are:

- Adoption of measures that encourage the hiring of suppliers of local and regional goods and services, through actions of the Local Suppliers Development Program;
- Hire as many local workers as possible, considering the municipalities of the ADI;
- Training of hired workers, aiming at their future employability, as well as expanding the future matrix of local specialized labor and enabling reintegration into the labor market

during the retirement phase. This measure should be part of the Labor Management Program;

- Establishment of frequent communication channels that provide official information on the demand and qualification required for hiring labor, in accordance with the actions provided for in the Social Communication Program;
- Dissemination of information to the population explaining how the recruitment and selection of labor activities will take place, in accordance with actions planned and provided for in the Labor Management Program.

c) Degree of Potentiation of Measures and degree of relevance of the impact

Degree of Empowerment and Relevance	
Degree of Potentiation of Measures	**High**
Relevance Degree of the Impact	**High**

The proposed measures have a high degree of potentiation and, since the impact was assessed as being of large magnitude, it can be considered as highly relevant.

B) Increase in government budget revenues

Activity and Aspect	
Activity	Acquisition of goods, supplies and services; Operation of the project and structure.
Aspect	Generation of taxes (taxes, fees, contributions, royalties).

During the operation phase, the increase in budgetary revenues will be limited to the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio, the first due to the location of the industrial structures of the project and the nickel mine, and the second due to the structures linked to the extraction of limestone. This increase will certainly be due to the increase in federal transfers, and probably in state transfers.

During the period of operation, the Piauí Nickel Project will increase savings with an estimated production of 100,000 tpy of Nickel Hydroxide Precipitate (NHP) and 5,000 tpy of Precipitated Cobalt. This production will cause the municipality of Capitão Gervásio Oliveira to start receiving the share of the Financial Compensation for the Exploration of Mineral Resources (CFEM) related to the extraction of ores.

Aiming the production process of NHP and Precipitated Cobalt, it will be necessary to extract about 476,000 tpy of limestone, whose mining area is located in the municipality of Dom Inocêncio. Thus, the municipality should also receive the share of CFEM related to this ore.

Until the present date, considering the current legislation, CFEM will be applied at a rate of 2% on billing, in the case of NHP and Cobalt Precipitates products, already in relation to limestone,

according to information from DNPM[3] and Federal Decree No. 1 of January 11, 1991, extraction costs should be considered as the basis for calculating the fee. Of CFEM's total, the municipalities' share is 65%, 23% of which goes to the state and 12% to the federal government.

In the municipality of Capitão Gervásio Oliveira, there may still be an increase in the municipal ICMS share as the project has a commercial production, which will increase the added value of the municipality. The added value is defined as the value of the annual product sold, from which the value of the inputs used for this same production is subtracted.

The added value of the municipality is measured by the State Finance Secretariat for the purpose of preparing the Municipality Participation Index (IPM), which determines the value of the transfer of the ICMS share that falls to each municipality. This index is calculated using a formula in which the value added variable has a minimum weight of 75%. In this way, the entry into operation of new productive projects, or the expansion of the production of existing ones, in the municipality increases the added value generated in its territory, which can raise the IPM and make the municipality receive a higher share of the ICMS. It is noteworthy that this is not a direct relationship, because even a municipality with an increase in its added value may not raise its IPM, if other municipalities in the state also have an equal or higher growth.

a) Evaluation of Impact

This impact is of a **positive** nature, of **certain** occurrence, considering that the increase in CFEM is certain and the increase in the participation of ICMS is very likely. It is still **located**, restricted to the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio, of **medium duration**, **direct** and **causing** interference, resulting from the production of the ore, **reversible**, and **temporary**, since it will cease with the end of the production of the Piauí Nickel Project.

Although, at the present moment, it is not yet known the expected billing values, and consequently, the collection of CFEM, nor the increase in added value of the municipality of Capitão Gervásio Oliveira, given the small collection capacity of the impacted municipalities, it is certain that the magnitude of this impact will be **large**.

Attributes			
Nature	Positive	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Large		

[3] Available at: http://www.dnpm-pe.gov.br/Legisla/Cfem.php. Accessed in February 2017.

b) Management Measures and Environmental and Social Programs

Provision of training for employees of the municipalities of the ADI municipalities in relation to public management in order to improve the collection and use of public resources. This activity should be greatly reinforced in the last years of operation so that the municipalities can prepare for the closure phase of the project.

This control measure have a medium degree of potentiation as it does not depend exclusively on the project, and must be part of the Interference Monitoring and Support to Public Services Program.

c) Degree of potentiation of the Measures and degree of relevance of the impact

Degree of Empowerment and Relevance	
Degree of Potentiation of Measures	**Medium**
Relevance Degree of the Impact	**High**

The proposed measures have a medium degree of potentiation and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

C) Increased discomfort to the population

Activity and Aspect	
Activity	Mine front opening; Circulation of vehicles (cargo, passengers, etc.); Ore extraction; Operation of the belt, pumps and crusher; ETA / ETE operation; Operation of administration structures, landfill (sanitary and civil); Operation of machines / equipment; Operation of the project and structure; Operation of the ore stockyard; Operation of the machinery yard; Rock drilling and dismantling (explosives, hydraulic or mechanical); Effluent treatment and discharge
Aspect	Generation of particulate material; Odor generation; Generation of gaseous pollutants; Noise generation; Traffic generation (vehicles / machines); Generation of terrain vibrations; Attraction of people

The transportation of the ore generated by the project and the necessary inputs for the operation will be carried out by road transportation. Thus, an increase in heavy and light vehicle traffic is expected on the PI-465 highway, which gives access to the project, and on the BR-020 main interconnection highway in the region. It is estimated that circulation on these roads will be increased, depending on the project, by about 50 trucks per day, due to both the destination of the production generated by the project and the delivery of the necessary inputs for production.

Considering the low flow of vehicles on the PI-465 highway and the size of the BR-020, it is understood that this increase should not significantly affect traffic in the region.

Thus, the Piauí Nickel Project's operational phase will have the main effect of causing discomfort to the population, the operation of mining mines, industrial plants and their support infrastructures and displacement through local access roads. The operations and activities to be carried out in the mines have a great potential for generating noise and emitting particulate matter.

The use of machinery and equipment, the transport of material and construction workers, as well as the use of explosives, should cause noise and vibration impacts in the areas closest to the emitting sources. These actions and the respective consequences are detailed in the impacts of the operation phase "Environmental discomfort - Vibration level and Environmental discomfort - Acoustic overpressure", previously presented.

As presented in the Project Description chapter, the production process requires the transportation of limestone from the Umbuzeiro area to the Hydrometallurgical Plants, which will be transported by trucks on unpaved roads. This transport should generate an elevation of suspended particulate material (dust) in the section covered, affecting the population that is in its surroundings.

It should be noted that the area of operation of the project has aggravating factors for this problem of particulate material, coming from both the roads and the mines, due to the low humidity of the air, with long periods of drought, and the strong winds that reach the region, so these factors can intensify both the production of particulate material and expand its dispersion, which would further affect the surrounding communities. Further details are presented in the impact of “Deterioration of air quality” in the operation phase.

The discomfort to the population should be concentrated in the communities closest to the structures of the project (DAA), namely: Carnaíba Settlement (100m from the pipeline); Várzea Settlement (50m from the pipeline), Veredas Settlement (350m from the pipeline), Brejo Seco Community (900 m from the explosives warehouse), Várzea de Cima Community (350 m dike 2), Veredas Community (500 m from the access road and 2 km from the Nickel Mine) and Umbuzeiro Community (1.4 km from the Limestone Plant).

Finally, it is important to remember that the Piauí Nickel Project already provides for the operation of an independent and exclusive road for the use of the project, located far from these surrounding communities precisely to reduce the use of pre-existing roads to the maximum and consequently this impact on the receivers closer together.

a) Evaluation of Impact

The impact is **negative** because, although there is an increase in the levels of sound pressure (noise) and vibration and dust generation that can affect the quality of life of workers and residents closest to the project, it will occur at levels much lower than obtained during the construction phase.

The impact has a **certain occurrence** because both operations in the mining areas, material transport, as well as possible detonations in the mine are necessary for the development of the final product, and should manifest in the **long term**.

The spatiality of this impact is **localized**, as it is concentrated in the area of the project and its surroundings (roads; area of noise propagation and, eventually, vibration; portion of the aerial basin affected by the dispersion of dust and gases and area of action of vectors). It is **reversible**, as it is directly linked to the period of operation and has a **temporary** duration, as it should end as soon as the project's operation phase ends.

The impact was considered to be of **medium** magnitude, as there are nine Surrounding Communities close to the project and which are expected to suffer the indicated impact.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Longo	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

To minimize the impacts caused by the project's operations, it is recommended:

- Prioritize the use of lower noise emission equipment;
- Implement sound barriers, and plant curtains around the main sources of particulate matter in the project, especially the nickel and limestone mining areas;
- Communicate to local residents in advance of the occurrence of activities of greatest inconvenience, such as detonation by explosives of intermittent occurrence. This measure should be part of the Social Communication Program;
- Implement the actions provided for in the Noise and Vibration Monitoring Program.
- Wetting of the ore and access roads as a way to avoid the suspension of particulate material.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as being of large magnitude, it can be considered as of **medium relevance**.

7.2.4. Closure Phase

7.2.4.1. Physical Environment

A) Soil degredation

Due to the onset of surface dynamic processes

Activity and Aspect	
Activity	Decommissioning of structures Waste and solid waste
Aspect	Soil exposure Deflagration of erosive processes and mass movement

During the closure phase of the project, some activities may imply the acceleration of processes of superficial dynamics within the limits of the DAA and surroundings. This phenomenon can develop due to the exposure of soils in the slopes of the waste dump and dry waste, pit area, as well as cuts and embankments.

It should also be noted that due to the more intense rainfall between the months of December and March, the outbreak of erosive processes and eventual mass movement should be more frequent.

The deterioration of the soil may also occur due to intense movement in the area, resulting in the alteration of its basic characteristics, such as permeability, compaction, etc.

a) Evaluation

Soil degradation is a **negative** impact, as it changes and deteriorates the quality of the soil, **direct** and of a **certain occurrence**. This impact should manifest itself in the **short term**, considering that it may occur soon after the execution of the triggering activities, it is **reversible**, since there is a way to return the natural conditions of the soil from a set of activities. It will occur in a **localized and dispersed** manner, once the processes referring to soil deterioration, will occur in general within the DAA. It is a causative and intensifying impact, since the outbreak of erosive processes is natural to the region, however the physical modifications of the soil (compaction, salinization, etc.) will be generated from the activities of decommissioning the project. It is **permanent**, as its manifestation will occur after its complete decommissioning, with no deadline for closing.

Due to the characteristics of the region and how this impact is reversible, it was assessed as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer and Intensifier
Occurance - Spatiality	Localized and dispersed	**Duration**	Permanent
Magnitude			
Qualitative	Small		

b) Proposed Measures

- Topographic and substrate reconformation of affected areas and / or areas that are not in conformity;
- The slopes in general must strictly follow the precepts of the engineering project and relevant Standards (such as NBR-11.682: 1991: slope stability and others);
- Promote systematic preventive and corrective actions in order to minimize possible environmental degradation as a result of the intensification of superficial dynamic processes;
- If necessary, carry out automated monitoring with relevant instruments (geotechnical monitoring);
- Recover the areas degraded by the project;
- Adoption of constructive soil protection techniques;
- Monitoring and control of erosion processes, mass movement and other processes of land instability.

The set of actions that encompass these abovementioned practices are found in the: Recovery of Degraded Areas Program; Program for the Prevention and Control of Surface Dynamics; Surface Water Quality Monitoring Program; as well as in the Preliminary Mine Closure Plan.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of low relevance.

B) Deterioration of Air Quality

Due to the resuspension of particulates and the emission of air pollutants

Activity and Aspect	
Activity	Land clearing and preparation Transport of personnel, supplies and equipment Recomposition of areas
Aspect	Generation of particulate material Burning fossil fuels

During the closure of the project, some activities may involve resuspension of particulate material and emission of pollutants, among which the following stand out: clearing the land, transporting personnel, supplies and equipment, and recomposing areas.

This increase in the emission of atmospheric pollutants will not occur continuously, varying according to the activities to be developed. The impact should be felt not only in the area of construction sites, but also in its surroundings, its extent depending on the location and type of activity.

The predominant component of moving vehicles in arid places is particulate material, characterized as resuspended dust, essentially earth and rock dust, which is inert. However, very small particles can penetrate the respiratory tract, reaching the pulmonary bronchi and alveoli and causing allergies and respiratory diseases (WHO, 2006). It is noteworthy that, in the incidence of strong winds, especially in the drier periods, the impacts caused by these emissions will be aggravated, due to the increased emission of particles by resuspension.

There will also be an impact caused by the generation of combustion gases during the closure of the project, due to the operation of light and heavy vehicles (automobiles, vans, pickup trucks, trucks, off-road, etc.), light and heavy equipment (compressors , tractors, loaders, etc.) that use engines based on the burning of fossil fuels as the driving force. Gaseous emissions will basically consist of gases such as carbon oxides (CO and CO_2), nitrogen oxides (NOx), sulfur oxides (SOx) and hydrocarbons.

a) Evaluation

It is a **negative**, **certain**, **dispersed** impact, since the impact can be felt beyond the immediate vicinity of the project, occurring in the **short term**, considering that it will occur soon after the execution of the triggering activity, **reversible** once the characteristics of the site may be recovered shortly after the completion of activities, **temporary**, as it will only occur during the project closure, **intensifier** and **causative** lasts, understanding that the resuspension of particulate material is currently occurring, due to the typology of the site, and the emission gas is something new, as it is outside the urban area and / or vehicle circulation area.

The impact in question is considered of **small** magnitude, considering that it is temporary and the project is planned outside the urban area, that is, in an area with a reduced number of receivers.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier and Causer
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Proposed Measures

- Establishment of vehicle speed limit, since the main factors that contribute to the increase in dust generation associated with vehicle traffic are weight and speed;
- Sprinkling water in the source areas with the greatest potential for generating particulate material and with the largest number of receivers;
- It is forbidden to transport without packaging materials that may provide the suspension of solid particles, thus the loads and bodies of trucks must be properly covered / buffered in order to minimize the emission of particulates;
- Surface coverage of provisional stacks of unconsolidated materials;
- Vegetation cover of exposed areas as soon as they are released;
- Inspection and preventive maintenance of vehicles, machines and equipment, in order to detect any abnormalities in the regulation of the combustion engines and also to minimize the emission of gases and black smoke;
- Monitoring and apparent measurement of the smoke density emanating from vehicles, machines and equipment, using the Ringelmann scale;
- Use of new vehicles / equipment or in good condition, regulated according to the manufacturer's instructions.

In addition, it is suggested that these controls be subsidized through the Environmental Management Plan of the project, as well as in the Preliminary Mine Closure Plan and Air Quality Monitoring Program.

c) Degree of resolution of the measures and degree of relevance of the impact

Mitigating Measures and Degree of Relevance	
Degree of resolution of measures	Medium
Degree of relevance of the impact	Low

The proposed measures have a medium degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

C) Deterioration of Soil and Groundwater Quality

Due to the presence of contaminating substances

Activity and Aspect	
Activity	Decommissioning of structures Cleaning the area Supply, maintenance and washing of machines and equipment Storage and / or use of general inputs and hazardous products
Aspect	Generation of liquid effluents Generation of solid waste Leak of contaminating substances

The change in the quality of soils and groundwater may be due to the closure phase, where the structures will be decommissioned and the area cleaned.

In order to carry out such activities, there will be circulation of vehicles (light and heavy), machines and equipment powered by combustion engines, subject to corrective maintenance, as well as the use of fuels and lubricating oils, representing risks of the occurrence of eventual accidents / leaks of these products. This can result in the occasional change in the quality of soils and groundwater in these work fronts.

It is important to note that the vulnerability of the aquifer, as described in the diagnosis, for the nickel pit area and industrial sector, is low, however, due to the karst environment in the limestone pit, the scenario is different, being a place with high vulnerability contamination.

In general, contamination of these environment is directly associated with localized and punctual events, such as fuel leaks, inadequate disposal of oils and greases, among others.

In addition, soil and groundwater contamination may also be caused by sanitary and industrial effluents, and solid waste generated at this stage.

a) Evaluation

The degradation of the quality of the soil and groundwater is a **negative** impact, as it changes and deteriorates the quality of these environments, **direct** and **likely to occur**. This impact should manifest itself in the **short term**, considering that it may occur soon after the execution of the triggering activities, it is **reversible**, since there is a way to return the natural conditions of the soil and groundwater if it occurs. It will occur **locally**, only at the DAA. It is a causative impact, since it is the result of the closure of the project, **temporary** once the source of contamination ceases, the impact tends to exist.

As this impact is likely to occur and has a reversible and permanent character, it was assessed as of **small magnitude**.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Proposed Measures

- Inspect and perform systematic maintenance:
  - In the storage structures for lubricating oils, greases and / or chemical products of any nature, according to, minimally, the requirements of ABNT / NBR 14725-2 and ABNT / NBR 7505-1;
  - In temporary and permanent drainage systems, as well as oil and grease separator boxes;
  - In fluid containment systems (waterproofing, drainage, oil and grease separators, etc.);
  - In the areas of segregation and temporary packaging in accordance with the provisions of CONAMA Resolution No. 307 of 2002 and in line with the guidelines proposed in the Environmental Management Program.
- All machines, equipment and vehicles used in the implementation of the project must undergo continuous inspection and routine maintenance actions (preventive and corrective) aimed at minimizing potential leaks of oils, greases and fuels.
- Implementation of the Solid Waste Management Program;
- Implementation of the Effluent Monitoring Program; and,
- Implementation of the Groundwater Monitoring Program.

The proposed measures are detailed in the Groundwater Monitoring Program, as well as in the Preliminary Mine Closure Plan, the Solid Waste Management Program; and Effluent Monitoring Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high resolution and, since the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

D) Deterioration of Surface Water Quality and Silting of the Drainage Network

Due to the generation and transport of sediments

Activity and Aspect	
Activity	Closure of the basic infrastructure of the mine, beneficiation plant, sulfuric acid plant facilities, nickel concentration plant, lime plant, fixed and mobile equipment, roads, accesses, transmission lines, etc. Recovering of pits, stockpiles and deposits Vehicle handling
Aspect	Generation of surplus materials Soil exposure Deflagration of erosive processes and mass movement Alteration of the characteristics of water bodies

During the closure phase of the project, some activities may cause, directly or indirectly, the carrying of sediments, which can potentially lead to the silting up of water courses and changes in the quality of surface water.

The most critical points in which sediment generation may occur during the project's decommissioning phase are associated with all areas that will undergo intervention for environmental recovery and adaptation of the areas according to future uses that are proposed. These areas should have their surfaces exposed for recovery, which may become sources of sediment.

The introduction of occasional punctual and diffuse loads in the water bodies may cause a drop in water quality and sanitary standards, affecting the multiple uses of water, with an increase in turbidity levels, an increase in the concentration of iron, manganese and nutrients in the water being expected. ADI waterways of the project.

a) Evaluation

This is a **negative**, **probable**, **dispersed** impact, because although the impact is mainly on the project's ADI, it may also reach the AII, of **short-term** occurrence, considering that it may occur soon after the activity is carried out. to trigger it; **temporary**, as its manifestation may cease after the end of the project; **intensifier**, since this process already occurs naturally and is **reversible**, considering the practice of controlled and periodic dredging, if necessary.

This is an impact of **small magnitude**, because although in the closure phase of the project there is a progressive reduction in the generation of sediments.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier

Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Proposed Measures

The following are some of the mitigating measures to be adopted:

- Recover and monitor altered and denuded areas;
- Punctual application of mitigation methods in order to reduce the processes of erosion and slipping in areas accidentally collapsed or eroded;
- Maintenance of temporary and permanent drainage systems in order to drain rainwater flows in an appropriate and safe way to the drainage points; and
- Cleaning and maintenance of the drainage system, removing sediment accumulated in the decantation boxes, clearing channels, ditches and manholes, possibly silted.

The actions to manage this impact are described in the Surface Water Quality Monitoring Program, as well as in the Preliminary Mine Closure Plan.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and, as the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.4.2. Biotic Environment

A) Deterioration in the quality of acquatic habitats

Due to the generation and transport of sediments

Activity and Aspect	
Activity	Closure of the basic infrastructure of the mine, beneficiation plant, sulfuric acid plant facilities, nickel concentration plant, lime plant, fixed and mobile equipment, roads, accesses, transmission lines, etc. Recovering of pits, stockpiles and deposits Vehicle handling
Aspect	Soil exposure Deflagration of erosive processes and mass movement Alteration of the characteristics of water bodies

During the closure phase of the project, some activities may cause, directly or indirectly, the carrying of sediments, which can potentially lead to the silting up of water courses and changes in the quality of surface water, with consequent damage to aquatic biota.

The damages caused to the aquatic communities in the decommissioning phase are very similar to those presented in the impacts to the aquatic communities in the construction and operation phases of the project and will mainly affect the Várzea stream and the tributaries of the Itaquatiara stream.

