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Detailed Project Engineering Design, Bid Documents
and Associated Safeguard Instruments Preparation for
Agua Grande Coastal Protection and Reconstruction of
Marginal Road

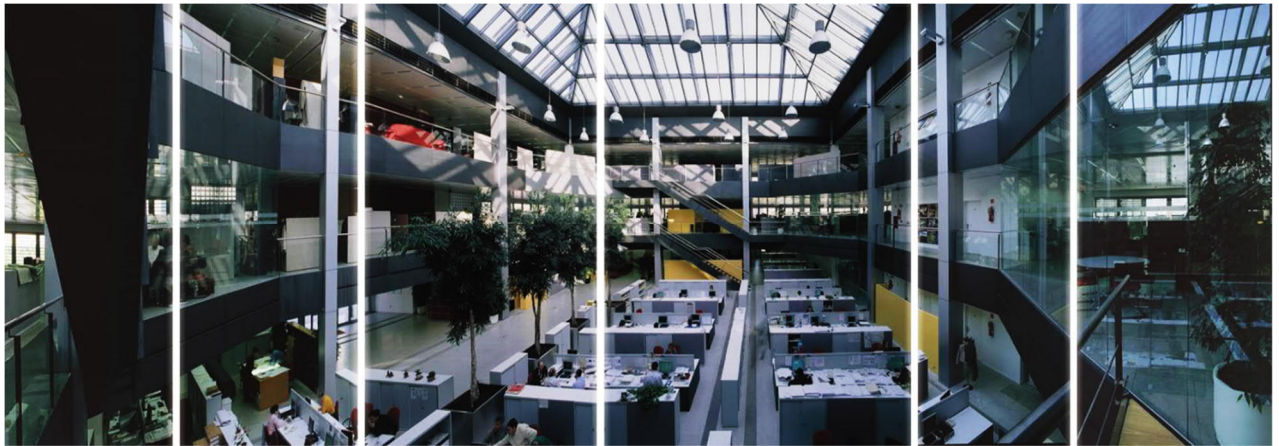
VOLUME 2 - ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

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12. ENVIRONMENTAL IMPACT ASSESSMENT

This chapter of the ESIA aims to analyze the environmental impacts associated with the construction, demobilization and operation phases caused by the solution chosen for road, coastal protection and landscape, comparatively to the Zero Alternative, which describes the evolution of the environmental conditions without the project.

The following sections also present the methodology used in environmental and social impact assessment, assessment of environmental impacts for each road lot and a synthesis of the environmental impacts caused by the project.

12.1. ZERO ALTERNATIVE

The following table summarizes the evolution of the Environmental Conditions without the project.

Environmental Factor	Zero Alternative
<p>Climate</p>	<p>According (WHO & UNFCCC, 2021) São Tomé Climate Trends are</p> <p><u>Rising Temperature</u></p> <p>Under a high emissions scenario, the mean annual temperature is projected to rise by about 3.2°C on average by the end-of-century (i.e., 2071–2100 compared with 1981–2010). If emissions decrease rapidly, the temperature rise is limited to about 1°C.</p> <p><u>Small increase in total precipitation</u></p> <p>Total annual precipitation is projected to increase by about 7% on average under a high emissions scenario, although the uncertainty range is large (-10% to +44%). If emissions decrease rapidly, there is less projected change on average: an increase of 4% with an uncertainty range of -5% to +20.</p> <p><u>Small increase in extreme rainfall</u></p> <p>Under a high emissions scenario, the proportion of total annual rainfall from very wet days and (about 28% for 1981–2010) can increase a little by the end-of-century (to about 33% on average with an uncertainty range of about 20% to 50%), with little change if emissions decrease rapidly. These projected changes are accompanied by small increases in total annual rainfall under a high emissions scenario.</p> <p><u>Wind</u></p> <p>Marginal effect of climate change on the offshore wind conditions has been observed in the climate simulations. It is therefore assumed no climate change effect on the wind conditions (both extreme and average normal climate) will take place till 2100 (CDR, 2019).</p>
<p>Geology and Geomorphology</p>	<p>In the absence of the Project's implementation, there is a need to conserve the existing sand bars on the Marginal beaches, as they protect the coastline against storm surges, high tides, and storm surges.</p>
<p>Soils</p>	<p>In the absence of a project it is expected that the deposition of wastewater and solid waste directly on the ground will remain in the area of intervention</p>

Environmental Factor	Zero Alternative
<p>Hydrology and water quality</p>	<p>In the absence of a project it is expected that the following situations will remain in the area of intervention:</p> <ul style="list-style-type: none"> - Deposition of solid urban waste in the bed of the water lines, causing their silting, which potentiates flood phenomena in periods of heavy precipitation; - Improper disposal of wastes with consequences for the water quality of the water lines; - Possibility of organic contamination of aquifers, due to inadequate management of solid waste and domestic effluents; - Contamination due to washing clothes in the water lines, open defecation, repair of boat motors near the beach. <p>The absence of the project corresponds to the maintenance of the current situation of direct discharge of wastewater into the soil, water lines or the sea, with repercussions on public health, on the quality of bathing water.</p>
<p>Biological marine environment</p>	<p>In the absence of the Project it is expected that the following situations will remain in the area of intervention, regarding marine habitats:</p> <ul style="list-style-type: none"> - Discharge of untreated domestic effluents, which reduce the quality of coastal waters and contributes to eutrophication processes that can lead to a reduction of dissolved oxygen levels in the water; - Improper disposal of wastes, including plastics that constitute pollution per se but are also a real threat to several marine species that take them for food. - Presence of sea turtles species and monitoring foraging of their grounds in north coast of São Tomé Island.
<p>Biological terrestrial environment</p>	<p>In the absence of the Project it is expected that large, root-bearing trees will remain in the area of intervention, damaging the sidewalks and invading the road, posing danger to citizens.</p> <p>Continuity of sea turtle monitoring program by the local ONG in São Tomé island and in the beaches in the direct influence area.</p> <p>Degradation of terrestrial and marine and riverine ecosystems due lack of wastewater treatment.</p> <p>Continuity of the presence of four sea turtles species ((hawksbill green, olive ridley and leatherback) using the coastal marine environment are in risk if sand in beaches disappears due coastal erosion and illegal mining in beaches.</p>
<p>Air Quality</p>	<p>In the absence of the project, it is expected that the air quality will deteriorate from the current situation due to the increase in population and tourists and the consequent increase in automobile traffic and air pollutants (CO₂, CO, NO_x, SO_x, HC, VOC's) the increase in the number of diesel generators as an alternative to the energy supply, inappropriate, gas emissions associated with automobile traffic and suspended particles.</p>
<p>Noise and Vibrations</p>	<p>Regarding the noise environment, the non-implementation of the project corresponds to a worsening of the current situation, due to the expected increase in population in the city and the increase in tourists, as a result of the growing car traffic associated with home-work transportation, the</p>

Environmental Factor	Zero Alternative
	demand for services and commerce, restaurants and the practice of sports and going to the beaches at Marginal de São Tomé.
Landscape	The absence of the Project represents a continuous degradation of the image of São Tomé city marginal. São Tomé. Marginal has great landscape quality, with a scenic view to sea, flanked by trees as Terminalia catappa L. (caroceiro) in Ana Chaves Bay, but in bad conservation status.
Waste Management	<p>The absence of the project represents an increase in the disposal of solid and liquid waste in inappropriate locations resulting in the pollution of soil, groundwater and waterways.</p> <p>It is worth mentioning that there are no waste paper bins in the intervention area, nor a residual water system.</p> <p>Penha dump receives all types of waste, is not fenced and dangerous waste is stored in containers, awaiting transport to an appropriate final destination.</p>

Table 1 Evolution of Environmental Conditions without Project

12.2. METHODOLOGY

The Checklist method was used to identify and evaluate **environmental and social impacts** generated and/or foreseen in the project's area of influence. This method consisted of an analysis of the activities foreseen in the different phases of the project (construction, demobilization and operation), verifying the adverse effects that each activity can have on a particular environmental and/or social aspect.

In this sense, all project activities were listed, according to the phases of construction, demobilization, and operation, where for each activity the environmental and social impacts generated and/or foreseeable were identified individually, attending to the environmental/social aspect affected.

For this, parameters were adopted that allowed an evaluation of the environmental and social impacts, using classification criteria in order to characterize the identified impacts. In this case, the parameters chosen were Nature, Incidence, Temporal Duration, Magnitude and Significance, whose definitions are presented in the following Table.

The comparative analysis considers the activities for the Construction, Demobilization and Operation Phase, which are set out in the table below:

Phases	Description
Construction	1- Hiring of staff; purchase of products and equipment, contracting services 2 - Clearing 3 - Embarkement 4 - Infrastructure construction 5 - Movement of machinery, vehicles and employees assigned to the works 6- Construction site and quarries operation 7 - Ligthing work fronts 8 - Cement preparation 9 - Removal and replacement of pavement layers

Phases	Description
	10 -Concrete mixer wash 11- Water pipe disinfection 12 - Storage and handling of hazardous products 13 – Operation of quarries 14– Beach nourishment
Demobilization of Construction Site and work fronts	1-Circulation of vehicles and equipment 2 -Removal of demolition debris of construction site 3- Reforestation 4 -Use of equipment and machines
Operation	1 - Presence of Infrastructures 2 - Activities associated with the operation of infrastructure 3 - Activities associated with the maintenance of infrastructure 4 - Traffic generated by the operation of infrastructures 5- Beach nourishment.

Table 2 Identification of Activities

For the comparative analysis of environmental and social impacts, the following classification was also considered in order to characterise the environmental and social impacts.

Criteria	Classification	Description
Nature (the impact produces benefits or damages to the environment and society)	Positive	Beneficial impact
	Negative	Harmful impact
Incidence (the impact will occur only inside or outside the project's area of influence)	Direct/Location	The impact is exclusively on the project's area of direct influence
	Indirect	Impact on the project's area of indirect influence
	Temporary	When an impact ceases to manifest its effects within a defined or known time horizon.

Criteria	Classification	Description
Duration (period of time in which the impact manifests itself)	Permanent	When an impact presents its effects extending beyond a defined or known defined or known time horizon.
Magnitude (size in absolute terms)	High	Impact with a strong intensity or extent of allocation
	Moderated	Impact with an intensity or extent of average allocation
	Reduced	Impact with a low intensity or extent of allocation
Significance (importance of environmental and social effects)	Very significant	Impacts of great importance
	Significant	Important impact
	Low significance	Minor impact

Table 3 Impact Classification

The environmental and social impacts generated and/or predicted by the activities recommended in the project, without the adoption of mitigating measures, will be described below for each lot.

The tables present impacts with and without mitigation measures to allow the identification of residual impacts.

12.3. POTENTIAL ENVIRONMENTAL IMPACTS - LAGARTO BAY

12.3.1 CONSTRUCTION PHASE

12.3.1.1 Greenhouse effect and climate change

Construction activities: The main impacts on climate result from the fuel, oil and lubricant consumption of machinery and electromechanical equipment handling, the electricity consumption for the electrical equipment and lighting of premises (building site), and the deforestation and tree removal.

Effects: increased Greenhouse Gases (GHG) emissions and reduction of CO₂ sequestration.

Impact Assessment: The impacts on current microclimate are inexistent since any actions on the climate result from the effect of the physical presence of the new infrastructure, a situation that will only occur in effective terms in the operation phase, with the completion of the implementation of the rehabilitated road and the construction of revetment and armour ridge for coastal protection.

In terms of climate change, the main construction activities that may have an impact have to do with the emissions of GHG from the vehicles associated with the works (CO, CO₂, NO_x, SO₂, among others) and any eventual concrete and bituminous plants (particles and VOC). Some of these are GHG and other GHG precursors.

Regarding the estimative of GHG emissions at this stage, they will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.).

Nevertheless, a brief estimative of the CO₂ emissions related to the transportation of the materials with a dump truck of 20 tonnes was assessed. This estimative has many unknown aspects related to the construction procedures and routes that the Contractor will use, so several assumptions were made:

- Use of a 20-ton dump truck for transporting materials;
- Debris resulting from the demolitions goes to the Penha dump;
- From the spillway and quarries, an average distance to the work front was assumed;

Regarding the CO₂ conversion factor for the dump truck, was used the value from¹ = 0.47 kg CO₂eq per t.km. The following table presents the estimated results.

Activities	Quantity (ton)	Distance (km)	Total number of trips (with 1 truck)	Total CO ₂ eq emitted (kg per t.km)	% Contribution
Excavations	70,397.12	10	7040	33086.65	50.39
Excavations and Debris	721.89	9	72	339.2883	0.52
Demolitions	2,395.58	9	239	1125.923	1.71
Materials	1,535.03	20	153	721.4641	1.10
Materials from quarries	8,599.61	20	860	4041.817	6.16
Coastal Protection Stones	47,377.83	20	4738	22267.58	33.92
Sand	8,665.71	6	867	4072.884	6.20

Table 4 CO₂ emissions from material transportation during construction stage

The transport emissions from excavation materials and the coastal protection stones have the major impact, mainly due to higher quantities required to be transported.

However, comparing to the most recent data regarding transport emissions in São Tomé and Príncipe (42.5434 Gg CO₂ in 2019²), the above obtained values correspond to the following very low percentages:

Activities	%
Excavations	0.078
Excavations and Debris	0.001
Demolitions	0.003

¹ https://www.winnipeg.ca/finance/findata/matmgt/documents/2012/682-2012/682-2012_Appendix_H-WSTP_South_End_Plant_Process_Selection_Report/Appendix%207.pdf

² Ministério das Infraestruturas e Recursos Naturais (2021). *Relatório de inventário de gases de efeito estufa no sector de energia para o período de 2010-2019*. 62 pp

Activities	%
Materials	0.002
Materials from quarries	0.010
Coastal Protection Stones	0.052
Sand	0.010

Table 5 Relative percentage of the material transportation emissions during construction stage, compared with transport annual emissions

The impacts **are not expected to be relevant**, in addition to being **temporary and mitigable**. The Impact is negative, direct, temporary, reduced magnitude and low significance.

During the construction phase, it is also worth mentioning the loss of a carbon sink with the destruction of vegetation cover in the project area. The increase in the concentration of greenhouse gases (GHG) in the atmosphere, namely CO₂, can be partially counteracted by carbon sequestration in forests that retain, in perennial biomass and in the soil, carbon that would otherwise be in the atmosphere in the form of CO₂.

Some trees (a total of 20) will need to be removed because of the large roots that are damaging the pavement and sidewalks. A brief calculation based on bibliographic references is presented to assess the CO₂ sequestration losses and gains with the removal and plantation of the trees.

Trees	Removal	Weight of CO ₂ Sequestred	Plantation	Weight of CO ₂ Sequestred
Coconut palms	16	30 kg/tree/year (1) 16*30= 891.12 kg/year		
<i>Terminalia catappa</i> (caroceiro)	4	Extrapolated from (2) 3564.5 kg/year		
<i>Washingtonian robusta</i> (Mexican palm tree)			14	221 kg/year (3) 14*221 = 3094 kg/year
<i>Vachellia karroo</i> (Karoo acacias)			17	645005.37 kg/ha (4) Assuming an area of 9m ² for each tree 9*17=153m ² 9868 kg/year
Tamarinds			5	50tC/ha (5). Assuming an area of 9m ² for each tree 9*5=45 m ² 225 kg/year
TOTAL		4455.6 kg/year		13217 kg/year

Table 6 CO₂ expected sequestration for the trees in Lagarto Bay

Legend: (1) BOOMIRAJ, K., R. Jagadeeswaran, S. Karthik, R. Poornima, S. Jothimani & R. Jude Sudhagar (2020). Assessing the Carbon Sequestration Potential of Coconut Plantation in Vellore District of Tamil Nadu, India. *International Journal of Environment and Climate Change* 10(12): 618-624; Article no.IJECC.66105; (2) NURSYAHBANDI, U.H., W Subchan & Suratno (2020). The estimation of CO₂ absorption and O₂ production from trees on main street in The City of Jember. *IOP Conf. Series: Earth and Environmental Science* 485 01204; (3) MADRID, A.Y.D. (2016). *Estimaciones de captura de los parques y emisiones de CO₂ vehicular en Tijuana, B.C.* Tesis para obtener el grado de Maestra en Administración Integral del Ambiente, El Colegio de La Frontera Norte, Mexico; (4) Based on a similar species (*Acacia mangium*) WIDHANARTO, G.O., R.H. Purwanto, A. Maryudi & Senawi (2016). Assessing Carbon Pool of Forest Plantation to Support REDD+ Implementation in Indonesia AIP Conference Proceedings 1755, 130008 (5) https://assets.publishing.service.gov.uk/media/57a08d58e5274a27b20017bf/R7274__Technical_specifications_Southern_India.pdf

Although the maximal CO₂ sequestration of the planted trees only occurs when the trees are fully growth, is already predicted that the landscape project will contribute significantly for mitigating climate changes compared to the current situation (almost twice the current sink capacity).

The impact of removing trees will be **residual and temporary** since 36 new trees will be planted with the landscape project.

12.3.1.2 Change in air quality

Construction activities: The main activities that generate the impact are earthmoving associated with road excavation and cleaning operations, transport of powdery materials for road rehabilitation, beach nourishment, circulation of equipment and machinery, demolition and removal of existing infrastructure (hydraulic crossings and paving) and the execution of paving, which may originate certain quantities of particulate material (dust) into the atmosphere, adding to other pollutants emitted by vehicles in circulation, namely, sulfur oxide, carbon monoxide, nitrogen oxides, volatile organic compounds, hydrocarbons, among others, damaging air quality during this stage.

Effects: Air pollution, nuisance to the health and welfare of the population in the area affected by the project and possible damage to the health of workers.

Impact assessment: Given that this is an already urbanized area where the main source of air pollution is the vehicles circulating on the Marginal and the proximity of the São Tomé airport, the impact on Air Quality is classified as negative, significant, direct, temporary and of moderate magnitude, during the construction activities along this lot, as a result of possible traffic jams on the Marginal and surrounding roads due to limitations in circulation due to occupation of the road, loading and unloading of construction materials and handling and loading of construction waste, circulation of heavy vehicles and, consequently, the construction workers and population in the direct catchment area may also be affected by the effects of this impact.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.3 Noise and Vibration Emissions

Construction activities: This impact is mainly associated with demolition activities and removal of infrastructure (hydraulic crossings, paving layers), movement of equipment, machinery and circulation of heavy vehicles.

Effects: Noise pollution, nuisance to the health and well-being of the population in the area affected by the project and possible damage to the health of workers (harmful hearing problems).

Impact assessment: The impact of noise and vibration emission is classified as negative, significant, direct, temporary and of moderate magnitude, due to the existence of increased noise levels in the vicinity of the works associated with construction activities, in an area where the main source of noise is road traffic from the marginal road and where there are hotel and sand beaches

that are very frequented by the inhabitants of the city of São Tomé and tourists. In addition, there are sensitive receptors in the area, namely Lar de Idosos - Casa da Misericórdia (CH 2+400), Hospital Central Ayres de Menezes (CH 2+320), whose noise interference can cause problems in the operation of these institutions.

Regarding Noise levels, the IFC/World Bank and World Health Organization (WHO) set standards for residential and industrial areas must be respected during construction.

Receptor	L (dBA) of 1 hour	
	Daytime period (07:00 - 22:00)	Night time (22:00 - 07:00)
Residential	55	45
Industrial, Commercial	70	70

Table 7 IFC General Environmental, Health and Safety Guidelines for Noise Levels

The limit value of the environmental noise indicator (LAeq) in the project intervention area, characterized as a residential area, is 55 dB(A) during the daytime period (7:00-22:00) and 45dB(A) at night. During the construction phase "temporary noisy activity" will be practiced with some frequency and will only be carried out during the daytime. It is prohibited on Sundays and holidays, and during weekdays between 10 pm and 7 am. However, in exceptional cases and duly communicated to the community, noise may be made on the prohibited days and times

Due to the expected changes, the construction activities may result in a low significant impact, if the measures recommended in the chapter 14 are adopted.

12.3.1.4 Soil Exposure to Erosive Agents

Construction activities: Earth moving and vegetation removal activities, which will proceed with the excavation for the replacement of the new two culvert boxes CH0+448 and CH 1+335).

Effects: Water pollution, resulting from increased turbidity and concentration of suspended solids and siltation in water courses.

Impact Assessment: In Lagarto Bay the geomorphology of the terrain is mild and the soil consists of Quaternary alluvial deposits, which cover the basaltic rock and the interventions foreseen removal of vegetation for placement of two culvert boxes (CH 0+448 and CH 1+335) to replace the existing ones, that exposes soil to erosive agents. The impact is negative, direct, temporary, reduced magnitude and low significance.

12.3.1.5 Soil Water Infiltration

Construction activities: Potential impact activities may be due to soil compaction associated with the movement of heavy equipment and machinery between the construction site, quarry and the construction site, and to the increase in impermeable area resulting from the rehabilitation of the Marginal road.

Effects: Flooding, water erosion, silting up. These activities contribute to a decrease in water infiltration into the soil, with a consequent increase in surface runoff, which can lead to flooding during periods of heavy rainfall.

Impact Assessment: The impact of water infiltration into the soil can be classified as negative, low significance direct, temporary and of moderate magnitude, because there will not be a substantial increase in the impermeable area with the rehabilitation of the Marginal road and coastal protection. In the selection of quarries and location of construction sites, preference will be given to existing ones, as well as in the access to the works, the opening of new accesses will be avoided. If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.6 Soil Contamination

Construction activities: The main impact-generating activities are associated with inappropriate handling or spillage of hazardous products such as fuel, oils, lubricants and bituminous materials demolition of infrastructure (drainage works CH 0+448 and CH 1+335), maintenance and washing of equipment and machinery, disposal of wastes in inappropriate places, earth moving during the works period.

Effects: Activities may result in contamination of soil, surface and groundwater, degradation of water courses, alteration of water quality, and may affect the aquatic ecosystem.

Impact Assessment: The negative impact is considered to be significant, temporary, local in scope and of moderate magnitude. The aforementioned activities are located on the banks of some water courses and near the sea, where soil is very permeable (sand) and the percolation of liquids is facilitated and may reach the water, there are potential events of risk of contamination of both soil and water. If this contamination occurs it will contribute to the current degradation of the quality of the soil and surface and underground water resulting from the discharge of domestic wastewater from households, washing of clothes in water courses and open defecation. With the implementation of the measures, presented in the chapter 14, the significance of the impact is expected to be reduced to low significance.

12.3.1.7 Alteration in Geomorphology

Construction activities: The alteration in geomorphology is due to the extraction of materials in quarries and the erosion process associated with logging activities, earthmoving, and the movement of equipment and machinery.

Effects: Earthmoving activity, especially excavations, as well as vegetation cover removal/tree felling may enhance erosion by dragging sediment to undesired areas, and may even result in siltation of water courses. For coastal protection deposition of sand for beach nourishment (CH 0+800 – CH 1+860) activities causes increase of suspended sediments in sea water.

Impact Assessment: The impact of changes in terrain is of certain occurrence, negative, low significance, direct, permanent, of reduced magnitude, with the scope in the area of direct influence of the project. Earth-moving activities, especially excavations, as well as the removal of vegetation cover/tree felling, may potentiate erosion by dragging sediment to undesired areas, and may even result in the silting up of water courses. Impacts resulting for deposition of sand causes increase of suspended sediments in sea water. These activities cause the topographic change of the land.

The erosion of the beach is currently increased by the raise of sea level due to climate change, with more energetic and longer waves coming in and reaching the road, accelerating erosion processes. By beach nourishment and raising the height of the beach by approximately 1 m, this effect is avoided and the breaker zone move away from the road, giving a width of 20-25 m to the beach at mid-tide level. This leads climate change adaptation by compensating the SLR effect by the raise of beach elevation.

Coastal erosion is expected to be small, as it is the one that has been occurring historically, which means practically no sediment transport resulting from hydrodynamics in the longitudinal direction of the beach and small in the transverse direction, caused by storms that "lower" the sand to depths from which it does not recover.

The plan designed with maintenance means that any erosion that may occur is compensated by reprofiling or recharging with sand from quarries. Therefore, the erosion that is currently occurring, which causes loss of habitat, loss of trees due to root erosion, etc., will be controlled. There will be no alteration of the coastal geomorphology as a result of hydrodynamics.

However, the significance of this impact may be reduced to low significance, if the mitigation measures foreseen in the chapter 14 are adopted.

12.3.1.8 Consumption of natural resources (fossil fuels, energy, water and construction materials)

Construction activities: Road rehabilitation, construction of hydraulic structures and coastal protection, movement of machinery and equipment, use of electrical equipment and lighting of the facilities (construction site), cement preparation, washing of concrete mixers, equipment and machinery, as well as the operation of the construction site, generate impacts on the consumption of natural resources.

Effects: Increased consumption of natural resources in the region.

Impact assessment: As this is a consumption of natural resources, it may have **negative** consequences on other aspects of the biophysical environment in the area of direct influence. During the period of construction activities, there is cement preparation, washing of concrete mixers and equipment, circulation and operation of equipment and machinery, as well as activities associated with the operation of the construction site (offices, bathrooms, warehouse, workshop among others) a result in substantial consumption of water, energy and fossil fuels

The energy estimate required for rehabilitation of road pavement in Lagarto Bay is estimated as 11,6 TJ. If some sections of pavement are rehabilitated (maintained and reuse), the value will be less because not all sections of road will have new pavement. Nevertheless, the energy consumption of rehabilitation is more advantageous, in comparison with the new pavement. The estimative of total energy consumption for country was according MIRN (2021) 2180,3 TJ for year 2019.

Thus, also for fossil fuels impact was considered negative, low significance, being direct, temporary and with reduced magnitude.

The coastal protection structures will require also some energy to their construction, but will be negligible. The impact of use of energy is negative, with reduced magnitude, temporary and low significance.

The materials necessary for the project are estimated 2974,87 m³ of concrete, 1477,45 m³ of materials from quarries, 14497,5 of stones and 14159,65 m³ of sand for costal protection in a total of 33 109, 47 m³.

During the construction phase, the demand for inert materials such as sand and stones may increase, which may cause a shortage of materials in the country, as well as encourage the exploitation of inert materials in unauthorised locations. For the construction activities planned in this region, this impact has been assessed as negative, significant, direct, temporary and of moderate magnitude.

For estimation of water consumption, it was assumed that for an average of 1 m² of road, 2 m³ of water will be consumed (consumption of concrete, construction / formwork and other washes and

trucks, etc). is estimated as 77 107,20m³. The impact is negative, temporary, moderate magnitude and significant.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.9 Alteration in Water quality

Construction activities: This impact is associated with the dragging of sediment into bodies of water, which in turn causes turbidity and suspended solids, leading to degradation of water quality. In fact, the main generating activities include the replacement of culvert boxes (CH0+448 and CH 1+335), earthmoving, removal of vegetation cover and coastal protection works, involving beach nourishment CH 0+800 – CH1+860, construction of the armature ridge and construction of walls.

Effects: Water pollution, affecting the aquatic ecosystem and inconveniencing the health and well-being of the population in the project's area of influence.

Impact Assessment: Lagarto Bay is an area frequented by the population of São Tomé for sea bathing and by tourists, diving but it is also an area without a wastewater drainage system, with wastewater being discharged into the sea, laundry being washed. Therefore it is considered that the impact resulting from the planned construction activities will result in a negative impact, significant, temporary, local in scope and of moderate magnitude. It is expected that with the implementation of the measures recommended in the chapter 14, the significance of the impact will be reduced to low significance.

The monitoring of water quality will help to know the impacts of constructions activities in water and if the efficiency of mitigation measures proposed.

12.3.1.10 Risk of surface/groundwater contamination

Construction activities: The main activities generating the risk of contamination of surface and groundwater are the activities of disinfection of new water pipes and the maintenance and washing of equipment and machinery affected to the work will be responsible for the production of liquid effluents, such as disinfectants, oils and grease, which may result in contamination of the water table if these operations do not take place in an impermeable site, with the respective retention basin.

Effects: Risk of contamination of surface and ground water and of aquatic ecosystems crossed by the water line.

Impact assessment: The risk of contamination may arise whenever there is a spill of products resulting from the storage and handling of hazardous products (fuels, oils, lubricants and concrete) in an inappropriate manner. Equipment and machinery movement activities, demolition of existing infrastructure including hydraulic structures, and construction of new CH 0+450 and CH 1+340 may also result in possible spillage of hazardous products. This can also occur as a result of traffic accidents between vehicles and machinery involved in this activity. At the site of the works, as the soil consists of alluvial sandy soils, percolation is facilitated and may reach surface water and groundwater. As mentioned above, it is expected that surface waters already have their quality altered and with the existence of a spill there will be a contamination of surface/ground waters, classifying this impact as negative, direct, of moderate to high magnitude, and the level of significance may be significant or very significant depending on the size of the spill.

The waste production and production of liquid wastes at construction site can have a negative, direct, temporary, with moderate or high very significant impact or significant impact in surface and groundwater contamination, but with mitigation measures proposed these impacts will be mitigated, to avoid soil and groundwater contamination.

In Sao Tomé there is no wastewater system nor wastewater treatment and final disposal for wastewater are septic tanks and sea, when there aren't directly discharged in water courses.

Regarding significance, if the measures foreseen in the chapter 14 are adopted, the level of impact significance will be reduced to low significance and significant, respectively.

12.3.1.11 Alteration in water flow patterns and flooding

Construction activities: The main impact-generating activities are associated with the demolition of existing infrastructure, including hydraulic structures and construction of new CH 0+450 and CH 1+340, construction of revetment and armor ridge for coastal protection, earthmoving and removal of vegetation cover or sidewalk, causing siltation of water courses triggered by the dragging or transport of fine material or sediments by the action of rain during the period when the soil is disintegrated.

Effects: Demolition of infrastructure near the water courses can alter water flow patterns and cause flooding.

Impacts Assessment: Impact resulting from the risk of flooding can be classified as negative, temporary, local in scope and reduced to moderate magnitude, mainly because during demolition and construction of the hydraulic crossings, it may cause silting up due to the opening of drains and detour channels, as well as the improper accumulation/deposit of waste in water bodies, resulting in the interruption of runoff if the drainage of water with its flow is not guaranteed. This is an impact whose level of significance ranges from low significance to significant.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance respectively, given the generating activity.

12.3.1.12 Landscape alteration and visual impact

Construction activities: The main activities generating impact on the landscape include the movement of heavy equipment and machinery, earthmoving, removal of vegetation cover for road rehabilitation, coastal protection including beach nourishment, construction of a playground and the construction of a laundry.

Effects: Change in the landscape in the project's area of influence, as a result of the presence of siding to fence off the construction work along the coast, which implies a change in the visual scenery.

Impact Assessment: The marginal in Lagarto Bay presents in general a high visual quality of great (palm trees, beach and sea) and with a low capacity of absorption of foreign elements to the landscape, with a large number of observers (users of the marginal road, bathers and tourists) due to its natural characteristics, these areas have great landscape sensitivity. The presence of the fence do not allow the sea visualization and changes the scenic quality for road users. Thus, the impact is considered negative, significant, direct, temporary, local and of moderate magnitude.

If the mitigation measures provided in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.13 Disturbance of the Terrestrial Ecosystem (flora and avifauna)

Construction Activities: The disturbance of the terrestrial ecosystem, especially flora and avifauna, is associated with removal of vegetation cover and activities that generate visual and noise pollution (disturbance), where the operations of heavy equipment and machinery, earthmoving, and road rehabilitation, coastal protection and beach nourishment stand out.



Effects: Reduction of habitats and pressure on associated fauna.

Impact Assessment: With the rehabilitation of the Marginal Road, there will be need to remove some tree specimens due to their consequences on the existing pavement (damage by the root system and implementation of the project). For Lagarto bay, is expected to be removed 16 coconut palms and 4 *Terminalia cattapa* (caroceiro). None of these species have protection status, although *T. cattapa* has a landscape value, due to their wide, open and almost horizontal canopies and their height (up to 25 m), providing enough shadow. This loss of potential habitats will be replaced by new planted trees, namely 14 *Washingtonian robusta* (Mexican palm tree), 17 *Vachellia karroo* (Karoo acacias) and 5 tamarinds, in a total of new 36 trees. These trees will be able to provide biotopes to several animal groups, especially invertebrates and birds.

Regarding the visual and noise disturbance, this can affect the existing avifauna in Lagarto Bay because the presence and increased noise levels resulting from vehicle movements, machinery operation, and the presence of workers during construction can affect the birds' life cycle, whether it be reproduction, resting or feeding. Besides this, the birds may suffer with the reduction of their areas of use, which can lead to their displacement to other locations with suitable habitat. However, considering that the project's area of influence is located in urbanized area, with intense visual disturbance and noise from automobile and air traffic, birds are already adapted to these urban impacts. In addition, the species occurring here are generalists, with no conservation status. The plantation of new trees mentioned above will contribute for potential nest, resting and feeding sites.

In view of the above, this can be classified as a negative, direct and temporary impact, reduced magnitude and level of significance is low.

With the adoption of the measures recommended in chapter 14, the significance of the impact will be further reduced.

12.3.1.14 Disturbance and degradation of the marine ecosystem

Construction Activities: The main activities generating impacts on disturbance and degradation on marine ecosystem are earthmoving, movement of heavy equipment and machinery, construction of revetment and armor ridge for coastal protection and beach nourishment CH 0+800 to CH 1+860). These activities may generate water turbidity and noise disturbance. Light disturbance during the construction stage is not expected, since the construction works will be performed only during daylight. Accidental spills of hazardous products (fuel, oil, lubricants and concrete) from heavy machinery and equipment can lead to contamination and destruction of marine ecosystems.

The origin of sand used for concrete and beach nourishment can create negative impacts on coastal and marine ecosystems if sands comes from marine dredging and beach sand mining as is commonly done in São Tomé Island. Is not the case in this project that sands come from quarries.

Effects: Contamination of local marine waters, and the driving away of marine species and/or death.

Impact Assessment: Earthmoving may lead to particles dragged into the water and cause turbidity in the intertidal area, with impacts on the existing organisms. Because of the already wave movement in the area, due to the shallow depth, is not expected that this turbidity will cause any significant impacts.

Coastal protection works may cause underwater noise and the temporary lighting of the works may affect turtle routes and nesting sites. This negative impact is considered to be significant, direct, temporary and of moderate magnitude.

The impacts from the spill of hazardous products are expected to be minimal or even non-existent, if all the mitigation measures are adopted. In addition, the quantities that may be accidentally dragged into the water are easily diluted in the sea water, so no permanent impacts are expected.

The impact of sea turtle nesting beaches degradation during the construction phase is considered to be negative, direct, permanent, moderate magnitude and significant considering the conservation status of these species.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.15 Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area

Construction Activities: The construction activities of revetment, armor crest, wall and beach nourishment CH 0+800 to CH 1+860.

Effects: Construction activities that involve occupation of the intertidal area may result in the loss or alteration of this area and consequent loss of biodiversity.

Impacts Assessment: Construction activities can affect the intertidal area in Lagarto Bay, which can be sandy beaches or rocky coast. This area is already subject to human pressure, with hunting, fishing or trampling of fauna, with more generalist species. Nevertheless, the impacts of loss of biodiversity by occupation of this area is considered negative, direct, permanent, significant and of moderate magnitude. With the stabilization of the structures, there is potential for flora and fauna colonization with new communities.

Emilia Beach in Lagarto Bay show turtle nesting activity even know these are not the main nesting areas in the island for turtle nesting. However, sea turtle harvesting for local consumption, human disturbance, beach erosion mainly driven by illegal sand mining and climate change, and the existence of stray dogs have contributed to the decrease of these populations

Project can impact on sea turtles when a project action affect a nest buried in the sand by the female or by disturbing female's behavior when trying to spawn in the sand of the beach.

Therefore, Project shall avoid:

- any actions on the beach to prevent impacts on nests and
- disturbance to females when arriving the beach to spawn.

As said before the Project's component that could affect the sandy beaches are those related to coastal protection. Design of Coastal protection, particularly rock revetment, could affect the top or high part of the beach in contact with the road rehabilitation. This is the major identified project action that shall be monitor and for which mitigation measures shall be put in place during construction phase to eliminate impact on the sea turtle nesting resource.

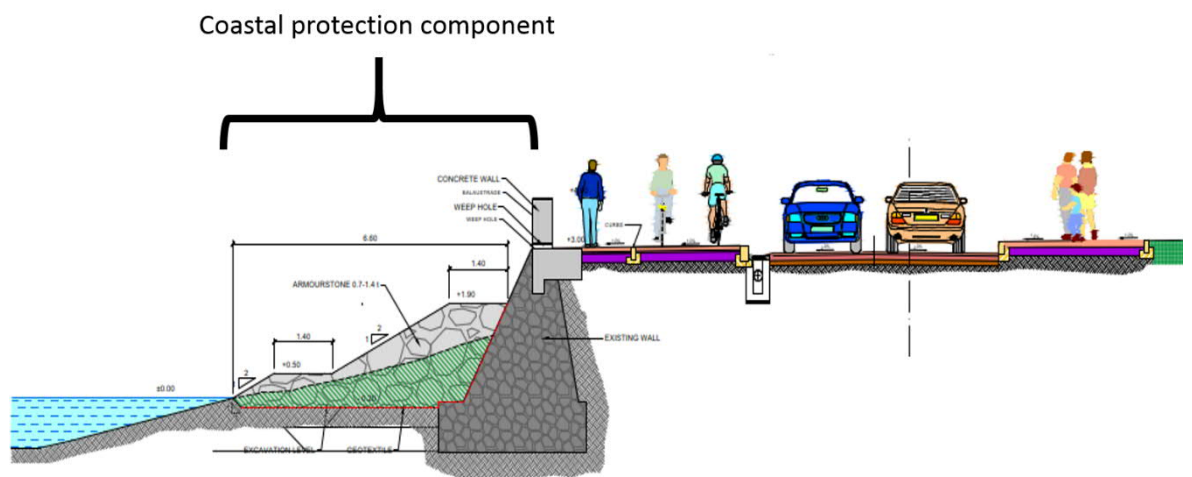


Figure 1 Coastal protection component (over a typical cross section)

Beach sections that keep suitable characteristics for turtle nesting, sandy beach and not rocky or without intertidal area or a wall, are shown in the figure below:



Figure 2 Beach section that could attract turtles for nesting.

Sea turtles nesting in Lagarto Bay beach will be negatively affected by the noise and presence of machinery during the construction work. Construction activity in coastal should be avoided during the sea turtle nesting season from October to April.

The consequences of beach nourishment on the sustainability for sea turtles nesting will depend on the characteristic and quality of the sand. If sand used for beach nourishment is not suitable for effective sea turtle nest digging, beach nourishment will cause negative impact on reproduction sites of threatened sea turtles species. Is foreseen a Beach Nourishment Management Plan to avoid this negative effects.

With the implementation of the measures recommended in the chapter 14, the significance of the impact is expected to be reduced to low significance. The mitigation measures in construction phase recommended to achieve a positive conservation outcome are:

- Code of Conduct for workers;
- Contractor's Workers sensitization.
- Work program for construction activities in beach from October to April, avoiding the nesting sea turtles season;

- Beach nourishment management plan;
- Turtles find Procedures;
- Turtles management Plan preparation and implementation.

12.3.1.16 Effect on Health (auditory system, respiratory system) of the Population and Workers

Construction activities: The activities of moving equipment and machinery, moving earth, building new infrastructure (roads, hydraulic structures and coastal protection, etc.), demolishing existing infrastructure, and removing paving layers, all lead to the production of dust and noise.

Effects: All the above-mentioned operations present potential for the availability of particulate material (dust) and noise emission, causing interference in the health and well-being of the population in the area of direct influence and of the workers affected by the execution of the operations.

Impacts Assessment: During the construction activities there will be an increase in noise levels, the production of dust, which may cause an impact on the health of the population and workers is classified as negative, direct, permanent and of high magnitude. This impact was considered significant (respiratory system) and very significant (auditory system).

If the mitigation/prevention measures recommended in the chapter 14 are applied, the significance of the impact will be reduced to low significance and significant, respectively.

12.3.1.17 Reduction of quality of life (population and workers)

Construction activities: During the execution of the work, the use of equipment and machinery and the circulation of equipment, machines and vehicles used to transport materials for the work are foreseen in the vicinity of residential areas and on roadways, with the removal and replacement of pavement layers, demolition of buildings such as walls, benches, and the construction of drainage works, coastal protection, the construction of a laundry and a playground promoting interference in the quality of life of the population.

Effects: The planned interventions in Largarto Bay will have interference in the life of the population, being a much sought after recreational space.

Impacts Assessment: Negative, very significant, direct, temporary and high magnitude impact. The planned interventions in the roads, being a much sought after leisure area, with hotels and residential areas, will interfere in the life of the population, in their habits of walking or going to the beach, with a large number of road users and near hotels and the bathing area of Lagarto beach, the movement of equipment, machinery and vehicles, especially heavy vehicles, will interfere in the life of the population, restrict local traffic, reduce parking places and have an effect on road safety.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to significant.

12.3.1.18 Occupational Health and Safety Risk

Construction activities: Workers involved in construction activities are exposed to various risks when using equipment and machinery.

Effects: Activities that include operation of electrical equipment and movement of machinery and vehicles, can result in electrocution, hit-and-runs, or to serious accidents.

Impact assessment: The construction activities will develop negative impact, significant, direct, temporary, restricted to workers on the site and reduced magnitude, and may cause problems for workers, altering health conditions and levels of safety at work.

If the measures set out in the chapter 14 are properly applied, the level of significance of the impact will be reduced to low significance.

12.3.1.19 Reduction of Road Safety (pedestrians and road users)

Construction activities: During the course of road construction activities, it will be necessary for machinery, equipment and heavy vehicles to circulate, traffic detour, reduction in vehicle speed, and the circulation of construction workers, causing interference with vehicle access for residents in the area affected by the construction work, as well as with road users.

Effects: All construction site activities that involve the operation and movement of machinery, equipment and heavy vehicles can increase the risk of road accidents if the proper safety measures are not taken to carry out the activities.

Impact assessment: The impact on road safety is considered negative, significant, restricted to the area of intervention of the work, whose duration will be while the work takes place, planned for 36 months. Considering that the population of the surrounding area, construction workers and road users, the frequenters of Emília Beach and will be directly affected by the construction activities, the magnitude is considered moderate.

If the mitigation and/or prevention measures foreseen in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.20 Occupation of Public Space (Waste Management)

Construction activities: The activities related to waste production at construction sites, namely the demolition of existing infrastructure and construction of new infrastructure (buildings, sidewalks, pipelines, etc.) promote the inadequate disposal of wastes, especially in public spaces.

Effects: Water pollution by dragging waste to water courses, sea and beach.

Impact assessment: The entrainment of unpackaged construction and demolition waste into water and sand lines can lead to a negative, significant, direct, temporary and reduced magnitude impact.

With the adoption of mitigation and preventive measures before and during construction, the significance of the impact will be reduced to low significance.

12.3.1.21 Population and workers health risk (waste management)

Construction activities: All road construction activities generate solid and liquid waste from demolition operations of existing infrastructure, road rehabilitation, construction of hydraulic structures and coastal protection, as well as from sanitary facilities at the construction site and on the

construction sites. During these activities, solid and liquid waste such as packaging, cardboard, concrete waste, cables, iron, rubble, demolition waste, wastewater, etc., domestic waste and hazardous waste must be transported to the appropriate final destination.

Effects: Waste management when performed improperly promotes a situation of risk to the health of the population and workers on site, as well as environmental degradation of the affected area.

Impacts assessment: Impacts on waste management is classified as negative, significant, direct, permanent and of high magnitude. Due to the fact that there are currently no bins for waste disposal, the works can generate solid waste and hazardous liquids that can contaminate the beach with risk to the health of the population of the direct influence area of the project. Likewise, waste from the construction site infrastructure (offices, bathrooms, warehouse, workshop among others) and the concentration of workers near the construction site will be responsible for the production of solid waste and wastewater, respectively. Therefore, the absence of adequate waste management endangers the health of the population, workers and/or generates adverse damage to the environment.

During the construction phase, wastes will be generated associated with the execution of the works, which have the following main typologies, according to the European Waste Codes (EWC):

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17
13 02 06 (*)	Synthetic engine, gear and lubricants oils
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used Tires
16 06	Bateries and Accumulators
16 01 07 (*)	Oil filters
17 01 01	Concrete
17 01 02	Bricks
17 01 03	Tiles, roof tiles and ceramic materials
17 01 06 (*)	Mixtures or separate fractions of concrete, bricks, tiles and ceramic materials containing hazardous substances
17 01 07	Concrete mixtures, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02 01	Wood
17 02 02	Glass

Code	Solid Wastes
17 02 03	Plastic
17 02 04 (*)	Glass, plastic and wood containing or contaminated with hazardous substances
17 03 01 (*)	Bituminous mixtures containing tar
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 03 03 (*)	Tar and tar products
17 04	Metals (including alloys)
17 04 01	Copper, bronze, and brass
17 04 02	Aluminum
17 04 03	Lead
17 04 04	Zinc
17 04 05	Iron and steel
17 04 06	Tin
17 04 07	Mixed metals
17 04 09 (*)	Metal waste contaminated with hazardous substances
17 04 10 (*)	Cables containing hydrocarbons, tar or other hazardous substances
17 04 11	Cables other than those mentioned in 17 04 10
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20 01 21	Fluorescent tubes and other mercury-containing waste
20 02	Garden and park wastes
20 03 04	Septic tank sludge

Table 8 - Construction wastes

(*) Hazardous wastes

In terms of quantification, for the **solid waste and effluents (fuel and wastewater)** produced during construction stage, it was assumed similar values as other projects developed in São Tomé and Príncipe³ and are presented in the following table:

Type / Waste category		Quantities produced (Kg)	
		Day	Week
Packages	Bags / Plastic Straps	21	126
	Cement bags	30	180

³ • The construction of the Fishing Dock Building, currently CKADO Supermarket; • Hospital Road Retaining Wall, in front of CKADO Supermarket • Containment of the seafront along the 250 m after the CKADO Supermarket, towards the center of São Tomé city

Type / Waste category		Quantities produced (Kg)	
		Day	Week
Work front	Demolition debris	450	2.700
	Road pavement scarification	1.350	8.100
	Remains of Materials	45	270
	Used waters	900	5.400
	Fuel	4,5	27
Office	Paper	36	216
	Used materials	7,5	45
	Dejects	72	432
	Wastewaters	900	5.400

Table 9 - Estimate of category and amount of solid waste and wastewater to be generated at Pantufo Coastline

A considerable part of the solid residues produced on the different work fronts, mainly debris resulting from the demolition of works of art and solid residues resulting from the scarification of the asphalt pavement will be recovered for use in repair work on dirt roads and macadam.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.1.22 Reuse of Recycled Glass

Construction activity: The activity generating this impact is associated with the construction of benches inherent to the landscape requalification of the Marginal, promoting the reuse of waste.

Effects: Building the benches and decreasing the amount of solid waste (glass) disposed in inappropriate places.

Impact Assessment: The reuse of recycled glass in the construction of new benches, is classified as a positive impact, significant, direct, temporary and of moderate magnitude, because it will reduce the volume of waste (glass bottles, etc.) that is out in the open on the island, as well as prevent possible accidents (cuts with glass) of people who frequent the streets.

If the measures in the chapter 14 are applied, the level of significance of the impact is expected to be reduced to low significance.

The following table summarizes the foreseen impacts during construction.

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Climate and Climate Change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	N	D	T	R	LS	LS
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	N	D	T	R	LS	LS
	Electricity consumption		Use of electrical equipment	N	D	T	R	LS	LS
			Lighting of premises (building site)	N	D	T	R	LS	LS
	Reduction of CO2 sequestration		Deforestation and felling of trees	N		T	R	LS	LS
	Increased GHG emissions		Construction of revetment and armour ridge for coastal protection and transportation of materials	N	D	T	R	LS	LS
Air quality	Dust production	Alteration of air quality (CO2, CO, NOX, SOX, HC, VOC's and PM)	Earthmoving	N	D	T	M	S	LS
Moving equipment and machinery									
Cement preparation									

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Air quality			Beach nourishment CH 0+800 to CH 1+860					S	LS
			Construction of revetment and armour ridge for coastal protection						
			Removal and replacement of pavement layers						
	Fuel consumption		Lighting of premises (building site)						
	Use of electronic and electromechanical equipment								
	Demolition of existing infrastructure including the hydraulic structure and CH 0+450 and CH 1+340)								
Noise	Noise generation	Noise and vibration emission	Removal and replacement of pavement layers	N	D	T	M	S	LS
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.						
			Moving equipment and machinery						

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Soil	Excavations for replacement of new hydraulic structures (CH 0 +450 and CH 1+340)	Increased exposure to erosive agents (water and wind)	Earthmoving	N	D	T	R	LS	LS
	Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Increase in the impermeable area with pavement	N	D	T	M	LS	LS
			Movement of heavy equipment and machinery on the access roads to the quarries	N	D	T	M	LS	LS
	Solid waste disposal in inadequate sites	Soil contamination	Operation of the construction site	N	D	T	M	S	LS
	Accidental spillage of hazardous products (fuel, oil, lubricants and concrete)		Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	M	S	LS
Production of solid waste and liquid effluents	Demolition of existing infrastructure		N	D	T	M	S	LS	
Geology			Removal of vegetation cover/tree felling	N	D	P	R	LS	LS

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
	Extraction of materials from quarries	Change in the topography of the land (geomorphology)	Earthmoving						
			Moving equipment and machinery						
	Coastal erosion	Changing the topography of the land (geomorphology)	Removal of vegetation cover/tree felling	N	D	T	R	LS	LS
Earthmoving for Coastal protection and beach nourishment CH 0+800 to CH 1+860									
Moving equipment and machinery									
Water resources	Water consumption	Consumption of water resources	Operation of the construction site	N	D	T	H	S	LS
			Cement preparation						
			Washing of concrete mixers, equipment and machinery						
	Dragging of sediments into water bodies (water turbidity)	Reduction in water quality	Earthmoving	N	D	T	M	S	LS
			Removal of vegetation cover	N	D	T	M	S	LS
			Rehabilitation of the hydraulic crossings	N	D	T	M	S	LS
	Waste production		Solid waste disposal in inadequate sites	N	I/D	T	H	VS	S

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Water resources	Production of liquid effluents	Contamination of surface/groundwater	Maintenance and washing of equipment and machinery	N	I/D	D	M	S	LS
			Disinfection of new water pipelines on the Marginal	N	I/D	D	M	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants and concrete)		Storage and handling of dangerous products	N	I/D	D	H	VS	S
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 0+450 and CH 1+340	N	T	D	M	S	LS
			Movement of equipment and machinery	N	T	D	M	S	LS
	Production of dust (turbidity)		Construction of revetment and armour ridge for coastal protection	N	T	D	M	S	LS
			Earthmoving	N	T	D	M	S	LS
			Movement of equipment and machinery	N	T	D	M	S	LS
			Removal of vegetation cover	N	D	T	R	LS	LS

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Water resources	Deposition of waste and sediments	Interruption of drainage patterns	Earthmoving	N	D	T	R	LS	LS
			Construction of revetment and armour ridge for coastal protection	N	D	T	R	LS	LS
			Demolition of existing infrastructure and construction of the new hydraulic structures CH+ 450 and CH 1+340	N	D	T	R	LS	LS
	Siltation of water courses	Flooding (destruction of infrastructure)	Construction of revetment and armour ridge for coastal protection	N	D	T	M	S	LS
			Demolition of existing infrastructure and construction of the new hydraulic structures CH 0+ 450 and CH 1+340						
			Earthmoving						
			Removal of vegetation cover						
Natural resources	Fuel consumption (diesel, gasoline)	Increased consumption of fossil fuels	Use of equipment and machinery	N	I	T	R	S	LS
	Electricity consumption		Use of electrical equipment	N	I	T	R	S	LS

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
		Increase in electricity consumption	Lighting of premises (building site)	N	I	T	R	S	LS
	Consumption of construction materials (stones, sand, wood, etc)	Increased consumption of construction materials	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	LS
			Cement preparation	N	D	T	M	S	LS
	Consumption of water	Increased consumption of water	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	LS
			Cement preparation						
	Landscape	Introduction of foreign elements that disturb the landscape	Landscape alteration	Removal of vegetation cover	N	D	T	R	LS
Earthmoving				N	D	T	R	LS	
Presence of fence				N	D	T	M	S	LS
Moving equipment and machinery				N	D	T	M	S	LS
Landscape		Visual Impact	Removal of vegetation cover	N	D	T	M	S	LS

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
	Destruction of vegetation cover		Earthmoving	N	D	T	M	S	LS
			Moving equipment and machinery	N	D	T	M	S	LS
Biodiversity	Noise emission	Disturbance of the Terrestrial Ecosystem (Flora and Fauna)	Earthmoving	N	D	T	R	LS	
			Handling of heavy equipment and machinery	N	D	T	R	LS	
			Road rehabilitation, coastal protection and beach nourishment (CH 0+800 – CH1+860)	N	D	T	R	LS	
			Removal vegetation cover	N	D	T	R	LS	
	New habitats for birds nest, breeding and rest		Grubbing 16 coconut palms and 4 <i>Terminalia cattapa</i> (caroceiro) and planted 36 trees 14 <i>Washingtonia robusta</i> (Mexican palm tree), 17 <i>Vachellia karroo</i> (Karoo acacias) and 5 tamarinds.	N	D	T	R	LS	
	Accidental spillage of hazardous products		Earthmoving	N	D	T	R	LS	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Biodiversity	(fuel, oil, lubricants and concrete)	Disturbance and degradation of the marine ecosystem							
	Alteration of water quality		Handling of heavy equipment and machinery	N	D	T	R	LS	
	Sea turtle nesting beaches disturbance		Coastal protection and beach nourishment CH 0+800 to CH 1+860	N	D	T	M	S	LS
	Quality of sand		Coastal protection and beach nourishment CH 0+800 to CH 1+860	N	D	T	M	S	LS
	Noise		Coastal protection and beach nourishment CH 0+800 to CH 1+860	N	D	T	M	S	LS
	Alteration of the intertidal habitat	Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area	Construction of revetment, armour crest, wall and beach nourishment CH 0+800 to CH 1+860	N	D	P	M	S	LS
Occupational Health and Safety	Accidents at work (falling, tripping, cuts)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	N	D	T	R	S	LS
		Reduced quality of life		N	D	T	H	VS	S
		Vehicle damage		N	D	T	R	S	LS

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
	Road accidents/tri-traffic trespassing	Reduced quality of life	Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	H	VS	S
	Dust emission	Harmful effects on the workers' respiratory system	Earthmoving	N	D	P	M	S	LS
			Infrastructure construction (road, hydraulic structures and coastal protection, etc)						
	Noise emission	Harmful effects on workers' hearing systems	Demolition of existing infrastructure	N	D	P	H	VS	LS
			Moving equipment and machinery						
			Infrastructure construction (road, hydraulic structures and coastal protection, etc)						
Community Health and Safety	Accidents falls	Reduced pedestrian safety	Use of construction material transport equipment and machinery and vehicles	N	D	T	M	S	LS
		Reduced quality of life		N	D	T	H	VS	S
		Reduced quality of life		N	D	T	H	VS	S

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Waste Management	Road accidents/tri-traffic trespassing	Reducing road safety	Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	M	S	LS
	Dust emission	Harmful effects on the population's respiratory system	Earthmoving	N	D	P	M	S	LS
			Removal and replacement of pavement layers						
			Demolition of existing infrastructure						
	Noise emission	Harmful effects on the population's hearing system	Moving equipment and machinery	N	D	P	H	VS	LS
			Demolition of existing infrastructure						
			Removal and replacement of pavement layers						
	Production of construction and demolition waste (buildings, floors, pipes, etc)	Occupation of public space	Demolition of existing infrastructure and construction of new infrastructure	N	D	T	R	S	LS

Factor	Aspect	Impact	Activity	Classification				Impact Without measures	Impact Without measurements
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significant/ Significant/ Very Significant)	Significance (Low Significant/ Significant, Very Significant)
Waste management	Waste water production	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	P	H	S	LS
		Harmful effects on the health of workers and community	Kitchen and sanitary installations in the Construction Site and sanitary installations in the work fronts.	N	D	P	H	S	LS
	Production of hazardous waste	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	H	VS	S
			Demolition of existing infrastructure						
	Use of waste	Using locally recycled glass	Construction of benches	P	D	T	M	S	
Production of domestic waste	Harmful effects on the health of workers and community	Kitchen and sanitary facilities in the Construction site and sanitary facilities at the work fronts	N	D	P	H	S	LS	

Table 10 Environmental Impact Assessment. Construction Phase. Lagarto Bay

12.3.2 DEMOBILIZATION PHASE

12.3.2.1 Greenhouse Effect and Climate Change

Demobilization activities: The main impacts on climate results from similar activities already described for construction stage, except the deforestation.

Effects: Increased Greenhouse Gases (GHG) emissions.

Impact Assessment: Similar to what was assessed for construction phase the estimative of GHG emissions at this phase will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.). However, these are not expected to be relevant, in addition to being temporary and mitigable.

12.3.2.2 Change in air quality

Demobilization activities: The generation of this impact is due to the increase in vehicle circulation and the operation of equipment and machinery used in the removal of equipment assigned to the construction site and the removal of demolition debris resulting from the installation of a construction site with infrastructure for offices, bathrooms, warehouse, workshop among others. Also in case of restoration of construction site it is foreseen reforestation.

Effects: Increase of number of vehicles for demobilization activities generates emission of dust and CO₂, CO, NO_x, SO_x, HC, VOC's.

Impact Assessment: Similar to what was assessed for construction phase the emissions at this phase will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.). However, is expected to be temporary, direct, reduced magnitude and low significance.

12.3.2.3 Noise and vibration emissions

Demobilization activities: The generation of this impact is due to the increase in vehicle circulation and the operation of equipment and machinery used in the removal of equipment assigned to the construction site and the removal of demolition debris resulting from the installation of a construction site with infrastructure for offices, bathrooms, warehouse, workshop among others.

Effects: Noise pollution, health nuisance for workers and the population in the surrounding area.

Impact Assessment: Demobilization activities are responsible for interference in the noise level, and may cause adverse impacts, either on the health of workers or on the health of the population of the project's area of influence, as well as on the environment (removal of local fauna).

The emission of noise and vibrations is classified as a negative impact, with local scope, which will last for the duration of the demobilization operations. This impact is significant and of reduced magnitude.

If the mitigation and/or prevention measures foreseen in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.2.4 Soil contamination

Demobilization activities: Soil contamination is associated with the various dismantling and decommissioning activities that imply, namely the movement of heavy equipment and machinery in the access to the construction site that may cause possible spills of hazardous products (oil, fuel, etc.), the demolition of support infrastructure (office, kitchen, bathrooms, etc.) promote waste production.

Effects: Soil contamination, landscape alteration due to waste disposal in inappropriate locations.

Impact Assessment: During the equipment and demolition debris removal operations, if mitigation and/or prevention measures are not adopted for proper waste management, and if waste disposal occurs in inappropriate locations, they are potential soil polluters due to the chemical characteristics of the different wastes, since project is in a coastal area, with sandy soils, already subject to soil contamination is classified as negative, significant, limited to the construction site, temporary and of moderate magnitude.

With the implementation of the measures foreseen in the chapter 14, the level of significance of the impact is expected to be reduced to low significance.

12.3.2.5 Increased Water infiltration into the soil

Demobilization activities: The main activity generating this impact may be the biophysical recovery of the area affected to the construction site, through reforestation, with the planting of native tree species.

Effects: Improvement of the landscape, increased water infiltration into the soil.

Impact Assessment: The reforestation activity at the construction site should it occur, will be evident the soil decompaction resulting from the tree planting process. In addition, with the reforestation of the affected area there will be a higher rate of water infiltration into the soil, because the roots of the plants promote the improvement of soil structure, increasing soil permeabilization.

The increase of water infiltration into the soil is classified as positive, significant, direct, permanent and of moderate magnitude. If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.2.6 Contamination of Surface/Groundwater

Demobilization activities: The activities of dismantling and disposal of demolition waste in inadequate locations inherent to the activities of moving and operating equipment and machinery, removing equipment and demolition debris from infrastructure installed on the construction site (offices, bathroom, warehouses, workshop, etc.).

Effects: Contamination of surface water (if the construction site is near a water line) and/or groundwater.

Impact Assessment: The contamination of surface/groundwater is associated with accidental spills of hazardous products (fuels, oils, lubricants) and the disposal of demolition waste in inadequate locations, if a spill of hazardous products occurs, through the percolation of these liquids on the ground, in addition to reaching surface water, it may also reach the groundwater. This impact is classified as negative, indirect, temporary, with reduced magnitude and of low significance.

With the implementation of the measures foreseen in the chapter 14, it is expected that the significance of the impact will be reduced to low significance.

12.3.2.7 Change in Water Quality

Demobilization activities: The alteration in water quality is associated with the dragging of sediments to waterways by rain/wind, promoting the turbidity of the water and the presence of total suspended solids (TSS), coming from the circulation of vehicles, use of equipment and machinery, and the removal of demolition debris from the infrastructure assigned to the construction site.

Effects: Alteration of water quality in the surrounding area and health nuisance to the population.

Impact Assessment: The change in water quality as a result of vehicle circulation and debris removal activities is classified as negative, significant, direct, temporary, and of moderate magnitude.

It is expected that the significance of the impact will be reduced to low significance if the measures recommended in the chapter 14 are adopted.

12.3.2.8 Decrease in consumption of natural resources (fossil fuels, energy)

Demobilization activities: The decrease in consumption of fossil fuels and energy is due to the cessation of construction work on the waterfront, coastal protection and infrastructure with the consequent demobilization of the construction site.

Effects: Decrease consumption of natural resources.

Impact Assessment: The cessation of construction activities implies a reduction in the number of vehicles in circulation that were assigned to the works, decreases fuel and energy consumption associated with the removal of luminary and electrical equipment at the construction site facilities, decrease of water consumption. The impact of consumption of natural resources is classified as negative, low significance, direct, temporary and of reduced magnitude.

12.3.2.9 Landscape Alteration and Visual Impact

Demobilization activities: The main activities generating this impact are associated with the movement of equipment and machinery and the removal of demolition debris.

Effects: Landscape alteration, visual impact and inconvenience to the well-being of the population.

Impact Assessment: During the cleaning action and biophysical recovery of the affected area, the flow of equipment and machinery increases as well as the volume of disposed construction and demolition waste in the open, from the front of the work and construction site, promoting the intrusion of foreign elements in the landscape and if mitigation and/or effective prevention measures are not adopted, the destruction of the vegetation cover of the surrounding area may occur. This impact is classified as negative, low significance, direct, temporary and of reduced magnitude.

If construction site is in a natural area and will be dismantled, restoration of the affected area with reforestation and soil decompaction of soil permits natural recovery and impact is a positive, direct, permanent, moderate and significant impact in landscape.

12.3.2.10 Disturbance of the Terrestrial Ecosystem (Flora and Fauna)

Demobilization Activities: The activities associated with the circulation of heavy vehicles for the demobilization of the construction site and the removal of equipment and demolition debris may cause some noise disturbance and possible spills of hazardous products such as fuel, oil, lubricants.

Effects: These activities can cause disturbance of territorial ecosystems in the area of influence of the construction and work fronts.

Impact Assessment: Considering that the main impacts already occurred during implementation of works, the main impact that may persist during the demobilization stage will be the disturbance (noise) on the surrounding fauna. This impact can be classified as negative, direct, temporary, reduced magnitude and low significance.

The same is true for the possible spills of hazardous products, which will be minimal if mitigation measures are adopted.

If the construction site is placed in an area that will be recovered the impact will be positive, direct, permanent, significant and moderate magnitude.

12.3.2.11 Disturbance and degradation of the marine ecosystem

Demobilization Activities: The activities associated with the circulation of heavy vehicles for the demobilization work fronts and the removal of equipment and demolition debris may cause some possible spills of hazardous products such as fuel, oil, lubricants.

Effects: These activities can cause disturbance and degradation in the area of influence of the work fronts if a spill of hazardous products occurs.

Impact Assessment: Considering that the main impacts already occurred during implantation of works, the main impact that may persist during demobilization stage and an increase of vehicles in demobilization can raise the risk of spill for beach and sea.

This impact can be classified as negative, direct, temporary, reduced magnitude and low significance.

12.3.2.12 Degradation of the public well being

Demobilization activities: The degradation of public roads is associated with accidental spills of hazardous products such as fuel, oils, lubricants, etc., inherent to vehicle circulation activities, traffic accidents and debris removal. These activities, particularly road traffic, contribute to the degradation of the sidewalk structure coating, causing wear of bituminous material.

Effects: Use of pavement, traffic congestion in the area, whose degradation of the road is more pronounced, inconvenience to the well-being of the population.

Impact Assessment: Public road degradation is classified as negative, significant, direct, temporary and of reduced magnitude.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.3.2.13 Changes in the level of comfort of the population

Demobilization activities: The main activities generating this impact are the movement of equipment and machinery and the removal of demolition debris from the infrastructure installed on the construction site.

Effects: Noise pollution, nuisance to the health and well-being of the population.

Impact Assessment: The malfunctioning of equipment and machinery as well as the demolition waste removal operation generate noise emission, which may cause harmful health problems to the population of the surrounding area, as well as nuisance to the population, especially during rest periods, if the schedules for the execution of the activities are not respected and the mitigating

measures for noise minimization are not implemented, during the demobilization activities of the construction site, depending on the location of the construction site.

This impact can be classified as negative, significant, with local scope, whose effects last as long as the decommissioning activities take place. The magnitude of the impact is reduced.

With the implementation of the planned measures, the significance of the impact is expected to be reduced to low significance.

12.3.2.14 Harmful effects on Health (respiratory and auditory system) of Workers and Population

Demobilization activities: This impact is associated with the production of dust inherent to the circulation of vehicles used to transport rubble, the use of equipment and machinery, and the removal of demolition debris from the infrastructure assigned to the construction site.

Effects: Noise pollution, air pollution, health nuisance for workers and population in the area of influence.

Evaluation of Impacts: These activities, during the dry season, promote the increase of quantities of suspended particles (dust), affecting the respiratory system of the workers and the population in a harmful way, if proper precautions are not taken. Likewise, these activities also generate noise emissions if the equipment and machinery are malfunctioning and the circulation of heavy vehicles on the access to the site is inadequate.

The harmful effects on the health of workers and the population are classified as negative, level of significance from low significance (respiratory system) to significant (auditory system), direct, permanent, and of reduced to moderate magnitude.

If the measures recommended in the next chapter are adopted, the significance of the impact will be reduced to low significance.

12.3.2.15 Reduction of Occupational Health and Safety

Demobilization activities: The reduction in occupational health and safety conditions is associated with possible work accidents such as falling, tripping, cuts, electrocution, etc., resulting from the use of equipment and machinery in the demobilization activities of the construction site.

Effects: Operations that include operation of electrical equipment and movement of machinery and vehicles, can result in electrocution, trampling or lead to serious accidents.

Evaluation of impacts: Indeed, during the operation of equipment and machinery, workers involved in these activities will be exposed to the risks substances, if mitigation and/or prevention measures are not properly implemented. This impact is classified as negative, significant, direct, temporary, restricted to site workers and of high magnitude, and may cause problems for workers, altering health and safety conditions at work.

It is expected that the level of significance of the impact will be reduced to low significant if the measures foreseen in the chapter 14 are implemented.

12.3.2.16 Quality of life of the population and workers

Demobilization activities: Demolition debris removal operations, circulation of machinery and vehicles used to transport demolition debris, and the use of equipment and machinery can generate impacts on the quality of life of the population

Effects: Loss of quality of life.

Impact Assessment: Reduced quality of life for both the population and workers is associated with the existence of machinery and vehicles assigned to the transportation of demolition debris and use of equipment and machinery, in a recreational area such as Lagarto Bay.

This impact can be classified as negative, with a level of significance ranging from low significance to very significant, direct, and may be temporary or permanent depending on the severity of the accident, and of reduced to high magnitude.

12.3.2.17 Waste disposal

Demobilization activities: During the demobilization phase it is considered that the volume of demolition waste from the infrastructures installed at the construction site is evidently large, given the number of infrastructures (offices, warehouse, workshop, bathrooms, among others). Thus, the waste from demolition should meet the appropriate transport and final destination, in order to avoid the disposal of wastes in inappropriate places, obeying the waste management plan.

Effects: Alteration of the local landscape, contamination of soil and surface/groundwater.

Impact Assessment: Waste from demolition should meet the appropriate transportation and final destination, in order to avoid waste disposal in inadequate locations, complying with the waste management plan. The temporary inadequate disposal of wastes before being transported to an adequate location may result in a negative, significant, direct, temporary impact of moderate magnitude.

With the implementation of the measures foreseen in the next chapter, the significance of the impact is expected to be reduced to low significance.

The following table summarize impacts identified in the demobilization phase.

