SECTION IV

COMPLEMENTARY ENVIRONMENTAL EVALUATION

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1.0 INTRODUCTION

This section identifies the potential impacts on the environment of changes introduced to the LNG Export Project during its construction and operations phases. In the EIA prepared in 2002-2003 (EIA 2002-2003) and approved in 2004, the environmental impacts identified for the various elements of the Project were evaluated. This complementary evaluation will focus only on the environmental impacts resulting from the changes introduced to the new design of the LNG plant.

The objectives of the environmental evaluation are:

- Identify the environmental, social and economic resources which could potentially be affected by the changes introduced to the Project.
- Evaluate the possible environmental impacts that could be generated by changes in the plant design.

For this complimentary environmental evaluation, changes in the project design and project activities were analyzed and compared to the effects identified in the original EIA (2002-2003) considering also the applicable environmental mitigation measures to determine the final residual effects..

The results of this section will be used to define the management strategies to control, prevent and mitigate the impacts generated. This will be carried out through the Environmental Management Data Sheet included in Section IV “Modification to the Social and Environmental Management Plan”, which modifies and complements the original EMP presented as part of the EIA 2002 - 2003.

2.0 IDENTIFICATION OF IMPACTS

The identification of potential impacts was based on the interaction between the new project activities related to changes in the project design and the status of the environmental components in the project area.

2.1 Project Activities

New project construction and operation activities related to changes made to the Liquefaction Plant are described below.

- ***Construction of Underpasses***, consists of all the construction activities required to establish access to the Plant such as: the construction of two highway underpasses, two acceleration and deceleration lanes and a gravel road. The gravel road will be used as a temporary detour during traffic interruption on the Panamerican South highway for construction of the aforementioned works.

- ***Rock Hauling***, trucks will be used to haul rock from a quarry that will be developed 20 Km east of the Panamerican highway at Km. 168. The haul trucks will cross the highway in an east-west direction entering the north side of the project. The rock will be used in construction of the load-out jetty and the breakwater. An Environmental and Social Impact Study of the quarry was submitted to the DGAAE in July 2005.

- ***Construction of the Rock Load-out Jetty and Modifications to the Dredging of the Navigational Channel.*** These activities are required for construction of the jetty located 800 m off-shore on the north side of the trestle. The jetty will facilitate rock loading and transport in ships for construction of the breakwater and could also be used as a service area and berth for small barges and vessels. Another design change involves an increase in the volume of material to be dredged due to an increase in the turning radius required in the navigational channel as described in Section I of this document.

- ***Changes and Relocation of Equipment,*** includes a change of the electrical generators and gas flares by more efficient equipment, an increase in the storage capacity of the liquefied natural gas tanks, modifications to the secondary containment pond, relocation of electrical sub-stations, service stations and refrigeration equipment. These changes and relocations will be evaluated for the operation phase of the plant only.

- ***Operation of Marine Facilities,*** involves the interaction of the project marine structures, including the trestle, rock load-out jetty and the breakwater, with the sea currents, wave action and sediment transport dynamics. The operation and maintenance of these structures were evaluated during the EIA of 2002-2003.

2.2 Impact Identification

Table 1 of Chapter IV of the EIA 2002-2003 described the change indicators established to identify the potential impacts on the environmental and social components during the baseline studies. These same indicators will be used for identifying the new potential impacts related to the changes introduced to the original Plant design.

Table 4.1 identifies 16 of the 22 change indicators originally identified in the EIA of 2002-2003 (Table 1 of Chapter IV) with which there is an interaction produced by the new Project activities (see Table 4.2). During this process no new impacts were identified as a result of the changes introduced to the original Project design.

Table 4. 1 Change Indicators

Environmental Component	Code	Change Indicators	Effects
Air	A-1	Alteration in the air quality	Includes environmental effects such as: generation of dust and particulate matter (PM10), atmospheric emissions of mobile sources (combustion gases of vehicles and equipment gases) and atmospheric emissions (NO2, SO2 and CO) of permanent sources.
Noise	R-1	Increase of the noise levels	Considers the increase of the environmental noise levels above the baseline levels due to the temporal introduction of the noise levels.
Water	H-1	Increase of the turbidity in the sea water.	Involves the direct increase of the particulate matter suspended in sea water and the alteration of the aquatic habitat.
	H-2	Alteration of the physical and chemical quantity and quality of the sea water and rivers.	The water quantity is related to the water demand required by the project and the supply and competition for its use. The physical quality is related to changes in the current direction and speed and its affect on typical sediment deposition patterns in the project area. Also, it refers to changes in the physical and chemical quality of the water caused by accidental hydrocarbon spills (such as fuels, greases and oils) or other substances related to discharges that affect the resource.
Soil and Landforms	SU-1	Alteration of the soil structure	Related to effects such as: soil mix and compacting of surface soils that may occur.
	SU-2	Alteration of the chemical and physical quality	The physical quality of the soil is related to the surface erosion caused by Aeolian or water-related transport of sediments, or the combination of both. Also, the chemical quality of the soil can be affected by accidental hydrocarbon spills (such as fuels, greases and oils) and other substances related to discharges that deteriorate the quality of the resource.
	SU-3	Alteration of the landforms	Related to the change of the land forms caused by cut and fill activities during the construction phase.
	SU-4	Alteration of the beach morphology	Related to the change in the sedimentation patterns generated by the interaction with the new permanent marine structures.
Terrestrial and Marine Flora and Fauna	FF-1	Loss of terrestrial vegetal cover	Removal of the typical vegetation of the project area characterized by “Tillandsias” (bromeliacea), an endemic bromelid plant that grows in sandy soils.