After the stage of recomposition of the project area, due to the resilience of the aquatic biota, a reorganization of the taxonomic composition of the aquatic organisms is expected if the damage caused during the implementation and operation phase is not very intense.

a) Evaluation of Impact

This is a **negative**, **probable**, **short-term** impact, **dispersed**, **intensified** by the project and **reversible** and **temporary** if there is a reduction in species richness and abundance. The impact is considered of **small magnitude**, since in the closure phase of the project there is a progressive reduction in the generation of sediments.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Probable	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Small		

b) Management Measures and Environmental and Social Programs

The same measures proposed for the maintenance of water quality and for the preservation of aquatic biota in the stages of implementation and operation of the Piauí Nickel Project will be appropriate for this impact.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high resolution and, since the impact was assessed as of small magnitude, it can be considered as of **low relevance**.

7.2.4.3. Socioeconomic Environment

A) Increase in discomfort to the population

Activity and Aspect	
Activity	Demobilization of the project
Aspect	Generation of particulate material; Noise generation; Traffic generation (vehicles / machines);

During the closure of the project, activities involving earthmoving and excavation equipment, concrete mixers, cranes and transportation of equipment, materials, people and waste should emit noise and vibration, thus causing discomfort to the population. The suspension of particles in the air can affect the population over a wider area, mainly causing respiratory problems.

In addition, there is a potential for health and safety risks for people living in communities close to the project, due to direct or indirect contact with hazardous materials and substances - toxic, combustible, flammable, corrosive, explosives, etc. - the proliferation of vectors and the transport of materials, equipment and workers, intensifying the traffic of heavy vehicles in the vicinity of the areas to be disabled and creating insecurity for vehicle traffic and pedestrians.

The discomfort to the population should be concentrated in the communities closest to the structures of the project that should be demobilized, namely: Carnaíba Settlement (100m from the pipeline); Várzea Settlement (50m from the pipeline), Veredas Settlement (350m from the pipeline), Brejo Seco Community (900m from the explosives warehouse), Várzea de Cima Community (350m dike 2), Veredas Community (500m from the access road and 2 km from the Nickel Mine) and Umbuzeiro Community (1.4 km from the Limestone Plant).

However, all the points listed above will occur at levels lower than those practiced during the operation of the project.

Finally, it is important to remember that the Piauí Nickel Project already provides for the operation of an independent and exclusive road for the use of the project, located far from these surrounding communities precisely to reduce the use of pre-existing roads to the maximum and consequently this impact on the receivers closer together.

a) Evaluation of Impact

The impact is **negative**, as it is a set of disturbances that will negatively affect the quality of life of workers in the decommissioning phase and of the communities close to the project.

The impact is **certain** to occur and is expected to manifest in the **short term**. The spatiality of this impact is **localized**, as it is concentrated in the area of the project and surroundings (roads; area of noise propagation and, eventually, vibration; portion of the aerial basin affected by the dispersion of dust and gases and area of action of vectors).

The impact is **reversible**, as it is directly linked to the period of activities necessary to deactivate the project. It has a **temporary** duration, returning to the previous situation when the activities of this phase cease.

The impact is considered to be of **medium** magnitude, due to the relative number of communities potentially affected.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Intensifier
Occurance - Spatiality	Localized	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

Some measures must be taken such as:

- Assess and identify sources of noise, requiring mitigating measures to contain and minimize these impacts. It is recommended to place sidings with height determined according to the height of the equipment (noise sources) to be used. It would also be important to schedule the noisiest activities for the day, leaving the night activities with less noise and vibrations;
- Inform the local residents in advance when the most disturbing activities occur. This measure should be part of the Social Communication Program.

To reduce the levels of noise and dust emitted by the traffic of heavy and light vehicles, it is recommended:

- Provide proper maintenance of roads;
- Establishment of ideal speed for vehicles, that is, that produces the lowest level of noise and dust;
- Sprinkling water on the roads to be used, in order to reduce the suspension of particulate matter;
- Traffic planning for heavy vehicles, avoiding the night shift.

The actions related to vehicle traffic may be included in the Environmental Management Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**High**
Relevance Degree of the Impact	**Low**

The proposed measures have a high degree of resolution and as the impact was assessed as medium in magnitude, it can be considered as of **low relevance**.

B) Decrease in jobs, income and economic activity

Activity and Aspect	
Activity	Demobilization of labour
Aspect	Generation of unemployment

The maximum operation of the project is expected to take 17.6 years. In this long-term horizon, there is a tendency to increase the economic dynamics, derived from the implementation and operation of the project, which will consolidate economic activities at a higher level than before the introduction of the project. However, with the closure phase of the project, impacts of a downturn in the regional economy are expected.

This is because the demobilization of labor directly employed by the project is expected to impact the indirect and income-effect jobs that the mobilization and increase in income helped to create. The services and supplies that will no longer be demanded by employees and the project itself, will also contribute to the decline in regional economic activity.

a) Evaluation of Impact

The retraction of the various regional economic sectors, resulting from the closure of the project in question, will have a **negative** and **certain** impact, although it **is indirect**, being relatively **dispersed** and **short-term**. **Reversible**, because the market will not depend beyond the medium term to adapt to the decrease, and assignment, of the activities of this project. Therefore, it can be considered **temporary**, since the project will no longer contribute to the dynamism of the local economy, however it will have to adapt to the new situation.

The impact is considered to be of **medium** magnitude, because, despite the direct economic benefits of the Piauí Nickel Project being exhausted, the dynamism that occurred in the previous phases should expand the economic capacity of the municipalities of the ADI.

Attributes			
Nature	Negative	**Order**	Indirect
Occurence - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Short	**Form of interference**	Causer
Occurence - Spatiality	Dispersed	**Duration**	Temporary
Magnitude			
Qualitative	Medium		

b) Management Measures and Environmental and Social Programs

The Social Communication Program should be implemented from the beginning of the operation stages, with characteristics of proactivity in the face of the impacts described here and consolidating a permanent and institutional monitoring that aims to mitigate them.

The actions to be identified should consider the articulation between communities, local governments, NGOs and other associations of organized civil society, church, schools and universities, media, etc. to establish priorities and an action plan aimed at the transition phase and the future reality, with due responsibilities.

This analysis should consider the impacts according to the social groups affected, since the most vulnerable populations, such as women, the elderly and migrants, for example, will need specific assistance actions.

If preventive actions are not taken, it is likely that, at the time of completion of the activities, the level of dependence of the communities in relation to the infrastructure and benefits provided by the project will be quite high.

One of the recommended actions would be to extend training opportunities and develop alternative income-generating activities. Another action refers to savings advice. Such measures can be adopted by institutionally established projects' partners, in order to create opportunities to reduce the degree of dependence on the project and, consequently, the damages potentially caused by its closure. Additionally, the project will be able to link other companies to the local business environment, seeking to attract new businesses that can make use of this workforce in the region.

Thus, it is recommended to apply the Self-Sustainable Development Program of Local Communities in order to prepare them adequately to face the end of the mining cycle in the region.

Other actions will be detailed in the Preliminary Mine Closure Plan.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**Medium**

The proposed measures have a medium degree of resolution and, since the impact was assessed as of medium magnitude, it can be considered as of medium relevance.

C) Reduction of Government Budget Revenues

Activity and Aspect	
Activity	Demobilization of labour; Demobilization of the project
Aspect	Reduction of taxes (taxes, fees, contributions, royalties)

During the closure phase, the productive activities of the Piauí Nickel Project will cease, as well as all taxes, fees and contributions levied during the operation phase, especially CFEM, as well as the increase in the added value of the municipality of Capitão Gervásio Oliveira. to be computed.

Thus, the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio are expected to suffer a drop in their budgetary revenues, with the first postponed for two years, maintaining the current ICMS distribution rules, since the one-year ICMS quota is calculated based on the value added two years before.

Although in general there is a drop in budget revenues, it should be noted that the contracting of services for demobilizing the structures of the Piauí Nickel Project will mitigate this drop due to the collection of ISSQN.

a) Evaluation of Impact

The reduction in budget revenues will have a **negative** and **certain** impact, although it is **direct**, being **located** in the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio and in the **medium term**. **Irreversible**, since, without changing the current characteristics of the municipalities, it is unlikely that other activities will be able to offset the benefits of the Piauí Nickel Project. Therefore, it can be considered **permanent**, since the project will no longer contribute to municipal revenues.

Considering the drop, the increase in revenue during the previous phase is considered to be of large magnitude, its inverse, during closure it cannot be lower, so this impact is assessed as being of **large** magnitude.

Attributes			
Nature	Negative	**Order**	Direct
Occurance - Probability	Certain	**Reversibility**	Reversible
Occurance - Term	Medium	**Form of interference**	Causer
Occurance - Spatiality	Dispersed	**Duration**	Permanent
Magnitude			
Qualitative	Large		

b) Management Measures and Environmental and Social Programs

Provision of training for employees of the municipalities of the ADI municipalities in relation to public management in order to improve the collection and use of public resources. This activity should be greatly reinforced in the last years of operation so that the municipalities can prepare for this closure phase of the project.

This control measure has a medium degree of mitigation as it does not depend exclusively on the project, and must be part of the Interference Monitoring and Support to Public Services Program.

c) Degree of resolution of the Measures and degree of relevance of the impact

Degree of Resolution and Relevance	
Degree of Resolution of Measures	**Medium**
Relevance Degree of the Impact	**High**

The proposed measures have a medium degree of resolution and, since the impact was assessed as being of large magnitude, it can be considered as **highly relevant**.

7.3. Summary and Balance of Impacts

In the Planning phase, two socio-economic and cultural impacts were identified, one of a negative nature and the other of a positive nature, both of low relevance.

In the Construction phase of the project, when the majority of the impacts were mapped, 8 impacts from the physical environment were identified, all of which are of a negative nature, between low and medium relevance; in the biotic environment 5 impacts of a negative nature were identified, being evaluated as of low relevance; in the socioeconomic and cultural environment 11 impacts were identified, three of which were positive in nature and had a high degree of relevance.

Another 8 impacts of a negative nature were identified in the socioeconomic and cultural environment for the Construction phase, evaluated between low, medium and high relevance.

In the Operation phase, 10 impacts of the physical environment were identified, all of negative nature, 5 of low relevance and 5 of medium relevance. In the biotic environment, 3 negative impacts were identified, assessed between low and medium relevance.

As for the socioeconomic and cultural environment, 3 impacts were identified, 2 of which were of a positive nature, with a high degree of relevance and a negative impact of medium relevance.

Finally, in the Closure phase, 4 negative impacts of the low relevance physical environment were identified; 1 impact of the biotic environment, of low relevance and negative nature. In the socioeconomic and cultural environment, a total of 3 negative impacts were identified in this phase, one being low, one medium and one highly relevant.

Table 7.3-1 – Balance of Environmental Impacts.

Nature	Type	Degree of Relevance		
		Low	Medium	High
Planning Phase				
Positive	Physical	--	--	--
	Biological	--	--	--
	Socioeconomic	1	--	--
Negative	Physical	--	--	--
	Biological	--	--	--
	Socioeconomic	1	--	--
Construction Phase				
Positive	Physical	--	--	--
	Biological	--	--	--
	Socioeconomic	--	--	3
Negative	Physical	6	2	--
	Biological	5	--	--
	Socioeconomic	1	4	3
Operation Phase				
Positive	Physical	--	--	--
	Biological	--	--	--
	Socioeconomic	--	--	2
Negative	Physical	5	5	--
	Biological	2	1	--
	Socioeconomic	--	1	--
Closure Phase				
Positive	Physical	--	--	--
	Biological	--	--	--
	Socioeconomic	--	--	--
Negative	Physical	4	--	--
	Biological	1	--	--
	Socioeconomic	1	1	1

Source: Arcadis, 2017.

Table 7.3-2 – Synthesis Matrix of Impacts and Programs.

Environment	Impact	Attributes								Magnitude	Measures	Degree of Resolution	Degree of Relevance
		Nature	Occurance			Order	Reversibility	Form of Interference	Duration		Programs		
			Probability	Term	Spatiality								
Planning													
SE & C	Creating Positive Expectations.	P	P	I	D	I	R	I	T	S	Social Communication Program.	H	L
	Creating Negative Expectations.	N	P	I	D	I	R	I	T	S	Social Communication Program.	H	L
Construction													
P	Deterioration of soil and groundwater quality - Due to the presence of contaminating substances.	N	P	I	L	D	R	C	T	M	Groundwater Monitoring Program; Solid Waste Management Program; and Effluent Monitoring Program. In the future, when developing the Risk Management Program and Emergency Response Plan, additional measures may be recommended.	M	M
	Degradation of the soil - Due to the generation of surplus materials and promotion of erosion processes.	N	C	I	L	D	R	C / I	P / T	M	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; and Surface Water Quality Monitoring Program.	H	L
	Deterioration of air quality - Due to the resuspension of particulates and the emission of air pollutants.	N	C	I	D	D	R	I / C	T	M	Environmental Management Program; Air Quality Monitoring Program.	M	M
	Degradation of speleological heritage - Due to the modification of the original topography and other related aspects.	N	P	I	L	D	I	C	P	S	Solid Waste Management Program; Effluent Control Program; and Environmental Education Program.	H	L
	Deterioration of Surface Water Quality and Silting of the Drainage Network - Due to the generation and transport of sediments.	N	P	I	D	D	R	I	T	M	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program.	H	L
	Deterioration of surface water quality by effluents and solid waste - Due to the generation of liquid and oily effluents and solid waste.	N	P	I	D	D	R	F	T	S	Liquid Effluent Management Program; Solid Waste Management Program; Surface Water Quality Monitoring Program.	H	L
	Changing the water network configuration - Due to the implementation of project structures.	N	P	I	L	D	I	F	P	S	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program.	M	L
	Environmental discomfort - Sound pressure Due to mobile and fixed equipment.	N	P	I	D	D	R	C	T	S	Noise and Vibration Monitoring Program; and Social Communication Program.	M	L
B	Loss of habitats.	N	C	I	L	D	R	I	P	S	Flora Suppression and Rescue Control Program; APP Intervention Compensation Program; and Degraded Areas Recovery Program (PRAD).	M	L
	Loss of specimens of native flora.	N	C	I	L	D	R	I	P	S	Flora Suppression and Rescue Control Program; APP Intervention Compensation Program; and Degraded Areas Recovery Program (PRAD).	M	L
	Dispersion and loss of terrestrial fauna specimens.	N	C	I	D	D	I	I	P	M	Environmental Education Program; Fauna Chase Away Management Program.	H	L
	Deterioration of aquatic habitat quality - Due to the generation and transport of sediments.	N	P	I	D	I	I	I	P	S	Degraded Areas Recovery Program (PRAD); Erosive Process Control and Monitoring Program and Surface Water Quality Monitoring Program	M	L
	Deterioration of the quality of aquatic habitats - Due to the generation of liquid and oily effluents and solid waste.	N	P	I	D	I	I	F	P	S	Liquid Effluent Management Program, Solid Waste Management Program and Surface Water Quality Monitoring Program	H	L

Environment	Impact	Attributes								Magnitude	Measures		
		Nature	Occurance			Order	Reversibility	Form of Interference	Duration		Programs	Degree of Resolution	Degree of Relevance
			Probability	Term	Spatiality								
Construction													
SE & C	Increase in economic activity.	P	C	M	D	D	R	I	T	L	Local Suppliers Development Program; and Social Communication Program.	H	H
	Increase in the demand for housing and prices' elevation.	N	C	M	L	I	R	C	T	M	Interference Monitoring and Support to Public Services Program.	L	M
	Increase in the demand for public services.	N	C	M	L	I	R	C	T	L	Interference Monitoring and Support to Public Services Program; Social Communication Program; and in the Workforce Management Program.	M	H
	Increase in prostitution / sexual exploitation.	N	P	M	L	I	R	I	T	L	Social Communication Program; and Environmental Education Program.	M	H
	Increase in government budget revenues.	P	C	M	L	D	R	C	T	L	Interference Monitoring and Support to Public Services Program.	M	H
	Increase in social conflicts.	N	P	I	L	I	R	I	T	M	Social Communication Program; Workeforce Management Program; Environmental Education Program.	M	M
	Increase in discomfort to the population.	N	C	I	L	D	R	I	T	L	Noise and Vibration Monitoring Program; Social Communication Program; and Environmental Management Program.	M	H
	Increase in the number of employed workers and the population's income.	P	C	I	D	D	R	I	T	L	Workforce Management Program; Social Communication Program.	H	H
	Decrease in jobs, income and economic activity (demobilization).	N	C	I	L	D	I	I	P	M	Local Suppliers Development Program; Workforce Management Program; Self-Sustainable Development Program for Local Communities.	M	M
	Increased incidence of disease (by vectors, endemic, STD / AIDs, cardiovascular, respiratory, etc.)	N	P	M	L	I	R	C	T	M	Social Communication Program; Environmental Education Program.	L	M
	Loss of productive areas (farming).	N	C	I	L	D	I	C	P	S	Land Negotiation Program.	H	L
Operation													
P	Environmental discomfort - Topographic change - Due to changes in the original land topography.	N	C	M	L	D	I	C	P	M	Preliminary Mine Closure Plan; and Degraded Areas Recovery Program (PRAD).	L	M
	Deterioration of soil and groundwater quality - Due to the deposition of dry tailings and ore processing, and the presence of contaminating substances.	N	P	M	L	D	R	C	T	A	Groundwater Monitoring Program; Solid Waste Management Program; and Effluent Control Program.	H	M
	Deterioration of air quality - Due to the resuspension of particulates and the emission of air pollutants.	N	C	I	D	D	R	I / C	T	M	Environmental Management Program; Air Quality Monitoring Program.	M	M
	Change in underground water availability - Due to the collection of groundwater for the implementation of the project and the lowering of the water table in the Umbuzeiro area.	N	P	M	L	D	R	C	T	M	Groundwater Monitoring Program.	L	M
	Environmental discomfort - Vibration level (due to the vibration level generated by rock dismantling by explosives).	N	C	I	D	D	R	C	T	M	Noise and Vibration Monitoring Program.	M	M
	Environmental discomfort - Accoustic overpressure (due to mobile and fixed equipment).	N	C	I	D	D	R	C	T	M	Noise and Vibration Monitoring Program.	H	L
	Degradation of the soil - Due to the generation of surplus materials and promotion of erosion processes.	N	C	I	L	D	R	C / I	P	S	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; and Surface Water Quality Monitoring Program.	M	L
	Deterioration of Surface Water Quality and Silting of the Drainage Network - Due to the generation and transport of sediments.	N	P	I	D	D	R	I	T	M	Degraded Areas Recovery Program (PRAD), Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; and Surface Water Quality Monitoring Program.	H	L
	Deterioration of surface quality by effluents and solid waste - Due to the generation of liquid and oily effluents and solid waste.	N	P	I	D	D	R	F	T	M	Solid Waste Management Program; Liquid Effluent Management Program; and Surface Water Quality Monitoring Program.	H	L
	Change in surface water availability - Due to water consumption.	N	C	I	L	D	R	F	T	S	Surface Water Quality Monitoring Program.	M	L

Environment	Impact	Attributes									Measures		
		Nature	Occurance			Order	Reversibility	Form of Interference	Duration	Magnitude	Programs	Degree of Resolution	Degree of Relevance
			Probability	Term	Spatiality								
Operation													
B	Deterioration of aquatic habitat quality - Due to sediment generation and carrying.	N	P	I	D	I	R	I	T	S	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; and Surface Water Quality Monitoring Program.	H	L
	Deterioration in the quality of aquatic habitats - Due to the generation of liquid and oily effluents and solid waste.	N	P	I	D	I	R	F	T	S	Surface Water Quality Monitoring Program, Solid Waste Management Program and Liquid Effluent Management Program.	H	L
	Fauna Loss and Disturbance	N	C	I	D	D	R	C	T	M	Environmental Management Program.	M	M
SE & C	Increase in jobs, income and economic activity.	P	C	I	D	D	R	I	T	L	Local Suppliers Development Program; Social Communication Program; Workforce Management Program.	H	H
	Increase in government budget revenues.	P	C	M	L	D	R	C	T	L	Interference Monitoring and Support to Public Services Program.	M	H
	Increased Discomfort to the Population.	N	C	L	L	D	R	C	T	M	Noise and Vibration Monitoring Program; Social Communication Program.	M	M
Closure													
P	Soil Degradation - Due to the onset of surface dynamic processes.	N	C	I	L / D	D	R	C / I	P	S	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; Surface Water Quality Monitoring Program; Preliminary Mine Closure Plan.	H	L
	Deterioration of air quality - Due to the resuspension of particulates and the emission of air pollutants.	N	C	I	D	D	R	I / C	T	S	Environmental Management Program; Preliminary Mine Closure Plan; and Air Quality Monitoring Program.	M	L
	Deterioration of soil and groundwater quality - Due to the presence of contaminating substances.	N	P	I	L	D	R	C	T	S	Groundwater Monitoring Program; Risk management program; Emergency care plan; Preliminary Mine Closure Plan; Solid Waste Management Program; and Effluent Control Program.	H	L
	Deterioration of Surface Water Quality and Silting of the Drainage Network - Due to the generation and transport of sediments.	N	P	I	D	D	R	I	T	S	Surface Water Quality Monitoring Program; Preliminary Mine Closure Plan.	H	L
B	Deterioration in the quality of acquatic habitats - Due to the generation and transport of sediments.	N	P	I	D	D	R	I	T	S	Degraded Areas Recovery Program (PRAD); Prevention and Control of Surface Dynamics and Silting of Water Bodies Program; Program for Monitoring Surface Water Quality.	H	L
SE & C	Increased discomfort to the population.	N	C	I	L	D	R	I	T	M	Environmental Management Program; Social Communication Program.	H	L
	Decrease in jobs, income and economic activity (demobilization).	N	C	I	D	I	R	C	T	M	Social Communication Program; Preliminary Mine Closure Plan; Local Communities Self-Sustainable Development Program.	M	M
	Reduction of government budget revenues.	N	C	M	D	D	R	C	P	L	Interference Monitoring and Support to Public Services Program.	M	H

Labels: ***Environment****: P – Physical, B – Biotic, SE&C Socioeconomic & Cultural;* ***Nature****: N – Negative, P – Positive;* ***Probability****: C – Certain, P – Probable;* ***Term****: I – Immediate, M – Medium, L - Long;* ***Spatiality****: L – Localized, D – Dispersed;* ***Order****: D – Direct, I – Indirect;* ***Reversibility****: R – Reversible, I – Irreversible;* ***Form of Interference****: C – Caused, I – Intensified, F – New Fact; Duration: T – Temporary, P – Permanent; Magnitude: S - Small, M – Medium, L – Large;* ***Degree of Resolution****: H – High, M – Medium, L – Low;* ***Degree of Relevance:*** *H – High, M – Medium, L – Low (green box - Positive Nature, red box - Negative Nature).*

8. Mitigating, Compensatory, and Environmental and Social Programs

8.1. Environmental and Social Management Program

8.1.1. Justification

The planning, construction, operation and closure phases of the Piauí Nickel Project require monitoring by Environmental and Social Programs, which aim to control, mitigate, monitor and prevent the negative environmental effects expected for the project's activities, as well as enhance the effects of the positive impacts. Thus, in order to manage the proposed Environmental and Social Programs both during the construction works and throughout the operation of the mining-industrial complex, it is essential to develop a management structure that will ensure that the execution of environmental plans and programs takes place in an integrated and satisfactory manner, and within the rules established by law and by environmental agencies when issuing their respective licenses.