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low, Significant/Significant/ Very Significant)	Significance (Low Significant/Significant, Very Significant)
Climate and climate change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	N	D	T	R	LS	LS
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	N	D	T	R	LS	LS
	Electricity consumption		Use of electrical equipment	N	D	T	R	LS	LS
	Reduction of CO2 sequestration		Lighting of premises (building site)	N	D	T	R	LS	LS
	GHG emissions		Transport emissions from materials and equipment	N	D	T	R	LS	LS
Air quality	Emission of dust generation on roadways	Alteration of air quality (PM5 and PM10)	Use of equipment and machinery	N	D	T	R	LS	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Movement of vehicles	N	D	T	R	LS	
			Removal of equipment						
			Removal of rubble						
Noise	Increase of Noise	Noise and vibration emission	Increase in vehicle circulation	N	D	T	R	S	LS

Noise			Use of equipment and machinery						
			Removal of equipment						
			Removal of demolition rubble in the construction site						
		Effect on the health of the population in the surrounding area	All the operation of clearing equipment, infrastructures and waste removal	N	D	T	R	LS	LS
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)	Soil contamination	Handling of heavy equipment and machinery at the access to the construction site	N	D	T	M	S	LS
	Production of demolition waste		Removal of equipment						
	Disposal of demolition waste in inappropriate places		Demolition of support infrastructures (office, kitchen, bathrooms, etc)						
	Soil permeabilisation and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	P	D	P	M	S	
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Removal of demolition rubble in the construction site	N	I/D	T	R	LS	
			Use of equipment and machinery						

Water resources	Accidental spillage of hazardous products (fuel, oil, lubricants)		Moving equipment and machinery						
			Removal of equipment						
			Removal of demolition rubble in the construction site						
	Sediment drift into watercourses (turbidity, TSS)	Reduction in water quality	Vehicle circulation	N	D	T	M	S	LS
			Use of equipment and machinery						
			Removal of demolition rubble in the construction site						
			Removal of rubble						
Soil permeabilisation and decompaction	Increased infiltration of water into the soil	Reforestation	P	D	P	M	S		
Natural resources	Fuel consumption (diesel, petrol)	Decrease of Fossil fuel consumption	Decreased use of vehicles	N	D	T	R	LS	
	Electricity consumption	Decrease of Electricity consumption	Removal of lamps and electrical equipment in the construction site	N	D	T	R	LS	
	Water consumption	Decrease of water consumption	Cessation of activities	N	D	T	R	LS	

Landscape	Destruction of vegetation cover	Landscape alteration	Moving equipment and machinery	N	D	T	R	LS	
			Removal of demolition rubble in the construction site						
	Introduction of foreign elements that disturb the landscape	Visual impact	Moving equipment and machinery	N	D	T	R	LS	
		Removal of demolition rubble in the construction site							
	Restoration of vegetation cover	Improving the landscape	Restoration of the affected area: reforestation, soil decompaction	P	D	P	M	S	
Biodiversity	Noise emission	Terrestrial Ecosystem (Flora and Fauna)	Vehicle movement	N	D	T	R	LS	
			Removal of equipment						
			Removal of demolition rubble in the construction site						
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Heavy goods vehicles on the access to the construction Site	N	D	T	R	LS	
	Restoration of habitats		Biophysical restoration of the affected area	P	D	P	M	S	

Biodiversity	Accidental spillage of hazardous products (fuel, oil, lubricants)	Disturbance and degradation of the marine ecosystem	Handling of heavy equipment and machinery	N	D	T	R	LS	
Occupational Health and Safety	Dust emission	Harmful effects on the workers' respiratory system	Movement of vehicles carrying rubble	N	D	P	M	LS	LS
			Use of equipment and machinery						
			Removal of demolition rubble						
	Noise emission	Harmful effects on workers' hearing systems	Heavy goods vehicles on the access to the construction Site	N	D	P	M	S	LS
			Use of equipment and machinery						
			Removal of demolition rubble in the construction site						
	Accidents at work (falling, tripping, cuts.)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	N	D	T	H	S	LS
		Reduced quality of life	Removal of demolition rubble in the construction site	N	D	T	H	S	LS
Road traffic accidents	Vehicle damage	Movement of machinery and vehicles used for the transportation of demolition debris	N	D	P	R	LS		
	Reduced quality of life		N	D	P	M	S	LS	
	Road traffic accidents	Vehicle damage	Movement of vehicles	N	D	T	R	LS	LS

Community Health and Safety		Reduced quality of life	Use of equipment and machinery						
	Dust emission	Harmful effects on the respiratory system	Movement of equipment and machinery	N	D	P	R	LS	LS
			Removal of demolition rubble in the construction site						
	Noise emission	Harmful effects on the hearing system	Movement of equipment and machinery	N	D	P	R	S	LS
Removal of demolition rubble in the construction site									
Waste management	Production of solid waste	Waste disposal in inappropriate places	Removal of demolition rubble in the construction site	N	D	T	M	S	LS
		Soil contamination	Removal of demolition rubble in the construction site	N	D	T	M	S	LS
	Production of liquid effluents		Maintenance of machinery and equipment	N	D	T	M	S	LS

Table 11 Environmental Impact Assessment. Demobilization Phase. Lagarto Bay

12.3.3 OPERATION PHASE

12.3.3.1 Greenhouse effect/climate change

Operation activities: Although the project involves the requalification of the Marginal Road, the expected traffic increase is not directly related to the project, but a consequence of the population increase and migratory movements of the inner communities to the coastline that will continue to use this already existing road. Therefore, the expected traffic emissions must not be considered a direct impact of the project. Nevertheless, the quantification of the CO₂ emissions from this traffic are important to understand how the project can help to mitigate these emissions by providing alternative paths for other less pollutant ways of transportations (namely bicycles).

A direct impact of the project is the emissions triggered by the electricity consumption for street lighting. Also a direct impact is the construction of the coastal protection structures that has the purpose of mitigate the impact of climate changes (flooding and sea level rising) in Lagarto Bay. In addition, refers the requalification of the road drainage system.

Effects: GHG emissions, coastal protection, flood drainage

Impact Assessment: The main impacts related to climate and climate changes are discussed below.

Traffic Increase

As mentioned above, the traffic increase is not directly related to the requalification of Marginal Road in Lagarto Bay. Nevertheless, a quantification of the expected CO₂ emissions is presented, based on bibliographic data, for the traffic data predicted for the Lagarto Bay project.

Light and heavy vehicles in São Tomé and Príncipe are usually imported from Europe, being mainly used cars, with more than 5 years of use⁴.

Considering only the Heavy vehicles for this assessment (more pollutant), was assumed a current value (year 2019) of 900 g CO₂/km⁵⁽⁶⁾: According to the same bibliographic references, is intended that average CO₂ emissions in 2025 will be 15% less than in 2019 and in 2030 30% less compared to 2019. Therefore, for the horizon year of 2045, it was assumed a CO₂ emission value of 630 g/km, which is less 30% than 2019.

The following table and figure compare the year 2021 with the horizon year, for each three traffic scenarios: pessimist, base and optimist.

⁴ MINISTRY OF PUBLIC WORKS, INFRASTRUCTURES, NATURAL RESOURCES AND THE ENVIRONMENT (2019). *Third National Communication of São Tomé and Príncipe within the UNFCCC*. 248 pp

⁵ <https://ec.europa.eu/clima/policies/transport/vehicles/>

⁽⁶⁾ AMBEL, C.C. (2015). *Too big to ignore – truck CO2 emissions in 2030*. A briefing by Transport & Environment

SECTION		Pessimistic		Base	Optimistic
		TRAFFIC VOLUME 2021 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)
CH- CH		gCO ₂ /km	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km
1	0+000-0+360	27000	32130	52290	78750
2	0+360-1+820	39600	47250	76230	115290
3	1+820-2+760	26100	30870	50400	76230

Table 12 CO₂ Emissions from the heavy vehicles predicted along Lagarto Bay Marginal Road

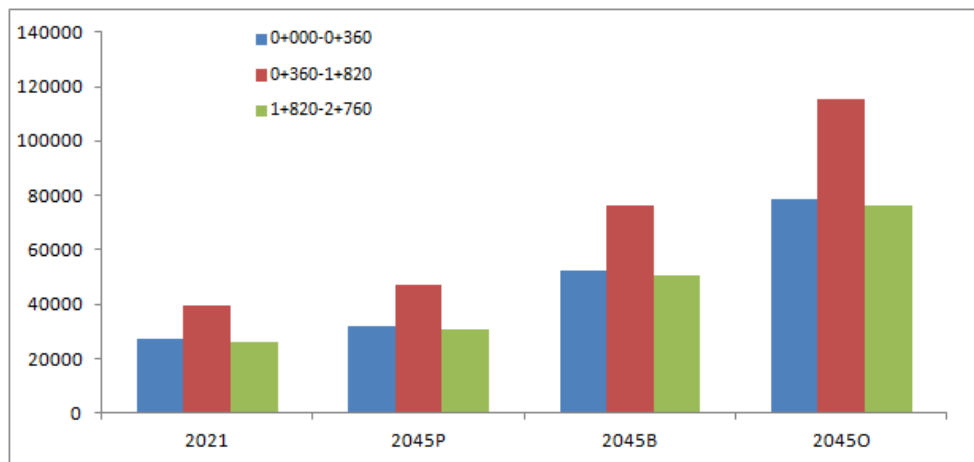


Figure 3 Comparison of different scenarios within each road section in Lagarto Bay

As seen, there are not many differences between the current emissions and the pessimist scenario, but differences are seen with the optimist scenario.

Comparing to the most recent data regarding transport emissions in São Tomé and Príncipe (42.5434 Gg CO₂ in 2019⁷), the above obtained values correspond to the following very low percentages:

⁷ Ministério das Infraestruturas e Recursos Naturais (2021). *Relatório de inventário de gases de efeito estufa no sector de energia para o período de 2010-2019*. 62 pp

			Pessimistic	Base	Optimistic
SECTION		TRAFFIC VOLUME 2021 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)
CH- CH		%	%	%	%
1	0+000-0+360	6.34646E-05	7.55E-05	0.000123	0.000185
2	0+360-1+820	9.30814E-05	0.000111	0.000179	0.000271
3	1+820-2+760	6.13491E-05	7.26E-05	0.000118	0.000179

Table 13 Relative percentage of the heavy traffic emissions along Lagarto Bay, compared with transport annual emissions

Besides this low percentage of emissions (reinforcing that these are not directly related to the project implementation), is important to mention that the requalification of Marginal Road in Lagarto Bay considers a 2.5 m wide cycle lane (two-way traffic) up to CH 1.800, which will potentially contribute for the decrease of motorized vehicles by increasing the use of non-pollutant bicycles (defined as a mitigation measure for climate change). This will also require a wider social awareness for the use of this individual transport.

The impacts of the project on traffic increase are inexistent, but are positive, permanent and significant regarding the offer of suitable conditions for using alternative and more environmental-friendly ways of transport.

Electricity Consumption

It has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is shown in the following table.

Circuit		Track		Power (kW)	Energy (kW/h)
Lagarto Bay - Street Lamp	LAG-I	CT-1	000-029	3,270	39 kW/h
Lagarto Bay - Street Lamp	LAG-II	CT-1	DP-LAG	1,260	15 kW/h
Lagarto Bay - Park Lamp	LAG-II	DP-LAG	LAG-II	1,260	15 kW/h
Lagarto Bay - Street Lamp	LAG-III	CT-2	030-060	3,379	41 kW/h

Table 14 Electricity consumption of laundry installation in Lagarto Bay

In the case of the circuit corresponding to the laundry that will be installed in Lagarto, it will have an energy consumption corresponding to 8 hours of operation, and a power of 10% of the maximum power that this installation has:

Circuit		Track		Power (kW)	Energy (kW/h)
Lagarto Bay - Laundry	LAG-IV	CT-2	DP-LAV	1,316	16 kW/h

Table 15 Electricity consumption of laundry installation in Lagarto Bay

The conversion factor for São Tomé and Príncipe operating grid electricity is 0.646 tCO₂/MWh⁸. The CO₂ emissions of the lighting circuit and the laundry are presented in the table below.

Based on the same reference document that was considered for the traffic emissions, the total energy consumption for Lagarto Bay is 9.45805E-05% of the total emissions of energy for 2019 (86,06 Gg CO₂), which is irrelevant.

Sites	Energy (kW/h)	CO ₂ Emissions (tCO ₂ /MWh)
Lagarto Bay - Street Lamp	39 kW/h	0.025194
Lagarto Bay - Road Lamp	15 kW/h	0.00969
Lagarto Bay - Park Lamp	15 kW/h	0.00969
Lagarto Bay - Road Lamp	41 kW/h	0.026486
Lagarto Bay - Laundry	16 kW/h	0.010336
TOTAL	126	0.081396

Table 16 Total CO₂ emissions from electricity consumption in Lagarto Bay

The impacts of the electricity CO₂ emissions, although negative, permanent, are low significant. The limitation of working hours will function as a mitigation measure for reducing electricity consumption and therefore reducing CO₂ emissions.

Coastal Protection

This area of Lagarto bay is a popular weekend spot for the inhabitants of the city of São Tomé, as well as a potential touristic development. The road is currently situated at a low level (estimated between +1.5 m and +2 m MSL), there are no walkways and there is stormwater runoff. Overtopping and coastal erosion are visible on some days of the year.

The main problems in the study area have been identified:

- Erosion of the shoreline and beaches;
- Damaged sidewalk pavements and at some places collapsed;
- Eroding beaches result in lack of space for fishermen boat landing sites and may impact tourism potential development (Lagarto);
- Occasional overtopping of the waves and flooding of the Marginal road.

⁸ CDM Standardized baseline: "Grid emission factor of São Tomé and Príncipe version 01.0 (ASB0020), based on the proposed new standardized baseline PSB009 "Grid Emission Factor of São Tomé and Príncipe" submitted by São Tomé and Príncipe. https://cdm.unfccc.int/methodologies/standard_base/2015/sb79.html

The most important direct effects of climate change are related to the exposure of the area to rising sea levels, floods, submergence of low-lying areas and the erosion of the coastline itself. Coastal protection structures constitute an adaptation measure against these climate change phenomena. How society responds to the forecasted risks is, therefore, paramount to the success of short and long-term sustainable development, community resilience and resultant community well-being⁹.

As described in Project description, coastal protection in Lagarto Bay mainly consists on installing a rock protection restoring the existing armourstone, along with a beach nourishment in the central and south part of Lagarto Bay.

The armourstone will be protected with revetment crest +3 m M.S.L., an armour rock (Z1A - 1,5 - 2,8 t; Z1B - 0,7 - 1,4 t; Z1C - 0.3-0.5 t), and a seawall (Z1A - up to +4 m; Z1b/C - up to +3.5 m). Geotextile is placed under this structure.

Adaptation to climate change has been carried out considering the sea level rise (SLR) values provided by the IPCC AR5 of 2014. The rise in sea level causes the coastline to recede, but also increases the wave height and increases the energy that reaches the coastal protections. For this project, these effects associated with the rise in sea level over a period of 50 years were considered. Also, for statistical action (wave, sea level) 100 years of return period is considered.

According to *Annex 14 Coastal Protection Structure Design for Lagarto Bay*, and to assess the suitability of the proposed solutions, overtopping analysis was conducted following two methods: 1) analytical formulation in accordance with EurOtop Manual (2018) and 2) for those critical zones a numerical model based on VOF (Volume of Fluid) to double check analytical results and study the convenience of optimization.

In order to study rock stability in shallow and very shallow waters and due to the lack of existence of one accepted formula, two methods were considered: 1) assuming the wave action as a flow that goes up and down along the slope of the coastal protection (run-up and run-down), and 2) assuming typical formulation for dykes under wave attack.

Different cross sections were defined considering these main aspects:

- Wave data.
- Bathymetry.
- Existing structures (groyne, peninsula, land point, harbour, etc) that create a physical barrier between zones.
- Existing uses of coastal areas.
 - Leisure places (Hotel, diving club, etc)
 - Beach.
 - Landing sites. Area on the beach where fishing boat are usually placed. In accordance with local information. In case of storm waves fishermen moves their boats from Ana Chaves Bay to Lagarto Bay due to fewer wave action.

⁹ SINAY, L. & R. W. (Bill) Carter (2020). Climate Change Adaptation Options for Coastal Communities and Local Governments. *Climate*, 8, 7

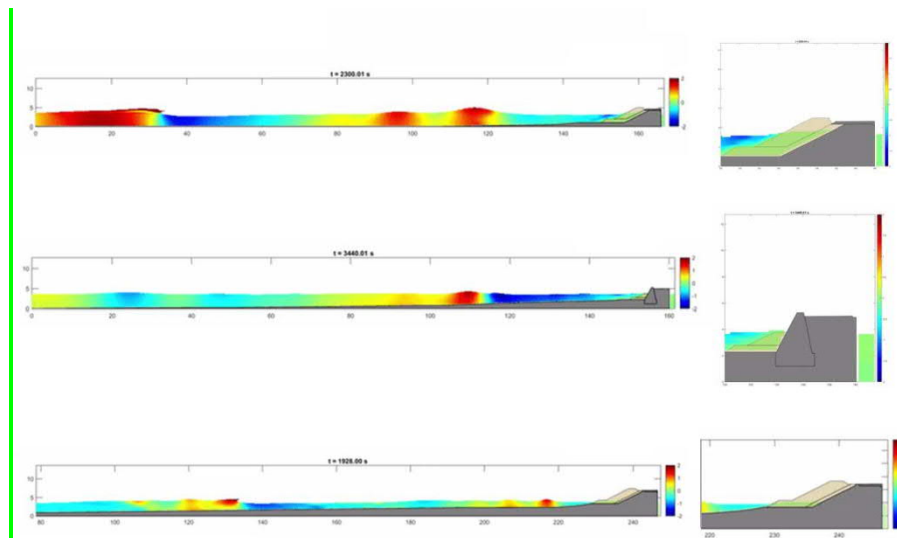


Figure 4 Output IH2VOF numerical simulation São Tomé. Overtopping assessment

Based on the results of this analysis, an optimization of the cross-sections where the overtopping was exceeded was performed and the solutions for coastal protection of Lagarto Bay already take in consideration the results of the above study and respective simulations, presenting the best technical solution for protecting the area from the predicted climate changes.

In this way, the impacts of these coastal protection structures as an adaptation measure to climate changes are positive, direct, permanent, moderate magnitude and significant.

Drainage System

Assuming the feasibility of the coastal protection structures described above for the sea-level rising and wave overtopping, another climate aspect to consider is the increase of intense precipitation events, with consequent increase of flooding that can come from the hinterland. The excess of water needs to be drained as quickly as possible, preferably to the sea, and the Marginal road should not constitute a barrier to these higher flows.

Since this is already an existing road, a field survey was performed to assess the conditions of the transversal drainage system. From the analysis carried out, it was concluded that the existing culverts do not have the necessary hydraulic capacity and it was therefore proposed that the replacement by others with a larger hydraulic section. Thus, the culvert at CH 0+448 is proposed to be replaced by a 4,60 x 1,40 m twin boxes and the culvert at CH 1+335 is proposed to be replaced by a 4,60 x 1,40 m triple boxes.

The flow capacity was determined for a 100-year maximal flood return period.

The drainage system has therefore capacity to guarantee, from now on, that these extreme events are taken care of, minimizing the situations of flooding of the platform, potential deterioration of the pavement, road accidents, the impact on the fluidity of traffic and the transport of food/goods, with consequent environmental and social positive impacts.

In this way, the impacts of the requalified drainage system as an adaptation measure to climate changes are positive, direct, permanent, moderate magnitude and significant.

12.3.3.2 Air quality improvement

Operation activities: Presence of more 16 trees and green spaces.

Effects: In this phase, after the landscape reconstruction of the site, the improvement of air quality will be significant, given that the increased number of trees and green spaces.

Impact Assessment: The main sources of particulate matter emissions are considered to be of the diffuse type, arising from wind action on roadways. In addition, the movement of vehicles emits particulate material in the exhausts due to fuel burning. However, the creation of green spaces with the consequent increase in the number of trees will favor the reduction of dust generation (PM10 and PM5) on the road. Thus, this impact was considered positive, significant and of direct impact. The impact may have a local scope, being permanent, and its magnitude may be moderate.

12.3.3.3 Change in air quality

Operation Activities: Traffic generated by operation of infrastructures

Effects: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non motorized transport).

Impact Assessment: During the operation phase, it is likely that there will be an increase in air pollutant emissions, mainly CO (carbon monoxide), due to the increase motorized traffic foreseen to Marginal road without project.

The expected traffic increase is not directly related to the project, being consequence of increase of population and movements of communities along coastline that will continue to use this already existing road.

However footpaths are proposed along the entire route with 2,0 m wide. A 2,5 m wide cycle lane (two-way traffic) is also proposed along Lagarto bay, up CH 1+800. This lane diverts to an area shared by the promontory road to the CKDO supermarket.

Project integrates circulation of vehicles with improved road safety conditions, restriction on speed of vehicles (50km/h) and in some sections 30 km/h, that results in more fluidity and tranquility, demanding less of the engines and, therefore, reducing the emissions of atmospheric pollutants (CO₂, CO, NOX, SOX, HC, VOC's) if the mitigation measures foreseen are adopted.

The implementation of project creating an alternative of motorized transports cause an impact of air quality classified as positive, significant, direct, permanent and moderate magnitude.

12.3.3.4 Noise and Vibration Emission

Operation Activities: Traffic generated by operation of infrastructures and presence of marginal requalified

Effects: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non motorized transport) induces to a reduction of noise emissions for population in surrounding areas.

Impact Assessment: As referred for air quality the existence of alternatives of safe circulation of non motorized transports contributes to reduction of noise emissions. The proposed of footpaths along entire route and cycle lanes up CH 1+800 and existence of new 36 trees contributes to the use of non motorized transport with reduction of noise emissions by vehicles.

The impact of noise and vibration emissions is classified as positive, significant, direct, permanent and of moderate magnitude.

12.3.3.5 Reducing exposure to erosive agents

Operation activities: This impact is mainly associated with the presence of coastal protection infrastructures.

Effects: Improvement and reinforcement of coastal protection, reduction of the advance of the coastline, with the beach nourishment (CH 0+800 –CH 1+ 860) and planned infrastructures.

Impact Assessment: With this work the coastal region will be protected from the action of erosive agents (water, wind, sea waves) that contribute to the advance of the coastline. In recent years, the rise in sea level has caused interference on the coastline, given that during periods of heavy rainfall the heavy impact of sea waves and the dragging of sediment by the force of the waters have caused the degradation of pavement and possible flooding on the Marginal road.

The impact of reduced exposure to erosive agents is classified as positive, very significant, direct, permanent and of high magnitude.

12.3.3.6 Soil Contamination

Operation Activities The main activities generating soil contamination are the increased flow of people in the region with increase of solid wastes and increase of traffic.

Effects: Soil contamination associated with solid wastes disposal of solid wastes in inadequate locations and the accidental spillage of hazardous products such as fuels, oils, lubricants from traffic accidents

Impact assessment: The increase people and solid wastes and increase of traffic is not directly related to the project. However, the improved conditions that the project will provide, paper bins and improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to soil.

The impact of soil contamination is thus classified as a negative, direct, temporary, low significance and reduced magnitude impact.

12.3.3.7 Surface/groundwater contamination

Operation activities: The main activities generating surface and groundwater contamination are related to the circulation of motorized and non-motorized transports, flow of people on the Marginal road (tourists and local population) and existence of women washing in river.

Effects: Risk of contamination of surface and ground water and aquatic ecosystems crossed by the water course.

Impact assessment: The increase people and solid wastes and circulation of motorized and non motorized transports is not directly related to the project. However, the improved conditions that the project will provide, paper bins every 40 m and improved road safety conditions, will contribute to the

reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to surface and groundwater.

The impact of soil contamination is classified as negative, low significance, direct, permanent and of reduced magnitude.

The presence of new infrastructure such the laundry have a septic tank with capacity of 3181,20 l /year, that should be cleaned yearly.

The current situation wastewater in the city of São Tomé is discharged into the sea or goes to septic tank, as there is no wastewater system in the city. The new infrastructure has septic tank, and can be considered a positive, low significance, direct, permanent and reduced magnitude impact.

12.3.3.8 Reduction of the water infiltration process in the soil

Operation Activities: The activities associated with the presence of the rehabilitation of the marginal road and associated infrastructure.

Effects: The rehabilitated road and new infrastructure will increase the waterproofed area and reduce soil infiltration.

Impacts assessment: The reduction of the water infiltration process into the soil is associated with the soil impermeabilization resulting from the presence of the rehabilitated road, with cycle lanes and sidewalks and new infrastructure (laundry, playground, etc). The impact of reduced infiltration of water into the ground is classified as negative, low significant, direct, permanent and of reduced magnitude. Although there will be an increase in impermeable area will not produce great interference in the volume of water that infiltrates the soil locally.

12.3.3.9 Improve drainage capacity of structures

Operation activities: The presence of rehabilitated drainage works. The culverts installed conform to the existing hydraulic capacity in order to prevent flooding, as referred above.

Effects: Improved drainage, avoiding flooding in the period of heavy rains.

Impact Assessment: This impact is mainly associated with the presence of drainage works that are resilient to climate change, in order to favor natural drainage. The improvement of the drainage capacity of the structures is classified as a positive, significant, direct, permanent and moderate impact.

12.3.3.10 Consumption of natural resources (fossil fuels and electrical energy)

Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non motorized transport) and a reduction of trends of increase of fossil fuels consumption and impact is classified as positive, permanent, direct, moderate magnitude and significant.

For energy consumption in Lagarto Bay, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is street luminary- circuit LAG- I track CT1 000-29 (39 kW/h), park luminary- circuit LAG- II track CT1 – LP_LAG (15 kW/h), park luminary circuit track LAG-II DP_LAG- LAG II (15 KW/h) and street luminary circuit LAG III track

CT2- 030-060 (41kW/h).The luminaries are LED low consumption with an angle of 90° avoid emission of light for beach and disturbance of turtles nesting.

Relatively to the circuit corresponding to the Laundry that will be installed in Lagarti Bay, it will have an energy consumption corresponding to 8 hours of operation, and a power of 10% of the maximum power that this installation has.The circuit is LAG-IV track CT2- DPLAV (16 KW/h).

Energy consumption for year 2019 was 2180,3 TJ for STP, according MIRN (2021) so the impact is negative, permanent, direct, reduced magnitude and low significance.

For water consumption infrastructures includes maintenance of green spaces, and 1 fountain.

Landscape design considers an Irrigation Consumption:2725,2 l per hour. In rain season is no needed to irrigate soil and 1 fountain with 120 l per hour.

The impact is negative, permanent, direct, reduced magnitude and low significance.

12.3.3.11 Improving the Marginal's image

Operation Activities: The presence of the rehabilitated marginal road, with the new infrastructures to be created, the feeding of the beach and its use.

Effects: Improved image of the waterfront, increased local tourism, improved air quality.

Assessment of impacts: This impact is mainly associated with landscape requalification, with an increase in green space and the planting of 36 trees, urban equipment (benches), trash cans, playgrounds, cycle lanes, among others. The improvement of the marginal's image is classified as a positive impact, very significant, local, permanent and of high magnitude.

The new planted trees, namely 14 *Washingtonian robusta* (Mexican palm tree), 17 *Vachellia karroo* (Karoo acacias) and 5 tamarinds, in a total of new 36 trees. These species were chosen because of their rapid growth. However, due to the landscape value of *T. cattapa* and the provision of adequate conditions for the local population to enjoy the new green spaces, this species must be also planted whenever possible, when these trees have to be felled for maintenance reasons with special care regarding location (far from the road as possible) to prevent future damage of the new pavement. If needed, a local nursery garden should be created to maintenance the specimens planted in Marginal.

12.3.3.12 Exclusion effect of marine animals (turtles: *Chelonia mydas*; *Lepidochelys olivacea* *Eretmochelys imbricata* and *Dermochelys coriacea*)

Operation activities: The main generating activities are due to the presence of the rehabilitated road and infrastructure operation. This impact is associated with noise production resulting from the increased flow of traffic, people, goods and services, as well as the artificial lighting of existing infrastructure. Refers that the project contemplates that lighting of the roadway and green areas is maintained for 12 hours when there is no natural light, meaning that the nocturnal period will be mostly brightened.

Effects: Increased noise and lighting can exclude out the marine animals that frequent the nearby sea waters and beach, including sea turtles using the beach for nesting, even know these are not the main nesting areas in the island for turtle nesting.

Impacts Assessment: Noise generation resulting from the increased volume of traffic and beach and green space frequenters causes disturbance to marine animals, as sound propagates five times faster in water than in air, and low frequency noises reach greater distances and therefore will affect the behavior of animals, which tend to move away from the emission source. However, the creation of green spaces (tree planting) will act as natural barriers, minimizing the propagation of sounds. This impact can be considered of reduced magnitude, direct and low significant, since this area is already a disturbed area and the existing maritime fauna is already adapted to these disturbances.

With respect to artificial lighting of public spaces (lamps), this disorients individuals, and may lead them to change their natural behavior, causing them to cease or reduce important behaviors for their life cycle, such as feeding, resting and reproduction. Although this is a local impact and is an already existing impact in the current Marginal Road, the main permanent consequences are the potential interference with the nocturnal nesting behavior of sea turtles in Lagarto bay beaches.

While considering the risk of sea turtle hatchlings death due to artificial light disorientation, this impact should be considered as negative, direct, permanent, moderate magnitude and significant.

It is foreseen in project the use of luminaires of LED low pressure downward oriented and near beaches there will be no direct lighting to these potential biotopes. It is important that monitoring of sea turtles is maintained to assess this mitigation measure and avoid impacts. Due the implementation of these type of luminaires the impact of lighting will be reduced to low significance.

12.3.3.13 Alteration of Ecological Areas

Operation activities: The presence of the coastal protection barriers and beach nourishment.

Effects: The presence of the coastal protection works has effects on the loss of natural habitat, due to the decrease in the existing ecological area, and may result in the exclusion of marine animals. On the other hand, it will also provide new foundations for new habitats, with new rock substrate and new sand area.

Impact Assessment: With the coastal protection and beach nourishment works, the natural and unique characteristics of the site will be altered, affecting, in this case, the marine fauna, which may lead to loss of habitats, facilitating competition between individuals, and may lead to the removal and/or extinction of the species at the site. Since this area is not the main nesting areas in the island for turtle nesting, with disturbance due to anthropogenic activities, this impact is considered to be negative, permanent, of moderate magnitude and significant.

With the stabilization of the structures, it is expected that these habitats can be recovered, with colonization of flora and fauna species, creating new communities and ecosystems. This impact is positive, permanent, direct and significant.

Additionally, beach nourishment will improve the current conditions of Lagarto bay beach currently under high erosion pressure. Beach nourishment can improve beach conditions for turtle nesting since gives a large surface and volume of sand nesting resources for sea turtles, therefore increase the suitable coastline for sea turtle nesting not only within the direct influence area of Project but for the north-east shoreline of São Tomé island That can be considered as a Net gain for sea turtles critical or natural habitat.

12.3.3.14 Degradation of marine ecosystems

Operation activities: Expected traffic increase.

Effects: The degradation of marine ecosystems is associated with the accidental spillage of hazardous products such as fuels, oils, lubricants from traffic accidents.

Impact Assessment: The increase in traffic is not directly related to the project. However, the improved conditions that the project will provide, with improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to the sea water. The degradation of marine ecosystems is thus classified as a negative, direct, temporary, low significant and reduced magnitude impact.

12.3.3.15 Reduction in the number of accidents

Operation activities: Traffic generated by the road and infrastructure leads to a greater number of vehicles and creation of cycle lanes.

Effects: Decreased risks and number of road accidents, due to increased road safety in the area of influence and consequent increased quality of life for people.

Impact Assessment: The reduction in the number of accidents during the operation of the development is associated with improved road safety with the implementation of speed restrictions, vertical road signs, crosswalks and the installation of lighting (street lamps) and reduction of velocity for vehicles. This impact is positive, very significant, direct, permanent and high magnitude, since increased accessibility and improved paving conditions generate an improvement in local traffic, promoting a more fluid circulation of vehicles and contributing substantially to reducing the number of accidents, especially between vehicles and cyclists, with the creation of cycle lanes.

12.3.3.16 Effect on the population's health (respiratory and auditory system)

Operation activities: Traffic generated by the marginal will be motorized and no motorized and road maintenance.

Effects: Alternative transports to motorized transports decreases air pollution and sound level, sweeping track maintenance gives rise to dust, and the presence of more 36 trees provides a noise barrier that will abate the negative effect on the health of the population in the surrounding area.

Impact assessment: Due to improvement of road and waterfront, better conditions for sports practice, walking and healthy habits, with decrease of noise and air pollution is considered a positive, significant, direct, permanent and local for population health health (respiratory and auditory system).

Road maintenance generating traffic for cleaning infrastructures, green spaces maintenance, environmental and social monitoring etc, generates a small increase of vehicle trips by day comparatively with traffic without project and impact in respiratory and auditory systems is low significance, direct, low magnitude.

12.3.3.17 Improve of healthy habits

Operation Activities: Presence of a drinking water fountain.

Effects: The presence of a drinking water fountain provide the users of Lagarto Bay with water for drinking.

Impact assessment: The impact caused by the presence of the drinking water fountain can be assessed as positive, low significance, direct, permanent, with local scope and with reduced magnitude.

12.3.3.18 Waste disposal on sidewalks and roads

Operation Activities: Presence of paper bins for garbage disposal.

Effects: The presence of paper bins can lead to a positive impact on waste disposal.

Impacts Assessment:

During the operation phase, waste will be generated associated with operation of road and infrastructures which have the following main typologies:

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used tires
16 01 07 (*)	Oil filters
16 01 12	Brake pads other than those specified in 16 01 11
16 01 17	Iron metals
16 01 18	Non-iron metals
16 01 19	Plastic
16 01 20	Glass
17 01 01	Concrete
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 04 07	Mixed metals
17 05 03 (*)	Soils and rocks containing hazardous substances

Code	Solid Wastes
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infections (for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20.01 02	Glass
20 01 19	Pesticides
20 01 39	Plastics
20 02	Garden and park wastes
20 03 04	Septic tank sludge
20 03 01	Other urban and similar waste, including waste mixtures

Table 17 - Operation wastes

(*) Hazardous Wastes

The current absence of paper bins currently leads that the presence of litter bins every 40 m can generate a positive impact, considering that the population should be made awareness campaign of its use and that the daily collection of waste produced is foreseen in the maintenance. This impact is considered **positive, significant, direct, temporary** and **of moderate magnitude**.

12.3.3.19 Reduction of wastewater discharge on beach

Operation Activities: Presence of Laundry

Effects: Presence of Laundry with a septic tank allow the reduction of wastewater discharge on the beach.

Impacts Assessment: The laundry has a septic tank with capacity of 3181,20 l /year, that should be cleaned yearly. The septic tank avoids direct discharge to beach and can be considered a positive, low significance, direct, permanent and reduced magnitude impact, because the final discharge of septic tank will be in the sea, because in São Tomé there is no Waste Treatment Plant (WTP).

The following table summarize impacts in operation phase.

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low Significance/ Significant/ Very Significant)
Climate and climate change	Consumption of fuel, oils and lubricants	Greenhouse effect/climate change	Traffic increasing	P	D	P	M	S	
	Electricity consumption		Lighting of premises (street lamps, park lamps and laundry)	N	D	P	M	LS	
	Coastal Protection		Presence of Coastal protection infrastructures	P	D	P	M	S	
	Drainage System		Requalification of drainage system	P	D	P	M	S	
Air quality	Reduction of dust generation on roadways	Improving air quality (PM5 and PM10)	Increasing the number of trees and green spaces	P	D	P	M	S	
	Emissions (CO ₂ , CO, NO _x , SO _x , HC, VOC's)	Alteration of air quality	Circulation of motorized and non motorized transports	P	D	P	M	S	
Noise	Noise generation	Noise and vibration emission	Circulation of motorized and non	P	D	P	M	S	

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Noise			motorized transports						
		Effect on the health of the population in the surrounding area	Increased vegetation cover (sound barrier)	P	D	P	M	S	
Soil	Coastal protection works	Reduced exposure to erosive agents (water, wind, sea waves)	Presence of Coastal Protection structures	P	D	P	H	VS	
	Disposal of solid urban waste in inadequate locations	Soil contamination	Increased flow of people	N	D	T	R	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Circulation of motorized and non motorized transports						
	Production of solid waste and liquid effluents		Existence of bins for rubbish disposal						
Water resources	Disposal of urban solid waste in inadequate locations	Contamination of surface/groundwater	Increased flow of people	N	D	P	R	LS	



Environmental and Social Impact Assessment



Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Water resources	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of traffic accidents	P	D	P	M	S	
	Water quality Alteration		Operation of laundry with septic tank	P	D	P	R	LS	
	Natural drainage	Improving the drainage capacity of structures	Presence of climate-resilient drainage works	P	D	P	M	S	
Natural resources	Fuel consumption (diesel, petrol)	Fossil fuel consumption	Circulation of motorized and non motorized transports	P	D	P	M	S	
	Increase in electricity consumption	Electricity consumption	Lighting of premises (street lamps, park lamps and laundry)	N	D	P	R	LS	LS
	Increase of water consumption	Water consumption	One fountain and laundry	N	D	P	R	LS	LS

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Landscape	Rehabilitation of the image of the Marginal	Improving the image of the Marginal Visual	Rehabilitation of the landscape, with an increase in green spaces, urban equipment (benches), litter bins, children's playgrounds, cycle lanes, etc.	P	D	P	H	VS	
Biodiversity	Noise emission	Removal of marine animals turtles species (<i>Chelonia mydas</i> ; <i>Lepidochelys olivácea</i> ; <i>Eretmochelys imbricata</i> and <i>Dermochelys coriacea</i>) Risk of death of sea turtle hatchlings due to artificial light pollution	Increased traffic flow	N	D	P	R	LS	
			Increased flow of people						
			Increase in goods and services						
	Light emission		Lighting of premises (street lamps)	N	D	P	M	S	LS
	Loss of habitats or/and completion between species	Alteration of ecological areas	Presence of coastal protection and beach nourishment	N	D	P	M	S	LS

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Biodiversity	Creation new habitats (rocks and sand areas)		CH0+800 – CH 1+860	P	D	P	M	S	
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Degradation of marine ecosystems	Road accidents	N	D	T	R	LS	
Community Health and Safety	Improving road safety	Reduction in the number of accidents	Movement of vehicles	P	D	P	H	VS	
			Vertical signage						
			Pedestrian crossings						
			Lighting of premises (street lamps)						
	Dust emission	Harmful effects on the respiratory system	Road infrastructures and maintenance	N	D	P	R	LS	
Noise emission	Harmful effects on the hearing system	Road infrastructures and maintenance	N	D	P	R	LS		

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Community Health and Safety	Improving Health	Effects on respiratory and auditing system	Presence of road requalification	P	D	T	M	S	
		Improve of healthy habits	Presence of drinking water fountain	P	D	P	M	S	
Waste management	Production of solid and liquid waste	Disposal of wastes on sidewalks and roads	Existence of bins for rubbish disposal	P	D	T	M	S	
		Wastewater discharge on beach	Existence of septic tank in laundry	P	D	T	R	LS	

Table 18 Environmental Impact Assessment – Operation Phase. Lagarto Bay

12.3.4 SYNTHESIS OF POTENTIAL ENVIRONMENTAL IMPACTS

The main environmental impacts for the construction, demobilization and operation phase for Lagarto Bay are presented below, considering the mitigation measures proposed:

Negative Impacts

Construction and Demobilization Phases

- Geomorphology alteration due extraction of materials in quarries and beach nourishment in beach (low significance);
- Disturbance in terrestrial fauna in flora due extraction of material in quarries and construction activities (low significance);
- Disturbance of marine ecosystems due construction activities in coastal area, including sea turtles nesting (low significance);
- Dust and noise emission due construction activities (low significance);
- Contamination of surface/groundwater in work fronts and in construction site due solid waste disposal in inadequate sites (significant);
- Contamination of surface and groundwater in work fronts and in construction site due to storage and handling of hazardous products (significant);
- Reduced quality of life in work fronts and construction site neighboring residents and road users due use of machinery and equipment and heavy vehicles for materials transportation (significant);
- Reduced quality of life due to removal of demolition rubble (significant);
- Harmful effects on the health of workers and community in due to road rehabilitation construction of hydraulic structures and coastal protection and demolition of existing infrastructures (significant).

Operation Phase

- Soil contamination resulting from disposal of solid urban waste in inadequate locations, Accidental spillage of hazardous products (fuel, oil, lubricants Production of solid waste and liquid effluents (low significance);
- Water and energy consumption (low significance);
- Degradation of marine ecosystems resulting form accidental spillage of hazardous products as fuel, oil and lubricants (low significance);
- Risk of death of sea turtle hatchlings due artificial light pollution (low significance).

Positive Impacts

Construction and Demobilization Phases

- Using locally recycled glass in the construction of benches (significant);

- Increased water infiltration into the soil through reforestation, with the planting of 36 trees (significant);
- Improving the landscape due to Restoration of the affected area: reforestation, soil decompaction (significant);
- Biophysical restoration of the affected area (significant).

Operation Phase

- Increase in traffic volume with motorized and no motorized transports, comparatively to increase with only motorized transports, resulting in a reduction of greenhouse gas emissions, noise and air pollution (significant);
- Reduced exposure to erosive agents (water, wind, sea waves) associated with the presence of coastal protection infrastructure (very significant);
- Improve drainage capacity of structures, avoiding flooding in the period of heavy rains (significant);
- Creation of new habitats (significant);
- Reduction in the number of accidents (very significant);
- Improve of healthy habits (significant);
- Reduction of disposal of wastes on sidewalks and roads due to existence of bin for rubbish disposal (significant).

12.4 POTENTIAL ENVIRONMENTAL IMPACTS - ANA CHAVES BAY

12.4.1 CONSTRUCTION PHASE

12.4.1.1 Greenhouse effect/climate change

Construction activities: The main impacts on climate results from the fuel, oil and lubricant consumption of machinery and electromechanical equipment handling, the electricity consumption for the electrical equipment and lighting of premises (building site), and the deforestation and tree removal.

Consequences: increased Greenhouse Gases (GHG) emissions and reduction of CO₂ sequestration.

Impact Assessment: The impacts on current microclimate are inexistent since any actions on the climate result from the effect of the physical presence of the new infrastructure, a situation that will only occur in effective terms in the operation phase, with the completion of the implementation of the rehabilitated road and the construction of revetment and armor ridge for coastal protection.

In terms of climate change, the main construction activities that may have an impact have to do with the emissions of GHG from the vehicles associated with the work (CO, CO₂, NO_x, SO₂, among others) and any eventual concrete and bituminous plants (particles and VOC). Some of these are GHG and other GHG precursors.

Regarding the estimative of GHG emissions at this stage, they will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.).

Nevertheless, a brief estimative of the CO₂ emissions related to the transportation of the materials with a dump truck of 20 ton was assessed. This estimative has many unknown aspects related to the construction procedures and routes that the Contractor will use, so several assumptions were made:

- Use of a 20-ton dump truck for transporting materials;
- Debris resulting from the demolitions goes to the Penha dump;
- From the spillway and quarries, an average distance to the work front was assumed;

Regarding the CO₂ conversion factor for the dump truck, was used the value from¹⁰ = 0.47 kg CO₂eq per t.km. The following table presents the estimated results.

Activities	Quantity (ton)	Distance (km)	Total number of trips (with 1 truck)	Total CO ₂ eq emitted (kg per t.km)	% Contribution
Excavations	64,632.49	10	5171	24301.816	23.37
Excavations and Debris	2,258.02	5	181	424.50776	0.41
Demolitions	542.70	5	43	102.0276	0.10
Materials	4,030.35	17	322	2576.1997	2.48
Materials from quarries	6,505.43	17	520	4158.2709	4.00
Coastal Protection Stones	112,866.10	17	9029	72144.011	69.37
Sand	2,601.00	3	104	293.3928	0.28

Table 19 CO₂ emissions from material transportation during construction phase

The transport emissions from excavation materials and the coastal protection stones have the major impact, mainly due to higher quantities required to be transported.

However, comparing to the most recent data regarding transport emissions in São Tomé and Príncipe (42.5434 Gg CO₂ in 2019¹¹), the above obtained values correspond to the following very low percentages:

¹⁰ https://www.winnipeg.ca/finance/findata/matmgt/documents/2012/682-2012/682-2012_Appendix_H-WSTP_South_End_Plant_Process_Selection_Report/Appendix%207.pdf

¹¹ Ministério das Infraestruturas e Recursos Naturais (2021). *Relatório de inventário de gases de efeito estufa no sector de energia para o período de 2010-2019*. 62 pp

Activities	%
Excavations	0.057
Excavations and Debris	0.001
Demolitions	0.000
Materials	0.006
Materials from quarries	0.010
Coastal Protection Stones	0.170
Sand	0,001

Table 20 Relative percentage of the material transportation emissions during construction stage, compared with transport annual emissions

The impacts are not expected to be relevant, in addition to being low significance, temporary, direct, reduced magnitude and mitigable.

During the construction phase, it is also worth mentioning the loss of a carbon sink with the destruction of vegetation cover in the project area. The increase in the concentration of greenhouse gases (GHG) in the atmosphere, namely CO₂, can be partially counteracted by carbon sequestration in forests that retain, in perennial biomass and in the soil, carbon that would otherwise be in the atmosphere in the form of CO₂.

Some trees (in a total of 4) will need to be removed because of the large roots that are damaging the pavement and sidewalks. A brief calculation based on bibliographic references is presented to assess the CO₂ sequestration losses and gains with the removal and plantation of the trees.

Trees	Removal	Weight of CO ₂ Sequestered	Plantation	Weight of CO ₂ Sequestered
Coconut palms	1	30 kg/tree/year (1) 1*30= 30 kg/year		
<i>Terminalia catappa</i> (caroceiro)	3	Extrapolated from (2) 2673.4 kg/year		
<i>Washingtonian robusta</i> (Mexican palm tree)			1	221 kg/year (3) 1*221 = 221 kg/year
<i>Vachellia karroo</i> (Karoo acacias)			83	645005.37 kg/ha (4) Assuming an area of 9m ² for each tree 9*83=747 m ² 48181.9 kg/year
Tamarinds			16	50tC/ha (5). Assuming an area of 9m ² for each tree 9*16=144 m ² 720 kg/year

Trees	Removal	Weight of CO ₂ Sequestered	Plantation	Weight of CO ₂ Sequestered
TOTAL		2703.4 kg/year		49122.9 kg/year

Table 21 CO₂ expected sequestration for the trees in Ana Chaves Bay project

Legend: (1) BOOMIRAJ, K., R. Jagadeeswaran, S. Karthik, R. Poornima, S. Jothimani & R. Jude Sudhagar (2020). Assessing the Carbon Sequestration Potential of Coconut Plantation in Vellore District of Tamil Nadu, India. *International Journal of Environment and Climate Change* 10(12): 618-624; Article no. IJECC.66105; (2) NURSYAHBANDI, U.H., W Subchan & Suratno (2020). The estimation of CO₂ absorption and O₂ production from trees on main street in The City of Jember. *IOP Conf. Series: Earth and Environmental Science* 485 01204; (3) MADRID, A.Y.D. (2016). *Estimaciones de captura de los parques y emisiones de CO₂ vehicular en Tijuana, B.C.* Tesis para obtener el grado de Maestra en Administración Integral del Ambiente, El Colegio de La Frontera Norte, Mexico; (4) Based on a similar species (*Acacia mangium*) WIDHANARTO, G.O., R.H. Purwanto, A. Maryudi & Senawi (2016). Assessing Carbon Pool of Forest Plantation to Support REDD+ Implementation in Indonesia AIP Conference Proceedings **1755**, 130008 (3) https://assets.publishing.service.gov.uk/media/57a08d58e5274a27b20017bf/R7274_-_Technical_specifications_Southern_India.pdf

Although the maximal CO₂ sequestration of the planted trees only occurs when the trees are fully growth, is already predicted that the landscape project will contribute significantly for mitigating climate changes compared to the current situation (18 times the current sink capacity).

The impact of removing trees will be residual and temporary since 100 new trees will be planted with the landscape project.

12.4.1.2 Change in air quality

Construction activities: The main activities generating impacts may be earthmoving associated with the operation of excavation and cleaning of the roads, transport of dust material for the rehabilitation of the road and beach nourishment, circulation of equipment and machinery, demolition and removal of existing infrastructure (hydraulic crossings and paving) and the execution of paving, which may originate certain quantities of particulate material (dust) into the atmosphere, adding to other pollutants emitted by vehicles in circulation, namely, sulfur oxide, carbon monoxide, nitrogen oxides, volatile organic compounds, hydrocarbons, among others, damaging the quality of the air during this stage.

Effects: Air pollution, nuisance to the health and welfare of the population in the area affected by the project and possible damage to the health of workers.

Impact assessment : Since this is an already urbanized area where the main source of air pollution is the vehicles circulating on the Marginal, the Port of São Tomé is located on this lot, the impact on air quality is classified as negative, significant, direct, temporary and of moderate magnitude, during construction activities along this lot, as a result of possible traffic jams on the Marginal and surrounding roads due to limitations in circulation, loading and unloading of construction materials and handling and loading of construction waste, circulation of heavy vehicles and, consequently, the construction workers and population in the direct influence area may also be affected by the effects of this impact.

If the measures recommended in the Chapter 16 are adopted, the significance of the impact will be reduced to low significance.

12.4.1.3 Noise and vibration emissions

Construction activities: This impact is mainly associated with demolition activities and removal of infrastructure (hydraulic crossings, paving layers), movement of equipment, machinery and circulation of heavy vehicles.

Effects: Noise pollution, nuisance to the health and wellbeing of the population in the area affected by the project and possible damage to the health of workers (harmful hearing problems).

Impact assessment: The impact of noise and vibration emission is classified as negative, significant, direct, temporary and moderate magnitude, due to the existence of increased noise levels in the proximity of the works associated with construction activities, in a central area of the city of São Tomé in which the main source of noise is road traffic and there are sensitive receptors as residential houses and "Bambino" school (CH 2+860) and St. Peter's church (CH 3+700).

Regarding Noise levels, the IFC/World Bank and World Health Organization (WHO) Standards for residential and industrial areas must be respected during construction.

Receptor	L (dBA) of 1 hour	
	Daytime period (07:00 - 22:00)	Night time (22:00 - 07:00)
Residential	55	45
Industrial, Commercial	70	70

Table 22 IFC General Environmental, Health and Safety Guidelines for Noise Levels

The limit value of the environmental noise indicator (LAeq) in the project intervention area, which is characterized as a residential area, is 55 dB(A) during the daytime period (7:00-22:00) and 45 dB(A) at night. During the construction phase "temporary noisy activity" will be practiced with some frequency and will only be carried out during the daytime. It is prohibited on Sundays and holidays, and during weekdays between 10 pm and 7 am. However, in exceptional cases, noise may be made on prohibited days and during prohibited hours, given that is communicated to the community.

With the adoption of the measures foreseen in the chapter 14, it is expected that the significance of the impact will be reduced to low.

12.4.1.4 Soil exposure to erosive agents

Construction activities: Earth moving and vegetation removal activities, which will proceed with the excavation for placement of bridge at CH 4+790, on the Água Grande River.

Effects: Water pollution, resulting from increased turbidity and concentration of suspended and settleable solids in water courses and seawater, and siltation of water courses.

Impact Assessment: The impact of soil exposure to erosive agents is classified as negative, low significance, direct, temporary and reduced magnitude, because the terrain at Ana Chaves Bay is flat and the soil consists of Quaternary alluvial deposits, which cover the basaltic rock.

12.4.1.5 Soil Water Infiltration

Construction activities: Potential impact activities may be due to soil compaction associated with the movement of heavy equipment and machinery between the construction site, quarry and the construction site, and to the increase in impermeable area resulting from the rehabilitation of the Marginal road.

Effects: Flooding, water erosion, silting up. These activities contribute to a decrease in water infiltration into the soil, with a consequent increase in surface runoff, which can lead to flooding during periods of heavy rainfall.

Impact Assessment: The impact of water infiltration into the soil can be classified as negative, non-significant, direct, temporary and moderate magnitude, because there will not be a substantial increase in the impermeable area with the rehabilitation of the Marginal road and coastal protection. In the selection of quarries and location of construction sites, preference will be given to existing ones, as well as in the access to the works, the opening of new accesses will be avoided.

12.4.1.6 Soil Contamination

Construction activities: The main impact-generating activities are associated with the improper handling or spillage of hazardous products such as fuel, oils, lubricants and bituminous materials, construction of the new bridge at CH 4+790, maintenance and washing of equipment and machinery, disposal of wastes in inappropriate places, earth moving during construction period.

Effects: Activities may result in contamination of soil, surface and groundwater, degradation of water courses, alteration of water quality, and may affect the aquatic ecosystem.

Impact Assessment: The negative impact is significant, temporary, local in scope and of moderate magnitude. The activities mentioned above are located on the banks of some water courses and near the sea, where soils are very permeable (sand) and the percolation of liquids is facilitated and can reach the water table, there are potential risk events of contamination of both soil and water, if this contamination occurs will contribute to the current degradation of soil quality and surface and groundwater resulting from domestic wastewater discharges from households and open defecation.

With the implementation of the measures foreseen in the chapter 14, it is expected that the significance of the impact will be reduced to low significance.

12.4.1.7 Alteration in Geomorphology

Construction activities: The alteration in geomorphology is due to the extraction of materials in quarries and the erosion process associated with logging activities, earthmoving, and the movement of equipment and machinery.

Effects: Earthmoving activity, especially excavations, as well as vegetation cover removal/tree felling may enhance erosion by dragging sediment to undesired areas, and may even result in siltation of water courses. For coastal protection deposition of sand for beach nourishment (CH CH 4+950 – CH 5+300) activities causes increase of suspended sediments in sea water.

Impact Assessment: The impact of landform modifications is certain to occur, negative, low significance, direct, with the scope in the area of direct influence of the project. This impact will be permanent and of reduced magnitude. In Ana Chaves Bay there are situations where the sidewalks have holes due to tree roots, combined with coastal erosion. Earth moving activities, especially excavations, as well as the removal of vegetation cover / tree felling may enhance erosion by dragging sediments to undesired areas, and may even result in silting of water courses. Impacts resulting from deposition of sand causes increase of suspended sediments in sea water. These activities cause the topographic change of the terrain.

The erosion of the beach is currently increased by the raise of sea level due to climate change, with more energetic and longer waves coming in and reaching the road, accelerating erosion processes. By beach nourishment and raising the height of the beach by approximately 1 m, this effect is avoided and the breaker zone move away from the road, giving a width of 20-25 m to the beach at mid-tide level. This leads climate change adaptation by compensating the SLR effect by the raise of beach elevation.

Coastal erosion is expected to be small, as it is the one that has been occurring historically, which means practically no sediment transport resulting from hydrodynamics in the longitudinal direction of the beach and small in the transverse direction, caused by storms that "lower" the sand to depths from which it does not recover.

The plan designed with maintenance means that any erosion that may occur is compensated by reprofiling or recharging with sand from quarries. Therefore, the erosion that is currently occurring, which causes loss of habitat, loss of trees due to root erosion, etc., will be controlled. There will be no alteration of the coastal geomorphology as a result of hydrodynamics.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.1.8 Consumption of natural resources (fossil fuels, energy, water and construction materials)

Construction activities: Road rehabilitation, construction of hydraulic structures and coastal protection, movement of machinery and equipment, use of electrical equipment and lighting of the facilities (construction site), cement preparation, washing of concrete mixers, equipment and machinery, as well as the operation of the construction site, generate impacts on the consumption of natural resources.

Effects: Increased consumption of natural resources in the region.

Impact assessment: As this is a consumption of natural resources, it may have negative

consequences on other aspects of the biophysical environment in the area of direct influence. During the period of construction activities, there is cement preparation, washing of concrete mixers and equipment, circulation and operation of equipment and machinery, as well as activities associated with the operation of the construction site (offices, bathrooms, warehouse, workshop among others) a result in substantial consumption of water, energy and fossil fuels.

Energy estimative required for rehabilitation of road pavement in Ana Chaves Bay is estimated as 12,7 TJ. If some sections of pavement are rehabilitated (maintained and reuse), the value will be less because not all sections of road will have new pavement Nevertheless, the energy consumption of rehabilitation is more advantageous, in comparison with the new pavement. The estimative of total energy consumption for country was according MIRN (2021) 2180,3 TJ for year 2019.

Thus, also for fossil fuels impact was considered negative, low significance, direct, temporary and reduced magnitude.

The coastal protection structures will require also some energy to their construction, but will be negligible. The impact of use of energy is negative, reduced magnitude, temporary and low significance.

The main materials necessary for the project are estimated as 7810,76 m³ of material (concrete), materials from quarries 10951,9 m³, 34536,75 m³ of stones an 4250,00 m³ of sand for costal protection in a total of 57549,41 m³ the use of material.

During the construction phase, the demand for inert materials such as sand and stones may increase, which may cause a shortage of materials in the country, as well as encourage the exploitation of inert materials in unauthorized locations. For the construction activities planned in this region, this impact has been assessed as negative, significant, direct, temporary and of moderate magnitude.

For estimation of water consumption, it was assumed that for an average of 1 m² of road, 2 m³ of water will be consumed (consumption of concrete, construction / formwork and other washes and trucks, etc.). Total of water consumption is estimated as 84 950,00m³. The impact is negative, temporary, moderate magnitude and significant.

12.4.1.9 Alteration in water quality

Construction activities: This impact is associated with the dragging of sediments into bodies of water, which in turn cause turbidity and suspended solids, leading to degradation of water quality. In fact, the main generating activities include the construction of a new bridge (CH 4+790), earthmoving, removal of vegetation cover and coastal protection works, involving beach nourishment CH 4+950-CH 5+300, construction of the armor ridge and construction of walls.

Effects: Water pollution, affecting the aquatic ecosystem, and inconvenience to the health and well-being of the population in the project's area of influence.

Impact Assessment: Ana Chaves Bay is a central area of the city of São Tomé with services and commerce, but also an area without wastewater drainage network, there are discharges of wastewater into the sea and open defecation, for this fact it is considered that the impact resulting from the planned construction activities will result in a negative impact, significant, temporary, local scope and moderate magnitude.

With the implementation of the recommended measures presented in Chapter 14, a reduction in the significance of the impact to low significance is expected.

12.4.1.10 Risk of surface/groundwater contamination

Construction activities: The main activities generating the risk of contamination of surface and groundwater are the activities of disinfection of new water pipes and the maintenance and washing of equipment and machinery affected to the work will be responsible for the production of liquid effluents, such as disinfectants, oils and grease, which may result in contamination of the water table if these operations do not take place in an impermeable site, with the respective retention basin.

Effects: Risk of contamination of surface and ground water and of aquatic ecosystems crossed by the water course.

Impact assessment: The risk of contamination may arise whenever there is a spill of products resulting from the storage and handling of hazardous products (fuels, oils, lubricants, concrete, etc.) inappropriately.

Improper storage and handling of hazardous products (fuels, oils, lubricants, concrete) can result in spill accidents. The movement of equipment and machinery, demolition of existing infrastructure, and the construction of new infrastructure such as the area for fishermen and the new bridge CH 4+490. The physical characteristics of the sandy soil facilitates the runoff of these effluents into the water table, since their percolation into the soil is facilitated.

At the construction site, as the soil is made up of alluvial sandy soils, percolation is facilitated and may reach surface water and the water table. As already mentioned, it is expected that surface waters already have their quality altered and with the existence of a spill there will be a contamination of surface/ground waters, classifying this impact as negative, direct, of moderate to high magnitude, and the level of significance may be significant or very significant depending on the size of the spill.

The waste production and production of liquid wastes at construction site can have a negative, direct, temporary, with moderate or high very significant impact or significant impact in surface and groundwater contamination, but with mitigation measures proposed these impacts will be mitigated, to avoid soil and groundwater contamination.

In São Tomé there is no wastewater system nor wastewater treatment and final disposal for wastewater are septic tanks and sea, when there aren't directly discharged in water courses.

12.4.1.11 Alteration in water flow patterns and flooding

Construction activities: The main impact-generating activities are associated with the demolition of existing infrastructure, including hydraulic structures and construction of the new bridge to replace the existing one (CH 4+790) construction of revetment and armor ridge for coastal protection, earthmoving and removal of vegetation cover or sidewalk, causing siltation of water courses triggered by the dragging or transport of fine material or sediments by the action of rain during the period when the soil is disintegrated.

Effects: Demolition of infrastructure near the water courses can alter water flow patterns and cause flooding.

Evaluation of impacts: Impact resulting from the risk of flooding can be classified as negative, temporary, local in scope and reduced to moderate magnitude, mainly because during demolition and construction of the new bridge over the Água Grande river, it may cause silting up due to the opening of drains and detour channels, as well as the improper accumulation/deposit of waste in bodies of water, resulting in the interruption of runoff if the drainage of water with its flow is not

guaranteed. This is an impact whose level of significance ranges from low significance to significant.

If the measures recommended in chapter 14 are adopted, the significance of the impact will be reduced to low significance, respectively, given the generating activity.

12.4.1.12 Landscape alteration and visual impact

Construction activities: The main activities generating impact on the landscape includes: movement of heavy equipment and machinery, earthmoving, removal of vegetation cover for road rehabilitation, coastal protection including beach nourishment, and construction of a playground and a fitness park, a new area for fishermen, fish sellers and a public toilet.

Effects: Landscape alteration in the project's area of influence, as a result of the presence of the fence off the works along the coast, causes a change in the visual scenery.

Impacts assessment: The Ana Chaves waterfront presents in general a visual quality (beach and sea) that due to the degradation of the waterfront promenade can be classified as reduced magnitude, and with a low capacity to absorb elements foreign to the landscape, with a large number of observers (users of the waterfront road, and tourists) due to its characteristics, it has areas of great landscape sensitivity. The presence of fence doesn't permit the sea visualization and changes scenic quality for road users. In addition, the circulation of heavy equipment and machinery results in the process of soil compaction in some natural areas near the beaches, which inhibits the growth of vegetation in the affected area, altering the landscape. Thus, the impact was considered negative, significant, direct, temporary, with local scope.

If the mitigation measures provided in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.1.13 Disturbance of the Terrestrial Ecosystem (flora and avifauna)

Construction Activities: The disturbance of the terrestrial ecosystem, especially flora and avifauna, is associated with removal of vegetation cover and activities that generate visual and noise pollution (disturbance), where the operations of moving heavy equipment and machinery, earthmoving, and road rehabilitation, coastal protection and beach nourishment stand out.

Effects: Reduction of habitats and pressure on associated fauna.

Impact Assessment: With the rehabilitation of the Marginal Road, there will be need to remove some tree specimens due to their consequences on the existing pavement (damage by the root system). For Ana Chaves bay, is expected to be removed 1 coconut palm and 3 *Terminalia cattapa* (caroceiro). None of these species have protection status, although *T. cattapa* has a landscape value, due to their wide, open and almost horizontal canopies and their height (up to 25 m), providing enough shadow. This loss of potential habitats will be replaced by new planted trees, namely 1 *Washingtonian robusta* (Mexican palm tree) and 83 *Vachellia karroo* (Karoo acacias) and 16 Tamarinds in a total of new 100 trees. These trees will be able to provide biotopes to several animal groups, especially invertebrates and birds.

Regarding the visual and noise disturbance, this can affect the existing avifauna in Ana Chaves Bay because the presence and increased noise levels resulting from vehicle movements, machinery operation, and the presence of workers during construction can affect the birds' life cycle, whether it be reproduction, resting or feeding. Besides this, the birds may suffer with the reduction of their areas of use, which can lead to their displacement to other locations with suitable habitat. However, considering that the project's area of influence is located in urbanized area, with intense visual disturbance and noise from automobile and air traffic, birds are already adapted to these urban impacts. In addition, the species occurring have no conservation status.

The plantation of new trees mentioned above will contribute for potential nest, resting and feeding sites.

In view of the above, this can be classified as a negative, direct and temporary impact, reduced magnitude and significance.

With the adoption of the measures recommended in the chapter 14, the significance of the impact will be further reduced.

12.4.1.14 Disturbance and degradation of the marine ecosystem

Construction activities: The main activities generating impacts on disturbance and degradation of marine ecosystem are earthmoving, movement of heavy equipment and machinery, vegetation removal, construction of revetment and armor ridge for coastal protection, beach nourishment CH 4+950 – CH 5+300, to build the new area for fishermen. These activities may generate water turbidity and noise disturbance. Light disturbance during construction stage is not expected, since the construction works will be performed only during daylight. Accidental spills of hazardous products (fuel, oil, lubricants and concrete) from heavy machinery and equipment can lead to contamination and destruction of marine ecosystems.

The origin of sand used for concrete and beach nourishment can create negative impacts on coastal and marine ecosystems if sands come from marine dredging and beach sand mining as is commonly done in São Tomé Island. It is not the case in this project that sands come from quarries.

Effects: Contamination of local marine waters, and the driving away of marine species and/or death.

Impact Assessment: Earthmoving may lead to particles dragged into the water and cause turbidity in the intertidal area, with impacts on the existing organisms. Because of the already wave movement in the area, due to the shallow depth, it is not expected that this turbidity will cause any significant impacts.

The impacts from the spill of hazardous products are expected to be minimal or even non-existent, if all the mitigation measures are adopted. In addition, the quantities that may be accidentally dragged into the water are easily diluted in the sea water, so no permanent impacts are expected.

The impact of sea turtle nesting beaches degradation during the construction phase is considered to be negative, direct, permanent, moderate magnitude and significant considering the conservation status of these species.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.1.15 Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area

Construction Activities: The construction activities of revetment, armor crest, wall and beach nourishment and embankment (CH 4+950 to CH 5+300), for construction of the new area for fishermen.

Effects: Construction activities that involve occupation of the intertidal area, will result in the loss or alteration of this area and consequent loss of biodiversity.

Assessment: Construction activities can affect the intertidal area in Ana Chaves Bay, which can be sandy beach or rocky coast. This area is already subject to human pressure, with hunting, fishing or trampling of fauna, with more generalist species. Nevertheless, the impacts of loss of biodiversity by occupation of this area is considered negative, direct, permanent, significant and moderate magnitude. With the stabilization of the structures, there is potential for flora and fauna.

Ponte Beach in Ana Chaves Bay has turtle nesting activity even know these are not the main nesting areas in the island for turtle nesting. However, sea turtle harvesting for local consumption, human disturbance, beach erosion mainly driven by illegal sand mining and climate change, and the existence of stray dogs have contributed to the decrease of these populations.

Project can impact on sea turtles when a project action affect a nest buried in the sand by the female or by disturbing female's behavior when trying to spawn in the sand of the beach.

Therefore, Project shall avoid:

- any actions on the beach to prevent impacts on nests and
- disturbance to females when arriving the beach to spawn.

As said before the Project's component that could affect the sandy beaches are those related to coastal protection. Design of Coastal protection, particularly rock revetment, could affect the top or high part of the beach in contact with the road rehabilitation. This is the major identified project action that shall be monitor and for which mitigation measures shall be put in place during construction phase to eliminate impact on the sea turtle nesting resource.

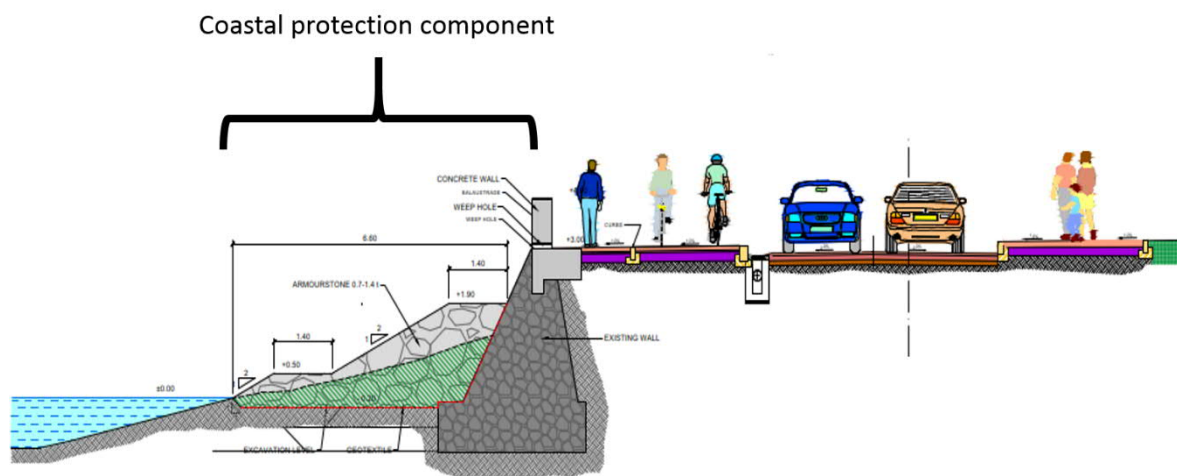


Figure 5 Coastal protection component (over a typical cross section)

Beach sections that keep suitable characteristics for turtle nesting, sandy beach and not rocky or without intertidal area o a wall, are shown in the figure below:



Figure 6 Beach section that could attract turtles for nesting

Sea turtles nesting in Ana Bay beaches will be negatively affected by the noise and presence of machinery during the construction work. Construction activity in coastal should be avoided during the sea turtle nesting season from October to April.

The consequences of beach nourishment on the sustainability for sea turtles nesting will depend on the characteristic and quality of the sand. If sand used for beach nourishment is not suitable for effective sea turtle nest digging, beach nourishment will cause negative impact on reproduction sites of threatened sea turtles species. Is foreseen a Beach Nourishment Management Plan to avoid this negative effects.