Environmental Component	Code	Change Indicators	Effects
	FF-2	Alteration of the structure and composition of marine communities.	Related to the direct disturbance of the marine substratum and effects on the habitat of planktonic and benthic communities of the subtidal and intertidal areas.
	FF-3	Changes in the fishing catch.	Related to the artisan fishing activity in the area and the reduction or increase of the fish catch in combination with other effects caused such as: fluctuations in the benthonic and planktonic communities and turbidity.
	FF-4	Reduction in the records of marine fauna.	Decrease of the number of sightings in the area or the direct eradication of species with conservation ranking that are directly related to accidental contacts with project elements or indirectly related due to the effects caused by trophic chain elements or their habitats.
Social	S-3	Nuisance to the population	Effects caused on the population living near to the roadways on which the equipment, supplies and personnel required for the project will be transported. Also, refers to the increase in the vehicle flow in the terrestrial ways and the accident potential.
	S-4	Interruption of the road infrastructure	Related to the effects on raffict conditions and damages on the roads and bridges that interrupt normal vehicle flows on the roadways.
Economic	E-3	Job creation	Related to the demand of workers (skilled and non-skilled) that the project will require throughout the construction and operation phase. The development of this project will produce two types of jobs: direct jobs, related to construction that will produce a direct decrease in the unemployment and underemployment rate, and the indirect jobs that will be generated by the increase in the demand for local goods and services.
Cultural	AR-1	Alteration or destruction of the archaeological heritage	Involves the archaeological remains not found during the CIRA process that are discovered during the construction activities and as the potential effects on them.

Table 4. 2 Matrix of Interaction of Environmental and Social Components with the New Activities of the Project

Environment	COMPONENT	PROJECT PHASE				
		Construction			Operation	
		Construction of Underpasses	*Rock Haulage*	*Construction of Load-Out Jetty and Modifications to the Dredging of the Navigational Channel*	*Changes and Relocation of Equipment*	*Operation of the Marine Facilities*
PHYSICAL	Air	A-1	A-1	A-1	A-1	
	Noise	R-1	R-1	R-1		
	Water			H-1		H-1
			H-2	H-2		H-2
	Soil	SU-1	SU-1			
		SU-2	SU-2	SU-2		
		SU-3		SU-3		
				SU-4		SU-4
BIOTHIC	Terrestrial and marine flora y fauna	FF-1				
				FF-2		FF-2
				FF-3		FF-3
				FF-4		
SOCIAL	Social	S-3		S-3		
		S-4				
	Economic	E-3		E-3		
	Cultural	AR-1				

Note: The description of each code of this table is presented in Table 4.1.

3.0 EVALUATION OF IMPACTS

The evaluation of impacts is based on the interaction matrix established for the changes introduced to the original design of the Project (Table 4.2) and the score assigned to each interaction.

3.1 Evaluation Criteria

The process used for evaluating the environmental impacts caused by changes in the design of the project uses the same attributes and scoring values as that used in the EIA of 2002-2003 that was approved in 2004.

The scoring system used in the evaluation of these impacts is shown in Table 4.3 The definition of these attributes is based on the behavior of typical impacts known, derived from the construction and operation of similar projects in the oil and gas industry.

Table 4. 3 Criteria of Impact Classification and Ranking

Ranking Criteria			Scale of Values for Impact Rating
Attribute	**Classification**	**Definition**	
Type (C)	Positive	Net benefit for the resource	1
	Neutral	No net benefits or detriment to the resource	0
	Negative	Net damage for the resource	-1
Geographic extent (E)	Direct	Confined to the area directly disturbed by the Project.	1
	Local	Exceeds the areas directly disturbed but is located within the boundaries of the assessment study that will be specified for each field or indicator.	2
	Regional	Extends beyond the local or administrative boundaries specified for each field or indicator. It is considered as an indirect impact .	3
Length of time (Du)	Short term	Less than one year	1
	Medium term	Between 1 and 5 years	2
	Long term	More than 5 years	3
Magnitude (M)	None	No change is foreseen	0
	Low	It is predicted that the disturbance will be slightly greater than the typical existing conditions.	1
	Medium	It is predicted that the effects are significantly higher than the typical existing conditions but without exceeding the	2

Ranking Criteria			Scale of Values for Impact Rating
Attribute	**Classification**	**Definition**	
		criteria established in the permissible limits or without causing changes in the economic, social and biological parameters under the ranks of natural variability or social tolerance.	
	High	The predictable effects exceed the criteria established or permissible limits related to potential negative effects or cause a detectable change in social, economic and biological parameters, beyond the natural variability of social tolerance.	3
Probability of Occurrence (Po)	Low	Slightly probable	0.4 - 0.1
	Medium	Possible or Probable	0.9 - 0.5
	High	Occurrence	1
Frequency (F)	Temporal	Confined to a specific period (e.g.: during the construction phase)	1
	Periodic / Occasional	Occurs intermittently but repeatedly at regular time intervals or also irregularly in the time interval (occasional) (E.g. during the maintenance activities)	2
	Permanent	Will occur continuously	3
Reversibility (R)	Short term	Can be reverted in a year or less	1
	Medium term	Can be reverted in more than a year, but less than ten years.	2
	Irreversible	Permanent effects	3
Classification (Ca)	***Ca = C x Po x (M + E+ Du + F + R)***		

The impact evaluation performed was developed using a Leopold modified matrix. The evaluation method used for the matrix consists of assigning values, in a relative scale, to all the attributes of the impact analyzed for each of the interrelations between the project activities and the environment (see Table 4.2).