The Environmental and Social Management Program refers to the set of systematized actions in the form of measures and procedures for the management of technical processes, which aims at the proper conduct and monitoring of the implementation of other Environmental and Social Programs aimed at monitoring, mitigation, control and enhancement of environmental impacts resulting from the project.

8.1.2. Objective

The general objective of this PGA is to provide the project with efficient management mechanisms that guarantee the execution and control of all actions planned in the Environmental and Social Programs, in order to efficiently mitigate, control and monitor the potential impacts generated, as well as potentiate the effects benefits of impacts identified as positive, and maintain a high standard of environmental quality in the future implementation and operation of the project.

8.1.3. Target Audience and Scope

The PGA covers all facilities covered by the Piauí Nickel project mining complex and is aimed at construction workers, contractors, service providers in general, public agencies, communities and civil society organizations that will participate directly and / or indirectly in all phases of the project.

8.1.4. Planned Actions

The actions planned for the Environmental Management Program must contemplate the planning, construction and post-construction (operational and closure) phases, as detailed below, following the IFC - International Financial Corporation (2012) Performance Standard on Socio-Environmental Sustainability (2012). However, as it extends to other Environmental and Social Programs, the PGA will also consider the following standards:

- Performance Standard 2: Employment and Work Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health and Safety
- Performance Standard 5: Land acquisition and involuntary resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 8: Cultural Heritage.

a) Planning

The main premise related to the PGA is the independence of carrying out the present program in relation to the progress of the work itself, which guarantees the effectiveness of the program, with environmental and social management managed by a single coordinator, so that decisions regarding the execution of actions have a broad authority. This independence is guaranteed by linking this coordination directly with the project, that is, the environmental and social inspection will be carried out by a company / team to be hired by the project, independent of the construction company (ies).

The planning of the environmental and social activities to be developed during the implementation of the project comprises:

- holding meetings to define the strategies to implement the actions foreseen in the Environmental and Social Programs, stipulating action plans with those responsible, the method of execution and deadlines;
- creating standard forms for reporting on observations of an environmental and social nature resulting from field findings and itemization of documentation to be used as evidence of compliance with legal requirements, procedures and work instructions, license conditions, and other requirements;
- defining parameters for contracting companies that execute construction works and services, aiming at contracting companies capable of executing the actions foreseen in the Environmental and Social Programs.

b) Execution during the construction works

This stage comprises the elaboration and execution of the following activities:

- meeting with the professionals involved, with representatives of environmental agencies, public authorities, communities and interested institutions, regarding the development of Environmental and Social Programs related to the project;
- hiring specialized teams in the period necessary for the implementation of actions related to the development of Environmental and Social Programs;
- developing integrated financial management of all Environmental and Social Programs to optimize the necessary and available resources;
- reviewing the adequacy and suitability, when necessary, of the activities that constitute the Environmental and Social Programs proposed within the scope of this Environmental and Social Impact Assessment, with a view to possible changes in the project detailed engineering;

- regular meetings with the professionals involved in conducting Environmental and Social Programs to discuss procedures, proposals and results;
- monitoring and evaluating the development of Environmental and Social Programs, through field monitoring and reports;
- supervising the works to ensure the implementation of the proposed measures and programs and discussion with those responsible for the works, regarding environmental non-conformities, forwarding proposals for corrective actions relevant to each case;
- issuing environmental inspection reports, evaluating the activities and conditions of the work regarding environmental, health and safety issues at work;
- dialogue with the environmental agencies, responding to any requests;
- periodic preparation of progress reports and the monitoring of works and Environmental and Social Programs;
- management of the complete demobilization of the construction site, which should start immediately after the completion of the works. Demobilization of construction sites includes activities such as dismantling of containers, demobilization of sanitary systems, among others.

c) Execution of the PGA after the end of the construction works

After the conclusion of the construction works, the actions listed above that will continue in place for the operational phase, as well as the monitoring of the Environmental and Social Programs applicable to this phase, should be continued.

In addition, the environmental management system should also permeate the planning and future operations of environmental and social activities, actions and programs associated with the Preliminary Mine Closure Plan and future details of the program.

8.1.5. Expected Results

The Environmental and Social Management Program will start in the planning phase and continue throughout the construction, future operation and decommissioning phase, with a view to implementing monitoring programs in all phases of the project.

8.1.6. Schedule

The Program will start in the planning phase and continue throughout the implementation, future operation and closure phase, with a view to implementing monitoring programs in all phases of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Environmental and Social Management Program	■	■	■	■

8.2. Solid Waste Management Program

8.2.1. Justification

The construction, operation and closure phases of the mineral-industrial complex will result in the generation of solid waste, thus creating a potential for soil and water contamination, in addition to the occurrence of several other impacts. Therefore, the search for prevention and minimization of possible environmental impacts, as well as meeting legal requirements (Federal Law 12,305 / 2010), determine the need to implement a Solid Waste Management Program.

The Solid Waste Management Program - PGRS - should be understood as a set of procedures and guidelines necessary for the various stages of solid waste management (segregation, collection, storage, transport and final destination).

8.2.2. Objectives

The objective of the Solid Waste Management Program (PGRS) is to establish the methodology and criteria for controlling waste for its proper management, in order to preserve the environmental quality and health of the population.

The program should adequately conduct the collection, temporary storage, transportation, treatment and final disposal of solid waste generated by the project, thus minimizing / avoiding the risk of contamination of soil and water resources. In addition, the PGRS aims to guarantee the protection of human beings and the environment and to guarantee the conservation of sanitary conditions in all areas linked to the project, with a view to protecting the environment in the areas of influence of the project.

8.2.3. Target Audience and Scope

This program should be adopted in all areas and sectors that generate solid waste at all stages of the project's life cycle.

The target audience basically comprises the project, employees in general, contractors responsible for the work, environmental agency (SEMAR), as well as companies contracted for waste management, especially the final recipients and transporters.

8.2.4. Planned Actions

The actions related to the PGRS are listed below and should be continuously carried out and reinforced, through the execution of systematic training, included in the Environmental Education Program.

- segregation of waste according to class (hazardous and non-hazardous) and identification of possibilities for reuse and / or recycling. Such activity must follow CONAMA Resolution 275/01 and NBR 10,004 / 04;
- separation and storage according to classes and technical standards;
- keeping an inventory of solid wastes and spreadsheets for the control of entry and exit of wastes, as well as weighing them at the entry and exit of temporary storage areas, as planned at the construction site and during the project's Closure and in a specific area during the operation;

- transporting waste to the final destination, after completing the Waste Transport Manifest (MTR) or equivalent document, in accordance with current legislation and technical standards NBR 7.503, NBR 7.500, NBR 13.221;
- management of service providers, as well as those responsible for transporting solid waste to its final destination, including verification audit steps;
- the provision, in the various stages of the project, of waste collection containers compatible with the volume of generation and characteristics of the waste, as well as selective collectors near the offices, cafeterias and changing rooms. All waste must be collected periodically and stored in the Intermediate Waste Deposit, taking into account its classification according to NBR 10.004 / 04, for later destination;
- the periodic collection of sanitary sludge from septic tanks / anaerobic filter and destination for external treatment, duly licensed and capable of receiving the amount generated;
- the periodic collection of oily residue, safe storage, in a place accessible for collection, in suitable containers, resistant to leakage and disposal for external treatment, in accordance with CONAMA Resolution 362/2005;
- surplus materials, such as rubble, shaped wood and other civil construction materials that cannot be used must be managed in accordance with CONAMA resolution 307/2002 (and its subsequent amendments);
- adopting, whenever possible, the practice of reusing / recycling materials in order to reduce the generation of waste;
- in the case of those residues that cannot be reused, they will be temporarily stored in the intermediate deposits, provided in for the construction and operational phases, and later sent for treatment in licensed sites and will record the amount generated, according to legal authorizations of operation, as required by the relevant environmental agency;
- ensuring the internal transport of waste safely so as not to compromise the segregation already carried out;
- setting up an agenda with specialized / contracted / registered companies, for the removal of waste from intermediate warehouses, and prior authorization from the person responsible for managing the project's waste;
- issuing invoices for the external transport of the waste;
- filing the registration of all invoices and other documents for internal control and presentation to the environmental agency whenever requested, in order to complement the waste inventory, according to CONAMA 313/2002;
- to ensure handling solid waste with the use of PPE (personal protective equipment); and
- training and periodic lectures to employees during construction and operation, aiming at the correct segregation of waste.

It should be noted that the Solid Waste Management Program of the mining-industrial complex was structured in order to comply, in all phases of the project, with IFC Performance Standard 3, which deals with Resource Efficiency and Pollution Prevention and Performance Standard 1, which addresses the Assessment and Management of Socioenvironmental Risks and Impacts. The details in the PBA must maintain compliance with these sustainability principles, and they must be incorporated into the company's corporate policies.

8.2.5. Expected Results

Establish adequate standards, respecting the current environmental norms, during the construction and operation of the mining complex, regarding the issues related to the management of solid waste generated in the project's facilities.

Furthermore, the entreprise is expected to minimize / avoid impacts related to the alteration of soil properties and / or the quality of groundwater / surface water.

8.2.6. Schedule

This program should be carried out during the entire construction and operation phase of the mining complex.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Solid Waste Management Program		■	■	■

8.3. Prevention and Control of Surface Dynamics and Silting of Water Bodies Program

8.3.1. Justification

Erosive processes and instability of rock masses and soils occur when the conditions of balance and resistance of the terrain are altered, due to natural or anthropic causes, causing the wear of the pedological cover and the movement of descent of a rock mass, or of soil, in slopes and / or embankments.

Erosive processes, mass movements and, consequently, the silting up of adjacent water bodies are associated with the construction, operational and closure phases of the project, and activities are planned that may suggest its occurrence, such as: clearing and preparing the land, conforming the geometry of the terrain, improvement of access, constructing and accepting drainage systems, and the disposal of ore and dry waste in stockpiles, as well as during the operational and closure phases of the project. All of these activities produce changes in the natural geometry of the terrain, being potential agents that trigger erosive and unstable processes.

As described in the diagnosis (item 5.1.5 and illustrated in Map 5.1-12), the susceptibility to material loss in the areas of the mineral-industrial complex is distributed as follows:

- 840 hectares are composed of areas with low fragility;
- 37 hectares for areas with medium to high fragility;
- 68 hectares are highly fragile; and,
- 218 hectares correspond to areas with very high fragility.

In this context, it is necessary to adopt guidelines, during the execution of the works, operations and closing of the project, which are aimed at at the prevention, control, mitigation and recovery of processes, Surface Dynamics and Silting of Water Bodies.

8.3.2. Objectives

The purpose of this program is to identify, register and monitor potentially unstable locations and locations where surface dynamics processes already exist, according to surveys previously carried out in the field.

In addition, other Program Objectives are:

- avoiding the appearance of erosive processes, mass movements and silting of watercourses;
- ensuring the implementation of preventive and mitigating and corrective practices and structures to the processes of superficial dynamics, such as: drainage systems, sediment containment structures, area slopes, and others;
- ensuring the adoption of corrective actions in unstable land, as well as maintening auxiliary and other structures;
- establishing actions to: (i) recover the vegetation cover on slopes along the areas under intervention and present in support areas; (ii) recovery of land in the areas altered by the works, providing the readjustment or improvement of the landscape and drainage conditions.

8.3.3. Target Audience and Scope

The target audience of this program is made up of the project itself, the environmental agency (SEMAR), the workers and those involved with the works and environmental issues, and inhabitants of the area surrounding the project.

8.3.4. Planned Actions

- The identification and registration of the target areas of this program, namely: susceptible to linear erosive processes, mass movements and other processes; drainage system and auxiliary devices; access routes; cut/fill areas, outlets; slopes and others;
- the systematic visual monitoring and with geotechnical instrumentation (when relevant) of the target areas. In the rainy season and after significant rainfall events, the inspection should be intensified due to the increase in the potential for carrying solids, which may generate accumulations / physical barriers in the channels, which may compromise the adequate flow to the respective points of initial release;
- the issuing of reports to stakeholders on the status and characterization of each target area, necessary actions (corrective, maintenance and others), as well as ranking them in priority. Prompting those responsible for preventive actions, maintenance / cleaning and correction of non-conformities;
- the implementation of the activities of contruction, operation and closing of the mining-industrial complex must be monitored, in order to ensure:
  - the application of sediment containment methods in areas with exposed soil (storage, excavation, borrowed material area, etc.), as well as implementation of a definitive and temporary drainage system equipped with sediment containment systems and other

relevant devices. Drainage ditches should be dug around the perimeter of any stored soil heaps;

- the sending of soil and surplus rock to licensed outlets;
- the protection and maintenance of slopes and cuts in an appropriate condition;
- the careful execution of earthmoving services, according to meteorological forecasts, so as not to expose areas more sensitive to erosion to rains, and adopting construction practices to prevent soil erosion, including measures to temporarily protect the slopes, for example, using blankets;
- the consolidation of the earthworks, and starting the recovery of the areas / plant protection, in sections as they reach their definitive geometry;
- every area subject to interventions such as vegetation removal, earthworks, cuts and embankments, among others, that lead to soil exposure, in addition to the recommended measures for soil containment and slope stabilization, must be provided with a water drainage system for temporary rainwater, with the necessary cleaning, unblocking and maintenance of the respective system;
- dump trucks must be covered with plastic sheeting, to avoiding soil spills and spreading.

It should be noted that the Program for the Prevention and Control of Surface Dynamics and Silting of Water Bodies in the mining-industrial complex was structured in order to comply with IFC Performance Standard 3, which deals with Resource Efficiency and Prevention of Pollution and Performance Standard 1 that addresses the Assessment and Management of Socioenvironmental Risks and Impacts. Both should also be considered when detailing and implementing this program.

8.3.5. Expected Results

Through this program, it is expected to achieve the prevention, mitigation and correction of instabilities in the land, avoiding impacts of soil degradation, loss of soil and silting up of local water bodies.

8.3.6. Schedule

The Program for the Prevention and Control of Surface Dynamics Processes and Silting of Water Bodies will begin in the construction phase, already investigating the potential areas and with the outbreak of morphogenetic processes extending to complete closure of the mine.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Prevention and Control of Surface Dynamics and Silting of Water Bodies Program		■	■	■

8.4. Air Quality Monitoring Program

8.4.1. Justification

As described in the item of Identification and Assessment of Environmental and Social Impacts, during the execution of the works, operations and closure of the mining complex, some activities may involve the emission of particulate material and pollutants.

In the construction phase, these emissions are mainly related to the activities of clearing and preparing the land, removing vegetation, earthworks, implementing support and operational structures, implementing environmental control systems and transporting personnel, inputs and equipment.

During the operation of the mining complex, the activities that may involve the emission of particulate matter and pollutants are: extraction of ores (Nickel and Limestone); processing of Nickel and Limestone; the operation of industrial plants (Nickel and Sulfuric Acid); the transportation of personnel, inputs, ore and equipment; the operation of ore stockpile structures, leaching, waste dumping, and others. Also, considering the existence of potential recipients close to the project's structures (Carnaíba Settlements; Várzea e Veredas and Brejo Seco Communities; Várzea de Cima; Veredas and Umbuzeiro Community), it is necessary to implement control measures that reduce and monitor changes in air quality.

8.4.2. Objectives

This program establishes the procedures and guidelines for the monitoring of particulates and atmospheric emissions, of black smoke in order to reduce the emission of pollutants in the mining complex, as well as providing subsidies for the adoption of mitigating and corrective measures when pertinent.

8.4.3. Target Audience and Scope

The target audience of this program is composed of the project itself, the environmental agency (SEMAR), the workers and those involved with the works and environmental issues, and recipients in the surrounding area.

8.4.4. Planned Actions

The actions of this program were planned and will be developed in accordance with international good practices, above all, in compliance with the guidelines presented in IFC's “Performance Standard 3: Resource Efficiency and Pollution Prevention”. It should be noted that many of these are obligations in Brazil. Performance Standard 1, which addresses the Assessment and Management of Socioenvironmental Risks and Impacts, was also considered in the preparation of the Air Quality Monitoring Program. Both standards must be maintained in the details of the program to be presented at the PBA.

The actions planned for monitoring air quality, both during construction and operation of the project are:

- water sprinkling in the source areas with the greatest potential for generating particulate material and with the largest number of recipients. During the works, the material extracted

during the civil activities of the works, such as excavations and land regularization, will be carried so that the emission of particles is maintained at acceptable levels;

- monitoring and apparent measurement of the smoke density emanating from vehicles, machines and equipment, using the Ringelmann scale;
- vehicle speed limitation, since the main factors that contribute to the increase in dust generation associated with vehicle traffic are weight and speed;
- control and guidance for the circulation of light and heavy vehicles by means of signs in the areas of the works and internal circulation routes, to avoid unnecessary dust formation, as well as signs for vehicle speed control;
- covering with canvas of the buckets of trucks that will transport the mined material to avoid the release of dust, the fall and the spreading of soil and other types of material along the route;
- inspection and preventive and corrective maintenance of vehicles, machines and equipment, aiming at the regulation of combustion engines to minimize the emission of gases and smoke and noise;
- ensuring the surface coverage of provisional stockpiles of unconsolidated materials;
- re-establishing the vegetation on exposed surfaces after the completion of the works;
- re-establishing the vegetation on exposed areas as soon as they are released;
- monitoring of PTS (total suspended solids) and inhalable particles, as well as other relevant pollutants for assessing air quality (construction and decommissioning stage), following the premises established in CONAMA Resolution No. 03/90; and
- in addition to the monitoring of PTS and inhalable particles, in the operational stage, the parameters SOx and Acid Mist that may be emitted from the Sulfuric Acid Plant must be considered at least.

8.4.5. Expected Results

It is expected through this program to minimize the resuspension of particulate matter, black smoke, as well as to ensure that the emission of pollutants is within the levels recommended by the current legislation.

8.4.6. Schedule

Program	Program Execution			
	Planning	Construction	Operation	Closure
Air Quality Monitoring Program		■	■	■

8.5. Noise and Vibration Monitoring Program

8.5.1. Justification

The Piauí Nickel Project encompasses a set of industrial and mining operations (with the break up of rock through the use of explosives) that have great potential for generating noise and vibration. Depending on the conditions for implementing the project, with open-air installations, the operational activities have the possibility of causing noise and vibration.