With the implementation of the measures recommended in the chapter 14, the significance of the impact is expected to be reduced to low significance. The mitigation measures in construction phase recommended to achieve a positive conservation outcome are:

- Code of Conduct for workers;

- Contractor's Workers sensitization.
- Work program for construction activities in beach from October to April, avoiding the nesting sea turtles season;
- Beach nourishment management plan;
- Turtles find Procedures;
- Turtles management Plan preparation and implementation.

12.4.1.16 Effect on Health (auditory system, respiratory system) of the Population and Workers

Construction activities: The activities of moving equipment and machinery, moving earth, building new infrastructure (roads, hydraulic structures and coastal protection, etc.), demolishing existing infrastructure, and removing paving layers, all lead to the production of dust and noise.

Effects: All the above-mentioned operations present potential for the availability of particulate material (dust) and noise emission, causing interference in the health and well-being of the population in the area of direct influence and of the workers affected by the execution of the operations.

Evaluation of Impacts: During the construction activities there will be an increase in noise levels, the production of dust, which may cause an impact on the health of the population and workers is classified as negative, direct, permanent and high magnitude. This impact was considered significant (respiratory system) and very significant (auditory system).

If the mitigation/prevention measures recommended in Chapter 14 are applied, the significance of the impact on the respiratory system will be reduced to low significance and the impact on the auditory system to significant.

12.4.1.17 Reduced quality of life (population and workers)

Construction activities: During the execution of the work, it is expected the use of equipment and machinery and the circulation of equipment, machines and vehicles used to transport materials for the work in the vicinity of residential areas and on roadways, with the removal and replacement of pavement layers, demolition of buildings such as walls, banks, and the construction of drainage works, construction of coastal protection, landfill and construction of the area for fishermen, promoting disturbance in the quality of life of the population.

Effects: The planned interventions in Ana Chaves Bay will disturb the population as it is a central place in São Tomé.

Assessment of impacts: The planned interventions in roadways, being a central area of the city of São Tomé, will interfere with the life of the population that travels to the city to work, trade or purchase services, as well as walking on the Marginal, the movement of equipment, machinery and vehicles, especially heavy vehicles, will interfere with the life of the population, local traffic conditions, reduction of parking spaces and effects on road safety. Impact is negative, very significant, direct, temporary and high magnitude.

With the adoption of the measures recommended in the chapter 14, it is expected that the significance of the impact will be reduced to significant.

12.4.1.18 Occupational Health and Safety Risk

Construction activities: Workers involved in construction activities are exposed to various risks when using equipment and machinery.

Effects: Activities that include operation of electrical equipment and movement of machinery and vehicles, can result in electrocution, hit-and-runs, or to serious accidents.

Impact assessment: The construction activities will develop negative impact, significant, direct, temporary, restricted to workers on the site and of reduced magnitude, and may cause problems for workers, altering health conditions and levels of safety at work.

It is expected that the significance of the impact will be reduced to low significance if the measures foreseen in the chapter 14 are adopted.

12.4.1.19 Reduced road safety (pedestrians and road users)

Construction activities: During the course of road construction activities there will be the need for machinery, equipment and heavy vehicles to circulate, traffic detour, reduction in vehicle speed, and the circulation of construction site workers, causing interference with vehicle access for residents, workers and commuters in the area affecting the construction site, as well as road users.

Effects: All construction site activities that involve the operation and movement of machinery, equipment and heavy vehicles can increase the risk of road accidents if the proper safety measures are not taken to carry out the activities.

Impact assessment: The impact on road safety is considered negative, significant, restricted to the area of intervention of the work, whose duration will be for the duration of the work, planned for 24 months. Considering that the population of the surrounding area, construction workers and road users, people who travel to the city center will be directly affected by the work activities, the magnitude is considered to be moderate.

If the mitigation and/or prevention measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.1.20 Occupation of Public Space (waste management)

Construction activities: The activities related to waste production at construction sites, namely the demolition of existing infrastructure and construction of new infrastructure (buildings, sidewalks, pipelines, etc.) promote the inadequate disposal of wastes, especially in public spaces.

Effects: Water pollution by dragging waste to water courses and sea, beach sand.

Impacts Assessment: The entrainment of unpackaged construction and demolition waste into water courses and sand may have a significant, direct, temporary and low significance negative impact.

It is foreseen the adoption of mitigation and preventive measures before and during the works, so that the significance of the impact is reduced to low significance, considering the measures presented in Chapter 14.

12.4.1.21 Population and workers health risk (waste management)

Construction activities: All road construction activities generate solid and liquid waste from demolition operations of existing infrastructure, road rehabilitation, construction of hydraulic structures and coastal protection, as well as from sanitary facilities at the construction site and on the construction sites. During these activities, solid and liquid waste such as packaging, cardboard, concrete waste, cables, iron, rubble, demolition waste, wastewater, etc., domestic waste and hazardous waste must be transported to the appropriate final destination.

Effects: Waste management when performed improperly promotes a situation of risk to the health of population and workers on site, as well as environmental degradation of the affected area.

Impact Assessment: The impacts on waste management are classified as negative, significant, direct, permanent and high magnitude due to the fact that there are currently no bins for waste disposal, the works may generate solid and liquid hazardous waste that can contaminate the beach sands with risk to the health of the population of the project's direct area of influence. Likewise, waste from the construction site infrastructures (offices, bathrooms, warehouse, workshop among others) and the concentration of workers near the construction site will be responsible for the production of solid wastes and wastewater, respectively. Therefore, the absence of adequate waste management endangers the health of the population, workers and/or generates adverse damage to the environment.

During the construction phase, wastes will be generated associated with the execution of the works, which have the following main typologies, according to the European Wastes Codes (EWC):

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17
13 02 06 (*)	Synthetic engine, gear and lubricants oils
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages



Code	Solid Wastes
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used Tires
16 06	Batteries and Accumulators
16 01 07 (*)	Oil filters
17 01 01	Concrete
17 01 02	Bricks
17 01 03	Tiles, roof tiles and ceramic materials
17 01 06 (*)	Mixtures or separate fractions of concrete, bricks, tiles and ceramic materials containing hazardous substances
17 01 07	Concrete mixtures, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 02 04 (*)	Glass, plastic and wood containing or contaminated with hazardous substances
17 03 01 (*)	Bituminous mixtures containing tar
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 03 03 (*)	Tar and tar products
17 04	Metals (including alloys)
17 04 01	Copper, bronze, and brass
17 04 02	Aluminum
17 04 03	Lead
17 04 04	Zinc
17 04 05	Iron and steel
17 04 06	Tin
17 04 07	Mixed metals
17 04 09 (*)	Metal waste contaminated with hazardous substances
17 04 10 (*)	Cables containing hydrocarbons, tar or other hazardous substances
17 04 11	Cables other than those mentioned in 17 04 10
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20 01 21	Fluorescent tubes and other mercury-containing waste
20 02	Garden and park waste
20 03 04	Septic tank sludge

Table 23 - Construction wastes

(*) Hazardous wastes

In terms of quantification, for the solid waste and effluents (fuel and wastewater) produced during construction stage, it was assumed similar values as other projects developed in São Tomé and Príncipe¹² and are presented in the following table:

Type / Waste category		Quantities produced (Kg)	
		Day	Week
Packages	Bags / Plastic Straps	21	126
	Cement bags	30	180
Work front	Demolition debris	450	2.700
	Road pavement scarification	1.350	8.100
	Remains of Materials	45	270
	Used waters	900	5.400
	Fuel	4,5	27
Office	Paper	36	216
	Used materials	7,5	45
	Dejects	72	432
	Wastewaters	900	5.400

Table 24 - Estimate of category and amount of solid waste and wastewater to be generated at Pantufo Bay

A considerable part of the solid wastes produced on the different work fronts, mainly debris resulting from the demolition of works of art and solid residues resulting from the scarification of the asphalt pavement will be recovered for use in repair work on dirt roads and macadam.

With the implementation of the measures recommended in the chapter 14, the significance of the impact is expected to be reduced to low significance.

12.4.1.22 Reuse of recycled glass

Construction activity: The activity generating this impact is associated with the construction and

¹² • The construction of the Fishing Dock Building, currently CKADO Supermarket; • Hospital Road Retaining Wall, in front of CKADO Supermarket • Containment of the seafront along the 250 m after the CKADO Supermarket, towards the center of São Tomé city



recovery of benches inherent to the landscape requalification of the Marginal, promoting the reuse of waste.

Effects: Construction of the benches and decreasing the amount of solid waste (glass) disposed in inappropriate places.

Impact Assessment: The reuse of recycled glass in the construction of new benches, is classified as a positive impact, significant, direct, temporary and of moderate magnitude, because it will reduce the volume of waste (glass bottles, etc.) that is out in the open on the island, as well as prevent possible accidents (cuts with glass) of people who frequent the streets.

The following table summarizes the impacts identified in the construction phase.

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Climate and Climate Change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	N	D	T	R	LS	LS
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	N	D	T	R	LS	LS
	Electricity consumption		Use of electrical equipment	N	D	T	R	LS	LS
	Reduction of CO2 sequestration		Lighting of premises (building site)	N	D	T	R	LS	LS
	Increased GHG emissions		Deforestation and felling of trees	N	D	T	R	LS	LS
			Construction of revetment and armor ridge for coastal protection and transportation of materials	N	D	T	R	LS	LS
Air quality	Dust CO2, CO, NOX, SOX, HC, VOC's and PM emissions	Alteration of air quality	Earthmoving	N	D	T	M	S	LS
			Moving equipment and machinery						
			Cement preparation						
			Beach nourishment and CH 4+950 – CH 5+300						
			Construction of revetment and armor						

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low significance/ Significant, Very Significant)	Significance (Low significance/ Significant, Very Significant)
Air quality	Fuel consumption		ridge for coastal protection						
			Removal and replacement of pavement layers						
			Lighting of premises (building site)						
			Use of electronic and electromechanical equipment						
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 4+790						
Noise	Noise generation	Noise and vibration emission	Removal and replacement of pavement layers	N	D	T	M	S	LS
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.						
			Moving equipment and machinery						

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Noise	Excavations for construction of coastal protection barriers	Increased exposure to erosive agents (water, wind, sea waves)	Earthmoving	N	D	T	R	LS	LS
	Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Increase in the impermeable area with pavement	N	D	T	M	LS	LS
			Movement of heavy equipment and machinery on the access roads to the quarries						
	Solid waste disposal in inadequate sites	Soil contamination	Operation of the construction site	N	D	T	M	S	LS
	Accidental spillage of hazardous products (fuel, oil, lubricants, concrete)		Circulation of equipment, machinery and vehicles used for transporting materials						
Production of solid waste and liquid effluents	Demolition of existing infrastructure								
Geology	Extraction of materials from quarries	Change in the topography of the land (geomorphology)	Removal of vegetation cover/tree felling	N	D	P	R	LS	LS
			Earthmoving						
			Moving equipment and machinery						

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low significance/ Significant, Very Significant)	Significance (Low significance/ Significant, Very Significant)
Geology	Coastal erosion	Changing the topography of the land	Removal of vegetation cover/tree felling	N	D	T	R	LS	LS
			Earthmoving and beach nourishment and CH 4+950 – CH 5+300)						
			Moving equipment and machinery						
Water resources	Water consumption	Consumption of water resources	Operation of the construction site	N	D	T	H	S	LS
			Cement preparation						
			Washing of concrete mixers, equipment and machinery						
	Dragging of sediments into water bodies (water turbidity)	Reduction in water quality	Earthmoving	N	D	T	M	S	LS
			Removal of vegetation cover						
			Rehabilitation of the hydraulic crossings						
Waste production	Contamination of surface/groundwater	Solid waste disposal in inadequate sites	N	I/D	T	M	VS	S	
Production of liquid effluents		Maintenance and washing of equipment and machinery	N	I/D	T	M	S	LS	

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Water resources	Accidental spillage of hazardous products (fuel, oil, lubricants)	Interruption of drainage patterns	Disinfection of new water mains on the Marginal	N	I/D	T	M	LS	
			Storage and handling of dangerous products	N	T	D	H	VS	S
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 0+450 and CH 1+340	N	T	D	M	S	LS
			Movement of equipment and machinery	N	T	D	M	S	LS
	Production of dust (turbidity)		Construction of revetment and armor ridge for coastal protection	N	T	D	M	S	LS
			Earthmoving	N	T	D	M	S	LS
			Movement of equipment and machinery	N	T	D	M	S	LS
	Deposition of waste and sediments		Removal of vegetation cover	N	D	T	R	LS	LS
			Earthmoving	N	D	T	R	LS	LS
			Construction of revetment and armor	N	D	T	R	LS	LS

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Water resources			ridge for coastal protection						
			Demolition of existing infrastructure including construction of new bridge CH 4+790	N	D	T	R	LS	LS
	Siltation on water courses	Flooding (destruction of infrastructure)	Construction of revetment and armor ridge for coastal protection	N	D	T	M	S	LS
			Demolition of existing infrastructure including construction of new bridge CH 4+790						
			Earthmoving						
			Removal of vegetation cover						
Natural resources	Fuel consumption (diesel, petrol)	Increased consumption of fossil fuels	Use of equipment and machinery	N	I	T	R	S	LS
	Electricity consumption	Increase in electricity consumption	Use of electrical equipment	N	I	T	R	S	LS
Lighting of premises (building site)									

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low significance/ Significant, Very Significant)	Significance (Low significance/ Significant, Very Significant)
Natural resources	Consumption of construction materials (stones, sand, wood, etc.)	Increased consumption of construction materials	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	LS
			Cement preparation						
	Water consumption	Increase of water consumption	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	LS
			Cement preparation						
Landscape	Introduction of foreign elements that disturb the landscape	Landscape alteration	Removal of vegetation cover	N	D	T	R	S	
			Earthmoving						
			Moving equipment and machinery						
			Presence of fence						
	Destruction of vegetation cover	Visual impact	Removal of vegetation cover	N	D	T	M	S	LS
			Earthmoving						
Moving equipment and machinery									

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Biodiversity	Noise emission	Disturbance of the Terrestrial Ecosystem (Flora and Fauna)	Earthmoving	N	D	T	R	LS	
			Handling of heavy equipment and machinery	N	D	T	R	LS	
			Road rehabilitation, coastal protection and beach nourishment beach CH 4+950 – CH 5+300	N	D	T	R	LS	
			Removal of vegetation cover	N	D	T	R	LS	
	New habitats for birds' nest, breeding and rest		Grubbing 1 coconut palm and 3 <i>Terminalia cattapa</i> (caroceiro) and 100 new planted trees, 1 <i>Washingtonian robusta</i> (Mexican palm tree) and 83 <i>Vachellia karroo</i> (Karoo acacias) and 16 Tamarinds.	N	D	T	R	LS	
Alteration of the intertidal habitat	Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area	Construction of revetment, armor crest, wall and beach nourishment CH 4+950 – CH 5+300	N	D	P	M	S	LS	
Accidental spillage of hazardous products (fuel, oil, lubricants and concrete)	Disturbance and degradation of the marine ecosystem	Earthmoving	N	D	T	R	LS		

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Biodiversity	Alteration of water quality		Handling of heavy equipment and machinery	N	D	T	R	LS	
	Sea turtle nesting beaches disturbance		Coastal protection and beach nourishment CH 4+950 to CH 5+300	N	D	T	M	S	LS
	Quality of sand		Coastal protection and beach nourishment CH 4+9500 to CH 5+300	N	D	T	M	S	LS
	Noise		Coastal protection and beach nourishment (CH 4+950 – CH 5+300	N	D	T	M	S	LS
Occupational Health and Safety	Accidents at work (falling, tripping, cuts)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	N	D	T	R	S	LS
		Reduced quality of life		N	D	T	H	VS	S
	Road traffic accidents	Vehicle damage	Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	R	S	LS
		Reduced quality of life		N	D	T	H	VS	S
	Dust emission	Harmful effects on the workers' respiratory system	Earthmoving Infrastructure construction (road, hydraulic structures and coastal protection, etc.)	N	D	P	H	S	LS

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures	
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)	
Occupational Health and Safety	Noise emission	Harmful effects on workers' hearing systems	Demolition of existing infrastructure							
			Moving equipment and machinery	N	D	T	H	VS	S	
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)							
		Demolition of existing infrastructure								
Community Health and Safety	Accidents falls	Reduced pedestrian safety	Use of construction material transport equipment and machinery and vehicles	N	D	T	M	S	LS	
		Reduced quality of life		N	D	T	M	S	LS	
	Road traffic accidents	Reduced quality of life	Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	M	S	LS	
		Reducing road safety		N	D	T	M	S	LS	
	Dust emission	Harmful effects on the population's respiratory system	Earthmoving	Removal and replacement of pavement layers	N	D	T	M	S	LS
			Demolition of existing infrastructure							
Noise emission			Moving equipment and machinery	N	D	P	M	S	LS	

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low significance/ Significant, Very Significant)	Significance (Low significance/ Significant, Very Significant)
Community Health and Safety		Harmful effects on the population's hearing system	Demolition of existing infrastructure						
			Removal and replacement of pavement layers						
Waste Management	Production of construction and demolition waste (buildings, floors, pipes, etc.)	Occupation of public space	Demolition of existing infrastructure and construction of new infrastructure	N	D	T	R	S	LS
	Waste water production	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	P	H	S	LS
			Kitchen and sanitary installations in the Construction Site and sanitary installations in the work fronts.	N	D	P	H	S	LS
	Production of hazardous waste	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	H	VS	S
Demolition of existing infrastructure									

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
				Positive/Negative	Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low significance/Significant, Very Significant)	Significance (Low significance/Significant, Very Significant)
Waste management	Use of waste	Using locally recycled glass	Construction of benches	P	D	T	M	S	
	Production of domestic waste	Harmful effects on the health of workers and community	Kitchen and sanitary facilities in the Construction Site and sanitary facilities at the work fronts	N	D	T	R	S	LS

Table 25 Environmental Impact Assessment – Construction Phase. Ana Chaves Bay

12.4.2 DEMOBILIZATION PHASE

12.4.2.1 Greenhouse Effect and Climate Change

Demobilization activities: The main impacts on climate results from similar activities already described for construction stage, except the deforestation.

Effects: Increased Greenhouse Gases (GHG) emissions.

Impact Assessment: Similar to what was assessed for construction stage, the estimative of GHG emissions at this stage will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.). However, these are not expected to be relevant, in addition to being temporary and mitigable.

12.4.2.2 Change in air quality

Demobilization activities: The generation of this impact is due to the increase in vehicle circulation and the operation of equipment and machinery used in the removal of equipment assigned to the construction site and the removal of demolition debris resulting from the installation of a construction site with infrastructure for offices, bathrooms, warehouse, workshop among others. Also, if in case of restoration of construction site, reforestation is foreseen.

Effects: Increase of the number of vehicles for demobilization activities generates emission of dust and CO₂, CO, NO_x, SO_x, HC, VOC's.

Impact Assessment: Similar to what was assessed for construction phase the emissions at this phase will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.). However, is expected to be temporary, direct, reduced magnitude and low significance.

12.4.2.3 Noise and vibration emissions

Demobilization activities: The generation of this impact is due to the increase in vehicle circulation and the operation of equipment and machinery used in the removal of equipment assigned to the construction site and the removal of demolition debris resulting from the installation of a construction site with infrastructure offices, bathrooms, warehouse, workshop among others.

Effects: Noise pollution, health nuisance for workers and the population in the surrounding area.

Impact Assessment: Demobilization activities are responsible for interference in the noise level, and may cause adverse impacts, either on the health of workers or on the health of the population of the project's area of influence, as well as on the environment (removal of local fauna).

The emission of noise and vibrations is classified as a negative impact, with local scope, which will last for the duration of the demobilization operations. This impact is significant and reduced magnitude.

If the mitigation and/or prevention measures foreseen in Chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.2.4 Soil contamination

Demobilization activities: Soil contamination is associated with the various dismantling and decommissioning activities that imply, namely the movement of heavy equipment and machinery in the access to the construction site that may cause eventual spills of hazardous products (oil, fuel, etc.), the demolition of support infrastructures (office, kitchen, bathrooms, etc.) promotes waste production.

Effects: Soil contamination, landscape alteration due to waste disposal in inappropriate locations.

Impact Assessment: During the equipment and demolition debris removal operations, if mitigation and/or prevention measures are not adopted for proper waste management, and if waste disposal occurs in inappropriate locations, they are potential soil polluters due to the chemical characteristics of the different wastes, since project is in a coastal area, with sandy soils, already subject to soil contamination is classified as negative, significant, limited to the construction site, temporary and moderate magnitude.

With the implementation of the measures foreseen in Chapter 14, the level of significance of the impact is expected to be reduced to low significance.

12.4.2.5 Increased water infiltration into the soil

Demobilization activities: The main activity generating this impact may be the biophysical recovery of the area affected to the construction site, through reforestation, with the planting of native tree species.

Effects: Improvement of the landscape, increased water infiltration into the soil.

Impact Assessment: The reforestation activity at the construction site, should it occur, will be evident the soil decompaction resulting from the tree planting process. In addition, with the reforestation of the affected area there will be a higher rate of water infiltration into the soil, because the roots of the plants promote the improvement of soil structure, increasing soil permeabilization.

The increase of water infiltration into the soil is classified as positive, significant, direct, permanent and moderate magnitude. If the measures recommended in Chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.2.6 Contamination of Surface/Groundwater

Demobilization activities: The activities of dismantling and disposal of demolition waste in inadequate locations inherent to the activities of moving and operating equipment and machinery, removing equipment and demolition debris from infrastructure installed on the construction site (offices, bathrooms, warehouse, workshop among others).

Effects: Contamination of surface water (if the construction site is near a water course) and/or groundwater.

Impact Assessment: The contamination of surface/groundwater is associated with accidental spills of hazardous products (fuels, oils, lubricants) and the disposal of demolition waste in inadequate locations, if a spill of hazardous products occurs, through the percolation of these liquids on the ground, in addition to reaching surface water, it may also reach the groundwater. This impact is classified as negative, direct or indirect, temporary, of reduced magnitude and low significance.

With the implementation of the measures foreseen in Chapter 14, it is expected that the significance of the impact will be reduced to low significance.

12.4.2.7 Change in Water Quality

Demobilization activities: The alteration in water quality is associated with the dragging of sediments to waterways by rain/wind, promoting the turbidity of the water and the presence of total suspended solids (TSS), coming from the circulation of vehicles, use of equipment and machinery, and the removal of demolition debris from the infrastructure assigned to the construction site.

Effects: Alteration of water quality in the surrounding area and health nuisance to the population.

Impact Assessment: The change in water quality as a result of vehicle circulation and debris removal activities is classified as negative, significant, direct, temporary, and moderate magnitude.

It is expected that the significance of the impact will be reduced to low significance if the measures recommended in Chapter 14 are adopted.

12.4.2.8 Decrease in consumption of natural resources (fossil fuels, energy)

Demobilization activities: The decrease in consumption of fossil fuels and energy is due to the cessation of construction work on the waterfront, coastal protection and infrastructure with the consequent demobilization of the construction site.

Effects: Reduced consumption of natural resources.

Impact Assessment: The cessation of construction activities implies a reduction in the number of vehicles in circulation that were assigned to the works, decreases fuel and energy consumption associated with the removal of luminary and electrical equipment at the construction site facilities, decrease of water consumption. The impact of consumption of natural resources is classified as negative, low significance, direct, temporary and of reduced magnitude.

With the implementation of the measures foreseen in the chapter 14, it is expected that the significance of the impact will be reduced to low significance.

12.4.2.9 Landscape alteration and visual impact

Demobilization activities: The main activities generating this impact are associated with the movement of equipment and machinery and the removal of demolition debris.

Effects: Landscape alteration, visual impact and inconvenience to the well-being of the population.

Impact Assessment: During the cleaning action and biophysical recovery of the affected area, the flow of equipment and machinery increases as well as the volume of disposed construction and demolition waste in the open, from the front of the work and construction site, promoting the intrusion of foreign elements in the landscape and if mitigation and/or effective prevention measures are not adopted, the destruction of the vegetation cover of the surrounding area may

occur. This impact is classified as negative, low significance, direct, temporary and of reduced magnitude.

If construction site is in a natural area and will be dismantled, restoration of the affected area with reforestation and soil decompaction of soil permits natural recovery and impact is a positive, direct, permanent, moderate and significant impact in landscape.

12.4.2.10 Impacts on Terrestrial Ecosystem (Flora and Fauna)

Demobilization Activities: The activities associated with the circulation of heavy vehicles for the demobilization of the construction site and the removal of equipment and demolition debris may cause some noise disturbance and possible spills of hazardous products such as fuel, oil, lubricants.

Effects: These activities can cause disturbance of territorial ecosystems in the area of influence of the construction and work fronts

Impact Assessment: Considering that the main impacts already occurred during implantation of works, the main impact that may persist during demobilization stage will be the disturbance (noise) on the surrounding fauna. This impact can be classified as negative, direct, temporary, reduced magnitude and low significance.

The same is true for the possible spills of hazardous products, which will be minimal if mitigation measures are adopted. With implementation measures recommended in Chapter 14 are adopted, the significance of the impact will be reduced to low significance.

If construction site is placed in an area that will be recovered, the impact will be positive, direct, permanent, significant and moderate magnitude.

12.4.2.11 Disturbance and degradation of the marine ecosystem

Demobilization Activities: The activities associated with the circulation of heavy vehicles for the demobilization at work fronts and the removal of equipment and demolition debris may cause some possible spills of hazardous products such as fuel, oil, lubricants.

Effects: These activities can cause disturbance of territorial ecosystems in the area of influence of the construction work fronts

Impact Assessment: Considering that the main impacts already occurred during implementation of works, the main impact that may persist during the demobilization stage will be the disturbance (noise) on the surrounding fauna. This impact can be classified as negative, direct, temporary, reduced magnitude and low significance.

The same is true for the possible spills of hazardous products, which will be minimal if mitigation measures are adopted.

If the construction site is placed in an area that will be recovered the impact will be positive, direct, permanent, significant and moderate magnitude.

12.4.2.12 Degradation of the public well being

Demobilization activities: The degradation of roads is associated to degradation of public roads is associated with accidental spills of hazardous products such as fuel, oils, lubricants, etc., inherent to vehicle circulation activities, traffic accidents and debris removal. These activities, particularly road traffic, contributes to degradation on the sidewalk structure coating, causing damages in bituminous material.

Effects: Use of pavement, traffic congestion in the area, whose degradation of the roads is more pronounced, inconvenience to the well-being of the population.

Impact Assessment: Public road degradation is classified as negative, significant, direct, temporary and of reduced magnitude.

If the measures recommended in Chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.4.2.13 Changes in the level of comfort of the population

Demobilization activities: The main activities generating this impact are the movement of equipment and machinery and the removal of demolition debris from the infrastructure installed on the construction site.

Effects: Noise pollution, nuisance to the health and well-being of the population.

Impact Assessment: The malfunctioning of equipment and machinery as well as the demolition waste removal operation generate noise emission, which may cause harmful health problems to the population of the surrounding area, as well as nuisance to the population, especially during rest periods, if the schedules for the execution of the activities are not respected and the mitigating measures for noise minimization are not implemented, during the demobilization activities of the construction site, depending on the location of the construction site.

This impact can be classified as negative, significant, with local scope, whose effects last as long as the decommissioning activities take place. The magnitude of the impact is reduced.

With the implementation of the planned measures, the significance of the impact is expected to be reduced to low significance.

12.4.2.14 Harmful effects on Health (respiratory and auditory system) of Workers and Population

Demobilization activities: This impact is associated with the production of dust inherent to the circulation of vehicles used to transport rubble, the use of equipment and machinery, and the removal of demolition rubble.

Effects: Noise pollution, air pollution, health nuisance for workers and population in the area of influence.

Impact Assessment: These activities, during the dry season, promote the increase of quantities of suspended particles (dust), affecting the respiratory system of the workers and the population in a harmful way, if proper precautions are not taken. Likewise, these activities also generate

noise emissions if the equipment and machinery are malfunctioning and the circulation of heavy vehicles on the access to the site is inadequate.

The harmful effects on the health of workers and the population are classified as negative, level of significance from low significance (respiratory system) to significant (auditory system), direct, permanent, and of reduced to moderate magnitude.

If the measures recommended in the next chapter are adopted, the significance of the impacts will be reduced to low significance and low significance, respectively.

12.4.2.15 Reduction of Occupational Health and Safety

Demobilization activities: The reduction in occupational health and safety conditions is associated with possible work accidents such as falling, tripping, cuts, electrocution, etc., resulting from the use of equipment and machinery in the demobilization activities of the construction site.

Effects: Operations that include operation of electrical equipment and movement of machinery and vehicles, can result in electrocution, trampling or lead to serious accidents.

Impacts Assessment: Indeed, during the operation of equipment and machinery, workers involved in these activities will be exposed to the risk's substances, if mitigation and/or prevention measures are not properly implemented. This impact is classified as negative, significant, direct, temporary, restricted to site workers and high magnitude, and may cause problems for workers, altering health and safety conditions at work.

It is expected that the level of significance of the impact will be reduced to low significant if the measures foreseen in Chapter 14 are implemented.

12.4.2.16 Quality of life of the population and workers

Demobilization activities: Demolition debris removal operations, circulation of machinery and vehicles used to transport demolition debris, and the use of equipment and machinery can generate impacts on the quality of life of the population

Effects: Loss of quality of life.

Impact Assessment: Reduced quality of life for both the population and workers is associated with the existence of machinery and vehicles assigned to the transportation of demolition debris and use of equipment and machinery.

This impact can be classified as negative, with a level of significance ranging from low significance to very significant, direct, and may be temporary or permanent depending on the severity of the accident, and of reduced to high magnitude.

12.4.2.17 Waste disposal

Demobilization activities: During the demobilization phase it is considered that the volume of demolition waste from the infrastructures installed at the construction site is evidently large, given the number of infrastructures (offices, bathrooms, warehouse, workshop among others). Thus, the waste from demolition should meet the appropriate transport and final destination, in order to avoid the disposal of wastes in inappropriate places, respecting the waste management plan.



Effects: Alteration of the local landscape, contamination of soil and surface/groundwater.

Impact Assessment: Waste from demolition should meet the appropriate transportation and final destination, in order to avoid waste disposal in inadequate locations, complying with the waste management plan. The temporary inadequate disposal of wastes before being transported to an adequate location may result in a **negative, significant, direct, temporary impact of moderate magnitude**.

With the implementation of the measures foreseen in the chapter 14, the significance of the impact is expected to be reduced to low significance.

The following table summarize the impacts identified in the demobilization phase.

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)
Climate and climate change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	N	D	T	R	LS	LS
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	N	D	T	R	LS	LS
	Electricity consumption		Use of electrical equipment	N	D	T	R	LS	LS
	Reduction of CO2 sequestration		Lighting of premises (building site)	N	D	T	R	LS	LS
	GHG emissions		Transport emissions from materials and equipment	N	D	T	R	LS	LS
Air quality	Emission of dust	Alteration of air quality (PM5 and PM10)	Use of equipment and machinery	N	D	T	R	LS	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Movement of vehicles	N	D	T	R	LS	
			Removal of equipment						
			Removal of rubble						
Noise	Increase of Noise	Noise and vibration emission	Increase in vehicle circulation	N	D	T	R	S	LS
			Use of equipment and machinery						
			Removal of equipment						

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)
Noise			Removal of demolition rubble in the construction site						
		Effect on the health of the population in the surrounding area	All the operation of clearing equipment, infrastructures and waste removal	N	D	T	R	LS	LS
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)	Soil contamination	Handling of heavy equipment and machinery at the access to the construction site	N	D	T	M	S	LS
	Production of demolition waste		Removal of equipment						
	Disposal of demolition waste in inappropriate places		Demolition of support infrastructures (office, kitchen, bathrooms, etc.)						
	Soil permeabilization and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	P	D	P	M	S	
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Removal of demolition rubble in the construction site	N	I/D	T	R	LS	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure	
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)	
Water resources	Accidental spillage of hazardous products (fuel, oil, lubricants)		Use of equipment and machinery							
			Moving equipment and machinery							
			Removal of equipment							
			Removal of demolition rubble in the construction site							
	Sediment drift into watercourses (turbidity, TSS)	Reduction in water quality	Vehicle circulation							
			Use of equipment and machinery	N	D	T	M			S
Removal of demolition rubble in the construction site										
Soil permeabilization and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	P	D	P	M	S			
Natural resources	Fuel consumption (diesel, petrol)	Decrease Fossil fuel consumption	Decreased use of vehicles	N	D	T	R	LS	LS	
	Electricity consumption	Decrease of electricity consumption	Removal of Luminary and electrical equipment on construction site	N	D	T	R	LS		
	Water consumption	Decrease of water consumption	Cessation of activities	N	D	T	R	LS		

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure	
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)	
Landscape	Destruction of vegetation cover	Landscape alteration	Moving equipment and machinery	N	D	T	R	LS		
			Removal of demolition rubble in the construction site							
	Introduction of foreign elements that disturb the landscape	Visual impact	Moving equipment and machinery	N	D	T	R	LS		
	Removal of demolition rubble in the construction site									
	Restoration of vegetation cover	Improving the landscape	Restoration of the affected area: reforestation, soil decompaction	P	D	P	M	S		
Biodiversity	Noise emission	Terrestrial Ecosystem (Flora and Fauna)	Vehicle movement	N	D	T	R	LS		
			Removal of equipment							
			Removal of demolition rubble in the construction site							
	Accidental spillage of hazardous products (fuel, oil, lubricants)			Heavy goods vehicles on the access to the construction Site	N	D	T	R	LS	
	Restoration of habitats			Biophysical restoration of the affected area	P	D	P	M	S	
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Disturbance and degradation of the marine ecosystem	Handling of heavy equipment and machinery	N	D	T	R	LS		

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)
Occupational Health and Safety	Dust emission	Harmful effects on the workers' respiratory system	Movement of vehicles carrying rubble	N	D	P	M	LS	LS
			Use of equipment and machinery						
			Removal of demolition rubble in the construction site						
	Noise emission	Harmful effects on workers' hearing systems	Movement of vehicles carrying rubble	N	D	P	M	S	LS
			Use of equipment and machinery						
			Removal of demolition rubble in the construction site						
	Accidents at work (falling, tripping, cuts.)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	N	D	T	H	S	LS
		Reduced quality of life	Removal of demolition rubble in the construction site	N	D	P	H	S	LS
	Road traffic accidents	Vehicle damage	Movement of machinery and vehicles used for the transportation of demolition debris	N	D	P	R	LS	
		Reduced quality of life		N	D	P	M	S	LS
	Road traffic accidents	Vehicle damage	Movement of vehicles	N	D	T	R	LS	LS

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)
Community health and safety		Reduced quality of life	Use of equipment and machinery						
	Dust emission	Harmful effects on the respiratory system	Movement of equipment and machinery	N	D	P	R	LS	LS
			Removal of demolition rubble in the construction site						
	Noise emission	Harmful effects on the hearing system	Movement of equipment and machinery	N	D	P	R	LS	LS
			Removal of demolition rubble in the construction site						
	Waste management	Production of solid waste	Waste disposal in inappropriate places	Removal of demolition rubble in the construction site	N	D	T	M	S
Soil contamination			Removal of demolition rubble in the construction site	N	D	T	M	S	LS
		Production of liquid effluents	Maintenance of machinery and equipment	N	D	T	M	S	LS

Table 26 Environmental Impact Assessment. Demobilization. Ana Chaves Bay

12.4.3 OPERATION PHASE

12.4.3.1 Greenhouse Effect/Climate Change

Operation activities: Although the project involves the requalification of the Marginal Road, the expected traffic increase is not directly related to the project, being consequence of the population increase and migratory movements of the inner communities to the coastline that will continue to use this already existing road. Therefore, the expected traffic emissions must not be considered a direct impact of the project. Nevertheless, the quantification of the CO₂ emissions from this traffic are important to understand how the project can help to mitigate these emissions by providing improved road conditions (pavement) and alternative paths for other less pollutant ways of transportations (namely bicycles).

A direct impact of the project is the emissions triggered by the electricity consumption for street lighting. Also, a direct impact is the construction of the coastal protection structures that has the purpose of mitigate the impact of climate changes (flooding and sea level rising) in Ana Chaves Bay. In addition, refers the requalification of the road drainage system.

Effects: GHG emissions, coastal protection, flood drainage.

Impact Assessment: The main impacts related to climate and climate changes are discussed below.

Traffic Increase

As mentioned above, the traffic increase is not directly related to the requalification of Marginal Road in Ana Chaves Bay. Nevertheless, a quantification of the expected CO₂ emissions is presented, based on bibliographic data, for the traffic data predicted for the Ana Chaves Bay project.

Light and heavy vehicles in São Tomé and Príncipe are usually imported from Europe, being mainly used cars, with more than 5 years of use¹³.

Considering only the Heavy vehicles for this assessment (more pollutant), was assumed a current value (year 2019) of 900 g CO₂/km¹⁴⁽¹⁵⁾. According to the same bibliographic references, is intended that average CO₂ emissions in 2025 will be 15% less than in 2019 and in 2030 30% less compared to 2019. Therefore, for the horizon year of 2045, it was assumed a CO₂ emission value of 630 g/km, which is less 30% than 2019.

		Pessimistic	Base	Optimistic
SECTION	TRAFFIC VOLUME 2021 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)
CH- CH	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km
2+760-3+860	27900	33390	53550	81270
	115200	137340	221760	335790
3+860-4+080	70200	83790	135450	204750

¹³ MINISTRY OF PUBLIC WORKS, INFRASTRUCTURES, NATURAL RESOURCES AND THE ENVIRONMENT (2019). *Third National Communication of Sao Tome and Principe within the UNFCCC*. 248 pp

¹⁴ <https://ec.europa.eu/clima/policies/transport/vehicles/>

⁽¹⁵⁾ AMBEL, C.C. (2015). *Too big to ignore – truck CO₂ emissions in 2030*. A briefing by Transport & Environment

		Pessimistic	Base	Optimistic
SECTION	TRAFFIC VOLUME 2021 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)
CH- CH	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km
4+080- 4+500	76500	91350	147420	223020
4+500-4+700	76500	91350	147420	223020
4+700- 4+940	76500	91350	147420	223020
4+940-5+200	122400	146160	235620	357210
5+200-5+300	122400	146160	235620	357210
5+300- 5+600	10800	120330	194040	294210
5+600- 5+900				

Table 27 CO2 Emissions from the heavy vehicles predicted along Ana Chaves Bay

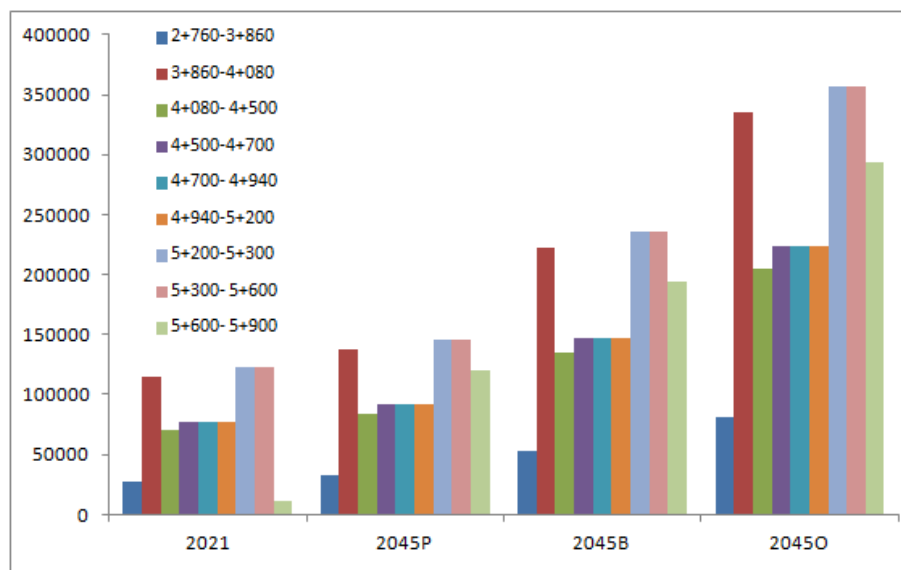


Figure 7 Comparison of the different scenarios within each section in Ana Chaves Bay

As seen, there are not many differences between the current emissions and the pessimistic scenario, but differences are seen with the optimistic scenario.

Comparing to the most recent data regarding transport emissions in São Tomé and Príncipe (42.5434 Gg CO₂ in 2019¹⁶), the above obtained values correspond to the following very low percentages:

		Pessimistic	Base	Optimistic
SECTION	TRAFFIC VOLUME 2021 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)
CH- CH	%	%	%	%
2+760-3+860	6.55801E-05	7.85E-05	0.000126	6.55801E-05
3+860-4+080	0.000270782	0.000323	0.000521	0.000270782
4+080- 4+500	0.000165008	0.000197	0.000318	0.000165008
4+500-4+700	0.000179816	0.000215	0.000347	0.000179816
4+700- 4+940	0.000179816	0.000215	0.000347	0.000179816
4+940-5+200	0.000179816	0.000215	0.000347	0.000179816
5+200-5+300	0.000287706	0.000344	0.000554	0.000287706
5+300- 5+600	0.000287706	0.000344	0.000554	0.000287706
5+600- 5+900	2.53858E-05	0.000283	0.000456	2.53858E-05

Table 28 Relative percentage of the heavy traffic emissions along Ana Chaves Bay, compared with transport annual emissions

Besides this low percentage of emissions (reinforcing that these are not directly related to the project implementation), is important to mention that the requalification of Marginal Road in Ana Chaves Bay considers a 2.5 m wide cycle lane (two-way traffic) along all sections, which will potentially contribute for the decrease of motorized vehicles by increasing the use of non-pollutant bicycles (defined as a mitigation measure for climate change). This will also require a wider social awareness for the use of this individual transport.

Also, refers the improvement of pavement that will contribute to a better car flow, with less traffic congestions and consequently lower GHG emissions.

The impacts of the project on traffic increase are inexistent, but are positive, permanent and significant regarding the offer of suitable conditions for using alternative and more environmental-friendly ways of transport.

¹⁶ Ministério das Infraestruturas e Recursos Naturais (2021). *Relatório de inventário de gases de efeito estufa no sector de energia para o período de 2010-2019*. 62 pp

Electricity Consumption

For the electricity consumption in Ana Chaves Bay, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is shown in the following table:

Circuit		Track		Power (kW)	Energy (kW/h)
Ana Chaves Bay - Street Luminary	ANA-I	CT-3	061-083	2,507	30 kW/h
Ana Chaves Bay- Street Luminary	ANA-II	CT-4	084-136	5,777	69 kW/h
Ana Chaves Bay - Park Luminary	ANA-III	CT-4	DP-ANA1	2,844	34 kW/h
Ana Chaves Bay - Park Luminary	ANA-III	DP-ANA1	DP-ANA2	1,008	12 kW/h
Ana Chaves Bay - Park Luminary	ANA-III	DP-ANA2	DP-ANA3	0,612	7 kW/h

Table 29 Electricity Consumption of the lighting circuits in Ana Chaves Bay

In the case of the installations to be built in Ana Chaves Bay, they will have an energy consumption corresponding to 8 hours of operation, and a power consumption of 10% of the maximum power of these installations.

Circuit		Track		Power (kW)	Energy (kW/h)
Ana Chaves Bay - Restaurant	ANA-IV	CT-4	DP-CHE	3,949	47 kW/h
Ana Chaves Bay – Fountain	ANA-IV	DP-CHE	DP-FUE	1,316	16 kW/h
Ana Chaves Bay - Fisheries	ANA-IV	DP-CHE	DP-FIS	1,316	16 kW/h

Table 30 Electricity Consumption of the installations in Ana Chaves Bay

The conversion factor for São Tomé and Príncipe operating grid electricity is 0.646 tCO₂/MWh¹⁷. The CO₂ emissions of the lighting circuit and buildings are presented in the table below.

Based on the same reference document that was considered for the traffic emissions, the total energy consumption for Ana Chaves Bay is 0.000173% of the total emissions of energy for 2019 (86,06 Gg CO₂), which is irrelevant.

Sites	Energy (kW/h)	CO ₂ Emissions (tCO ₂ /MWh)
Ana Chaves Bay – Street Luminary	30 kW/h	0.01938
Ana Chaves Bay – Street Luminary	69 kW/h	0.044574
Ana Chaves Bay – Park Luminary	34 kW/h	0.021964
Ana Chaves Bay – Park Luminary	12 kW/h	0.007752

¹⁷ CDM Standardized baseline: "Grid emission factor of São Tomé and Príncipe version 01.0 (ASB0020), based on the proposed new standardized baseline PSB009 "Grid Emission Factor of São Tomé and Príncipe" submitted by São Tomé and Príncipe. https://cdm.unfccc.int/methodologies/standard_base/2015/sb79.html

Sites	Energy (kW/h)	CO2 Emissions (tCO2/MWh)
Ana Chaves Bay – Park Luminary	7 kW/h	0.004522
Ana Chaves Bay – Restaurant	47 kW/h	0.030362
Ana Chaves Bay - Fountain	16 kW/h	0.010336
Ana Chaves Bay - Fisheries	16 kW/h	0.010336
TOTAL	231	0.149226

Table 31 Total CO2 emissions from electricity consumption in Ana Chaves Bay

The impacts of the electricity CO₂ emissions, although negative, permanent, are low significance. The limitation of working hours will function as a mitigation measure for reducing electricity consumption and therefore reducing CO₂ emissions.

Coastal Protection

Along the whole Ana Chaves Bay, the coastal protection exists of a seawall. At two locations (western end and at the “tree park”) the wall is collapsed. At most other areas, the main structure of the wall seems to be in relatively good condition.

The part west of the “tree park” has a concrete (or masonry) top wall / upper structure. This wall is about 50 cm of height and too low related to safety for pedestrians and for overtopping. Towards the east, around the old jetties, some parts of the upper structure have been replaced by a concrete balustrade. This barrier does not function well against overtopping as it is open.

The main problems in the study area have been identified:

- Erosion of the shoreline and beaches;
- Damaged sidewalk pavements and at some places collapsed;
- Eroding beaches result in lack of space for fishermen boat landing sites;
- Occasional overtopping of the waves and flooding of the Marginal road.

The most important direct effects of climate change are related to the exposure of the area to rising sea levels, floods, submergence of low-lying areas and the erosion of the coastline itself. Coastal protection structures constitute an adaptation measure against these climate change phenomena. How society responds to the forecasted risks is, therefore, paramount to the success of short and long-term sustainable development, community resilience and resultant community well-being¹⁸.

As described in Project description, coastal protection in Ana Chaves Bay mainly consists on installing a rock protection in front of existing rubble masonry seawall, restore masonry seawall and balustrade where damaged and install sandy material to replenishment for beach or fisheries in two specific areas São Pedro and Praia Chel. The rock protection will have the following characteristics:

¹⁸ SINAY, L. & R. W. (Bill) Carter (2020). Climate Change Adaptation Options for Coastal Communities and Local Governments. *Climate*, 8, 7

Z2A
Seawall up to +4,0 m
Berm in front of sea wall
Revetment crest at +2,30 m
Armour rock 1,5 - 2,8 t.
Z2B
Seawall up to +4 m
Berm in front of sea wall
Revetment crest at +1,90 m
Armour rock 0,7 - 1,4 t.
Z2C
Seawall up to +4m
Berm in front of sea wall
Revetment crest at +1,90 m
Armour rock 0,7 - 1,4 t.
Beach nourishment
Z2D
Seawall up to +4 m
Berm in front of sea wall
Revetment crest at +2,60 to 2,80 m
Armour rock 0,7 - 1,4 t.

Figure 8 Features of the rock protection Ana Chaves Bay

Geotextile is placed under this structure.

Adaptation to climate change has been carried out considering the sea level rise (SLR) values provided by the IPCC AR5 of 2014. The rise in sea level causes the coastline to recede, but also increases the wave height and increases the energy that reaches the coastal protections. For this project, these effects associated with the rise in sea level over a period of 50 years were considered. Also, for statistical action (wave, sea level) 100 years of return period is considered.

According to *Annex 14 Coastal Protection Structure Design for Ana Chaves Bay*, and to assess the suitability of the proposed solutions, overtopping analysis was conducted following two methods: 1) analytical formulation in accordance with Eurotop Manual (2018) and 2) for those critical zones a numerical model based on VOF (Volume of Fluid) to double check analytical results and study the convenience of optimization.

In order to study rock stability in shallow and very shallow waters and due to the lack of existence of one accepted formula, two methods were considered: 1) assuming the wave action as a flow that goes up and down along the slope of the coastal protection (run-up and run-down), and 2) assuming typical formulation for dykes under wave attack.

Different cross sections were defined considering these main aspects:

- Wave data.
- Bathymetry.
- Existing structures (groin, peninsula, land point, harbor, etc.) that create a physical barrier between zones.
- Existing uses of coastal areas.
 - Leisure places (Hotel, diving club, etc.)
 - Beach.

- Landing sites. Area on the beach where fishing boat are usually placed. In accordance with local information. In case of storm waves fishermen moves their boats from Ana Chaves Bay to Lagarto Bay due to fewer wave action.

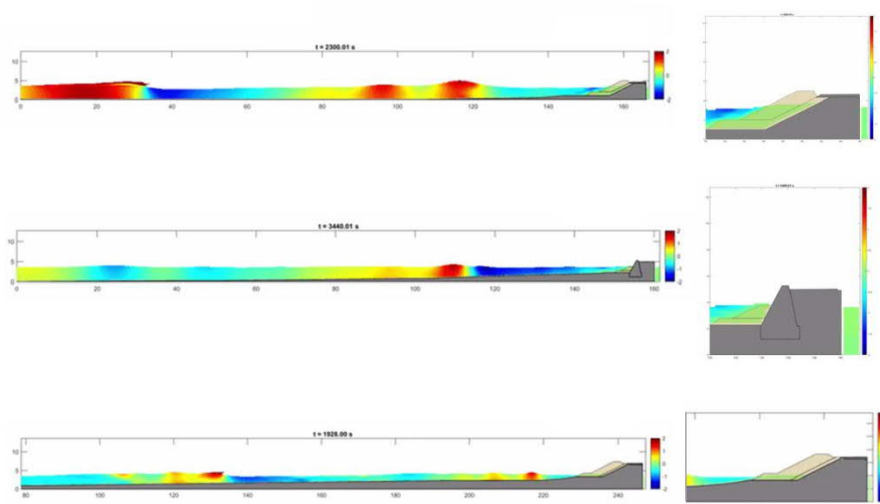


Figure 9 Output IH2VOF numerical simulation São Tomé. Overtopping assessment

Based on the results of this analysis, an optimization of the cross-sections where the overtopping was exceeded was performed and the solutions for coastal protection of Ana Chaves Bay already take in consideration the results of the above study and respective simulations, presenting the best technical solution for protecting the area from the predicted climate changes.

In this way, the impacts of these coastal protection structures as an adaptation measure to climate changes are positive, direct, permanent, moderate magnitude and significant.

Drainage System

Assuming the feasibility of the coastal protection structures described above for the sea-level rising and wave overtopping, another climate aspect to consider is the increase of intense precipitation events, with consequent increase of flooding that can come from the hinterland. The excess of water needs to be drained as quickly as possible, preferably to the sea, and the Marginal road should not constitute a barrier to these higher flows.

Since this is already an existing road, a field survey was performed to assess the conditions of the transversal drainage system. From the analysis carried out, it was concluded that the existing culvert have the necessary hydraulic capacity. However, the structural state of the culvert is not optimal, so it is recommended to replace it with a new one with the same capacity. Thus, the culvert at CH4+790 is proposed to be replaced by an 8,50 x 2,05 m twin boxes.

The flow capacity was determined for a 100-year maximal flood return period.

The drainage system has therefore capacity to guarantee, from now on, that these extreme events are taken care of, minimizing the situations of flooding of the platform, potential deterioration of the pavement, road accidents, the impact on the fluidity of traffic and the transport of food/goods, with consequent environmental and social positive impacts.

In this way, the impacts of the requalified drainage system as an adaptation measure to climate changes are positive, direct, permanent, moderate magnitude and significant.

12.4.3.2 Air quality improvement

Operation activities: Presence of more 96 trees and green spaces.

Effects: In this phase, after the landscape reconstruction of the site, the improvement of air quality will be significant, given that the increased number of trees and green spaces.

Impact Assessment: The main sources of particulate matter emissions are considered to be of the diffuse type, arising from wind action on roadways. In addition, the movement of vehicles emits particulate material in the exhausts due to fuel burning. However, the creation of green spaces with the consequent increase in the number of trees will favor the reduction of dust generation (PM10 and PM5) on the roadway. Thus, this impact was considered positive, significant and of direct impact. The impact may have a local scope, being permanent, and moderate magnitude.

12.4.3.3 Change in air quality

Operation Activities: Traffic generated by operation of infrastructures.

Effects: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non-motorized transport).

Impact Assessment: During the operation phase, it is likely that there will be an increase in air pollutant emissions, mainly CO (carbon monoxide), due to the increase motorized traffic foreseen to Marginal road without project.

The expected traffic increase is not directly related to the project, being consequence of increase of population and movements of communities along coastline that will continue to use this already existing road.

The configuration in design is a single carriageway with one lane on each direction. In the first 1.450 m (CH 4+250) have parking areas where the section allows it. Regarding the cross section, the vehicular lanes proposed within the carriageway are 3,0 meters wide. The proposed footpaths along the entire route are 2,0 m wide. A 2,5 m wide cycle lane (two-way traffic).

Project integrates circulation of vehicles with improved road safety conditions, restriction on speed of vehicles 40 km/h, except from CH 4150 to CH 4700, which will be 30 km/h due to the largest number of people on this section and the existence of several successive crossings.

That results in more fluidity and tranquility, demanding less of the engines and, therefore, reducing the emissions of atmospheric pollutants (CO₂, CO, NOX, SOX, HC, VOC's) if the mitigation measures foreseen are adopted.

The implementation of project creating an alternative of motorized transports cause an impact of air quality classified as positive, significant, direct, permanent and moderate magnitude.

12.4.3.4 Noise and Vibration Emission

Operation Activities: Traffic generated by operation of infrastructures and presence of marginal requalfied

Effects: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non-motorized transport) induces to a reduction of noise emissions for population in surrounding areas.

Impact Assessment: As referred for air quality the existence of alternatives of safe circulation of

non-motorized transports contributes to reduction of noise emissions. The proposed of footpaths along entire route and cycle lanes and existence of new 100 trees contribute to the use of non-motorized transport with reduction of noise emissions by vehicles.

The impact of noise and vibration emissions is classified as positive, significant, direct, permanent and of moderate magnitude.

12.4.3.5 Reducing exposure to erosive agents

Operation activities: This impact is mainly associated with the construction of coastal protection. With this work the coastal region will be protected from the action of erosive agents (water, wind, sea waves) that contribute to the advancement of the coastline. In recent years, the rise in sea level has interfered with the coastline, given that during periods of heavy rainfall the heavy impact of sea waves and the dragging of sediment by the force of the waters has caused degradation of the paving and possible flooding on the Marginal road.

Effects: Improvement and reinforcement of coastal protection, decrease in the advance of the coastline.

Impact Assessment: The impact of reduced exposure to erosive agents is classified as positive, very significant, direct, permanent and of high magnitude.

12.4.3.6 Soil Contamination

Operation Activity: The main activities generating soil contamination are the increased flow of people in the region with increase of solid wastes and increase of traffic.

Effects: Soil contamination associated with solid wastes disposal of solid wastes in inadequate locations and the accidental spillage of hazardous products such as fuels, oils, lubricants from traffic accidents

Impact assessment: The increase people and solid wastes and increase of traffic is not directly related to the project. However, the improved conditions that the project will provide, paper bins and improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to soil.

The impact of soil contamination is thus classified as a negative, direct, temporary, low significance and reduced magnitude.

12.4.3.7 Surface/groundwater contamination

Operation activities: The main activities generating surface and groundwater contamination are related to the increased volume of traffic and flow of people on the Marginal road (tourists and local population).

Effects: Risk of contamination of surface and ground water and aquatic ecosystems crossed by the water course.

Impact assessment: The increase people and solid wastes and increase of traffic is not directly related to the project. However, the improved conditions that the project will provide, paper bins every 40 m and improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to surface and groundwater.

The impact of soil contamination by solid wastes is classified as negative, low significance, direct or indirect, permanent and of reduced magnitude.

The presence of new infrastructure such the fishery, the public toilets and boat workshop have a septic tank with capacity of 10.100 l /year, that should be clean yearly.

The current situation wastewater in the city of São Tomé is discharged into the sea or goes to septic tank, as there is no wastewater system in the city. The new infrastructure has septic tank, and can be considered a positive, significant, direct, or indirect, permanent and of moderate magnitude.

12.4.3.8 Reduction of the water infiltration into the soil

Operation activities: The reduction of the water infiltration into the soil is associated with the presence of road, cycle lanes and sidewalks and infrastructures.

Effects: The rehabilitated road and new infrastructure will increase the waterproofed area and reduce soil infiltration.

Impact assessment: The reduction of the water infiltration process into the soil is associated with the soil waterproofing resulting from the presence of the rehabilitated road, with cycle lanes and sidewalks and new infrastructure (fishermen area, playground, etc.). The impact of reduced infiltration of water into the ground is classified as negative, low significance, direct, permanent and of reduced magnitude. Although there will be an increase in the impermeable area will not produce great interference in the volume of water that infiltrates the soil locally.

12.4.3.9 Improve drainage capacity of structures

Operational activities: This impact is mainly associated with the construction of drainage works that are resilient to climate change, in order to favor natural drainage. This activity will allow an efficient drainage of rainwater avoid flooding.

Effects: Improved drainage, avoid flooding in the period of heavy rains.

Impact Assessment: Improving the drainage capacity of the structures is classified as a positive, significant, direct, permanent impact of moderate magnitude.

12.4.3.10 Consumption of natural resources (fossil fuels, water electrical energy)

Operation activities: The main activities generating this impact are the increase in traffic volume, street lighting, park lighting and buildings

Effects: Consumption of electricity for street Luminary, park Luminary, fountain, fishermen area, restaurant

Impact Assessment: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non-motorized transport) and a reduction of trends of increase of fossil fuels consumption and impact is classified as positive, permanent, direct, moderate magnitude and significant.

For energy consumption in Ana Chaves Bay, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is street luminary - circuit ANA I track CT3 061-0831 (30 kW/h), street luminary - circuit AN II track CT4 - 084-136 (69 kW/h), park luminary circuit ANA-III CT4-DP-ANA 1 (34 KW/h), park luminary circuit PAN III DP-ANA1 – DP-ANA 2 (12kW/h) and park luminary ANA III – DP ANA 2 –DP ANA 3 (7kW7h). The luminaries are LED low consumption with an angle of 90° avoid emission of light for beach and disturbance of turtles nesting.

Relatively to the circuit corresponding to the buildings that will be installed in Ana Chaves Bay, it will have an energy consumption corresponding to 8 hours of operation, and a power of 10% of the maximum power that this installation has. The circuits are Restaurant ANA-IV Track CT-4 DP-CHE (47 KW/h), Fountain ANA-IV, track DP-CHE (16 KW/h) and Fish Market ANA-IV Track DP-CHE DP-FIS (16 KW/h).

Energy consumption for year 2019 was 2180,3 TJ for STP, according MIRN (2021) so the impact is negative, permanent, direct, reduced magnitude and low significance.

For water consumption infrastructures includes maintenance of green spaces, 5 fountains. Toilets. fisheries and boat workshop.

Landscape design considers an Irrigation Consumption: 6999,48 l per hour. In rain season is no needed to irrigate soil and 5 fountains with a total of 600 l per hour.

Water consumption in toilets will be less than 3.759 l/h. Water consumption in fishery will be less than 542 l/h. Water consumption in boat workshop will be less than 542 l/h.

The impact is negative, permanent, direct, reduced magnitude and of low significance.

12.4.3.11 Improving the Marginal's image

Operation activities: This impact is mainly associated with the landscape rehabilitation activity, with increased green space, urban equipment (benches), paper bins, playgrounds, cycle lanes, among others.

Effects: Improved image of the waterfront, increased local tourism, improved air quality.

Impact Assessment: The improvement of the marginal's image is classified as a positive impact, very significant, with local scope, permanent and high magnitude, since the landscape rehabilitation includes the creation of cycle lanes, contributing significantly to the reduction of the number of accidents mainly between vehicles and cyclists. Indeed, the local tourism sector will tend to grow with the improvement of the landscape conditions of the site.

The new planted trees, namely 1 *Washingtonian robusta* (Mexican palm tree) and 83 *Vachellia karroo* (Karroo acacias) and 16 Tamarinds in a total of new 100 trees. These species were chosen because of their rapid growth. However, due to the landscape value of *T. cattapa* and the provision

of adequate conditions for the local population to enjoy the new green spaces, this species must be also planted whenever possible, when these trees have to be felled for maintenance reasons with special care regarding location (far from the road as possible) to prevent future damage of the new pavement. If needed, a local nursery garden should be created to maintenance the specimens planted in Marginal.

12.4.3.12 Exclusion effect of marine animals (turtles: *Chelonia mydas*, *Lepidochelys olivacea*, *Eretmochelys imbricata* and *Dermochelys coriacea*)

Operation activities: The main generating activities are due to the presence of the rehabilitated road and infrastructure operation. This impact is associated with noise production resulting from the increased flow of traffic, people, goods and services, as well as the artificial lighting of existing infrastructure. Refers that the project contemplates that lighting of the roadway and green areas is maintained for 12 hours when there is no natural light, meaning that the nocturnal period will be mostly brightened.

Effects: Increased noise and lighting can exclude out the marine animals that frequent the nearby sea waters and beach.

Impacts Assessment: Noise generation resulting from the increased volume of traffic and beach and green space users causes disturbance to marine animals, as sound propagates five times faster in water than in air, and low frequency noises reach greater distances and therefore will affect the behavior of animals, which tend to move away from the emission source. However, the creation of green spaces (tree planting) will act as natural barriers, minimizing the propagation of sounds. This impact can be considered of reduced magnitude and low significance, permanent and direct since this area is already a disturbed area and the existing maritime fauna is already adapted to these disturbances.

With respect to artificial lighting of public spaces (lamps), this disorients individuals, and may lead them to change their natural behavior, causing them to cease or reduce important behaviors for their life cycle, such as feeding, resting and reproduction. Although this is a local impact and is an already existing impact in the current Marginal Road, the main permanent consequences are the potential interference with the nocturnal nesting behavior of sea turtles in Lagarto bay beaches.

While considering the risk of sea turtle hatchlings death due to artificial light disorientation, this impact should be considered as negative, direct, permanent, moderate magnitude and significant.

It is foreseen in project the use of luminaires of LED low pressure downward oriented and near beaches there will be no direct lighting to these potential biotopes. It is important that monitoring of sea turtles is maintained to assess this mitigation measure and avoid impacts. Due the implementation of these type of luminaires the impact of lighting will be reduced to low significance.

12.4.3.13 Alteration of Ecological Areas

Operation activities: The presence of the coastal protection barriers and beach nourishment.

Effects: The presence of the coastal protection works has effects on the loss of natural habitat, due to the decrease in the existing ecological area, and may result in the exclusion of marine animals. On the other hand, it will also provide new foundations for new habitats, with new rock subtract and new sand area.

Impact Assessment: With the coastal protection and beach nourishment works, the natural and unique characteristics of the site will be altered, affecting, in this case, the marine fauna, which may lead to loss of habitats, facilitating competition between individuals, and may lead to the removal and/or extinction of the species at the site. Since this area is not the main nesting area in the island for turtle nesting and is already with some disturbance due to anthropogenic activities, this impact is considered to be negative, permanent, of moderate magnitude and significant.

With the stabilization of the structures, is expected that these habitats can be recovered, with colonization of flora and fauna species, creating new communities and ecosystems. This impact is positive, significant, permanent and direct.

Additionally, beach nourishment will improve the current conditions of Ana Chaves Bay coastline, currently under high erosion pressure. Beach nourishment can improve beach conditions for turtle nesting since gives a large surface and volume of sand nesting resources for sea turtles, therefore increase the suitable coastline for sea turtle nesting not only within the direct influence area of Project but for the north-east shoreline of São Tomé island that can be considered as a Net gain for sea turtles critical or natural habitat.

12.4.3.14 Degradation of marine ecosystems

Operation activities: Expected traffic increase.

Effects: The degradation of marine ecosystems is associated with the accidental spillage of hazardous products such as fuels, oils, lubricants from traffic accidents.

Impact Assessment: The increase in traffic is not directly related to the project. However, the improved conditions that the project will provide, with improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to the sea water. The degradation of marine ecosystems is thus classified as a negative, direct, temporary, low significant and reduced magnitude impact.

12.4.3.15 Reduction in the number of accidents

Operation activities: Traffic generated by the road and infrastructure leads to a greater number of vehicles and creation of cycle lanes.

Effects: Decreased risks and number of road accidents, due to increased road safety in the area of influence and consequent increased quality of life for people.

Evaluation of Impacts: The reduction in the number of accidents during the operation of the development is associated with improved road safety with the implementation of speed restrictions, vertical road signs, crosswalks and the installation of lighting (street Luminary) and reduction of velocity for vehicles. This impact is positive, very significant, direct, permanent and high magnitude, since increased accessibility and improved paving conditions generate an improvement in local traffic, promoting a more fluid circulation of vehicles and contributing substantially to reducing the number of accidents, especially between vehicles and cyclists, with the creation of cycle lanes.

12.4.3.16 Effect on the population's health (respiratory and auditory system)

Operation activities: Traffic generated by the marginal will be motorized and no motorized with the presence of a greater number of trees with plantation of 100 new trees and road maintenance.

Effects: Alternative transports to motorized transports decreases air pollution and sound level,

sweeping track maintenance gives rise to dust, and the presence of more trees provides a noise barrier that will abate the negative effect on the health of the population in the surrounding area.

Impact assessment: Due to improvement of road and waterfront, better conditions for sports practice, walking and healthy habits, with decrease of noise and air pollution is considered a positive, significant, direct, permanent and local for population health (respiratory and auditory system).

Road maintenance generating traffic for cleaning infrastructures, green spaces maintenance, environmental a social monitoring etc., generates a small increase of vehicle trips by day comparatively with traffic without project and impact in respiratory and auditory systems is low significance, direct, low magnitude.

12.4.3.17 Improve of healthy habits

Operation Activities: Presence of five drinking water fountain.

Effects: The presence of five drinking water fountain provide the users of Ana Chaves Bay with drinking water.

Impact assessment: The presence of five fountains provide to users of Marginal road, playground and fitness area drinking. The impact caused by the presence of the drinking water fountain can be assessed as positive, significant, direct, permanent, with local scope.

12.4.3.18 Waste disposal on sidewalks and roads

Operation Activities: Presence of paper bins for rubbish disposal.

Effects: The presence of litter bins every 40 m can lead to a positive impact on waste disposal.

Impacts Assessment: During the operation phase, waste will be generated associated with operation of road and infrastructures which have the following main typologies:

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used tires
16 01 07 (*)	Oil filters
16 01 12	Brake pads other than those specified in 16 01 11

Code	Solid Wastes
16 01 17	Iron metals
16 01 18	Non-iron metals
16 01 19	Plastic
16 01 20	Glass
17 01 01	Concrete
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 04 07	Mixed metals
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20.01 02	Glass
20 01 19	Pesticides
20 01 39	Plastics
20 02	Garden and park waste
20 03 04	Septic tank sludge
20 03 01	Other urban and similar waste, including waste mixtures

Table 32 - Operation wastes

(*) Hazardous wastes

The current absence of paper bins currently means that the presence of paper bins every 40 m can generate a positive impact, considering that the population should be made aware of their use and that the daily collection of the waste produced is foreseen in the maintenance. This impact is considered positive, significant, direct, temporary and of moderate magnitude.

The current absence of paper bins currently leads that the presence of paper bins every 40 m can generate a positive impact, considering that the population should be made awareness campaign of its use and that the daily collection of waste produced is foreseen in the maintenance. This impact is considered positive, significant, direct, temporary and of moderate magnitude.

It is suggested to have an oil separator is system that received wastewater from workshop. Oils can be used as lubricant, as is usual in STP avoiding to be disposal in sea. Also, fish scales can be reused in creation of handicrafts for tourists.

12.4.3.19 Reduction of wastewater discharge on beach and open defecation

Operation Activities: Presence of boat workshop, fisheries and public toilets

Effects: Presence of these infrastructures with a septic tank with capacity of 10 100/year allows reduction of wastewater discharge on beach and avoid open defecation.

Impacts Assessment: These infrastructures with a septic tank should be cleaned yearly.



The septic tank avoids direct discharge to beach and can be considered a positive, low significance, indirect, permanent and reduced magnitude impact, because the final discharge of septic tank will be in the sea, because in São Tomé there is no Water Treatment Plant.

The following table summarize the impacts identified in the operation phase.