The assignation of values to each attribute of environmental effect generated a multiple index with the quantitative and qualitative characteristics of the impact: determined through the following equation:

$$Ca = C \times Po \times (M + E + Du + F + R)$$

Where:

Ca: Classification index of multiple impacts

C : Type

Po : Probability of occurrence

M : Magnitude

E : Geographic extent

Du : Length of time

F : Frequency

R : Reversibility

Each attribute is analyzed individually for each impact identified and according to the behavior defined in Table 4.3. Attributes Po, M and R are re-evaluated when there is the probability of applying a management measure for controlling, preventing or mitigating the environmental impact.

3.2 Evaluation of Impacts

With the aim of visualizing the quantitative and qualitative characteristics of the impact analyzed in the matrix of interactions, a ranking system was established (associated with the score identified for each impact resulting from the above equation) with a color code assigned to each one. See table below:

Ranks of Values and Color Code

Ranks of Value		
	Predicted effect	**Color Code**
De +15 a +1	Positive	
0	Neutral	
De -5 a -1	Slightly negative	
De -10 a -5,1	Moderately negative	
De -15 a -10,1	Highly negative	

The results of this process of evaluation of impacts are shown in the Leopold modified matrix presented below in Table 4.4:

Table 4. 4 Matrix of Evaluation of Impacts – Changes in the Project –Construction and Operation Phase

ENVIRONMENT	COMPONENT	INDICATOR	PROJECT PHASE				
			Construction			Operation	
			Construction of Underpasses	*Rock Haulage*	*Construction of the Rock Load-out Jetty and Modifications to the Dredging of the Navigational Channel*	*Changes and Relocation of Equipment*	Operation of the Marine Facilities
PHYSICAL	Air	A-1	-3	-3	-3	5	
	Noise	R-1	-2.5	-2.5	-3.5		
	Water	H-1			-4.9		-4.5
		H-2		-1..2	-3		-5
	Soil	SU-1	-1.6	-5			
		SU-2	-2.5	-2.5	-3		
		SU-3	-6		-9		
		SU-4			-3.5		-5
BIOTIC	Terrestrial and Marine Flora and Fauna	FF-1	-1				
		FF-2			-8		0
		FF-3			0		0
		FF-4			-4.2		
SOCIAL	Social	S-3	-3		-3		
		S-4	-3				
	Economic	E-3	7		7		
	Cultural	AR-1	-1				

Note: For the preparation of this Matrix of Evaluation of Impacts, all the change indicators used in the Environmental Evaluation of Chapter IV, EIA 2002-2003 were considered. However, this matrix shows only the indicators that were identified in interaction with the new activities.

The spreadsheets provided in Appendix F "Evaluation to the Modifications of the EIA" includes the values obtained in the impacts evaluation.

4.0 ANALYSIS OF IMPACTS

This section presents an analysis of the environmental impacts that could potentially occur during the construction and operations phases of the project, determined according to the process described before.

4.1 Physical Environment

4.1.1 Air Quality

Construction Phase

It is considered that slightly negative temporal and intermittent impacts will occur on air quality during the construction phase due to the construction of underpasses along the Panamerican highway, rock haulage activity, construction of the rock load-out jetty and modifications to the dredging of the navigational channel.

The impacts on air quality will be produced mainly from dust raised by vehicles traveling along the gravel road constructed as a temporary detour at the Panamerican highway and by trucks hauling rock along the gravel road to the north side of the project. The impacts on air quality during construction are considered local impacts.

The dust generated during construction activities shall be controlled by dust suppressor agents that may include river water, well water, sea water, water treated from the domestic effluent treatment plant or other dust suppressor agents such as polymers designed for this purpose or other environmentally friendly agents. The effectiveness of the dust suppressor agent used shall be monitored. Watering the road and work surfaces with sea water for dust control is a sustainable alternative since the use of river water may affect the river through the extraction of excessive volumes during periods of low flow.

It is necessary to employ the mitigation programs and methods for dust and water control indicated in the modified datasheets for the EMP construction phase and provided in Section IV of this document,:

- AC-2R Transport
- AC-4R Site Preparation

The impacts on air quality during construction of the rock load-out jetty and dredging of the navigational channel will be caused mainly by the emissions from combustion engines used such as cranes, self-propelled barges, tug boats and dredges.