As presented in the Identification and Assessment of Environmental and Social Impacts, according to the vibration and noise simulations carried out considering the detonation plan, the implementation and operation of the project should not cause discomfort to the populations surrounding the project, on the basis of vibration speed values and insignificant particulates in these locations, as well as low levels of sound

Considering that the simulations carried out were based on data from the specialized bibliography, without taking into account the specifics of the rock in the mining areas and other local information that can directly influence the results of sound pressure and vibration, this monitoring will allow the detection of any impacts on the workers and communities located nearby, mainly the Brejo Seco Community (closer to the future nickel mine, although outside the areas subject to noise and vibration as shown in Map 7.2 2 and Map 7.2 4), and the necessary and viable mitigation measures for minimizing them. The program should create a historical series of levels of noise and vibration in the area, thus informing the evolution of conditions in the vicinity of the project.

8.5.2. Objective

The program aims to assess the noise and vibration emissions resulting from the project's implementation and operational activities through regular monitoring, focusing on potential recipients, who will suffer discomfort if the limits are exceeded. In this sense, the program aims to provide guidelines for:

- monitoring the noise and vibrations caused by the project as a way of ensuring environmental and social quality for the region;
- identifying areas of change in noise and vibration levels arising from the project's activities; and
- taking mitigating actions in relation to noise and vibration emissions from the project, minimizing discomfort for workers and communities located near the project, especially in the Brejo Seco Community.

8.5.3. Target Audience and Scope

The actions of the Noise and Vibration Monitoring Program will be applied to receiving sources located in the vicinity of the project, covering areas where there will be fixed sources (such as machinery and large equipment) and mobile sources (such as the use of trucks and transport vehicles) of noise emission throughout the construction period until its conclusion, including the operational and closing stages of the construction sites, for the recovery of degraded areas.

The target audience comprises the resident population in the vicinity, mainly the Brejo Seco Community, the employees involved in activities related to the mining complex, and the fauna surrounding the project. The target audience also includes the project itself, as well as the environmental agency (SEMAR), which will evaluate the monitoring information.

8.5.4. Planned Actions

The noise measurement procedures must be carried out in accordance with NBR 10.151 / 2000 and CONAMA Resolution No. 01/1990. Daytime and evening noise measurements should be carried out, taking into account the mine's opening hours. Characterization of sources and noise levels, in dB (A), should be carried out in the area of influence of the project, close to existing

settlements. The results must comply with NBR 10.151 / 00, however, the limits for noise pollution in the State of Piauí and in the adjacent municipalities should also be observed, if any.

For vibration monitoring, the recommendations of NBR 9653: 2005 must be observed, which establishes a methodology to reduce the risks inherent to the dismantling of rock with the use of explosives in mining. High technology explosives and accessories should be used and, if possible, perform a vibration modeling of the terrain in such a way that it is possible to predict how the seismic waves propagate in the terrain in the area of influence of the mine, to see if they will affect neighboring communities .

The equipment must have calibration certificates with validity terms in force, issued by INMETRO, or another body that is integrated into the Brazilian Calibration Network and duly accredited by INMETRO. Calibration certificates must be attached to the periodic reports.

In order to minimize noise and vibration levels, in addition to monitoring, the following mitigating measures should be applied throughout the life of the project:

- detonations must be previously communicated and signaled through sound mechanisms (such as sirens) to the closest recipients (PNM itself and adjacent communities). Explosions should only occur at certain times, not occurring outside of these times;
- creating a communication channel with the surrounding communities to systematically check requests and complaints involving issues of vibration and noise (according to the Social Communication Program);
- giving priority to carrying out works during daytime hours. In the case of needing to carry out works at night, the number of machines and equipment used must be reduced, in order to adapt the noise emissions to the standards recommended by the current legislation;
- regular maintenance and adjustment of machinery and equipment;
- carrying out monitoring throughout the period of the work, based on the applicable legislation. The monitoring periods will be detailed in the later licensing phase, in the Basic Environmental Plan.

In addition to complying with regulatory obligations, the Noise and Vibration Monitoring Program was developed following the parameters of good international practices, highlighting the guidelines presented in IFC Performance Standard 3, which deals with Resource Efficiency and Pollution Prevention in conjunction with Performance Standard 1, which addresses the Assessment and Management of Socioenvironmental Risks and Impacts.

8.5.5. Expected Results

Through the execution of the program, it is expected to verify the efficiency of the control equipment used and mitigating measures applied, aiming at maintaining noise and vibration at levels that do not affect the health of the local population and fauna. If the result of the monitoring shows that the applied actions are not being effective, the present program should propose new recommendations so that the legal requirements are duly met.

8.5.6. Schedule

Sampling campaigns should start in the implementation phase, lasting during the operations and closure of the Piauí Nickel Project.

Guidelines/Actions	Phases of the Project		
	Planning	Construction	Operation
Noise and Vibration Monitoring Program		■	■

8.6. Effluent Monitoring Program

8.6.1. Justification

In the stages involving construction works, operation and closure of the project, effluents will originate at the construction site (initially in the Brejo Seco and Umbuzeiro regions), in the equipment repair and maintenance workshops and in the fuel supply locations. Such effluents are rich in oils, surfactants and solids, in addition to hydrocarbons.

During the operation of the mineral-industrial complex, the industrial liquid effluents will be mainly those resulting from the manufacture of sulfuric acid and from the precipitation of nickel. Although the operation of the project foresees the total recirculation of effluents in a closed circuit system so that no discharges occur in the environment, there is the possibility of some trace of sulfuric acid reaching the rain drainage during periods of rain and, consequently, reaching the streams of water, especially the Várzea stream and its tributaries.

There will also be liquid effluents triggered by rain, and generated throughout the abovementioned three stages, essentially composed of water and sediments from the disintegration of soils, where there is an impact of rain on unprotected surfaces such as roads, accesses, embankments and other areas without vegetation cover, causing the movement of sediment via surface runoff to the bottom of valleys where the water bodies are located.

In view of this, the present Liquid Effluent Management Program is justified by the need to monitor possible changes in the quality of the effluents generated by the project.

8.6.2. Objectives

The program aims to present guidelines for monitoring the effluents generated by the project and to ensure the treatment of liquid effluents generated during the project's construction, operation and closure, and to evaluate the efficiency of the proposed treatment systems and ensuring compliance with legislation and regulations relating to environmental quality.

8.6.3. Target Audience and Scope

The liquid effluent management program covers all of the project's generating sources and respective control systems, whether in the construction, operation or closure phases.

The target audience of this program is composed of the project itself, the environmental agency (SEMAR), the workers and those involved with the works, operations and closure.

8.6.4. Planned Actions

The Effluent Monitoring Program is in accordance with the guidelines presented in IFC Performance Standard 3, which deals with Resource Efficiency and Pollution Prevention, as

well as Performance Standard 1, which addresses Risk Assessment and Management and Socioenvironmental Impacts.

The actions are listed below and should be constantly carried out and reinforced whenever necssary:

- during the construction, operational and closing phases, analytical monitoring in all relevant structures related to the collection, treatment, transport and final disposal of liquid effluents, based on the relevant standards and recommendations of NBR 9897/87 and CONAMA Resolution 430 / 11;
- samples of the effluents must be sent for analysis in laboratories with the respective chain of custody, thus ensuring the reliability of the reports delivered by the contracted laboratory;
- the collected data as well as the analysis and results must be compiled in spreadsheets containing the identification of the sample points by geographic coordinates;
- records of the monitoring carried out must be kept for later presentation to the environmental agency, together with the regular reports;
- avoiding undue dumping of liquid products, especially those that may compromise the physical-chemical characteristics of the effluent entering the system and the consequent loss of treatment efficiency;
- performing visual inspections periodically to identify potential points that may develop clogging and leakage, aiming at preventive maintenance and corrective actions;
- establishing an inspection routine in the operating rain drainage system during construction and operation, checking all pumping points, passing on to the perons responsible information regarding the need for corrective maintenance and / or clearance, if pertinent;
- intensifying the cleaning and inspections of the rainwater collection network during periods of greater rain intensity, due to the likelihood of carrying solids and generating potential accumulation points throughout the system;
- the carrying out of corrective maintenance when pipes break and / or water leaks due to some physical impact;
- maintaining the record of the due preventive / corrective maintenance of the treatment systems;
- the design of septic tank / anaerobic filter systems must be in accordance with NBR 7.229 / 1993 and NBR 13,969 / 1997; and
- the collection, at the intervals determined by the respective sizing, of the sanitary sludge accumulated in the anaerobic treatment systems, and of the effluents from the kitchen temporarily stored in a retaining box, and the water and oil separation box installed in the workshop.

8.6.5. Expected Results

Establish adequate standards, respecting the current environmental norms, during the construction and operation of the mining complex, regarding the issues related to the management and control of the effluents generated in the project's facilities.

8.6.6. Schedule

This program must be executed during the entire construction, operations and closure of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Effluent Monitoring Program		■	■	■

8.7. Surface Water Quality Monitoring Program

8.7.1. Justification

As the results of the water quality and aquatic biota campaign carried out in February, March and May 2008 attest, in the context of environmental studies, the waters included in the Piauí Nickel Project's area of influence already signal ecological and sanitary changes given the accumulation of organic matter, originating from the presence of domestic animals that use water courses for watering, which may eventually be exacerbated with the implementation of the future project, due, in particular, to the exposure of the soil, as well as the triggering of erosive processes and consequent silting up of water courses.

According to the assessment of environmental impacts, some associated activities, such as vegetation removal, earthworks and soil unblocking, may cause, directly or indirectly, the generation of sediments, effluents and solid waste, which may reach the water courses, resulting in changes in the quality of surface water, especially in relation to solids, color, turbidity and oils and greases.

In this sense, the Surface Water Quality Monitoring Program, described in the subsequent items, is justified given the need to monitor the evolution of water quality during the construction, operational and closure phases of the project.

However, the fact that all water courses directly affected by the project are temporary, remaining dry for a good part of the year (with the exception of the Jenipapo dam), so that the monitoring has to be proposed differently from the usual pattern.

The issue of aquatic biota, for example, loses its function of being a good bioindicator since it disappears during the dry season. At that time, the bed of the water courses starts to be exposed to all kinds of alterations, including the use as a planting area by the local population and as a pasture area for the various herds of domestic animals raised extensively in the region.

Due to this in the first rain (which can correspond to all rains of a given year), the water quality in the beds of local rivers and streams is significantly altered as shown in the diagnosis, departing from the standards of good quality set out in the current reference legislation.

Accordingly, it is understood that the establishment of monitoring points directly in the water courses of the ADI as the only monitoring measure is not a very efficient way of evaluating possible interference by the project on the quality of the local surface waters. In this sense, it is recommended that the focus be given to the monitoring of rainwater drainage systems or to the

exit points of water holding and containment structures (containment dikes, rainwater pass boxes), in the area of the Brejo Seco mining complexes and Umbuzeiro before they connect with the natural drainage network.

The water intake at the Jenipapo dam should be monitored for the quality of the resource routinely added in order to ensure the efficiency of the treatments necessary to make it suitable for the intended use.

It is worth mentioning that the linear works projects linked to the project (such as highways, pipelines and transmission lines) should not cause changes in water quality as long as the erosive processes are contained and not active along their routes.

8.7.2. Objectives

Monitor and detect any interference in water resulting from anthropic actions caused by the activities of in the Piauí Nickel Project and provide subsidies for the identification of environmental problems that require mitigating actions or the development of specific detailed studies.

8.7.3. Target Audience and Scope

The target audience mainly comprises the users of water resources in the Piauí River sub-basin, as well as the project, the contractors hired to carry out the works and environmental agencies.

8.7.4. Planned Actions

The Surface Water Quality Monitoring Program was developed based on the information presented in the Environmental and Social Diagnosis and in the Project Description chapters.

The design of the sampling network for the Surface Water Quality Monitoring Program should focus on the drainage and water containment systems of the mining complexes as already stated above. Additionally, one can consider strategic sampling points in the watersheds of the Várzea stream, the São Domingos stream, the Gameleiras stream and the Itaquatiara stream, in addition to the Piauí river, near the Jenipapo dam bus. Thus, it is expected that the sampling network represents well the area influenced by the construction, operation and closure of the project, mainly at the Brejo Seco Mine and the Umbuzeiro Mine.

It should be noted that, when possible, the locations of the points sampled in the campaigns carried out in 2008 can be used in order to have relevant background data.

Regarding the parameters, those associated with the project's construction and operational activities, including physical-chemical and occasionally bacteriological analyzes (if deemed necessary) should be analyzed, in particular parameters that can identify any contamination by sulfuric acid, one of the main inputs of the process.

The project must also maintain measuring equipment to monitor the flow captured at the Jenipapo dam, always seeking efficiency in the use of water.

The parameters, when possible, will be compared to the limits established by CONAMA Resolution No. 357/05 for class 2 waters.

Based on the results obtained after the second year of implementation of this program, a reassessment of the monitoring variables defined for the evaluation of water quality should be made, allowing for any adjustments to the monitoring program. The same can be done in relation to the sampling points and monitoring frequency.

Monitoring and evaluation will be carried out by issuing consolidated technical reports for presentation to SEMAR. In these reports, values that are in disagreement with current legal standards will be highlighted, allowing significant changes in water quality to be identified, composing an environmental indicator.

The results should be interpreted aiming, whenever possible, to indicate if a possible increase in the results of any parameter may be related to the works / operation of the project or if it is due to the other contributions of the basin. In this sense, the field assessment in area around the sampling site will be very important.

As the region where the project will be implemented has public supply problems, it is recommended that the developer develop a study of alternative water collection for the project's operational stage, in order to ensure the continued operation of the Piauí Nickel Project in case of a suspension of the water abstraction right at Jenipapo dam. It is known that, according to Federal Law No. 9433/97, there is a possibility of suspending the right in situations of calamity, such as severe droughts or the need for water to meet public demand for which there is no available, alternative sources.

All actions described here are in accordance with the Performance Standards on Socio-Environmental Sustainability (IFC), ensuring compliance, in particular, with “Performance Standard 6: Conservation of Biodiversity and Sustainable Management of Living Natural Resources”.

8.7.5. Expected Results

The program should ensure that the surface water that passes through the area of the project maintains the minimum standards established by the legislation in force before its release into the natural drainage network. In addition, the program may have control points located in the project's ADI in order to prove the efficiency of the control systems adopted by the project so as not to interfere with the quality of the water resource.

8.7.6. Schedule

This program should be started before construction and continue throughout the project's operation. In the construction, operational and closure stages, the need to continue monitoring after the second year of its initiation should be assessed.

Due to the typical seasonality of the region and the intermittent nature of most drainages, sampling should be carried out only in the rainy season, with the exception of perennial water bodies, where sampling should be done every six months.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Surface Water Quality Monitoring Program		■	■	■

8.8. Groundwater Monitoring Program

8.8.1. Justification

The activities of vegetation removal, remodeling of the land and excavations for the activities and construction of support and operational structures carried out during the construction, can cause a change in the quality of the soil and groundwater. This is because the performance of such activities will require intense circulation of vehicles (light and heavy), machines and equipment powered by combustion engines, increasing the soil and groundwater already exposed by the work, to the potential presence of chemical compounds.

During the operation, the exploitation and lowering of the water table, for example, can lead to a lower availability of water resources in the vicinity of the project, since the activities related to the works themselves and also the improvement of the ROM and deposition of dry waste, may change the quality of groundwater. It is important to highlight the possibility of the need to lower the water table in the limestone mine, located in the Umbuzeiro region.

In addition, contamination of soil and groundwater may also be caused by sanitary / domestic and oily effluents, and solid waste generated at construction sites and structures during the construction and operation of the mineral-industrial complex. It is important to highlight that the engineering of this project comprises specific control systems for the management and control of the aspects mentioned.

It is important to note that the vulnerability of the aquifer, as described in the diagnosis, for the nickel pit area and industrial sector, is low, however, due to the karst environment in the limestone pit, the scenario is different, being a place with high vulnerability to contamination.

Thus, it is important to have a continuous monitoring of local aquifers, both in matters related to hydrodynamics, and in matters concerning the deterioration of the water resource due to the presence of contaminants, as well as the interrelation between the lowering of the water table and the dynamics of the systems, being local aquifers and groundwater resources.

8.8.2. Objectives

This program aims to monitor the quality of groundwater, as well as the hydrodynamics of the aquifers and the interrelationship between the lowering of the water table and the dynamics of the aquifer systems with the surface water resources. In addition, the present program aims to support the adoption of mitigating actions and operational restrictions when pertinent.

8.8.3. Target Audience and Scope

The target audience of this program is made up of the project itself, the environmental agency (SEMAR), workers and people involved with the works and environmental issues, and inhabitants of the surrounding area / users of underground and surface water resources.

8.8.4. Planned Actions

The Groundwater Monitoring Program of the mining-industrial complex, in the construction, operation and Closure phases, was designed to maintain compliance with IFC Performance Standard 3, which deals with Resource Efficiency and Pollution Prevention, together with Performance Standard 1, which addresses the Assessment and Management of Social and Environmental Risks and Impacts. Thus, the activities set out below are highlighted:

- for the control and maintenance of groundwater quality, the most important thing is to avoid or minimize contamination of the aquifer. The preventive, control and recovery measures proposed for the project are presented in the Solid Waste Management Program; Effluent Monitoring Program; and in the Degraded Areas Recovery Program;
- implementation of a network of monitoring wells and complete and systematic physical-chemical analyzes regarding the quality of groundwater in the light of CONAMA Resolution No. 396/2008 and standards relevant to the implementation of wells and sampling; and
- periodic sampling of the tailings, in accordance with Standard NBR 10.004 / 04, as well as continuous inspections in the drain cores to be installed in the various structures provided for in the project (aiming to ensure no leaks of potential contaminants).

If the groundwater is intercepted and there is need to lower the water table level, this program should also contain:

- monitoring and integrated management of water resources (surface and underground) through continuous monitoring, geological and hydrological studies, as well as detailing the relationship between the lowering of the water table and aspects of groundwater dynamics with the dynamics of surface waters. Therefore, this action must include:
    - basic studies and elaboration of a geological and hydrogeological model;
    - the definition and implementation of structures and equipment necessary for monitoring groundwater quality, water level, climatological, fluviometric, as well as all instruments relevant to the registration of pumping rates and others;
    - an inventory of water points;
    - undertaking a drawdown project, carrying out pumping tests and calculating and monitoring the water table level lowering cone;
    - monitoring actions: groundwater quality, pumping rates, water level and groundwater dynamics, hydrological parameters of springs and water and climatological bodies;
    - issuing technical reports consolidating the data obtained and indicating any necessary adjustments for the continuity of the program, as well as mitigating measures and operational restrictions when applicable;
    - these reports should detail the dynamics of groundwater and surface water in order to assess the reduction of groundwater resource and respective impacts

including the interplay between pumping / lowering of the N.A. of aquifers and the dynamics of surface water (springs and drainages).

8.8.5. Expected Results

Monitor any changes in the quality and dynamics of groundwater affected by the project, as well as the adoption of corrective measures relevant to non-conformities, including operational restrictions.

8.8.6. Schedule

This Program must be executed during the entire construction phase and also during the operation phase.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Groundwater Monitoring Program		■	■	■*

** In the event of a change in the quality or dynamics of the water table, this program should extend not only in the Closure stage, but after that stage, also.*

8.9. Flora Supression and Rescue Control Program

8.9.1. Justification

Vegetation removal, although it can be considered a harmful action to the environment, is essential to the installation and operation of the project.

To avoid the elimination of unnecessary areas, this program is justified by the premise of adopting guidelines regarding the process of removing vegetation for the implementation of the Piauí Nickel Project.

The present program is directly aimed at reducing the losses of existing plant populations in the Directly Affected Area, as well as the eventual rescue of propagules of the selected species that corresponded in principle to those considered rare and threatened with extinction.

8.9.2. Objectives

- ensuring the controlled removal of the vegetation cover, only to the strictly necessary extent, minimizing the harmful effects to the local biota;
- guiding the vegetation removal, aiming for the least impact on the remaining flora, promoting, whenever possible, the collection of plant material of species for use in the restoration of areas to be recovered, contributing to the conservation of these species;
- guiding and improving the economic use of woody material from plant removal.
- assisting in the conservation of threatened species that may exist in the area to be suppressed, with emphasis on the species ipê-cascudo (Handroanthus spongiosus).

8.9.3. Target Audience and Scope

The Flora Removal and Rescue Control Program aims to provide information to the Environmental Agency responsible for the licensing process (SEMAR), to the company responsible for the undertaking and implementation of the program (Piauí Nickel Metais S / A), to the company contracted to execute the program, the scientific community (researchers) and to the institutions responsible for receiving samples that may be collected (eg herbariums).

This program should be implemented in the Directly Affected Area (DAA), specifically where there is vegetation removal, including construction sites, support areas, cut/fill areas, areas for depositing surplus material, access and service routes.