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low, Significance Significant/ Very Significant)
Climate and climate change	Consumption of fuel, oils and lubricants	Greenhouse effect/climate change	Traffic increase	P	D	P	M	S	
	Electricity consumption		Lighting of premises (street Luminary, park Luminary, fishermen areas, public toilets)	N	D	P	R	LS	
	Coastal Protection		Presence of Coastal protection infrastructures	P	D	P	M	S	
	Drainage System		Requalification of drainage system	P	D	P	M	S	
Air quality	Reduction of dust generation on roadways	Improving air quality (PM5 and PM10)	Increasing the number of trees and green spaces	P	D	P	M	S	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Circulation of motorized and non-motorized transports	P	D	P	M	S	
Noise	Noise emission	Noise and vibration emission	Circulation of motorized and non-motorized transports	P	D	P	M	S	
		Effect on the health of the population in the surrounding area	Increased vegetation cover (sound barrier)	P	D	P	M	S	
Soil	Coastal protection works	Reduced exposure to erosive agents (water, wind, sea waves)	Presence of Coastal Protection Works	P	D	P	H	VS	

Soil	Disposal of solid urban waste in inadequate locations	Soil contamination	Increased flow of people	N	D	T	R	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of Traffic Accident						
	Production of solid waste and liquid effluents		Existence of bins for rubbish disposal						
Water resources	Disposal of urban solid waste in inadequate locations	Contamination of surface/groundwater	Increased flow of people	N	D/I	P	R	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Traffic accidents (increase in traffic)						
	Water quality Alteration	Improving the drainage capacity of structures	Operation of public toilets, boat workshop, fish market area with septic tank	P	D	P	R	LS	
	Natural drainage		Presence of climate-resilient drainage works	P	D	P	M	S	
Natural resources	Fuel consumption (diesel, petrol)	Fossil fuel consumption	Circulation of motorized and non-motorized transports	P	D	P	M	S	
	Increase in electricity consumption	Electricity consumption	Lighting of premises (street Luminary, park Luminary, fisheries area, public toilets)	N	D	P	R	LS	LS



Environmental and Social Impact Assessment



	Increase of water consumption	Water consumption	Five fountains, public toilets, fishery, boat workshop, green spaces	N	D	P	R	LS	LS
Landscape	Rehabilitation of the image of the Marginal	Improving the image of the Marginal Visual	Rehabilitation of the landscape, with an increase in green spaces, urban equipment (benches), litter bins, children's playgrounds, cycle lanes, etc.	P	D	P	H	VS	
Biodiversity	Noise emission	Removal of marine animals turtles species (<i>Chelonia mydas</i> ; <i>Lepidochelys olivacea</i> ; <i>Eretmochelys imbricata</i> and <i>Dermochelys coriacea</i>)	Increased traffic flow	N	D	P	M	LS	
			Increased flow of people						
			Increase in goods and services						
	Light emission	Risk of death of sea turtle hatchlings due to artificial light pollution	Lighting of premises (street Luminary)	N	D	P	M	S	LS
		Loss of habitats or/and completion between species	Alteration of ecological areas	Coastal protection	N	D	P	M	S
	Creation New habitats (rocks and sand areas)	Presence of coastal protection and beach nourishment CH 4+950 – CH 5+300		P	D	T	M	S	
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Degradation of marine ecosystems	Road accidents	N	D	T	R	LS	
Community Health and Safety	Improving road safety	Reduction in the number of accidents	Movement of vehicles	P	D	P	H	VS	
			Safety I signage						
			Pedestrian crossings						

Community Health and Safety			Lighting of premises (street Luminary)						
	Dust emission	Harmful effects on the respiratory system	Road and infrastructures maintenance	N	D	T	R	LS	
	Noise emission	Harmful effects on the auditing system	Road and infrastructures maintenance	N	D	T	R	LS	
	Improving Health	Effects on respiratory and auditing system	Presence of road requalification	P	D	P	M	S	
Improve of healthy habits		Presence of five drinking water fountain	P	D	P	M	S		
Waste management	Production of solid and liquid waste	Disposal of wastes on sidewalks and roads	Existence of bins for rubbish disposal	P	D	T	M	S	
		Reduction of wastewater discharge on beach and open defecation	Operation of public toilets, fish market boat workshop with septic tank.	P	I	T	R	LS	

Table 33 - Environmental Impact Assessment – Operation Phase. Ana Chaves Bay

12.4.4 SYNTHESIS OF POTENTIAL ENVIRONMENTAL IMPACTS

The main environmental impacts for the construction, demobilization and operation phase for Ana Chaves Bay are presented below, considering the mitigation measures proposed.

Negative Impacts

Construction and Demobilization Phases

- Geomorphology alteration due extraction of materials in quarries and beach nourishment in beach (low significance);
- Disturbance in terrestrial fauna in flora due extraction of material in quarries and construction activities (low significance);
- Dsiturbance of marine ecosystems due construction activities in coastal area, including sea turtles nesting (low significance);
- Dust and noise emission due construction activities (low significance);
- Contamination of surface/groundwater in work fronts and in construction site due solid waste disposal in inadequate sites (significant);
- Contamination of surface and groundwater in work fronts and in construction site due to storage and handling of hazardous products (significant);
- Reduced quality of life in work fronts and construction site neighboring residents and road users due use of machinery and equipment and heavy vehicles for materials transportation (significant);
- Reduced quality of life due to removal of demolition rubble (significant).

Operation Phase

- Soil contamination resulting from disposal of solid urban waste in inadequate locations, Accidental spillage of hazardous products (fuel, oil, lubricants Production of solid waste and liquid effluents (low significance);
- Water and energy consumption (low significance);
- Degradation of marine ecosystems resulting form acidental spillage of hazardous products as fuel, oil and lubricants (low significance);
- Risk of death of sea turtle hatchlings due artificial light pollution (low significance).

Positive Impacts

Construction and Demobilization Phases

- Improving the landscape due to Restoration of the affected area: reforestation, soil decompaction (significant);
- Biophysical restoration of the affected area (significant).

Operation Phase

- Increase in traffic volume with motorized and no motorized transports, comparatively to increase with only motorized transports, resulting in a reduction of greenhouse gas emissions, noise and air pollution (significant);
- Reduced exposure to erosive agents (water, wind, sea waves) associated with the presence of coastal protection infrastructure (very significant);
- Improve drainage capacity of structures, avoiding flooding in the period of heavy rains (significant);
- Creation of new habitats (significant);
- Reduction in the number of accidents (very significant);
- Improve of healthy habits (significant);
- Reduction of disposal of wastes on sidewalks and roads due to existence of bin for rubbish disposal (significant).

12.5 POTENTIAL ENVIRONMENTAL IMPACTS - PANTUFO COASTLINE

12.5.1 CONSTRUCTION PHASE

12.5.1.1 Greenhouse effect and climate change

Construction activities: The main impacts on climate results from the fuel, oil and lubricant consumption of machinery and electromechanical equipment handling, the electricity consumption for the electrical equipment and lighting of premises (building site), and the deforestation and tree removal.

Consequences: increased Greenhouse Gases (GHG) emissions and reduction of CO₂ sequestration

Impact Assessment: The impacts on current microclimate are inexistent since any actions on the climate result from the effect of the physical presence of the new infrastructure, a situation that will only occur in effective terms in the operation phase, with the completion of the implementation of the rehabilitated road and the construction of revetment and armor ridge for coastal protection.

In terms of climate change, the main construction activities that may have an impact have to do with the emissions of GHG from the vehicles associated with the work (CO, CO₂, NO_x, SO₂, among others) and any eventual concrete and bituminous plants (particles and VOC). Some of these are GHG and other GHG precursors.

Regarding the estimative of GHG emissions at this stage, they will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.).

Nevertheless, a brief estimative of the CO₂ emissions related to the transportation of the materials with a dump truck of 20-ton was assessed. This estimative has many unknown aspects related to the construction procedures and routes that the Contractor will use, so several assumptions were made:

- Use of a 20-ton dump truck for transporting materials;
- Debris resulting from the demolitions goes to the Penha dump;
- From the spillway and quarries, an average distance to the work front was assumed;

Regarding the CO₂ conversion factor for the dump truck, was used the value from¹⁹ = 0.47 kg CO₂eq per t.km. The following table presents the estimated results.

Activities	Quantity (ton)	Distance (km)	Total number of trips (with 1 truck)	Total CO ₂ eq emitted (kg per t.km)	% Contribution
Excavations	18,480.17	14	1478	9727.9615	30.52
Excavations and Debris	171.20	8	14	51.49696	0.16
Demolitions	2,608.19	8	209	784.54355	2.46
Materials	307.49	20	25	231.23248	0.73
Materials from quarries	3,661.96	20	293	2753.7939	8.64
Coastal Protection Stones	24,373.14	20	1950	18328.601	57.50

Table 34 CO₂ emissions from material transportation during construction stage

The transport emissions from excavation materials and the coastal protection stones have the major impact, mainly due to higher quantities required to be transported.

However, comparing to the most recent data regarding transport emissions in São Tomé and Príncipe (42.5434 Gg CO₂ in 2019²⁰), the above obtained values correspond to the following very low percentages:

Activities	%
Excavations	0.023
Excavations and Debris	0.000
Demolitions	0.002
Materials	0.001
Materials from quarries	0.006
Coastal Protection Stones	0.043

Table 35 Relative percentage of the material transportation emissions during construction stage, compared with transport annual emissions

The impacts are not expected to be relevant, in addition to being temporary and mitigable. The

¹⁹ https://www.winnipeg.ca/finance/findata/matmgt/documents/2012/682-2012/682-2012_Appendix_H-WSTP_South_End_Plant_Process_Selection_Report/Appendix%207.pdf

²⁰ Ministério das Infraestruturas e Recursos Naturais (2021). *Relatório de inventário de gases de efeito estufa no sector de energia para o período de 2010-2019*. 62 pp

Impact is negative, direct, temporary, reduced magnitude and low significance.

During the construction phase, it is also worth mentioning the loss of a carbon sink with the destruction of vegetation cover in the project area. The increase in the concentration of greenhouse gases (GHG) in the atmosphere, namely CO₂, can be partially counteracted by carbon sequestration in forests that retain, in perennial biomass and in the soil, carbon that would otherwise be in the atmosphere in the form of CO₂.

Some trees (in a total of 2) will need to be removed because of the large roots that are damaging the pavement and sidewalks. A brief calculation based on bibliographic references is presented to assess the CO₂ sequestration losses and gains with the removal and plantation of the trees.

Trees	Removal	Weight of CO ₂ Sequestered	Plantation	Weight of CO ₂ Sequestered
<i>Terminalia catappa</i> (caroceiro)	2	Extrapolated from (1) 1782.2 kg/year		
<i>Vachellia karroo</i> (Karoo acacias)			15	645005.37 kg/ha (2) Assuming an area of 9m ² for each tree 9*15=135 m ² 8707.6 kg/year
Tamarinds			21	50tC/ha (3). Assuming an area of 9m ² for each tree 9*21=189 m ² 945 kg/year
TOTAL		1782.2 kg/year		9652.6 kg/year

Table 36 CO₂ expected sequestration for the trees Pantufo Coastline

Legend (1) NURSYAHBANDI, U.H., W Subchan & Suratno (2020). The estimation of CO₂ absorption and O₂ production from trees on main street in The City of Jember. *IOP Conf. Series: Earth and Environmental Science* 485 01204; (2) Based on a similar species (*Acacia mangium*) WIDHANARTO, G.O., R.H. Purwanto, A. Maryudi & Senawi (2016). Assessing Carbon Pool of Forest Plantation to Support REDD+ Implementation in Indonesia AIP Conference Proceedings **1755**, 130008; (3) https://assets.publishing.service.gov.uk/media/57a08d58e5274a27b20017bf/R7274_-_Technical_specifications_Southern_India.pdf

Although the maximal CO₂ sequestration of the planted trees only occurs when the trees are fully growth, is already predicted that the landscape project will contribute significantly for mitigating climate changes compared to the current situation (more than 5x the current sink capacity).

The impact of removing trees will be residual and temporary since 36 new trees will be planted with the landscape project.

12.5.1.2 Alteration of air quality

Construction activities: The main activities that may generate the impact are earthmoving associated with the operation of excavation and cleaning of the roads, transport of dusty material for the rehabilitation of the road, circulation of equipment and machinery, demolition and removal of existing infrastructure (hydraulic crossings and paving) and the execution of paving, which may give rise to certain quantities of particulate matter (dust) into the atmosphere, adding to other pollutants emitted by vehicles in circulation, namely sulphur oxide, carbon monoxide, nitrogen

oxides, volatile organic compounds, hydrocarbons, among others, damaging the quality of the air during this stage.

Effects: Air pollution, nuisance to the health and well-being of the population in the area affected by the project and possible damage to the health of workers.

Impact assessment : As this is an already urbanized area where the main source of air pollution is the vehicles circulating on the Marginal, the impact on air quality is classified as negative, significant, direct, temporary and of moderate magnitude during the construction activities along this lot, as a result of possible traffic jams on the Marginal and surrounding roads due to traffic restrictions caused by occupation of the road, loading and unloading of construction materials and handling and loading of construction waste, circulation of heavy vehicles and, consequently, the construction workers and the population in the direct catchment area may also be affected by the effects of this impact.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.1.3 Noise and vibration emissions

Construction activities: this impact is mainly associated with demolition and removal of infrastructures (hydraulic crossings, paving layers), movement of equipment, machinery and circulation of heavy vehicles.

Effects: Noise pollution, nuisance to the health and well-being of the population in the area affected by the project and possible damage to the health of workers (harmful hearing problems).

Impact assessment: The impact of noise and vibration emission is classified as negative, significant, direct, temporary and of moderate magnitude, due to the existence of increased noise levels in the vicinity of the works associated with construction activities, in an area where the main source of noise is road traffic from the marginal road and where there are hotels, the National High School (CH 6+850) and beaches frequented by the inhabitants of the city of São Tomé and tourists. Due to the expected changes, the construction activities may result in a low significant impact, if the measures recommended in the chapter 14 are adopted.

Regarding Noise levels, the IFC/World Bank and World Health Organization (WHO) Standards set for residential and industrial areas must be respected during construction.

Receptor	L (dBA) of 1 hour	
	Daytime period (07:00 - 22:00)	Night time (22:00 - 07:00)
Residential	55	45
Industrial, Commercial	70	70

Table 37 IFC General Environmental, Health and Safety Guidelines for Noise Levels

The limit value of the environmental noise indicator (LAeq) in the project intervention area, which is characterized as a residential area, is 55 dB (A) during the daytime period (7:00-22:00) and 45

dB(A) at night. During the construction phase "temporary noisy activity" will be practiced with some frequency and will only be carried out during the daytime. It is prohibited on Sundays and holidays, and during weekdays between 10 pm and 7 am. However, in exceptional cases and duly communicated to the community, noise may be made on the prohibited days and times

12.5.1.4 Soil exposure to erosive agents

Construction activities: Earth moving and vegetation removal activities, which will proceed with the excavation for the replacement of the culvert box CH 7+312.

Effects: Water pollution, resulting from increased turbidity and concentration of suspended solids and siltation in water courses.

Impact Assessment: In Pantufo Coastline the terrain is mild and the soil consists of Quaternary alluvial deposits, which cover the basaltic rock and the interventions foreseen removal of vegetation for placement of culvert box (CH 7+312) to replace the existing ones, that exposes soil to erosive agents. The impact is negative, direct, temporary, reduced magnitude and low significance.

The significance of the impact will not be significant, given the measures recommended in the chapter 14.

12.5.1.5 Soil Water infiltration

Construction activities: potential impact-generating activities may be due to soil compaction associated with the movement of heavy equipment and machinery between the construction site, quarries and site and to the increase in the impermeable area resulting from the rehabilitation of the Marginal road.

Effects: Flooding, water erosion, silting up. These activities contribute to a reduction in the infiltration of water into the soil, with a consequent increase in surface runoff, which can lead to flooding during periods of heavy rainfall.

Impact Assessment: The impact of water infiltration into the soil can be classified as negative, low significance, direct, temporary and of moderate magnitude, because there will not be a substantial increase in the impermeable area with the rehabilitation of the Marginal road and coastal protection. In the selection of quarries and location of construction sites, preference will be given to existing ones, as well as in the access to the works, the opening of new accesses will be avoided. If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.1.6 Soil contamination

Construction activities: The main impact-generating activities are associated with inappropriate handling or possible spillage of hazardous products such as fuel, oils, lubricants, and bituminous materials, the replacement of the culvert CH 7+312, maintenance and washing of equipment and machinery, waste disposal in inappropriate places, earth moving during the works period.

Effects: Activities may result in contamination of soil, surface and groundwater, degradation of water lines, alteration of water quality and may affect the aquatic ecosystem.

Impact Assessment: Considered the negative impact, significant, direct, temporary, local

scope and moderate magnitude. The aforementioned activities are located on the banks of some watercourses and near the sea, where the soil is very permeable (sand) and the percolation of liquids is facilitated and may reach the water table. There are potential events of risk of contamination of both soil and water if this contamination occurs, it will contribute to the current degradation of the quality of the soil and of surface and underground water resulting from the discharge of domestic wastewater from dwellings and open defecation.

With the implementation of the measures foreseen in the chapter 14, it is expected that the level of significance will be reduced to low significance.

12.5.1.7 Alteration in geomorphology

Construction activities: The alteration of geomorphology is due to the extraction of materials in quarries and the erosion process associated with tree felling, earth moving and the movement of equipment and machinery.

Effects: Earthmoving activity, particularly excavations, as well as the removal of vegetation cover/treefelling can enhance erosion with the dragging of sediment to undesired areas and may even result in siltation of water lines.

Impact Assessment: The impact of changes in relief is of certain occurrence, negative, low significance, direct, with the scope in the area of direct influence of the project. This impact will be permanent and of low magnitude. In Pantufo Coastline there are situations where the pavements are very degraded due to the existence of tree roots. Earth moving activities, especially excavations, as well as the removal of vegetation cover / tree felling may enhance erosion by dragging sediment to undesired areas and may even result in siltation of water lines. These activities cause the topographic change of the land.

It is expected that the significance of the impact will be reduced to low significance if the measures recommended in the chapter 14 are adopted.

12.5.1.8 Consumption of natural resources (fossil fuels, energy, water and construction materials)

Construction activities: Road rehabilitation, construction of hydraulic structures and coastal protection, movement of machinery and equipment, use of electrical equipment and lighting of the facilities (construction site), preparation of cement, washing of concrete mixers, equipment and machinery, as well as the operation of the construction site, generate impacts on the consumption of natural resources.

Effects: Increased consumption of natural resources in the region.

Impact assessment: As this is a consumption of natural resources, it may have negative consequences on other aspects of the biophysical environment in the area of direct influence. During the period of construction activities, there is cement preparation, washing of concrete mixers and equipment, circulation and operation of equipment and machinery, as well as activities associated with the operation of the construction site (toilets, canteens, offices, kitchen, dormitories), which result in substantial consumption of water, energy and fossil fuels.

Energy estimative required for rehabilitation of road pavement in Pantufo Coastline is estimated as 7.6 TJ if all pavement is rehabilitated, the value will be less because not all road will be rehabilitated. Nevertheless, the energy consumption of rehabilitation is more advantageous, in comparison with the new pavement. The estimative of total energy consumption for country was according MIRN (2021) 2180,3 TJ for year 2019.

Thus, also for fossil fuels impact was considered negative, low significance, being direct, temporary and reduced magnitude.

The coastal protection structures will require also some energy to their construction, but will be negligible. The impact of use of energy is negative, reduced magnitude, temporary and low significance.

The materials needed for the project are estimated as 595,91 m³ of material (concrete), materials from quarries 6164, 92 m³ and 7458 m³ stones for costal protection in a total of 14 218,95 m³ the use of material.

During the construction phase, the demand for inert materials such as sand and stones may increase, which may cause a shortage of materials in the country, as well as encourage the exploitation of inert materials in unauthorized locations. For the construction activities planned in this region, this impact has been assessed as negative, significant, direct, temporary and of moderate magnitude.

For estimation of **water** consumption, it was assumed that for an average of 1 m² of road, 2 m³ of water will be consumed (consumption of concrete, construction / formwork and other washes and trucks, etc.). is estimated as 50 980 m³. The impact is negative, temporary, moderate magnitude and significant.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significant.

12.5.1.9 Alteration in water quality

Construction activities: This impact is associated with the dragging of sediments into the bodies of water, which in turn cause turbidity and suspended solids, leading to degradation of water quality. In fact, the main generating activities include the replacement of the culvert (CH 7+312), earth moving, removal of plant cover and coastal protection works, involving construction of the armor ridge and construction of walls.

Effects: Water pollution, affectation of the aquatic ecosystem and inconvenience to the health and well-being of the population in the project's area of influence.

Impact Assessment: The Pantufo Coastline is an area of the city of São Tomé with hotels, residences, National High School but also an area without wastewater drainage network, there are discharges of wastewater into the sea and open defecation, for this fact it is considered that the impact resulting from the planned construction activities will result in a negative Impact, significant, temporary, local scope and moderate magnitude.

If the measures foreseen in the chapter 14 are adopted, the significance of the impact is expected to be reduced to low significance.

12.5.1.10 Risk of surface/groundwater contamination

Construction activities: The main activities generating the risk of contamination of surface and

groundwater are the activities of disinfection of new water pipes and the maintenance and washing of equipment and machinery affected to the construction work will be responsible for the production of liquid effluents, such as disinfectants, oils and grease, which may result in contamination of the water table if these operations do not take place in an impermeable site with the respective retention basin.

Effects: Risk of contamination of surface and underground water and of aquatic ecosystems crossed by the water line.

Impact assessment: The risk of contamination may arise whenever products are spilled as a result of inappropriate storage and handling of dangerous products (fuels, oils, lubricants, concrete).

Improper storage and handling of hazardous products (fuels, oils, lubricants, concrete) may result in spill accidents. The movement of equipment and machinery, demolition of existing infrastructure and the construction of new infrastructure such as the fishermen's area and the replacement of the culvert box (CH 7+312) The physical characteristics of the sandy soil facilitates the runoff of these effluents into the groundwater, since their percolation into the soil is facilitated.

At the construction site, as the soil is made up of alluvial sand, percolation is facilitated and may reach surface water and the water table. As already mentioned, it is expected that surface waters already have their quality altered and with the existence of a spill there will be a contamination of surface/groundwaters, classifying this impact as negative, direct, of moderate to high magnitude, and the level of significance may be significant or very significant depending on the size of the spill.

The waste production and production of liquid wastes at construction site can have a negative, direct, temporary, with moderate or high very significant impact or significant impact in surface and groundwater contamination, but with mitigation measures proposed these impacts will be mitigated, to avoid soil and groundwater contamination.

In São Tomé there is no wastewater system nor wastewater treatment and final disposal for wastewater are septic tanks and sea, when there aren't directly discharged in water courses.

Regarding significance, if the measures foreseen in the chapter 14 are adopted, the level of impact significance will be reduced to low significance and significant, respectively.

12.5.1.11 Alteration in water flow patterns and flooding

Construction activities: The main impact-generating activities are associated with the demolition of existing infrastructures, including hydraulic structures and the replacement of the culvert box (7+312) construction of revetments and armor ridge for coastal protection, earth moving and removal of plant cover or pavement, causing siltation of water courses triggered by the dragging or transport of fine material or sediments by the action of rain during the period when the soil is disintegrated.

Effects: Demolition of infrastructure near the water courses can alter drainage patterns and cause flooding.

Assessment of impacts: Impact resulting from flood risk may be classified as negative, temporary, local and of reduce to moderate magnitude, mainly because during demolition and replacement of the culvert box (CH 7+312), it may cause silting up due to the opening of drains and diversion channels, as well as the accumulation/deposit of waste in water bodies, resulting in

the interruption of runoff, if the drainage of water with its flow rate is not guaranteed. This is an impact whose level of significance ranges from low significance to significant.

If the measures foreseen in the chapter 14 are adopted, it is expected that the significance of the impact will be reduced to low significant.

12.5.1.12 Landscape Alteration and Visual Impact

Construction activities: The main activities generating impact on the landscape include the movement of heavy equipment and machinery, earth moving, removal of vegetation cover for road rehabilitation, coastal protection and construction of a playground and landscaping.

Effects: Change in the landscape in the area of influence of the project as a result of the presence of the fence off the works along the coast, which implies a change in the visual scenery.

Impact assessment: The waterfront on the Pantufo Coastline presents in general a high visual quality of great (beach and sea) and with a low capacity to absorb elements foreign to the landscape, with a large number of observers (users of the waterfront road and tourists) due to its characteristics, it has areas of great landscape sensitivity. The presence of fence doesn't permit the sea visualization and changes scenic quality for road users. Furthermore, the circulation of heavy equipment and machinery results in the process of soil compaction in some natural areas, close to the beaches, which inhibits the growth of vegetation in the affected area, altering the landscape. Thus, the impact was considered negative, significant, direct, temporary, local and of reduced magnitude.

If the mitigation measures provided for in the chapter 14 are adopted, the significance of the impact will be reduced to low significant.

12.5.1.13 Disturbance of the terrestrial ecosystem (flora and avifauna)

Construction Activities: The disturbance of the terrestrial ecosystem, especially flora and avifauna, is associated with removal of vegetation cover and activities that generate visual and noise pollution (disturbance), where the operations of moving heavy equipment and machinery, earthmoving, and road rehabilitation, coastal protection stand out.

Effects: Reduction of habitats and pressure on associated fauna.

Impact Assessment: With the rehabilitation of the Marginal Road, there will be need to remove some tree specimens due to their consequences on the existing pavement (damage by the root system). For Pantufo Coastline, is expected to be removed 2 *Terminalia cattapa* (caroço). This species has no protection status, although *Terminalia cattapa* has a landscape value, due to their wide, open and almost horizontal canopies and their height (up to 25 m), providing enough shadow. This loss of potential habitats will be replaced by new planted trees, namely 15 *Vachellia karroo* (Karoo acacias) and 21 tamarinds, in a total of new 36 trees. These trees will be able to provide biotopes to several animal groups, especially invertebrates and birds.

Regarding the visual and noise disturbance, this can affect the existing avifauna in Pantufo Coastline because the presence and increased noise levels resulting from vehicle movements, machinery operation, and the presence of workers during construction can affect the birds' life cycle, whether it be reproduction, resting or feeding. Besides this, the birds may suffer with the reduction of their areas of use, which can lead to their displacement to other locations with suitable habitat. However, considering that the project's area of influence is located in urbanized area, with intense visual disturbance and noise from automobile and air traffic, birds are already adapted to these urban impacts. In addition, the species occurring here are generalists, with no

conservation status. The plantation of new trees mentioned above will contribute for potential nest, resting and feeding sites.

In view of the above, this can be classified as a negative, direct and temporary impact, whose magnitude is reduced and level of significance is low significance.

With the adoption of the measures recommended in the chapter 14, the significance of the impact will be further reduced.

12.5.1.14 Disturbance and degradation of the marine ecosystem

Construction activities: The main activities generating impacts on the disturbance and degradation of the marine ecosystem are earthmoving, movement of heavy equipment and machinery, removal of vegetation, construction of revetments and armor plating for coastal protection. These activities may generate water turbidity and noise disturbance. Light disturbance during the construction stage is not expected, since the construction works will be performed only during daylight. Accidental spills of hazardous products (fuel, oil, lubricants, concrete) from heavy machinery and equipment can lead to contamination and destruction of marine ecosystems.

Effects: Contamination of local marine waters, and the exclusion of marine species and/or death.

Impact Assessment: Earthmoving may lead to particles dragged into the water and cause turbidity in the intertidal area, with impacts on the existing organisms. Because of the already wave movement in the area, due to the shallow depth, is not expected that this turbidity will cause any significant impacts.

Coastal protection works may cause underwater noise and the temporary lighting of the works may affect turtle routes and nesting sites. This negative impact is considered to be significant, direct, temporary and of moderate magnitude.

The impacts from the spill of hazardous products are expected to be minimal or even non-existent, if all the mitigation measures are adopted. In addition, the quantities that may be accidentally dragged into the water are easily diluted in the sea water, so no permanent impacts are expected.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.1.15 Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area

Construction activities: The construction activities of cladding, armor ridge and wall.

Effects: Construction activities involving the occupation of the intertidal area, will result in the loss or alteration of this area and consequent loss of biodiversity.

Assessment: Construction activities can affect the intertidal area in Pantufo Bay, which can be sandy beach or rocky coast. This area is already subject to human pressure, with hunting, fishing or trampling of fauna, with more generalist species. Nevertheless, the impacts of loss of biodiversity by occupation of this area is considered negative, direct, permanent, significant and of moderate magnitude. With the stabilization of the structures, there is potential for flora and fauna colonization with new communities.

Several beaches in Pantufo Coastline have turtle nesting activity even know these are not the main nesting areas in the island for turtle nesting. However, sea turtle harvesting for local consumption,

human disturbance, beach erosion mainly driven by illegal sand mining and climate change, and the existence of stray dogs have contributed to the decrease of these populations.

Project can impact on sea turtles when a project action affect a nest buried in the sand by the female or by disturbing female's behavior when trying to spawn in the sand of the beach.

Therefore, Project shall avoid:

- any actions on the beach to prevent impacts on nests and
- disturbance to females when arriving the beach to spawn.

As said before the Project's component that could affect the sandy beaches are those related to coastal protection. Design of Coastal protection, particularly rock revetment, could affect the top or high part of the beach in contact with the road rehabilitation. This is the major identified project action that shall be monitor and for which mitigation measures shall be put in place during construction phase to eliminate impact on the sea turtle nesting resource.

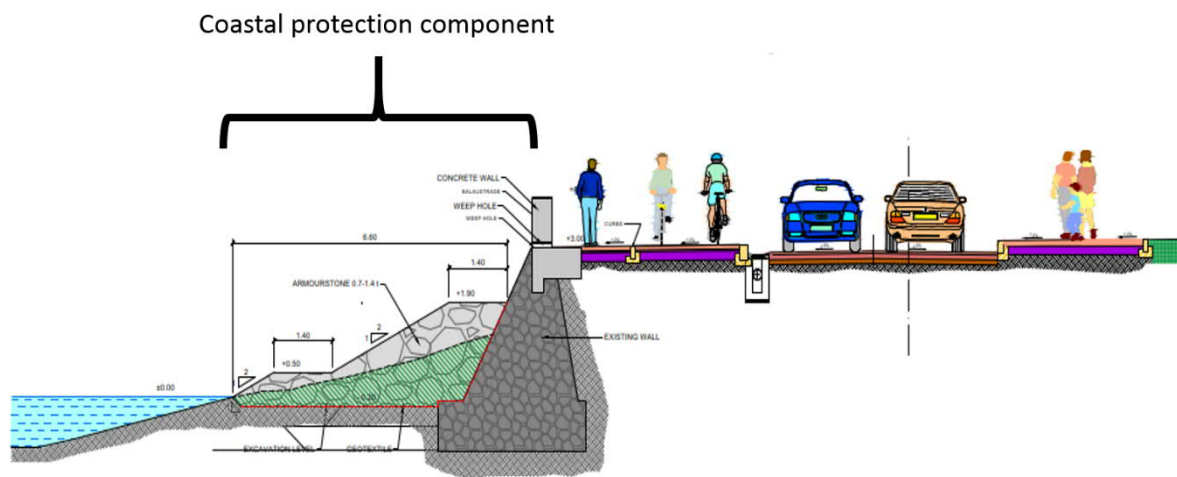


Figure 10 Coastal protection component (over a typical cross section)

Beach sections that keep suitable characteristics for turtle nesting, sandy beach and not rocky or without intertidal area o a wall, are shown in the figure below:



Figure 11 Beach section that could attract turtles for nesting.

Sea turtles nesting in Pantufo Coastline will be negatively affected by the noise and presence of machinery during the construction work. Construction activity in coastal should be avoided during the sea turtle nesting season from October to April.

If the measures provided for in the chapter 14 are adopted, the significance of the impact will be reduced to low significance. The mitigation measures in construction phase recommended to achieve a positive conservation outcome are:

- Code of Conduct for workers;
- Contractor's Workers sensitization.
- Work program for construction activities in beach from October to April, avoiding the nesting sea turtles season;
- Turtles find Procedures;
- Turtles management Plan preparation and implementation.

12.5.1.16 Effect on the health (hearing system, respiratory system) of the population and workers

Construction activities: Activities involving the movement of equipment and machinery, earthmoving, construction of new infrastructure (roads, hydraulic structures and coastal

protection, etc.), demolition of existing infrastructure and the removal of pavement layers give rise to the production of dust and noise.

Effects: Noise pollution, air pollution, health nuisance for workers and the population in the area of influence.

Assessment of Impacts: These activities, during the dry season, promote the increase of quantities of suspended particles (dust), affecting the respiratory system of the workers and the population in a harmful way, if proper precautions are not taken. Likewise, these activities also generate noise emissions, if the equipment and machinery are malfunctioning and the circulation of heavy vehicles on the access to the construction site is inadequate.

The harmful effects on the health of workers and the population are classified as negative, with a level of significance from low significance (respiratory system) to significant (auditory system), direct, permanent and of low to moderate magnitude.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.1.17 Reduced quality of life (population and workers)

Construction activities: During the execution of the work, the use of equipment and machinery and the circulation of equipment, machinery and vehicles used to transport materials for the work are expected to take place in the vicinity of residential areas and on roadways, with the removal and replacement of pavement layers, demolition of buildings such as walls, benches, and the construction of drainage works, construction of the coastal protection, landfill and construction of the area for fishermen, causing interference in the quality of life of the population.

Effects: The planned interventions on the Pantufo Coastline will have interference in the lives of the population, being a space of the city of São Tomé.

Assessment of impacts: Negative, very significant, direct, temporary and high magnitude impact. The planned interventions on the roads, as this is an area of the city of São Tomé, will interfere with the life of the population that travels to the city to work, trade or purchase services. Walking on the Marginal, the movement of equipment, machinery and vehicles, especially heavy vehicles, will interfere with the life of the population, restrict local traffic, reduce the number of parking spaces and have an effect on road safety.

It is expected that with the adoption of the measures foreseen in the chapter 14, the significance of the impact will be reduced to significant.

12.5.1.18 Occupational Health and Safety Risk

Construction activities: Workers involved in construction activities are exposed to various risks when using equipment and machinery.

Effects: Activities that include operation of electrical equipment and movement of machinery and vehicles may result in electrocution, pedestrian collisions or serious accidents.

Impact assessment: Construction activities will have a negative, significant, direct, temporary impact, restricted to construction site workers and of reduced magnitude, which may cause problems for workers, altering health conditions and levels of safety at work.

It is expected that the significance of the impact will be reduced to insignificant if the measures recommended in the chapter 14 are implemented.

12.5.1.19 Reduction in road safety (pedestrians and road users)

Construction activities: During the execution of road works there will be the need for machinery, equipment and heavy vehicles to circulate, traffic diversions, reduction in vehicle speed and the circulation of construction site workers, causing interference with vehicle access for residents, workers and people travelling to the city centre in the area affected by the works, as well as road users.

Effects: All construction site activities that involve the operation and movement of machinery, equipment and heavy vehicles can increase the risk of road accidents if the appropriate safety measures are not adopted.

Impact assessment: The impact on road safety is considered negative, significant, restricted to the area of intervention of the work, whose duration will be for the duration of the work, planned for 24 months. Given that the population of the surrounding area, construction workers and road users will be directly affected by the work, the magnitude of the impact is considered to be moderate.

If the mitigation and/or prevention measures foreseen in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.1.20 Occupation of Public Space (waste management)

Construction activities: Activities related to waste production at construction sites, namely the demolition of existing infrastructures and the construction of new infrastructures (buildings, pavements, pipelines, etc.) promote the inadequate disposal of wastes, especially in public spaces.

Effects: Water pollution by dragging waste to water lines and sea, beach sand.

Impact Assessment: The drift of unconditioned construction and demolition waste into water and sand lines may cause a significant, direct, temporary and small negative impact.

It is planned to adopt mitigation and preventive measures before and during the works, so that the level of significance of the impact is reduced to insignificant.

12.5.1.21 Risk to public and workers' health (waste management)

Construction activities: All road construction activities generate solid and liquid waste from demolition operations of existing infrastructure, road rehabilitation, construction of hydraulic structures and coastal protection, as well as from sanitary facilities at the construction site and in the work fronts. During these activities, solid and liquid waste such as packaging, cardboard, concrete waste, cables, iron, rubble, demolition waste, waste water, etc., domestic waste and hazardous waste must be transported to the appropriate final destination.

The following table shows potential waste resulting from the rehabilitation of the marginal road, coastal protection and landscaping component and arrangement of urban space.

Effects: Waste management when carried out inadequately promotes a situation of risk to the health of the population and workers on site, as well as environmental degradation of the affected area.

Impact assessment: The impacts on waste management are classified as negative, significant, direct, permanent and of high magnitude. Due to the fact that there are currently no bins for waste disposal, the works can generate hazardous solid and liquid waste that can contaminate the beach sands with risk to the health of the population of the project's direct area of influence.

Similarly, the waste from the construction site infrastructure (offices, canteens, toilets) and the concentration of workers near the construction site will be responsible for the production of solid waste and wastewater, respectively. Therefore, the absence of adequate waste management endangers the health of the population, workers and/or generates adverse damage to the environment.

During the construction phase, wastes will be generated associated with the execution of the works, which have the following main typologies, according to the European Wastes Codes (EWC):

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17
13 02 06 (*)	Synthetic engine, gear and lubricants oils
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used Tires
16 06	Batteries and Accumulators
16 01 07 (*)	Oil filters
17 01 01	Concrete
17 01 02	Bricks
17 01 03	Tiles, roof tiles and ceramic materials
17 01 06 (*)	Mixtures or separate fractions of concrete, bricks, tiles and ceramic materials containing hazardous substances
17 01 07	Concrete mixtures, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 02 04 (*)	Glass, plastic and wood containing or contaminated with hazardous substances
17 03 01 (*)	Bituminous mixtures containing tar
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 03 03 (*)	Tar and tar products
17 04	Metals (including alloys)

Code	Solid Wastes
17 04 01	Copper, bronze, and brass
17 04 02	Aluminum
17 04 03	Lead
17 04 04	Zinc
17 04 05	Iron and steel
17 04 06	Tin
17 04 07	Mixed metals
17 04 09 (*)	Metal waste contaminated with hazardous substances
17 04 10 (*)	Cables containing hydrocarbons, tar or other hazardous substances
17 04 11	Cables other than those mentioned in 17 04 10
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infections (for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20 01 21	Fluorescent tubes and other mercury-containing waste
20 02	Garden and park waste
20 03 04	Septic tank sludge

Table 38 - Construction wastes

(*) Hazardous wastes

In terms of quantification, for the solid waste and effluents (fuel and wastewater) produced during construction stage, it was assumed similar values as other projects developed in São Tomé and Príncipe²¹ and are presented in the following table:

Type / Waste category		Quantities produced (Kg)	
		Day	Week
Packages	Bags / Plastic Straps	21	126
	Cement bags	30	180
Work front	Demolition debris	450	2.700
	Road pavement scarification	1.350	8.100
	Remains of Materials	45	270
	Used waters	900	5.400

²¹ • The construction of the Fishing Dock Building, currently CKADO Supermarket; • Hospital Road Retaining Wall, in front of CKADO Supermarket • Containment of the seafront along the 250 m after the CKADO Supermarket, towards the center of São Tomé city

Type / Waste category		Quantities produced (Kg)	
		Day	Week
	Fuel	4,5	27
Office	Paper	36	216
	Used materials	7,5	45
	Dejects	72	432
	Wastewaters	900	5.400

Table 39 - Estimate of category and amount of solid waste and wastewater to be generated at Pantufo Bay

A considerable part of the solid residues produced on the different work fronts, mainly debris resulting from the demolition of works of art and solid residues resulting from the scarification of the asphalt pavement will be recovered for use in repair work on dirt roads and macadam.

If the measures foreseen for waste management, reflected in the chapter 14, are implemented, it is expected that the significance of the impact will be reduced to insignificant.

12.5.1.22 Reuse of recycled glass

Construction activity: The activity generating this impact is associated with the construction and recovery of benches inherent to the landscape requalification of the Marginal, promoting the reuse of waste.

Effects: Construction of the benches and decrease in the amount of solid waste (glass) disposed in inappropriate places.

Impact assessment: The reuse of recycled glass in the construction of new benches is classified as a positive, significant, direct, temporary impact of moderate magnitude, as it will make it possible to reduce the volume of waste (glass bottles, etc.) that is disposed of in the open air on the island, as well as to avoid possible accidents (cuts with glass) of people who frequent the streets.

The following table summarize impacts identified in the construction phase.

Environmental and Social Impact Assessment

Factor	Environmental Aspect	Environmental Impact	Activity	Classification				Impacts Without measures	Impacts with measures
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Climate and Climate Change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	N	D	T	R	LS	LS
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	N	D	T	R	LS	LS
	Electricity consumption		Use of electrical equipment	N	D	T	R	LS	LS
	Reduction of CO2 sequestration		Deforestation and felling of trees	N		T	R	LS	LS
	Increased GHG emissions		Construction of revetment and armor ridge for coastal protection and transportation of materials	N	D	T	R	LS	LS
Air quality	Dust emission	Alteration of air quality (CO2, CO, NOX, SOX, HC, VOC's and PM)	Earthmoving	N	D	T	M	S	LS
			Moving equipment and machinery						
			Cement preparation						
			Construction of revetment and armor ridge for coastal protection						
	Fuel consumption		Removal and replacement of pavement layers						
			Lighting of premises (building site)						
			Use of electronic and electromechanical equipment						



			Enlargement of hydraulic structure CH 7+312						
Noise	Noise generation	Noise and vibration emission	Removal and replacement of pavement layers	N	D	T	M	S	LS
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.						
			Moving equipment and machinery						
	Excavations for construction of coastal protection barriers	Increased exposure to erosive agents (water, wind, sea waves)	Earthmoving	N	D	T	R	LS	LS
	Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Increase in the impermeable area with pavement	N	D	T	M	NS	
			Movement of heavy equipment and machinery on the access roads to the quarries						
Solid waste disposal in inadequate sites	Soil contamination	Operation of the construction site	N	D	T	M	S	NS	
Accidental spillage of hazardous products (fuel, oil, lubricants, concrete)		Circulation of equipment, machinery and vehicles used for transporting materials							
Production of solid waste and liquid effluents		Demolition of existing infrastructure							
Geology	Extraction of materials from quarries	Change in the topography of the land	Removal of vegetation cover/tree felling	N	D	P	R	LS	
			Earthmoving						



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Geology		(geomorphology)	Moving equipment and machinery						
	Coastal erosion	Changing the topography of the land (geomorphology)	Removal of vegetation cover/tree felling	N	D	T	R	LS	LS
			Earthmoving						
			Moving equipment and machinery						
Water resources	Water consumption	Consumption of water resources	Operation of the construction site	N	D	T	E	S	LS
			Cement preparation						
			Washing of concrete mixers, equipment and machinery						
	Dragging of sediments into water bodies (water turbidity)	Reduction in water quality	Earthmoving	N	D	T	M	S	LS
			Removal of vegetation cover						
			Rehabilitation of the hydraulic crossings						
	Waste production	Contamination of surface/groundwater	Solid waste disposal in inadequate sites	N	D	T	H	VS	S
	Production of liquid effluents		Maintenance and washing of equipment and machinery	N	D	T	M	S	LS
			Disinfection of new water mains on the Marginal	N	D	T	M	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants, concrete)		Storage and handling of dangerous products	N	D	T	H	VS	S
Demolition of existing infrastructure including the enlargement of hydraulic structure CH 7+312		N	D	T	M	S	LS		



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Water resources	Production of dust (turbidity)		Movement of equipment and machinery	N	T	D	M	S	LS
			Construction of revetment and armor ridge for coastal protection	N	T	D	M	S	LS
			Earthmoving	N	T	D	M	S	LS
			Movement of equipment and machinery	N	T	D	M	S	LS
Water resources	Deposition of waste and sediments	Interruption of drainage patterns	Removal of vegetation cover	N	D	T	R	LS	LS
			Construction of revetment and armor ridge for coastal protection	N	D	T	R	LS	LS
			Rehabilitation of culvert box structures CH 7+312	N	D	T	R	LS	LS
	Siltation on water courses	Flooding (destruction of infrastructure)	Construction of revetment and armor ridge for coastal protection	N	I	T	M	S	LS
			Rehabilitation of hydraulic structure CH 7+312						
			Earthmoving						
			Removal of vegetation cover						
Natural resources	Fuel consumption (diesel, petrol)	Increased consumption of fossil fuels	Use of equipment and machinery	N	I	T	R	LS	LS
	Electricity consumption	Increase of electricity	Use of electrical equipment	N	I	T	R	LS	LS



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Natural resources		consumption	Lighting of premises (building site)						
	Consumption of construction materials (stones, sand,)	Increased consumption of construction materials	Road rehabilitation, construction of hydraulic structures and coastal protection, etc. Cement preparation	N	D	T	M	S	LS
	Water consumption	Increase of water consumption	Road rehabilitation, construction of hydraulic structures and coastal protection, etc. Cement preparation	N	D	T	M	S	LS
	Landscape	Introduction of foreign elements that disturb the landscape	Landscape alteration	Removal of vegetation cover	N	D	T	M	S
Earthmoving				N	D	T	M	S	
Moving equipment and machinery				N	D	T	M	S	
Presence of fence				N	D	T	M	S	LS
Destruction of vegetation cover		Visual impact	Removal of vegetation cover	N	D	T	M	S	LS
			Earthmoving						
			Moving equipment and machinery						
Biodiversity		Noise emission	Disturbance of the Terrestrial Ecosystem (Flora and Fauna)	Earthmoving	N	D	T	R	LS
	Handling of heavy equipment and machinery								
	Road rehabilitation, coastal protection								
	Removal of vegetation cover								
	New habitats for birds' nest, breeding and rest		Grubbing 2 <i>Terminalia catappa</i> (caroceiro) and planted 36	N	D	T	R	LS	



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Biodiversity			trees 15 <i>Vachellia karroo</i> (Karoo acacias) and 21 tamarinds.							
	Accidental spillage of hazardous products (fuel, oil, lubricants, concrete)	Disturbance and degradation of the marine ecosystem	Earthmoving	N	D	T	R	LS		
	Alteration of water quality		Handling of heavy equipment and machinery	N	D	T	R	LS		
	Sea turtle nesting beaches disturbance		Coastal protection	N	D	T	M	S	LS	
	Noise		Coastal protection Construction of revetment, armor crest	N	D	T	M	S		
	Alteration of the intertidal habitat	Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area	Coastal protection	N	D	P	M	S		
Occupational Health and Safety	Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	N	D	T	R	S	LS	
		Reduced quality of life		N	D	T	M	S	LS	
	Road traffic accidents	Vehicle damage	Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	R	S	LS	
		Reduced quality of life		N	D	T	M	S	LS	
	Dust emission	Harmful effects on the workers' respiratory system	Earthmoving	Infrastructure construction (road, hydraulic structures and coastal protection, etc.)	N	D	T	H	S	LS
			Demolition of existing infrastructure							



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Occupational Health and Safety	Noise emission	Harmful effects on workers' hearing systems	Moving equipment and machinery	N	D	T	H	VS	LS
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)						
			Demolition of existing infrastructure						
Community Health and Safety	Accidents falls	Reduced pedestrian safety	Use of construction material transport equipment and machinery and vehicles	N	D	T	M	S	LS
		Reduced quality of life		N	D	T	M	S	LS
	Road accidents/triot-trespassing	Reduced quality of life	Circulation of equipment, machinery and vehicles used for transporting materials	N	D	T	M	S	LS
		Reducing road safety		N	D	T	M	S	LS
	Dust emission	Harmful effects on the population's respiratory system	Earthmoving	N	D	T	M	S	LS
			Removal and replacement of pavement layers						
			Demolition of existing infrastructure						
	Noise emission	Harmful effects on the population's hearing system	Moving equipment and machinery	N	D	P	M	S	LS
			Demolition of existing infrastructure						
			Removal and replacement of pavement layers						
Waste Management	Production of construction demolition (buildings, floors, pipes, etc.)	Occupation of public space		N	D	P	R	S	LS



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Waste Management	Waste production water	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	P	H	S	LS
		Harmful effects on the health of workers and community	Kitchen and sanitary installations in the Construction Site and sanitary installations in the work fronts.	N	D	P	H	S	LS
	Production of hazardous waste	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	H	S	LS
			Demolition of existing infrastructure						
	Use of waste	Using locally recycled glass	Construction of benches	P	D	T	M	S	
Production of domestic waste	Harmful effects on the health of workers and community	Kitchen and sanitary facilities in the Construction Site and sanitary facilities at the work fronts	N	D	T	H	S	LS	

Table 40 Environmental Impact Assessment. Construction Phase. Pantufo Coastline

12.5.2 DEMOBILIZATION PHASE

12.5.2.1 Greenhouse effect/climate change

Construction activities: The main impacts on climate results from similar activities already described for construction stage, except the deforestation.

Effects: increased Greenhouse Gases (GHG) emissions.

Impact Assessment: Similar to what was assessed for construction stage, the estimative of GHG emissions at this stage will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.). However, these are not expected to be relevant, in addition to being temporary and mitigable.

12.5.2.2 Change in air quality

Demobilization activities: The generation of this impact is due to the increase in vehicle circulation and the operation of equipment and machinery used in the removal of equipment assigned to the construction site and the removal of demolition debris resulting from the installation of a construction site with infrastructure for offices, bathrooms, warehouse, workshop among others. Also, if in case of restoration of construction site, it is foreseen reforestation.

Effects: Increase of number of vehicles for demobilization activities generates emission of dust and CO₂, CO, NO_x, SO_x, HC, VOC's.

Impact Assessment: Similar to what was assessed for construction phase the emissions at this phase will depend on several factors not yet known (characteristics and quantity of equipment to be used, operating regimes, etc.). However, is expected to be temporary, direct, reduced magnitude and low significance.

12.5.2.3 Noise and vibration emissions

Construction activities: the generation of this impact is due to the increase in vehicle circulation and the operation of equipment and machinery used in the removal of equipment assigned to the building site and the removal of demolition debris resulting from the installation of a building site with infrastructure for offices, canteen, bathrooms, dormitories, infirmary, among others.

Effects: Noise pollution, health nuisance for workers and population of the surrounding area.

Impact Assessment: Demobilization activities are responsible for interference in noise levels, which may cause adverse impacts on both the health of workers and the health of the population in the project's area of influence, as well as on the environment (removal of local fauna).

The emission of noise and vibrations is classified as a negative impact, with local scope, and which will last for the duration of the decommissioning operations. This impact is significant and of low magnitude.

If the mitigation and/or prevention measures foreseen in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.2.4 Soil contamination

Construction activities: Soil contamination is associated with the various dismantling and decommissioning activities involved, namely the movement of heavy equipment and machinery

in the access to the construction site that may cause possible spillage of hazardous products (oil, fuel, etc.), the demolition of support infrastructures (office, kitchen, bathrooms, etc.) and the production of waste.

Effects: Soil contamination, landscape alteration due to waste disposal in inappropriate locations.

Impact Assessment: During the equipment and demolition debris removal operations, if mitigation and/or prevention measures are not adopted for proper waste management, and if waste disposal occurs in inappropriate locations, they are potential soil polluters due to the chemical characteristics of the different wastes, since project is in a coastal area, with sandy soils, already subject to soil contamination is classified as negative, significant, limited to the construction site, temporary and of moderate magnitude.

With the implementation of the measures foreseen in the chapter 14, the level of significance of the impact is expected to be reduced to insignificant.

12.5.2.5 Increased water infiltration into the soil

Construction activities: The main activity generating this impact may be the biophysical recovery of the area affected to the construction site, through reforestation, with the planting of native tree species.

Effects: Improvement of the landscape, increased water infiltration into the soil.

Impact Assessment: The reforestation activity at the construction site, should it occur, will be evident the soil decompaction resulting from the tree planting process. Furthermore, with the reforestation of the affected area there will be a higher rate of water infiltration into the soil, as the roots of the plants promote the improvement of soil structure, increasing soil permeability.

The increase in water infiltration into the soil is classified as positive, significant, direct, permanent and of moderate magnitude. If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.2.6 Contamination of surface/groundwater

Construction activities: The dismantling and disposal of demolition waste in unsuitable locations inherent to the activities of moving and operating equipment and machinery, removing equipment and demolition rubble from infrastructures installed on the construction site (offices, canteens, bathrooms, dormitories, etc.).

Effects: Contamination of surface water (if the construction site is near a water line) and/or groundwater.

Impact Assessment: Contamination of surface/groundwater is associated with accidental spillage of hazardous products (fuel, oil, lubricants) and the dumping of demolition waste in unsuitable locations. If hazardous products are spilled, percolation of these liquids on the ground may reach not only surfacewater but also the water table. This impact is classified as negative, direct or indirect, temporary, of reduced magnitude and of low significance.

With the implementation of the measures foreseen in the chapter 14, it is expected that the significance of the impact will be reduced to low significant.

12.5.2.7 Change in Water Quality

Construction activities: The alteration in water quality is associated with the dragging of

sediments to water courses by the action of rain/wind, promoting the turbidity of the water and the presence of total suspended solids (TSS), coming from the circulation of vehicles, the use of equipment and machinery and the removal of debris from the demolition of infrastructures assigned to the construction site.

Effects: Alteration of water quality in the surrounding area and inconvenience to the health of the population.

Impact Assessment: The change in water quality as a result of vehicle circulation and debris removal activities is classified as negative, significant, direct, temporary and of moderate magnitude.

It is expected that the significance of the impact will be reduced to low significant if the measures recommended in the chapter 14 are adopted.

12.5.2.8 Consumption of natural resources (fossil fuels, energy and water)

Construction activities: The decrease in consumption of fossil fuels and energy is due to the cessation of construction work on the waterfront, coastal protection and infrastructure with the consequent demobilization of the construction site.

Effects: Reduced consumption of natural resources.

Impact Assessment: The cessation of construction activities implies a reduction in the number of vehicles in circulation that were assigned to the works, decreases fuel and energy consumption associated with the removal of luminary and electrical equipment at the construction site facilities, decrease of water consumption. The impact of consumption of natural resources is classified as negative, low significance, direct, temporary and of reduced magnitude.

With the implementation of the measures foreseen in the chapter 14, it is expected that the significance of the impact will be reduced to low significance.

12.5.2.9 Landscape alteration and visual impact

Activities: The main activities generating this impact are associated with the movement of equipment and machinery and the removal of demolition debris.

Effects: Landscape alteration, visual impact and inconvenience to the well-being of the population.

Impact Assessment: During the cleaning action and biophysical recovery of the affected area, the flow of equipment and machinery increases as well as the volume of disposed construction and demolition waste in the open, from the front of the work and construction site, promoting the intrusion of foreign elements in the landscape and if mitigation and/or effective prevention measures are not adopted, the destruction of the vegetation cover of the surrounding area may occur. This impact is classified as negative, low significance, direct, temporary and of reduced magnitude.

If construction site is in a natural area and will be dismantled, restoration of the affected area with reforestation and soil decompaction of soil permits natural recovery and impact is a positive, direct, permanent, moderate and significant impact in landscape.

With the implementation of the measures foreseen in the chapter 14, it is expected that the

significance of the impact will be reduced to low significance.

12.5.2.10 Impacts on Terrestrial Ecosystem (Flora and Fauna)

Demobilization Activities: The activities associated with the circulation of heavy vehicles for the demobilization of the construction site and the removal of equipment and demolition debris may cause some noise disturbance and possible spills of hazardous products such as fuel, oil, lubricants.

Effects: These activities can cause disturbance to territorial ecosystem in the area of influence of construction site and work fronts

Impact Assessment: Considering that the main impacts already occurred during implantation of works, the main impact that may persist during demobilization stage will be the disturbance (noise) on the surrounding fauna. This impact can be classified as negative, direct, temporary, reduced magnitude and low significance.

The same is true for the possible spills of hazardous products, which will be minimal if mitigation measures are adopted. with implementation measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

If construction site is placed in an area that will be recovered the impact will be positive, direct, permanent, significant and moderate magnitude, considering revegetation with native species.

12.5.2.11 Disturbance and degradation of the marine ecosystem

Demobilization Activities: The activities associated with the circulation of heavy vehicles for the demobilization at work fronts and the removal of equipment and demolition debris may cause some possible spills of hazardous products such as fuel, oil, lubricants.

Effects: These activities can cause disturbance and degradation in the area of influence of the work fronts if a spill of hazardous products occur

Impact Assessment: Considering that the main impacts already occurred during implantation of works, the main impact that may persist during demobilization stage and an increase of vehicles in demobilization can increase the risk of spill for beach and sea

This impact can be classified as negative, direct, temporary, reduced magnitude and low significance.

12.5.2.12 Degradation of public well being

Construction activities: The degradation of public roads is associated with accidental spillage of hazardous products such as fuel, oils, lubricants inherent to vehicle circulation activities, traffic accidents and debris removal. These activities, in particular road traffic, contribute to the degradation of **the pavement structure coating**, providing wear of bituminous material.

Effects: Use of pavement, traffic congestion in the area, whose degradation of the roads is more pronounced, inconvenience to the well-being of the population.

Impact Assessment: The degradation of the public highway is classified as negative, significant, direct, temporary and of low magnitude.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significance.

12.5.2.13 Changes in the level of comfort of the population

Construction activities: The main activities generating this impact are the movement of equipment and machinery and the removal of demolition debris from infrastructures installed on the construction site.

Effects: Noise pollution, nuisance to health and well-being of the population.

Impact Assessment: The malfunctioning of equipment and machinery as well as the operation of demolition waste removal generate noise emission, which may cause harmful health problems to the population of the surrounding area, as well as nuisance to the population, especially during rest periods, if the execution schedules of the activities are not respected and the mitigating measures for noise minimization are not implemented, during the demobilization activities of the construction site, depending on the location of the construction site.

This impact may be classified as negative, significant, local in scope, with effects lasting as long as decommissioning activities take place. The magnitude of the impact is reduced.

With the implementation of the planned measures, the significance of the impact is expected to be reduced to low significance.

12.5.2.14 Harmful effects on health (respiratory and auditory system) of workers and population

Construction activities: this impact is associated with the production of dust inherent to the circulation of vehicles used to transport rubble, the use of equipment and machinery and the removal of demolition rubble.

Effects: Noise pollution, air pollution, health nuisance for workers and the population in the area of influence.

Assessment of Impacts: These activities, during the dry season, promote the increase of quantities of suspended particles (dust), affecting the respiratory system of the workers and the population in a harmful way, if proper precautions are not taken. Likewise, these activities also generate noise emissions, if the equipment and machinery are malfunctioning and the circulation of heavy vehicles on the access to the construction site is inadequate.

The harmful effects on the health of workers and the population are classified as negative, with a level of significance from low significance (respiratory system) to significant (auditory system), direct, permanent and of low to moderate magnitude.

If the measures recommended in the chapter 14 are adopted, the significance of the impact will be reduced to low significant and low significance, respectively.

12.5.2.15 Reduction of Occupational Health and Safety

Construction activities: The reduction in occupational health and safety conditions is associated with possible accidents at work such as falling, tripping, cuts, electrocution, etc., resulting from the use of equipment and machinery in the demobilization activities of the construction site.

Effects: Operations including operation of electrical equipment and movement of machinery and vehicles, may result in electrocution, tripping or lead to serious accidents.

Evaluation of impacts: In effect, during the operation of equipment and machinery, workers involved in these activities will be exposed to the risk substances, if mitigation and/or prevention measures are not properly implemented. This impact is classified as negative, significant, direct,

temporary, restricted to construction site workers and of high magnitude, and may cause problems for workers, altering health and safety conditions at work.

The level of significance of the impact is expected to be reduced to low significant if the measures foreseen in the chapter 14 are implemented.

12.5.2.16 Quality of life of the population and workers

Construction activities: the removal of demolition debris, the circulation of machinery and vehicles used to transport demolition debris and the use of equipment and machinery can have an impact on the quality of life of the population

Effects: Loss of quality of life.

Impact Assessment: Reduced quality of life, both for the population and workers, is associated with the existence of machinery and vehicles assigned to the transportation of demolition debris and use of equipment and machinery.

This impact may be classified as negative, with a level of significance ranging from low significance to very significant, direct, and may be temporary or permanent depending on the severity of the accident, and of low to high magnitude.

12.5.2.17 Waste disposal

Construction activity: During the demobilization phase it is considered that the volume of demolition waste from the infrastructures installed at the construction site is obviously large, given the number of infrastructures (offices, cafeterias, bathrooms, dormitories, infirmary, among others). Thus, the waste from demolition should meet the appropriate transport and final destination, in order to avoid the disposal of wastes in inappropriate places, obeying the waste management plan.

Effects: Alteration of the local landscape, contamination of soil and surface/groundwater.

Impact Assessment: Demolition waste must be transported and disposed of appropriately in order to avoid waste disposal in inadequate locations, in accordance with the waste management plan. The temporary inadequate disposal of wastes before being transported to an adequate place may result in a negative, significant, direct and temporary impact of moderate magnitude.

With the implementation of the measures foreseen in the chapter 14, the significance of the impact is expected to be reduced to low significance.

The following table summarize impacts identified in the demobilization phase.

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
Climate and climate change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	N	D	T	R	LS	LS
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	N	D	T	R	LS	LS
	Electricity consumption		Use of electrical equipment	N	D	T	R	LS	LS
	Reduction of CO2 sequestration		Lighting of premises (building site)	N	D	T	R	LS	LS
	GHG emissions		Transport emissions from materials and equipment	N	D	T	R	LS	LS
Air quality	Emission dust on roadways	Alteration of air quality (PM5 and PM10)	Use of equipment and machinery	N	D	T	R	LS	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Movement of vehicles	N	D	T	R	LS	
			Removal of equipment						
			Removal of rubble						
Noise	Increase of Noise	Noise and vibration emission	Increase in vehicle circulation	N	D	T	R	S	LS
			Use of equipment and machinery						
			Removal of						

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
Noise			equipment						
			Removal of demolition rubble in the construction site						
		Effect on the health of the population in the surrounding area	All the operation of clearing equipment, infrastructures and waste removal	N	D	T	R	LS	LS
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)	Soil contamination	Handling of heavy equipment and machinery at the access to the construction site	N	D	T	M	S	LS
	Production of demolition waste		Removal of equipment						
	Disposal of demolition waste in inappropriate places		Demolition of support infrastructures (office, kitchen, bathrooms, etc.)						
	Soil permeabilization and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	P	D	P	M	S	
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Removal of demolition rubble in the	N	I/D	T	R	LS	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
	Accidental spillage of hazardous products (fuel, oil, lubricants)		construction site						
			Use of equipment and machinery						
			Moving equipment and machinery						
			Removal of equipment						
			Removal of demolition rubble in the construction site						
	Sediment drift into watercourses (turbidity, TSS)	Reduction in water quality	Vehicle circulation						
			Use of equipment and machinery	N	D	T	M		
			Removal of demolition rubble in the construction site						
			Removal of rubble						
	Soil permeabilization and decompaction	Increased infiltration of water into the soil	Reforestation	P	D	P	M	S	
Natural resources	Fuel consumption (diesel, petrol)	Decreased of consumption of fossil fuels	Decreased use of vehicles and equipment	N	D	T	R	LS	
	Electricity consumption	Decrease of electricity consumption	Removal of Luminary and electrical equipment on	N	D	T	R	LS	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
Natural resources			construction site						
	Water consumption	Decrease of water consumption	Cessation of activities	N	D	T	R	LS	
Landscape	Destruction of vegetation cover	Landscape alteration	Moving equipment and machinery	N	D	T	R	LS	
			Removal of demolition rubble in the construction site						
	Introduction of foreign elements that disturb the landscape	Visual impact	Moving equipment and machinery	N	D	T	R	LS	
			Removal of demolition rubble in the construction site						
Restoration of vegetation cover	Improving the landscape	Restoration of the affected area: reforestation, soil decompaction	P	D	P	M	S		
Biodiversity	Noise emission	Terrestrial Ecosystem (Flora and Fauna)	Vehicle movement	N	D	T	R	LS	
			Removal of equipment						
	Removal of demolition rubble in the construction site								
	Accidental spillage of hazardous products (fuel,		Heavy goods vehicles on the access to the	N	D	T	R	LS	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
Biodiversity	oil, lubricants)		construction Site						
	Restoration of habitats		Biophysical restoration of the affected area	P	D	P	M	S	
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Disturbance and degradation of the marine ecosystem	Handling of heavy equipment and machinery	N	D	T	R	LS	
Occupational health and safety	Dust emission	Harmful effects on the workers' respiratory system	Movement of vehicles carrying rubble	N	D	P	M	LS	LS
			Use of equipment and machinery						
			Removal of demolition rubble in the construction site						
	Noise emission	Harmful effects on workers' hearing systems	Heavy goods vehicles on the access to the Construction Site	N	D	P	M	S	LS
			Use of equipment and machinery						
			Removal of demolition rubble in the construction site						
Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	N	D	T	H	S	LS	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
Occupational health and safety		Reduced quality of life	Removal of demolition rubble in the construction site	N	D	P	H	VS	S
	Road traffic accidents	Vehicle damage	Movement of machinery and vehicles used for the transportation of demolition debris	N	D	P	R	LS	
		Reduced quality of life		N	D	P	M	S	LS
Community health and safety	Road traffic accidents	Vehicle damage	Movement of vehicles						
		Reduced quality of life	Use of equipment and machinery	N	D	T	R	LS	LS
	Dust emission	Harmful effects on the respiratory system	Movement of equipment and machinery	N	D	P	R	LS	LS
			Removal of demolition rubble in the construction site						
	Noise emission	Harmful effects on the hearing system	Movement of equipment and machinery	N	D	P	R	LS	LS
			Removal of demolition rubble in the construction site						
Waste management	Production of solid waste	Waste disposal in inappropriate places	Removal of demolition rubble in the construction site	N	D	T	M	S	LS

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance / Significant/Very Significant)
Waste management		Soil contamination	Removal of demolition rubble in the construction site	N	D	T	M	S	LS
	Production of liquid effluents		Maintenance of machinery and equipment	N	D	T	M	S	LS

Table 41 Environmental Impact Assessment. Demobilization. Pantufo Coastline

12.5.3 OPERATION PHASE

12.5.3.1 Greenhouse effect/climate change

Operation activities: Although the project involves the requalification of the Marginal Road, the expected traffic increase is not directly related to the project, being consequence of the population increase and migratory movements of the inner communities to the coastline that will continue to use this already existing road. Therefore, the expected traffic emissions must not be considered a direct impact of the project. Nevertheless, the quantification of the CO₂ emissions from this traffic are important to understand how the project can help to mitigate these emissions by providing alternative paths for other less pollutant ways of transportations (namely bicycles).

A direct impact of the project is the emissions triggered by the electricity consumption for street lighting. Also, a direct impact is the construction of the coastal protection structures that has the purpose of mitigate the impact of climate changes (flooding and sea level rising) in Pantufo Bay. In addition, refers the requalification of the road drainage system.

Effects: GHG emissions, coastal protection, flood drainage

Impact Assessment: The main impacts related to climate and climate changes are discussed below.

Traffic Increase

As mentioned above, the traffic increase is not directly related to the requalification of Marginal Road in Pantufo Coastline. Nevertheless, a quantification of the expected CO₂ emissions is presented, based on bibliographic data, for the traffic data predicted for the Pantufo Coastline

Light and heavy vehicles in São Tomé and Príncipe are usually imported from Europe, being mainly used cars, with more than 5 years of use²².

Considering only the Heavy vehicles for this assessment (more pollutant), was assumed a current value (year 2019) of 900 g CO₂/km²³⁽²⁴⁾: According to the same bibliographic references, is intended that average CO₂ emissions in 2025 will be 15% less than in 2019 and in 2030 30% less compared to 2019. Therefore, for the horizon year of 2045, it was assumed a CO₂ emission value of 630 g/km, which is less 30% than 2019.