Operation Phase

Changes to the project design involving the relocation of equipment are expected to have a positive impact in comparison with the original design and aspects evaluated in Section 4.1.1 of Chapter IV of the EIA 2002-2003 which presented the results of the modeling performed for the original configuration of the Liquefaction Plant design. An “Industrial Source Complex Short-Term” (ISCST3, Version 02035 EPA, 2002) air dispersion model was used to predict the maximum concentrations of contaminants in the air generated by the different Project emission sources.

Due to the changes introduced to the project design, the parameters considered in the former air modeling exercise such as: emission sources and data, meteorological information, location of the receptor sites, the building wake effects and the local surveying were reviewed and updated. Also, the information about air quality was updated with the data obtained during the baseline update performed in June 2005.

The review of emission sources and data took into account the following changes in the Project Design:

- The change of the gas turbine model to be used for power generation. The new turbines will require less air flow for its operation and produce less emissions than the former model. Table 4.5 shows the average performance estimated for the new turbines.

- Changes in the wet and dry flares. The new design considers the use of “Indair” flares that use the same pre-mix of air with hydrocarbons to create a more efficient combustion system, generating less emissions. Item 2.2, Section II of this report describes the system and Table 4.6 – Estimation of the Emission Factors AP-42 shows the results expected of the emissions to the atmosphere. The emission factors AP-42 has the approval of the U.S. Environmental Protection Agency (EPA).

- Relocation of “Boil-off-Gas” (BOG) flares to a position 10 m higher than the former position, will allow better dissipation of the combustion gases.

Table 4. 5 Average of the Performance Estimated of the New Turbines (Information provided by the manufacturer, General Electric)

Estimated Average Engine Performance

Performance By: **Johnny Metcalf**
Project Info: **Hunt Power - LNG Fuel 2 - 81 deg F - base and part loads x10%**

Engine: **LM2500+ 6 Stage DLE (PR)**
Deck Info: **GE166B - 7r1.scp**
Generator: **193ER 60Hz, 13.8kV, 0.85PF (10799)**
Fuel: **Site Gas Fuel#900-931, 21116 Btu/lb,LHV**

Date: **12/27/2004**
Time: **2:17:48 PM**
Version: **3.2.7**

Case #	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**
Ambient Conditions										
Dry Bulb, °C	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Wet Bulb, °C	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
RH, %	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Altitude, m	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0
Ambient Pressure, kPa	99.596	99.596	99.596	99.596	99.596	99.596	99.596	99.596	99.596	99.596
Engine Inlet										
Comp Inlet Temp, °C	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
RH, %	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Conditioning	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Tons or kBtu/hr	0	0	0	0	0	0	0	0	0	0
Pressure Losses										
Inlet Loss, mmH2O	101.60	101.60	101.60	101.60	101.60	101.60	101.60	101.60	101.60	101.60
Exhaust Loss, mmH2O	152.40	152.40	152.40	152.40	152.40	152.40	152.40	152.40	152.40	152.40
Partload %	**100**	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**
kW, Gen Terms	**26160**	**23550**	**20936**	**18321**	**15707**	**13092**	**10480**	**7869**	**5263**	**2680**
Est. kJ/kWh, LHV	**9731**	**9934**	**10223**	**10998**	**11972**	**13059**	**13178**	**15782**	**17492**	**27708**
Guar. kJ/kWh, LHV	**9880**	**10085**	**10378**	**11166**	**12155**	**13258**	**13379**	**16023**	**17758**	**28130**
Fuel Flow										
GJ/hr, LHV	254.6	233.9	214.0	201.5	188.0	171.0	138.1	124.2	92.1	74.3
kg/hr	5183	4763	4358	4103	3829	3481	2812	2529	1874	1512
Control Parameters										
HP Speed, RPM	9868	9774	9672	9577	9478	9362	9176	9033	8820	8479
PT Speed, RPM	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
PS3 - CDP, kPa	2062.9	1943.3	1818.7	1670.8	1520.0	1371.9	1257.4	1082.5	945.7	721.7
T3 - CDT, °C	500.2	487.2	473.7	457.0	439.3	421.0	405.8	380.4	358.5	317.0
T48, °K	1095	1070	1046	1049	1053	1046	968	978	877	882
Exhaust Parameters										
Temperature, °C	531.7	520.9	512.5	528.3	546.6	557.4	508.7	541.1	478.3	520.3
kg/sec	78.2	74.5	70.5	64.9	59.1	53.7	51.0	43.9	40.3	30.9
kg/hr	281462	268169	253739	233462	212821	193379	183568	158084	145079	111345
Energy, J/s- ref 0 °K	67688623	63481316	59325517	55806616	52165608	48075490	42553529	38331764	32096922	26142349
Kj/kg-R	1.1620	1.1574	1.1537	1.1591	1.1650	1.1675	1.1478	1.1583	1.1336	1.1465
Emissions										
NOx mg/Nm3 Ref 15% O2	51	51	51	51	51	51	82	82	103	103
NOx as NO2, kg/hr	11	10	9	9	8	7	10	9	8	6
CO mg/Nm3 Ref 15% O2	31	31	31	31	31	31	50	50	50	50
CO, kg/hr	6.68	6.14	5.61	5.29	4.93	4.49	5.78	5.21	3.85	3.11
HC mg/Nm3 Ref 15% O2	11	11	11	11	11	11	18	18	21	21
HC, kg/hr	2.26	2.08	1.90	1.79	1.67	1.52	2.03	1.83	1.63	1.31