8.9.4. Planned Actions

- Demarcating and monitoring work in the areas of removal to avoid affecting areas outside what is necessary, especially in areas of permanent conservation;
- whenever possible, collecting seeds from specimens of the species ipê-cascudo (*Handroanthus spongiosus*) before removal;
- training the team responsible for removal in order to ensure that the trees are cut in such a way that the felling occurs inside the deforestation area.
- monitoring deforestation areas for the delimbing of vegetation and cutting to sizes that can be used as firewood;
- monitoring the correct storage of the woody material within the domain range so that it can dry out, if necessary, facilitating its removal and final destination;
- guiding the contractor to perform the excavation with a bulldozer and to remove the material to the areas of designated for excess material;
- guiding the team and monitoring the areas with regard to the removal of litter, the remains of stripped vegetation (branches and leaves), as well as from the surface horizon of the soil (horizon A) to the sides of the affected area, where it will be stored for a short period of time, to be used in the recovery of degraded areas.
- in addition, the program will be able to identify specimens of species of interest in the area to be affected, for collecting seeds to be used in the production of seedlings. These seedlings should preferably belong to species threatened with extinction, with medicinal and / or food value, species of ornamental and fruit value and of wood value.

The planned actions must be implemented only after obtaining the Vegetation Removal Authorization from the responsible environmental agency - SEMAR / PI, before the works, remaining until the completion of all necessary vegetation removal, aiming at meeting the conditions of the aforementioned authorization.

It is noteworthy that the actions proposed in this Program are in line with international good practices whose objectives are in line with IFC's “Performance Standard 6: Conservation of Biodiversity and Sustainable Management of Living Natural Resources”.

8.9.5. Expected Results

Restrict the loss of habitats and specimens of threatened native flora to what is strictly necessary for engineering projects, ensuring the recovery of plant material from threatened

species and seeking to preserve the genetic variability present in its population in the region of the project.

8.9.6. Schedule

This Program must be executed during the construction stage, particularly during the process of vegetation removal.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Flora Removal and Rescue Control Program		■		

8.10. Fauna Chase Away and Management Program

8.10.1. Justification

With the implementation of the various components of the project, there will be a need to remove the vegetation cover that comprises areas of remnants of different physiognomies of Caatinga in different states of conservation.

This vegetation clearance process will reduce areas occupied by several species of native fauna, in addition to interfering with shelters in rocky outcrops. Aiming to minimize the impacts on wild fauna due to the clearance of habitats and pedestrian accidents during the construction and operation of the project, this program aims to take measures to chase away the species present in the areas, as well as to rescue and move the specimens of reduced locomotion, and monitor pedestrian accidents in order to reduce them.

8.10.2. Objectives

- Minimizing the direct impacts on fauna during vegetation clearance;
- scientific use of biological material (animals that may eventually die or be irreparably injured during the clearance activity);
- monitoring the running over of fauna in order to take measures to reduce the occurrences during construction, operation and closure of the project.

8.10.3. Target Audience and Scope

The Fauna Chase Away and Rescue Program aims to provide information to the Environmental Agency responsible for the licensing process (SEMAR), to the company responsible for the undertaking and implementation of the program (Piauí Nickel Metais S / A), to the company contracted to carry out the program, to the scientific community (researchers) and to institutions responsible for receiving animals that may be sent there or collected (scientific collections, natural history museums, zoos and breeding sites).

This program should be implemented in the directly affected area (DAA), specifically where there is interference such as vegetation clearance, including construction sites, support areas, cut/fill areas and deposits of surplus material.

8.10.4. Planned Actions

- Prior to clearance activities, the teams will carry out active search, removing tree branches that have fallen to the ground, stumps and nests, in order to scare the animals to safe areas, ensuring their survival;
- Scare away fauna at the same time as machinery and equipment used when cutting and removing vegetation;
- Capture, transport and translocate specimens of reduced locomotion, found during the clearance of vegetation, with subsequent sorting and release in previously chosen areas;
- Proceed to the scientific use, forwarding the specimens that may eventually die or be irreparably injured during the clearance activity, to the institutions;
- Implement a system for monitoring the running over of fauna on the roads used by the project, aiming to map the critical points and take appropriate measures to reduce the occurrences of accidents of this nature (eg intensify training, inspection and control of drivers of vehicles and machines; redesign flows and vehicle schedules; improve road signage etc.).

This program must be started as soon as the Authorization for Rescue and Transport of Biological Material is granted, and must be extended as long as the activities of clearance of vegetation and interference in natural environments last, as well as during the operation and closure of the project.

It should be noted that all the actions described in this program already include the guidelines presented in the “Performance Standard 6: Conservation of Biodiversity and Sustainable Management of Living Natural Resources”, by IFC.

8.10.5. Expected Results

Minimize the loss of animal specimens from being run over during vegetation removal, construction and subsequent operation of the project.

8.10.6. Schedule

This Program must be executed during the construction stage, specifically during the vegetation removal process, and during the operation of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Fauna and Fauna Management Program		■	■	■

8.11. Degraded Areas Recovery Program

8.11.1. Justification

The activities related to the construction, operation and closure of the Piauí Niquel Metais mining complex, imply changes in the natural terrain, with the exploration of rock material, cuts and earthworks, and consequent exposure of the soil to the processes of surface dynamics. All of these activities promote the emergence of potential areas of environmental degradation, which must be properly recovered.

During the carrying out of the work, points of degradation caused by erosive processes that require short-term corrective actions may appear. This program provides guidelines for the actions necessary to comply with environmental procedures for controlling degradation processes. The integration of this Program with the Prevention and Control of Surface Dynamics and Silting of Water Bodies Program is important, as both are complementary.

8.11.2. Objectives

This program aims to establish guidelines for the recovery of altered areas in order to reestablish physical stability, as well as the readjustment and / or improvement of landscape and environmental conditions, restoring, when necessary, the economic use of the affected area.

8.11.3. Target Audience and Scope

The program proposed here is related to the project's Directly Affected Area (DAA).

The target audience comprises the project, contractors responsible for the works and closure of the project, in addition to the environmental team (s) that will be (s) facing the program in its execution and management.

8.11.4. Planned Actions

The measures defined in the Degraded Areas Recovery Program are in accordance with the guidelines presented in IFC Performance Standard 3, which deals with Resource Efficiency and Pollution Prevention, as well as Performance Standard 1, which addresses the Assessment and Management of Socio-Environmental Risks and Impacts.

The definition of the measure to be used, its type and dimension, will depend on the specific characteristics of each location and type of intervention. Thus, as suggested in SEMAR Technical Opinion No. 7,975 / 16, the methodologies and techniques for repairing degraded environments will be based on studies and surveys, bibliographic and field reviews.

The determination of the necessary actions to be carried out in any program / project for the recovery of degraded areas is initially made based on the definition of the future use of the target areas, which can be done at the end of the construction phase and start of operation of the project or at the end of the use of the area. It is worth mentioning that the definition of future use depends on the will / interest of the owner of the area at the time of the intervention, in addition to the soil and biological characteristics of the land.

Each type of future use, whether it will be linked to economic activities or the restoration of natural ecosystems, requires the adoption of a differentiated set of measures primarily related to the physical environment and the biotic environment.

The measures aimed at the physical environment are primarily aimed at stopping the erosive processes installed, reconforming the land according to its future purpose, the stabilization of altered areas, the control and reorganization of the drainage flows of rainwater and protection of the uncovered soil areas, among others.

The construction of vegetation cover normally corresponds to the final phase of any project to recover degraded areas. This vegetation cover can vary from the use of rustic fast-growing herbaceous species (native or exotic) whose function is to cover the soil in the shortest possible time until the introduction of tree-shrub species seedlings aiming at the restoration of the region's native vegetation.

At this point, it is worth noting that the caatinga biome, mainly due to the severe restrictions on water availability during much of the year, imposes serious challenges for the choice of techniques and species adapted to the region and that are able to establish themselves in the precarious conditions of the relevant area.

The limited literature available on the subject of recovery of degraded areas in the caatinga biome works only with the solution for planting tree species to restore the ecosystem. To be successful in this endeavor, some points must be observed as:

- correct soil preparation that requires physical analysis of water percolation and chemical rates to determine fertility, which in turn leads to the correct liming and fertilization recommendation;
- correct season for revegetation actions, indicating the period immediately after the beginning of the rains for maximum use of the resource;
- correct choice of plant species to be used, with preference for those native to the target region that have rapid growth;
- isolation of the area under recovery from access by domestic animals that can decimate large areas in a short time if access is free.

Examples of restoration work on degraded areas in the caatinga biome can be obtained in the works of Resende & Chaer (2010), Figueiredo (2010), Araújo Filho (2007), Vieira (2012), Gonçalves et al. (2012), Figueiredo et al. (2012), Freitas (2010) and Soliveres (2010), among others.

However, the definition of the techniques to be effectively adopted for the areas to be recovered in the Piauí Nickel project must be detailed in the PBA (in the next licensing stage) where the present program should acquire a more executive character.

In addition, the following guidelines are put forward:

- to promote the reuse of the “top-soil” as far as possible;
- to promote the use of material from seeds, to be carried out during the activities proposed in the Flora Removal and Rescue Control Program;

- to register the limits of the target areas to be recovered and / or monitored (including drainage structures and others);
- to define the future use of each target area considering the legal requirements, the purpose of the area, the interest of the land owner, the objectives of the recovery, the defined schedule and the available resources;
- monitoring actions must include all types of target areas defined under this program, and in general, the actions must raise the general conditions of each of the areas, check if the recovery of the areas is in line with the projects executives, as well as gather specific information to be used in subsequent actions, whether maintenance and / or corrective actions; and
- the issuance of monitoring and status reports for the target areas, indicating non-conformities, criticisms thereof, as well as the necessary actions to remedy any non-conformities. The reports should be sent to those responsible for the recovery of the areas so that the parties can initiate the necessary actions.

8.11.5. Expected Results

With the result, it is expected that all degraded areas during the life cycle of the project will be stabilized, with activities to restore their functions (new or prior to the intervention), recovery and restoration, considering their different degrees of degradation environmental, prioritizing those most critical in terms of operational safety and those aimed at maintaining the environmental quality of the region where the project is located.

8.11.6. Schedule

This program should start, still, during the construction phase and end completely only after the closure and conclusion of the recovery of all areas of the mining complex (there may be gaps in the program during the operation).

Program	Program Execution			
	Planning	Construction	Operation	Closure
Degraded Areas Recovery Program		■	■	■

8.12. APP Intervention Compensation Program

8.12.1. Justification

The program was designed to meet a legal requirement determined by CONAMA Resolution 369/06.

According to the preliminary project, the implementation of the project will be carried out mainly on areas currently covered by native vegetation formations of various categories belonging to the caatinga biome (about 1,121.33 ha or 96.32% of the DAA). In addition to the areas with native vegetation, the project provides for the interception of 132.18 ha of areas considered to be of permanent preservation (about 11.35% of the DAA), with 98.6% of the APP area being covered by caatinga in different stages, regeneration / conservation stages.

According to paragraph 2 of article 5 of CONAMA Resolution 369/06, interventions in APP must be compensated, and the compensatory measures consist of the effective recovery or recomposition of APP without specification of the methodology to be used and must occur in the same hydrographic sub-basin, preferably in the area of influence of the project and at the head of the rivers.

In the present case, the PNM project has a particularity in relation to the APP's intercepted by the project (DAA). Of the entire DAA APP area, adding all the structures and works of the project (totaling 132.18ha), about 105.36ha (= 79.71%) are determined as hilltop APPs corresponding essentially to the nickel deposit to be explored.

APPs linked to water bodies correspond to only 26.05 ha, equivalent to 2.28% of the entire DAA covered by native formations. This demonstrates that the availability of land located in the marginal bands of watercourses in the region is naturally low and this fact was considered in the elaboration of this program.

In this sense, it is worth mentioning that the restoration of an area equivalent to the APP's affected by the project is not obliged to be done exclusively through planting seedlings in order to restore the local caatinga. In detailing the program to be presented at the PBA, other techniques for recovering the original vegetation cover should also be considered. As an example, the practice of isolating an area close to a fragment can be cited so that, free from predation and degradation caused by domestic fauna, the area recovers naturally, either from the supply of propagules from neighboring vegetation or through regrowth of plants of the remaining species.

Planting in islands of diversity, use of artificial perches, use of vegetative structures, debris from clearances and the topsoil from deforested areas, should also be considered when choosing the appropriate vegetation recovery technique.

Another possibility regarding the subject of restoration of APP's for which the analysis of SEMAR's technical staff is requested concerns the eventual acquisition of preserved APP area with high biological importance and for the conservation of water resources, as a way to compensate for the intervention in APP's of the project, especially the APP of the nickel hill area that will lose its relief characteristics (hill top) at the end of the mineral exploration.

This request is justified due to the reduced amount (size) of degraded APP areas for restoration throughout the project's ADI, while the existing ones are in third-party areas where the guarantee of long-term preservation becomes fragile, especially considering the recurrent use of these areas for subsistence agricultural production by the local population. This exchange of areas has the advantage of ensuring the conservation of areas of greater environmental relevance, making it more efficient for maintaining the region's biological diversity and with better results for the conservation of the basin's water resources.

It is noteworthy that the areas covered by caatinga outside APP do not have legal protection and planned compensation mechanisms, and therefore will not be the target of this program.

8.12.2. Objectives

Among the objectives of this program we can highlight:

- the indication of possible techniques for the restoration of APP's in the caatinga biome;
- the current guidelines for choosing target areas for compensatory restoration;
- ensuring the success of works to recover or preserve vegetation cover in the chosen areas;
- improving the connection of fragments of native vegetation remaining in the project's ADI.

8.12.3. Target Audience and Scope

As the target audience of this program, the Environmental Agency responsible for the licensing process (SEMAR), the company responsible for the undertaking and implementation of the program (Piauí Niquel Metais), the company contracted to carry out the program, the scientific community can be mentioned (researchers) and institutions responsible for receiving samples that may be collected (eg herbariums).

This program may be implemented in the Directly Affected Area (DAA), specifically where there is vegetation clearance, including construction sites, support areas, cut/fill areas, areas for depositing surplus material, access and service routes.

8.12.4. Planned Actions

- Choice of target areas preferably also in APP and in the same hydrographic basin as the project;
- in the case of planting seedlings, it is recommended to collect soil for fertility analysis and liming and fertilization prescription to improve the development of seedlings to be planted;
- elaboration of the restoration project in an executive character, indicating all stages of the process from the preparation of the area to maintenance activities, including Schedule;
- in the case of planting, indicate the species to be used contemplating the use of endangered, rare, endemic species and also those with economic uses (wood and non-wood products) and ornamental.

8.12.5. Expected Results

Recover or ensure the preservation of part of the ADI’s vegetation cover in order to compensate for interventions carried out in APPs and improve the connection between the remaining fragments, preserving part of the diversity of species and their genetics in the region, in addition to providing a greater supply of diverse habitat and resources for local fauna.

8.12.6. Schedule

This Program should preferably be carried out during the construction stage, specifically after the process of vegetation removal. However, the program can also be applied during the operational phase as the process of defining the target areas is usually time-consuming due to bureaucratic, operational and other reasons.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Compensation Program for Intervention in APPs		■	■	

8.13. Social Communication Program - PCS

8.13.1. Justification

The Piauí Nickel Project's Social Communication Program (PCS) is part of the set of Environmental and Social Programs designed within the scope of ESIA/RIMA with a view to the environmental licensing of this project. It is based on some basic assumptions:

- communication is essential to clarify and raise awareness among the population and other interested parties regarding the Piauí Nickel Project;
- communication is essential for the population and other interested parties to understand the project and the changes that its arrival will cause in the daily life of the region;
- communication supports dialogue, by bringing relevant and transparent information to the community that will be impacted by the project;
- communication should serve the impacted communities and society in general, to take into account their wishes and proposals with the project, with regard to the impacts generated by the project;
- communication is the best tool for establishing an approximate interface between the company and the local community to take advantage of growth and development opportunities, both for individual and community presented by the project.

Thus, the present program is justified as a necessary measure to ensure communication channels between the project and the different actors involved in the stages of planning, construction, operation and closure of the Piauí Nickel Project. Still, it presents itself as an essential way to control the impacts related to the generation of expectations in the population, which can already be seen in the Surrounding Communities and in the project's ADI, as shown in the environmental perception survey and highlighted in the impact assessment.

In this way, the actions to be implemented, to transmit security to the community involved, must be constant and occur not only to comply with requirements for the environmental licensing of the project in question. They should also, fundamentally, seek dialogue with interested parties.

The basic actions are focused on the definition of the public and the means so that the communication between the project and the interested parties is established in a harmonious way. It is through this Program that information about the nature, strategic importance, implementation of the project, activities related to its operation and closure and its socio-environmental implications will be shared.

In general, these actions will allow the management of possible conflicts generated by the project throughout its useful life and the exercise of citizenship, since the dissemination of

information and the opening of communication channels to listen to the population, allow a coherent analysis on the positive and negative impacts and what attitudes are to be taken by the population and the project.

Thus, the PCS is one of the instruments that will act in the environmental management of the Piauí Nickel Project, in the interaction between the actions provided for in all programs, as well as in maintaining a flow of communication with society, in order to identify the population's wishes in all segments affected by the project, giving adequate feedback to doubts, suggestions or complaints and promoting the leveling of information about the project.

8.13.2. Objectives

The general objective of this Program is to establish communication channels between the project and the different parties and the various segments involved, informing the target audience about the planning, implementation, operation and closure of the Piauí Nickel Project, its impacts and the respective measures of control and [making themselves available] for an ongoing dialogue. Thus, the PCS is characterized by its preventive nature, meaning the establishment of channels for presenting and exchanging information, encouraging the participation of the various parts of society.

8.13.3. Target Audience and Scope

The Social Communication Program should operate essentially in the ADI municipalities of the project, Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, with some actions that may extend to other municipalities in the region, especially those related to the Workforce Management Program. The PCS will act on several fronts associated with the different interest groups active in the area of influence, thus segmented:

- Internal Public - formed of the workers of the project;
- External Public - understood to be public institutions or civil society, residents who live in the Area of Direct Influence of the project, in particular, the residents of the surrounding communities affected by the project.

8.13.4. Planned Actions

The approach proposed here is centered on the recognition of cultural diversity and plurality, seeking to contextualize all the actions and activities planned. It is important to highlight that the recognition of plurality and cultural diversity are conditions for the exercise of citizenship and for social participation, as, to the extent that social groups build and update their references and their conditions of survival on a daily basis, define their identities or set of social references.

The actions proposed in this PCS are in line with international good practices, such as, for example, meeting the objectives[4] of IFC's “Performance Standard 1: Assessment and Management of Risks and Social and Environmental Impacts”.

[4] Above all: ensure that Affected Communities' complaints and external communications from other stakeholders are responded to and managed appropriately, and; promote and provide means of appropriate engagement with Affected Communities throughout

In this way, forms of communication / dialogue inherent to the planning, implementation, operation and closure processes will be built, based on:

- establishing a communication channel for continuous dialogue between the project and society, especially with the population directly affected by the project, as well as the surrounding communities, in order to answer their questions and demands through: a 0800 telephone channel , a specific e-mail account for questions, suggestions and complaints, polls and suggestions boxes distributed in strategic locations, and regular visits by the program team to the surrounding communities most impacted;
- disclosing to the ADI population information about the project, the execution schedule, its potential environmental and social impacts and the mitigating measures to be implemented by the project, through the organization of forums and distribution of communication material;
- making contacts aimed at partnerships with City Halls, Government Departments, NGOs, Associations and Institutions operating in the region;
- carrying out campaigns, through effective means of communication at the local level (ADI) and the entities representing the social sectors, the guidelines for hiring local labor and qualifying it, in all stages of the project (planning, implementation and operation) , thus contributing to the generation of jobs and local income;
- providing support to other Environmental and Social Programs for their integration with the workers of the project and the local population;
- carrying out clarification campaigns on specific topics that are raised during the period, such as issues related to the health, education, training of labor, job offerings, works, etc.

The main communication tools to be used are as follows:

- meetings involving local leaders, to present the project to the community;
- printed material: leaflets, booklets, newsletters, newsletters and brochures;
- institutional videos;
- written media: local and regional newspapers that can carry a wide variety and amount of information;
- insertions in local and regional media (radio and television) to disseminate relevant information related to the implementation of the project;
- an information center to provide clarification and disseminate information that meets the expectations of the population;
- provision of 0800 telephone contact, e-mail account and installation of “ballot boxes” in strategic locations, aiming to collect the doubts, suggestions and complaints of the population.

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the life cycle of the project with respect to issues that would have the potential to affect them and ensure that relevant socio-environmental information is disclosed and disseminated.

8.13.5. Expected Results

With the implementation of the Social Communication Program, the creation of communication channels between the project and the various segments of society is expected, informing the target audience about the project, planning, works, operation and closure, its impacts and the measures adopted and making the project available for an ongoing dialogue.

8.13.6. Schedule

The Program must be implemented continuously from the planning phase, including the implementation, operation and decommissioning phase.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Social Communication Program	■	■	■	■

Elaboration: Arcadis, 2017.

8.14. Workforce Management Program

8.14.1. Justification

Considering the great demand for labor to be generated by the Piauí Nickel Project and, above all, the impacts that will be triggered by it, it is necessary to put forward measures aimed at mitigating negative impacts, as well as enhancing the positive impacts of activity of hiring workers.