SECTION		TRAFFIC VOLUME 2021 (day)	Pessimistic TRAFFIC VOLUME 2045 (day)	Base TRAFFIC VOLUME 2045 (day)	Optimistic TRAFFIC VOLUME 2045 (day)
CH- CH		gCO ₂ /km	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km
13	5+900-6+960	32400	38430	62370	94500

²² MINISTRY OF PUBLIC WORKS, INFRASTRUCTURES, NATURAL RESOURCES AND THE ENVIRONMENT (2019). *Third National Communication of Sao Tome and Principe within the UNFCCC*. 248 pp

²³ <https://ec.europa.eu/clima/policies/transport/vehicles/>

⁽²⁴⁾ AMBEL, C.C. (2015). *Too big to ignore – truck CO₂ emissions in 2030*. A briefing by Transport & Environment

SECTION		TRAFFIC VOLUME 2021 (day)	Pessimistic TRAFFIC VOLUME 2045 (day)	Base TRAFFIC VOLUME 2045 (day)	Optimistic TRAFFIC VOLUME 2045 (day)
CH- CH		gCO ₂ /km	gCO ₂ /km	gCO ₂ /km	gCO ₂ /km
14	6+960-7+800	14400	17010	27720	42210
15	7+800 – end of the section	12600	15120	24570	36540

Table 42 CO2 Emissions from the heavy vehicles predicted along Pantufo Coastline

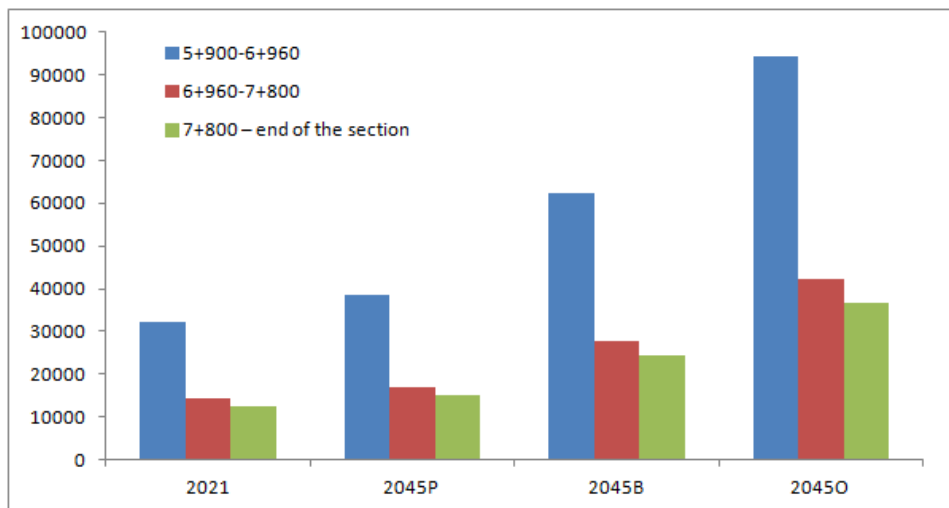


Figure 12 Comparison of the different scenarios within each section in Pantufo Coastline

As seen, there are not many differences between the current emissions and the pessimistic scenario, but differences are seen with the optimistic scenario.

Comparing to the most recent data regarding transport emissions in São Tomé and Príncipe (42.5434 Gg CO₂ in 2019²⁵), the above obtained values correspond to the following very low percentages:

²⁵ Ministério das Infraestruturas e Recursos Naturais (2021). *Relatório de inventário de gases de efeito estufa no sector de energia para o período de 2010-2019*. 62 pp

			Pessimistic	Base	Optimistic
SECTION		TRAFFIC VOLUME 2021 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)	TRAFFIC VOLUME 2045 (day)
CH- CH		%	%	%	%
13	5+900-6+960	7.61575E-05	9.03E-05	0.000147	0.000222
14	6+960-7+800	3.38478E-05	4E-05	6.52E-05	9.92E-05
15	7+800 – end of the section	2.96168E-05	3.55E-05	5.78E-05	8.59E-05

Table 43 Relative percentage of the heavy traffic emissions along Pantufo Coastline, compared with transport annual emissions

Besides this low percentage of emissions (reinforcing that these are not directly related to the project implementation), is important to mention that the requalification of Marginal Road in Pantufo Bay considers a 2.5 m wide cycle lane (two-way traffic) along all sections, which will potentially contribute for the decrease of motorized vehicles by increasing the use of non-pollutant bicycles (defined as a mitigation measure for climate change). This will also require a wider social awareness for the use of this individual transport.

Also, refers the improvement of pavement that will contribute to a better car flow, with less traffic congestions and consequently lower GHG emissions.

The impacts of the project on traffic increase are inexistent, but are positive, permanent, moderated magnitude and significant regarding the offer of suitable conditions for using alternative and more environmental-friendly ways of transport.

Electricity Consumption

For the electricity consumption in Pantufo Coastline it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is shown in the following table:

Circuit		Track		Power (kW)	Energy (kW/h)
Pantufo Coastline - Street Luminary	PAN-I	CT-5	137-180	4,687	56 kW/h
Pantufo Coastline – Park Luminary	PAN-II	CT-5	DP-SCH	3,528	42 kW/h
Pantufo Coastline – Park Luminary	PAN-II	DP-SCH	DP-SAO	1,512	18 kW/h
Pantufo Coastline – Street Luminary	PAN-III	CT-6	181-224	4,796	58 kW/h

Table 44 Electricity consumption of the lighting circuits in Pantufo Coastline

The conversion factor for São Tomé and Príncipe operating grid electricity is 0.646 tCO₂/MWh²⁶. The CO₂ emissions of the lighting circuit and the laundry are presented in the table below.

Based on the same reference document that was considered for the traffic emissions, the total energy consumption for Pantufo Coastline is 0.000131% of the total emissions of energy for 2019 (86,06 Gg CO₂), which is **irrelevant**.

Sites	Energy (kW/h)	CO ₂ Emissions (tCO ₂ /MWh)
Pantufo Coastline - Street Luminary	56 kW/h	0.036176
Pantufo Coastline - Park Luminary	42 kW/h	0.027132
Pantufo Coastline - Park Luminary	18 kW/h	0.011628
Pantufo Coastline - Street Luminary	58 kW/h	0.037468
TOTAL	174	0.149226

Table 45 Total CO₂ emissions from electricity consumption in Pantufo Coastline

The impacts of the electricity CO₂ emissions, although negative and permanent, are low significant. The limitation of working hours will function as a mitigation measure for reducing electricity consumption and therefore reducing CO₂ emissions.

COASTAL PROTECTION

Along the eastern coast, towards Pantufo, there is in general no major coastal erosion. However, the seawall from Fort towards Pestana hotel needs rehabilitation of the upper part. At a few locations, during rough sea conditions, some overtopping occurs. Constructing the upper part as a closed wall of about 1 m reduce this. At a few locations some rock revetment is recommended to support the seawall.

Just north of Pestana, a rock revetment is proposed as there is no coastal protection at present. South between Pestana and Pirata Bar, coastal erosion is visible, and a rock revetment proposed is the most suitable option. The main problems in the study area have been identified:

- Erosion of the shoreline and beaches;
- Damaged sidewalk pavements and at some places collapsed;
- Eroding beaches result in lack of space for fishermen boat landing sites;
- Occasional overtopping of the waves and flooding of the Marginal road.

²⁶ CDM Standardized baseline: "Grid emission factor of São Tomé and Príncipe version 01.0 (ASB0020), based on the proposed new standardized baseline PSB009 "Grid Emission Factor of São Tomé and Príncipe" submitted by São Tomé and Príncipe. https://cdm.unfccc.int/methodologies/standard_base/2015/sb79.html

The most important direct effects of climate change are related to the exposure of the area to rising sea levels, floods, submergence of low-lying areas and the erosion of the coastline itself. Coastal protection structures constitute an adaptation measure against these climate change phenomena. How society responds to the forecasted risks is, therefore, paramount to the success of short and long-term sustainable development, community resilience and resultant community well-being²⁷.

As described in Project description, coastal protection in Pantufo Bay mainly consists on:

- First section consists on installing a main protection of rocks 0.7-1.4 tons till +3.70 m r/MSL. The crest of coastal protection is crowned by a concrete wall that reaches +4.00 r/MSL that is built on the existing wall. Additionally, a geotextile is placed between rock protection and existing wall and the natural terrain as well to avoid loss of terrain
- Second section consists on installing a main protection of rocks 0.7-1.4 tons till +5.00 m r/MSL. A filter layer of 35-75 kg is placed. To crown the coastal protection a concrete wall that reaches +5.50 r/MSL is proposed and a geotextile between rock protection and natural terrain is placed.

Adaptation to climate change has been carried out considering the sea level rise (SLR) values provided by the IPCC AR5 of 2014. The rise in sea level causes the coastline to recede, but also increases the wave height and increases the energy that reaches the coastal protections. For this project, these effects associated with the rise in sea level over a period of 50 years were considered. Also, for statistical action (wave, sea level) 100 years of return period is considered.

According to *Annex 14 Coastal Protection Structure Design for Pantufo Bay*, and to assess the suitability of the proposed solutions, overtopping analysis was conducted following two methods: 1) analytical formulation in accordance with Eurotop Manual (2018) and 2) for those critical zones a numerical model based on VOF (Volume of Fluid) to double check analytical results and study the convenience of optimization.

In order to study rock stability in shallow and very shallow waters and due to the lack of existence of one accepted formula, two methods were considered: 1) assuming the wave action as a flow that goes up and down along the slope of the coastal protection (run-up and run-down), and 2) assuming typical formulation for dykes under wave attack.

Different cross sections were defined considering these main aspects:

- Wave data.
- Bathymetry.
- Existing structures (groin, peninsula, land point, harbor, etc.) that create a physical barrier between zones.
- Existing uses of coastal areas.
 - Leisure places (Hotel, diving club, etc.)
 - Beach.
 - Landing sites. Area on the beach where fishing boat are usually placed. In accordance with local information. In case of storm waves fishermen moves their boats from Ana Chaves Bay to Lagarto Bay due to fewer wave action.

²⁷ SINAY, L. & R. W. (Bill) Carter (2020). Climate Change Adaptation Options for Coastal Communities and Local Governments. *Climate*, 8, 7

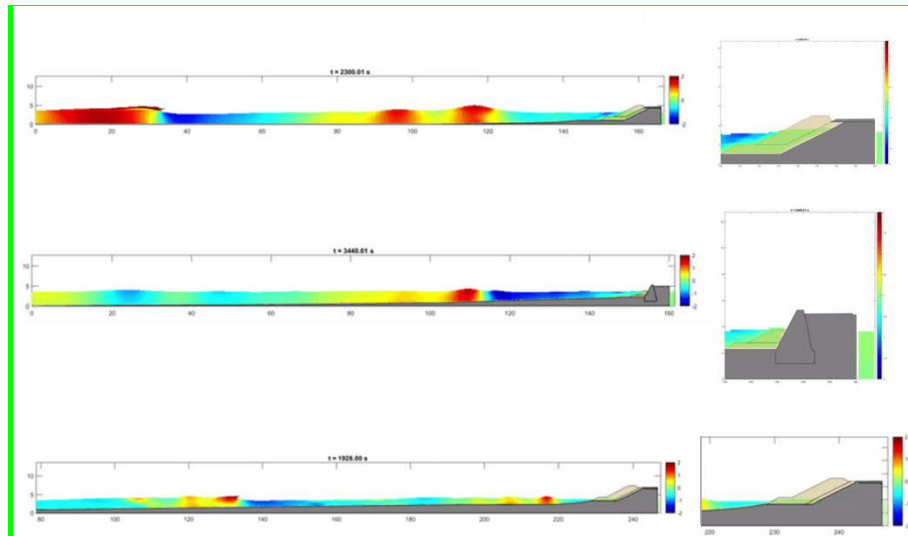


Figure 13 Output IH2VOF numerical simulation São Tomé Overtopping assessment

Based on the results of this analysis, an optimization of the cross-sections where the overtopping was exceeded was performed and the solutions for coastal protection of Pantufo Coastline already take in consideration the results of the above study and respective simulations, presenting the best technical solution for protecting the area from the predicted climate changes.

In this way, the impacts of these coastal projection structures as an adaptation measure to climate changes are positive, direct, permanent, moderate magnitude and significant.

Drainage System

Assuming the feasibility of the coastal protection structures described above for the sea-level rising and wave overtopping, another climate aspect to consider is the increase of intense precipitation events, with consequent increase of flooding that can come from the hinterland. The excess of water needs to be drained as quickly as possible, preferably to the sea, and the Marginal road should not constitute a barrier to these higher flows.

Since this is already an existing road, a field survey was performed to assess the conditions of the transversal drainage system. From the analysis carried out, it was concluded that the existing culvert has the necessary hydraulic capacity. However, the culvert will need to be enlarged because of the new road section. Thus, the culvert at CH 7+312 is proposed to be enlarged with the same hydraulic section.

The flow capacity was determined for a 100-year maximal flood return period.

The drainage system has therefore capacity to guarantee, from now on, that these extreme events are taken care of, minimizing the situations of flooding of the platform, potential deterioration of the pavement, road accidents, the impact on the fluidity of traffic and the transport of food/goods, with consequent environmental and social positive impacts.

In this way, the impacts of the requalified drainage system as an adaptation measure to climate changes are positive, direct, permanent, moderate magnitude and significant.

12.5.3.2 Improvement of air quality

Operation activities: Presence of more 34 trees and green spaces.

Effects: In this phase, after the landscape reconstruction of the site, the improvement of air quality will be significant, given that the increased number of trees and green spaces.

Impact Assessment: The main sources of particulate matter emissions are considered to be of the diffuse type, arising from wind action on roadways. In addition, the movement of vehicles emits particulate material in the exhausts due to fuel burning. However, the creation of green spaces with the consequent increase in the number of trees will favor the reduction of dust generation (PM10 and PM5) on the roadway. Thus, this impact was considered positive, significant and of direct impact. The impact may have a local scope, being permanent, and its magnitude may be moderate.

12.5.3.3 Change in air quality

Operation Activities: Traffic generated by operation of infrastructures

Effects: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non-motorized transport).

Impact Assessment: During the operation phase, it is likely that there will be an increase in air pollutant emissions, mainly CO (carbon monoxide), due to the increase motorized traffic foreseen to Marginal road without project.

The expected traffic increase is not directly related to the project, being consequence of increase of population and movements of communities along coastline that will continue to use this already existing road.

The configuration in design is a single carriageway with one lane on each direction. In the first 1.700 m (CH 7+600) Regarding the cross section, the vehicular lanes proposed within the carriageway are 3,0 meters wide. The proposed footpaths along the entire route are 2,0 m wide. A 2,5 m wide cycle lane (two-way traffic). With parking areas where the section allows it.

Project integrates circulation of vehicles with improved road safety conditions, restriction on speed of vehicles is 50 km/h except between CH 6+459 and CH 6+700 where it is 30 km/h, near the Portuguese Lyceum, due to the largest number of people on this section and the existence of several successive crossings.

From CH 7+600 to CH 7+680, the typical cross section changes. The cycle lane disappears, but the 2 m wide sidewalks are maintained on both sides of the road.

That results in more fluidity and tranquility, demanding less of the engines and, therefore, reducing the emissions of atmospheric pollutants (CO₂, CO, NOX, SOX, HC, VOC's) if the mitigation measures foreseen are adopted.

The implementation of project creating an alternative of motorized transports cause an impact of air quality classified as positive, significant, direct, permanent and moderate magnitude.

12.5.3.4 Noise and Vibration Emission

Operation Activities: Traffic generated by operation of infrastructures

Effects: Project implementation creates alternatives to use of motorized transports in Marginal

road with existence of cycle lanes (non-motorized transport).

Impact Assessment: As referred for air quality the increased of motorized traffic is foreseen to Marginal Road without project. The proposed of footpaths along entire route and cycle lanes and existence of new 36 trees contribute to the use of non-motorized transport with reduction of noise emissions by vehicles.

The impact of noise and vibration emissions is classified as positive, significant, local, permanent and of moderate magnitude.

12.5.3.5 Reducing exposure to erosive agents

Operation activities: This impact is mainly associated with the construction of coastal protection. With this work the coastal region will be protected from the action of erosive agents (water, wind, sea waves) that contribute to the advancement of the coastline. In recent years, the rise in sea level has interfered with the coastline, given that during periods of heavy rainfall the heavy impact of sea waves and the dragging of sediment by the force of the waters has caused degradation of the paving and possible flooding on the Marginal road.

Effects: Improvement and reinforcement of coastal protection, decrease in the advance of the coastline.

Impact Assessment: The impact of reduced exposure to erosive agents is classified as positive, very significant, direct, permanent and of high magnitude.

12.5.3.6 Soil Contamination

Operation Activity: The main activities generating soil contamination are the increased flow of people in the region with increase of solid wastes and increase of traffic

Effects: Soil contamination associated with solid wastes disposal of solid wastes in inadequate locations and the accidental spillage of hazardous products such as fuels, oils, lubricants from traffic accidents.

Impact assessment: The increase people and solid wastes and increase of traffic is not directly related to the project. However, the improved conditions that the project will provide, paper bins and improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to soil.

The impact of soil contamination is classified as negative, low significance, direct, permanent and of reduced magnitude.

12.5.3.7 Surface/groundwater contamination

Operation activities: The main activities generating surface and groundwater contamination are related to the increased volume of traffic and flow of people on the Marginal road (tourists and local population).

Effects: Risk of contamination of surface and ground water and aquatic ecosystems crossed by the water course.

Impact assessment: The increase people and solid wastes and increase of traffic is not directly related to the project. However, the improved conditions that the project will provide, paper bins every 40 m and improved road safety conditions, will contribute to the reduction of road accidents

and therefore to the reduction of accidental spillages of hazardous products to surface and groundwater.

The impact of soil contamination is classified as negative, low significant, direct or indirect, permanent and of reduced magnitude.

12.5.3.8 Reduction of the water infiltration process in the soil

Operation Activities: The activities associated with the presence of the rehabilitation of the marginal road and associated infrastructure.

Effects: The rehabilitated road and new infrastructure will increase the waterproofed area and reduce soil infiltration.

Impact assessment: The reduction of the water infiltration process into the soil is associated with the soil impermeabilization resulting from the presence of the rehabilitated road, with bike lanes and sidewalks and new infrastructure (playground). The impact of reduced infiltration of water into the ground is classified as negative, low significance, direct, permanent and of reduced magnitude. Although there will be an increase in impermeable area will not produce great interference in the volume of water that infiltrates the soil locally.

12.5.3.9 Improving drainage capacity of structures

Operation activities: This impact is mainly associated with the construction of drainage works that are resilient to climate change in order to favor natural drainage. This activity will provide efficient storm water drainage and if the drainage line is interrupted it will cause flooding.

Effects: Improvement of drainage, avoiding flooding in the period of heavy rainfall.

Impact Assessment: The improvement of the drainage capacity of the structures is classified as a positive, significant, direct, permanent impact of moderate magnitude.

12.5.3.10 Consumption of natural resources (fossil fuels, water and electrical energy)

Operation activities: The main activities generating this impact are the increase in traffic volume, the operation of infrastructures that involve energy consumption for public lighting and the operation of new infrastructures and for green areas, fountain and water consumption.

Effects: Increased consumption of water and electrical energy

Impact Assessment: Project implementation creates alternatives to use of motorized transports in Marginal road with existence of cycle lanes (non-motorized transport) and a reduction of trends of increase of fossil fuels consumption and impact is classified as positive, permanent, direct, moderate magnitude and significant.

For **energy** consumption in Pantufo Coastline, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is street luminary - circuit PAN I (56 kW/h), street luminary - circuit PAN II (42 kW/h), park luminary - circuit PAN II (18 kW/h) and street luminary circuit PAN III (58 kW/h). The luminaries are LED low consumption with an angle of 90° avoid emission of light for beach and disturbance of turtles nesting.

Energy consumption for year 2029 was 2180,3 TJ in STP, according MIRN (2021) so the impact is negative, permanent, direct, reduced magnitude and low significance.

For water consumption Pantufo Coastline infrastructures includes maintenance of green spaces and 3 fountains.

Landscape design considers an Irrigation Consumption:2.350,9 l per hour. In rain season is no needed to irrigate soil and 3 fountains with a total of 360 l per hour. The impact is negative, permanent, direct, reduced magnitude and low significance.

12.5.3.11 Improving Marginal's image

Operation Activities: The presence of the rehabilitated marginal road, with the new infrastructures to be created.

Effects: Improved image of the waterfront of Marginal city.

Impacts Assessment: This impact is mainly associated with landscape requalification, with an increase in green space and the planting of 36 trees, urban equipment (benches), trash cans, playgrounds, cycle lanes, among others. The improvement of the marginal's image is classified as a positive impact, very significant, local, permanent and of high magnitude.

The new planted trees, namely 15 *Vachellia karroo* (Karoo acacias) and 21 tamarinds, in a total of new 36 trees. These species were chosen because of their rapid growth. However, due to the landscape value of *T. cattapa* and the provision of adequate conditions for the local population to enjoy the new green spaces, this species must be also planted whenever possible, when these trees have to be felled for maintenance reasons with special care regarding location (far from the road as possible) to prevent future damage of the new pavement. If needed, a local nursery garden should be created to maintenance the specimens planted in Marginal.

12.5.3.12 Exclusion effect of marine animals (turtles: *Chelonia mydas*, *Lepidochelys olivacea*; *Eretmochelys imbricata* and *Dermochelys coriacea*)

Operation activities: The main generating activities are due to the presence of the rehabilitated road and infrastructure operation. This impact is associated with noise production resulting from the increased flow of traffic, people, goods and services, as well as the artificial lighting of existing infrastructure. Refers that the project contemplates that lighting of the roadway and green areas is maintained for 12 hours when there is no natural light, meaning that the nocturnal period will be mostly brightened.

Effects: Increased noise and lighting can exclude out the marine animals that frequent the nearby sea waters and beach.

Impacts Assessment: Noise generation resulting from the increased volume of traffic and beach and green space frequenters causes disturbance to marine animals, as sound propagates five times faster in water than in air, and low frequency noises reach greater distances and therefore will affect the behavior of animals, which tend to move away from the emission source. However, the creation of green spaces (tree planting) will act as natural barriers, minimizing the propagation of sounds. This impact can be considered of low magnitude since this area is already a disturbed area and the existing maritime fauna is already adapted to these disturbances.

With respect to artificial lighting of public spaces (Luminary), this disorients individuals, and may lead them to change their natural behavior, causing them to cease or reduce important behaviors for their life cycle, such as feeding, resting and reproduction. Although this is a local impact and

is an already existing impact in the current Marginal Road, the main permanent consequences are the potential interference with the nocturnal nesting behavior of sea turtles in Pantufo bay beaches.

While considering the risk of sea turtle hatchlings death due to artificial light disorientation, this impact should be considered as negative, direct, permanent, moderate magnitude and significant.

It is foreseen in project the use of luminaires of LED low pressure downward oriented and near beaches there will be no direct lighting to these potential biotopes. It is important that monitoring of sea turtles is maintained to assess this mitigation measure and avoid impacts. Due the implementation of these type of luminaires the impact of lighting will be reduced to low significance.

12.5.3.13 Alteration of ecological areas

Operation activities: Presence of the coastal protection barriers.

Effects: The presence of the coastal protection works has effects on the loss of natural habitat, due to the decrease in the existing ecological area, and may result in the exclusion of marine animals, especially turtles. On the other hand, it will also provide new foundations for new habitats, with new rock substrat.

Impact Assessment: With the coastal protection works, the natural and unique characteristics of the site will be altered, affecting, in this case, the marine fauna, which may lead to loss of habitats, facilitating competition between individuals, and may lead to the removal and/or extinction of the species at the site. Since this area is not the main nesting area in the island for turtle nesting and is already with some disturbance due to anthropogenic activities, this impact is considered to be negative, permanent, of moderate magnitude and significant.

With the stabilization of the structures, is expected that these habitats can be recovered, with colonization of flora and fauna species, creating new communities and ecosystems. This impact is positive, temporary, moderate magnitude and significant.

12.5.3.14 Degradation of marine ecosystems

Operation activities: Expected traffic increase.

Effects: The degradation of marine ecosystems is associated with the accidental spillage of hazardous products such as fuels, oils, lubricants from traffic accidents.

Impact Assessment: The increase in traffic is not directly related to the project. However, the improved conditions that the project will provide, with improved road safety conditions, will contribute to the reduction of road accidents and therefore to the reduction of accidental spillages of hazardous products to the sea water. The degradation of marine ecosystems is thus classified as a negative, direct, temporary, not significant and reduced magnitude impact.

12.5.3.15 Reduction in the number of accidents

Operation activities: The reduction in the number of accidents during the operation of the development is associated with improved road safety with the implementation of vehicle circulation activities, vertical signage, pedestrian crossings and the installation of lighting (street Luminary).

Effects: Decrease in the risks and number of road accidents, with a consequent improvement in the quality of life of the population in the area of direct influence resulting from increased road safety.

Assessment of impacts: The reduction in the number of accidents during the operation of the development is associated with improved road safety with the implementation of speed restrictions, vertical road signs, crosswalks and the installation of lighting (street Luminary) and reduction of velocity for vehicles. This impact is positive, very significant, direct, permanent and high magnitude, since increased accessibility and improved paving conditions generate an improvement in local traffic, promoting a more fluid circulation of vehicles and contributing substantially to reducing the number of accidents, especially between vehicles and cyclists, with the creation of cycle lanes.

12.5.3.16 Effect on public health (respiratory and auditory system)

Operation activities: Traffic generated by the marginal will be motorized and no motorized with the presence of a greater number of trees with plantation of 36 new trees and road maintenance.

Effects: Alternative transports to motorized transports decreases air pollution and sound level, sweeping track maintenance gives rise to dust, and the presence of more 34 trees provides a noise barrier that will abate the negative effect on the health of the population in the surrounding area.

Impact assessment: Due to improvement of road and waterfront, better conditions for sports practice, walking and healthy habits, with decrease of noise and air pollution is considered a positive, significant, direct, permanent and local for population health (respiratory and auditory system).

Road maintenance generating traffic for cleaning infrastructures, green spaces maintenance, environmental a social monitoring etc., generates a small increase of vehicle trips by day comparatively with traffic without project and impact in respiratory and auditory systems is low significance, direct, low magnitude.

12.5.3.17 Improvement of healthy habits

Operation Activities: Presence of a drinking two water fountains.

Effects: The presence of a drinking water fountains provide the users of Pantufo Coastline with water for drinking.

Impact assessment: The impact caused by the presence of the drinking water fountain can be assessed as low significance, direct, permanent, with local scope and with low significance.

12.5.3.18 Waste disposal on footpaths and road (waste management)

Operation Activities: Presence of paper bins for rubbish disposal.

Effects: The presence of litter bins every 40 m can lead to a positive impact on waste disposal.

Impacts Assessment: During the operation phase, waste will be generated associated with operation of road and infrastructures which have the following main typologies:

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17

Code	Solid Wastes
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used tires
16 01 07 (*)	Oil filters
16 01 12	Brake pads other than those specified in 16 01 11
16 01 17	Iron metals
16 01 18	Non-iron metals
16 01 19	Plastic
16 01 20	Glass
17 01 01	Concrete
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 04 07	Mixed metals
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infections (for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20.01 02	Glass
20 01 19	Pesticides
20 01 39	Plastics
20 02	Garden and park waste
20 03 04	Septic tank sludge
20 03 01	Other urban and similar waste, including waste mixtures

Table 46 - Operation wastes

(*) Hazardous wastes

The actual absence of paper bins currently means that the presence of paper bins every 40 m can generate a positive impact, considering that the population should be made aware of their use and that the daily collection of the waste produced is foreseen in the maintenance. This impact is considered positive, significant, direct, temporary and of moderate magnitude.



The following table summarize impacts identified in the operation phase.

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Climate and climate change	Consumption of fuel, oils and lubricants	Greenhouse effect/climate change	Traffic increase	P	D	P	M	S	
	Electricity consumption		Lighting of premises (street Luminary, park Luminary and laundry)	N	D	P	R	LS	
	Coastal Protection		Presence of Coastal protection infrastructures	P	D	P	M	S	
	Drainage System		Requalification of drainage system	P	D	P	M	S	
Air quality	Reduction of dust generation on roadways	Alteration of air quality	Traffic generated by operation of infrastructures	P	D	P	M	S	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Improvement of air quality	Presence of more 34 trees and green spaces	P	D	P	M	S	
Noise	Increase of Noise	Noise and vibration emission	Circulation of non/motorized and non-motorized transports	P	D	P	M	S	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Noise		Effect on the health of the population in the surrounding area	Increased vegetation cover (sound barrier)	N	D	T	R	LS	
Soil	Coastal protection works	Reduced exposure to erosive agents (water, wind, sea waves)	Presence of Coastal Protection Works	P	D	P	H	VS	
Soil	Disposal of solid urban waste in inadequate locations	Soil contamination	Increased flow of people	N	D	P	R	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of traffic accidents						
	Production of solid waste and liquid effluents		Existence of bins for rubbish disposal						
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Increased flow of people	N	D	P	R	LS	
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of traffic accidents	P	D	P	M	S	
	Natural drainage	Improving the drainage capacity of structures	Presence of climate-resilient drainage works	P	D	P	M	S	
Natural resources	Decreased fuel consumption (diesel, petrol)	Fossil fuel consumption	Circulation of motorized and non/motorized	P	D	P	M	S	

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Natural resources			transports						
	Electricity consumption	Increase of Electricity consumption	Lighting of premises (street luminary, park luminary)	N	D	P	R	LS	LS
	Water consumption	Increase of water consumption	Green spaces and 3 fountains	N	D	P	R	LS	LS
Landscape	Rehabilitation of the image of the Marginal	Improving the image of the Marginal Visual	Rehabilitation of the landscape, with an increase in green spaces, urban equipment (benches), litter bins, children's playgrounds, cycle lanes, e	P	D	P	H	VS	
Biodiversity	Noise emission	Removal of marine animals turtles species (<i>Chelonia mydas</i> ; <i>Lepidochelys olivacea</i> ; <i>Eretmochelys imbricata</i> and <i>Dermochelys coriacea</i>)	Increased traffic flow	N	D	P	M	S	
			Increased flow of people						
	Increase in goods and services								
	Light emission		Lighting of premises (street luminary)	N	D	P	M	S	LS

Environmental and Social Impact Assessment

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Biodiversity	Loss of habitats or/and completion between species	Alteration of ecological areas	Coastal protection	N	D	P	M	S	
	Creation New habitats (rocks)			P	D	T	M	S	
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Degradation of marine ecosystems	Road accidents	N	D	T	R	LS	
Community Health and Safety	Improving road safety	Reduction in the number of accidents	Movement of vehicles	P	D	P	H	VS	
			Vertical and horizontal signage						
			Pedestrian crossings						
	Dust emission	Harmful effects on the respiratory system	Road maintenance	N	D	P	R	LS	
			Improvement of road and waterfront	P	D	P	M	S	
Noise emission	Harmful effects on the hearing system	Road maintenance	N	D	P	R	LS		

Environmental Factor	Aspect	Environmental Impact	Activity	Classification				Impact Without measure	Impact With measure
				Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Community Health and Safety		Decrease of noise	Improvement of road and waterfront	P	D	P	M	S	
	Drinking Water	Improve of healthy habits	Presence of drinking water fountain	P	D	P	M	S	
Waste management	Production of solid and liquid waste	Disposal of wastes on sidewalks and roads	Existence of bins for rubbish disposal	P	D	T	M	S	

Table 47 Environmental Impact Assessment – Operation Phase. Pantufo Coastline

12.5.4 SYNTHESIS OF POTENTIAL ENVIRONMENTAL IMPACTS

The main environmental impacts for the construction, demobilization and operation phase for Pantufo Coastline are presented below, considering the mitigation measures proposed:

Negative Impacts

Construction and Demobilization Phases

- Geomorphology alteration resulting due extraction of materials in quarries (low significance);
- Disturbance in terrestrial fauna in flora due extraction of material in quarries and construction activities (low significance);
- Disturbance of marine ecosystems due construction activities in coastal area, including sea turtles nesting (low significance);
- Dust and noise emission due construction activities (low significance);
- Contamination of surface/groundwater in work fronts and in construction site due solid waste disposal in inadequate sites (significant);
- Contamination of surface and groundwater in work fronts and in construction site due to storage and handling of hazardous products (significant);
- Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal area (significant);
- Reduced quality of life due to removal of demolition rubble (significant).

Operation Phase

- Soil contamination resulting from disposal of solid urban waste in inadequate locations, Accidental spillage of hazardous products (fuel, oil, lubricants Production of solid waste and liquid effluents (low significance);
- Water and energy consumption (low significance);
- Degradation of marine ecosystems resulting form accidental spillage of hazardous products as fuel, oil and lubricants (low significance);
- Risk of death of sea turtle hatchlings due artificial light pollution (low significance).

Positive Impacts

Construction and Demobilization Phases

- Using locally recycled glass in the construction of benches (significant);
- Increased water infiltration into the soil through reforestation, with the planting of native tree species (significant);
- Improving the landscape due to Restoration of the affected area: reforestation, soil decompaction (significant);
- Biophysical restoration of the affected area (significant).

Operation Phase

- Creation of new habitats (significant);

- Increase in traffic volume with motorized and no motorized transports, comparatively to increase with only motorized transports, resulting in a reduction of greenhouse gas emissions, noise and air pollution (significant);
- Reduced exposure to erosive agents (water, wind, sea waves) associated with the presence of coastal protection infrastructure (very significant);
- Improve drainage capacity of structures, avoiding flooding in the period of heavy rains (significant);
- Reduction in the number of accidents (very significant);
- Improve of healthy habits (significant);
- Reduction of disposal of wastes on sidewalks and roads due to existence of bin for rubbish disposal (significant).

12.6 CUMULATIVE ENVIRONMENTAL IMPACTS

It is proposed the rehabilitation of Marginal Road is divided in three lots Lagarto Bay, Ana Chave Bay and Pantufo Coastline in the city of São Tomé and Príncipe. In addition to these projects, the project for the rehabilitation of the EN1 connecting the city of São Tomé to Neves is being implemented in parallel, it is foreseen to be concluded in 2022.

This cumulative environmental impact assessment aims to assess the potential impacts of the three Projects and associated with EN1 which potentially occur in close proximity. The following tables summarize these assessments for construction and operation phases.

Environmental Factor	Impact	Description
Climate and Climate changes	GHG emissions	Potential cumulative construction periods between EN1 requalification Project and each Marginal Road Lot (machinery and equipment fuel emissions and electricity consumption) Impact negative, temporary, reduced magnitude, low significance
	CO2 sequestration	Cumulative removal of trees that will decrease the CO2 sequestration. Impact negative, temporary, reduced magnitude low significance
Soils	Compaction and decrease of water infiltration	Potential cumulative needed materials from quarries, for the 3 projects at same time can cause compaction of soil and decrease of water infiltration caused for an increase of heavy vehicle circulation.

Environmental Factor	Impact	Description
		Impact negative, temporary, moderate magnitude, significant.
Biodiversity	Removal of vegetation	The removal of trees and aquatic vegetation may decrease the existing biotopes for terrestrial and aquatic fauna, which are already adapted to disturbed conditions. Impact negative, temporary, reduced magnitude, low significance.
	Fauna disturbance	Occur mainly because of the traffic and people noise, it is not expected that it will cause any significant impact, since it is already an altered ecosystem Impact negative, permanent, reduced magnitude, low significant
Air Quality	Decrease of air pollutants emissions (CO ₂ , CO, NO _x , SO _x , HC, VOC's)	Potential cumulative construction periods when all the Projects (three lots and EN1) transport goods and materials by road there will be increased vehicle movements in the area as trucks will be required to transport materials and equipment. The increase in traffic can create dust and emissions of air pollutants that affects other road users and people living or working within close proximity to the roads on the selected transport routes Impact negative, temporary, moderate magnitude, significant
Noise and Vibration	Noise and vibrations emissions	Potential cumulative construction periods when all the Projects (three lots and EN1) transport goods and materials by road there will be increased vehicle movements in the area as trucks will be required to transport materials and equipment. The increase in traffic can create noise and vibrations that affects other road users and people living, working within close proximity to the roads on the selected transport routes Impact negative, temporary, moderate magnitude, significant
Landscape	Landscape alteration	Potential cumulative construction of three projects with land occupation and placement of fence along marginal change scenic view, don't allow visualization of the sea, along majority of Marginal roads for inhabitants of São Tomé and tourists,

Environmental Factor	Impact	Description
		Impact negative, temporary, high magnitude, very significant
Community Health and Safety	Decrease of safety	<p>Potential cumulative construction periods when all the Projects (three lots and EN1) transport goods and materials by road there will be increased vehicle movements in the area as trucks will be required to transport materials and equipment. The increase in traffic can create decrease of road safety (including injury or even death due to accidents) that affects other road users and people living or working within close proximity to the roads on the selected transport route.</p> <p>Impact negative, temporary, moderate magnitude, significant</p>
Waste Management	Increased of Construction and Demolish Wastes	<p>Potential cumulative construction when all the Projects produces large quantities of wastes from demolitions can create congestions in accesses of Penha Dump for disposal of wastes.</p> <p>Impact negative, temporary, moderate magnitude, low significant</p>

Table 48 Environmental Cumulative Impacts Assessment. Construction Phase

Some measures suggested to mitigate cumulative environmental impacts are:

- Develop an integrated traffic management plan for use of main public roads, particularly for heavy vehicles that may affect other traffic movements in the area. This plan should include traffic routes, speeds, timing of movements to minimize congestion and accidents.
- Develop an integrated schedule of noisy activities and inform population.

Environmental Factor	Impact	Description
Climate and Climate changes	Electricity consumption	Lighting and eventual installations of each road will need electricity that will increase the CO2 emissions . Impact negative, permanent, reduced magnitude, low significance
	Requalification of the drainage system	The improvement of the existing drainage system for all the roads contributes for a better adaptation to extreme climate events. Impact positive, permanent, moderate magnitude significant
Hydrology and water quality	Improvement of water courses drainage	The improvement of the existing drainage system for all the roads contributes for a better drainage in basins that flow to sea. Impact positive, permanent, moderate magnitude significant
Biodiversity	Increased number of planted trees – new biotopes	The plantation of a higher number of trees along each lot will contribute to create ecologic corridors and provide new biotopes for feeding and nesting. Impact positive, permanent, moderate magnitude, significant
	Artificial lighting	Artificial lighting can affect the turtles nesting behavior along bays of Marginal Road. Monitoring and avoid direct lighting to the beaches is mandatory. Impact negative, permanent, moderate magnitude, significant
	Coastal protection structures	During construction, they may affect aquatic communities, although these are already adapted to disturbed conditions. After stabilization, these structures can provide new biotopes for the aquatic organisms. Impact positive, permanent, moderate magnitude, significant
	Fauna disturbance	Occur mainly because of the traffic and people noise, Is not expected that it will cause any significant impact, since is already an altered ecosystem. Impact negative, permanent, reduced magnitude, low significance
Air Quality	Decrease of air pollutants emissions (CO2, CO, NOX, SOX, HC, VOC's)	Potential cumulative impacts of 3 Projects results of alternative non-motorized transportation along Marginal road with creation of cycle lanes and sideways for walking that permits a reduction of dust and air pollution.

Environmental Factor	Impact	Description
		Impact positive, permanent, moderate magnitude, significant.
Noise and Vibration	Decrease of noise	<p>Potential cumulative impacts of three Projects results of alternative non-motorized transportation along Marginal road with creation of cycle lanes and sideways for walking that permits a reduction of noise along the marginal road.</p> <p>Impact positive, permanent, moderate magnitude, significant.</p>
Landscape	Landscape Alteration	<p>The requalification of waterfront in the three lots in terms of landscape and urbanism allows for a continuous improvement tacking in account the particular characteristics of each bay.</p> <p>Impact positive, permanent high magnitude very significant.</p>
Community Health and Safety	Increase of road safety	<p>Potential cumulative of three Projects results of increased safety circulation for road users of motorized and no motorized transports with safety signage, speed limitations for vehicles that contributes to an increase of road safety (including injury or even death due to accidents) that affects all users of Marginal road</p> <p>Impact positive permanent, moderate magnitude, significant</p>
Waste Management	Decrease of incorrect waste disposal	<p>Potential cumulative of three lots with litter bins in every 4 0m contribute to avoid wastes disposal in ground and for population create new habits.</p> <p>Impact positive, permanent, moderate, significant.</p>

Table 49 Environmental Cumulative Impacts Operation phase

13. SOCIAL IMPACTS ASSESSMENT

This chapter of ESIA aims to analyze comparatively the social impacts associated with the construction, demobilization and operation phases of the solution for road, coastal protection and landscape comparatively to No Project or Zero Alternative (evolution of social conditions without project).

In next sections are present the evolution of social conditions without project, the methodology used in environmental and social impact assessment, for each lot and a synthesis of social impact. The methodology for assessment social impact has already been described in section 12.2.

13.1 EVOLUTION OF SOCIAL CONDITIONS WITHOUT PROJECT

The following table summarizes the evolution of Social Conditions without project (Zero Alternative).

Social Factor	Evolution of Social Conditions without project
Demography	INE projections point to a total population of 284.293 in 2035 and the continuation of the district of Água Grande to have about 40% of the country's population
Employment	In STP the employment opportunities are scarce, being young people the age group with the highest level of unemployment.
Tourism	Tourism is a very important sector for the economy of São Tomé, the pandemic brought a sharp drop in the number of tourists visiting the island.
Fisheries	Fisheries In the absence of the project, the activities related to fishing, such as space for fishermen's parking, storage of fishing r, tend to disappear due to the reduction of the beach. The conditions for repairing boats and fishing motors, as well as for selling fish, continued to be very precarious.
Economy	The absence of the project may have an influence on the active capacity of the population, considering the effects on health due to the increase of automobile traffic and stress caused to the population An unhealthy population tends to have less productivity and this influences the local economy and the population's livelihood.
Transports Infrastructure	In the absence of Project due the increase of population in island, and links of Marginal between Airport, Hospital and São Tomé city with central services the marginal road is expected to have an increase of motorized transports and remain without safety road conditions, lack of signage, degraded, with strong exposure to the sea but attractive for sports practices.
Water supply infrastructure	It is foreseen a Project for an improvement in supply to the city of São Tomé and the periphery with an EIB project.

Social Factor	Evolution of Social Conditions without project
Sewage infrastructures	There is no planned construction of network and waste treatment plan for collection and treatment of wastewater produced in São Tomé city. In the current situation sea as final disposal.
Energy	The lack of lighting in Marginal road and degradation of luminaries will continue.
Cultural Heritage and traditional events	It is expected that the state of some of the identified colonial houses will deteriorate if measures are not taken for their preservation and inhabitants of São Tomé city participate in events in beaches New Yea and linked to sea, as São Pedro festival, patron saint of fishermen.
Landscape	The absence of the Project represents a continues degradation of image of São Tomé city, with a Marginal of great landscape quality, flanked by trees as Terminalia catappa L. (caroceiro) in Ana Chaves Bay, but with bad status of conservation of walls and sidewalls.

Table 50 Evolution of Social Conditions without Project

13.2 POTENCIAL SOCIAL IMPACTS LAGARTO BAY

13.2.1 CONSTRUCTION PHASE

13.2.1.1 Job Creation

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction create temporary jobs in São Tomé island.

Effects: The project will create employment, as the bulk of the staff recruited will be from within the area including the involvement of a range of entities in the provision of goods and services as direct positive impacts of the project. The Contractor will commit to a policy that gives priority to the locals in the neighborhood at the time of employing casual or skilled labor. Employment will also facilitate the transfer of skills such as driving, welding, bricklaying to local employees. Those that will be employed directly will also have potential to accumulate household and economic and productive assets.

Impact Assessment: Impact of job creation is classified as positive, direct and indirect, temporary and with magnitude high and very significant due employment for the execution of the construction work can increase the income of the local population, improving their current condition. Also, during the construction phase, there are indirect employment opportunities through other local services, such as small businesses and services for construction workers and construction sites in general. It will also provide an opportunity for the ladies who sell food and other food in the vicinity of the construction sites.

The project will create employment, as the bulk of the staff recruited will be from within the area including the involvement of a range of entities in the provision of goods and services as direct positive impacts of the project. The Contractor will commit to a policy that gives priority to the locals in the neighborhood at the time of employing casual or skilled labor. Employment will also facilitate the transfer of skills such as driving, welding, bricklaying to local employees.

This project will have a very significant impact on job creation, especially in the young population. According to the estimate of the unemployed, in 2015 the country had about 8,882 unemployed, of which 7,457 were between the ages of 15 and 34. It should also be noted that of the 8,882 unemployed, about half, or 4,062 of the unemployed population is in the Água Grande district. (Estimation of employment and unemployment, INE 2015).²⁸

13.2.1.2 Demand of Housing and Food Consumption

Activities: Contracting staff for the works construction can generate a demand of housing and food consumption

Effects: Contracting staff for the works during 24 months of construction works produce direct and indirect income generation and increase of demand in housing and food consumption

Impact Assessment: Impact on demand of housing and food consumption is classified of positive, insofar as it will lead to increased demand, increased consumption and therefore increased sales and household income, direct and temporary and with magnitude moderate and significant due increase food consumption and demand of housing due of workers there are not inhabitants of São Tomé city and surroundings.

13.2.1.3 Increase of tax collection and coins circulation

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: The construction, rehabilitation of sidewalks and road, will generate economic growth and positive externalities, including increased income of the population, increased circulation of money, which in turn will induce an increase in consumption and consequently the increase in consumption will cause an increase in revenue collection by the state, increased tax collection.

The construction work, rehabilitation of sidewalks and roads along the waterfront, being labor intensive, can contribute to the generation of employment and income for the population. The investment for the realization of these works will contribute to increase the national Gross Domestic Product (GDP) and revenue collection.

Impact Assessment: The impact of construction work, rehabilitation of sidewalks and road along the waterfront is classified of positive, direct and temporary and with magnitude moderate and significant in increasing revenue collection, taxes, and increasing the circulation of money in the economy.

13.2.1.4 Impacts on Distancing Bathers and Tourists

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: Emilia beach in Lagarto Bay, usually has a large number of bathers especially on Sundays and Tourists.

Impact Assessment: The implementation of this project will have a negative, direct, temporary, high magnitude and very significant impact, for the population that usually frequents these beaches. Especially Emilia Beach in Lagarto Bay, because during the construction phase they

²⁸ <https://www.ine.st/index.php/publicacao/documentos/file/301-estimativa-do-emprego-e-desemprego-por-sexo-e-idade-segundo-distrito-2000-2015>

will see limited access and movement on the beaches. On the other hand, for those people who in the late afternoon stroll along the waterfront will be deprived of the sea view.

13.2.1.5 Impacts on Traffic

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The implementation of this project directly influences the emergence/ worsening of traffic congestion, particularly on the waterfront. It is an access road to the main points of economic activity in the country, namely, the International Airport, not to mention the various services and institutions that are located near the waterfront.

Impact Assessment: This project can have a negative, direct, temporary, with moderate magnitude and significant impact on traffic, as the road construction and coastal protection works can cause congestion and delays in the circulation of vehicles and even cause road accidents

13.2.1.6 Road Damage

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The circulation of heavy vehicles for transporting materials on the roads leading to the construction sites may cause degradation of the asphalt on the roads

Impact Assessment: The movement of heavy goods vehicles and materials for the works can have a significant direct, temporary, with moderate magnitude, negative impact on the degradation of the road surface.

13.2.1.7 Population Influx on the beach

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Emilia beach in Lagarto Bay, usually has a large number of bathers especially on Sundays.

Impact Assessment: The implementation of this project will have a significant, direct, temporary, with moderate magnitude, negative impact for the population that usually frequents these beaches. Especially Emilia Beach in Lagarto Bay, because during the construction phase they will see limited access and movement on the beaches. On the other hand, for those people who in the late afternoon stroll along the waterfront will be deprived of the sea view.

13.2.1.8 Disruption of daily activities and the movements of people and vehicles

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: There is enormous variability regarding the possible impacts derived from construction works on roads and coastal protection, road congestion, delays in the circulation of public and

individual transport, traffic accidents, etc. Taking into account that this is a carriageway with only 2 lanes, one in each direction, and being aware of the volume of heavy vehicles circulating.

Impact Assessment: The project can have a very significant, direct, temporary, with high magnitude, negative impact on the disruption of daily activities and movement of people and vehicles during the construction phase, as it can cause road cuts and or narrowing, congestion on access roads, and cause accidents and delays on the roads.

The wash women during construction have access guaranteed to laundry without having impact in wash clothes activity.

13.2.1.9 Limitation to sports activities (walking, running, cycling)

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: Despite the state of the sidewalk, the waterfront is used daily by hundreds or thousands of people, pedestrians, sports enthusiasts, cyclists, and joggers, who during the construction phase, due to the fencing of the spaces, the movement of machinery and equipment, may see the practice of these activities limited in these places.

Impact Assessment: The project will have a significant direct, temporary, with moderate magnitude, negative impact for people who practice sports, namely, walking, running, cycling, due to the works, construction, it will not be possible to practice these sports on the sidewalks during the construction phase.

13.2.1.10 Affecting the holding of festivals and New Year parties on the beaches

Activities: reconstruction and requalification of the waterfront

Effects: In São Tomé and Príncipe it is customary to hold festivals and New year parties on the beaches. Emilia beach is one of the reference places for end of the year festivities. However, due to the reconstruction and requalification works on the waterfront, the population of the capital city and its surroundings will see its space for New Year festivities restricted due to the presence of equipment, materials and heavy vehicles in the intervention areas.

Impact Assessment: the reconstruction and requalification of the waterfront in the Lagarto Bay will have a direct, temporary, with moderate magnitude, significant and negative impact on the holding of festivals and New Year parties on the beaches.

13.2.1.11 Interruption of supply of infrastructure services such as water and energy

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The interruption of supply of infrastructures services may cause inconvenience to the population.

Impact Assessment: The economic and social infrastructures such as electrical and water infrastructures are fundamental for the daily life of the communities and during the construction

phase the renovation of existing electrical and water infrastructures underground will be replaced and may cause inconvenience to the population.

To avoid impact of interruption of supply of infrastructures services population will be informed and interruption will be in short time to avoid economic effects and discomfort in population, impact will be negative, with reduced magnitude, low significance, temporary and direct.

13.2.1.12 Women's Business opportunities through itinerant businesses or in areas bordering the works

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The concentration of a large number of people, workers and companies providing services for the rehabilitation works of the waterfront in Lagarto Bay, for the activities of land removal, demolition and construction of infrastructure, etc., will lead to an increase in demand for small businesses that are mainly developed by women, including the sale of water, seasonal fruits, various homemade cakes, pre-cooked food.

Impact Assessment: This will have a direct, temporary, with moderate magnitude, significantly positive impact for the small business routes in the project intervention area. This is positive because, usually, in São Tomé and Príncipe when there is a big construction site in a certain place, people, mostly women, move near the construction sites to do business, such as selling food, water and other types of services.

13.2.1.13 Women's increase family income due to participation in construction activities

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: This project will also give a great opportunity for women to be employed; This project will also give a great opportunity for women to be employed in different jobs, such as cleaning, engineers, construction helpers, administration, supervision etc. this will in turn enhance the situation of women. This can be affected if the contractor has a deliberate policy of giving opportunities to women when hiring workers. However, the impact would be selective in those job seekers for work will be dominated by males.

Impact Assessment: This project will direct and positively impact in job creation for women, direct for those directly working on the construction sites, and indirectly for the suppliers of services it can increase the women income and improving their current condition. The impact is temporary, with moderate magnitude and significant.

Employment for the execution of the construction work can increase the income of the local population, improving their current condition. Also, during the construction phase, there are indirect employment opportunities through other local services, such as small businesses and services for construction workers and construction sites in general. It will also provide an opportunity for the ladies who sell food and other food in the vicinity of the construction sites. By way of example, we have the women's cooperative for waste recovery, which processes glass into vibrant colored jewelry. This cooperative will produce benches with glass sand and urban furniture, urban ornamentation pieces with recycled glass.

13.2.1.14 Gender Base Violence and Harassment

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Harassment and gender-based violence is a reality in the world of work in São Tomé and Príncipe, driven largely by the cultural and social norms of society, particularly in the construction sector, where maxims mentality and behavior still prevail. For this reason, the project must address all aspects of preventing harassment and gender-based violence in the workplace.

Impact assessment: As mentioned above, the construction sector is predominantly male, despite the growing presence of women. On the other hand, São Toméan society is still by a male dominant culture. Therefore, the risk of gender-based violence and harassment is significant in this project, causing a negative, direct, temporary, with high magnitude, very significant impact.

13.2.1.15 Increased Incidence of contagious diseases COVID 19 and sexually transmitted infections STIs

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: There is a potential for increased incidence of sexually transmitted diseases (STDs) and HIV/AIDS due to the project. During construction and maintenance, there is the possibility that local and outside workers will have greater financial possibilities, which may attract more women (both local and sex workers) to have sex. For the outworkers, there is also the fact that they are working for some time away from their families. In addition, sex workers may be attracted or encouraged on the project site.

Impact Assessment: The risk of increased incidence of sexually transmitted diseases, including HIV/AIDS is significant direct, negative moderate due to the increased number, presence, and concentration of working people in the project vicinity, the risk of sexual incident and transmission of sexually transmitted diseases, including HIV/AIDS, may increase.

13.2.1.16 Conflicts Between workers and the local population in the project Area.

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction

Effects: Projects involving works of considerable significance often generate social conflicts between workers who stay temporarily on site and community residents.

Impact Assessment: The impacts are generally related to socially unacceptable behavior according to local social standards and may be observed, for example, cases of drunkenness and disregard or lack of respect for local customs. Although part of the workforce is recruited locally, this impact must be considered, not only because of other workers from other areas, but also because local workers themselves may generate social unrest in the community, once they feel that employment or other conditions give them a different status.

Due to the increased number, concentration, presence of people, project workers in the communities. The risk and impact of conflicts is direct, negative, temporary and with moderate magnitude and can be reduced to low significance with sensitization and implementation of Code of conduct for workers.

The following table summarize impacts in construction phase.

Environmental and Social Impact Assessment

Aspect	Socio economic and social Impact	Activity	Classification				Impact without measures	Impact with measurements
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low significance/ Significant, Very Significant)
Employment	Job creation	Earthmoving	P	I/D	T	H	VS	
		Removal of vegetation cover	P	I/D	T	H	VS	
		Infrastructure construction (roads, coastal protection, etc)	P	I/D	T	H	VS	
Direct and indirect income generation	Increased demand for housing and food consumption	Hiring staff for the works	P	D	T	M	S	
Stimulating economic activities	Increased tax collection	Hiring staff; purchasing inputs and equipment and contracting services	P	D	T	M	S	
	Increase in coins in circulation	Consumption by workers and commercials	P	D	T	M	S	
Limitations on beach access	Distancing bathers and tourists	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	H	VS	S
Increase in the number of heavy vehicles for transporting materials	Increase of traffic	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	N	D	T	M	S	LS
	Road Damage	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	N	D	T	M	S	LS

Environmental and Social Impact Assessment

Aspect	Socio economic and social Impact	Activity	Classification				Impact without measures	Impact with measurements
			Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)
Occupation of public space and roads	Population Influx on the beach	Infrastructure construction (roads, coastal protection, etc.)	N	D	T	M	S	LS
	Limitation to sports activities (walking, running, cycling)	Infrastructure construction (roads, coastal protection, etc.)	N	D	T	M	S	LS
	Disruption of daily activities and the movements of people and vehicles	Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	N	D	T	H	VS	LS
Cultural and Traditional Aspects	Affecting the holding of festivals and end-of-year parties on the beaches	Works, infrastructure construction (roads, coastal protection barriers, promenades, etc.),	N	D	T	M	S	LS
Infrastructures	Interruption of supply of infrastructure services such as water, energy, sanitation	Infrastructure construction (roads, coastal protection etc)	N	D	T	R	LS	
	Road damage	Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	N	D	T	R	LS	
Women's participation in economic activities	Business opportunities through itinerant businesses or in areas bordering the works	Infrastructure construction (roads, coastal protections, etc)	P	D	T	M	S	
	Increased family income due to participation in benches construction	Building benches with recycled glass	P	D	T	M	S	

Environmental and Social Impact Assessment

Aspect	Socio economic and social Impact	Activity	Classification				Impact without measures	Impact with measurements
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low significance/ Significant, Very Significant)
Significant migration of workers to the site	Increased risk of sexual harassment and gender-based violence	Infrastructure construction (roads, coastal protection, etc)	N	D	T	H	VS	S
Contact between workers, people from the community	Increase in incidence of contagious diseases COVID 19 and sexually transmitted infections STIs	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS
Drinking water consumption, energy and waste production	Conflicts between workers and local community over increased pressure on water supply, energy and waste collection systems	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS

Table 51 Social Impact Assessment. Construction Phase. Lagarto Bay

13.2.2 DEMOBILIZATION PHASE

13.2.2.1 Increase of skilled workers

Activities: End of Construction Site demobilization activities

Effects: End of construction have effect in reduction of workers but a bigger availability of workers skilled.

Impact Assessment: Once the implementation phase is concluded, a large part of the workforce of contracted workers will be demobilized. With the end of the construction phase, it becomes necessary to demobilize materials, equipment and some infrastructure mobilized and built during the construction phase and demobilize the team of workers. This action will lead to a significant reduction of workers but bigger availability of workers skilled.

These workers can have more chances in work in other big public projects, this positive impact is direct, low significance to significant and reduced magnitude.

13.2.2.2 Road Damage

Activities: Vehicle circulation, road accidents and removal of rubble

Effects: The need to mobilize various equipment and transport materials and products, including stones, sand, clay, etc., by heavy vehicles during the construction phase and the demobilization of equipment and materials during the decommissioning phase may cause significant damage and degradation to the roads that directly connect to the waterfront and to the roads surrounding the waterfront.

Impact Assessment: The activities of Vehicles circulation, road accidents and removal of rubble for demobilization of materials, equipment and infrastructure in the demobilization phase of the project can have a direct and indirect, significant, temporary and with moderate magnitude and negative impact on the roads damage. Contractor have the responsibility to restore the damage caused in roads.

13.2.2.3 Disturbances to the health, comfort of the population

Activities: Circulation of heavy vehicles, equipment and machinery and removal of rubble

Effects: During the demobilization phase of the project, circulation of vehicles, equipment and machinery and removal of rubble from construction site, cause dust and noise and can lead to disturbance to health, comfort of population surrounding the project intervention area and construction site.

Impact Assessment: These activities of demobilization can have impacts in sensitive receptors health and comfort. On the other hand, the large movement and transport of heavy vehicles in communities near the project may cause traffic accidents and/or situations of conflict and confrontation with the population.

The demobilization of equipment, materials activities can cause a negative, significant, direct, moderate and temporary impact on the health of the populations near the project's areas of intervention and construction site.

The measures identified in Chapter 17 reduce the impacts for low significance.

13.2.2.4 Reduced quality of life

Activities: Circulation of heavy vehicles, equipment and machinery and removal of rubble

Effects: During the demobilization phase of the project, circulation of vehicles, equipment and machinery and removal of rubble from construction site, cause dust and noise and can lead to a reduction in the quality of life of the population surrounding the project intervention area and construction site.

Impact Assessment: The demobilization of equipment, materials activities cause dust, noise e a negative, significant, direct, moderate and impact on the health of the populations near the project's areas of intervention and construction site.

The measures identified in Chapter 17 reduce the impacts for low significance.

13.2.2.5 Impacts in health, injuries, deaths

Activities: Circulation of machinery and vehicles used for the transportation of demolition rubble

Effects: Circulation of machinery and vehicles used for the transportation of demolition rubble can increase risk of accidents in roads used by vehicles a machinery

Impact Assessment: The demobilization of equipment, materials activities can increase risk of accidents in roads used by vehicles a machinery, if mitigation measures as limitation of speed are respected the impact will be negative, low significance, direct, reduced and temporary.

The following table summarize impacts in demobilization phase.

Environmental and Social Impact Assessment

Aspect	Social Impact	Activity	Classification				Impact Without measure	Impact With measure
			Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance/Significant/Very Significant)	Significance (Low significance/Significant, Very Significant)
Employment	Increase of skilled workers	End of Construction Site demobilization activities	P	D	P	R/M	LS	
Accidental spillage of hazardous products (fuel, oil, lubricants)	Road Damage	Vehicle circulation	N	D	T	M	S	LS
		Road accidents						
		Removal of rubble						
Noise generation	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	N	D	T	M	S	LS
		Removal of demolition rubble						
	Reduced quality of life	Removal of demolition rubble	N	D	P	M	S	LS
Emission of pollutants and dust	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	N	D	T	R	S	LS
		Removal of demolition rubble						
	Reduced quality of life	Removal of demolition rubble	N	D	P	M	S	LS
Road traffic accidents	Impacts in health, Injuries, deaths	Circulation of machinery and vehicles used for the transportation of demolition rubble	N	D	T	R	LS	
	Reduced quality of life		N	D	P	M	S	LS

Table 52 Social Impact Assessment. Demobilization. Lagarto Bay

13.2.3 OPERATION PHASE

13.2.3.1 Jobs creation

Activities: Maintenance activities of infrastructures

Effects: The maintenance activities of infrastructures to be implemented by the project also create job opportunities

Impacts assessment: Rehabilitation of marginal road needs maintenance of infrastructures, cleaning, green spaces maintenance and also creates opportunities for national companies and organizations, mainly GIME (Road Intervention and Maintenance Group) and ONG's. Impact creation can be direct or indirect. Some suggestion for enhancement of positive impacts and indirect jobs creation are: creation of plant nursery for green spaces maintenance including caroceiro *Terminalia cattapa L.*, creation of a road safety training center, with focus awareness of road safety for non-motorized transports as bicycle; creation of handicrafts for tourists with fish scales.

This impact is considered to be positive, low significance to significant, permanent, depends of implementation of indirect projects.

13.2.3.2 Accessibility improvement

Activity: Operation of the road signage improvements

Effects: The implementation of this project of requalification of the waterfront, consequent improvements in infrastructure, particularly the road. It is noteworthy that the 12 de Julho waterfront road provides access and connects the main infrastructures of the country, namely, the Port of Ana Chaves and the International Airport of São Tomé and Príncipe. It gives access to the largest supermarket in the country – CKDO. On the other hand, it connects with the three main highways of the country, National 1 EN1, National 2 and National 3. On the other hand, when the road is rehabilitated, it will involve more traffic and a greater number of users. This can create self-employment opportunities for small traders to sell local products and not only for travelers.

The marginal road connects to the Dr. Aires de Menezes Central Hospital which is the only reference hospital in the country. All the serious health problems and emergencies in the country are conducted to this hospital centre. In this sense, it is on this road that ambulances travel to help the sick, pregnant women, people injured.

Impact Assessment: The requalification of the waterfront will substantially improve access, reduce time and cost of mobility in the waterfront and consequently in the city of São Tomé.

This project will make life easier for the taxi drivers who transport people to the hospital, as well as for those who go to the hospital on foot, who will have better access routes for walking.

This project will have a very significant positive impact on improving mobility and access to such services. The project will contribute to the creation of a more coherent urban network, improve the connection between the capital and the country's main airport, improve mobility conditions within the capital, contributes to the improvement of the road network by reinforcing the connection between the national roads EN1, EN2 and EN3.

13.2.3.3 Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation

Activities: Operation of the road signage improvements

Effects: Presence of cycle lanes and pedestrian circulation with road safety conditions improves road safety for all users.

Impact Assessment: Construction of pavements on both sides of the road, creation of pedestrian space accessible to all passersby with pedestrian spans, special paving, and handrails to create a barrier-free public space. Creating a cycle track at pavement level offers cyclists' greater safety from road traffic and also allows for the extension of pedestrian space when cyclists are not circulating. The creation of road openings for car access to private plots adjacent to the promenade has an effect on road safety. Also, limitation of speed for vehicles of 30km/h in some sections and safety signage contributes to road safety improvement.

The requalification of road and waterfront, namely the presence of pedestrian walkways, the cycle track for cyclists and redesign of the road will have a direct, significant and positive impact on road traffic safety conditions.

13.2.3.4 Increased protection from flood, coastal erosion and storm surge risks

Activities: Presence coastal protection infrastructure and rehabilitation of hydraulic infrastructures

Effects: The coastal protection infrastructures and rehabilitation of hydraulic infrastructures increases protection of road users and population from flood, coastal erosion and storm surge risks

Impact Assessment: The construction of coastal protection infrastructure, through installation of a rock shield that restores the existing armor, beach nourishment CH 3+420 – CH 3+710 and CH 4+950 – CH 5+300 will reduce wave agitation within the bay by dissipating wave energy, a rehabilitation of hydraulic infrastructures thereby increasing the safety and attractiveness of the capital's waterfront for both locals and tourism development.

The construction of coastal protection infrastructure will have a direct, permanent, with moderate magnitude, significant and positive impact on the safety and attractiveness of the bay.

13.2.3.5 Better conditions for sports on the waterfront

Activities: Improvements of the coastal protection and road infrastructure

Effects: The number of sports practitioners has been increasing in São Tomé and Príncipe. The waterfront has been the privileged place for lovers of various sports such as walking, gymnastics, running, cycling, etc. Therefore, the reconstruction and modernization of the waterfront will provide better conditions for the practice of sports in safety and encourage the increase in the number of practitioners of these sports.

Impacts: the reconstruction and upgrading of the waterfront will have a direct, permanent, with moderate magnitude, significant and positive impact on the practice of sports on the waterfront.

13.2.3.6 Increase in the number of people on beaches of Marginal

Activities: improvements of the coastal protection and road infrastructure

Effects: Emilia beach in Lagarto bay, normally receive large numbers of bathers especially on Sundays. The lack of public toilets is a major problem faced by beach goers today, with the placement of public toilets it will improve the sanitary problems currently experienced by beach goers. And it can be the reason for more attraction to the beach.

Impact assessment: this project will have a very significant positive impact on improving access and sanitation conditions on the beaches. With the improvements of the coastal protection and road infrastructure, there will be an increase of people on the beaches. This is will have a direct, permanent, with moderate magnitude, significant and positive impact on the number of sports users.

13.2.3.7 Improvement of quality of urban space with a new image of capital city

Activity: requalification of the waterfront

Effects: This project will have a very significant impact on the attractiveness of the capital and the entire waterfront for both nationals and tourists. The modernization of the waterfront will boost this entire waterfront area in the capital of São Tomé, and will constitute a centrality with multifunctional, combining new recreational and leisure uses, environmental recovery of urban and natural spaces, projecting a new image of our capital city and the country.

Impact assessment: The implementation of this marginal requalification project will mark a change in the renovation of the city's waterfront, and will have a direct, permanent, with high magnitude, very significant positive impact throughout the country and will contribute to establishing a new paradigm for the quality of urban space and the enhancement of its environmental components.

The implementation of this project will have a very significant positive impact not only for the capital but for the country as a whole. The project will bring improvements in public spaces, including squares, gardens, parks, better conditions on the beaches and morphological elements that will certainly inspire experiences of individual and collective nature. It should be noted that public spaces are currently very scarce in our city.

The project will also contribute to the development of key social activities for the quality of the city, such as construction and or improvement of sidewalks for walking, running, construction of bicycle lanes, among others.

13.2.3.8 Work conditions of Affected People

Activities: Enabling a new space for laundry

Effects: This project will also contribute directly to the improvement of working conditions in the communities affected by the project and develop actions aimed at improving the washwoman. For example, the project foresees the construction of laundry facilities in Lagarto bay.

Impacts Assessment: The project will have a direct, permanent, with high magnitude, very significant positive impact for the working conditions of laundry, with the construction of an adequate space for the exercise of these activities.

The following table summarize impacts in operation phase.

Environmental and Social Impact Assessment

Aspect	Social impact	Activity	Impacts Classification				Impact Without measure	Impact With measure
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low significance/ Significant, Very Significant)
Employment	Jobs creation	Maintenance of infrastructures	P	I/D	P	M	S	
Improved Accessibility	Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost	Operation of the road with pavement and signage improvements,	P	D	P	M	S	
	Improved access to the coastline and capital city centre, reduced travel time and cost	Operation of the road with pavement and signage improvements,	P	D	P	M	S	
	Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3	Operation of the road with pavement and signage improvements,	P	D	P	M	S	
	Improved access and reduced cost and time at the only referral hospital in the country	Operation of the road with pavement and signage improvements,	P	D	P	M	S	
	Improved accessibility to various institutions and services	Operation of the road with pavement and signage improvements,	P	D	P	M	S	
Road Safety	Improvement of road traffic safety conditions	Operation of the road with pavement and	P	D	P	H	VS	

Environmental and Social Impact Assessment

Aspect	Social impact	Activity	Impacts Classification				Impact Without measure	Impact With measure
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low significance/ Significant, Very Significant)
Road safety		signage improvements,						
	Improvement of safety conditions in pedestrian circulation	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Increased protection from flood, coastal erosion and storm surge risks	Strengthening coastal protection	P	D	P	M	S	
Sports practice on the Marginal	Greater number of sports practitioners	Pavement rehabilitation, green spaces, signposting, pedestrian crossings on the Marginal	P	D	P	M	S	
	Better conditions for sports on the waterfront	Landscaping, green spaces, pavement, cycle track, children's playground, public toilets	P	D	P	M	S	
Attractiveness of the capital and its seafront	Modernization and revitalization of the seafront	Landscaping, green spaces, cycle path, children's playground, public toilets	P	D	P	M	S	
	Increase in the number of people on the beaches and the Marginal		P	D	P	M	S	
	Creating a new image for our capital city and country		P	D	P	H	VS	

Environmental and Social Impact Assessment

Aspect	Social impact	Activity	Impacts Classification				Impact Without measure	Impact With measure
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low significance/ Significant, Very Significant)
	Improving the quality of urban space		P	D	P	H	VS	
Working conditions in the communities affected by the project	Improvement of the conditions for the development of economic activities in the communities affected by the project	Construction of laundry in Lagarto Bay	P	D	P	H	VS	

Table 53 Social Impact Assessment. Operation Phase. Lagarto Bay

13.2.4 SYNTHESIS OF SOCIAL IMPACTS

The main Social I impacts for the construction, demobilization and operation phase for Lagarto Bay are presented below with the mitigation measures proposed:

Negative Impacts

Construction and Demobilization Phases

- Distancing bathers and tourists (significant);
- Increased risk of sexual harassment and gender-based violence (significant)

Positive Impacts

Construction and Demobilization Phases

- Job creation (very significant);
- Increased demand for housing and food consumption (significant);
- Increased tax collection and coins circulation (significant);
- Business opportunities through itinerant businesses or in areas bordering the works (significant);
- Increased family income due to participation in benches construction (significant).