Table 4. 6 Estimation of the Emission Factors API-42 for the Gas flares

System	kg/hr	lb/hr	H2S (Mol %)	Btu/lb	MMbtu/hr	DE %	Unburned HC		CE %	CO		NOx		SOx	
Dry Flare	2030000	4475338	0	22009	98497.5	99.7%	13,789.65	lb/hr UHC	98.9%	36,444.07	lb/hr CO	6697.83	lb/hr NOx	0	lb/hr SOx
Wet Flare	158944	350408	0	23445	8215.2	99.7%	1,150.13	lb/hr UHC	98.8%	3,039.63	lb/hr CO	558.63	lb/hr NOx	0	lb/hr SOx
BOG Flare	20000	44092	0	19705	868.84	99.7%	121.64	lb/hr UHC	99.0%	321.47	lb/hr CO	59.08	lb/hr NOx	0	lb/hr SOx

API-42
Unburned H/C 0.14 lb UHC / MMBtu burned
CO = 0.37 lb CO / MM Btu burned
Nox = 0.068 lb Nox / MM Btu burned

DE % = Total HC - UHC / Total HC
CE % = Total HC - UHC - CO / Total HC

Sox = 99% H2S DE

Dry Flare	1737.47	grams/sec	4591.88	grams/sec	843.91	grams/sec	0	grams/sec
Wet Flare	144.91	grams/sec	382.99	grams/sec	70.39	grams/sec	0	grams/sec
BOG Flare	15.33	grams/sec	40.50	grams/sec	7.44	grams/sec	0	grams/sec

Table 4.7 presents the gas emissions expected from a blowndown in the gas flares and by maintenance of their pilot flame. The blowndown is for ensuring that no air enters the flare and the pilot flame is for keeping the flare lit.

Table 4. 7 Emissions by Gas flares and Pilot System

Gas Flare	Blowndown	Pilot	Total
BOG: blowndown + pilot	635 scfh	150 scfh	785 scfh
Dry Gas: blowndown + pilot	40 scfh	200 scfh	240 scfh
Wet Gas: blowndown + pilot	1,455 scfh	600 scfh	2,055 scfh
Total volume blowndown + pilot	2,120 scfh	950 scfh	3,070 scfh

scfh = standard cubic feet of gas per hour

Figure 4.1 Gas flares – Plant, and Figure 4.2 Gas flares – Elevation, show their location. Although these are conceptual not final designs, they are close to the final design.

The relocation of the staff housing area (workers' camp) to the east was considered in the identification of receptor sites. This relocation maintains the same separation distance between the workers and the main emission sources as the original design. With the predominant wind direction being from the south-east, the relocation of staff housing will not produce additional air quality impacts.