In this sense, the implementation of a Labor Management Program (PGMO) for the Piauí Nickel Project is justified, setting out the guidelines, activities and procedures that will guide the fulfillment of the demands for manpower necessary for the implementation and operational stages of the project, from the recruitment and selection of personnel, through training until demobilization and re-entry into the labor market.

The main guideline for hiring labor, both for civil works in the construction phase of the project, and for the operation phase, taking into account the qualifications required for the activities to be performed, will be the hiring of the largest possible number of employees from local labor, with at least 60% preferentially coming from the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, depending on the supply of available labor suitable for the jobs at the moment of hiring.

8.14.2. Objectives

The main objectives of this program are: i) to make maximum use of the local supply of workers, especially during the implementation of the project, ii) to seek to increase the professional qualification of contracted workers; iii) to carry out actions aimed at professional training; and iv) to contribute to a improved prospects in the labor market, easing the difficulties inherent in the demobilization process.

8.14.3. Target Audience and Scope

The target audience of this program is made up of the population who are of economically active age living in the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, and the municipalities are also the limit of the area covered by this program.

8.14.4. Planned Actions

The actions of this program are in line with international good practices, above all, in compliance with the guidelines presented in IFC's "Performance Standard 2: Employment and Work Conditions". It should be noted that many of these are legal obligations in Brazil.

Recruitment and selection

The recruitment of the necessary workers during the implementation and operational phases of the project will be carried out in accordance with the recruitment and selection guidelines to be established by the project, which should have as a main objective the absorption of the largest possible contingent of workers from the ADI, with the experience and skills for the vacancies available and, if necessary, of the other municipalities in the region, always taking into account the minimum qualification required for the performance of each function.

To this end, the project must develop a database with the professional profile records of residents of the ADI municipalities who want to register. Thus, partnerships can be made with the public authorities in the municipalities, as well as registration campaigns, especially in the surrounding communities. These activities must be carried out during the planning phase.

The execution of these guidelines will be carried out both by the project (during the operational phase) and by the contracted company (ies) for the execution of the works of the project's implementation phase.

Training of Workers

Once the recruitment, selection and hiring of personnel are completed, the training of the workforce should continue, tailored to the functions that each contracted worker will perform.

The training actions will be the responsibility of each contractor (both of the project and contracted company (ies)), and may be carried out through partnerships with public or private research, teaching, or development institutions, that have the experience and track record in the region.

During the implementation phase, courses and training should be offered, especially for workers used in this phase, in order to make it possible to hire them in the operational phase, mitigating part of the inconveniences caused by the demobilization of labor in this phase. In the final period of the operational phase, courses and training should be offered to workers who will be gradually demobilized, enabling their re-entry into the labor market and the development of alternative income-generating activities.

Demobilization of labor

At the end of the Piauí Nickel Project's implementation and operational phases, the workforce will be demobilized gradually, whether there is a partial or total demobilization. Thus, in both phases, the PGMO should ease the difficulties inherent in the demobilization of workers who will no longer work at the Piauí Nickel Project, helping this group to re-enter the labor market.

Thus, in addition to the courses and training mentioned in the previous item, opportunities for reintegration into the local labor market for demobilized workers should be mapped out and disseminated as part of the Social Communication Program.

8.14.5. Expected Results

It is hoped, with the proposed actions, to take advantage of the local offer of workers, above all, from residents in the municipalities of the ADI, to build up the necessary staff for the implementation and operational phases of the Piauí Nickel Project, as well as improving the opportunity of re-entry into the labor market at the end of both phases, so mitigating the impacts resulting from the demobilization of labor.

8.14.6. Schedule

The actions of the Labor Management Program shall be implemented throughout the life of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Workforce Management Program	■	■	■	■

Prepared: Arcadis, 2017.

8.15. Local Suppliers Development Program

8.15.1. Justification

The introduction of large-scale projects into municipalities with low economic dynamism, as is the case of the Piauí Nickel Project, if harnessing all the productive potential available in the municipalities, is an important way to leverage local socioeconomic development. In this sense, the training of local suppliers is a measure that may cover a significant number of local economic agents, since the undertaking's demand for goods, raw materials, inputs and services will be quite high.

Whereas the undertaking will be planned in a socioeconomic context in which local suppliers have little chance of meeting their demands with the quality, specifications and necessary scale, in view of the low level of economic diversification, the high dependence on the public sector, and the low formality of the local economy, characteristics seen, especially in the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira and Dom Inocêncio (as presented in the Environmental and Social Diagnosis), it will be necessary to develop a Program that enables the training of local suppliers to establish a commercial interface to respond to the demands to be generated by the Piauí Nickel Project.

Thus, this program must assess, in view of the future demand for investments in the Piauí Nickel Project, the potential and needs for the economic development of the region and define actions that enable local and existing companies and projects to structure themselves to be able to compete under equal environmental, technical and economic conditions.

8.15.2. Objectives

The main objective of the program is to support local productive activities so that they can participate in the economic development process established by the implementation of the Piauí Nickel Project in the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, so that they can become direct or indirect suppliers of the project.

8.15.3. Target Audience and Scope

This program is aimed at companies and projects from the cities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, who are interested in becoming potential suppliers of the Piauí Nickel Project and its subcontracted companies.

8.15.4. Planned Actions

In order to achieve these objectives, the following actions should be developed:

- sign partnerships and agreements with research, development and strengthening of productive activities institutions, such as, for example, SENAC, SENAI, SEBRAE, IFPI, FIEPI, and the municipalities of the ADI;
- prepare the registration of companies and businesses in the municipalities of the ADI;
- from the register, diagnose the situation of companies and businesses in the municipalities of the ADI, in order to set up the activities to be developed;
- promote activities and events that aim at regularizing, training and developing local projects / traders, through partnerships established;
- identify, quantify and disseminate the goods and services that will be sourced locally;
- establish and disseminate transparent procedures for selecting local suppliers.

8.15.5. Expected Results

It is expected that in the implementation of the Piauí Nickel Project, the project will be able to use suppliers from the municipalities of the ADI and the AII to provide inputs, even the simplest ones, during the civil construction process of the project, as well as ancillary inputs during the construction and operational phases. Thus, there will be an increase in the regional technical qualification and the level of dynamism of the local economy.

8.15.6. Schedule

The Program must be implemented during the planning, implementation and initial years of operation of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Local Supplier Development Program	■	■	■	

Prepared: Arcadis, 2017.

8.16. Environmental Education Program - PEA

8.16.1. Justification

In view of the inherent socio-environmental change that will occur due to the implementation of the Piauí Nickel Project, it is necessary to put forward measures so that this change can also have positive aspects, in addition to mitigating those that are negative.

In this sense, the Environmental Education Program (PEA) is understood as an instrument for environmental awareness that seeks to change behavior and attitudes towards the environment in which the community works to improve their living conditions.

Thus,

> Environmental Education is understood as the processes by which the individual and the community build social values, knowledge, skills, attitudes and competences aimed at the conservation of the environment, a common good for the people, essential to a healthy quality of life and its sustainability. (Federal Law No. 9,795 / 99 - Art. 1).

As determined by the National Environmental Education Policy (Law 9,795 / 99) and Decree 4,281 / 02 that regulates it, the actions of this program are important instruments for the implementation of any undertakings that, in some way, affect the environment and, consequently, the quality of life of the population.

In this context, environmental education seeks to develop citizens who recognize the close relationship between society and the environment, with an active stance in the search for solutions to current and future problems.

The PEA's principle is to inform and train the target audience as a way to promote the development of knowledge, attitudes and skills necessary to preserve and improve the environmental quality of the region.

As for the legal requirements and determinations that guide and define Environmental Education and its practice in Brazil, the Program complies with Federal Law No. 9,795, of 4/27/99 and Decree No. 4,281 / 2002. Additionally, it is indicated that the present PEA can be prepared in accordance with the guidelines presented in Normative Instruction (IN) 02/2012 of IBAMA, highlighting the emphasis on participatory processes, involving the target audiences from the definition of the themes that will be developed up to the format of the actions that will be proposed.

8.16.2. Objectives

The PEA aims to disseminate knowledge related to the environmental aspects involved in the Piauí Nickel Project and the socioenvironmental aspects of the region where the project is implemented and also:

- mobilize and raise awareness among workers directly and indirectly involved in the different phases of the project, the school community, the communities surrounding the project in relation to environmental issues;
- train multiplier agents capable of disseminating the knowledge, skills and values learned by their peers, enabling the continuous and permanent development of environmental education;
- encourage the practice of responsible attitudes in the company and in the daily lives of workers and contractors, expanding these practices to their families;
- work on issues related to the spread of infectious, parasitic and chronic diseases; and the possibility of increasing social conflicts.

8.16.3. Target Audience and Scope

The Environmental Education Program will cover the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, the ADI of the Piauí Nickel Project.

The target audience for this PEA is composed of:

- Internal public - workers and contractors involved in the different phases of the Piauí Nickel Project;
- External public - social groups in the areas of influence of the project, including the school community in the municipalities of the ADI and the residents of the communities surrounding the project.

8.16.4. Planned Actions

Seeking to follow the premise that the PEA must adhere to the local reality and its target audience, one must consider in the planning of its activities a step of raising the interests, expectations and priorities of its different target audiences, through diagnosing participatory socioenvironmental activities, to defining which themes are to be worked on in environmental education activities and which are the best working methods / application of each activity.

The following are suggestions for topics to be worked on by the public.

Internal public (workers and contractors):

- the environmental licensing process for the project and the presentation of environmental standards that must be followed by workers and contractors;
- the norms / forms of respectful coexistence between “different” people, from different cultures, as well as respect for local traditions and habits;
- the prevention of sexually transmitted diseases (STDs);
- the dissemination of basic concepts and care for the environment (the reduction of and correct disposal of waste, the importance and protection of flora and fauna, etc.);

- combating the sexual exploitation of children and adolescents;
- adequate hygiene and cleaning procedures for the working environment (waste disposal, sanitary treatment, etc.).

External public (school community, surrounding communities):

- the identification of socio-environmental problems faced by the locality and / or municipality and subsequent dissemination of information and training that can assist in overcoming these problems (participatory Environmental and Social Diagnosis);
- the dissemination of basic concepts and care for the environment (reduction of generation and correct disposal of waste, importance and protection of flora and fauna, etc.);
- the prevention of sexually transmitted diseases (STDs);
- campaigns to raise awareness and combat violence and intolerance. Various topics must be addressed, such as: bullying; pedophilia; religious intolerance; violence against women; racism and homophobia.

Partnerships may be established with the public education network and with civil society organizations that operate in the region and that develop works in the area of environmental education.

It is suggested as materials and methods to implement illustrative and interactive lectures, games and dynamics. For the development of the program, some activities and resources necessary for the execution of its activities may be: the preparation and distribution of folders, booklets, the provision of materials such as [panels], power points, etc.

8.16.5. Expected Results

With the implementation of the planned actions, the level of knowledge of the population served by the PEA is expected to increase, enabling a change in behavior and attitude towards the environment, over which the target public defined here has the power to act, aiming at improving their living conditions and environmental quality in the region.

It should be noted that the Program meets the requirements of IFC's “Performance Standard 1: Assessment and Management of Social and Environmental Risks and Impacts”.

8.16.6. Schedule

The actions of the Environmental Education Program must be implemented throughout the life of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Environmental Education Program	■	■	■	■

Prepared: Arcadis, 2017.

8.17. Interference Monitoring and Support to Public Services Program

8.17.1. Justification

Even prioritizing the hiring of local labor for the Piauí Nickel Project, it is considered that a part of the workers, estimated at around 750 workers during the implementation phase, may migrate from other municipalities that do not make up the ADI, depending the stock of qualified labor available at the time of hiring. In addition to the direct workers of the project, it is expected that the increase in the dynamism of the economy of the municipalities of the ADI, Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí, will attract more migrants from other locations to the municipalities of the ADI.

Thus, during the period of construction, the social dynamics of the local community may be temporarily affected, generating some degree of overload in the infrastructure and public services existing in the municipalities of the ADI. Considering health equipment, the possible pressure may be concentrated in the municipality of São João do Piauí; this refers to those services not available in Campo Alegre do Fidalgo and Capitão Gervásio Oliveira.

On the other hand, the introduction of the project in the municipalities of the ADI will generate a large increase in municipal revenues that can be invested in the expansion, adaptation or improvement of infrastructure and public services for the population of the municipalities.

Thus, it is necessary to implement an Environmental Program that presents the activities that can, on the one hand, establish technical parameters to verify the real degree of interference in the infrastructure and public services of housing, health and education, in addition to other services of public character, originated from the influx of people attracted by the works of the Piauí Nickel Project; on the other hand, that can support the municipalities to expand their management capacity in order to improve the quality of services provided, especially in the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio, during the operational phase of the project.

8.17.2. Objective

The main objectives of this program are: (i) to monitor interference with infrastructure and public services in ADI municipalities; (ii) assess, using indicators, the degree of interference detected in the monitoring; (iii) support, if it is in the interest of the public authorities, municipalities by providing training for managers of public services in ADI municipalities.

8.17.3. Target Audience and Scope

The actions of this program include the infrastructures and public services of the municipalities of the ADI that may suffer interference due to the temporary increase of the population during the period of works, resulting from the implementation of the Piauí Nickel Project.

8.17.4. Planned Actions

In order to fulfill the objectives of the Interference Monitoring and Support to Public Services Program, the following activities will be carried out:

- conduct a survey of the existing public services equipment in the municipalities of the ADI, mainly health and education, indicating the situation of demand and the capacity to attend, before and during the construction phase of the project;
- conduct a survey of the empty properties available for rent and the availability of accommodation in the municipalities of the ADI, as a way to subsidize the decision as to whether or not to build accommodation on the construction site (s);
- the systematization of the data obtained in the survey and establishment of monitoring indicators, in line with indexes of reference institutions related to each theme;
- an analysis of monitoring results, indicating, if necessary, preventive and / or corrective actions to optimize and / or adapt equipment and services in view of additional temporary demand;
- maintaining with the PCS an orientation channel on possible indirect impacts of the project, such as, for example, helping possible abuses of tenants, indicating the protection measures that these people can resort to;
- offer municipalities technical training in public management to city hall employees (this activity should be the only one to continue in the operational and decommissioning phases).

8.17.5. Expected Results

Through the actions of the program, it is expected to minimize the eventual overload on infrastructure and public services, resulting from the temporary increase of population in the period of construction, as a result of the undertaking. Still, it is hoped that the improvement of municipal employees can guarantee an improvement in the provision of public services to the population.

8.17.6. Schedule

The Program for Monitoring Interference and Support to Public Services should start before the beginning of the works and extend throughout the life of the project.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Interference Monitoring and Support to Public Services Program	■	■	■	■

Prepared: Arcadis, 2017.

8.18. Land Negotiation Program

8.18.1. Justification

The need for negotiation and acquisition/lease of land by the project is a fact that contributes to mismatched information and the generation of real estate speculation. For this reason, it is essential to establish procedures and competences related to the land negotiation and acquisition process, activities that make it necessary to implement a Land Negotiation Program.

Thus, this Program was conceived with actions related to the registration of the directly affected population and the physical registration, necessary for the negotiation process, and indemnification of the people who will have part of their property affected by the Piauí Nickel Project.

Specifically, in the case of beneficiaries of agrarian reform programs, with part of their parcels affected, the negotiation of the areas to be acquired will be carried out through the intermediation and the consent of the respective agency.

The relationship with those affected will be guided by friendly and participatory negotiation, guaranteeing fair compensation to all, and technical support to families that need relocation.

8.18.2. Objectives

The objective of this Program is to develop appropriate and required actions for the acquisition of the areas necessary for the project, in order to guarantee the maintenance or improvement of the levels of economic activity and the quality of life of families that have their properties impacted by the project.

8.18.3. Target Audience and Scope

The present Program should cover all properties in which the Piauí Nickel Project DAA is present, its target audience being the entire population that has its properties / improvements affected, partially or totally, by the project.

8.18.4. Planned Actions

The guiding guideline of this program is focused on socially and legally fair procedures in which the actions are the result of the processes of negotiation and social interaction with the target audience. In other words, all the planned actions will be planned and executed based on a participatory process that guarantees the interaction of all those involved, considering the legal procedures and criteria.

In addition to complying with legal obligations, the Land Negotiation Program is in line with international good practices, highlighting the guidelines presented in IFC's “Performance Standard 5: Land Acquisition and Involuntary Resettlement”.

The main activities of this program are:

- communication actions, together with the Social Communication Program, that inform the population about the areas to be affected by the project, talking directly with the owners, in order to avoid real estate speculation;
- execution of Socioeconomic Registration for purposes of identification, quantification, qualification and public registration of the affected population;
- preparation of the Physical-Territorial Register of the affected properties, in order to establish the percentage of each property affected;
- the setting out of criteria to guide the evaluation of the affected properties and improvements. The criteria should consider norms and legal provisions, as well as analyzes of the local land market;

- conducting a negotiation meeting (s) between the project and the affected families in order to present the evaluation criteria for the affected lands and improvements, in order to ensure equity between the properties during the evaluations;
- the setting up of appraisal reports for the affected properties / improvements;
- negotiation for land acquisition based on the report of each property, with the objective of amicable negotiation;
- monitoring of the productive capacity of the families affected by the project, whether reallocated or not, in order to ensure that the new property, or the remaining portion, is sufficient to maintain or improve the quality of life they obtained from the property negotiated (this action should extend over a period of 2 years during the operation phase), therefore, owners who are not economically dependent on production from the traded properties should be excluded from this monitoring.

8.18.5. Expected Results

It is hoped that the actions of this Program may prevent the acquisition of land necessary for the Piauí Nickel Project from causing disturbances to the population, such as real estate speculation, and, above all, from decreasing the productive capacity and / or quality of life of families directly affected by the project.

8.18.6. Schedule

Program	Program Execution			
	Planning	Construction	Operation	Closure
Land Negotiation Program	■	■	■	

8.19. Local Communities Self-Sustainable Development Program

8.19.1. Justification

The introduction of the Piauí Nickel Project may contribute to the formation of a cycle of economic growth and to the increase of income levels in the municipalities where it will be located, with the positive effects being able to extend to the regional context. However, it is expected that the growth rates observed in the period of implementation and operation of the project will reduce with its closure.

Thus, it is necessary to implement a Self-Sustainable Development Program for Local Communities, so that a positive legacy of the project can be consolidated in the municipalities of the ADI. To this end, in addition to promoting economic growth with its own dynamics, the Piauí Nickel Project must contribute to the self-sustainable development of the productive activities of the municipalities of the ADI, so that the community can continue to develop after the closure of the project.

8.19.2. Objectives

The main objective of this program is to foster the skills and capacities of the local community, promoting the development of other activities in parallel to the Piauí Nickel Project and independent of it, expanding the local productive dynamics and capacity.

8.19.3. Target Audience and Scope

This program covers the municipalities of the ADI, Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio, and São João do Piauí during the works or operation of the project.

8.19.4. Planned Actions

Considering that the actions of this program should result in improvements in the economies of the municipalities of the ADI, it is understood that this should be implemented in an integrated manner to the different segments of society, so that the proposed actions can be effective with the local development.

Thus, it is understood that this program should be prepared in accordance with the Preliminary Mine Closure Plan and have as its main activities:

- the creation of a working group, composed of representatives of organized civil society, local government, and impacted communities, focusing on proposing and monitoring local development activities;
- the setting up of a diagnostic study of the economic potential of the municipalities of the ADI, which must be done in rural and urban areas;
- the creation of partnerships with institutions, public and / or private, for the development of the program's actions;
- proposals from the pilot project's working group, based on the diagnosis made, which should be for both rural and urban areas;
- monitoring of the developed projects, through indicators, targets, and action plans;
- the offering of courses and training related to the development of activities relating to pilot projects, giving successful activities sufficient scale to develop the local community;
- supporting the implementation of infrastructure that can serve as drivers of productive activities, such as irrigation projects.

It is important to emphasize as a guideline that the activities proposed for the development of local communities must not maintain an economic relationship with the activities of the Piauí Nickel Project, so that they can be self-sustainable even after the project is deactivated.

8.19.5. Expected Results

It is hoped that with the implementation of this program, the benefits generated by the implementation and operation of the undertaking may contribute to the self-sustainable economic development of the ADI municipalities, so that, even after the Piauí Nickel Project is deactivated, there may be social and economic gains for the local population.

8.19.6. Schedule

The Program must be implemented during the operation and decommissioning phases.

Program	Program Execution			
	Planning	Construction	Operation	Closure
Local Communities Self-Sustainable Development Program			■	■

Prepared: Arcadis, 2017.

8.20. Environmental Compensation Program

8.20.1. Justification

The impossibility of full recovery of the affected environmental assets justifies the use of compensatory measures as a form of civil reparation for the damage caused, in line with the polluter pays principle.

Therefore, in view of the legal determination expressed in Federal Law 9,985 / 2000, any project with a significant environmental impact must allocate a sum of financial resources to actions aimed at environmental conservation, the amount of which must be calculated according to the procedure specified in Federal Decree 4,340 / 2002, as amended by Decree 6.848 / 2009.