Operation Phase

- Job creation (significant);
- Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost (significant);
- Improved access to the coastline and capital city centre, reduced travel time and cost (significant);
- Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3 (significant);
- Improved access and reduced cost and time at the only referral hospital in the country (significant);
- Improved accessibility to various institutions and services (significant);
- Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation (very significant);
- Increased protection from flood, coastal erosion and storm surge risks (significant);
- Better conditions for sports on the waterfront (significant);
- Increase in the number of people on the beaches and the Marginal (significant);
- Creating a new image for our capital city and country (very significant);
- Improving the quality of urban space (very significant);
- Improvement of the conditions for the development of economic activities in the communities affected by the project (very significant).



13.3 POTENCIAL SOCIAL IMPACTS ANA CHAVES BAY

13.3.1 CONSTRUCTION PHASE

13.3.1.1 Job creation

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction create temporary jobs in São Tomé island.

Effects: The project will create employment, as the bulk of the staff recruited will be from within the area including the involvement of a range of entities in the provision of goods and services as direct positive impacts of the project. The Contractor will commit to a policy that gives priority to the locals in the neighborhood at the time of employing casual or skilled labor. Employment will also facilitate the transfer of skills such as driving, welding, bricklaying to local employees. Those that will be employed directly will also have potential to accumulate household and economic and productive assets.

Impact Assessment: Impact of job creation is classified as positive, direct and indirect, temporary and with magnitude high and very significant due employment for the execution of the construction work can increase the income of the local population, improving their current condition. Also, during the construction phase, there are indirect employment opportunities through other local services, such as small businesses and services for construction workers and construction sites in general. It will also provide an opportunity for the ladies who sell food and other food in the vicinity of the construction sites.

The project will create employment, as the bulk of the staff recruited will be from within the area including the involvement of a range of entities in the provision of goods and services as direct positive impacts of the project. The Contractor will commit to a policy that gives priority to the locals in the neighborhood at the time of employing casual or skilled labor. Employment will also facilitate the transfer of skills such as driving, welding, bricklaying to local employees.

This project will have a very significant impact on job creation, especially in the young population. According to the estimate of the unemployed, in 2015 the country had about 8,882 unemployed, of which 7,457 were between the ages of 15 and 34. It should also be noted that of the 8,882 unemployed, about half, or 4,062 of the unemployed population is in the Água Grande district. (Estimation of employment and unemployment, INE 2015).²⁹

13.3.1.2 Impacts on demand of housing and food consumption

Activities: Contracting staff for the works construction can generate a demand of housing and food consumption

Effects: Contracting staff for the works during 36 months of construction works produce direct and indirect income generation and increase of demand in housing and food consumption

Impact Assessment: Impact on demand of housing and food consumption is classified of positive, direct and temporary and with magnitude moderate and significant due increase food consumption and demand of housing due of workers there are not inhabitants of São Tomé city and surroundings.

²⁹ <https://www.ine.st/index.php/publicacao/documentos/file/301-estimativa-do-emprego-e-desemprego-por-sexo-e-idade-segundo-distrito-2000-2015>

13.3.1.3 Increase of Tax Collection and Coins Circulation

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: The construction, rehabilitation of sidewalks and road, will generate economic growth and positive externalities, including increased income of the population, increased circulation of money, which in turn will induce an increase in consumption and consequently the increase in consumption will cause an increase in revenue collection by the state, increased tax collection.

The construction work, rehabilitation of sidewalks and roads along the waterfront, being labor intensive, can contribute to the generation of employment and income for the population. The investment for the realization of these works will contribute to increase the national Gross Domestic Product (GDP) and revenue collection.

Impact Assessment: The impact of construction work, rehabilitation of sidewalks and road along the waterfront is classified of positive, direct and temporary and with magnitude moderate and significant in increasing revenue collection, taxes, and increasing the circulation of money in the economy.

13.3.1.4 Allocation of income of the population

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Along the section there are a number of assets of individuals that can be affected by the actions of the project. These are 15 fruit sellers, 15 fish sellers, 50 fishermen, one restaurant Paraíso dos Grelhados with 7 workers.

Impact Assessment: The implementation of this project can have a significant, negative, with moderate magnitude, direct impact, particularly in Ana Chaves bay to the extent that it can entail the displacement of some people and economic activities. This can lead to temporary loss of income for these same people and their families.

13.3.1.5 Relocation of economic activities/livelihoods

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Relocation, temporary closure of economic activity, related to the project or restrictions on access to public and private services may have adverse impacts on communities and individuals.

Impact Assessment: Construction activities e construction phase will cause physical relocation, resettlement, economic losses (loss of assets, or access to assets, including those leading to loss of sources of income or other livelihoods), in particular:

- Displacement of 50 fishermen from São Pedro beach, may lead to loss of income for them, especially during the transition period and installation in a new space;
- Displacement of a small outboard motor repair shop on São Pedro beach, resulting in temporary loss of income, especially during the installation phase and during the first months of activity;
- Temporary displacement of 15 women fish sellers in São Pedro beach and temporary loss of income due to the move to a new space and the installation period;

- Temporary displacement of 15 women ' fruit sellers in São Pedro beach, resulting in temporary loss of income, especially during the period of reinstatement of the activity in another space until the resumption of income at the level of the period before displacement;
- Closure of a restaurant, resulting in loss of income for the owner and loss of jobs for 7 workers;
- Closing of an ice-cream and candy kiosk (small container shop);
- Removal of outdoor publicity space.

The construction, rehabilitation of the promenade and the marginal July 12th Road will have a direct, significant, temporary or permanent, with moderate magnitude, negative impact on the relocation, relocation of economic activities

All these impacts are addressed with compensation for relocation, income, and livelihood restoration and with the implementation of Abbreviated Compensation Action Plan reduce the significance of impacts to low.

13.3.1.6 Impacts on distancing bathers and tourists

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: Ex-PM Beach in Ana Chaves bay, usually has a large number of bathers and tourist especially on Sundays.

Impact Assessment: The implementation of this project will have a significant negative, direct, temporary, high magnitude and very significant impact, for the population that usually frequents these beaches. Especially Ex-PM Beach, because during the construction phase they will see limited access and movement on the beaches. On the other hand, for those people who in the late afternoon stroll along the waterfront will be deprived of the sea view.

13.3.1.7 Increase in Traffic

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The implementation of this project directly influences the emergence/ worsening of traffic congestion, particularly on the waterfront. It is an access road to the main points of economic activity in the country, namely, the Port of Ana Chaves, not to mention the various services and institutions that are located near the waterfront.

Impact Assessment: This project can have a very significant, temporary, with high magnitude, direct and negative impact on traffic, as the road construction and coastal protection works can cause congestion and delays in the circulation of vehicles and even cause road accidents.

13.3.1.8 Road Damage

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The circulation of heavy vehicles for transporting materials on the roads leading to the construction sites may cause degradation of the asphalt on the roads

Impact Assessment: The movement of heavy goods vehicles and materials for the works can have a significant direct, temporary, with moderate magnitude, negative impact on the degradation of the road surface.

13.3.1.9 Population influx on the beach

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction create

Effects: Limited access to Ex-PM Beach in Ana Chaves bay, usually has a large number of bathers especially on Sundays.

Impact Assessment: The implementation of this project will have a significant, direct, negative impact for the population that usually frequents these beaches. Especially Ex-PM Beach, because during the construction phase they will see limited access and movement on the beaches. On the other hand, for those people who in the late afternoon stroll along the waterfront will be deprived of the sea view. The impact is temporary and with moderate magnitude.

13.3.1.10 Limitation to sports activities (walking, running, cycling)

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Despite the state of the sidewalk, the waterfront is used daily by hundreds or thousands of people, pedestrians, sports enthusiasts, cyclists, and joggers, who during the construction phase, due to the fencing of the spaces, the movement of machinery and equipment, may see the practice of these activities limited in these places.

Impact Assessment: The project will have a significant direct, negative impact for people who practice sports, namely, walking, running, cycling, due to the works, construction sites, it will not be possible to practice these sports on the sidewalks during the construction phase. The impact is temporary and with moderate magnitude.

13.3.1.11 Disruption of Daily activities and the movement of people and vehicles

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: There is enormous variability regarding the possible impacts derived from construction works on roads and coastal protection, road congestion, delays in the circulation of public and individual transport, traffic accidents, etc. Taking into account that this is a carriageway with only 2 lanes, one in each direction, and being aware of the volume of heavy vehicles circulating.

Impact Assessment: The project can have a very significant negative impact on the disruption of daily activities and movement of people and vehicles during the construction phase, as it can cause road cuts and or narrowing, congestion on access roads, and cause accidents and delays on the roads. The impact is direct, temporary and of moderate magnitude.

13.3.1.12 Degradation of the built cultural heritage with the appearance of cracks

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure

Effects: In the intervention areas of the project, the marginal 12 de julho, there are several buildings of colonial traces, of historical and cultural value that constitute today, the image of our architectural heritage, example the national museum, the former fortress St. Sebastian, a space that keeps our colonial past and history. The project also covers some of the main squares in our city, such as Independence Square, the place where national independence was proclaimed.

Impact Assessment: The works in the phase of construction and remodeling of infrastructure, the circulation of heavy transport and equipment can cause direct, negative and significant damage to the historical cultural heritage sites mentioned above. The impact is temporary and of moderate magnitude.

13.3.1.13 Allocation of the celebration of popular festivities in the locality of São Pedro

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction

Effects: Limited space for celebration São Pedro festival

Impact Assessment: As is tradition in São Tomé and Príncipe, communities celebrate the festivities of popular saints. the beach community São Pedro, annually celebrates the popular festival alluding to the patron saint of fishermen, São Pedro. However, during the phase of requalification works of the waterfront, due to the fencing of the spaces, the presence of equipment, materials and the movement of heavy goods vehicles, this community may see very limited spaces for the celebration of this popular festival. In last years, due Covid 19 restriction these events are not being held.

The celebration of popular festivals in the locality of São Pedro is negative, directly, significantly, with moderate magnitude, and temporary impacted by the requalification works of road and works of the waterfront.

13.3.1.14 Affecting the holding of festivals and New Year parties on the beaches

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction

Effects: Restriction access space for celebration festival and New Year parties

Impact Assessment: In São Tomé and Príncipe it is traditional hold festivals and New Year parties on the beaches. At Ana Chaves Bay, particularly the ex-PM beach is one of the reference places for New Year festivities. However, due to the requalification works on road and waterfront, the population of the capital city and its surroundings will see its space for New Year festivities restricted due to the presence of equipment, materials and heavy vehicles in the intervention areas.

The requalification of road and waterfront in the Ana Chaves Bay will have a direct, significant and negative impact, direct, temporary, with moderate magnitude on the holding of festivals and New Year parties on the beaches.

13.3.1.15 Interruption of supply of infrastructure services such as water and energy

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The interruption of supply of infrastructures services may cause inconvenience to the population.

Impact Assessment: The economic and social infrastructures such as electrical and water infrastructures are fundamental for the daily life of the communities and during the construction phase the renovation of existing electrical and water infrastructures underground will be replaced and may cause inconvenience to the population.

To avoid impact of interruption of supply of infrastructure services population will be informed and interruption will be in short time to avoid economic effects and discomfort in population, impact will be negative, low significance, temporary, with reduced magnitude and direct.

13.3.1.16 Women's Business opportunities through itinerant businesses or in areas bordering the works

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction create women's business opportunities

Impact Assessment: The concentration of a large number of people, workers and companies providing services for the rehabilitation works of the waterfront in Ana Chaves for the activities of land removal, demolition and construction of infrastructure, etc., will lead to an increase in demand for small businesses that are mainly developed by women, including the sale of water, seasonal fruits, various homemade cakes, pre-cooked food. Impact can be significant positive, direct, temporary and with moderate magnitude impact for the small business in the project intervention area.

13.3.1.17 Women's increase family income due to participation in construction activities

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: This project will also give a great opportunity for women to be employed; this will in turn enhance the situation of women. This can be affected if the contractor has a deliberate policy of giving opportunities to women when hiring workers. However, the impact would be selective in those job seekers for work will be dominated by males.

Impact Assessment: This project will direct and positively impact in job creation for women, direct for those directly working on the construction sites, and indirectly for the suppliers of services it can increase the women income and improving their current condition. The impact will be temporary and with moderate magnitude.

Employment for the execution of the construction work can increase the income of the local population, improving their current condition. Also, during the construction phase, there are

indirect employment opportunities through other local services, such as small businesses and services for construction workers and construction sites in general. It will also provide an opportunity for the ladies who sell food and other food in the vicinity of the construction sites. By way of example, we have the women's cooperative for waste recovery, which processes glass into vibrant colored jewelry. this cooperative will produce benches with glass sand and urban furniture, urban ornamentation pieces with recycled glass.

13.3.1.18 Gender Base Violence and Harassment

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction.

Effects: Harassment and gender-based violence is a reality in the world of work in São Tomé and Príncipe, driven largely by the cultural and social norms of society, particularly in the construction sector, where maxims mentality and behavior still prevail. For this reason, the project must address all aspects of preventing harassment and gender-based violence in the workplace.

Impact assessment: As mentioned above, the construction sector is predominantly male, despite the growing presence of women. On the other hand, São Tomean society is still by a male dominant culture. Therefore, the risk of gender-based violence and harassment is significant in this project, resulting on a negative, temporary, with high magnitude, direct, very significant impact.

13.3.1.19 Increased Incidence of contagious diseases COVID 19 sexually transmitted infections STIs

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: There is a potential for increased incidence of sexually transmitted diseases (STDs) and HIV/AIDS due to the project. During construction and maintenance, there is the possibility that local and outside workers will have greater financial possibilities, which may attract more women (both local and sex workers) to have sex. For the outworkers, there is also the fact that they are working for some time away from their families. In addition, sex workers may be attracted or encouraged on the project site.

Impact Assessment: The risk of increased incidence of sexually transmitted diseases, including HIV/AIDS is direct, negative, moderate due to the increased number, presence, and concentration of working people in the project vicinity, the risk of sexual incident and transmission of sexually transmitted diseases, including HIV/AIDS, may increase. The impact is temporary and significant.

13.3.1.20 Inadequate participation of VG's not meeting their needs

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction

Effects: Inadequate participation of VG's can lead to their needs not being met. Inadequate participation means that their expectations and interests are not properly taken into account. On the contrary, adequate participation of VG's optimizes opportunities, makes them integrated and involved, and improves VG's' perception of the project. It is therefore important to promote the participation of all affected parties and to meet their needs.



Impact Assessment: In the present project the vulnerable groups identified 15 fruit sellers and with implementation of Abbreviated Resettlement Action Plan and Stakeholders Management Plan implementation VG's are consulted and in constantly communication with social team so impact foreseen in VG's participation is negative, low significance, temporary and reduced magnitude.

13.3.1.21 Conflicts Between Workers and Population in the Project Area

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction

Effects: Projects involving works of considerable significance often generate social conflicts between workers who stay temporarily on site and community residents.

Impact Assessment: The impacts are generally related to socially unacceptable behavior according to local social standards and may be observed, for example, cases of drunkenness and disregard or lack of respect for local customs. Although part of the workforce is recruited locally, this impact must be considered, not only because of other workers from other areas, but also because local workers themselves may generate social unrest in the community, once they feel that employment or other conditions give them a different status.

Due to the increased number, concentration, presence of people, project workers in the communities. The risk and impact of conflicts is direct, negative and with moderate magnitude and can be reduced to low significance with sensitization and implementation of Code of conduct for workers.

The following table summarize impacts in construction phase.

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Impacts classification				Impacts without measures	Impacts With measures
			Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant, Very Significant)	Significance (Low Significance/ Significant, Very Significant)
Employment	Job creation	Earthmoving	P	I/D	T	H	VS	
		Removal of vegetation cover	P	I/D	T	H	VS	
		Infrastructure construction and demolition (roads, coastal protection barriers, etc)	P	ID	T	H	VS	
Direct and indirect income generation	Increased demand for housing and food consumption	Hiring staff for the works	P	D	T	M	S	
Stimulating economic activities	Increased tax collection	Hiring staff; purchasing inputs and equipment and contracting services	P	D	T	M	S	
	Increase in coins in circulation	Consumption by workers and commercials	P	D	T	M	S	
Displacement of economic activities	Allocation of income of the population (fruit stand, fishermen, kiosk next to the Museum)	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	R	S	LS
	Relocation of economic activities/livelihoods (palaies)	Infrastructure construction (roads, coastal protection barriers, etc)	N	D	T	M	S	LS
Limitations on beach access	Distancing bathers and tourists	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	H	VS	LS

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Impacts classification				Impacts without measures	Impacts With measures
			Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant, Very Significant)	Significance (Low Significance/ Significant, Very Significant)
Increase in the number of heavy vehicles for transporting materials	Increase of Traffic	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	N	D	T	H	VS	LS
	Road damage	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	N	D	T	M	S	LS
Occupation of public space and roads	Population Influx on the beach	Infrastructure construction (roads, coastal protection barriers, etc.)	N	D	T	M	S	LS
	Limitation to sports activities (walking, running, cycling)	Infrastructure construction (roads, coastal protection barriers, etc.)	N	D	T	M	S	LS
	Disruption of Daily activities and the movements of people and vehicles	Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	N	D	T	M	VS	LS
Cultural and Traditional Aspects	Degradation of the built cultural heritage with the appearance of cracks	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	LS
		Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	N	D	T	M	S	LS

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Impacts classification				Impacts without measures	Impacts With measures
			Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant, Very Significant)	Significance (Low Significance/ Significant, Very Significant)
Cultural and Traditional Aspects	Allocation of the celebration of popular festivities in the locality of São Pedro	Works, infrastructure construction (roads, coastal protection, promenades, etc),	N	D	T	M	S	LS
	Affecting the holding of festivals and end-of-year parties on the beaches	Works, infrastructure construction (roads, coastal protection, promenades, etc),	N	D	T	M	S	LS
Infrastructures	Interruption of supply of infrastructure services such as water, energy, sanitation	Infrastructure construction (roads, coastal protection, etc)	N	D	T	R	LS	LS
Limitations on women's participation in economic activities	Business opportunities through itinerant businesses or in areas bordering the works	Infrastructure construction (roads, coastal protection,, etc)	P	D	T	M	S	
	Increased family income due to participation in bench construction	Building benches with recycled glass	P	D	T	M	S	
Significant migration of workers to the site	Increased risk of sexual harassment and gender-based violence	Infrastructure construction (roads, coastal protection, etc)	N	D	T	H	VS	S
Contact between workers, people from the community	Increase in incidence of contagious diseases COVID 19 sexually transmitted infections STIs	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS
Participation of vulnerable groups	Inadequate participation of VMs not meeting their needs (fruit sellers)	Infrastructure construction (roads, coastal protection, etc)	N	D	T	R	LS	LS

Aspect	Impact	Activity	Impacts classification				Impacts without measures	Impacts With measures
			Positive/ Negative	Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant, Very Significant)	Significance (Low Significance/ Significant, Very Significant)
Unacceptable behavior according to local social standards	Conflicts between workers and local community	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS

Table 54 Social Impact Assessment. Construction Phase. Ana Chaves Bay

13.3.2 DEMOBILIZATION PHASE

13.3.2.1 Increase of skilled workers

Activities: End of Construction Site demobilization activities

Effects: End of construction have effect in reduction of workers but a bigger availability of workers skilled.

Impact Assessment: Once the implementation phase is concluded, a large part of the workforce of contracted workers will be demobilized. With the end of the construction phase, it becomes necessary to demobilize materials, equipment and some infrastructure mobilized and built during the construction phase and demobilize the team of workers. This action will lead to a significant reduction of workers but bigger availability of workers skilled.

These workers can have more chances in work in other big public projects, this positive impact is direct, low significance to significant and reduced magnitude.

13.3.2.2 Road Damage

Activities: Vehicle circulation, road accidents and removal of rubble

Effects: The need to mobilize various equipment and transport materials and products, including stones, sand, clay, etc., by heavy vehicles during the construction phase and the demobilization of equipment and materials during the decommissioning phase may cause significant damage and degradation to the roads that directly connect to the waterfront and to the roads surrounding the waterfront.

Impact Assessment: The activities of Vehicles circulation, road accidents and removal of rubble for demobilization of materials, equipment and infrastructure in the demobilization phase of the project can have a direct and indirect, significant, temporary, with reduced magnitude, and negative impact on the roads damage. Contractor have the responsibility to restore the damage caused in roads.

13.3.2.3 Disturbances to the health, comfort of the population

Activities: Circulation of heavy vehicles, equipment and machinery and removal of rubble

Effects: During the demobilization phase of the project, circulation of vehicles, equipment and machinery and removal of rubble from construction site, cause dust and noise and can lead to disturbance to health, comfort of population surrounding the project intervention area and construction site.

Impact Assessment: These activities of demobilization can have impacts in sensitive receptors health and comfort. On the other hand, the large movement and transport of heavy vehicles in communities near the project may cause traffic accidents and/or situations of conflict and confrontation with the population.

The demobilization of equipment, materials activities can cause a negative, significant, direct, temporary, moderate impact on the health of the populations near the project's areas of intervention and construction site.

The measures identified in Chapter 17 reduce the impacts for low significance.

13.3.2.4 Reduced quality of life

Activities: Circulation of heavy vehicles, equipment and machinery and removal of rubble

Effects: During the demobilization phase of the project, circulation of vehicles, equipment and machinery and removal of rubble from construction site, cause dust and noise and can lead to a reduction in the quality of life of the population surrounding the project intervention area and construction site.

Impact Assessment: The demobilization of equipment, materials activities cause dust, noise and a negative, significant, direct, moderate and impact on the health of the populations near the project's areas of intervention and construction site.

The measures identified in Chapter 17 reduce the impacts for low significance.

13.3.2.5 Impacts in health, injuries, deaths

Activities: Circulation of machinery and vehicles used for the transportation of demolition rubble

Effects: Circulation of machinery and vehicles used for the transportation of demolition rubble can increase risk of accidents in roads used by vehicles and machinery

Impact Assessment: The demobilization of equipment, materials activities can increase risk of accidents in roads used by vehicles a machinery, if mitigation measures as limitation of speed are respected the impact will be low significance, direct, reduced and temporary.

The following table summarize impacts in demobilization phase.

Environmental and Social Impact Assessment

Aspect	Social Impact	Activity	Classification				Impact Without measure	Impact With measure
			Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low, Significant/Significant/ Very Significant)	Significance (Low significance/Significant, Very Significant)
Employment	Increase of skilled workers	End of Construction Site demobilization activities	P	D	P	R/M	LS	
Accidental spillage of hazardous products (fuel, oil, lubricants)	Road Damage	Vehicle circulation	N	D	T	R	S	LS
		Road accidents						
		Removal of rubble						
Noise generation	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	N	D	T	M	S	LS
		Removal of demolition rubble						
	Reduced quality of life	Removal of demolition rubble	N	D	P	M	S	S
Road traffic accidents	Impacts in health, Injuries, deaths	Circulation of machinery and vehicles used for the transportation of demolition rubble	N	D	T	R	LS	

Table 55 Social Impact Assessment – Demobilization. Ana Chaves Bay

13.3.3 OPERATION PHASE

13.3.3.1 Jobs creation

Activities: Maintenance activities of infrastructures

Effects: The maintenance activities of infrastructure to be implemented by the project also create job opportunities

Impacts assessment: Rehabilitation of marginal road needs maintenance of infrastructures, cleaning, green spaces maintenance and also creates opportunities for national companies and organizations, mainly GIME (Road Intervention and Maintenance Group) and ONG's. Impact creation can be direct or indirect. Some suggestion of enhancement of positive impacts and indirect jobs creation are: plant nursery for green spaces maintenance including caroceiro (*Terminalia cattapa L.*) road safety training center, with focus awareness of non-motorized transports as bicycle; creation of handicrafts for tourists with fish scales.

This impact is considered to be positive, low significance to significant, permanent, reduced magnitude, direct and indirect depends of implementation of indirect projects.

13.3.3.2 Accessibility Improvement

Activities: Operation of the road signage improvements

Effects: The implementation of this project of requalification of the waterfront, consequent improvements in infrastructure, particularly the road. It is noteworthy that the 12 de Julho waterfront road provides access and connects the main infrastructures of the country, namely, the Port of Ana Chaves and the International Airport of São Tomé and Príncipe. It gives access to the largest supermarket in the country – CKDO On the other hand, it connects with the three main highways of the country, National 1 EN1, National 2 and National 3. On the other hand, when the road is rehabilitated, it will involve more traffic and a greater number of users. This can create self-employment opportunities for small traders to sell local products and not only for travelers.

The marginal road connects to the Dr. Aires de Menezes Central Hospital which is the only reference hospital in the country. All the serious health problems and emergencies in the country are conducted to this hospital centre. In this sense, it is on this road that ambulances travel to help the sick, pregnant women, people injured.

Impact Assessment: The requalification of the waterfront will substantially improve access, reduce time and cost of mobility in the waterfront and consequently in the city of São Tomé.

This project will have a very significant positive impact on improving mobility and access to such services. The project will contribute to the creation of a more coherent urban network, improve the connection between the capital and the country's main airport, improve mobility conditions within the capital, contributes to the improvement of the road network by reinforcing the connection between the national roads EN1, EN2 and EN3.

13.3.3.3 Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation

Activities: Operation of the road signage improvements

Effects: Presence of cycle lanes and pedestrian circulation with road safety conditions improves road safety for all users.

Impact Assessment: Construction of pavements on both sides of the road, creation of pedestrian space accessible to all passersby with pedestrian spans, special paving, and handrails to create a barrier-free public space. Creating a cycle track at pavement level offers cyclists' greater safety from road traffic and also allows for the extension of pedestrian space when cyclists are not circulating. The creation of road openings for car access to private plots adjacent to the promenade has an effect on road safety. Also, limitation of speed for vehicles of 30km/h in some sections and safety signage contributes to road safety improvement.

The requalification of road and waterfront, namely the presence of pedestrian walkways, the cycle track for cyclists and redesign of the road will have a direct, permanent, with moderate magnitude, significant and positive impact on road traffic safety conditions.

13.3.3.4 Increased protection from flood, coastal erosion and storm surge risks

Activities: Presence coastal protection infrastructure and rehabilitation of hydraulic infrastructures

Effects: The coastal protection infrastructures and rehabilitation of hydraulic infrastructures increases protection of road users and population from flood, coastal erosion and storm surge risks

Impact Assessment: The construction of coastal protection infrastructure, through installation of a rock shield that restores the existing armor, beach nourishment CH 3+420 – CH 3+710 and CH 4+950 – CH 530 will reduce wave agitation within the bay by dissipating wave energy, a rehabilitation of hydraulic infrastructures thereby increasing the safety and attractiveness of the capital's waterfront for both locals and tourism development.

The construction of coastal protection infrastructure will have a direct, permanent, with moderate magnitude, significant and positive impact on the safety and attractiveness of the bay.

13.3.3.5 Better conditions for sports on the seafront

Activities improvement of sidewalks and construction of cycle tracks

Effects: The pedestrian zones from Marginal are much used for sport, whether cycling, hiking or even running. The current state of the pavements has caused injuries to people who do these practices and makes it difficult for others who intend to do so.

Impact assessment: With the improvement of the pavements, more people will be able to practice sports along the waterfront, especially in the area between CKDO Supermarket and the National Museum.

It is also worth mentioning the urban furniture, the children's and sports parks, and the increase of green spaces. All of this will make the waterfront more attractive and change the image of waterfront. This will have a direct, permanent, with moderate magnitude, significant and positive impact on sports practice on the marginal.

13.3.3.6 Increase in the number of people on the beaches on the Marginal

Activity: improvements of the coastal protection and road infrastructure

Effects: São João, São Pedro beaches and above all, the ex-PM beach in Ana Chaves bay, normally receives large numbers of bathers especially on Sundays. The lack of public toilets is a major problem faced by beach goers today, with the placement of public toilets it will improve the sanitary problems currently experienced by beach goers. And also, it can be the reason for more attraction to the beach.

Impact assessment: this project will have a very significant positive impact on improving access and sanitation conditions on the beaches. With the improvements of the coastal protection and road infrastructure, there will be an increase of people on the beaches, causing a direct, permanent, with high magnitude, very significant impact.

13.3.3.7 Improvement of quality of urban space with a new image of capital city

Activity: presence of road and rehabilitated waterfront

Effects: This project will have a very significant impact on the attractiveness of the capital and the entire waterfront for both nationals and tourists. The modernization of the waterfront will boost this entire waterfront area in the capital of São Tomé, and will constitute a multifunctional centrality, combining new recreational and leisure uses, environmental recovery of urban and natural spaces, projecting a new image of our capital city and the country.

Impact assessment: The implementation of this marginal requalification project will mark a change in the renovation of the city's waterfront, and will have a very significant positive impact throughout the country and will contribute to establishing a new paradigm for the quality of urban space and the enhancement of its environmental components.

The implementation of this project will have a very significant positive impact not only for the capital but for the country as a whole. The project will bring improvements in public spaces, including squares, gardens, parks, better conditions on the beaches and morphological elements that will certainly inspire experiences of individual and collective nature. It should be noted that public spaces are currently very scarce in our city.

The project will also contribute to the development of key social activities for the quality of the city, such as construction and or improvement of sidewalks for walking, running, construction of bicycle lanes, among others, causing a direct, permanent, with high magnitude, very significant impact.

13.3.3.8 Work conditions of Affected People

Activity: Enabling a new space for fishermen, workers of motor engine boat repair and fish sellers

Effects: This project will also contribute directly to the improvement of working conditions in the communities affected by the project.

Impacts Assessment: The project will have a very significant, direct, permanent, with high magnitude, positive impact for the working conditions of 50 fishermen, workers of boat engine repair and 15 fish sellers, with the construction of an adequate space for the exercise of these activities.



13.3.3.9 Alteration of the location or livelihood of vulnerable groups

Activities: Operation of the Marginal road and requalified infrastructures

Effects: The VG affected by the project can have an alteration of the location of livelihood of resulting in life conditions.

Impact assessment: The alteration of the road and waterfront will lead to relocation and resettlement of some affected parts and alteration of the way of life of vulnerable groups. For this study, vulnerable people and groups were considered to be 15 fruit sellers due to the characteristics and vulnerability of their economic activities and because most of the women in this situation are heads of their households.

The reconstruction and requalification of the waterfront will have a direct, permanent, of reduced magnitude, negative, low significance impact on changing the location or way of life of vulnerable groups in Ana Chaves bay, 15 fruit sellers will be relocated temporary in one other space and Abbreviated Resettlement Plan implementation giving special attention to these groups.

The following table summarize impacts in operation phase.

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low significance/ Significant/ Very Significant)	Significance (Low significance/ Significant, /Very Significant)
Employment	Jobs creation	Maintenance infrastructures of	P	I/D	P	R	LS	
Accessibility	Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improved access to the coastline and capital city centre, with institutions and services reduced travel time and cost	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improved access and reduced cost and time at the only referral hospital in the country	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
Road safety	Improvement of road traffic safety conditions with cycle lanes and pedestrian circulation	Operation of the road with pavement and signage improvements,	P	D	P	H	S	

	Increased protection from flood, coastal erosion and storm surge risks	Strengthening coastal protection	P	D	P	H	S	
Sports practice on the Marginal	Better conditions for sports on the waterfront	Landscaping, green spaces, pavement, cycle track, children's playground, fitness centre, public toilets	P	D	P	M	S	
Attractiveness of the capital and its waterfront	Increase in the number of people on PM beach	Operation of the Marginal road and requalified infrastructures	P	D	P	H	VS	
	Improvement of quality of urban space with a new image of capital city		P	D	P	H	VS	
Working conditions in the communities affected by the project	Improvement of the conditions for the development of economic activities in the communities affected by the project	New space for 50 fishermen, workers of boat engine repair and 15 fish sellers in Ana Chaves	P	D	P	H	VS	
	Alteration of the location or livelihood of vulnerable groups (fruit sellers)	Operation of the Marginal road and requalified infrastructures	N	D	P	R	LS	

Table 56 Social Impact Assessment – Operation Phase. Ana Chaves Bay

13.3.4 SYNTHESIS OF SOCIAL IMPACTS

The main Social I impacts for the construction, demobilization and operation phase for Ana Chaves Bay are presented below with the mitigation measures proposed:

Negative Impacts

Construction and Demobilization Phases

- Distancing bathers and tourists (significant);
- Increased risk of sexual harassment and gender-based violence (significant);
- Reduced quality of life due to removal of demolition rubble (significant);
- Displacement of economic activities (fishermen, fruit sellers, fish sellers, removal restaurant, ice-cream candy kiosk (small container shop) and outdoor publicity space (low significance);
- Alteration of the location of vulnerable persons women fruit sellers (low significance).

Operation Phase

- Alteration of the location of vulnerable persons women fruit sellers (low significance).

Positive Impacts

Construction and Demobilization Phases

- Job creation (very significant);
- Increased demand for housing and food consumption (significant);
- Increased tax collection and coins circulation (significant);
- Business opportunities through itinerant businesses or in areas bordering the works (significant);
- Increased family income due to participation in benches construction (significant).

Operation Phase

- Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost (very significant);
- Improved access to the coastline and capital city centre, reduced travel time and cost (very significant);
- Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3 (very significant);
- Improved access and reduced cost and time at the only referral hospital in the country (very significant);
- Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation (significant);
- Increased protection from flood, coastal erosion and storm surge risks (significant);
- Better conditions for sports on the waterfront (significant);

- Increase in the number of people on the beaches and the Marginal (very significant);
- Creating a new image for our capital city and country (very significant);
- Improving the quality of urban space with a new image of capital city (very significant);
- Improvement of the conditions for the development of economic activities in the communities affected by the project with construction of boat workshop and fish market (very significant).

13.4 POTENCIAL SOCIAL IMPACTS PANTUFO COASTLINE

13.4.1 CONSTRUCTION PHASE

13.4.1.1 Job Creation

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction create temporary jobs in São Tomé island.

Effects: The project will create employment, as the bulk of the staff recruited will be from within the area including the involvement of a range of entities in the provision of goods and services as direct positive impacts of the project. The Contractor will commit to a policy that gives priority to the locals in the neighborhood at the time of employing casual or skilled labor. Employment will also facilitate the transfer of skills such as driving, welding, bricklaying to local employees. Those that will be employed directly will also have potential to accumulate household and economic and productive assets.

Impact Assessment: Impact of job creation is classified as positive, direct and indirect, temporary and with magnitude high and very significant due employment for the execution of the construction work can increase the income of the local population, improving their current condition. Also, during the construction phase, there are indirect employment opportunities through other local services, such as small businesses and services for construction workers and construction sites in general. It will also provide an opportunity for the ladies who sell food and other food in the vicinity of the construction sites.

The project will create employment, as the bulk of the staff recruited will be from within the area including the involvement of a range of entities in the provision of goods and services as direct positive impacts of the project. The Contractor will commit to a policy that gives priority to the locals in the neighborhood at the time of employing casual or skilled labor. Employment will also facilitate the transfer of skills such as driving, welding, bricklaying to local employees.

This project will have a very significant impact on job creation, especially in the young population. According to the estimate of the unemployed, in 2015 the country had about 8,882 unemployed, of which 7,457 were between the ages of 15 and 34. It should also be noted that of the 8,882 unemployed, about half, or 4,062 of the unemployed population is in the Água Grande district. (Estimation of employment and unemployment, INE 2015).³⁰

³⁰ <https://www.ine.st/index.php/publicacao/documentos/file/301-estimativa-do-emprego-e-desemprego-por-sexo-e-idade-segundo-distrito-2000-2015>

13.4.1.2 Impacts on Demand of Housing and Food Consumption

Activities: Contracting staff for the works construction can generate a demand of housing and food consumption

Effects: Contracting staff for the works during 36 months of construction works produce direct and indirect income generation and increase of demand in housing and food consumption.

Impact Assessment: Impact on demand of housing and food consumption is classified of positive, direct and temporary and with magnitude moderate and significant due increase food consumption and demand of housing due of workers there are not inhabitants of São Tomé city and surroundings.

13.4.1.3 Increase of Tax Collection and Coins Circulation

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: The construction, rehabilitation of sidewalks and road, will generate economic growth and positive externalities, including increased income of the population, increased circulation of money, which in turn will induce an increase in consumption and consequently the increase in consumption will cause an increase in revenue collection by the state, increased tax collection.

The construction work, rehabilitation of sidewalks and roads along the waterfront, being labor intensive, can contribute to the generation of employment and income for the population. The investment for the realization of these works will contribute to increase the national Gross Domestic Product (GDP) and revenue collection.

Impact Assessment: The impact of construction work, rehabilitation of sidewalks and road along the waterfront is classified of positive, direct and temporary and with magnitude moderate and significant in increasing revenue collection, taxes, and increasing the circulation of money in the economy.

13.4.1.4 Allocation of income

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Along the section there are a number of assets of individuals that can be affected by the actions of the project.

Impact Assessment: The implementation of this project can have a significant, negative, reduced magnitude, direct impact, particularly in Pantufo Coastline to the extent that it can entail the displacement of some people and economic activities, for example, roulote near the Pirate restaurant and roulote in front of the National Museum. This can lead to temporary loss of income for these same people and their families.

These impacts are addressed with compensation for income losses and livelihood restoration with the implementation of Abbreviated Compensation Action Plan reduce the significance of impacts to low significance

13.4.1.5 Relocation of economic activities/livelihoods

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Along the section there are a number of assets of individuals that can be affected by the actions of the project. These are the roulotes close to National Museum and close to restaurant O Pirata in Pantufo Coastline.

Impact Assessment: The implementation of this project can have a significant, negative, moderate magnitude, direct impact, particularly in Pantufo Coastline to the extent that it can entail the displacement of some people and economic activities. This can lead to temporary loss of income for these same people and their families.

The roulotes could move to another side of the road while works take place. The roulote close restaurant Pirate is foreseen to be displaced permanently to vehicles parking in the other side of road.

These impacts are addressed with compensation for relocation with the implementation of Abbreviated Compensation Action Plan reduce the significance of impacts to low significance.

In Pantufo Coastline no vulnerable groups were identified.

13.4.1.6 Impacts on Distancing bathers and Tourists

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction.

Effects: Dangerous Beach (Praia Perigosa) in Pantufo Coastline, usually has a large number of bathers especially on Sundays and Tourists.

Impact Assessment: The implementation of this project will have a significant negative, direct, temporary, moderate magnitude impact, for the population that usually frequents these beaches. Especially Praia Perigosa because during the construction phase they will see limited access and movement on the beaches. On the other hand, for those people who in the late afternoon stroll along the waterfront will be deprived of the sea view.

13.4.1.7 Impacts on Traffic

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The implementation of this project directly influences the emergence/ worsening of traffic congestion, particularly on the waterfront. It is an access road to the main points of economic activity in the country, namely, Hotel Mira mar, Hotel Pestana, various services and institutions that are located near the waterfront, e.g., National Parliament.

Impact Assessment: This project can have a very significant, direct, high magnitude, and negative impact on traffic, as the road construction and coastal protection works can cause temporary congestion and delays in the circulation of vehicles and even cause road accidents.

13.4.1.8 Road damage

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The circulation of heavy vehicles for transporting materials on the roads leading to the construction sites may cause degradation of the asphalt on the roads

Impact Assessment: The movement of heavy goods vehicles and materials for the works can have a significant direct, temporary, with moderate magnitude, negative impact on the degradation of the road surface.

13.4.1.9 Population Influx on the Beach

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Praia Perigosa in Pantufo Coastline, usually has a large number of bathers especially on Sundays.

Impact Assessment: The implementation of this project will have a significant, direct, temporary, with moderate magnitude, negative impact for the population that usually frequents these beaches. Especially Praia Perigosa, because during the construction phase they will see limited access and movement on the beaches. On the other hand, for those people who in the late afternoon stroll along the waterfront will be deprived of the sea view.

13.4.1.10 Disruption of Daily Activities and the movement of People and Vehicles

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: There is enormous variability regarding the possible impacts derived from construction works on roads and coastal protection, road congestion, delays in the circulation of public and individual transport, traffic accidents, etc. Taking into account that this is a carriageway with only 2 lanes, one in each direction, and being aware of the volume of heavy vehicles circulating.

Impact Assessment: The project can have a very significant, direct, temporary, with high magnitude, negative impact on the disruption of daily activities and movement of people and vehicles during the construction phase, as it can cause road cuts and or narrowing, congestion on access roads, and cause accidents and delays on the roads.

13.4.1.11 Limitation to sports activities (walking, running, cycling)

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Despite the state of the sidewalk, the waterfront is used daily by hundreds or thousands of people, pedestrians, sports enthusiasts, cyclists, and joggers, who during the construction phase, due to the fencing of the spaces, the movement of machinery and equipment, may see the practice of these activities limited in these places.

Impact Assessment: The project will have a significant direct, temporary, with moderate magnitude, negative impact for people who practice sports, namely, walking, running, cycling,

due to the works, construction of barriers, construction sites, it will not be possible to practice these sports on the sidewalks during the construction phase.

13.4.1.12 Degradation of the built cultural heritage with the appearance of cracks

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: In the intervention areas of the project, the marginal 12 de Julho, there are several buildings of colonial traces, of historical and cultural value that constitute today, the image of our architectural heritage, example the national museum, the former fortress St. Sebastian, a space that keeps our colonial past and history. The project also covers some of the main squares in our city, such as Independence Square, the place where national independence was proclaimed.

Impact Assessment: The works in the phase of construction and remodeling of infrastructure, the circulation of heavy transport and equipment can cause direct, temporary, with moderate magnitude, negative and significant damage to the historical cultural heritage sites mentioned above.

13.4.1.13 Impacts and Interruption of Existing Service Infrastructures

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: The interruption of supply of infrastructures services may cause inconvenience to the population.

Impact Assessment: The economic and social infrastructures such as electrical and water infrastructures are fundamental for the daily life of the communities and during the construction phase the renovation of existing electrical and water infrastructures underground will be replaced and may cause inconvenience to the population.

To avoid impact of interruption of supply of infrastructure services population will be informed and interruption will be in short time to avoid economic effects and discomfort in population, impact will be negative, low significance, temporary, with reduced magnitude, and direct.

13.4.1.14 Women's Business opportunities through itinerant businesses or in areas bordering the works

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction create women's business opportunities

Impact Assessment: The concentration of a large number of people, workers and companies providing services for the rehabilitation works of the waterfront in Ana Chaves for the activities of land removal, demolition and construction of infrastructure, etc., will lead to an increase in demand for small businesses that are mainly developed by women, including the sale of water, seasonal fruits, various homemade cakes, pre-cooked food. Impact can be significant positive, direct, temporary and with moderate magnitude for the small business in the project intervention area.

13.4.1.15 Women's increase family income due to participation in construction activities

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: This project will also give a great opportunity for women to be employed; this will in turn enhance the situation of women. This can be affected if the contractor has a deliberate policy of giving opportunities to women when hiring workers. However, the impact would be selective in those job seekers for work will be dominated by males.

Impact Assessment: This project will direct and positively impact in job creation for women, direct for those directly working on the construction sites, and indirectly for the suppliers of services it can increase the women income and improving their current condition. The impact is temporary, with moderate magnitude and significant.

Employment for the execution of the construction work can increase the income of the local population, improving their current condition. Also, during the construction phase, there are indirect employment opportunities through other local services, such as small businesses and services for construction workers and construction sites in general. It will also provide an opportunity for the ladies who sell food and other food in the vicinity of the construction sites. By way of example, we have the women's cooperative for waste recovery, which processes glass into vibrant colored jewelry. This cooperative will produce benches with glass sand and urban furniture, urban ornamentation pieces with recycled glass.

13.4.1.16 Gender Base Violence and Harassment

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: Harassment and gender-based violence is a reality in the world of work in São Tomé and Príncipe, driven largely by the cultural and social norms of society, particularly in the construction sector, where maxims mentality and behavior still prevail. For this reason, the project must address all aspects of preventing harassment and gender-based violence in the workplace.

Impact assessment: As mentioned above, the construction sector is predominantly male, despite the growing presence of women. On the other hand, Santomean society is still by a male dominant culture. Therefore, the risk of gender-based violence and harassment is significant in this project, causing a negative, direct, temporary, with high magnitude, very significant impact

13.4.1.17 Increased Incidence of Sexually Transmitted Diseases, including HIV/AIDS

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructure construction

Effects: There is a potential for increased incidence of sexually transmitted diseases (STDs) and HIV/AIDS due to the project. During construction and maintenance, there is the possibility that local and outside workers will have greater financial possibilities, which may attract more women (both local and sex workers) to have sex. For the outworkers, there is also the fact that they are working for some time away from their families. In addition, sex workers may be attracted or encouraged on the project site.



Impact Assessment: The risk of increased incidence of sexually transmitted diseases, including HIV/AIDS is significant, direct, negative moderate due to the increased number, presence, and concentration of working people in the project vicinity, the risk of sexual incident and transmission of sexually transmitted diseases, including HIV/AIDS, may increase.

13.4.1.18 Conflicts Between Workers and Population in the Project Area

Activities: Activities of earthmoving, removal of vegetation cover and infrastructure demolition and infrastructures construction

Effects: Projects involving works of considerable significance often generate social conflicts between workers who stay temporarily on site and community residents.

Impact Assessment: The impacts are generally related to socially unacceptable behavior according to local social standards and may be observed, for example, cases of drunkenness and disregard or lack of respect for local customs. Although part of the workforce is recruited locally, this impact must be considered, not only because of other workers from other areas, but also because local workers themselves may generate social unrest in the community, once they feel that employment or other conditions give them a different status.

Due to the increased number, concentration, presence of people, project workers in the communities. The risk and impact of conflicts is direct, negative, temporary, significant, and with moderate magnitude and can be reduced to low significance with sensitization and implementation of Code of conduct for workers.

The following table summarize impacts in construction phase.

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Impacts Classification				Impacts Without measures	Impacts with measures
			Nature Positive/ Negative	Incidence Direct/ Indirect	Duration Permanent/ Temporary	Magnitude (Reduced/ Moderate/High)	Significance (Low Significance/ Significant/ Very Significant)	Significance (Low Significance/ Significant/ Very Significant)
Hiring of labor	Job creation	Earthmoving	P	I/D	T	H	VS	
		Removal of vegetation cover	P	I/D	T	H	VS	
		Infrastructure construction (roads, coastal protection, etc)	P	I/D	T	H	VS	
Direct and indirect income generation	Increased demand for housing and food consumption	Hiring staff for the works	P	D	T	M	S	
Stimulating economic activities	Increased tax collection	Hiring staff; purchasing inputs and equipment and contracting services	P	D	T	M	S	
	Increase in coins in circulation	Consumption by workers and commercials	P	D	T	M	S	
Displacement of economic activities	Allocation of income of the population of two roulotes	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	R	S	LS
	Relocation of economic activities/livelihoods of two roulotes	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS

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Limitations on beach access	Distancing bathers and tourists	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	LS
Increase in the number of heavy vehicles for transporting materials	Increase of traffic	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	N	D	T	H	VS	
	Road damage	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	N	D	T	M	S	
Occupation of public space and roads	Population influx on the beach	Infrastructure construction (roads, coastal protection, etc.)	N	D	T	M	S	LS
	Limitation to sports activities (walking, running, cycling)	Infrastructure construction (roads, coastal protection, etc.)	N	D	T	M	S	LS
	Disruption of daily activities and the movements of people and vehicles	Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	N	D	T	H	VS	LS
Cultural and traditional aspects	Degradation of the built cultural heritage with the appearance of cracks	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	N	D	T	M	S	NS
		Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	N	D	T	M	S	NS
Infrastructures	Interruption of supply of infrastructure services such as water, energy, sanitation	Infrastructure construction (roads, coastal protection, etc)	N	D	T	R	LS	LS

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Limitations on women's participation in economic activities	Business opportunities through itinerant businesses or in areas bordering the works	Infrastructure construction (roads, coastal protection, etc)	P	D	T	M	S	
	Increased family income due to participation in bank construction	Building benches with recycled glass	P	D	T	M	S	
Significant migration of workers to the site	Increased risk of sexual harassment and gender-based violence	Infrastructure construction (roads, coastal protection, etc)	N	D	T	H	VS	S
Contact between workers, people from the community	Increase in incidence of contagious diseases COVID 19 sexually transmitted infections STIs	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS
Unacceptable behaviour according to local social standards	Conflicts between workers and local community	Infrastructure construction (roads, coastal protection, etc)	N	D	T	M	S	LS

Table 57 Social Impact Assessment – Construction Phase. Pantufo Coastline

13.4.2 DEMOBILIZATION PHASE

13.4.2.1 Increase of skilled workers

Activities: End of Construction Site demobilization activities

Effects: End of construction have effect in reduction of workers but a bigger availability of workers skilled.

Impact Assessment: Once the implementation phase is concluded, a large part of the workforce of contracted workers will be demobilized. With the end of the construction phase, it becomes necessary to demobilize materials, equipment and some infrastructure mobilized and built during the construction phase and demobilize the team of workers. This action will lead to a significant reduction of workers but bigger availability of workers skilled.

These workers can have more chances in work in other big public projects, this positive impact is direct, low significance to significant and reduced magnitude.

13.4.2.2 Road Damage

Activities: Vehicle circulation, road accidents and removal of rubble

Effects: The need to mobilize various equipment and transport materials and products, including stones, sand, clay, etc., by heavy vehicles during the construction phase and the demobilization of equipment and materials during the decommissioning phase may cause significant damage and degradation to the roads that directly connect to the waterfront and to the roads surrounding the waterfront.

Impact Assessment: The activities of Vehicles circulation, road accidents and removal of rubble for demobilization of materials, equipment and infrastructure in the demobilization phase of the project can have a direct and indirect, temporary, reduced magnitude, significant and negative impact on the roads damage. Contractor have the responsibility to restore the damage caused in roads.

13.4.2.3 Disturbances to the health, comfort of the population

Activities: Circulation of heavy vehicles, equipment and machinery and removal of rubble

Effects: During the demobilization phase of the project, circulation of vehicles, equipment and machinery and removal of rubble from construction site, cause dust and noise and can lead to disturbance to health, comfort of population surrounding the project intervention area and construction site.

Impact Assessment: These activities of demobilization can have impacts in sensitive receptors health and comfort. On the other hand, the large movement and transport of heavy vehicles in communities near the project may cause traffic accidents and/or situations of conflict and confrontation with the population.

The demobilization of equipment, materials activities can cause a negative, significant, temporary, direct, moderate impact on the health of the populations near the project's areas of intervention and construction site.

The measures identified in Chapter 17 reduce the impacts for low significance.

13.4.2.4 Reduced quality of life

Activities: Circulation of heavy vehicles, equipment and machinery and removal of rubble

Effects: During the demobilization phase of the project, circulation of vehicles, equipment and machinery and removal of rubble from construction site, cause dust and noise and can lead to a reduction in the quality of life of the population surrounding the project intervention area and construction site.

Impact Assessment: The demobilization of equipment, materials activities cause dust, noise and a negative, significant, direct, moderate impact on the health of the populations near the project's areas of intervention and construction site.

The measures identified in Chapter 17 reduce the impacts for low significant.

13.4.2.5 Impacts in health, injuries, deaths

Activities: Circulation of machinery and vehicles used for the transportation of demolition rubble

Effects: Circulation of machinery and vehicles used for the transportation of demolition rubble can increase risk of accidents in roads used by vehicles a machinery

Impact Assessment: The demobilization of equipment, materials activities can increase risk of accidents in roads used by vehicles a machinery, if mitigation measures as limitation of speed are respected the impact will be low significance, direct, reduced and temporary.

The following table summarize impacts in demobilization phase.

Environmental and Social Impact Assessment

Aspect	Social Impact	Activity	Classification				Impact Without measure	Impact With measure
			Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significance / Significant / Very Significant)	Significance (Low significance/ Significant, Very Significant)
Employment	Increase of skilled workers	End of Construction Site demobilization activities	P	D	P	R/M	LS	
Accidental spillage of hazardous products (fuel, oil, lubricants)	Road Damage	Vehicle circulation	N	D	T	R	S	LS
		Road accidents						
		Removal of rubble						
Noise generation	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	N	D	T	M	S	LS
		Removal of demolition rubble						
	Reduced quality of life	Removal of demolition rubble	N	D	P	H	VS	S
Emission of dust	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	N	D	T	R	S	LS
		Removal of demolition rubble						
	Reduced quality of life	Removal of demolition rubble	N	D	P	M	S	S
Road traffic accidents	Impacts in health, Injuries, deaths	Circulation of machinery and vehicles used for the transportation of demolition rubble	N	D	T	R	LS	
	Reduced quality of life		N	D	T	M	S	LS

Table 58 Environmental Impact Assessment – Demobilization. Pantufo Coastline

13.4.3 OPERATION PHASE

13.4.3.1 Jobs creation

Activities: Maintenance of infrastructures

Effects: The maintenance activities of the entire infrastructure to be implemented by the project also create job opportunities

Impacts assessment: Rehabilitation of marginal road needs maintenance of infrastructures, cleaning, green spaces maintenance and also creates opportunities for national companies and organizations, mainly GIME (Road Intervention and Maintenance Group) and ONG's. Impact creation can be direct or indirect. Some suggestion of enhancement of positive impacts and indirect jobs creation are: plant nursery for green spaces maintenance including *caroceiro Terminalia cattapa L.* road safety training center, with focus awareness of non-motorized transports as bicycle; creation of handicrafts for tourists with fish scales.

This impact is considered to be positive, low to significant, permanent, depends of implementation of indirect projects, with reduced magnitude.

13.4.3.2 Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation

Activities: Operation of the road signage improvements

Effects: Presence of cycle lanes and pedestrian circulation with road safety conditions improves road safety for all users.

Impact Assessment: Construction of pavements on both sides of the road, creation of pedestrian space accessible to all passersby with pedestrian spans, special paving, and handrails to create a barrier-free public space. Creating a cycle track at pavement level offers cyclists' greater safety from road traffic and also allows for the extension of pedestrian space when cyclists are not circulating. The creation of road openings for car access to private plots adjacent to the promenade has an effect on road safety. Also, limitation of speed for vehicles of 30km/h in some sections and safety signage contributes to road safety improvement.

The requalification of road and waterfront, namely the presence of pedestrian walkways, the cycle track for cyclists and redesign of the road will have a direct, permanent, with moderate magnitude, significant and positive impact on road traffic safety conditions.

13.4.3.3 Increased protection from flood, coastal erosion and storm surge risks

Activities: Presence coastal protection infrastructure and rehabilitation of hydraulic infrastructures

Effects: The coastal protection infrastructures and rehabilitation of hydraulic infrastructures increases protection of road users and population from flood, coastal erosion and storm surge risks

Impact Assessment: The construction of coastal protection infrastructure, through installation of a rock shield that restores the existing armor will reduce wave agitation within the bay by dissipating wave energy, a rehabilitation of hydraulic infrastructures thereby increasing the safety and attractiveness of the capital's waterfront for both locals and tourism development.

The construction of coastal protection infrastructure will have a direct, permanent, with moderate magnitude, significant and positive impact on the safety and attractiveness of Pantufo Coastline.

13.4.3.4 Accessibility improvement

Activities: requalification of road and waterfront.

Effects: The implementation of this project of requalification of the waterfront, consequent improvements in infrastructure, particularly the road. It is noteworthy that the 12 de Julho waterfront road provides access and connects the main infrastructures of the country, namely, the Port of Ana Chaves and the International Airport of São Tomé and Príncipe. It gives access to the largest supermarket in the country – CKDO. On the other hand, it connects with the three main highways of the country, National 1 EN1, National 2 and National 3. On the other hand, when the road is rehabilitated, it will involve more traffic and a greater number of users. This can create self-employment opportunities for small traders to sell local products and not only for travelers.

The marginal road connects to the Dr. Aires de Menezes Central Hospital which is the only reference hospital in the country. All the serious health problems and emergencies in the country are conducted to this hospital centre. In this sense, it is on this road that ambulances travel to help the sick, pregnant women, people injured.

Impact Assessment: The requalification of the waterfront will substantially improve access, reduce time and cost of mobility in the waterfront and consequently in the city of São Tomé.

This project will make life easier for the taxi drivers who transport people to the hospital, as well as for those who go to the hospital on foot, who will have better access routes for walking.

This project will have a very significant positive impact on improving mobility and access to such services. The project will contribute to the creation of a more coherent urban network, improve the connection between the capital and the country's main airport, improve mobility conditions within the capital, contributes to the improvement of the road network by reinforcing the connection between the national roads EN1, EN2 and EN3.

13.4.3.5 Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation

Activities: Presence of road and waterfront rehabilitated

Effects: Rehabilitation and water front and the road improves of road traffic safety.

Impact Assessment: Rehabilitation and water front of the road, creation of pedestrian space accessible to all passersby with pedestrian spans, special paving, and handrails to create a barrier-free public space, limitation of speed for vehicles in some sections of 30 km/h and safety signage promotes an improvement of road traffic safety conditions. This positive impact is direct, significant, permanent and with moderate magnitude.

13.4.3.6 Increased protection from flood, coastal erosion and storm surge risks

Activities: Presence coastal protection infrastructure and hydraulic infrastructures rehabilitated

Effects: Increased of road safety and protection of people and infrastructures from flood, coastal and storm surge risks.

Impact Assessment: The presence of coastal protection infrastructure, through installation of a rock shield that restores the existing armor, will reduce wave agitation within the bay by dissipating wave energy, and hydraulic infrastructures rehabilitated increases road safety in Marginal. This impact is positive, significant, direct, permanent and with moderate magnitude.

13.4.3.7 Better conditions for sports on the waterfront

Activities: improvement of sidewalks and construction of cycle tracks

Effects: The pedestrian zones from Marginal are much used for sport, whether cycling, hiking or even running. The current state of the pavements has caused injuries to people who do these practices and makes it difficult for others who intend to do so.

Impact assessment: With the improvement of the pavements, more people will be able to practice sports along the waterfront, especially in the area between CKDO Supermarket and the National Museum.

It is also worth mentioning the urban furniture, the children's and sports parks, and the increase of green spaces. All of this will make the waterfront more attractive and change the image of our waterfront. This impact will be positive significant, direct, permanent and with moderate magnitude.

13.4.3.8 Increase in the number of people on beaches of Marginal

Activities: improvements of the coastal protection and road infrastructure

Effects: Clube Náutico and Hotel Pestana beaches are normally receives some bathers. The lack of public toilets is a major problem faced by beach goers today, with the placement of public toilets it will improve the sanitary problems currently experienced by beach goers, and it can be the reason for more attraction to the beach.

Impact assessment: this project will have a very significant positive impact on improving access and sanitation conditions on the beaches. With the improvements of the coastal protection and road infrastructure, there will be an increase of people on the beaches. This impact will be positive significant, direct, permanent and with moderate magnitude.

13.4.3.9 Improvement of quality of urban space with a new image of capital city

Activities: requalification of the waterfront

Effects: This project will have a very significant impact on the attractiveness of the capital and the entire waterfront for both nationals and tourists. The modernization of the waterfront will boost this entire waterfront area in the capital of São Tomé, and will constitute a centrality with multifunctional, combining new recreational and leisure uses, environmental recovery of urban and natural spaces, projecting a new image of our capital city and the country.

Impact assessment: The implementation of this marginal requalification project will mark a change in the renovation of the city's waterfront, and will have a very significant positive impact throughout the country and will contribute to establishing a new paradigm for the quality of urban space and the enhancement of its environmental components.



The implementation of this project will have a very significant positive impact not only for the capital but for the country as a whole. The project will bring improvements in public spaces, including squares, gardens, parks, a bus stop with shelter in front National Lyceum, better conditions on the beaches and morphological elements that will certainly inspire experiences of individual and collective nature, causing a positive very significant impact, direct, permanent and with high magnitude. It should be noted that public spaces are currently very scarce in our city.

The project will also contribute to the development of key social activities for the quality of the city, such as construction and or improvement of sidewalks for walking, running, construction of bicycle lanes, among others.

13.4.3.10 Work conditions of Affected People

Activities: Presence of road and waterfront rehabilitated

Effects: The requalification of road and waterfront will lead to the relocation and resettlement of some affected parts. In Pantufo coastline two trailers will be particularly affected, one near O Pirata Restaurant, and the other located in front of the National Museum.

Impacts assessment: These affected parts will be compensated for the negative impacts caused during the construction phase

These impacts are positive low significance, direct, permanent and with reduced magnitude, in the operation phase on the working conditions of affected people

In Pantufo Coastline no vulnerable groups were identified.

The following table summarize impacts in operation phase.

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Classification				Impact Without measure	Impact With measure
			Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significant/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Employment	jobs creation	Maintenance of infrastructures	P	D	P	R	LS	
Accessibility	Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improved access to the coastline and capital city centre, reduced travel time and cost	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improved access and reduced cost and time at the only referral hospital in the country	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
	Improved accessibility to various institutions and services	Operation of the road with pavement and signage improvements,	P	D	P	H	VS	
Road safety	Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation	Operation of the road with pavement and signage improvements,	P	D	P	M	S	
	Increased protection from flood, coastal erosion and storm surge risks	Presence of coastal protection and hydraulic infrastructures rehabilitated	P	D	P	M	S	

Aspect	Impact	Activity	Classification				Impact Without measure	Impact With measure
			Nature Positive/Negative	Incidence Direct/Indirect	Duration Permanent/Temporary	Magnitude (Reduced/Moderate/High)	Significance (Low Significant/Significant/Very Significant)	Significance (Low Significance/Significant/Very Significant)
Sports practice on the Marginal	Better conditions for sports on the waterfront	Landscaping, green spaces, pavement, cycle track, children's playground, public toilets	P	D	P	M	S	
Attractiveness of the capital and waterfront	Increase in the number of people on the beaches at Marginal	Landscaping, green spaces, cycle path, playground and fitness centre, public toilets, bus stop next to the high school	P	D	P	M	S	
	Improvement the quality of urban space with new image of capital city		P	D	P	H	VS	
Working conditions in the communities affected by the project	Improvement of the conditions for the development of economic activities in the communities affected by the project (two roulotes)	Operation of the Marginal road and requalified infrastructures	P	D	P	R	LS	

Table 59 Social Impact Assessment – Operation Phase. Pantufo Coastline

13.4.4 SYNTHESIS OF SOCIAL IMPACTS

The main Social I impacts for the construction, demobilization and operation phase for Pantufo Coastline are presented below with the mitigation measures proposed:

Negative Impacts

Construction and Demobilization Phases

- Road damage due to circulation of heavy vehicles for transporting materials on the access roads to the construction site (significant);
- Increased risk of sexual harassment and gender-based violence (significant);
- Reduced quality of life due to removal of demolition rubble (significant);
- Displacement of economic activities one roulote near National Museum other near Restaurant O Pirata (low significance).

Positive Impacts

Construction and Demobilization Phases

- Job creation (very significant);
- Increased demand for housing and food consumption (significant);
- Increased tax collection and coins circulation (significant);
- Business opportunities through itinerant businesses or in areas bordering the works (significant);
- Increased family income due to participation in benches construction (significant).

Operation Phase

- Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost (very significant);
- Improved access to the coastline and capital city centre, reduced travel time and cost (very significant);
- Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3 (very significant);
- Improved access and reduced cost and time at the only referral hospital in the country (very significant);
- Improvement of road traffic safety conditions, with cycle lanes and pedestrian circulation (significant);
- Increased protection from flood, coastal erosion and storm surge risks (significant);
- Better conditions for sports on the waterfront (significant);
- Increase in the number of people on the beaches and the Marginal (significant);
- Improving the quality of urban space with a new image of capital city (very significant);
- Improvement of the conditions for the development of economic activities in the communities affected by the project (very significant).

13.5 CUMULATIVE SOCIAL IMPACTS

As mentioned the rehabilitation of Marginal Road is divided in 3 lots Lagarto Bay, Ana Chave Bay and Pantufo Coastline in the city of São Tomé and Príncipe. In addition to these projects, the project for the rehabilitation of the EN1 connecting the city of São Tomé to Neves is being implemented in parallel, it is foreseen to be concluded in 2022.

This cumulative social impact assessment aims is to assess the potential impacts of the three Projects and associated with EN1 which potentially will be constructed and operated in close proximity. The following tables summarizes these assessments for construction and operation phases.

Social Factor	Impact	Description
Employment	Jobs creation	The development of the four projects can have benefits if the projects are developed sequentially permitting the possibility for those who have gained skills working for contractors and sub-contractors in one project and transfer skills acquired in EN1 project or other lots. Impact positive, temporary, moderate magnitude, significant
Sexual harassment and gender-based violence	Increased risk of sexual harassment and gender-based violence	Potential cumulative impacts of Projects at same time with presence of workforce has potential to increase the risk of sexual harassment and gender-based violence. Impact negative, temporary, moderate magnitude, significant.
Safety	Decrease of Road Safety	Potential cumulative impacts of Projects at same time with circulation of heavy vehicles has potential to increase road damage with decrease of road safety for road users. Contractors using the same routes at same time difficult the determination of responsibilities when the repair need to be done right away. Impact negative, temporary, moderate magnitude, significant
Limitations on accesses to beaches and waterfront	Distancing bathers, sport practitioners and tourists	Potential cumulative impacts of Projects at same time have a result that inhabitants of São Tomé city that usually go to beaches, stroll in Marginal with sea view or practices sports at construction phase it not be possible to these activities. Impact negative, temporary, moderate magnitude, significant.

Stakeholders Engagement	Community Relations	Potential cumulative impacts of Projects at same time can give rise to discomfort of population and an increase of grievances. Impact negative, temporary, moderate magnitude, significant
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Table 60 Social Cumulative Impacts. Construction phase

Some measures suggested to mitigate cumulative social impacts are in construction phase:

- Implement an efficient Worker Code of Conduct at first stage of construction, for guiding personnel about forbidden activities and community worker interactions;
- Implement awareness sessions for workers about sexual harassment and gender-based violence.

Social Factor	Impact	Description
Accessibility	Increase of accessibility	Potential impacts of projects contribute improving mobility and access to such Hospital Dr, Ayres Menezes, Airport and creation of a more coherent urban network, improve the connection between the capital and by reinforcing the connection between the national roads EN1, EN2 and EN3 Impact Positive permanent, high magnitude, very significant.
Sport Practices	Increase of better conditions for sports practices	Potential cumulative impacts of Projects give better conditions for sport practices and on a longer stretch of road contributing to healthy habits. Impact Positive permanent, high magnitude, very significant.
Road Safety	Increase of Road Safety	Potential cumulative impacts of Projects give an improvement of safety road conditions for roads users, motorized and non-motorized along Marginal road contributing to reduce accidents. Impact Positive permanent, high magnitude, very significant.

Social Factor	Impact	Description
Stakeholders' engagement	Increase of community relations	Potential cumulative impacts of community relations can give rise to a more efficient implementation stakeholders engagement, with responses to grievances and other activities being undertaken process. Impact Positive, temporary, moderate magnitude, significant

Table 61 Social Cumulative Impacts. Operation phase

14. MEASURES FOR ENVIRONMENTAL IMPACTS

In this chapter of ESIA, a set of mitigating measures is identified to prevent or minimize the potential environmental and social impacts associated with the Project.

The impact mitigation measures that are presented in this report are intended to avoid and eliminate potential environmental and social impacts of this project, where applicable.

Avoidance applies in situations where modifications can be made in project in order to evade potential impacts, such as working at night, to eliminate noises and vibrations.

Reduction applies in situations where certain aspects of the project, such as access roads to quarry sites, cannot be avoided but can be minimized in order to reduce potential environmental impacts to manageable levels.

Elimination applies in situations where aspects are integrated in project, such as fishermen boat workshop and fish market in Ana Chaves Bay and a Laundry in Lagarto Bay.

Measures for potential impacts apply in situations where the impact cannot be avoided and also cannot be adequately mitigated and therefore may have to be through compensation. These measures include compensation for affected people, identified in A- RAP.

Mitigation before construction commences, there is going to be pre-construction activities that are going to take place to prepare the site for the construction works. These activities include:

- Compliance with São Tomé legislation on public works contracts, especially those relating to working conditions and wages, child labor, non-discrimination, safety and health of workers, etc.
- Application of good practices, São Tomé legislation, EIB and IFC Performance Standards, mitigation of impacts, appropriate compensation, complaint procedures, etc.
- Preparation of Site Construction Plan, Traffic Management Plan, Code of Conduct, Occupational Health and Safety Plan, Community Health and Safety Plan, Emergency Response Management Plan, Solid Waste and Wastewater Management Plan, Archeological Chance Find Procedures, Sea Turtles Find Procedures, Beach Nourishment

Management Plan, Sea Turtles Management Plan and Human Resources management Plan.

- Obtain licenses for works activities (trees grubbing, site possession, fencing, etc.), and subcontractors (quarries, wastes transportation, etc.);
- Construction site location should be approved by supervision and preferably in an area previously intervened, without any conservation value or even clearings resulting from previous misuse.