Figure 4. 1 Gas flare – Plant View

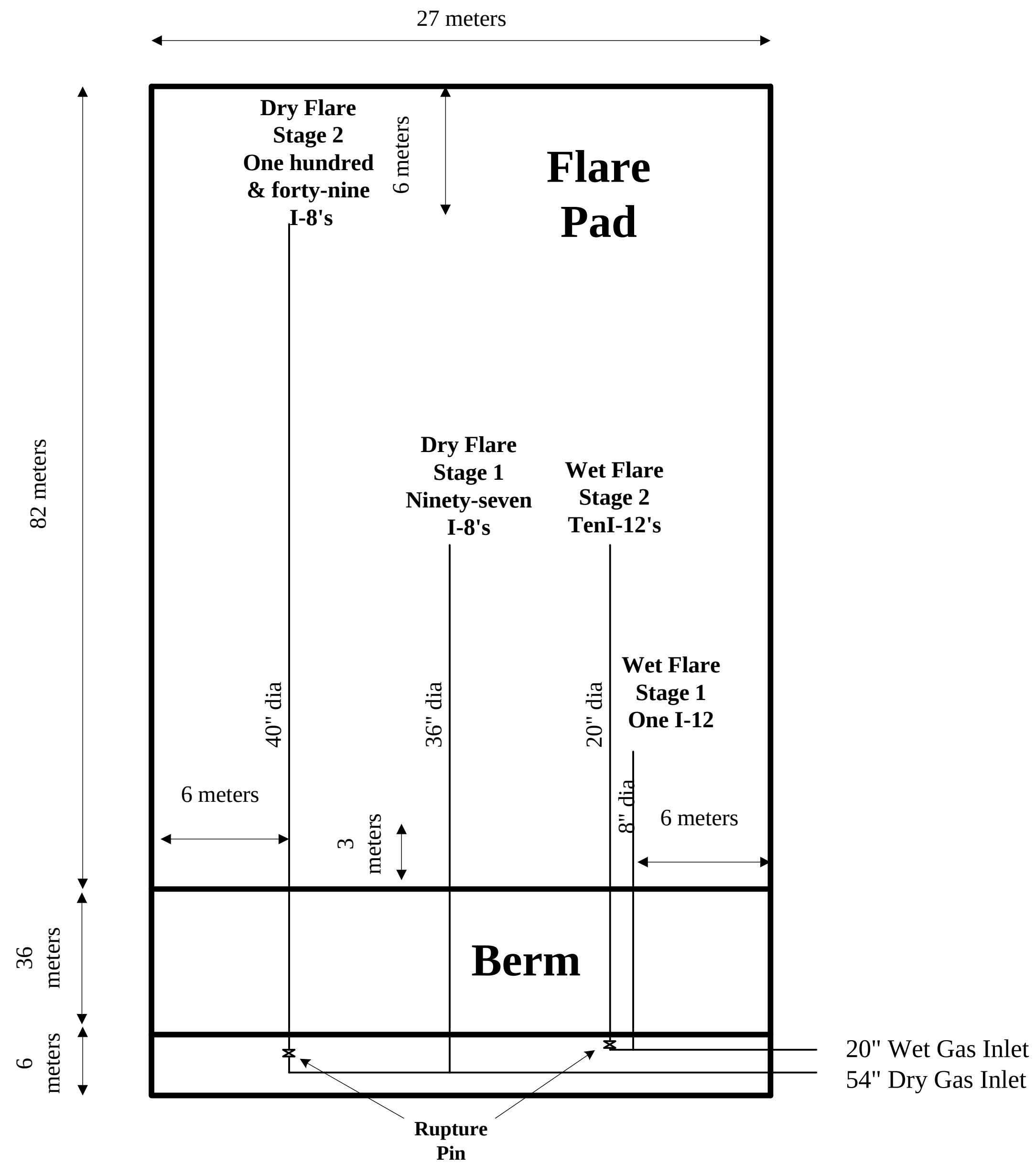
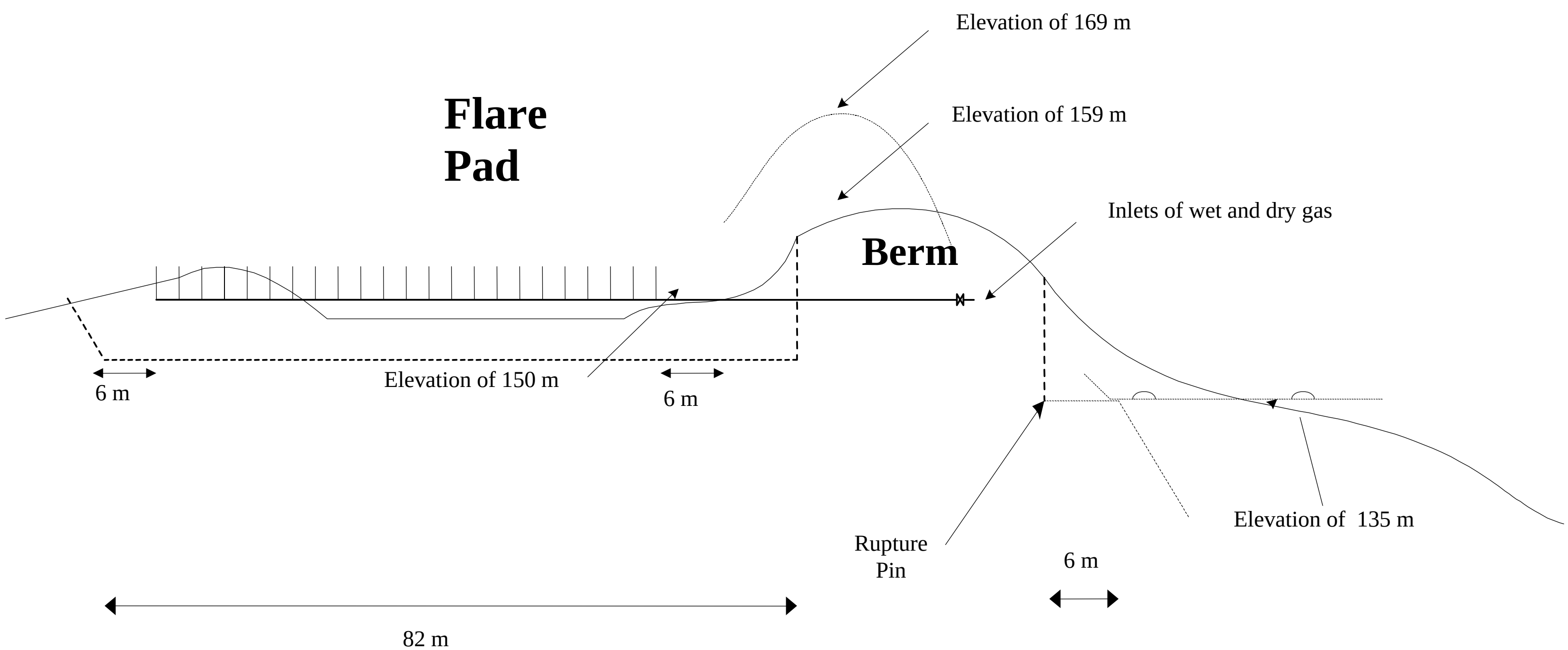


Figure 4. 2 Gas flare - Elevation



Conclusions

A review of the emissions generated by the new equipment was obtained based on the information available, drawing the following conclusions:

As it is shown in Table 4.8, the gas turbines of General Electric GE-LM2500+ generators require less air flow, which produce lower emissions of NOx and CO than the previous GE-MS5001 turbines (see Table 4.9). This is considered a positive impact.