8.20.2. Objective

The Environmental Compensation Program aims to put forward compensatory proposals for the implementation of the Piauí Nickel Project, with the application of resources in existing conservation units closest to the project.

8.20.3. Target Audience and Scope

The environmental agency (SEMAR-PI), or the Clearing House, which will be responsible for approving the calculation and proposals to be submitted, is considered to be the target audience.

The Compensation Program covers the Conservation Unit that will receive the compensation amount.

8.20.4. Actions

A) Calculation of Compensation

Article 36 of Law No. 9,985, of July 18, 2000, which establishes the National System of Nature Conservation Units - SNUC, determines that in cases of environmental licensing of undertakings with significant environmental impact, as considered by the competent environmental agency, based on an environmental and social impact assessmentand the respective report - ESIA / RIMA, the project is obliged to support the implementation and maintenance of a conservation unit, in accordance with the provisions of this article and the regulation of that Law.

The SNUC is managed by the National Environment Council - CONAMA, with the task of monitoring the implementation of the System; by the Ministry of the Environment, in order to coordinate the System and by IBAMA (Brazilian Institute of the Environment and Renewable Natural Resources) and state and municipal bodies, with the function of implementing it,

subsidizing the creation proposals and managing federal, state and municipal conservation units in their respective spheres of activity.

By art. 31-A of Federal Decree No. 4,340 / 2002, added by Federal Decree No. 6,848 / 09, it is defined that the Value of Environmental Compensation (CA) must be calculated by the product of the Degree of Impact (GI) with the Reference Value (VR)), according to the formula:

- CA = VR x GI

The Reference Value is understood as “the sum of the investments required to implement the project, not including investments related to the plans, projects and programs required in the environmental licensing procedure to mitigate the impacts caused by the project, as well as the charges and costs incurred on the financing of the project, including those related to guarantees, and the costs of personal and real insurance policies and premiums ”.

According to Federal Decree No. 6,848 / 2009, the IG is restricted between the values of 0 to 0.5% and must be calculated by the licensing agency based on the methodology presented in its Annex. The GI is calculated using the formula: GI = ISB + CAP + IUC. The ISB variables (Impact on Biodiversity); CAP (Priority Area Commitment); and IUC (Influence on Conservation Units) are obtained, in turn, as follows:

- ISB = IM x IB (IA+IT)/140;
- CAP = IM x ICAP x IT/70; e
- IUC obtained directly from the assessment of possible impacts on conservation units and/or buffer zones.

Therefore, the GI calculation depends on the evaluation of the following variables:

- IM (Magnitude Index);
- IB (Biodiversity Index);
- IA (Coverage Index);
- IT (Temporality Index);
- ICAP (Priority Area Commitment Index);
- IUC (Influence on Conservation Units).

Finally, taking into account that the investment amount presented in item 2.6 of this ESIA / RIMA is an estimate calculated for the current details of the project (prepared from databases of Brazilian local engineering companies and costs of recent similar projects), the effective calculation of the environmental compensation value of the Piauí Nickel Project should be carried out by the Piauí Environmental Compensation Chamber only in the next stage of environmental licensing (when obtaining the Installation License - LI of the project, as provided for the aforementioned current legislation), when there will be a detailing of the executive engineering projects of the project and the respective values of implementation, more precise and assertive, may be presented.

B) Proposal for the allocation of resources

The resources from the Environmental Compensation must be allocated according to an order of priorities provided for in Federal Decree No. 4,340/2002, article 33.:

I –land tenure regularization and land demarcation;

II – the preparation, review or implementation of a management plan;

III – the acquisition of goods and services necessary for the construction, management, monitoring and protection of the unit, including its buffer area;

IV – the development of studies necessary for the creation of a new conservation unit; and

V – the development of research necessary for the management of the conservation unit and buffer area.

Thus, based on what was expressed in the previous items and the guidelines of this Environmental Compensation Program, it is suggested that, in terms of allocation of resources from the Environmental Compensation (to be calculated in the next stage of the environmental licensing of the Piauí Nickel project , to obtain LI), the values must be applied in the Serra da Capivara National Park, UC closest to the project's areas of influence. It should be noted that it will not be impacted by the implementation, operation or closure of this project as supported by the impact assessment carried out in this ESIA / RIMA.

Finally, it is emphasized that the definition of the application and the destination of the resources coming from the Environmental Compensation of undertakings with significant environmental impact, licensed within the scope of the State of Piauí, will fall to the Environmental Compensation Chamber, instituted by Portaria SEMAR Nº 46 of 05/08 / 2015.

8.21. Preliminary Mine Closure Plan

8.21.1. Justification

This Preliminary Mine Closure Plan for the Piauí Nickel Project has been already prepared according to the guidelines of the Mine Closure Planning Guide (SÁNCHEZ et al. 2013) launched in 2013 by the Brazilian Mining Institute (IBRAM) and currently the biggest reference on the theme in Brazil, although it is not a legal instrument.

As highlighted by the IBRAM guide (SÁNCHEZ et al. 2013), the closing phase of a mining project is nothing more than the moment immediately after the end of the life of a mine that marks the end or closure of the decommissioning activities [(also decommissioning)] of this project. Therefore, it is important to differentiate these two moments in the life of the project. The closure of the mine begins a few years before the end of mineral production in that project. It is the period when the structures are decommissioned, the areas are rehabilitated and all necessary measures are taken to ensure the environmental stability of the area where the project is located.

However, when it comes to Mine Closure, it is very important to note that since the beginning of the project's life, that is, in its planning, one must already think about “how to close the mine”. This procedure is called Mine Closure Planning, a recent practice still being assimilated by the Brazilian mineral sector precisely because of the contemporary character of the theme. Thus, it is extremely important to think about the mining undertaking from beginning to end, anticipating problems, financial expenses with recovery and environmental control measures in such a way

that, at the end of the mine's useful life, it is only concerned with the final aftermath since most of the costs and activities must have been diluted over the course of the project.

A mine closure plan should ensure that public health and safety will not be compromised, that environmental resources will not be subject to physical and chemical deterioration, that future use of the area will be beneficial and sustainable in the long run, that the socio-economic impacts of adverse effects will be minimized and that all socio-economic benefits are maximized.

For this, it is necessary to carry out a program, together with the authorities and the local society, aiming to minimize the impacts of the closure of the mines, such as, for example, the loss or reduction of the supply of services, the increase in the unemployment rate, the reduction of economic activities and the degradation of infrastructure due to lack of maintenance, in addition to environmental degradation.

Due to the long useful life of the mine, when the closing moment approaches, the ways of dealing with this issue and the legal requirements will probably have undergone modifications or additions. The strategy outlined here therefore represents an initial milestone in the Closure Planning of the Piauí Nickel Project. This plan is completely conceptual and preliminary in order to meet the ESIA of the project in question, and should serve as a basis for future updates from the Installation License stage - LI.

8.21.2. Objectives

The main objective of the Preliminary Mine Closure Plan for the Piauí Nickel Project corroborates what was exposed in the previous items, which is to guarantee, after the end of the project's activities in the area, the physical, chemical, social and biological stability of the components directly linked to the project, in order to eliminate or mitigate any type of remaining liabilities so that the affected area is available for the future use chosen as most appropriate.

It is worth mentioning that the specific objectives of the closure need to be detailed and updated throughout the closure planning process of that project, so that it can adapt to all changes that occur over the life of the project.

8.21.3. Target Audience and Scope

The Project's Preliminary Mine Closure Plan should cover not only the project area (DAA), but also the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira, Dom Inocêncio and São João do Piauí, which will be directly affected by the end of activities of the project in question.

The target audience of this Plan is composed of:

- employees directly and indirectly linked to or dependent on said project;
- adjacent communities, mainly considering the municipalities in the coverage area;
- Piauí Nickel Metais, with the purpose of conceiving a balanced and realistic closure, which can be financed and sustained by the company, favoring the environmental stability of the affected area and the institutional image of the company;
- the public authority in the form of the municipal and state government;

- environmental entities interested in the future scenario to be left by the decommissioned project, such as Non-Governmental Organizations (NGOs), the Public Ministry, political organizations, community associations, among others.

8.21.4. Preliminary closure analysis

8.21.4.1. Mine Closure Planning Principles

The principles of Mine Closure Planning have the primary function of guaranteeing the physical, biological and social stability of the area in which a mining project is planned, such as the Piauí Nickel Project.

These principles, according to the Mine Closure Planning Guide (SÁNCHEZ et al, 2013) are as follows:

- the protection of environmental quality, safety and public health;
- the guarantee of the recovery of degraded areas, enabling a use compatible with local skills and restrictions and with local and regional demands;
- achieving a post-closure situation that constitutes a beneficial and lasting legacy for the community.

8.21.4.2. Mine Closure Planning Guidelines

The planning for closing a Miner-Industrial complex must follow guidelines for decommissioning. An important part of these guidelines refers to the understanding that the environmental and social impacts of closing a mine must be predicted and assessed as early as possible. However, it must be taken into account that a long-term project needs a constant socio-environmental and economic study to update the closure plan. Table 8.21 1 presents guidelines and good practices recommended in the Mine Closure Planning Guide (SÁNCHEZ et al. 2013).

Table 8.21-1 – Mine Closure Planning Guidelines and Best Practices.

Guidelines	Good Practices
Closure planning must start from a new mine project being conceived	Consider closure planning in the company's strategic planning
	Define closure objectives, including future use of the area, together with the analysis of project alternatives
	Consider closure objectives when designing the mine project
	Identify and evaluate the social and environmental impacts of the closure when preparing the Environmental and Social Impact Assessmentfor the project
	Prepare an acid drainage prevention study and plan, when necessary
	Consider different closure scenarios
The company must plan the closure of operational mines	Gather technical documentation about the mine
	Set out the mine history
	Consider mining and industrial heritage in defining closure objectives
	Perform or update accurate Environmental and Social Diagnosis
	Assess the risks of existing structures
	Define closure objectives, including future use of the area
	Promote the progressive recovery of degraded areas
Closure planning should involve external and internal stakeholders	Identify external and internal stakeholders
	Communicate information about the closing process
	Consult external and internal stakeholders
	Implement a mechanism for receiving and registering complaints and conflict management
	Involve stakeholders in post-closure monitoring

Guidelines	Good Practices
Planning results should be recorded in closure plans and other related documents	Record the planning results in a Closure Plan
	Prepare decommissioning and environmental recovery programs
	Prepare Contingency Plan
	Prepare social programs
	Assess and manage the risks of closure measures and programs
The company must estimate all costs associated with closing a mine	Estimate the costs of programs related to closure
	Periodically update the cost estimate for programs related to closure
	Make financial provision for closing
The company must monitor the local socioeconomic development	Analyze the local and regional socioeconomic context
	Monitor development and quality of life indicators
	Develop programs that foster the diversification of the local production base
	Implement programs aimed at community development
The closure plan must be updated whenever there are substantial changes in the mine design or in the surrounding conditions	Update the assessment of environmental and social impacts
	Track regulatory changes that may influence closure objectives
	Keep stakeholder mapping up to date
	Consider closing objectives through investments in research and technological development and in innovation management
	Consider closing the information management system
	Give systematic treatment to the uncertainties inherent in mine closure planning
	Update the Closure Plan periodically or as needed

Source: Sánchez et al, 2013.

As previously mentioned and mentioned in the good practices listed in Table 8.21 1, due to the long life of the mine, the strategy outlined here represents a first approximation of the problem, and should be periodically reviewed during the operation phase.

First, the objective that will guide the decisions about the probable new uses of the area must be defined, considering the most viable alternatives from the economic and environmental point of view in the given context. This decision-making should be supported by studies and surveys of detailed information on the area's history and its current situation. The studies must include a characterization of the area related to possible types and quantities of contaminants. To this end, an inventory is made of all machines, materials and waste resulting from the mine's useful life. In areas identified as possibly contaminated, an investigation should be carried out using wells, trenches and probes, for sampling soil, groundwater and soil gases. Waste and materials will be classified according to their riskiness, the possibility of recycling and commercialization. It is important to establish quantities for all materials and residues, as well as for the possibly contaminated soils, which will enable an accurate estimate of the cost of different alternatives for environmental recovery.

With detailed knowledge of the site, alternatives for dismantling the facilities and environmental recovery must be developed, always taking into account the legal requirements and regulations, public policies and guidelines and standards of the company itself. For some activities, it will be necessary to obtain government licenses and authorizations, accompanied by public consultations when there is such a requirement.

The closure plan must contain execution schedules, in addition to environmental clauses in contracts with contractors and other companies involved in the work, in order to ensure that the works will be conducted according to the plan.

In this phase, the following actions should be undertaken:

- the disassembly of the electrical and hydraulic systems;
- the disassembly of installations and mechanical systems;
- the purging of fluids and removal of solid waste;
- the disassembly or demolition of buildings;
- the removal of foundations and buried tanks;
- the filling out excavations;
- embankment, leveling and earthwork;
- waste and rubble sorting;
- the removal and final destination of waste and rubble.

The entire process must be monitored, which can be done by a specialized company, which can also be responsible for managing the project's execution. The results must be in line with the objectives and goals outlined in the initial project and any changes must be approved by the competent authority. Potential environmental impacts generated during the decommissioning phase must be foreseen, evaluated and minimized, such as noise, particulate matter emission, truck traffic and disturbances to the neighborhood. Care must be taken to protect the health and safety of workers, who in some cases will be dealing with hazardous substances.

Demolition and cleaning must be done separately, so that inert residues from demolition can be used for recycling, or as a landfill. Cleaning can be done with a water jet under pressure with detergents or solvents. Any buried installation must be removed and purged properly.

A final report must be made to document all operations and results, including all stages of the work, including the history of use of the area.

8.21.4.3. Closing Scenarios - Future Uses

The alternatives for future use of a project such as the Piauí Nickel Project need to consider a series of issues, mainly with regard to the costs, benefits, advantages, disadvantages and risks identified for each alternative. Added to this are legal and internal policy factors of the company itself.

The proposed conceptual closing plan envisages, at this stage, the destination of completed areas of the project for agropastoral and reforestation purposes, a context in which the area of the project is currently planned, given the lack of alternatives in the regional economy.

Before closing, it is essential to prepare a study that considers the characteristics and socioeconomic trends of the region and the municipalities in the area of influence of the project and, above all, that proceeds to a careful and detailed survey of the local society as a whole, in such a way that the plan to close and recover the mined area can be developed in line with the expectations, needs and demands expressed by the community.

The following are the measures to be taken during the operation of the mine and immediately after its closure, to promote stability and safety, facilitating the work of recovery and final destination of the area.

A) For Final Slopes

Physical stability aims to ensure the safety of anyone who will move around the Nickel and Limestone mines after its closure, and involves restricting access to hazardous areas, with installation of ditches, fences and signposts around of the holes, as well as the stabilization of the slopes, by the reducing slope angles, if insufficient.

The entry of rainwater and sediment must be avoided with the construction of drainage channels around the pits. These should form a set from the upper levels, up to the regional drainage level, where the rainwater will be directed.

Erosive processes upstream of the pits should be monitored and resolved when they present a risk of compromising the pits. The excavation in rock should be stabilized, according to the stability calculations, construction of continuous slopes, at the projected heights. The excavation of the final walls must be done by the damped detonation method or another suitable method, to avoid over-breaking in the final wall. The shoulders between embankments must be stabilized and continuous.

In order to guarantee the productivity of the area and reduce visual impacts, the area should be recovered in a similar way or close to its original situation or, still looking for another acceptable use alternative, restoring its drainage. As seen above, planing the upper slopes must be done.

Organic soil from the stripping of deposits should be used to cover the slopes and the final shoulders in the first years of operation of the project.

This organic soil must be deposited on the final slopes with the aid of machines, followed by its covering with the construction of grasses in slabs or with the use of water seeding. The berms must follow the same procedures and will be revegetated with native tree species.

With regard to chemical stability, the nickel deposit will be monitored for the possibility of water contamination by some reaction process, during the entire life of the project. Due to the chemical characteristics of limestone, in particular the presence of carbonates, its use will result in basic drainage. However, a sampling system should be implemented in the discharge of the local drainage network, for knowledge and control, ensuring the quality and stability of the drained water.

B) For Waste dumps and Residue Storage

The waste deposits of the mines will be formed during the implementation period of the project, from the beginning of the stripping activities of organic soil and waste material from the areas to be mined, and will continue to receive the waste material from the mines during the entire useful life of the project. During the operation of the project, the waste from the hydrometallurgical plant (IFC, composed mainly of iron, aluminum and plaster hydroxides) and the residual ore exhausted from the heaps after leaching will be disposed, in a residue storage area.

With regard to physical stability, both in the waste and waste deposits, the purpose of the proposed recovery is to avoid ruptures and slips, settlements, deformations in the structure of the stockpiles, as well as sediment discharge. At the outset, appropriate locations should be selected - usually valley bottoms - and the foundation should be avoided with low resistance; build the stacks upwards, according to the projected geometry; build internal drains to prevent the increase in neutral pressure and the stability of the stockpile; install rainwater drainage systems; put ditches to control water infiltration, revegetate slopes and shoulders; establish protective rockfill, if necessary.

Stockpiles containing soil and other vegetation materials should preferably be used for topographical reconstruction of the pit and surroundings. The remaining stockpile must conform to the projected angles. Revegetation work with native, fruit, ornamental or other species, all of which are subject to future economic exploitation, will start from the moment when the embankments and embankments reach their final configuration, when the stored organic soil from the stripping will be deposited. deposits.

The revegetation of surfaces should reduce the visual impact and material erosion caused by rainwater. As well as established for the stockpiles of rocks, a solution must be presented for the sediments present in the drainages, such as the execution of solid separation boxes and decantation basins.

As for the chemical stability of the sediments present in the drainages, a solids decanting / retention system will be implemented.

In order to ensure that contaminants do not seep into the soil and groundwater, the residue storage deposit will be built on compacted soil and geomembrane waterproofing over clay, with

a drainage system that directs the percolated water to a containment pond and later reused as process water or planned for a duly licensed landfill.

Also to ensure that there is no infiltration of effluents and liquids into the soil or groundwater, periodic monitoring of groundwater will be carried out through wells installed around the main structures of the project.

C) For Civil Works, Installations and Equipment

Civil constructions carried out to serve the basic infrastructure of the mines, beneficiation plants, sulfuric acid plant facilities, nickel and cobalt concentration hydrometallurgical plant, fixed equipment, mobile equipment, some roads and accesses, transmission lines, etc., should be disabled. Fixed and mobile equipment, in addition to various metallic materials, can be sold in the state they are in. The infrastructure works, with the necessary adjustments and improvements, may be planned for some economic or social use, according to the region's demand. The structures that should be definitively deactivated will be removed, and the sites recovered and revegetated.

The solution ponds, containment and emergency pond will be drained, cleaned and deactivated, with revegetation or use for other uses of social interest (eg surface water storage ponds for animal drinking).

Buildings, equipment and storage areas will be recovered to control the entry of unauthorized persons. Any soil contamination will be decontaminated, if necessary, dismantled and all equipment and constructions removed; filling of existing or resulting auxiliary excavations will be carried out; buried tanks were removed and drainage of areas was restored.

Buildings and storage areas for gas, chemicals, fuels, oils and greases must be deactivated and recovered to meet criteria for maintaining drainage water quality and to dispose of chemicals in other licensed locations.

Chemical products of any kind must be recycled, returned to the dealer, sold or disposed of in licensed locations. The sulfuric acid plant facilities must be dismantled and removed from the site. The entire chemical storage and handling area must be evaluated by a specialized company and, if soil contamination has occurred, remediation must be carried out using a plan approved by the control agencies.

8.21.5. Expected Results

It is expected that with the preparation and periodic updates of the Mine Closure Plan, the Closure of the Piauí Nickel Project will be conducted in order to ensure that public health and safety will not be compromised, that environmental resources will not be subject to physical, chemical or biological deterioration, that the future use of the area will be beneficial and sustainable in the long term, that adverse socio-economic impacts will be minimized and that all socio-economic benefits are maximized.

8.21.6. Schedule

As already explained, mine closure planning should start in the planning of the undertaking, at first on a preliminary and later conceptual basis. Updates should be carried out throughout the life of the project.

Following is the schedule of the Preliminary Mine Closure Plan:

Program	Program Execution			
	Planning	Construction	Operation	Closure
Preliminary Mine Closure Plan	■	■	■	■

9. Prognosis with Environmental & Social Impact Assessment

9.1. Prognosis

This item approaches the Prospective Tables in a comparative way, with the hypotheses of what is expected to happen with and without the implementation of the project, addressing the socio-environmental factors of the region of interest (Table 9.1 1 to Table 9.1 3).

It should be noted that the analysis of the prospective picture with the project includes the implementation of the impact management actions, taking into account the mitigating measures (negative impacts) and potentializing measures (positive impacts), as well as the closure of the project, presenting the general context and the assumptions made.