The following areas should be avoided:

- sensitive ecological and scenic areas;
 - surroundings of water lines, permanent or temporary and potential inundations areas;
 - areas of high infiltration;
 - areas with high density of shrub and/or arboreal vegetation cover.
- Advertising for local workers recruitment;
 - Conducting of Information Education and Communication (IEC) amongst the community and the project staff;
 - Identify trees needing removal and implementation of selective clearing of vegetation making sure that only the vegetation that must be cut down is removed;
 - Collection of all the excavated soil during site preparation and ensuring appropriate temporary storage before disposal. This is to be done to ensure control of soil wash off that can cause siltation of rivers;
 - Implementation of dust control measures by sprinkling of water. Use of serviceable equipment and vehicles to control smoke emission;
 - Ensuring availability of waste bins for collection of pre-construction wastes;
 - Providing sanitary facilities for construction activities in construction site and front works.

Measures for construction, demobilization of works and operation phases for environmental impacts are presented in the following tables and for social impacts in the following chapter.in the following tables, allowing for quick consultation throughout the Project, for each lot.

14.1 LAGARTO BAY

14.1.1 CONSTRUCTION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Climate and Climate Change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	LS	LS	Proper maintenance of equipment to ensure efficient operation		
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	LS	LS	Monitoring of equipment fuel consumption	Forward planning to ensure efficient operations, including works planning	
	Electricity consumption		Use of electrical equipment	LS	LS	Use equipment that promotes energy efficiency		
			Lighting of premises (building site)	LS	LS	Use of low energy consumption LED lamps		
	Reduction of CO2 sequestration		Deforestation and felling of trees	LS	LS			Planting of 36 trees
	Increased GHG emissions		Construction of revetment and armor ridge for coastal protection and transportation of materials	LS	LS		Forward planning to ensure efficient operations, including works planning	
Air quality	Dust production	Alteration of air quality (CO2, CO, NOX, SOX, HC, VOC's and PM)	Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Carrying out regular maintenance on vehicles and equipment	
			Moving equipment and machinery			The movement of equipment and machinery during the dry season should be done at reduced speed.	Avoid obstacles to fluid circulation	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Air quality							Air quality monitoring and reviewed at regular intervals and compared with the values standards to adopted corrective actions if necessary	
						Use equipment with low air pollutant emissions.	Carrying out regular maintenance on vehicles and equipment	
						Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	Use of filters on machinery and changing filters regularly.	
			Cement preparation				Use equipment with low air pollutant emissions.	
			Beach nourishment CH 0+800 to CH 1+860				Carry out the operations at times of low wind speed, reducing the emission of particles	
			Construction of revetment and armor ridge for coastal protection				Reduce dust emission during transport of waste resulting from demolition and dismantling by applying vehicle loading cover.	Use more efficient construction methods in order to avoid the emission of gaseous pollution
	Fuel consumption	Removal and replacement of pavement layers	Lighting of premises (building site)	Installation of efficient/low-energy light bulbs.	Perform control of fuel consumption			

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Air quality			Use of electronic and electromechanical equipment	S	LS	Use low consumption, more efficient equipment and machines.	Carry out regular maintenance of equipment and machinery to detect possible malfunctions in terms of fuel consumption	
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 0+450 and CH 1+340					
Noise	Noise generation	Noise and vibration emission	Removal and replacement of pavement layers	S	LS	Reduce the speed of vehicles during the execution of the work	Acquire and use equipment and machinery with low noise and vibrations emissions and approved by Supervision No night time construction	
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.					
			Moving equipment and machinery				Carry out regular maintenance of equipment and machinery to detect possible malfunctions	
Soil	Excavations for replacement of new hydraulic structures (CH)	Increased exposure to erosive agents (water, wind, sea waves)	Earthmoving	LS	LS	Excess excavation material should be transported and deposited in suitable locations.	Earthworks should be started as soon as the ground is clear, avoiding repetition of actions on the same area.	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Soil	0 +448 and CH 1+335)					The surplus materials from excavations to be carried out during the works, if they have suitable geotechnical characteristics, should, whenever possible, be (re)used in the embankments associated with the construction of the different infrastructures, to restore the morphology of the borrow areas and landscape recovery.	Restrict, where possible, earth moving activities to the dry season to reduce the risk of water erosion.	
	Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Increase in the impermeable area with pavement	LS	LS	The movement of machinery should be limited to the construction zone, avoiding the indiscriminate movement of machinery all over the site.		Once the works are completed, it will be necessary to carry out soil decompaction in order to create favorable conditions for the natural regeneration of the vegetation cover and allow the recovery of habitats.
			Movement of heavy equipment and machinery on the access roads to the quarries			The circulation of vehicles and heavy machinery should follow predefined routes, making maximum use of existing paths so as to reduce soil compaction and sealing.		
	Solid waste disposal in inadequate sites	Soil contamination	Operation of the construction site	S	LS	All solid waste produced on site must be stored in the appropriate area (waste park)	Hazardous waste must be stored in areas with retention basins	If waste is deposited in unauthorized or unsuitable places, it should be collected immediately.

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants and concrete)		Circulation of equipment, machinery and vehicles used for transporting materials	LS	LS	Provide arrangements for the collection and storage of soil contaminated with hazardous substances from soil spills and produced on site and dispose of it appropriately	The maintenance and/or repair of vehicles and machinery should be carried out in a defined place in the yard, in an impermeable area with a hydrocarbon separator, to avoid spillage of oils and fuels onto the ground.	
						In case of spillage on the ground, collect the product with absorbent material so as to minimize soil contamination	Precede the collection of contaminated material and the cleaning of the affected area, thus avoiding soil contamination	
						Hazardous waste (solids and liquids) must be stored in places with retention basins	Store contaminated material in an appropriate and safe place	
	Production of solid waste and liquid effluents		Demolition of existing infrastructure			Categorize demolition waste according to its typology, identifying the dangerous ones in order to know their adverse effects	Stored waste should be handled properly to prevent accidental spillage and packages should be kept closed	
		Implementation of the solid waste and liquid effluent management plan						
Geology	Extraction of materials from quarries	Change in the topography of the land (geomorphology)	Removal of vegetation cover/tree felling	LS	LS	Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exit from workings.	Contractors shall select a quarry with a licenses/permits from relevant authorities to operate quarry	Implementation of quarries Landscape Restoration Plan
			Earthmoving					
			Moving equipment and machinery					

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Geology	Coastal erosion	Changing the topography of the land	Removal of vegetation cover/tree felling	S	LS	Extraction of materials shall clearly be demarcated and marked to minimize vegetation clearing, that prevents erosion.	Implement Beach Nourishment Maangement Plan	
			Earthmoving and beach nourishment					
Water resources	Water consumption	Consumption of water resources	Operation of the construction site	S	LS	Use of timer taps on drinking fountains, washbasins, in order to control water consumption.	Avoid water abstraction for the works that can endanger the supply of the population in the area affected by the project.	
			Cement preparation			Adopt measures to reuse water, whenever possible.	Regular maintenance of the water pipes on site to prevent possible leaks.	
			Washing of concrete mixers, equipment and machinery			Implement a water consumption rationalization plan.	Avoiding water wastage during construction work activities.	
	Dragging of sediments into water bodies (water turbidity)	Reduction in water quality	Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Avoid carrying out earthworks during periods of heavy rainfall.	
The execution of earth moving works must be limited to a predefined area						Avoid earth moving in areas near water lines.	Water quality monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources			Removal of vegetation cover			All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.	Mark the trees to be cut down/ felled in order to avoid unnecessary spillover of other tree species	
			Rehabilitation of the hydraulic crossings			Implement adequate drainage systems in the working areas in order to minimize erosion and the transport of solids.	The Contractor shall construct, maintain, remove and reinstall, as necessary, temporary drainage works and take all other necessary precautions to prevent the entrainment of sediment into water bodies.	
						Reduce construction time to what is strictly necessary next to water lines in order to reduce the dragging and deposition of sediments in their beds.	Restoration of the banks and beds of the watercourse.	
						During the rainy season of greatest intensity, the activities that generate earth movement must be controlled, in order to reduce the risks of erosion and the consequent transport of solids and sediments to the aquatic environments (water line).		
Waste production	Contamination of surface/groundwater	Solid waste disposal in inadequate sites	VS	S	All solid materials (CDW) deposited on the ground and all rubble should be removed, leaving the land clean.	After completion of the work at a particular site, all water lines and drainage systems that may contain residues resulting from the work should be cleaned, in order to avoid water pollution problems.	The elimination of dumps, open air solid waste landfills	
					Collection of waste and packaging of hazardous products, which cause adverse effects on the environment			

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources	Production of liquid effluents					No waste of any kind may be discharged into the sea, waterways or soil.		
			Maintenance and washing of equipment and machinery			Concrete mixer washing and machinery maintenance should take place in a waterproofed area.	There should be strict controls on the maintenance and/or repair of vehicles and working machinery, in order to avoid oil and fuel spills in water bodies.	
						No vehicles or machinery used in the construction work should be serviced outside the areas set aside for the site.	Define appropriate places for washing and maintenance of vehicles that include hydrocarbon separators.	
						Water containing a high concentration of oils and grease must be conveyed to a watertight tank on sealed ground.	Check that the non-return valve does not have any openings that allow liquid to escape from it.	
						Adequate treatment of wastewater must be provided at construction sites, quarries and sandpit.	Prohibit any untreated water drainage.	
					Regular observation of the machines to quickly detect possible leaks.			
	Disinfection of new water pipes on the Marginal		LS				Use and application of disinfection product to be approved by the inspection body that does not cause impact on water quality.	
	Accidental spillage of hazardous products (fuel,		Storage and handling of dangerous products	VS	S	Proper storage and handling of fuels, oils, lubricants, paints, tar and other substances to prevent spills and leakages.	Storage areas should be properly marked and compartmentalized to avoid spillage.	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources	oil, lubricants and concrete)			S	LS	Equip areas for the storage of fuel, oils and lubricants, among others, with retention basins.	In case of spillage into surface waters, collect the product with suitable absorbent material and then contact the national environmental agency.	
						All stored drums should be labelled, and safety and site signs should be displayed.	Raise awareness among workers on the correct handling of dangerous products.	
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 0+450 and CH 1+340	S	LS	Use more efficient construction methods when carrying out demolition or construction work, ensuring good environmental practices.	Placing signs on bridges and steep places to avoid the risk of accidents and spills.	
	Movement of equipment and machinery		S	LS		To make workers aware of the proper use of safe equipment and machinery in order to avoid accidents		
	Production of dust (turbidity)		Construction of revetment and armor ridge for coastal protection	S	LS	When carrying out earth moving work it should be done when the wind speed is moderate.		
			Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	All earthmoving activities must be limited to the areas strictly necessary for the execution of the work	Moisten the ground work areas regularly.

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Waster resources	Deposition of waste and sediments	Interruption of drainage patterns	Movement of equipment and machinery	S	LS	The movement of equipment and machinery during the dry season should be done at reduced speed.	Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	
			Removal of vegetation cover	LS	LS	All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.		
			Earthmoving	LS	LS	All earthmoving operations must be limited to the areas strictly necessary for the execution of the work.	Constantly cover the load cover of earth moving vehicles.	
			Construction of revetment and armor ridge for coastal protection	LS	LS	After completion of the work at a particular site, all water lines and drainage systems that may contain residues resulting from the work should be cleaned to avoid obstruction and flooding.	Monitoring of the drainage infrastructures adjacent to the work, ensuring that they are unobstructed.	
	Demolition of existing infrastructure and construction of the new hydraulic structures CH+450 and CH 1+340	LS	LS	Replace all existing drainage infrastructure damaged by construction, immediately after notification of the occurrence.	Momentary obstructions should be resolved as quickly as possible in order to restore the runoff to its normal flow section, promoting natural drainage.			
	Siltation of water courses	Flooding (destruction of infrastructure)	Construction of revetment and armor ridge for coastal protection	S	LS			

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures			
						Mitigate	Avoid	Eliminate	
Water resources			Demolition of existing infrastructure and construction of the new hydraulic structures CH 0+450 and CH 1+335			Intervention in hydraulic crossings should be carried out whenever possible in the period when there is less rainfall, spending as little time as possible and trying to alter the natural course of the water lines as little as possible, thus avoiding flooding.			
			Earthmoving			All removal of vegetation cover, movement and deposit of materials must be limited to the areas strictly necessary for the work to be carried out.			
			Removal of vegetation cover						
Natural resources	Fuel consumption (diesel, gasoline)	Increased consumption of fossil fuels	Use of equipment and machinery	S	LS	Use low consumption vehicles	Carry out periodic maintenance of equipment and machinery on site		
						Use equipment and machinery with the power required for the work to be carried out	Scheduling and rationalizing vehicle movements		
	Electricity consumption	Increase in electricity consumption	Use of electrical equipment	S	LS	Use more efficient equipment.	Carry out periodic maintenance of electrical equipment		
						Lighting of premises (building site)	Use energy-saving/more efficient light bulbs	Regularly check the operation of the lamps	
	Consumption of construction materials (stones, sand, wood, etc.)	Increased consumption of construction materials	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	If necessary, to export the materials required for the work, so as not to cause a shortage of materials on the domestic market and, consequently, create a conflict situation with the local population	Control of electric energy consumption		
							Schedule the activities according to the number of materials to be used during the construction work		

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Natural resources	Water Consumption	Increased water consumption	Cement preparation					
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS		Carry out monitoring of water consumption	
			Cement preparation					
Landscape	Introduction of foreign elements that disturb the landscape	Landscape alteration	Removal of vegetation cover	LS				
			Earthmoving	LS				
			Moving equipment and machinery	LS				
			Presence of fence	S	LS	Place fence with viewing panel or viewing window hole to allow road users see sea, satisfy and satisfy curiosity in a safe way.		
Landscape	Destruction of vegetation cover	Visual impact	Removal of vegetation cover	S	LS	All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.	Replacing the vegetation cover	Planting of 36 trees
						The introduction of exotic/alien species should not be used to restore the vegetation cover.		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Landscape			Earthmoving			All earthmoving work shall be limited to the areas strictly necessary for the execution of the work.		
			Moving equipment and machinery			The definition of temporary accesses should avoid the felling of vegetation, and favor the use of existing access paths.		
						The circulation of vehicles and machinery supporting the work should be rationalized.		
Biodiversity	Noise emission	Disturbance of the Terrestrial Ecosystem (Flora and Fauna)	Earthmoving	LS		The movement of equipment and machinery should be limited to the construction zone.		
			Handling of heavy equipment and machinery	LS				
			Road rehabilitation, coastal protection and beach nourishment (CH 0+800 – CH 1+860)	LS				
			Removal of vegetation cover	LS				
	New habitats for birds' nest,		Grubbing 16 coconut palms and 4 <i>Terminalia</i>	LS				

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Biodiversity	breeding and rest		<i>cattapa</i> (caroceiro) and planted 36 trees 14 <i>Washingtonian robusta</i> (Mexican palm tree), 17 <i>Vachellia karroo</i> (Karoo acacias) and 5 tamarinds.					
	Accidental spillage of hazardous products (fuel, oil, lubricants and concrete)	Disturbance and degradation of the marine ecosystem	Earthmoving	LS		The movement of equipment and machinery should be limited to the construction zone.		
	Alteration of water quality		Handling of heavy equipment and machinery	LS		Integrate into the code of conduct rules, procedures and prohibitions regarding the interaction of construction site employees with wildlife present in the area to be intervened: including hunting, touching, handling or collecting a (unless required to implement mitigation).	Implement penalties for employees and contractors who violate the code of conduct. Training all staff on the value of biodiversity and the importance of its conservation	Perform of washing of sands prior to its placement on beach and forward washing water for adequate treatment
	Sea turtle nesting beaches disturbance			S	LS		Avoid construction works in beaches from October to April Awareness campaign for workers and fishermen	
Quality of sand			S	LS		Implementation of Beach Nourishment management Plan		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Biodeiversity	Noise		Coastal protection and beach nourishment CH 0+800 to CH 1+860	S			Implementation of Sea Turtles Management Plan	
Biodiversity	Alteration of the intertidal habitat	Loss of Biodiversity and affection of Fauna and Flora in the Intertidal Area	Construction of revetment, armor crest, wall and beach nourishment CH 0+800 to CH 1+860	S	LS	The movement of equipment and machinery should be limited to the construction zone.	<p>Create a procedure in case a turtle nest is found, in order to transfer it to another beach, to be carried out in partnership with NGOs with experience in this area.</p> <p>Planning of works to avoid intervention in interstitial habitats during peak nesting periods for turtles (October – April)</p>	
Occupational Health and Safety	Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	S	LS	Inform about the sanctions applicable in the event of non-compliance with hygiene and safety rules at work.	<p>Training on the proper use of equipment and machinery</p> <p>Use of personal protective equipment (PPEs)</p>	Construction of revetment, armor crest, wall and beach nourishment CH 0+800 to CH 1+860
		Reduced quality of life		VS	S	<p>Ensuring occupational safety for workers</p> <p>Allocation of health insurance for workers</p>	The site and the different work fronts must be equipped with all the necessary materials and means to respond in incident/accident situations	
	Road traffic accidents/triot-trespassing	Vehicle damage	Circulation of equipment, machinery and vehicles used for	S	LS	Installation of adequate signage in and around the area where the work is being carried out	Conducting road safety training	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Occupational Health and Safety			transporting materials					
		Reduced quality of life		VS	S	The access of non-contracted personnel should be prevented or, if possible, forbidden.	Raising drivers' awareness of safe driving. Installation of signposting during the works	
	Dust emission	Harmful effects on the workers' respiratory system	Earthmoving			Adopt measures to minimize Dust emission	Use of appropriate personal protective equipment (PPE)	
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)	S	LS			
			Demolition of existing infrastructure					
	Occupational Health and Safety	Noise emission	Harmful effects on workers' hearing systems	Moving equipment and machinery	VS	LS	Periodic maintenance of equipment and machinery	Installation of silencers on equipment and machinery, avoiding noise pollution
Infrastructure construction (road, hydraulic structures and coastal protection, etc.)				Application of more efficient and less noisy construction methods, taking into account the period of execution of the works			Use of appropriate personal protective equipment (PPE)	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
			Demolition of existing infrastructure	VS	LS			
Community Health and Safety	Accidents falls	Reduced pedestrian safety	Use of construction material transport equipment and machinery and vehicles	S	LS	Installation of adequate signage in and around the area where the work is being carried out	Placing a signalman at pedestrian crossings, ensuring that vehicles stop before crossing	
		Reduced quality of life		VS	S		The intervention areas should be marked and, where appropriate, fenced	
	Road traffic accidents	Reduced quality of life	Circulation of equipment, machinery and vehicles used for transporting materials	VS	S		Access by non-contract staff should be prevented or, if possible, forbidden.	
Community Health and Safety		Reducing road safety		S	LS	<p>Due the presence of a kindergarden is recommended that transportation activities been carry out during off peak hours and avoid early morning a before school starts and afternoon after school finishes.</p> <p>Conduct education to schools c for the road safety by closely with local people including NGOs</p> <p>Near schools the Contractor shall provide sufficient signs and flagmen to traffic control.</p>		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures			
						Mitigate	Avoid	Eliminate	
Community Health and Safety	Dust emission	Harmful effects on the population's respiratory system	Earthmoving	S	LS	Moisten the whole area to be treated, reducing the production of dust	Construction near schools should have crossing and be designated safe school routes.		
			Removal and replacement of pavement layers			Implement more efficient and less time-consuming techniques and/or construction methods during the execution of the operations			
			Demolition of existing infrastructure						
	Noise emission	Harmful effects on the population's hearing system	Moving equipment and machinery	VS	LS	Where there are dwellings, which are mainly at the access points to the site, vehicles should preferably be moved during daylight hours and on weekdays.	Encourage drivers to apply reduced speed in residential areas		
							Implement the Traffic Management Plan		
			Demolition of existing infrastructure			The works should be carried out during periods not coinciding with the times when the population of the surrounding area is in their homes	Inform the population of the time of execution of the works, bearing in mind that the operations may take a long time, thus avoiding possible effects on the population's health		
			Removal and replacement of pavement layers				Implement a Communication Plan with the population of the surrounding area to disseminate		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
							information about the constraints of the project	
Waste management	Production of construction and demolition waste (buildings, floors, pipes, etc.)	Occupation of public space	Demolition of existing infrastructure and construction of new infrastructure	S	LS	Verify the type and classification of the waste to be produced and provide for its segregation, adapting it to the needs, quantities and characteristics of the containers to be placed on the site for temporary storage.	Correct separation of the waste generated at the site, thus avoiding mixing of waste and subsequently promoting a reduction in the volume of CDW to be treated	
						Evaluate, whenever possible, the possibility of reusing waste in other work processes	To promote the recovery and reuse of waste generated on construction sites.	
						Evaluate the construction techniques taking into account the minimization of waste production (CDW)	All surplus material, rubble, scaffolding and the like must be removed at the end of the work.	
						After unloading the concrete, the truck mixers should be cleaned to remove concrete residues from the mixers.	To assign an adequate final destination to all the demolition and construction waste (CDW) produced during the works, complying with the national legislation in force. Penha dump receives all type of construction wastes.	

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Waste Management	Waste water production	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	All waste that may generate effluents contaminated by rainwater percolation must be stored in a covered park.	Installation of sewage and sanitation networks for the protection of marine and territorial waters	
		Harmful effects on the health of workers and community	Kitchen and sanitary installations in the Construction site and sanitary installations in the work fronts.	S	LS	Installation of septic tanks to treat domestic wastewater generated on site, avoiding direct discharge into the natural waterways	Implement the control system for waste water produced during activities	
	Production of hazardous waste	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	VS	S	All waste classified as hazardous, such as used oils, lubricants, paints and solvents, as well as waste contaminated by oils, should be properly conditioned and stored in an appropriate place.	The oils used in the periodic maintenance of the equipment and machinery should be collected and stored in suitable containers and then transported for proper hazardous waste treatment.	
			Demolition of existing infrastructure			Safe transportation of hazardous waste to the appropriate licensed final destination		
	Use of waste	Using locally recycled glass	Construction of benches	S				



Environmental and Social Impact Assessment



Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Waste management	Production of domestic waste	Harmful effects on the health of workers and community	Kitchen and sanitary facilities in the construction site and sanitary facilities at the work fronts	S	LS	On site there should be containers for the collection of this type of waste, allowing the separation of this waste from industrial, hazardous and non-hazardous waste. For organic waste, composting solutions should be preferred.	Implementation of devices for selective collection, transport and recovery or final destination of domestic waste	Disposal of deposits, landfills of domestic waste in the open air

Table 62 Environmental Mitigation Measures. Construction Phase. Lagarto Bay

14.1.2 DEMOBILIZATION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Climate and climate change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	LS		Proper maintenance of equipment to ensure efficient operation		
	Oil and lubricant consumption		Use of electromechanical equipment and machinery			Monitoring of equipment fuel consumption	Forward planning to ensure efficient operations, including works planning	
	Electricity consumption		Use of electrical equipment			Use equipment that promotes energy efficiency		
	Reduction of CO2 sequestration		Lighting of premises (building site)	Use of low energy consumption LED lamps				
	GHG emissions		Transport emissions from materials and equipment	Proper maintenance and transports planning to ensure reduce of emissions				
Air quality	Emission of dust generation on roads	Alteration of air quality (PM5 and PM10)	Use of equipment and machinery	LS		The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Carrying out regular maintenance on vehicles and equipment	
	Emissions (CO ₂ , CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Movement of vehicles	LS		The movement of equipment and machinery during the dry season should be done at reduced speed.	Avoid obstacles to fluid circulation	
			Removal of equipment			Use equipment with low air pollutant emissions.	Carrying out regular maintenance on vehicles and equipment	
			Removal of rubble			Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	Use of filters on machinery and changing filters regularly.	
Noise	Increase of Noise	Noise and vibration emission	Increase in vehicle circulation	S	LS	Reduce the speed of vehicles during works	Carry out regular maintenance of	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Noise			Use of equipment and machinery				equipment and machinery to detect possible malfunctions No night time demobilization activities	
			Removal of equipment					
Removal of demolition rubble								
		Effect on the health of the population in the surrounding area	All the operation of clearing equipment, infrastructures and waste removal	LS	LS			
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)	Soil contamination	Handling of heavy equipment and machinery at the access to the construction site	S	LS	In case of spillage on the ground, collect the product with absorbent material so as to minimize soil contamination	The maintenance and/or repair of vehicles and machinery should be carried out in a defined place in the yard, in an impermeable area with a hydrocarbon separator, to avoid spillage of oils and fuels onto the ground.	
						Hazardous waste (solids and liquids) must be stored in places with retention basins	Store contaminated material in an appropriate and safe place	
	Production of demolition waste		Removal of equipment			Demolition of support infrastructures (office, kitchen, bathrooms, etc.)	Categorize demolition waste according to its typology, identifying the dangerous ones in order to know their adverse effects	

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Soil	Disposal of demolition waste in inappropriate places		Removal of demolition rubble					
	Soil permeabilization and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	S				
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Removal of demolition rubble	LS				
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Use of equipment and machinery					
			Moving equipment and machinery					
			Removal of equipment					
			Removal of demolition rubble					
	Sediment drift into watercourses (turbidity, TSS)	Reduction in water quality	Vehicle circulation	S	LS	Intervention should be carried out whenever possible in the period when there is less rainfall, spending as little time as possible.		
			Use of equipment and machinery					
			Removal of demolition rubble					
Removal of rubble								
Soil permeabilization and decompaction	Increased infiltration of water into the soil	Reforestation	S					

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Natural resources	Fuel consumption (diesel, petrol)	Decrease of Fossil fuel consumption	Decreased use of vehicles	LS				
	Electricity consumption	Decrease of Electricity consumption	Removal of lamps and electrical equipment on construction site	LS				
	Water consumption	Decrease of water consumption	Cessation of activities	LS				
Landscape	Destruction of vegetation cover	Landscape alteration	Moving equipment and machinery	LS				
			Removal of demolition rubble					
	Introduction of foreign elements that disturb the landscape	Visual impact	Moving equipment and machinery	LS				
			Removal of demolition rubble					
Restoration of vegetation cover	Improving the landscape	Restoration of the affected area: reforestation, soil decompaction	S					
Biodiversity	Noise emission	Terrestrial Ecosystem (Flora and Fauna)	Vehicle movement	LS		Avoid construction works in beaches from October to April		
		Removal of equipment						
		Removal of demolition rubble						

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigations Measures		
				Without measure	With measure	Mitigate	Avoid	Eliminate
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Heavy goods vehicles on the access to the Construction site	LS				
Biodiversity	Restoration of habitats	Terrestrial Ecosystem (Flora and Fauna)	Biophysical restoration of the affected area	S				
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Disturbance and degradation of the marine ecosystem	Handling of heavy equipment and machinery	LS				
Occupational Health and Safety	Dust emission	Harmful effects on the workers' respiratory system	Movement of vehicles carrying rubble	LS	LS	Adopt measures to minimize dust emission	Use of appropriate personal protective equipment (PPE)	
			Use of equipment and machinery					
			Removal of demolition rubble					
	Noise emission	Harmful effects on workers' hearing systems	Heavy goods vehicles on the access to the Construction site	S	LS	Take into account the period of execution of the works	Use of appropriate personal protective equipment (PPE)	
			Use of equipment and machinery					
			Removal of demolition rubble					
Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	VS	S	Inform about the sanctions applicable in the event of non-compliance with hygiene and safety rules at work.	Training on the proper use of equipment and machinery		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigations Measures		
				Without measure	With measure	Mitigate	Avoid	Eliminate
Occupational Health and Safety	Road traffic accidents	Reduced quality of life	Removal of demolition rubble	VS	S		Use of appropriate personal protective equipment (PPE)	
		Vehicle damage	Movement of machinery and vehicles used for the transportation of demolition debris	LS				
		Reduced quality of life		S	LS			
Community Health and Safety	Road traffic accidents	Vehicle damage	Movement of vehicles	LS	LS	Installation of road signs to warn the community about the circulation of vehicles and machinery during the demobilization operation.	Carrying out an awareness campaign with the community in order to avoid possible accidents.	
		Reduced quality of life	Use of equipment and machinery					
	Dust emission	Harmful effects on the respiratory system	Movement of equipment and machinery	S	LS	Promote the circulation of vehicles at low speed in areas close to populations/residences.		
			Removal of demolition rubble			Use moistening the material to be collected if it is powdery.		
	Noise emission	Harmful effects on the hearing system	Movement of equipment and machinery	S	LS	Use more effective and less noisy rubble removal techniques.	The execution of the works must take into account the population's rest period, prohibiting activities between 10pm and 7am.	
			Removal of demolition rubble					

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Waste Mangement	Production of solid waste	Waste disposal in inappropriate places	Removal of demolition rubble	S	LS	The concrete material removed can be crushed and reused in the construction industry as filler material in paving bases for roads.	To recover and reuse the materials resulting from the demolition.	
			Removal of demolition rubble	S	LS	The metallic materials removed from the equipment should be taken to the final destination to be integrated in appropriate recycling processes.		
	Production of liquid effluents	Soil contamination	Maintenance of machinery and equipment	S	LS	The oils should be collected, transported and taken to their final destination, receiving the appropriate hazardous waste treatment.		

Table 63 Environmental Mitigation Measures - Demobilization. Lagarto Bay

14.1.3 OPERATION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Climate and climate change	Consumption of fuel, oils and lubricants	Greenhouse effect/climate change	Traffic increasing	S				
	Electricity consumption		Lighting of premises (street lamps, park lamps and laundry)	LS		Proper maintenance of equipment to ensure efficient operation		
	Coastal Protection		Presence of Coastal protection infrastructures	VS				
	Drainage System		Requalification of drainage system	S				
Air quality	Reduction of dust generation on roadways	Improving air quality (PM5 and PM10)	Increasing the number of trees and green spaces	S				
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Circulation of motorized and non-motorized transports	S				
Noise	Noise generation	Noise and vibration emission	Circulation of motorized and non-motorized transports	S				
		Effect on the health of the population in the	Increased vegetation cover (sound barrier)	LS				

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
		surrounding area						
Soil	Coastal protection works	Reduced exposure to erosive agents (water, wind, sea waves)	Presence of Coastal Protection Works	VS				
	Disposal of solid urban waste in inadequate locations	Soil contamination	Increased flow of people	LS		Prohibit the disposal of municipal solid waste (MSW) on the ground.		
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Circulation of motorized and non-motorized transports					
	Production of solid waste and liquid effluents		Existence of bins for rubbish disposal				Carrying out awareness campaigns among the population on the proper disposal of wastes	
Water resources	Disposal of urban solid waste in inadequate locations	Contamination of surface/groundwater	Increased flow of people	LS		Maintenance of hydraulic structures clean without solid wastes		
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of traffic accidents					
	Water quality Alteration		Operation of laundry with septic tank	LS				
	Natural drainage	Improving the drainage	Presence of rehabilitated drainage works	S				

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
		capacity of structures						
Natural resources	Fuel consumption (diesel, petrol)	Fossil fuel consumption	Circulation of motorized and non-motorized transports	S				
	Increase in electricity consumption	Electricity consumption	Lighting of premises (street luminary, park luminary)	LS	LS	Use of more efficient, low consumption light lamps	Carry out periodic maintenance of the lamps to detect malfunctions, avoiding excessive consumption of electricity	
	Increase of water consumption	Water consumption	One fountain and laundry	LS	LS		Water management for green spaces irrigation	
Landscape	Rehabilitation of the image of the Marginal	Improving the image of the Marginal Visual	Rehabilitation of the landscape, with an increase in green spaces, urban equipment (benches), litter bins, children's playgrounds, cycle paths, etc.	VS				
Biodiversity	Noise emission	Removal of marine animals turtles species (<i>Chelonia mydas</i> ; <i>Lepidocheil</i>)	Increased traffic flow Increased flow of people Increase in goods and services	LS		Continuation of Tatô 's monitoring Programme		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Biodiversity	Light emission	<i>ys olivacea; Eretmochel ys imbricata and Dermochel ys coriacea)</i>	Lighting of premises (street lamps)	S	LS	Lighting effects monitoring		
	Loss of habitats or/and completion between species	Alteration of ecological areas	Presence of coastal protection and beach nourishment	S	LS		Sea Turtles Management Plan Beach Nourishment management Plan	
	Creation New habitats (rocks and sand areas)		CH0+800 – CH 1+860	S				
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Degradation of marine ecosystems	Road accidents	LS				
Community Health and Safety	Improving road safety	Reduction in the number of accidents	Movement of vehicles	VS			Awareness population about safe cycling and new cycle lanes and pedestrian paths	
			Vertical signage				Awareness population about safety signage and new rules of traffic circulation, speeds, use restricted of cycle lanes for bicycles	
			Pedestrian crossings					
			Lighting of premises (street lamps)			As supply of energy is not reliable it is mandatory it's mandatory that at night cyclists use reflectors in bicycles and reflector vest.		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety						As supply of energy is not reliable it is mandatory it's mandatory that at night cyclists use reflectors in bicycles and reflector vest		
	Dust emission	Harmful effects on the respiratory system	Road and infrastructures maintenance	LS				
	Noise emission	Harmful effects on the hearing system	Road and infrastructures maintenance	LS				
	Improving Health	Effects on respiratory and auditing system	Presence of road requalification	S				
Improve of healthy habits		Presence drinking water fountain	S					
Waste management	Production of solid and liquid waste	Disposal of wastes on sidewalks and roads	Existence of bins for rubbish disposal	S		Prohibit the disposal of municipal solid waste (MSW) on the ground.	Carrying out awareness campaigns about the population on the proper disposal of wastes Raise of awareness with incentives to keep beach clean	Regular beach cleaning

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
		Wastewater discharge on beach	Existence of septic tanks in laundry	LS		Empty and Clean septic tank annually	Carrying out awareness campaigns about the wash women about health and water use	

Table 64 Environmental Mitigation Measures - Operation Phase. Lagarto Bay

14.2 ANA CHAVES BAY

14.2.1 CONSTRUCTION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Climate and Climate Change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	LS	LS	Proper maintenance of equipment to ensure efficient operation		
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	LS	LS	Monitoring of equipment fuel consumption	Forward planning to ensure efficient operations, including works planning	
	Electricity consumption		Use of electrical equipment	LS	LS	Use equipment that promotes energy efficiency		
			Lighting of premises (building site)	LS	LS	Use of low energy consumption LED lamps		
	Reduction of CO2 sequestration		Deforestation and felling of trees	LS	LS			Planting 100 trees

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
	Increased GHG emissions		Construction of revetment and armor ridge for coastal protection and transportation of materials	LS	LS		Forward planning to ensure efficient operations, including works planning	
Air quality	Dust emission	Alteration of air quality (CO ₂ , CO, NO _x , SO _x , HC, VOC's and PM)	Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Carrying out regular maintenance on vehicles and equipment	
			Moving equipment and machinery			The movement of equipment and machinery during the dry season should be done at reduced speed.	Avoid obstacles to fluid circulation Air quality monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	
						Use equipment with low air pollutant emissions.	Carrying out regular maintenance on vehicles and equipment	
				Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	Use of filters on machinery and changing filters regularly.			
			Cement preparation	S	LS	Carry out the operations at times of low wind speed, reducing the emission of particles	Use equipment with low air pollutant emissions.	
			Beach nourishment 4+950 – CH 5+300				Use equipment with low air pollutant emissions.	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Air quality	Fuel consumption		Construction of revetment and armor ridge for coastal protection			Reduce dust emission during transport of waste resulting from demolition and dismantling by applying vehicle loading cover.	Use more efficient construction methods in order to avoid the emission of gaseous pollution	
			Removal and replacement of pavement layers					
			Lighting of premises (building site)			Installation of efficient/low-energy light bulbs.	Perform control of fuel consumption	
			Use of electronic and electromechanical equipment			Use low consumption, more efficient equipment and machines.	Carry out regular maintenance of equipment and machinery to detect possible malfunctions in terms of fuel consumption	
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 4+790					
Noise	Noise generation	Noise and vibration emission	Removal and replacement of pavement layers	S	LS		Acquire and use equipment and machinery with low noise and vibrations emissions and approved by supervision	
			Removal and replacement of pavement layers				No night time construction Noise monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	
			Moving equipment and machinery			Reduce the speed of vehicles during the execution of the work	Carry out regular maintenance of equipment	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.				and machinery to detect possible malfunctions	
Soil	Excavations for construction of new bridge CH 4+790	Increased exposure to erosive agents (water, wind, sea waves)	Earthmoving	LS	LS	Excess excavation material should be transported and deposited in suitable locations.	Earthworks should be started as soon as the ground is clear, avoiding repetition of actions on the same area.	
						The surplus materials from excavations to be carried out during the works, if they have suitable geotechnical characteristics, should, whenever possible, be (re)used in the embankments associated with the construction of the different infrastructures, to restore the morphology of the borrow areas and landscape recovery.	Restrict, where possible, earth moving activities to the dry season to reduce the risk of water erosion.	
	Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Increase in the impermeable area with pavement	LS	LS			
			Movement of heavy equipment and machinery on the access roads to the quarries			The movement of machinery should be limited to the construction zone, avoiding the indiscriminate movement of machinery all over the site.		Once the works are completed, it will be necessary to carry out soil decompaction in order to create favorable conditions

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Soil						The circulation of vehicles and heavy machinery should follow pre-defined routes, making maximum use of existing paths so as to reduce soil compaction and sealing.	Soil removal should be kept to a minimum and take place before the areas are used for construction work activities, in order to avoid soil compaction and thus reducing the water infiltration process into the soil.	for the natural regeneration of the vegetation cover and allow the recovery of habitats.
	Solid waste disposal in inadequate sites	Soil contamination	Operation of the construction site	S	LS	All solid waste produced on site must be stored in the appropriate area (waste park)	Hazardous waste must be stored in areas with retention basins	If waste is deposited in unauthorized or unsuitable places, it should be collected immediately.
Accidental spillage of hazardous products (fuel, oil, lubricants, concrete, asphalt)	Circulation of equipment, machinery and vehicles used for transporting materials		Provide arrangements for the collection and storage of soil contaminated with hazardous substances from soil spills and produced on site and dispose of it appropriately			The maintenance and/or repair of vehicles and machinery should be carried out in a defined place in the yard, in an impermeable area with a hydrocarbon separator, to avoid spillage of oils and fuels onto the ground.		
			In case of spillage on the ground, collect the product with absorbent material so as to minimize soil contamination			Precede the collection of contaminated material and the cleaning of the affected area, thus avoiding soil contamination		
Soil	Production of solid waste and liquid effluents		Demolition of existing infrastructure			Hazardous waste (solids and liquids) must be stored in places with retention basins	Store contaminated material in an appropriate and safe place	
		Categorize demolition waste according to its typology, identifying the dangerous ones in order to know their adverse effects		Stored waste should be handled properly to prevent accidental spillage and packages should be kept closed				

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
							Implementation of the solid waste and liquid effluent management plan	
Geology	Extraction of materials from quarries	Change in the topography of the land (geomorphology)	Removal of vegetation cover/tree felling	LS	LS	Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exit from workings.	Contractors shall select a quarry with a licenses/permits from relevant authorities to operate quarry	Implementation of quarries Landscape Restoration Plan
			Earthmoving					
			Moving equipment and machinery					
	Coastal erosion	Changing the topography of the land	Removal of vegetation cover/tree felling	LS	LS	Extraction of materials shall clearly be demarcated and marked to minimize vegetation clearing, that prevents erosion.		
			Earthmoving					
			Moving equipment and machinery					
Water consumption	Consumption of water resources		Operation of the construction site	S	LS	Use of timer taps on drinking fountains, washbasins, in order to control water consumption.	Avoid water abstraction for the works that can endanger the supply of the population in the area affected by the project.	
			Cement preparation			Adopt measures to reuse water, whenever possible.	Regular maintenance of the water pipes on site to prevent possible leaks.	
			Washing of concrete mixers, equipment and machinery			Implement a water consumption rationalization plan.	Avoiding water wastage during construction work activities.	
	Dragging of sediments into water	Reduction in water quality	Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with	Avoid carrying out earthworks during periods of heavy rainfall.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Water resources	bodies (water turbidity)					a cover to reduce particulate emissions.		
						The execution of earth moving works must be limited to a predefined area	Avoid earth moving in areas near water lines. Water quality monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	
						Removal of vegetation cover	Mark the trees to be cut down/felled in order to avoid unnecessary spillover of other tree species	
						Rehabilitation of the hydraulic crossings	Implement adequate drainage systems in the working areas in order to minimize erosion and the transport of solids.	The Contractor shall construct, maintain, remove and reinstall, as necessary, temporary drainage works and take all other necessary precautions to prevent the entrainment of sediment into water bodies.
Reduce construction time to what is strictly necessary next to water lines in order to reduce the dragging and deposition of sediments in their beds.	Restoration of the banks and beds of the watercourse.							
Water resources						During the rainy season of greatest intensity, the activities that generate earth movement must be controlled, in order to reduce the risks of erosion and the consequent transport of solids and sediments to the aquatic environments (water line).		

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Water Resources	Waste production	Contamination of surface/groundwater	Solid waste disposal in inadequate sites	VS	S	All solid materials (CDW) deposited on the ground and all rubble should be removed, leaving the land clean.	After completion of the work at a particular site, all water lines and drainage systems that may contain residues resulting from the work should be cleaned, in order to avoid water pollution problems.	The elimination of dumps, open air solid waste landfills
						Collection of waste and packaging of hazardous products, which cause adverse effects on the environment		
						No waste of any kind may be discharged into the sea, waterways or soil.		
	Production of liquid effluents		Maintenance and washing of equipment and machinery	S	LS	Concrete mixer washing and machinery maintenance should take place in a waterproofed area.	There should be strict controls on the maintenance and/or repair of vehicles and working machinery, in order to avoid oil and fuel spills in water bodies.	
						No vehicles or machinery used in the construction work should be serviced outside the areas set aside for the site.	Define appropriate places for washing and maintenance of vehicles that include hydrocarbon separators.	
						Water containing a high concentration of oils and grease must be conveyed to a watertight tank on sealed ground.	Check that the non-return valve does not have any openings that allow liquid to escape from it.	
						Adequate treatment of wastewater must be provided at construction sites, quarries and sandpit.	Prohibit any untreated water drainage.	
							Regular observation of the machines to quickly detect possible leaks.	

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Water Resources	Accidental spillage of hazardous products (fuel, oil, lubricants, concrete, asphalt)		Disinfection of new water mains on the Marginal	LS				Use and application of disinfection product to be approved by the inspection body that does not cause impact on water quality.
			Storage and handling of dangerous products	VS	S	Proper storage and handling of fuels, oils, lubricants, paints, tar and other substances to prevent spills and leakages.	Storage areas should be properly marked and compartmentalized to avoid spillage.	
						Equip areas for the storage of fuel, oils and lubricants, among others, with retention basins.	In case of spillage into surface waters, collect the product with suitable absorbent material and then contact the national environmental agency.	
						All stored drums should be labelled, and safety and site signs should be displayed.	Raise awareness among workers on the correct handling of dangerous products.	
			Demolition of existing infrastructure including hydraulic structures and construction of new CH 0+450 and CH 1+340	S	LS	Use more efficient construction methods when carrying out demolition or construction work, ensuring good environmental practices.	Placing signs on bridges and steep places to avoid the risk of accidents and spills.	
			Movement of equipment and machinery	S	LS		To make workers aware of the proper use of safe equipment and machinery in order to avoid accidents	
	Production of dust (turbidity)		S	LS	When carrying out earth moving work it should be done when the wind speed is moderate.			

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Water resources			Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	All earthmoving activities must be limited to the areas strictly necessary for the execution of the work	Moisten the ground work areas regularly.
			Movement of equipment and machinery	S	LS	The movement of equipment and machinery during the dry season should be done at reduced speed.	Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	
	Deposition of waste and sediments	Interruption of drainage patterns	Removal of vegetation cover	LS	LS	All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.		
			Earthmoving	LS	LS	All earthmoving operations must be limited to the areas strictly necessary for the execution of the work.	Constantly cover the load cover of earth moving vehicles.	
			Construction of revetment and armor ridge for coastal protection	LS	LS	After completion of the work at a particular site, all water lines and drainage systems that may contain residues resulting from the work should be cleaned to avoid obstruction and flooding.	Monitoring of the drainage infrastructures adjacent to the work, ensuring that they are unobstructed.	
			Demolition of existing infrastructure including construction of new bridge CH 4+790	LS	LS	Replace all existing drainage infrastructure damaged by construction, immediately after notification of the occurrence.	Momentary obstructions should be resolved as quickly as possible in order to restore the runoff to its normal flow section, promoting natural drainage.	
	Siltation of water lines		Construction of revetment and armor	S	LS			

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
		Flooding (destruction of infrastructure)	ridge for coastal protection					
			Demolition of existing infrastructure including construction of new bridge CH 4+790			Intervention in hydraulic crossings should be carried out whenever possible in the period when there is less rainfall, spending as little time as possible and trying to alter the natural course of the water lines as little as possible, thus avoiding flooding.		
			Earthmoving			All removal of vegetation cover, movement and deposit of materials must be limited to the areas strictly necessary for the work to be carried out.		
			Removal of vegetation cover					
Natural resources	Fuel consumption (diesel, petrol)	Increased consumption of fossil fuels	Use of equipment and machinery	S	LS	Use low consumption vehicles	Carry out periodic maintenance of equipment and machinery on site	
						Use equipment and machinery with the power required for the work to be carried out	Scheduling and rationalizing vehicle movements	
	Electricity consumption	Increase in electricity consumption	Use of electrical equipment	S	LS	Use more efficient equipment.	Carry out periodic maintenance of electrical equipment	
			Lighting of premises (building site)			Use energy-saving/more efficient light bulbs	Regularly check the operation of the lamps	
						Control of electric energy consumption		

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
	Consumption of construction materials (stones, sand, wood, etc.)	Increased consumption of construction materials	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	If necessary, to export the materials required for the work, so as not to cause a shortage of materials on the domestic market and, consequently, create a conflict situation with the local population	Schedule the activities according to the number of materials to be used during the construction work	
			Cement preparation					
	Water Consumption	Increased of water consumption	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS		Carry out monitoring of water consumption	
			Cement preparation					
Landscape	Introduction of foreign elements that disturb the landscape	Landscape alteration	Removal of vegetation cover	LS				
			Earthmoving	LS				
			Moving equipment and machinery	LS				
			Presence of fence	S	LS	Place fence with viewing panel or viewing winddown hole to allow road users see sea, satisfy and satisfy curiosity in a safe way.		

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
	Destruction of vegetation cover	Visual impact	Removal of vegetation cover	S	LS	All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.	Replacing the vegetation cover	Planting 100 trees
			Earthmoving			The introduction of exotic/alien species should not be used to restore the vegetation cover.		
			Moving equipment and machinery			All earthmoving work shall be limited to the areas strictly necessary for the execution of the work.		
						The definition of temporary accesses should avoid the felling of vegetation, and favor the use of existing access paths.		
						The circulation of vehicles and machinery supporting the work should be rationalized.		
	Noise emission	Disturbance of the Terrestrial Ecosystem (Flora and Fauna)	Earthmoving	LS		The movement of equipment and machinery should be limited to the construction zone.		
			Handling of heavy equipment and machinery	LS				
			Road rehabilitation, coastal protection and beach nourishment beach CH 4+950 – CH 5+300	LS				

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Biodiversity			Removal of vegetation cover	LS				
	New habitats for birds' nest, breeding and rest		Grubbing 1 coconut palm and 3 <i>Terminalia cattapa</i> (caroceiro) and 100 new planted trees, 1 <i>Washingtonian robusta</i> (Mexican palm tree) and 83 <i>Vachellia karroo</i> (Karoo acacias) and 16 Tamarinds.	LS	LS			
	Alteration of the intertidal habitat	Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area	Construction of revetment, armor crest, wall and beach nourishment CH 4+950 – CH 5+300	S	LS	The movement of equipment and machinery should be limited to the construction zone.	Create a procedure in case a turtle nest is found, in order to transfer it to another beach, to be carried out in partnership with NGOs with experience in this area. Planning of works to avoid intervention in interstitial habitats during peak nesting periods for turtles (October – April)	
Biodiversity	Accidental spillage of hazardous products (fuel, oil, lubricants and concrete)	Disturbance and degradation of the marine ecosystem	Earthmoving	LS		Reduce the area of any and all interventions on natural habitat sites		
Biodiversity								

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
	Alteration of water quality		Handling of heavy equipment and machinery	LS		Integrate into the code of conduct rules, procedures and prohibitions regarding the interaction of construction site employees with wildlife present in the area to be intervened: including hunting, touching, handling or collecting a (unless required to implement mitigation).	Implement penalties for employees and contractors who violate the code of conduct. Training all staff on the value of biodiversity and the importance of its conservation	
	Sea turtle nesting beaches disturbance		Coastal protection and beach nourishment CH 4+950 – CH 5+300)	S	LS		Avoid construction works in in beaches from October to April Awareness campaign for workers and fishermen	Perform of washing of sands prior to its placement on beach and forward washing water for adequate
	Quality of sand			S	LS		Implementation of Beach Nourishment management Plan	
	Noise			S	LS		Implementation of Sea Turtles Management Plan	
	Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	S	LS	Inform about the sanctions applicable in the event of non-compliance with hygiene and safety rules at work.	Training on the proper use of equipment and machinery	
		Reduced quality of life				Ensuring occupational safety for workers	Use of personal protective equipment (PPEs)	
				VS	LS	Allocation of health insurance for workers	The site and the different work fronts must be equipped with all the necessary materials and means to respond in incident/accident situations	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Occupational Health and Safety	Road traffic accidents	Vehicle damage	Circulation of equipment, machinery and vehicles used for transporting materials	S	LS	Installation of adequate signage in and around the area where the work is being carried out	Conducting road safety training	
		Reduced quality of life		S	LS	The access of non-contracted personnel should be prevented or, if possible, forbidden.	Raising drivers' awareness of safe driving. Installation of signposting during the works	
	Dust emission	Harmful effects on the workers' respiratory system	Earthmoving	S	LS	Adopt measures to minimize Dust emission	Use of appropriate personal protective equipment (PPE)	
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)			Monitoring the state of health of each worker		
			Demolition of existing infrastructure					
	Noise emission	Harmful effects on workers' hearing systems	Moving equipment and machinery	BS	LS	Periodic maintenance of equipment and machinery	Installation of silencers on equipment and machinery, avoiding noise pollution	
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)			Application of more efficient and less noisy construction methods, taking into account the period of execution of the works	Use of appropriate personal protective equipment (PPE)	
			Demolition of existing infrastructure					
	Accidents falls	Reduced pedestrian safety	Use of construction material transport equipment and machinery and vehicles	S	LS	Installation of adequate signage in and around the area where the work is being carried out	Placing a signalman at pedestrian crossings, ensuring that vehicles stop before crossing	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety		Reduced quality of life		S	LS		The intervention areas should be marked and, where appropriate, fenced	
	Road traffic accidents	Reduced quality of life	Circulation of equipment, machinery and vehicles used for transporting materials	S	LS		Access by non-contract staff should be prevented or, if possible, forbidden.	
		Reducing road safety		S	LS			
	Dust emission	Harmful effects on the population's respiratory system	Earthmoving	S	LS	Moisten the whole area to be treated, reducing the production of dust	Inform the population of the time of execution of the works, bearing in mind that the operations may take a long time, thus avoiding possible effects on the population's health	
			Removal and replacement of pavement layers			Implement more efficient and less time-consuming techniques and/or construction methods during the execution of the operations		
			Demolition of existing infrastructure					
	Noise emission	Harmful effects on the population's hearing system	Moving equipment and machinery	S	LS	Where there are dwellings, which are mainly at the access points to the site, vehicles should preferably be moved during daylight hours and on weekdays.	Encourage drivers to apply reduced speed in residential areas	
			Demolition of existing infrastructure			The works should be carried out during periods not coinciding with the times when the population of the surrounding area is in their homes	Implement the Traffic Management Plan	Inform the population of the time of execution of the works, bearing in mind that the operations may take a long time, thus avoiding

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety				S	LS		possible effects on the population's health	
			Removal and replacement of pavement layers				Implement a Communication Plan with the population of the surrounding area to disseminate information about the constraints of the project	
Waste management	Production of construction and demolition waste (buildings, floors, pipes, etc.)	Occupation of public space	Demolition of existing infrastructure and construction of new infrastructure	S	LS	Verify the type and classification of the waste to be produced and provide for its segregation, adapting it to the needs, quantities and characteristics of the containers to be placed on the site for temporary storage.	Correct separation of the waste generated at the site, thus avoiding mixing of waste and subsequently promoting a reduction in the volume of CDW to be treated	
						Evaluate, whenever possible, the possibility of reusing waste in other work processes	To promote the recovery and reuse of waste generated on construction sites.	
						Evaluate the construction techniques taking into account the minimization of waste production (CDW)	All surplus material, rubble, scaffolding and the like must be removed at the end of the work.	
						After unloading the concrete, the truck mixers should be cleaned to remove concrete residues from the mixers.	To assign an adequate final destination to all the demolition and construction waste (CDW) produced during the works, complying with the national legislation in force	

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Waste Management	Waste water production	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	All waste that may generate effluents contaminated by rainwater percolation must be stored in a covered park.	Installation of sewage and sanitation networks for the protection of marine and territorial waters	
		Harmful effects on the health of workers and community	Kitchen and sanitary installations in the Construction site and sanitary installations in the work fronts.	S	LS	Installation of septic tanks to treat domestic wastewater generated on site, avoiding direct discharge into the natural waterways	Implement the control system for waste water produced during activities	
						Carry out regular and adequate maintenance of the water treatment system in order to ensure its cleanliness and avoid obstructions	Plan should have a solution for waste water treatment to be approved by supervision	
	Production of hazardous waste	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	VS	S	All waste classified as hazardous, such as used oils, lubricants, paints and solvents, as well as waste contaminated by oils, should be properly conditioned and stored in an appropriate place.	The oils used in the periodic maintenance of the equipment and machinery should be collected and stored in suitable containers and then transported for proper hazardous waste treatment.	
			Demolition of existing infrastructure				Safe transportation of hazardous waste to the appropriate licensed final destination	
	Use of waste	Using locally recycled glass	Construction of benches	S				



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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impacts with Measures	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Waste management	Production of domestic waste	Harmful effects on the health of workers and community	Kitchen and sanitary facilities in the Construction site and sanitary facilities at the work fronts	S	LS	On site there should be containers for the collection of this type of waste, allowing the separation of this waste from industrial, hazardous and non-hazardous waste. For organic waste, composting solutions should be preferred.	Implementation of devices for selective collection, transport and recovery or final destination of domestic waste	Disposal of deposits, landfills of domestic waste in the open air

Table 65 Environmental Mitigation Measures – Construction Phase. Ana Chaves Bay

14.2.2 DEMOBILIZATION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Climate and climate change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	LS	LS	Proper maintenance of equipment to ensure efficient operation		
	Oil and lubricant consumption		Use of electromechanical equipment and machinery			Monitoring of equipment fuel consumption	Forward planning to ensure efficient operations, including works planning	
	Electricity consumption		Use of electrical equipment			Use equipment that promotes energy efficiency		
	Reduction of CO2 sequestration		Lighting of premises (building site)			Use of low energy consumption LED lamps		
	GHG emissions		Transport emissions from materials and equipment			Proper maintenance and transports planning to ensure reduce of emissions		
Air quality	Emission of dust	Alteration of air quality (PM5 and PM10)	Use of equipment and machinery	LS		The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Carrying out regular maintenance on vehicles and equipment	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Movement of vehicles	LS		The movement of equipment and machinery during the dry season should be done at reduced speed.	Avoid obstacles to fluid circulation	
			Removal of equipment			Use equipment with low air pollutant emissions.	Carrying out regular maintenance on vehicles and equipment	
			Removal of rubble			Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	Use of filters on machinery and changing filters regularly.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Noise	Increase of Noise	Noise and vibration emission	Increase in vehicle circulation	S	LS	Reduce the speed of vehicles during works	Carry out regular maintenance of equipment and machinery to detect possible malfunctions No night time demobilization activities	
			Use of equipment and machinery					
Removal of equipment								
Removal of demolition rubble								
		Effect on the health of the population in the surrounding area	All the operation of clearing equipment, infrastructures and waste removal	LS	LS			
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)	Soil contamination	Handling of heavy equipment and machinery at the access to the construction site	S	LS	In case of spillage on the ground, collect the product with absorbent material so as to minimize soil contamination	The maintenance and/or repair of vehicles and machinery should be carried out in a defined place in the yard, in an impermeable area with a hydrocarbon separator, to avoid spillage of oils and fuels onto the ground.	
	Removal of equipment							
	Production of demolition waste		Demolition of support infrastructures (office, kitchen, bathrooms, etc.)					

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures					
						Mitigate	Avoid	Eliminate			
Soil	Disposal of demolition waste in inappropriate places	Increased infiltration of water into the soil	Removal of demolition rubble in construction site								
	Soil waterproofing and decompaction		Restoration of the affected area: reforestation	S							
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Removal of demolition rubble in construction site	LS							
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Use of equipment and machinery								
			Moving equipment and machinery								
			Removal of equipment								
			Removal of demolition rubble in the construction site								
	Sediment drift into watercourses (turbidity, TSS)	Reduction in water quality	Vehicle circulation	S	LS	Intervention should be carried out whenever possible in the period when there is less rainfall, spending as little time as possible.					
			Use of equipment and machinery								
Removal of demolition rubble in the construction site											

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources								
	Soil permeabilization and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	S				
Natural resources	Fuel consumption (diesel, petrol)	Decrease of Fossil fuel consumption	Decreased use of vehicles	LS				
	Electricity consumption	Decrease of Electricity consumption	Removal of lamps and electrical equipment in the construction site	LS				
	Water consumption	Decrease of water consumption	Cessation of activities	LS				
Landscape	Destruction of vegetation cover	Landscape alteration	Moving equipment and machinery	LS				
			Removal of demolition rubble in the construction site					
	Introduction of foreign elements that disturb the landscape	Visual impact	Moving equipment and machinery	LS				
			Removal of demolition rubble in the construction site					
Restoration of vegetation cover	Improving the landscape	Restoration of the affected area:	S					

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Landscape			reforestation, soil decompaction					
Biodiversity	Noise emission	Terrestrial Ecosystem (Flora and Fauna)	Vehicle movement	LS			Avoid construction works in beaches from October to April	
			Removal of equipment					
			Removal of demolition rubble in the construction site					
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Heavy goods vehicles on the access to the construction site	LS				
	Restoration of habitats		Biophysical enhancement of the affected area	S				
Accidental spillage of hazardous products (fuel, oil, lubricants)	Disturbance and degradation of the marine ecosystem	Handling of heavy equipment and machinery	LS					
Occupational health and safety	Dust emission	Harmful effects on the workers' respiratory system	Movement of vehicles carrying rubble	LS	LS	Adopt measures to minimize dust emission	Use of appropriate personal protective equipment (PPE)	
			Use of equipment and machinery					
			Removal of demolition rubble					

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Occupational health and safety	Noise emission	Harmful effects on workers' hearing systems	Movement of vehicles carrying rubble	S	LS	Take into account the period of execution of the works	Use of appropriate personal protective equipment (PPE)	
			Use of equipment and machinery					
			Removal of demolition rubble in the construction site					
	Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	VS	S	Inform about the sanctions applicable in the event of non-compliance with hygiene and safety rules at work.	Training on the proper use of equipment and machinery	
		Reduced quality of life	Removal of demolition rubble in the construction site	VS	S		Use of appropriate personal protective equipment (PPE)	
	Road traffic accidents	Vehicle damage	Movement of machinery and vehicles used for the transportation of demolition debris	LS				
Reduced quality of life		S		LS				
Community health and safety	Road traffic accidents	Vehicle damage	Movement of vehicles	LS	LS	Installation of road signs to warn the community about the circulation of vehicles and machinery during the demobilization operation.	Carrying out an awareness campaign with the community in order to avoid possible accidents.	
		Reduced quality of life	Use of equipment and machinery	LS	LS			
	Dust emission	Harmful effects on the respiratory system	Movement of equipment and machinery	LS	LS	Promote the circulation of vehicles at low speed in areas close to populations/residences.		

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Community health and safety	Noise emission	Harmful effects on the hearing system	Removal of demolition rubble in the construction site	LS	LS	Use moistening the material to be collected if it is powdery.		
			Movement of equipment and machinery	LS	LS	Use more effective and less noisy rubble removal techniques.	The execution of the works must take into account the population's rest period, prohibiting activities between 10pm and 7am.	
			Removal of demolition rubble in the construction site	LS	LS			
Waste management	Production of solid waste	Waste disposal in inappropriate places	Removal of demolition rubble	S	LS	The concrete material removed can be crushed and reused in the construction industry as filler material in paving bases for roads.	To recover and reuse the materials resulting from the demolition.	
			Removal of demolition rubble in the construction site	S	LS	The metallic materials removed from the equipment should be taken to the final destination to be integrated in appropriate recycling processes.		
	Production of liquid effluents	Soil contamination	Maintenance of machinery and equipment	S	LS	The oils should be collected, transported and taken to their final destination, receiving the appropriate hazardous waste treatment.		

Table 66 Environmental Mitigation Measures – Demobilization Phase. Ana Chaves Bay

14.2.3 OPERATION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Climate and climate change	Consumption of fuel, oils and lubricants	Greenhouse effect/climate change	Traffic increasing	S				
	Electricity consumption		Lighting of premises (street lamps, park lamps and laundry)	LS		Proper maintenance of equipment to ensure efficient operation		
	Coastal Protection		Presence of Coastal protection infrastructures	VS				
	Drainage System		Requalification of drainage system	S				
Air quality	Reduction of dust generation on roadways	Improving air quality (PM5 and PM10)	Increasing the number of trees and green spaces	S				
	Emissions (CO ₂ , CO, NO _x , SO _x , HC, VOC's)	Alteration of air quality	Circulation of motorized and non-motorized transports	S				
Noise	Noise generation	Noise and vibration emission	Circulation of motorized and non-motorized transports	S				
		Effect on the health of the population in the surrounding area	Increased vegetation cover (sound barrier)	LS				

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Soil	Coastal protection works	Reduced exposure to erosive agents (water, wind, sea waves)	Presence of Coastal Protection Works	VS				
	Disposal of solid urban waste in inadequate locations	Soil contamination	Increased flow of people	LS		Prohibit the disposal of municipal solid waste (MSW) on the ground.		
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Circulation of motorized and non-motorized transports					
	Production of solid waste and liquid effluents		Existence of bins for rubbish disposal				Carrying out awareness campaigns among the population on the proper disposal of wastes	
Water resources	Disposal of urban solid waste in inadequate locations	Contamination of surface/groundwater	Increased flow of people	LS		Maintenance of hydraulic structures clean without solid wastes		
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of traffic accidents					
	Water quality Alteration		Operation of laundry with septic tank	LS				

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Water resources	Natural drainage	Improving the drainage capacity of structures	Presence of rehabilitated drainage works	S				
Natural resources	Fuel consumption (diesel, petrol)	Fossil fuel consumption	Circulation of motorized and non-motorized transports	S				
	Increase in electricity consumption	Electricity consumption	Lighting of premises (street luminary, park luminary)	LS	LS	Use of more efficient, low consumption light lamps	Carry out periodic maintenance of the lamps to detect malfunctions, avoiding excessive consumption of electricity	
	Increase of water consumption	Water consumption	One fountain and laundry	LS	LS		Water management for green spaces irrigation	
Landscape	Rehabilitation of the image of the Marginal	Improving the image of the Marginal Visual	Rehabilitation of the landscape, with an increase in green spaces, urban equipment (benches), litter bins, children's playgrounds, cycle paths, etc.	VS				
Biodiversity	Noise emission	Removal of marine animals turtles species (<i>Chelonia mydas</i> ;	Increased traffic flow Increased flow of people	LS		Continuation of Tatô 's monitoring Programme		

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Measures		
				Without measure	With measure	Mitigate	Avoid	Eliminate
Biodiversity		<i>Lepidochelys olivacea</i> ; <i>Eretmochelys imbricata</i> and <i>Dermochelys coriacea</i>)	Increase in goods and services					
	Light emission		Lighting of premises (street lamps)	S	LS	Lighting effects monitoring		
	Loss of habitats or/and completion between species	Alteration of ecological areas	Presence of coastal protection and beach nourishment	S	LS		Sea Turtles Management Plan Beach Nourishment management Plan	
	Creation New habitats (rocks and sand areas)		CH 4+950–CH 5+300	S				
	Accidental spillage of hazardous products (fuel, oil, lubricants)	Degradation of marine ecosystems	Road accidents	LS				
Community health and safety	Improving road safety	Reduction in the number of accidents	Movement of vehicles	VS			Awareness population about safe cycling and new cycle lanes and pedestrian paths	
			Vertical signage				Awareness population about safety signage and new rules of traffic circulation, speeds, use restricted of cycle lanes for bicycles	
			Pedestrian crossings					
			Lighting of premises (street lamps)			As supply of energy is not reliable it is mandatory it's mandatory that at night cyclists		

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Measures		
						Mitigate	Avoid	Eliminate
Community health and safety						use reflectors in bicycles and reflector vest. As supply of energy is not reliable it is mandatory it's mandatory that at night cyclists use reflectors in bicycles and reflector vest		
	Dust emission	Harmful effects on the respiratory system	Road and infrastructures maintenance	LS				
	Noise emission	Harmful effects on the hearing system	Road and infrastructures maintenance	LS				
	Improving Health	Effects on respiratory and auditing system	Presence of road requalification	S				
		Improve of healthy habits	Presence drinking water fountain	S				
Waste management	Production of solid and liquid waste	Disposal of wastes on sidewalks and roads	Existence of bins for rubbish disposal	S		Prohibit the disposal of municipal solid waste (MSW) on the ground.	Carrying out awareness campaigns about the population on the proper disposal of wastes Raise of awareness with incentives to keep beach clean	Regular beach cleaning
		Wastewater discharge on beach	Existence of septic tanks in public toilet	LS		Empty and Clean septic tank annually	Carrying out awareness campaigns about the wash women about health and water use	

Table 67 Environmental Mitigation Measures – Operation Phase. Ana Chaves Bay

14.3 PANTUFO COASTLINE

14.3.1 CONSTRUCTION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Climate and Climate Change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	LS	LS	Proper maintenance of equipment to ensure efficient operation		
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	LS	LS	Monitoring of equipment fuel consumption	Forward planning to ensure efficient operations, including works planning	
	Electricity consumption		Use of electrical equipment	LS	LS	Use equipment that promotes energy efficiency		
	Reduction of CO2 sequestration		Deforestation and felling of trees	LS	LS			Planting 36 trees
	Increased GHG emissions		Construction of revetment and armor ridge for coastal protection and transportation of materials	LS	LS		Forward planning to ensure efficient operations, including works planning	
Air quality	Dust emission	Alteration of air quality (CO2, CO, NOX, SOX, HC, VOC's and PM)	Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Carrying out regular maintenance on vehicles and equipment	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Air quality			Moving equipment and machinery			The movement of equipment and machinery during the dry season should be done at reduced speed.	Avoid obstacles to fluid circulation Air quality monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	
						Use equipment with low air pollutant emissions.	Carrying out regular maintenance on vehicles and equipment	
						Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	Use of filters on machinery and changing filters regularly.	
			Cement preparation			Carry out the operations at times of low wind speed, reducing the emission of particles	Use equipment with low air pollutant emissions.	
			Construction of revetment and armor ridge for coastal protection			Reduce dust emission during transport of waste resulting from demolition and dismantling by applying vehicle loading cover.	Use more efficient construction methods in order to avoid the emission of gaseous pollution	
			Removal and replacement of pavement layers					
	Fuel consumption	Lighting of premises (building site)	Installation of efficient/low-energy light bulbs.	Perform control of fuel consumption				

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Air quality			Use of electronic and electromechanical equipment			Use low consumption, more efficient equipment and machines.	Carry out regular maintenance of equipment and machinery to detect possible malfunctions in terms of fuel consumption	
			Replacement of box culvert CH 7+312					
Noise	Noise generation	Noise and vibration emission	Removal and replacement of pavement layers	S	LS		Acquire and use equipment and machinery with low noise and vibrations emissions and approved by inspection No night time constructions Noise monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	Use of personal protective equipment, especially hearing protection
			Road rehabilitation, construction of hydraulic structures and coastal protection, etc.					
			Moving equipment and machinery					
Soil	Excavations for construction of coastal protection barriers	Increased exposure to erosive agents (water, wind, sea waves)	Earthmoving	LS	LS		Use construction methods for each activity previously approved by the supervision	
	Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Increase in the impermeable area with pavement	NS				

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Soil			Movement of heavy equipment and machinery on the access roads to the quarries					
	Solid waste disposal in inadequate sites	Soil contamination	Operation of the construction site	S	NS	All deforestation, felling and tree felling should be limited to the areas of intervention	Carry out these activities in the period that does not coincide with the rest hours of the population of the surrounding area	
	Accidental spillage of hazardous products (fuel, oil, lubricants, concrete)		Circulation of equipment, machinery and vehicles used for transporting materials					
	Production of solid waste and liquid effluents		Demolition of existing infrastructure					
Geology	Extraction of materials from quarries	Change in the topography of the land (geomorphology)	Removal of vegetation cover/tree felling	LS	LS	Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exit from workings.	Contractors shall select a quarry with a licenses/permits from relevant authorities to operate quarry	Implementation of Quarries Landscape Restoration Plan
			Earthmoving					
	Moving equipment and machinery							
	Coastal erosion	Changing the topography of the land	Removal of vegetation cover/tree felling	LS	LS			

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures			
						Mitigate	Avoid	Eliminate	
Geology		(geomorphology)	Earthmoving			Extraction of materials shall clearly be demarcated and marked to minimize vegetation clearing, that prevents erosion.			
			Moving equipment and machinery						
Water resources	Water consumption	Consumption of water resources	Operation of the construction site	S	LS	Use of timer taps on drinking fountains, washbasins, in order to control water consumption.	Avoid water abstraction for the works that can endanger the supply of the population in the area affected by the project.		
			Cement preparation			Adopt measures to reuse water, whenever possible.			Regular maintenance of the water pipes on site to prevent possible leaks.
			Washing of concrete mixers, equipment and machinery			Implement a water consumption rationalization plan.			Avoiding water wastage during construction work activities.
	Dragging of sediments into water bodies (water turbidity)	Reduction in water quality	Earthmoving		S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Avoid carrying out earthworks during periods of heavy rainfall.	
The execution of earth moving works must be limited to a predefined area							Avoid earth moving in areas near water lines.	Water quality monitoring and reviewed at regular intervals and compared with the standards values to adopted corrective actions if necessary.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources			Removal of vegetation cover			All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.	Mark the trees to be cut down/felled in order to avoid unnecessary spillover of other tree species	
			Rehabilitation of the hydraulic crossings			Implement adequate drainage systems in the working areas in order to minimize erosion and the transport of solids.	The Contractor shall construct, maintain, remove and reinstall, as necessary, temporary drainage works and take all other necessary precautions to prevent the entrainment of sediment into water bodies.	
						Reduce construction time to what is strictly necessary next to water lines in order to reduce the dragging and deposition of sediments in their beds.	Restoration of the banks and beds of the watercourse.	
						During the rainy season of greatest intensity, the activities that generate earth movement must be controlled, in order to reduce the risks of erosion and the consequent transport of solids and sediments to the aquatic environments (water line).		
Waste production	Contamination of surface/groundwater	Solid waste disposal in inadequate sites	VS	S	All solid materials (CDW) deposited on the ground and all rubble should be removed, leaving the land clean.	After completion of the work at a particular site, all water lines and drainage systems that may contain residues resulting from the work should be cleaned, in	The elimination of dumps, open air solid waste landfills	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures				
						Mitigate	Avoid	Eliminate		
Water resources				[Red Cell]	[Orange Cell]	Collection of waste and packaging of hazardous products, which cause adverse effects on the environment	order to avoid water pollution problems.			
						No waste of any kind may be discharged into the sea, waterways or soil.				
	Production of liquid effluents		Maintenance and washing of equipment and machinery	[Orange Cell]	[Yellow Cell]	S	LS	Concrete mixer washing and machinery maintenance should take place in a waterproofed area.	There should be strict controls on the maintenance and/or repair of vehicles and working machinery, in order to avoid oil and fuel spills in water bodies.	
								No vehicles or machinery used in the construction work should be serviced outside the areas set aside for the site.	Define appropriate places for washing and maintenance of vehicles that include hydrocarbon separators.	
								Water containing a high concentration of oils and grease must be conveyed to a watertight tank on sealed ground.	Check that the non-return valve does not have any openings that allow liquid to escape from it.	
								Adequate treatment of wastewater must be provided at construction sites, quarries and sandpit.	Prohibit any untreated water drainage.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources							Regular observation of the machines to quickly detect possible leaks.	
			Disinfection of new water mains on the Marginal	LS				Use and application of disinfection product to be approved by the inspection body that does not cause impact on water quality.
	Storage and handling of dangerous products		VS	S	Proper storage and handling of fuels, oils, lubricants, paints, tar and other substances to prevent spills and leakages.	Storage areas should be properly marked and compartmentalized to avoid spillage.		
					Equip areas for the storage of fuel, oils and lubricants, among others, with retention basins.	In case of spillage into surface waters, collect the product with suitable absorbent material and then contact the national environmental agency.		
			All stored drums should be labelled, and safety and site signs should be displayed.	Raise awareness among workers on the correct handling of dangerous products.				
	Accidental spillage of hazardous products (fuel, oil, lubricants, concrete, asphalt)		Demolition of existing infrastructure including the widening of the drainage works CH 7+312	S	LS	Use more efficient construction methods when carrying out demolition or construction work, ensuring good environmental practices.	Placing signs on bridges and steep places to avoid the risk of accidents and spills.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources	Production of dust (turbidity)		Movement of equipment and machinery	S	LS		To make workers aware of the proper use of safe equipment and machinery in order to avoid accidents	
			Construction of revetment and armor ridge for coastal protection	S	LS	When carrying out earth moving work it should be done when the wind speed is moderate.		
			Earthmoving	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	All earthmoving activities must be limited to the areas strictly necessary for the execution of the work	Moisten the ground work areas regularly.
			Movement of equipment and machinery	S	LS	The movement of equipment and machinery during the dry season should be done at reduced speed.	Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	
	Deposition of waste and sediments	Interruption of drainage patterns	Removal of vegetation cover	LS	LS	All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.		
			Construction of revetment and armor ridge for coastal protection	LS	LS	After completion of the work at a particular site, all water lines and drainage systems that may contain residues resulting from the work should be cleaned to	Monitoring of the drainage infrastructures adjacent to the work, ensuring that they are unobstructed.	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Water resources						avoid obstruction and flooding.		
			Rehabilitation of culvert box structures CH 7+312	LS	LS	Replace all existing drainage infrastructure damaged by construction, immediately after notification of the occurrence.	Momentary obstructions should be resolved as quickly as possible in order to restore the runoff to its normal flow section, promoting natural drainage.	
	Siltation of water lines	Flooding (destruction of infrastructure)	Construction of revetment and armor ridge for coastal protection	S	LS	Intervention in hydraulic crossings should be carried out whenever possible in the period when there is less rainfall, spending as little time as possible and trying to alter the natural course of the water lines as little as possible, thus avoiding flooding.		
			Rehabilitation of hydraulic structure CH 7+312					
Earthmoving								
Removal of vegetation cover	All removal of vegetation cover, movement and deposit of materials must be limited to the areas strictly necessary for the work to be carried out.							
Natural resources	Fuel consumption (diesel, petrol)	Increased consumption of fossil fuels	Use of equipment and machinery	S	LS	Use low consumption vehicles	Carry out periodic maintenance of equipment and machinery on site	
						Use equipment and machinery with the power required for the work to be carried out	Scheduling and rationalizing vehicle movements	
	Electricity consumption		Use of electrical equipment	S	LS	Use more efficient equipment.	Carry out periodic maintenance of electrical equipment	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Natural resources		Increase in electricity consumption	Lighting of premises (building site)	S	LS	Use energy-saving/more efficient light bulbs	Regularly check the operation of the lamps	
							Control of electric energy consumption	
	Consumption of construction materials (stones, sand, wood, etc.)	Increased consumption of construction materials	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	If necessary, to export the materials required for the work, so as not to cause a shortage of materials on the domestic market and, consequently, create a conflict situation with the local population	Schedule the activities according to the number of materials to be used during the construction work	
			Cement preparation					
	Water Consumption	Increased water consumption	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS		Carry out monitoring of water consumption	
			Cement preparation					
Landscape	Introduction of foreign elements that disturb the landscape	Landscape alteration	Removal of vegetation cover	LS				
			Earthmoving	LS				
			Moving equipment and machinery	LS				
			Presence of fence	S	LS	Place fence with viewing panel or viewing		

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Landscape	Destruction of vegetation cover	Visual impact		S	LS	windown hole to allow road users see sea, satisfy and satisfy curiosity in a safe way.		
			Removal of vegetation cover			All removal of vegetation cover must be limited to the areas strictly necessary for the work to be carried out.	Replacing the vegetation cover	Planting of 36 trees
			Earthmoving			The introduction of exotic/alien species should not be used to restore the vegetation cover.		
			Moving equipment and machinery			All earthmoving work shall be limited to the areas strictly necessary for the execution of the work.		
						The definition of temporary accesses should avoid the felling of vegetation, and favor the use of existing access paths.		
		The circulation of vehicles and machinery supporting the work should be rationalized.						
Biodiversity	Noise emission	Disturbance of the Terrestrial Ecosystem (Flora and Fauna)	Earthmoving	LS		The movement of equipment and machinery should be limited to the construction zone.		