Table 4. 8 Comparison of Operation and Emission Parameters of the Original Turbine Vs the Current Turbines

Emission sources	Information of the Operation Activities		Information of Pollutant Emissions	
	Outlet flow	Temperature	NO_x	CO
	(kg/hr)	(^oC)	(kg/hr)	(kg/hr)
Turbine GE-MS5001 (original)	439,000	488.30	14.10	10.0
Turbine GE-LM2500+ (at present)	281, 462	531.70	11.0	6.68

The information about the original turbines and the current turbines comes from Tables 4.5 and 4.9, respectively.

As the impacts estimated in the air modeling conducted for the EIA 2002-2003 from these emission sources (GE-MS5001 turbine) were 60% below the air quality standards (see Table 4.10), it is expected that the impacts generated by the new turbines LM2500+ will be even lower, since they use less air flow and emit lower quantities of NOx and CO. For these reasons and considering there are no significant changes in the diameter and height of the stacks, in the height or width of the surrounding structures and buildings that might affect the original model configuration, it was not considered necessary to conduct a new air modeling exercise for the new generators.

Regarding the SO_2 and particulate emissions from the turbines, since the air flow through the turbines is less, it is estimated that these emission rates will also be less than for the original MS5001 turbine considered in the EIA 2002-2003. As a result, the impact caused by these pollutants and this design change will continue to be very low.

Regarding the gas flares, since the new design has a horizontal configuration instead of the original vertical configuration, air impacts may occur caused by these sources. The former analysis considered dry and wet gas flares as well as BOG flares at outlet heights of 150, 150 and 20 m, respectively. The current design considers the installation of dry and wet gas flares at a ground level pad, and the discharges will be produced at this level. The BOG flares will be at 30-m height.

However, the new flare configuration has an air/hydrocarbons pre-mix system for obtaining more efficient combustion. Additionally, gas flares will have non-continuous, intermittent flow and will be emergency emissions only (during maintenance and start-up of the general plant system), except for the pilot flame whose emissions are insignificant as is shown in Table 4.7. Comparing the current emission values estimated in Table 4.6 'Estimation of Emissions AP-42' versus the values estimated previously in Table 4.9 for the EIA of 2002-2003, it was concluded that the volume of atmospheric emissions will not increase.

The decrease of the outlet heights for the wet and dry gas flares compared to the original design is considered a positive impact due to the reduction of risks for aerial navigation. Also, from a visual point of view, the reduction of the heights of outlets and structures is considered a positive impact since there is no presence of discordant elements on a undulating landscape without high elevations.

An air quality follow-up shall be conducted according to the air quality monitoring program included in Data Sheet SO-5 Monitoring of Air Quality, Chapter V of EIA 2002-2003.

Table 4. 9 Data of Pollutant Emission Used for Air Modeling of EIA 2002-2003 (...)

Emission Source	Continuous (C) or Intermittent (I)	Stack data		Data of Operation Activities					Pollutant Emission Data											
		Height	Diameter	Flow		Speed	Temperature		NO_x		SO_2		CO		PM		MP10		VOC	
			(m)	(kg/hr)	(m^3/hr)	(m/s)	(°C)	(K)	(kg/hr)	(g/s)	(kg/hr)	(g/s)	(kg/hr)	(g/s)	(kg/hr)	(g/s)	(kg/hr)	(g/s)	(kg/hr)	(g/s)
GT Power Generator No. 1 (G-4001)	C	36	4.00	439,000	985,085	21.8	488.3	761	14.1	3.92	Neg.	Neg.	10	2.78	2	0.56	1	0.28	4.1	1.14
GT Power Generator No. 2 (G-4002)	C	36	4.00	439,000	985,085	21.8	488.3	761	14.1	3.92	Neg.	Neg.	10	2.78	2	0.56	1	0.28	4.1	1.14
GT Power Generator No. 3 (G-4003)	C	36	4.00	439,000	985,085	21.8	488.3	761	14.1	3.92	Neg.	Neg.	10	2.78	2	0.56	1	0.28	4.1	1.14
Dry Gas Flare Stack (B-6220)	C	150	1.53	NA	NA	0.1[d]	18	291	0.28	0.08		NA	1.45	0.40		NA		NA	0	0.00
	I[c]						46	319	2.01	0.56[e]			10.45	2.90[e]					101.5	28.19[e]
Wet Gas Flare Stack (B-6210)	C	150	0.915	NA	NA	0.1[d]	18	291	0.05	0.01		NA	0.25	0.07		NA		NA		NA
	I[c]								171	47.50[e]			888.5	246.81[e]		`				
LNG Tank /Ship BOG Flare Recirculation System (B-3710)	C	35	0.305	NA	NA	0.1[d]	18	291	0.01	0.003		NA	0.07	0.02		NA		NA		NA
	I[c]								10.8	3.00[e]			56	15.56[e]						

[a] 2 power generators operate at the same time while the third is shutdown. [b] Unit operates 50% of the time at full duty; 50% in standby.[c] Operated for 1 hour per week for maintenance; 100 hours maximum per year. [d] Assumed velocity since flow data was not provided [e] Maximum at emergency flare load. [f] Diameter based on two stacks with diameters of 0.152 m each.una

(…) The information included in this table comes from Table 9 “Stack, Operating, and Pollutant Emission Data for the Project Used in the Air Dispersion Modeling Analysis” of Section 4.1.1, Chapter IV of EIA 2002-2003.