In compliance with item IV of SEMAR Technical Opinion number 7,975 / 16, this item also addressed the topics: groundwater quality, impact on the road network and social responsibility measures. It is worth mentioning that the theme related to tailings dams will not be addressed, because, as presented in the Project Description chapter, there are no tailings dams designed for this project.

Table 9.1-1 – Prospective Framework - Physical Environment.

Components	Without the Company	With the Company and Measures (17.6 years)
Soil, Relief and Land	Relief should continue without major changes as well as the dynamics of the terrains marked by small points of instability in the passage of the existing accesses through the regions of greater relief movement (mountains).	The intervention points for the implementation and operation of the project correspond to the Brejo Seco (nickel) and Umbuzeiro (limestone) mining complexes. In these locations corresponding to the mining fronts, various erosion control measures will be applied, as provided for in environmental programs aimed at soil conservation. The construction of the accesses mainly in the crossing points of mountains and in the transposition of water courses can lead to the installation of erosive processes that can cause damage in the region if they are not controlled / mitigated. Thus, the Basic Environmental Plan also includes the area of access and its domain ranges within the scope of mitigation programs, including actions to control and monitor any erosion processes that may arise. The associated linear projects (transmission line and pipeline) in turn have a low potential to cause changes in the natural dynamics of the terrain due to the characteristics of their projects. In the area of the nickel hill there will be a change in the relief, but the modification of the landscape at the site was not considered to be of relevance and therefore does not require any mitigating measures other than the implementation of the PRAD.

Components	Without the Company	With the Company and Measures (17.6 years)
Soil and Surface Water	The current flow of surface watercourses is expected to be maintained together with the maintenance of the quality of its waters. All water courses that drain the ADI and DAA are intermittent and are located on the right bank of the Piauí River (Várzea Creek, Gameleiras, São Domingos, Itaquatiara, Caraíbas and Piauí River). During the dry season, the bed of the rivers and streams in the region are used as a planting area by the local population and for grazing by livestock herds, being exposed to all types of contamination. Thus, in the current scenario, the water quality in the region already shows signs of change, with several parameters not complying with the quality standards established in the current environmental legislation, as shown by the results of the analyzes carried out and presented in the diagnosis. Without the project, there would still be no catchment at the Jenipapo dam, which in theory would leave a larger volume of water available for other uses.	Strictly speaking, the project as a whole has little direct impact on water courses in the region, which happens only in the transposition of drainages by linear structures (accesses, pipeline and transmission line). Even so, during all phases of the project (installation, operation and closing) there is the possibility of alteration in the surface waters and silting of the channels due to the flow of particles and surpluses produced by the project, such as: generation of liquid and oily effluents, leakage of contaminating substances, generation of solid residues, liquid effluents of sanitary origin that can originate in the construction sites and support areas used during the implementation of the project, as well as in the mining complexes of Brejo Seco and Umbuzeiro. Considering the mitigation of this impact, several preventive and control environmental programs were planned, in addition to a water quality monitoring program whose focus was set on the quality control of surface / rainwater that passes through the project's structures, supported in a complementary sampling network in the project's ADI. In order to maintain its operation, the project requires the supply of water that will be collected at the Jenipapo dam in the municipality of São João do Piauí at a rate of 460m3 / h, flow rate, already granted and considered small in view of the reservoir capacity.
Soil and Groundwater	It is expected to maintain the level of the water table, providing that the altimetric levels of the	The generation of waste and sanitary and industrial effluents by the project can contribute to the percolation of contaminating substances to the soil and groundwater. In this way, several programs and actions for the management, prevention, control and monitoring of soil and

Components	Without the Company	With the Company and Measures (17.6 years)
	springs within the ADI do not change and that the quality of the groundwater in the area remains unchanged. In this regard, the most fragile area and the most vulnerable to groundwater contamination is the Umbuzeiro region, where the environment is karst and has greater permeability.	groundwater contamination will be applied, in addition to various engineering solutions (involving construction methods and design solutions for civil works), such as the adoption of floors and areas and installation of water and sewage treatment plants. It is worth mentioning the implementation of the groundwater quality monitoring program in the region of the 2 mining complexes, with special emphasis on the Umbuzeiro (limestone) region, where mining activities and groundwater abstraction may cause a decrease in the water table and changes in quality and availability of surface water near the future limestone mine.
Soil / Speleological Heritage	Without the implementation of the project, the current scenario is maintained where the natural underground cavities will be maintained.	The construction phase of the project is more critical in relation to the potential for degradation of the speleological heritage, as this is when the preliminary infrastructure services (vegetation removal, soil stripping and earthworks) occur; construction of access roads; and the other structures themselves. The few speleological features identified are located in places away from the most critical activities of the Construction phase, including heavy machinery traffic and the use of explosives. Even so, during the phase of elaboration and implementation of the project of the structures foreseen for the Arenitic Escarpment Area, technical supervision of a speleologist is foreseen to ensure that there is no damage to the region's speleological heritage, whose preservation will be ensured by the execution of an environmental program. specific. It is noteworthy that the project for the implementation of the Transmission Line has a high degree of flexibility in defining the location of the towers, which will allow the diversion of any area assessed as most sensitive from the point of view of the speleological heritage.

Components	Without the Company	With the Company and Measures (17.6 years)
Air - Quality	The region already has a suspension of particulate matter for natural reasons. Dust suspension due to the long dry period (9 months) through the region's intense winds, whose highest frequency is observed from the southeast to northwest direction.	Both in the construction phase and in the operation phase of the project, with the increase in traffic in the region, it is expected that there will be an increase in the generation of particulate materials, greater burning of fossil fuel and emission of other pollutants by a wide range of activities, changing the air quality in the region. This fact is enhanced by the local climatic conditions, where strong winds and low rainfall predominate, favoring the resuspension of solids in the air (dust). These aspects can cause discomfort to communities located close to the project (DAA and surroundings), such as the Community and Veredas Settlement, Carnaíba Settlement and Várzea. In order to control such adversities, it is proposed to establish a vehicle speed limit, sprinkling water in the source areas with the greatest potential for generating particulate material and monitoring Air Quality through specific programs, in addition to building an exclusive access route to the project. away from the homes and communities registered in the surroundings.
Air - Noise and Vibration	As it is located outside a consolidated urban area, the project's ADI has noise and vibration values within the limits established by current legislation.	Some activities foreseen for this project may generate noise discomfort and also due to vibration, mainly those related to the extraction of ores in the Brejo Seco (nickel and cobalt) and Umbuzeiro (limestone) areas, with this discomfort experienced by the employees themselves. and any service providers located within the complexes. The operation of industrial plants should not cause any inconvenience to the surrounding communities (which are far from the most affected area). Even so, to alleviate such problems, explosions should only occur at certain times and must be signaled in advance. In addition, the project will develop specific programs and will have a constant communication channel with the surrounding communities to receive and resolve any inconveniences generated in this or any other aspect of the project throughout its life cycle.

Table 9.1-2 – Prospective Table - Biotic Environment.

Components	Without the Company	With the Company and Measures (17.6 years)
Flora and fauna	Maintenance of 1,121.33 ha of native vegetation and continued human activities such as illegal extraction of native vegetation and extensive grazing of several species of domestic animals.	Associated with the construction stage, the clearance of 1,121.33 ha of native vegetation is expected. Vegetation provides three-dimensionality to the environment, plays a structuring role in habitats, as well as a source of trophic resources for fauna. Thus, associated with the clearance of vegetation is the disappearance of habitats to which animal species are associated. The damage to vegetation is associated with the opening of access roads and the construction of structures. It is noteworthy, however, that the vegetation to be impacted will correspond to less than 5% of all vegetation matrix existing in the ADI, whose area is already undergoing intense anthropization with the incidence of several degradation factors, of which the cutting of vegetation and extensive grazing of several species of domestic animals (especially goats). To mitigate the impacts on flora and natural habitats, Flora Clearance and Rescue Control Programs are proposed; Recovery of Degraded Areas Program (PRAD) and Compensation for Intervention in APP's, in addition to an environmental education and social communication program with all internal and external employees aimed at the preservation of natural resources.
Flora and fauna	Maintenance of eventual pressure on fauna (hunting, fishing and being run over) and flora (removal of plant specimens) due to the movement of people and domestic animals in the region, as well as by vehicle traffic.	The anthropization process, already existing in the region, will tend to intensify with the implementation of the project and with the largest number of people who will be present in the area, thus increasing the pressure on the fauna and flora in the region. Educational and social communication campaigns planned with internal and external collaborators will help to curb pedestrian behavior and mitigate these impacts. The running over of animal species will occur more often because of the increased circulation of trucks and other vehicles in the region. This impact will be the object of specific mitigating measures related to traffic control (signaling and speed reducers), educational and communication campaigns, in addition to evaluating the need to implement a program to monitor the running over of animals along the roads used by the project. The discharge of effluent into water bodies, even if the parameters for discharge provided for in the legislation are respected, can cause damage to the aquatic ecosystem, which will be prevented through the installation and monitoring of storm and surface water drainage systems, and related programs and measures.

Table 9.1-3 – Prospective Framework - Socioeconomic Environment.

Components	Without the Company	With the Company and Measures (17.6 years)
Social	Maintenance of the population's way of life and daily life	A possible increase in cases of social conflicts and violence due to the possible arrival of immigrants, notably: disputes over job opportunities; loving relationships; disagreements between colleagues; social marginality. An increase in the movement of people, machinery, equipment and vehicles, which may generate changes in the levels of noise, vibration, traffic (of people and vehicles) and suspension of particulate material (dust) in the region, which can cause discomfort to construction workers and communities close to the project. A possible increase in cases of sexual exploitation and pregnancy in children and adolescents, due to the number of workers during the construction phase and the characteristics of construction workers. The implementation of the programs provided for here aims to reduce, monitor and mitigate these potential impacts. Social Communication Program; Local Producers Development Program; Program for Monitoring Interference and Support for Public Services; Workforce Management Program; Environmental Education Program; Noise and Vibration Monitoring Program.

Components	Without the Company	With the Company and Measures (17.6 years)
Social	Maintenance of demand levels for equipment and public services: below ideal - insufficient hospitals, beds and doctors (from the municipalities directly affected only São João do Piauí has a hospital), despite the fact that primary care centers such as Basic Health Units (UBS) are able to meet the existing demand; education is another sector that also presents weaknesses, such as the displacement of people from rural areas to schools and a single center of higher education (also in São João do Piauí).	There may be an increase in demand for public services and equipment, due to the attraction of immigrants during the construction phase. On the other hand, there is also the opportunity to improve existing urban equipment and services due to the increase in municipal revenues (taxes and transfers, fees and contributions). In order to prevent possible problems and assist in the resolution of those that arise, the Program for Monitoring Interference and Support for Public Services, and related programs, are planned to address potential discomforts in this regard.
Social	Maintenance of the level of spread and prevalence of diseases, the greatest indications of which are currently related to pregnancy, childbirth and the puerperium (among women) and problems of the respiratory system and external causes (injuries) among men.	Possible spread of infectious diseases that can occur due to the activities related to the works of the project and the possible increase in the population coming from other locations. Possible increase in cases of sexually transmitted diseases - STDs, considering the characteristics of the eventual attracted population. For these problems, it is stipulated to maintain adequate sanitary conditions at the construction site and to strengthen the sex education policy. The programs that aim to remedy this situation are the Social Communication and Environmental Education Programs. The possible increase in disease will occur during the construction phase of the project, so it is expected that the situation will stabilize at levels close to the period prior to the project's installation works.

Components	Without the Company	With the Company and Measures (17.6 years)
Social	Maintenance of the employment and income indices of the inhabitants: low economic dynamics, jobs totally dependent on the public administration (case of the municipalities of Campo Alegre do Fidalgo, Capitão Gervásio Oliveira).	Substantial increase in the level of employment as a result of the opportunities offered by the project, and the consequent increase in household income. With the Closure of the project, a probable drop in the number of jobs is pointed out, with consequences on the average family income, however, it should remain at levels higher than the situation prior to the project. It is worth mentioning the implementation of several Environmental and Social Programs to address this issue, in particular the Self-Sustainable Development Program for Local Communities during operation and Closure of the project.
Social	Maintenance of economic activities developed in the region	Replacement of few areas used in agricultural production by mining activities. Expansion of the dynamics of the local economy, since the increase in the number of direct jobs in one economic sector stimulates an increase in production and the generation of additional jobs in other sectors. If the opportunities generated during the implementation and operation phases are taken advantage of, it is expected that after the end of the project's activities, a new economic dynamic will have emerged in the municipalities of the ADI. This new dynamic is expected to be greater than that seen in the pre-development period, however, being less than the period of operation of the same. As mentioned in the previous item, the Self-Sustainable Development Program for Local Communities during operation and decommissioning of the project aims to enhance the stability of the local economic dynamics.
Social	Maintenance of budget revenues in the municipalities of Capitão Gervásio Oliveira and Dom Inocêncio	During the period of operation, the Piauí Nickel Project will increase savings with the estimated production and sale of 100,000 tpy of Nickel Hydroxide Precipitate (NHP) and 5,000 tpy of Precipitated Cobalt. This production will cause the municipality of Capitão Gervásio Oliveira to start receiving the share of the Financial Compensation for the Exploration of Mineral Resources (CFEM) related to the extraction of ores. Aiming the production process of NHP and Precipitated Cobalt, it will be necessary to extract about 476,000 tpy of limestone, whose mining area is located in the municipality of Dom Inocêncio. Thus, the municipality should also receive the share of CFEM related to this ore. In addition to this main additional source of income for municipalities, it is important to highlight the considerable volume of other indirect taxes that will be generated by the high demand and consumption of services and inputs by the project in the municipalities of the ADI.

Components	Without the Company	With the Company and Measures (17.6 years)
Social	Maintenance of vehicle traffic on the local road network	For the installation period of the project, alternative access constructions are foreseen to avoid the concentration of vehicles on the local roads, in particular an exclusive access road between the project and the PI-465 state road, projected far from the residents and local communities exactly to avoid related discomfort. During the period of operation, a total of 59 truck trips / day are planned for the transportation of inputs and products on different tracks. These being: 25 trips per day on the route to be established between Brejo Seco and Umbuzeiro; 24 trips per day via the exclusive access route to the project and PI-465 to receive sulfur and approximately 10 trips per day on these same routes for shipping products. Despite being in accordance with the transport capacity of local roads, transport and vehicle flow management measures and program will be implemented to reduce discomfort in this regard, and which will also take into account the specifications referring to Mining Regulatory Norms - Circulation and Transport .

10. Conclusions

The present Environmental and Social Impact Assessment presents and analyzes the main characteristics and the environmental and socioeconomic dynamics of the area where the Piauí Nickel Project is planned, aiming to identify and evaluate its impacts, in order to establish under which conditions the implementation and operation of this system reaches its socio-environmental viability.

This project aims to extract and process nickel laterite ore for the production of Nickel Hydroxide Precipitate (NHP) and another Cobalt product, thus exploiting the Nickel and Limestone reserves existing in the DNPM 804.290/1970 and 803.144/2002, respectively, consisting of 5 main structures that will be implemented and will operate in an integrated manner, namely: Nickel Mine and Industrial Area (Brejo Seco), 69kV Transmission Line, Water Supply (Jenipapo Dam), Limestone Mine (Umbuzeiro) and Access Roads, involving areas located in the municipalities of Capitão Gervásio Oliveira, Campo Alegre do Fidalgo, São João do Piauí and Dom Inocêncio.

The final arrangement of these structures went through the study of locational and technological alternatives in order to allow their implementation and operation with the best cost / benefit ratio and with the least possible socio-environmental impact. It is worth adding that during the next engineering development stages of this project, additional improvements are expected that may further increase its safety and operational efficiency, and consequently its positive socio-environmental balance.

The diagnosis of the physical and biotic environments did not indicate the presence of any particular and / or restrictive aspect to the areas of implementation and planned operation of the project (DAA). In relation to the physical environment, there is a dominance of areas of low environmental fragility in terms of erosion processes in the DAA and the ADI, associated with the absence of restrictive speleological features in the mining areas and other structures, and with the expected interference only on small and small surface drains (mostly intermittent). The low water availability associated with the climate was also overcome by the forecast of installing a pipeline that will bring the water from the Jenipapo reservoir, and the volume required for the implementation and operation of the project is already granted by the National Water Agency and is considered small in relation to the reservoir storage capacity and current demand for water extraction.

In relation to the biotic environment, the current landscape in the region corresponds to a continuous caatinga matrix, but already with signs of anthropization, and therefore it was assessed as being able to receive the project and its associated impacts without affecting the survival of any species of flora and fauna occurring in the project's areas of influence. The survey of primary flora and fauna data did not detect any species considered to be threatened with extinction present exclusively in the project's DAA, and the few observed in its ADI also occur in regions that will not be affected by the project, thus ensuring the maintenance of viable populations of these species.

From a socioeconomic and cultural point of view, the installation and operation of the mining company will offer conditions for attracting labor and generating jobs, income but also for

pressures on public services in the municipality of Capitão Gervásio Oliveira and surroundings. According to the assessment of the consulting team, it is in the socioeconomic environment that the most sensitive issues of the project reside.

Considering all 4 phases of the undertaking (planning, implementation, operation and decommissioning), 50 impacts were identified, being predominantly negative but evaluated as being of low to medium relevance in the vast majority. Only for the socio-economic environment, positive and negative impacts of high relevance were identified in the phases of implementation, operation and Closure of the project, which highlights the importance of the project for the regional economy and improving the living conditions of the local population.

Considering the analysis carried out, all the expected negative impacts were presented with preventive, control and monitoring, mitigating and / or compensatory measures, and the positive impacts measures aimed at enhancing their relevance. These actions are organized in 21 Environmental and Social Programs presented below, which will consist of the Basic Environmental Plan - PBA of the project (to be detailed and presented in the next stage of environmental licensing):

1. the Environmental and Social Management Program - responsible for ensuring compliance with the other programs of the Basic Environmental Plan in accordance with the recommended technical recommendations and within the schedule to be required by the environmental agency together with meeting all conditions of the future Preliminary License;
2. the Solid Waste Management Program responsible for ensuring the proper management of solid waste generated by the implementation, operation and decommissioning stages of the project;
3. the Program for the Prevention and Control of Surface Dynamics and Silting of Water Bodies - responsible for guiding the work of conservation of soil and regional water bodies;
4. the Air Quality Monitoring Program - responsible for actions aimed at maintaining air quality and mitigating the impacts caused;
5. the Noise and Vibration Monitoring Program, which should monitor these factors mainly around the areas subject to the use of explosives to blast ores (Brejo Seco and Umbuzeiro complex);
6. the Effluent Monitoring Program - indicates the necessary measures to ensure control over the disposal of effluents generated by the project's implementation and operation;
7. the Surface Water Quality Monitoring Program - aims to ensure that the quality of surface water does not change due to activities related to the project;
8. the Groundwater Monitoring Program - must ensure the maintenance of the quality of the water captured or that which may be affected by the project;
9. the Flora Clearance and Rescue Control Program - aims to restrict the removal of vegetation to the minimum necessary as well as assist in the conservation of local flora populations;
10. the Fauna Chase Away and Management Program - aims to minimize the loss of fauna individuals during the clearance work as well as to monitor the effects of the project's construction on this component of the biotic environment;
11. the Degraded Areas Recovery Program - provides the necessary recommendations for the environmental restoration of any environmental liabilities created by the implementation, operation and Closure of the project;

12. the APP's Intervention Compensation Program - brings the necessary recommendations to meet the legal requirement that determines the restoration of native vegetation cover according to the amount of permanent preservation areas impacted by the project;
13. the Social Communication Program, which deals with guidelines related to the dissemination of activities related to the different phases of the project;
14. the Workeforce Management Program - includes the valorization and training of local labor;
15. the Local Suppliers Development Program that includes courses and other activities aimed at training suppliers;
16. the Environmental Education Program - includes actions aimed at the internal public (workers and service providers) and the external public (suppliers and surrounding residents);
17. the Program for Monitoring Interferences and Supporting Public Services - covers activities to support public services offered by municipalities affected by the project's activities;
18. the Land Negotiation Program, which dictates the rules and procedures to be followed in the negotiation for use and / or alteration in the dominance of the properties necessary for the implementation of the project as a whole;
19. the Program for the Self-Sustainable Development of Local Communities, necessary to introduce new activities that may prove viable to replace mining after the depletion of mineral reserves;
20. the Environmental Compensation Program - presents financial environmental compensation and suggests allocation of resources to the Serra da Capivara National Park;
21. the Preliminary Mine Closure Plan brings the activities involved at the end of the mining cycle, covering all affected environments.

It is noteworthy that the aforementioned Programs were developed in order to comply with international good practices, including IFC's Performance Standards on Social and Environmental Sustainability, and therefore meet and exceed current legal requirements.

In summary, considering the absence of impeding factors linked to the physical, biotic, socioeconomic and cultural environments of the region to the implementation of the project and provided that all preventive, mitigating, compensatory and monitoring measures proposed here are implemented correctly, the consulting team understands that the Piauí Nickel Project seeks premises and precautions for sustainable development, and therefore its implementation presents socio-environmental viability.

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Support					
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