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Biodiversity			Handling of heavy equipment and machinery	LS				
			Road rehabilitation, coastal protection	LS				
			Removal of vegetation cover	LS				
	New habitats for birds' nest, breeding and rest		Grubbing 2 <i>Terminalia cattapa</i> (caroceiro) and planted 36 ; 15 <i>Vachellia karroo</i> (Karroo acacias) and 21 tamarinds.	LS				
Accidental spillage of hazardous products (fuel, oil, lubricants, concrete)	Disturbance and degradation of the marine ecosystem	Earthmoving	LS		Reduce the area of any and all interventions on natural habitat sites.			

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Biodiversity	Alteration of water quality		Handling of heavy equipment and machinery	LS		Integrate into the code of conduct rules, procedures and prohibitions regarding the interaction of construction site employees with wildlife present in the area to be intervened: including hunting, touching, handling or collecting a (unless required to implement mitigation).	Implement penalties for employees and contractors who violate the code of conduct. Training all staff on the value of biodiversity and the importance of its conservation	
	Sea turtle nesting beaches disturbance			S	LS		Avoid construction works in beaches from October to April Awareness campaign for workers	
	Noise		Coastal protection Construction of revetment, armor crest	S	LS		Implementation of Sea Turtles Management Plan	
	Alteration of the intertidal habitat	Loss of Biodiversity and affectation of Fauna and Flora in the Intertidal Area	Coastal protection	S	LS	The movement of equipment and machinery should be limited to the construction zone.	Create a procedure in case a turtle nest is found, in order to transfer it to another beach, to be carried out in partnership with NGOs with experience in this area. Planning of works to avoid intervention in interstitial habitats during peak nesting periods for turtles (October – April)	
Occupational Health and Safety	Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and	Use of equipment and machinery	S	LS	Inform about the sanctions applicable in the event of non-	Training on the proper use of equipment and machinery	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Occupational Health and Safety		health conditions at work				compliance with hygiene and safety rules at work.		
						Provide information and training to workers in the tasks, in the use of equipment of the equipment and the correct techniques for handling loads		
				Use of personal protective equipment (PPEs)				
		Ensuring occupational safety for workers		The site and the different work fronts must be equipped with all the necessary materials and means to respond in incident/accident situations				
	Allocating health insurance for workers							
	Sufficient breaks must be implemented and organized to ensure that sufficient breaks should be implemented and organized to ensure that there is rest, especially in very hot conditions.							
Road traffic accidents	Vehicle damage	Reduced quality of life	Circulation of equipment, machinery and vehicles used for transporting materials	S	LS	Installation of adequate signage in and around the area where the work is being carried out	Conducting road safety training	
	Reduced quality of life					S	LS	The access of non-contracted personnel

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Occupational Health and Safety	Dust emission	Harmful effects on the workers' respiratory system				should be prevented or, if possible, forbidden.	Installation of signposting during the works	
			Earthmoving	S	LS	Adopt measures to minimize dust emission	Use of appropriate personal protective equipment (PPE)	
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)			Monitoring the state of health of each worker		
	Demolition of existing infrastructure							
	Noise emission	Harmful effects on workers' hearing systems	Moving equipment and machinery	VS	LS	Periodic maintenance of equipment and machinery	Installation of silencers on equipment and machinery, avoiding noise pollution	
			Infrastructure construction (road, hydraulic structures and coastal protection, etc.)			Application of more efficient and less noisy construction methods, taking into account the period of execution of the works	Use of appropriate personal protective equipment (PPE)	
Demolition of existing infrastructure								
Community Health and Safety	Accidents falls	Reduced pedestrian safety	Use of construction material transport	S	LS	Installation of adequate signage in and around	Placing a signalman at pedestrian crossings, ensuring that vehicles stop before crossing	

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety		Reduced quality of life	equipment and machinery and vehicles	S	LS	the area where the work is being carried out	The intervention areas should be marked and, where appropriate, fenced	
		Reduced quality of life		S	LS		Access by non-contract staff should be prevented or, if possible, forbidden.	
	Road traffic accidents/triot-trespassing	Reducing road safety	Circulation of equipment, machinery and vehicles used for transporting materials	S	LS		Due the presence of National Lyceum is recommended that transportation activities been carry out during off peak hours and avoid early morning a before school starts and afternoon after school finishes. Conduct education to schools c for the road safety by closely with local people including NGOs Near schools the Contractor shall provide sufficient signs and flagmen to traffic control. Construction near schools should have crossing and be designated safe school routes	
	Dust emission	Harmful effects on the population's respiratory system	Earthmoving	S	LS	Moisten the whole area to be treated, reducing the production of dust	Inform the population of the time of execution of the works, bearing in mind that the operations may take a long time, thus avoiding possible effects on the population's health	
			Removal and replacement of pavement layers			Implement more efficient and less time-consuming techniques and/or construction methods during the execution of the operations		
			Demolition of existing infrastructure					

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety	Noise emission	Harmful effects on the population's hearing system	Moving equipment and machinery	S	LS	Where there are dwellings, which are mainly at the access points to the site, vehicles should preferably be moved during daylight hours and on weekdays.	Encourage drivers to apply reduced speed in residential areas	
						Select less noisy equipment		
						Install noise barriers	Develop mechanism to record and respond to complaints	
						Install silencers on some equipment, when possible		
						Locate noise sources to fewer sensitive areas to take advantage of advantage of distance and natural barriers		
						Build up the construction areas (concrete plants, tar plants quarries, etc.) and construction sites away from communities whenever possible		
Vehicles and equipment should be inspected regularly to ensure them ensure their proper operation and minimize noise emission								

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Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety			Demolition of existing infrastructure			The works should be carried out during periods not coinciding with the times when the population of the surrounding area is in their homes	Inform the population of the time of execution of the works, bearing in mind that the operations may take a long time, thus avoiding possible effects on the population's health	
			Removal and replacement of pavement layers				Implement a Communication Plan with the population of the surrounding area to disseminate information about the constraints of the project	
Waste management	Production of construction and demolition waste (buildings, floors, pipes, etc.)	Occupation of public space		S	LS	Verify the type and classification of the waste to be produced and provide for its segregation, adapting it to the needs, quantities and characteristics of the containers to be placed on the site for temporary storage.	Correct separation of the waste generated at the site, thus avoiding mixing of waste and subsequently promoting a reduction in the volume of CDW to be treated	
						Evaluate, whenever possible, the possibility of reusing waste in other work processes	To promote the recovery and reuse of waste generated on construction sites.	
						Evaluate the construction techniques taking into account the minimization of waste production (CDW)	All surplus material, rubble, scaffolding and the like must be removed at the end of the work.	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Waste Management						After unloading the concrete, the truck mixers should be cleaned to remove concrete residues from the mixers.	To assign an adequate final destination to all the demolition and construction waste (CDW) produced during the works, complying with the national legislation in force	
	Waste water production	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	All waste that may generate effluents contaminated by rainwater percolation must be stored in a covered park.	Installation of sewage and sanitation networks for the protection of marine and territorial waters	
		Harmful effects on the health of workers and community	Kitchen and sanitary installations in the Construction site and sanitary installations in the work fronts.	S	LS	Installation of septic tanks to treat domestic wastewater generated on site, avoiding direct discharge into the natural waterways	Implement the control system for waste water produced during activities	
	Production of hazardous waste	Harmful effects on the health of workers and community	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	MS	S	Carry out regular and adequate maintenance of the water treatment system in order to ensure its cleanliness and avoid obstructions	Site Plan should have a solution for waste water treatment to be approved by supervision	
						All waste classified as hazardous, such as used oils, lubricants, paints and solvents, as well as waste contaminated by oils, should be properly conditioned and stored in an appropriate place.	The oils used in the periodic maintenance of the equipment and machinery should be collected and stored in suitable containers and then transported for proper hazardous waste treatment.	

Factor	Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Waste management			Demolition of existing infrastructure	S	LS		Safe transportation of hazardous waste to the appropriate licensed final destination	
	Use of wastes	Using locally recycled glass	Building n of benches	S				
	Production of domestic waste	Harmful effects on the health of workers and community	Kitchen and sanitary facilities in the Construction site and sanitary facilities at the work fronts	S	LS	On site there should be containers for the collection of this type of waste, allowing the separation of this waste from industrial, hazardous and non-hazardous waste. For organic waste, composting solutions should be preferred.	Implementation of devices for selective collection, transport and recovery or final destination of domestic waste	Disposal of deposits, landfills of domestic waste in the open air

Table 68 Environmental Mitigation Measures – Construction Phase. Pantufo Coastline

14.3.2 DEMOBILIZATION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Climate and climate change	Fuel consumption	Greenhouse effect/climate change	Machinery handling	LS	LS	Proper maintenance of equipment to ensure efficient operation		
	Oil and lubricant consumption		Use of electromechanical equipment and machinery	LS	LS	Monitoring of equipment fuel consumption	Forward planning to ensure efficient operations, including works planning	
	Electricity consumption		Use of electrical equipment	LS	LS	Use equipment that promotes energy efficiency		
	Reduction of CO2 sequestration		Lighting of premises (building site)	LS	LS	Use of low energy consumption LED lamps		
	GHG emissions		Transport emissions from vehicles and equipment	LS	LS	Proper maintenance and transports planning to ensure reduce of emissions		
Air quality	Emission dust on roadways	Alteration of air quality (PM5 and PM10)	Use of equipment and machinery	LS		The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.	Carrying out regular maintenance on vehicles and equipment	
	Emissions (CO2, CO, NOX, SOX, HC, VOC's)	Alteration of air quality	Movement of vehicles	LS		The movement of equipment and machinery during the dry season should be done at reduced speed. Use equipment with low air pollutant emissions. Washing of wheels whenever temporary tracks are used, which lead to greater suspension of particles (dust) in the atmosphere.	Avoid obstacles to fluid circulation Carrying out regular maintenance on vehicles and equipment Use of filters on machinery and changing filters regularly.	
			Removal of equipment					
	Increase of Noise	Noise and vibration emission	Increase in vehicle circulation	S	LS			

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Noise			Use of equipment and machinery			Reduce the speed of vehicles during works	Carry out regular maintenance of equipment and machinery to detect possible malfunctions	No night time demoblzatiion activities
			Removal of equipment					
Removal of demolition rubble								
Noise		Effect on the health of the population in the surrounding area	All the operation of clearing equipment, infrastructures and waste removal	LS	LS			
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)	Soil contamination	Handling of heavy equipment and machinery at the access to the construction site	S	LS			
	Production of demolition waste		Removal of equipment					
	Disposal of demolition waste in inappropriate places		Demolition of support infrastructures (office, kitchen, bathrooms, etc.)					
	Soil permeabilization and decompaction	Increased infiltration of water into the soil	Restoration of the affected area: reforestation	S				
Water resources	Disposal of demolition waste in inadequate sites	Contamination of surface/groundwater	Removal of demolition rubble	LS				

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Water resources	Accidental spillage of hazardous products (fuel, oil, lubricants)		Use of equipment and machinery	S	LS			
			Moving equipment and machinery					
			Removal of equipment					
			Removal of demolition rubble					
	Sediment drift into watercourses (turbidity, TSS)	Reduction in water quality	Vehicle circulation	S	LS	Intervention should be carried out whenever possible in the period when there is less rainfall, spending as little time as possible.		
			Use of equipment and machinery					
			Removal of demolition rubble					
Waterproofing and soil compaction	Reduction of the water infiltration process into the soil	Heavy goods vehicles on the access to the Construction site	LS					
		Removal of rubble						
Soil permeabilization and decompaction	Increased infiltration of water into the soil	Reforestation	S					
Natural resources	Fuel consumption (diesel, petrol)	Decrease of Fossil fuel consumption	Decreased use of vehicles	S				
	Electricity consumption	Decrease of Electricity consumption	Removal of lamps and electrical equipment on construction site	S				

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Natural resources	Water consumption	Decrease of water consumption	Cessation of activities	S				
Landscape	Destruction of vegetation cover	Landscape alteration	Moving equipment and machinery	LS				
			Removal of demolition rubble					
	Introduction of foreign elements that disturb the landscape	Visual impact	Moving equipment and machinery	LS				
	Restoration of vegetation cover	Improving the landscape	Restoration of the affected area: reforestation, soil decompaction	S				
Biodiversity	Noise emission	Removal of animals	Vehicle movement	LS			Avoid construction works in beaches from October to April	
			Removal of equipment					
	Recovery of natural areas	Increase in natural areas	Biophysical restoration of the affected area	S				

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Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Biodiversity	Accidental spillage of hazardous products (fuel, oil, lubricants)	Destruction of ecosystems	Heavy goods vehicles on the access to the Construction site	LS				
Occupational Health and Safety	Dust emission	Harmful effects on the workers' respiratory system	Movement of vehicles carrying rubble	S	LS	Adopt measures to minimize dust emission.		
			Use of equipment and machinery			Monitoring the state of health of each worker		
			Removal of demolition rubble					
	Noise emission	Harmful effects on workers' hearing systems	Heavy goods vehicles on the access to the Construction site	S	LS	Ensuring occupational safety for workers		
			Use of equipment and machinery			Application of more efficient and less noisy methods, taking into account the period of execution of the works		
			Removal of demolition rubble					
	Accidents at work (falling, tripping, cuts,)	Reduction of hygiene, safety and health conditions at work	Use of equipment and machinery	VS	S	Allocating health insurance for workers	Use of appropriate personal protective equipment (PPE)	
						Ensuring occupational safety for workers	Training on the proper use of equipment and machinery	
		Reduced quality of life	Removal of demolition rubble	VS	S	Sufficient breaks must be implemented and organized to ensure that there is rest, especially in very hot conditions	Installation of signposting during the works	

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Occupational Health and Safety	Road traffic accidents	Vehicle damage	Movement of machinery and vehicles used for the transportation of demolition debris	LS		Provide information and training to workers in the tasks, in the use of equipment of the equipment and the correct techniques for handling loads	Conducting road safety training	
		Reduced quality of life		S	LS	Inform about the sanctions applicable in the event of non-compliance with hygiene and safety rules at work.		
Community Health and Safety	Road traffic accidents	Vehicle damage	Movement of vehicles	LS	NS	Installation of road signs to warn the community about the circulation of vehicles and machinery during the demobilization operation.	Carrying out an awareness campaign with the community in order to avoid possible accidents.	
		Reduced quality of life	Use of equipment and machinery					
	Dust emission	Harmful effects on the respiratory system	Movement of equipment and machinery	LS	NS	Promote the circulation of vehicles at low speed in areas close to populations/residences.		
			Removal of demolition rubble			Use moistening the material to be collected if it is powdery.		
	Noise emission	Harmful effects on the hearing system	Movement of equipment and machinery	LS	NS	Use more effective and less noisy rubble removal techniques.	The execution of the works must take into account the population's rest period, prohibiting activities between 10pm and 7am.	
			Removal of demolition rubble					

Environmental and Social Impact Assessment

Factor	Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
						Mitigate	Avoid	Eliminate
Waste management	Production of solid waste	Waste disposal in inappropriate places	Removal of demolition rubble	S	LS	The concrete material removed can be crushed and reused in the construction industry as filler material in paving bases for roads.	To recover and reuse the materials resulting from the demolition.	
			Removal of demolition rubble	S	LS	The metallic materials removed from the equipment should be taken to the final destination to be integrated in appropriate recycling processes.		
	Production of liquid effluents	Soil contamination	Maintenance of machinery and equipment	S	LS	The oils should be collected, transported and taken to their final destination, receiving the appropriate hazardous waste treatment.		

Table 69 Mitigation Measures Environment– Demobilization . Pantufo Coastal

14.3.3 OPERATION PHASE

Factor	Aspect	Impact	Activity	Significance of Impact without measure	Significance of Impact With Measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Climate and climate change	Consumption of fuel, oils and lubricants	Greenhouse effect/climate change	Traffic increase	S				
	Electricity consumption		Lighting of premises (street lamps)	LS				
	Coastal Protection		Presence of Coastal protection infrastructures	S				
	Drainage System		Requalification of drainage system	S				
Air quality	Reduction of dust generation on roadways	Alteration of air quality	Traffic generated by operation of infrastructures	S				
	Emissions (CO ₂ , CO, NO _x , SO _x , HC, VOC's)	Improvement of air quality	Presence of more 34 trees and green spaces	S				
Noise	Increase of Noise	Noise and vibration emission	Circulation of motorized and non-motorized transports	S				
		Effect on the health of the population in the surrounding area	Increased vegetation cover (sound barrier)	LS				
Soil	Coastal protection works	Reduced exposure to erosive agents (water, wind, sea waves)	Presence of Coastal Protection Works	VS				
	Disposal of solid urban waste in inadequate locations	Soil contamination	Increased flow of people	LS		Prohibit the disposal of municipal solid waste (MSW) on the ground.		

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Factor	Aspect	Impact	Activity	Significance of Impact without measure	Significance of Impact With Measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Soil	Accidental spillage of hazardous products (fuel, oil, lubricants)		Reduction of traffic accidents					
	Production of solid waste and liquid effluents		Existence of bins for rubbish disposal					
Water resources	Disposal of urban solid waste in inadequate locations	Contamination of surface/groundwater	Increased flow of people	NS				
	Accidental spillage of hazardous products (fuel, oil, lubricants)		Traffic accidents (increase in traffic)	S				
	Natural drainage	Improving the drainage capacity of structures	Construction of climate-resilient drainage works	S				
Natural resources	Decreased fuel consumption (diesel, petrol)	Fossil fuel consumption	Circulation of motorized and non-motorized transports	S				
	Electricity consumption	Increase of Electricity consumption	Lighting of premises (street luminary, park luminary)	LS	LS	Use of more efficient, low consumption light bulbs	Carry out periodic maintenance of the lamps to detect malfunctions, avoiding excessive consumption of electricity	
	Water consumption	Increase of water consumption	Green spaces and 3 fountains	LS	LS			
Landscape	Rehabilitation of the image of the Marginal	Improving the image of the Marginal Visual	Rehabilitation of the landscape, with an	VS				

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Factor	Aspect	Impact	Activity	Significance of Impact without measure	Significance of Impact With Measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Landscape			increase in green spaces, urban equipment (benches), litter bins, children's playgrounds, cycle paths, etc.					
	Noise emission	Removal of marine animals (turtles)	Increased traffic flow	LS				
			Increased flow of people					
			Increase in goods and services					
	Decrease of ecological areas	Alteration of ecological areas	Construction of coastal protection	S				
Accidental spillage of hazardous products (fuel, oil, lubricants)	Destruction of marine ecosystems	Road accidents	LS					
Biodiversity	Noise emission	Removal of marine animals turtles species (<i>Chelonia mydas</i> ; <i>Lepidochelys olivacea</i> ; <i>Eretmochelys imbricata</i> and <i>Dermochelys coriacea</i>)	Increased flow of people	S	LS	Continuation of Tatô 's monitoring Program		
	Light emission		Increase in goods and services					
	Loss of habitats or/and completion between species	Alteration of ecological areas	Lighting of premises (street luminary)	S	LS	Lighting effects monitoring		
	Creation New habitats (rocks and sand areas)		Coastal protection Presence of coastal protection	S	LS		Sea Turtles Management Plan	
				S				

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Factor	Aspect	Impact	Activity	Significance of Impact without measure	Significance of Impact With Measure	Mitigation Measures			
						Mitigate	Avoid	Eliminate	
Biodiversity	Accidental spillage of hazardous products (fuel, oil, lubricants)	Degradation of marine ecosystems	Road accidents	LS					
Community Health and Safety	Improving road safety	Reduction in the number of accidents	Movement of vehicles	VS			Awareness population about safe cycling and new cycle lanes and pedestrian paths		
			Vertical signage				Awareness population about safety signage and new rules of traffic circulation, speeds, use restricted of cycle lanes for bicycles		
			Pedestrian crossings						
			Lighting of premises (streetlamps)			As supply of energy is not reliable it is mandatory it's mandatory that at night cyclists use reflectors in bicycles and reflector vest			
	Dust emission	Harmful effects on the respiratory system	Road maintenance		LS		Avoid maintenance work on windy days in order to control the incidence of this impact		
	Noise emission	Harmful effects on the hearing system	Road maintenance		LS		Select less noisy equipment Limit the working hours for certain mobile		

Factor	Aspect	Impact	Activity	Significance of Impact without measure	Significance of Impact With Measure	Mitigation Measures		
						Mitigate	Avoid	Eliminate
Community Health and Safety						machinery particularly in conurbations		
	Drinking water	Improve of healthy habits	Existence of bins for rubbish disposal	S				
Waste management	Production of solid and liquid waste	Disposal of wastes on curbside and track	Existence of bins for rubbish disposal	S		Prohibit the disposal of municipal solid waste (MSW) on the ground.	Carrying out campaigns among the population on the proper disposal of wastes Raise of awareness with incentives to keep beach clean	Regular beach cleaning

Table 70 Environmental Mitigation Measures – Operation Phase. Pantufo Coastline.



15. MITIGATION AND ENHANCEMENT MEASURES FOR SOCIAL IMPACTS

The enhancement measures proposed for positive impacts in construction phase are:

- Communicate job opportunities that can be filled by residents of local communities, giving especially attention to the most vulnerable, promoting local development and increased income;
- Is recommended that local commerce whenever possible is prioritize in the purchase of products and services, enhancing the positive impact;
- Implementation of Human Resources Management Plan.

One suggestion is to use a construction works fence at Marginal painted by local artists.

Jobs creation and success of project in operation phase could be enhance by implementation of the following measures:

- creation of a plant nursery for green spaces maintenance including caroceiro *Terminalia cattapa* L.;
- creation of a road safety training center, with focus awareness for road safety of non-motorized transports as bicycle;
- Training for creation of handicrafts with fish scales for sell to tourists;
- carry out awareness campaigns on open defecation and health;
- carry out awareness campaigns on beaches and mining and worsen effects of climate changes.

The following tables presented mitigation measures for the 3 lots: Lagarto Bay, Ana Chaves Bay and Pantufo Coastline

15.1 LAGARTO BAY

15.1.1 CONSTRUCTION PHASE

Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of impact With Measures	Mitigation measures		
					Mitigate	Avoid	Eliminate
Employment	Job creation	Earthmoving	VS				
		Removal of vegetation cover	VS				
		Infrastructure construction (roads, coastal protection, etc)	VS				
Direct and indirect income generation	Increased demand for housing and food consumption	Hiring staff for the works	S				
Stimulating economic activities	Increased tax collection	Hiring staff; purchasing inputs and equipment and contracting services	S				
	Increase in coins in circulation	Consumption by workers and commercials	S				



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Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of impact With Measures	Mitigation measures		
					Mitigate	Avoid	Eliminate
Limitations on beach access	Distancing bathers and tourists	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	VS	S	Create parking lots in safe locations away from the construction sites	Creation of circulation routes for pedestrians, thus avoiding the exposure of people to moving vehicles	
Increase in the number of heavy vehicles for transporting materials	Increase of traffic	Circulation of heavy vehicles for transporting materials on the access roads to the construction site .	S	LS	Install adequate signage in work areas, indicating alternative routes, speed restrictions speed restrictions and detours on Installation of adequate signage indicating entry and exit of heavy vehicles	Collaborate with local communities in road safety education particularly in schools or other places of concentration of pedestrians particularly children	
	Road Damage	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	S	LS	When road damage cannot be avoided, restore as it was before the work.		
Occupation of public space and roads	Population Influx on the beach	Infrastructure construction (roads, coastal protection, etc.)	S	LS	Create, limit space for beachgoers and car parking for people using the beaches	Signposting temporary access roads to the beaches	
	Limitation to sports activities (walking,	Infrastructure construction (roads, coastal	S	LS	Create circulation routes for pedestrians thus avoiding the	Inform about access restrictions, and alternatives whenever these are planned	

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Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of impact With Measures	Mitigation measures		
					Mitigate	Avoid	Eliminate
	running, cycling)	protection, etc.)			exposure of people to moving vehicles.		
	Disruption of daily activities and the movements of people and vehicles	Circulation of heavy vehicles for transporting materials on the access roads to the construction	VS	LS	<p>Hire and train signalmen to orient drivers and pedestrians in high-traffic areas and pedestrians in high-traffic areas</p> <p>Use a safe passage over the ditches that will be opened, in order to minimize inconvenience to the local population.</p>	Inform about traffic restrictions, whenever these are planned	
Cultural and Traditional Aspects	Affecting the holding of festivals and end-of-year parties on the beaches	Works, infrastructure construction (roads, coastal protection, promenades, etc),	S	LS	Create an alternative space on the coastline where the New Year's Event can be celebrated and the traditional washing of the year can take place	<p>Dissemination of information to communities about alteration of traditional events.</p> <p>Inform workers about Archeological Find Procedures.</p> <p>Any intervention that has direct relations with objects of historical-cultural value must have the approval of the historical-cultural heritage authorities of STP.</p>	
Infrastructures	Interruption of supply of infrastructure services such as water, energy, sanitation	Infrastructure construction (roads, coastal protection, etc)	LS			Dissemination of information on the interruption of services to communities.	
	Road damage	Circulation of heavy vehicles for	LS		Restore the pavement as it was before the work		

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Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of impact With Measures	Mitigation measures		
					Mitigate	Avoid	Eliminate
		transporting materials on the access roads to the construction sites					
Women's participation in economic activities	Business opportunities through itinerant businesses or in areas bordering the works	Infrastructure construction (roads, coastal protection, etc)	S				
	Increased family income due to participation in benches construction	Building benches with recycled glass	S				
Significant migration of workers to the site	Increased risk of sexual harassment and gender-based violence	Infrastructure construction (roads, coastal protection, etc)	VS	S	Implementation of a Complaints Redress Mechanism for workers and communities	Raising employees' awareness and obligation to respect the individual Code of Conduct Awareness of workers about gender violence	
Contact between workers, people from the community	Increase in incidence of contagious diseases COVID 19 sexually transmitted infections STIs	Infrastructure construction (roads, coastal protection etc)	S	LS	Implementation of preventive measures Covid 19 Plan	Awareness raising among employees and obligation to respect the individual Code of Conduct. Awareness-raising actions and prevention measures. Distribution of condoms. All workers have to sign codes of conduct that instruct them on prohibited behaviors and ethical expectations	



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Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of impact With Measures	Mitigation measures		
					Mitigate	Avoid	Eliminate
Unacceptable behaviour according to local social standards	Conflicts between workers and local community	Infrastructure construction (roads, coastal protection, etc)	S	LS		<p>Reinforce the importance of maintaining a good relationship with local communities with workers;</p> <p>Among local workers there should be a community liaison group responsible for establishing communication between project staff and the community, which will be particularly important in cases of conflict. This group should be familiar with the project in general and be able to properly to properly clear up any difficulties or pass on any complaints/claims.</p> <p>All workers have to sign codes of conduct that instruct them on prohibited behaviors and ethical expectations</p>	

Table 71 Social Mitigation Measures. Construction Phase. Lagarto Bay

15.1.2 DEMOBILIZATION PHASE

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigations Measures		
			Without measure	With measure	Mitigate	Avoid	Eliminate
Employment	Increased of skilled workers	End of Construction site and demobilization activities	LS				
Accidental spillage of hazardous products (fuel, oil, lubricants)	Road Damage	Vehicle circulation	S	LS			Restore the pavement as it was before the works.
		Road accidents					
		Removal of rubble					
Noise generation	Disturbances to the health, comfort and property of the population	Circulation of equipment and machinery	S	LS	Periodic maintenance of equipment and machinery Application of more efficient and less noisy construction methods, taking into account the period of execution of the works		
		Removal of demolition rubble					
Emission of dust and CO ₂ , CO, NO _x , SO _x , HC, VOC's	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	S	LS	The transportation of earth should be done in closed box trucks with a cover to reduce particulate emissions.		
	Reduced quality of life	Removal of demolition rubble	S	LS	The transportation of demolition rubble should be done in closed box trucks with a cover to reduce particulate emissions.		
Road traffic accidents	Impacts in health, Injuries, deaths	Circulation of machinery and vehicles used for the	LS			Traffic Management Plan Implementation	



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Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigations Measures		
			Without measure	With measure	Mitigate	Avoid	Eliminate
	Reduced quality of life	transportation of demolition rubble	S	LS	Placing a signalman at pedestrian crossings, ensuring that vehicles stop before crossing		

Table 72 Mitigation Measures Social Impacts - Demobilization Phase. Lagarto Bay

15.1.3 OPERATION PHASE

Aspect	Social impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
					Mitigate	Avoid	Eliminate
Employment	Creation of jobs	Maintenance activities of the entire infrastructure	S				
Improved Accessibility	Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost	Operation of the road with pavement and signage improvements,	S				
	Improved access to the coastline and capital city centre, reduced travel time and cost	Operation of the road with pavement and signage improvements,	S				
	Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3	Operation of the road with pavement and signage improvements,	S				
	Improved access and reduced cost and time at the only referral hospital in the country	Operation of the road with pavement and signage improvements,	S				
	Improved accessibility to various institutions and services	Operation of the road with pavement and signage improvements,	S				

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Aspect	Social impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
					Mitigate	Avoid	Eliminate
Road safety	Improvement of road traffic safety conditions	Operation of the road with pavement and signage improvements	VS				
	Improvement of safety conditions in pedestrian circulation	Operation of the road with pavement and signage improvements	VS				
	Increased protection from flood, coastal erosion and storm surge risks	Strengthening coastal protection	S				
Sports practice on the Marginal	Greater number of sports practitioners	Pavement rehabilitation, green spaces, signposting, pedestrian crossings on the Marginal	S				
	Better conditions for sports on the waterfront	Landscaping, green spaces, pavement, cycle track, children's playground, public toilets	S				
Attractiveness of the capital and its seafront	Modernization and revitalization of the seafront	Landscaping, green spaces, cycle path, children's playground, public toilets	S				
	Increase in the number of people on the beaches and the Marginal	Landscaping, green spaces, cycle path, children's playground, public toilets	S				



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Aspect	Social impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
					Mitigate	Avoid	Eliminate
	Creating a new image for our capital city and country		VS				
	Improving the quality of urban space		VS				
Working conditions in the communities affected by the project	Improvement of the conditions for the development of economic activities in the communities affected by the project	Laundry in Lagarto Bay	VS				

Table 73 Social Mitigation Measures – Operation Phase. Lagarto Bay

15.2 ANA CHAVES BAY

15.2.1 CONSTRUCTION PHASE

Aspect	Impact	Activity	Significance of Impact Without measures	Significance of impact With measurements	Mitigation measures		
					Mitigate	Avoid	Eliminate
Hiring of labor	Job creation	Earthmoving	VS				
		Removal of vegetation cover	VS				
		Infrastructure construction (roads, coastal protection, etc)	VS				
Direct and indirect income generation	Increased demand for housing and food consumption	Hiring staff for the works	S				
Stimulating economic activities	Increased tax collection	Hiring staff; purchasing inputs and equipment and contracting services	S				
	Increase in coins in circulation	Consumption by workers and commercials	S				
	Allocation of income of the	Road rehabilitation,	S	LS	Implementation of A-RAP		



Environmental and Social Impact Assessment



Aspect	Impact	Activity	Significance of Impact Without measures	Significance of impact With measurements	Mitigation measures		
					Mitigate	Avoid	Eliminate
Displacement of economic activities	population (fruit stand, fishermen, fish sellers, etc)	construction of hydraulic structures and coastal protection, etc.					
	Relocation of economic activities/livelihoods (palaies), fishermens, etc	Infrastructure construction (roads, coastal protection, etc)	S	LS			
Limitations on beach access	Distancing bathers and tourists	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	VS	LS	Create, limit space for beachgoers and car parking for people using the beaches	Signposting temporary access roads to the beaches	
Increase in the number of heavy vehicles for transporting materials	Increase of Traffic	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	VS	LS	Inform the population in good time about any traffic diversions or changes to traffic circulation	Signposting temporary access roads to the beaches	
	Road damage	Circulation of heavy vehicles for transporting materials on the access roads to the	S	LS	Restoring the pavement as it was before the work		



Environmental and Social Impact Assessment



Aspect	Impact	Activity	Significance of Impact Without measures	Significance of impact With measurements	Mitigation measures		
					Mitigate	Avoid	Eliminate
		construction site					
Occupation of public space and roads	Population Influx on the beach	Infrastructure construction (roads, coastal protection, etc.)	S	LS	Create, limit pedestrian and car parking space	Signposting safe routes for pedestrians	
	Limitation to sports activities (walking, running, cycling)	Infrastructure construction (roads, coastal protection, etc.)	S	LS		Creation of alternative routes for pedestrians and sports practitioners	
	Disruption of Daily activities and the movements of people and vehicles	Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	VS	LS	Inform the population in good time about any traffic diversions or changes to traffic circulation	Implementation of the Traffic Management Plan	
Cultural and Traditional Aspects	Degradation of the built cultural heritage with the appearance of cracks	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS		Preparation of a report with a photographic record of cultural heritage, including colonial houses. Contractor should select equipment that does not emit high values of vibrations and submit to approval of supervision.	
		Circulation of heavy vehicles for	S	LS			



Environmental and Social Impact Assessment



Aspect	Impact	Activity	Significance of Impact Without measures	Significance of impact With measurements	Mitigation measures		
					Mitigate	Avoid	Eliminate
Cultural and Traditional Aspects		transporting materials on the access roads to the construction sites					
	Allocation of the celebration of popular festivities in the locality of São Pedro	Works, infrastructure construction (roads, coastal protection, promenades, etc),	S	LS	Create an event for fishermen where they can celebrate in a more restricted way	Dissemination of information to communities.	
	Affecting the holding of festivals and end-of-year parties on the beaches	Works, infrastructure construction (roads, coastal protection, promenades, etc),	S	LS	Create an alternative space on the coastline where the New Year's Eve can be celebrated and the traditional washing of the year can take place	Dissemination of information to communities.	
Infrastructures	Interruption of supply of infrastructure services such as water, energy, sanitation	Infrastructure construction (roads, coastal protection, etc)	LS	LS		Dissemination of information on the interruption of services to communities	
Limitations on women's participation in economic activities	Business opportunities through itinerant businesses or in areas bordering the works	Infrastructure construction (roads, coastal protection, etc)	S				

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Significance of Impact Without measures	Significance of impact With measurements	Mitigation measures		
					Mitigate	Avoid	Eliminate
	Increased family income due to participation in bank construction	Building benches with recycled glass	S				
Significant migration of workers to the site	Increased risk of sexual harassment and gender-based violence	Infrastructure construction (roads, coastal protection, etc)	vs.	S		Raising employees' awareness and obligation to respect the individual Code of Conduct	
Contact between workers, people from the community	Increase in incidence of contagious diseases COVID 19 sexually transmitted infections STIs	Infrastructure construction (roads, coastal protection, etc)	S	LS		Awareness raising among employees and obligation to respect the individual Code of Conduct. Awareness-raising actions and prevention measures. Distribution of condoms.	
Participation of vulnerable groups	Inadequate participation of VG not meeting their needs fruit sellers	Infrastructure construction (roads, coastal protection, etc)	LS	LS		Continue to ensure participation of VG in consultations know livelihoods to avoid loss of income	
Unacceptable behavior according to local social standards	Conflicts between workers and local community	Infrastructure construction (roads, coastal protection, etc)	S	LS			

Table 74 Social Mitigation Measures. Construction Phase. Ana Chaves Bay

15.2.2 DEMOBILIZATION PHASE

Aspect	I Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
					Mitigate	Avoid	Eliminate
Employment	Increased of skilled workers	End of Construction site and demobilization activities	LS				
Accidental spillage of hazardous products (fuel, oil, lubricants)	Road Damage	Vehicle circulation	S	LS			Restore the pavement as it was before the works
		Road accidents					
		Removal of rubble					
Noise generation	Disturbances to the health, comfort and property of the population	Circulation of equipment and machinery	S	LS	Periodic maintenance of equipment and machinery		
		Removal of demolition rubble			Application of more efficient and less noisy construction methods, taking into account the period of execution of the works		
	Reduced quality of life	Removal of demolition rubble	S	S	The transportation of earth should be done in closed box trucks with a cover to		



Environmental and Social Impact Assessment



Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigation Measures		
					Mitigate	Avoid	Eliminate
					reduce particulate emissions.		
Road traffic accidents	Impacts in health, Injuries, deaths	Circulation of machinery and vehicles used for the transportation of demolition rubble	LS		Placing a signalman at pedestrian crossings, ensuring that vehicles stop before crossing		

Table 75 Social Mitigation Measures. Demobilization. Ana Chaves Bay

15.2.3 OPERATION PHASE

Environmental Aspect	Environmental Impact	Activity	Significance Impact	Significance Impact	Mitigations Measures		
			Without measure	With measure	Mitigate	Avoid	Eliminate
Employment	Jobs creation	Maintenance of infrastructures	LS				
Accessibility	Improved access to the international airport and the largest supermarket in the country with reduced travel time and cost	Operation of the road with pavement and signage improvements,	VS				
	Improved access to the coastline and capital city centre, with institutions and services reduced travel time and cost	Operation of the road with pavement and signage improvements,	VS				
	Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3	Operation of the road with pavement and signage improvements,	VS				
	Improved access and reduced cost and time at the only referral hospital in the country	Operation of the road with pavement and signage improvements,	VS				
Road safety	Improvement of road traffic safety conditions with cycle lanes and pedestrian circulation	Operation of the road with pavement and signage improvements,	S				

Environmental and Social Impact Assessment

Environmental Aspect	Environmental Impact	Activity	Significance Impact	Significance Impact	Mitigations Measures		
			Without measure	With measure	Mitigate	Avoid	Eliminate
	Increased protection from flood, coastal erosion and storm surge risks	Strengthening coastal protection	S				
Sports practice on the Marginal	Better conditions for sports on the waterfront	Landscaping, green spaces, pavement, cycle track, children's playground, fitness centre, public toilets	S				
Attractiveness of the capital and its waterfront	Increase in the number of people on PM beach	Operation of the Marginal road and requalified infrastructures	VS				
	Improvement of quality of urban space with a new image of capital city		VS				
Working conditions in the communities affected by the project	Improvement of the conditions for the development of economic activities in the communities affected by the project	Operation of the space for fishermen, warehouse and in Ana Chaves	VS				
	Alteration of the location or livelihood of vulnerable groups (15 fruit sellers)	Operation of the Marginal road and requalified infrastructures	LS			Use the Grievance Redress Mechanism to ensure that all participate and that all complaints are resolved.	

Table 76 Social Mitigation Measures - Operation Phase. Ana Chaves Bay

15.3 PANTUFO COASTLINE

15.3.1 CONSTRUCTION PHASE

Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigation Measures		
			Without Measures	With Measures	Mitigate	Avoid	Eliminate
Hiring of labor	Job creation	Earthmoving	VS				
		Removal of vegetation cover	VS				
		Infrastructure construction (roads, coastal protection, etc)	VS				
Direct and indirect income generation	Increased demand for housing and food consumption	Hiring staff for the works	S				
Stimulating economic activities	Increased tax collection	Hiring staff; purchasing inputs and equipment and contracting services	S				
	Increase in coins in circulation	Consumption by workers and commercials	S				
Displacement of economic activities	Allocation of the population's roulotes next to O Pirata Restaurant and near Museum	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	Implementation of A-RAP		

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigation Measures		
			Without Measures	With Measures	Mitigate	Avoid	Eliminate
	Relocation of economic activities/livelihoods	Infrastructure construction (roads, coastal protection, etc)	S	LS			
Limitations on beach access	Distancing bathers and tourists	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS	Create, limit space for beachgoers and car parking for people using the beaches	Signposting temporary access roads to the beaches	
Increase in the number of heavy vehicles for transporting materials	Increase of traffic	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	VS		Inform the population in good time about any traffic diversions or changes to traffic circulation	Signposting temporary access roads to the beaches	
	Road damage	Circulation of heavy vehicles for transporting materials on the access roads to the construction site	S		Restoring the pavement as it was before the work		
Occupation of public space and roads	Constraints on pedestrian circulation on the waterfront	Infrastructure construction (roads, coastal protection, etc.)	S	LS	Create, limit pedestrian and car parking space	Signposting safe routes for pedestrians	
	Limitation to sports activities (walking, running, cycling)	Infrastructure construction (roads, coastal protection, etc.)	S	LS		Creation of alternative routes for pedestrians and sports practitioners	

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigation Measures		
			Without Measures	With Measures	Mitigate	Avoid	Eliminate
	Disruption of daily activities and the movements of people and vehicles	Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	VS	LS	Inform the population in good time about any traffic diversions or changes to traffic circulation	Implementation of the Traffic Management Plan	
Cultural and Traditional Aspects	Degradation of the built cultural heritage with the appearance of cracks	Road rehabilitation, construction of hydraulic structures and coastal protection, etc.	S	LS		Preparation of a report with a photographic record of cultural heritage, including colonial houses	
		Circulation of heavy vehicles for transporting materials on the access roads to the construction sites	S	LS		Contractor should select equipment that does not emit high values of vibrations and submit to approval of supervision.	
Infrastructures	Interruption of supply of infrastructure services such as water, energy, sanitation	Infrastructure construction (roads, coastal protection, etc)	LS	LS		Dissemination of information on the interruption of services to communities	
Limitations on women's participation in economic activities	Business opportunities through itinerant businesses or in areas bordering the works	Infrastructure construction (roads, coastal protection, etc)	S				
	Increased family income due to	Building benches with recycled glass	S				

Environmental and Social Impact Assessment

Aspect	Impact	Activity	Significance of Impact	Significance of Impact	Mitigation Measures		
			Without Measures	With Measures	Mitigate	Avoid	Eliminate
	participation in bank construction						
Significant migration of workers to the site	Increased risk of sexual harassment and gender-based violence	Infrastructure construction (roads, coastal protection, etc)	VS	S		Raising employees' awareness and obligation to respect the individual Code of Conduct	
Contact between workers, people from the community	Increase in incidence of contagious diseases COVID 19 sexually transmitted infections STIs	Infrastructure construction (roads, coastal protection etc)	S	LS		Awareness raising among employees and obligation to respect the individual Code of Conduct. Awareness-raising actions and prevention measures. Distribution of condoms.	
Unacceptable behavior according to local social standards	Conflicts between workers and local community	Infrastructure construction (roads, coastal protection, etc)	S	LS		Continue to ensure participation of LG in consultations Know livelihoods to avoid loss of income	

Table 77 Social Mitigation Measures - Construction Phase. Pantufo Coastline



15.3.2 DEMOBILIZATION PHASE

Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
					Mitigate	Avoid	Eliminate
Employment	Increase of skilled workers	End of Construction site demobilization activities	LS				
Accidental spillage of hazardous products (fuel, oil, lubricants)	Road Damage	Vehicle circulation	S	LS			
		Road accidents					
		Removal of rubble					
Noise generation	Disturbances to the health, comfort and property of the population	Circulation of equipment and machinery	S	LS			
		Removal of demolition rubble					
	Reduced quality of life	Removal of demolition rubble	VS	S			
Emission of dust	Disturbances to the health, comfort of the population	Circulation of equipment and machinery	S	LS	Promote the circulation of vehicles at low speed in areas close to populations/residences.		
		Removal of demolition rubble					
	Reduced quality of life	Removal of demolition rubble	S	S	Use moistening the material to be collected if it is powdery.		



Environmental and Social Impact Assessment



Aspect	Impact	Activity	Significance of Impact Without measure	Significance of Impact With measure	Mitigations Measures		
					Mitigate	Avoid	Eliminate
Road traffic accidents	Impacts in health ,Injuries, deaths	Circulation of machinery and vehicles used for the transportation of demolition rubble	LS		Use more effective and less noisy rubble removal techniques.		The execution of the works must take into account the population's rest period, prohibiting activities between 10pm and 7am.
	Reduced quality of life		S	LS			

Table 78 Social Mitigation Measures. Demobilization Phase. Pantufo Coastline



15.3.3 OPERATION PHASE

Aspect	Impact	Activity	Significance of Impact Without Measures	Significance of Impact With Measures	Mitigation Measures		
					Mitigate	Avoid	Eliminate
Employment	Jobs creation	Maintenance of infrastructures	LS				
Improved Accessibility	Improved access to the coastline and capital city centre, reduced travel time and cost	Operation of the road with pavement and signage improvements	VS				
	Improving the road network by reinforcing the links between national roads EN1, EN2 and EN3	Operation of the road with pavement and signage improvements	VS				
	Improved access and reduced cost and time at the only referral hospital in the country	Operation of the road with pavement and signage improvements	VS				
	Improved accessibility to various institutions and services	Operation of the road with pavement and signage improvements	VS				
Road safety	Improvement of road traffic safety conditions	Operation of the road with pavement and signage improvements	VS				
	Improvement of safety conditions in pedestrian circulation, with cycle lanes and pedestrian circulation	Operation of the road with pavement and signage improvements	S				

	Increased protection from flood, coastal erosion and storm surge risks	Presence of coastal protection and hydraulic infrastructures rehabilitated	S				
	Better conditions for sports on the waterfront	Landscaping, green spaces, pavement, cycle track, children's playground	S				
Attractiveness of the capital and its seafront	Increase in the number of people on the beaches and the Marginal	Landscaping, green spaces, cycle path, playground and fitness centre, public toilets, bus stop next to the high school	S				
	Improvement the quality of urban space with new image of capital city		VS				
Working conditions in the communities affected by the project	Improvement of the conditions for the development of economic activities in the communities affected by the project	Operation of the Marginal road and requalified infrastructures	VS				

Table 79 Social Mitigation Measures - Operation Phase. Pantufo Coastline



16. MONITORING PLAN

This monitoring plan for the project in practical terms, it details how the mitigation measures proposed should be follow up during the phases of project including: description, frequency, local, performance indicator and responsibility. The budget will be presented in Environmental and Social Management Plan.

The proposed Monitoring Plan is presented in the following tables.



Lot	Description	Frequency	Local	Responsibility
All	Obtaining the necessary permits	Before the start of work	Institutions	Contractor
	Advertise job vacancies	Before the start of work	Newspapers	Contractor
	Preparation of Environmental and Social Management Plan	Before the start of work	Construction Site	Contractor
	Approval Environmental and Social Management Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Solid Waste and Wastewater Management Plan	Before the start of work	Construction Site	Contractor
	Approval of Solid Waste and wastewater Management Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Emergency Response and Preparedness Plan	Before the start of work	Construction Site	Contractor
	Approval of Emergency Response and Preparedness Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Occupational Safety and Health Management Plan	Before the start of work	Construction Site	Contractor
	Approval of Occupational Safety and Health Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Community Safety and Health Management Plan	Before the start of work	Construction Site	Contractor
	Approval of Community Safety and Health Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Contingency Plan Covid 19	Before the start of work	Construction Site	Contractor
	Approval of Contingency Plan Covid 19	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Human Resources Management Plan	Before the start of work	Construction Site	Contractor



Lot	Description	Frequency	Local	Responsibility
All	Approval of Human Resources Management Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Site Plan	Before the start of work	Construction Site	Contractor
	Approval of Site Plan	Before the start of work	Construction Site /Offices	Supervision
	Preparation of Sea Turtles Management Plan	Before the start of work	Construction Site	Contractor
	Approval of Sea Turtles Management Plan	Before the start of work	Construction Site/Offices	Supervision
	Preparation of Code of conduct	Before the start of work	Construction Site	Contractor
	Awareness on Code of Conduct to workers	Before the start of work	Construction Site	Contractor
	Check subcontractors' licenses	Before the start of work	Construction Site	Contractor
	Notification to relevant communities and institutions	Before the start of work	Community and Institutions	Contractor
	Raise awareness about safety measures for workers and citizens	Before the start of work	Construction Site	Contractor
	Raise awareness about Grievance Redress Mechanism	Before the start of work	Community and Institutions	Supervision/Contractor
	Preparation of Traffic Management Plan	Before the start of work	Construction Site	Contractor



Lot	Description	Frequency	Local	Responsibility
	Approval of Traffic Management Plan	Before the start of work	Construction Site /Offices	Supervision
	Establish a Traffic Management mechanism that permits integrate the traffic generated for construction of 3 lots and EN1	Beginning of contract	INEA	INEA/Contractor/Supervision
	Check if Shortest land transportation routes established. Vehicle idle time minimised.	One week before the start of work	Institutions	Contractor
	Air Quality PM10 e PM2,5 measurement with optical automatic method NO2 sampling method during 7 days for each sampling point	Before the start of works	5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors	Contractor
	Noise Equivalent continuous sound level (LAeq) measurements during 24h	Before the start of works	5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors	Contractor
	Water Quality PH, BOD5, Total suspended solids and fecal coliforms	Before the start of works	Two samplings in sea water and one or in two water course (see next table construction phase)	Contractor
Lot 1 and Lot 2	Preparation of Beach Nourishment Management Plan	Before the start of work	Construction Site	Contractor



Lot	Description	Frequency	Local	Responsibility
	Approval of Beach Nourishment Management Plan	Before the start of work	Construction Site /Offices	Supervision
Lot 2 and 3	Preparation of a report with a photographic record of cultural heritage, including colonial houses	Before the start of work	Construction Site	Contractor
	Approval of a report with a photographic record of cultural heritage, including colonial houses	Before the start of work	Construction Site /Offices	Supervision

Table 80 Monitoring Plan Pre-Construction Phase

Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
All	Dust (Particulates)	Visual observation of dust emission daily.	Daily.	Near construction sites and on unpaved access roads		Contractor
	Air Quality PM ₁₀ e PM _{2,5} and NO ₂	PM ₁₀ e PM _{2,5} measurement with optical automatic method NO ₂ sampling method during 7 days for each sampling point	Annually	Lot 1 - 5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors Lar de Idosos - Casa da Misericórdia (CH 2+400), Hospital Central Ayres de Menezes (CH 2+320)	NO ₂ - 200 µg/m ³ (1 hour)	



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
				Lot 2 - 5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors Bambino" school (CH 2+860) and St. Peter's church (CH 3+700	PM ₁₀ – 50 µg/m ³ (1 hour) PM _{2.5} - 25 µg/m ³ (1 hour)	Contractor
				Lot 3 - 5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors National High School (CH 6+850) and Hotel Pestana		
	Gas emissions	Visual observation of emissions to be carried out on a daily basis and at maintenance inspections of vehicles and equipment.	Regularly	Maintenance materials and on the access roads to the construction site.		Contractor
	Noise and vibrations	Verification of noisy activities on normal working days and hours.	Continually	Near construction site, front work work and on access roads		Contractor
Checking maintenance inspections of vehicles and equipment and recording them.		Daily	At the Construction site's maintenance workshop or the workshop performing the maintenance.		Contractor	



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
		Equivalent continuous sound level (LAeq) measurements during 24h	Annually	<p>Lot 1 - 5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors Lar de Idosos - Casa da Misericórdia (CH 2+400), Hospital Central Ayres de Menezes (CH 2+320)</p> <p>Lot 2 - 5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors "Bambino" school (CH 2+860) and St. Peter's church (CH 3+700)</p> <p>Lot 3 - 5 sampling points: one near construction site, two in unpaved access roads and two in Marginal near sensitive receptors National High School (CH 6+850) and Hotel Pestana</p>	<p>Day time period 7:00 – 22:00 55 L (dB A)</p> <p>Night time period 22:00 – 7:00 45 L (dB A)</p>	Contractor
	Solid Waste and wastewater	Verify the waste disposal sites, how segregation, transport and packaging is done	Daily	Temporary waste disposal sites on the construction site	Volume of waste generated by wastes classification	Contractor
		Checking maintenance of septic tanks and mobile toilets	Daily	Septic tank in construction site and mobile toilets in work fronts	Volume of wastewater generated	Contractor



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
All		Check when hiring the company if it has a license, given	Annually	Construction site		Contractor
		Check the Waste Records	Regularly	Construction site	Volume of wastes transported	Contractor
	Biodiversity	Removal of vegetation and protection of existing trees		Along the Marginal	Area of vegetation removed (only in areas strictly necessary) Record of trees removal	Contractor
		Plantation of new trees		Along the Marginal	Record of trees plantation	Contractor
		Check the nº of trainings/ awareness raising on turtles nesting protection and procedures	Continually	Construction site	Nº of trainings/awareness raising on turtles nesting protection and procedures for workers	Contractor
		Check the nº of trainings/ awareness raising on turtles nesting protection and procedures	Continually	Construction site	Nº of trainings/awareness raising on turtles nesting protection and procedures for fishermen	Contractor
		Protection of turtle nesting	Continually	At beaches along the Marginal	Record of turtles nesting and number of eggs relocate	Contractor
Check the nº of trainings/ awareness raising on fauna and flora protection	Continually	Construction site and work fronts	Nº of trainings/awareness raising on fauna and flora protection	Contractor		



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
		Use of LED low pressure luminaries downwards oriented	Continually	Work front works on the Marginal	Record of number of lamps fitted and replaced	Contractor
	Water Resources	Water drainage system conditions	Continually	Drainage water courses in are of influence of project	Absence of obstructions, flooding	Contractor
All	Surface Water Quality	Check whether wastes is deposited near rivers with the potential to degradation status of water line	Regularly	Near the water courses		Contractor
	Water Quality	BOD5, Total suspended solids and fecal coliforms sampling	Annually	Lot 1 Two samplings in sea water, two samplings in water courses Água Palito CH 0+448 and Agua Melo CH 1+335	BOD5 less 5 mg/l	Contractor
				Lot 2 Two samplings in sea water, and one in Agua Grande CH 4+470	Total suspended solids - 2,500 mg/l	
				Lot 3 Lot 2 Two samplings in sea water, and one Água Sela CH 7+312	Fecal coliforms -0	
	Soils	Continuous visual inspection for soil contamination	Regularly	Along the Marginal and construction site		Contractor
Road safety	Check the signage of the works	Daily.	Along the Marginal and area of influence of project		Contractor	
	Check during work the use of CPE	Daily.	Along the Marginal and area of influce of project		Contractor	



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
	Local employment	Check if there are any workers in vulnerable situations	Continually	Construction site and work fronts	No. of contract workers in vulnerable situations (long-term unemployment, precarious living conditions, female head of household, etc.)	Contractor
		Check that preference is being given to local workers with adequate training	Continually	Construction site and work fronts	No. of local workers	Contractor
	Gender	Check the nº of trainings/ awareness raising on GBV/SAE	Continually	Construction site	Nº of trainings/awareness raising on Gender Based Violence and Sexual Abuse and Exploitation	Contractor
All	Occupational Health and Safety	Check the nº of female employees	Continually	Construction site and work fronts	No. of female employees hired	Contractor
		Identify Non Conformities of health and Safety measures and its resolution	Continually	Construction site, front works and accesses	Number of Non- conformities of Health and Safety Measures identified to protect workers open and closed	Contractor
		Check the nº of trainings/ awareness raising on endemic and STD and Covid 19	Continually	Construction site	Nº of trainings/awareness raising on endemic sexually transmitted diseases and Covid 19	Contractor



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
		Check the nº of trainings/ awareness raising on road safety	Continually	Construction site	Nº of training courses on themes related to road safety	Contractor
		Check Nº of environmental incidents/accidents that have occurred	Continually	Construction site, work fronts and accesses	Nº of environmental incidents/accidents that have occurred	Contractor
		Check Nº of incidents/accidents that occurred during the works by category	Continually	Construction site, work fronts and accesses	Nº of incidents/accidents that occurred during the works by category	Contractor
		Check Nº of complaints from the GRM by workers	Continually	Construction site, work fronts and accesses	Nº of complaints from the worker's GRM (received/answered sealed/closed and open)	Contractor/Supervision
		Check Nº of Non- conformities of Health and	Continually	Construction site, work fronts and accesses	Number of Non- conformities of Health and	Contractor
All	Community Health and Safety	Safety Measures identified to protect the local community			Safety Measures identified to protect the local community	
		Check Nº of recorded accidents/incidents involving Project workers and a member of the local community	Continually	Construction site, work fronts and accesses	Nº of recorded accidents/incidents involving Project workers and a member of the local community	Contractor



Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
		Check N° of complaints from the communities GRM	Continually	Construction site , work fronts and accesses	Nºr of complaints from the communities GRM (received/answered sealed/closed and open)	Contractor/Supervision
		Nª of records of accidents/incidents involving local community		Construction site, work fronts and accesses	Nª of records of accidents/incidents involving local community	Contractor
		Check N° of sessions, participants, themes, papers, tools, materials	Continually	Construction site, work fronts and accesses	Nº of sessions, participants, themes, papers, tools, materials	Contractor
All	Emergency Response	Check N° of training/awareness raising sessions on emergency procedures	Continually	Construction site	Nº of training/awareness raising sessions on emergency procedures for workers	Contractor
		Check N° of community awareness actions	Continually	Construction site	Nº of community awareness actions	Contractor
		Check N° Simulations	Continually	Construction site, work fronts and accesses	Nº of accident simulations	Contractor
	Resettlement	Check N° of families and persons affected by the project activities	Continually	Near the construction sites	Nº of families and persons affected by the project activities	Contractor

Lots	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
	Grievance Resolution Mechanim	Check N° of complaints made by employees	Continually	Construction site	Nº. of complaints made by employees	Contractor
		Check N° of complaints made by community	Continually	Construction site and community	Nº of Complaints made by the community	Contractor
Lot 2 Lot 3	Cultural Heritage	Check N° of complaints degradation cultural values	Continually	Work fronts	Nº of Complaints about degradation of cultural values (received/answered sealed/closed and open)	Contractor

Table 81 Monitoring Plan Construction Phase

Lot	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
All	Beach maintenance	Profile/volume measures with topographical equipment	Same season each year and with the same tide level. Better after storm season.	Along the Marginal with reference to monitoring stations established	Width of beaches	Port Captancy
	Risk of Inundations	Record of unusual weather related events flooding, damages to infrastructures, properties	Bi- Annual	Along the Marginal		INEA
	Waste Management	Proper waste temporary disposal	Continually	Along the Marginal (litter bins)	No destruction/degradation of litter bins	Àgua Grande District Council
		Proper maintenance of	Continually	Public toilets,	No degradation of infrastrutures	Àgua Grande District



Lot	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
All		septic tanks		laundry, fisheries	with clean and emptying	Council
		Proper waste collection and transportation to Penha Dump		Along the Marginal	Absence of wastes in ground	Àgua Grande District Council
	Road Safety	Visual observations of road surface conditions	On a continuous basis and especially at times of heavy rain	Along the Marginal	Absence pavement damage	INEA
		Visual observations of signage conditions	Continually	Along the Marginal	Absence of damage to signage	INEA
		Visual observations of the condition of the drainage works	On a continuous basis and specially at times of heavy rainfall	Along the Marginal	Absence of damage caused by drainage	INEA
		Observation of the new infrastructures for fishermen, wash area, playground, bike path, etc.	Continually	Along the Marginal	Absence of damage to the infrastructure created	INEA
	Biodiversity	Replacement of lamps LED low pressure	Continually	Along the Marginal	Lamps replacement	Àgua Grande District Council
		Protection of turtle nesting	Continually	At beaches along the Marginal	Record of turtles nesting and number of eggs relocate	Àgua Grande District Council/ ONG
		Protection and maintenance of green spaces and trees	Continually	Along the Marginal	Maintenance of green spaces and trees	Àgua Grande District Council



Lot	Parameter	Description	Frequency	Local	Performance Indicator	Responsibility
	Water Resources	Water staage system conditions	Continually	Water lines	Absence of obstructions, flooding	INEA
	Resettlement	Follow up the affected families	2-3 years		Nº of families and persons affected with living conditions restored	INEA / Consultant
	Grievances Resolution Mechanism	Check Nº of complaints	Continually		Nº of complaints from the worker's GRM (received/answered sealed/closed and open)	INEA/Consultant

Table 82 Monitoring Plan Operation Phase



17. CONCLUSIONS

The Environmental and Social Impact Assessment has been carried out to assess the overall impacts on Environmental and Social components as a result of construction and operation of Agua Grande Coastal Protection and Reconstruction of the Marginal Road that includes the 3 lots: Lagarto Bay, Ana Chaves Bay and Pantufo Coastline.

The three lots will have positive impacts in terms of adaptation of climate changes (protection of the coastal stretch along the road against erosion and flooding), reduction in greenhouse gases, improvement of connection between the capital and airport and network with national roads EN1, EN2 and EN3, improve mobility and making more attractive the use of non-motorized transports (bicycle and walking), improvement water front for sports practice, and improve work conditions for fishermen with construction of boat workshop and fish market for women and a laundry for washerwomen,

For environmental component design foreseen increase of green spaces areas and planting of trees. For sea turtles nesting in beaches as also considered mitigation measures for construction phase and operation phase avoiding negative impacts and enhance benefits of beach nourishment and continuity of habitats of turtles, that are in risk with climate change.

Some impacts are identified as negative, mostly for construction phase related with noise, air pollution, associated to works construction and movement of heavy vehicles, landscape alteration and limited access and movement on the beaches, sports practices on waterfront. Assuming that the mitigation measures identified in this ESIA are successfully implemented, it will be possible to mitigate most adverse effects associated with the three projects and the classification of majority of impacts after mitigation would be classified as low Significance.

As per the ESIA, the proposed Projects is unlikely to generate negative, very significant permanent impacts, providing that the proposed mitigation measures, monitoring are implemented appropriately. The Project should be allowed to proceed when the process of compensation and relocation of economic activities/livelihoods on and is successfully concluded as per the A-RAP.

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