Table 4. 10 Maximum Pollutant Impacts Predicted in Air Quality Modeling for EIA 2002-2003

Pollutants	Average Period	Value	Maximum Predicted Concentrations ($\mu g/m^3$)[a] Total of Modeled Sources Total	GT Drivers	GT Power Generators	*Heaters*	Flares	Emergency Diesel Generators [d]	Fire Diesel Pumps[d]	Seawater Fire Pumps [d]
Meteorological Data from Pisco										
Nitrogen Dioxide (NO_2) [b]	Annual	Maximum	4.0	0.15	0.20	2.9	0.022	0.59	1.2	0.58
	24-Hours	Maximum	25.8	0.77	0.78	8.1	0.07	7.4	10.9	5.4
		98th percentile	24.2							
Particulate Matter	Annual	Maximum	0.054	0.019	0.037	NM	NM	0.014	0.026	0.013
(MP_{10})	24-Hours	Maximum	0.52	0.102	0.15	NM	NM	0.17	0.25	0.12
		98th percentile	0.49							
Sulfur Dioxide (SO_2)	Anual	Maximum	0.23	NM	NM	NM	NM	0.078	0.104	0.052
	24-hours	Maximum	2.3	NM	NM	NM	NM	1.0	0.94	0.47
		98th percentile	2.2							
Carbon Monoxide (CO)	24-hours	Maximum	5.6	0.38	0.74	NM	0.58	1.1	3.0	1.5
	8-hours	Maximum	25.7	0.93	1.5	NM	1.2	5.5	13.9	7.0
	1-hour	Maximum	294	4.2	4.8	NM	4.1	75.2	156	78.2
Meteorological Data from Lima										
Nitrogen Dioxide (NO_2) [b]	Annual	Maximum	3.7	0.093	0.14	3.0	0.029	0.51	1.1	0.53
	24-hours	Maximum	27.6	0.69	0.57	9.3	0.14	6.6	12.0	6.0
		98th percentile	22.1							
Particulate Matter	Annual	Maximum	0.046	0.012	0.027	NM	NM	0.012	0.023	0.012
(MP^{10})	24-hours	Maximum	0.57	0.092	0.11	NM	NM	0.15	0.27	0.14
		98th percentile	0.45							
Sulfur Dioxide (SO_2)	Annual	Maximum	0.20	NM	NM	NM	NM	0.067	0.094	0.047
	24-hours	Maximum	2.4	NM	NM	NM	NM	0.87	1.0	0.52
		98th percentile	1.9							
Carbon Monoxide (CO)	24-hours	Maximum	6.1	0.34	0.53	NM	1.2	1.0	3.3	1.7
	8-horas	Maximum	28.3	1.0	1.3	NM	2.8	5.0	15.7	7.8

NM= not modeled due to minimal emissions
[a] *Maximum concentrations were predicted using the USEPA ISCST3 model for hourly measurements during 1996. The meteorological data was from Pisco and Lima.*
[b] *Maximum NOx concentrations were multiplied by the following ratio to account for the NO_2 portion of NOx emissions: 0.75*
[c] *98th Percentile or seventh-highest concentration for 24 hour averaging period (equivalent to the 2% value or 0.02 x 365 (number of 24-hour values in a year)).*
[d] *Intermittent sources that operate for 1 hour per week for maintenance; maximum of 100 hours per year.*
(…) The information included in this table comes from Table 10 "Maximum Pollutant Impacts Predicted for the Project Sources Using 1996 Meteorological Data from Pisco and Lima, Peru" of Section 4.1.1, Chapter IV of EIA 2002-2003.

4.1.2 Noise

Construction Phase

The noise produced during construction of the underpasses along the Panamerican highway and the rock hauling activity will have a slightly negative effect on the illegal human settlements adjacent to the project area.

At this time there are several illegal settlements located on lands adjacent to the Project (see Section II Update of Baseline), that did not exist during the Baseline Studies of the EIA (2002-2003). The settlements which are closest to the work areas are those located along the Panamerican highway: They include: “CETEC” located approx. 1 km south of the project site, “Trébol del Pacífico” and “Las Brisas de Concon” located approx. 4 km north of the project site. It has been observed that most of the settlements do not have a permanent population as residents are present only one day a week or generally on weekends (see Section II Update of Baseline). According to the information provided in Section 4.1.2. of Chapter IV Environmental Evaluation of the EIA 2002-2003, there is a high sound impact in the area due to the vehicle traffic on the Panamerican highway. However, it is expected that the noise levels generated during construction will be localized, intermittent and of short duration and thus will not be a significant negative impact.

The noise that will be generated during construction of the rock load-out jetty and modifications to the dredging of the navigational channel will have an intermittent and slightly negative effect on the fishermen of the zone. The noise will be confined to the area directly altered by the work and will be slightly higher than the typical noise levels in the zone. It will be necessary to monitor noise levels generated by the construction activities through the program included in the EMP and identified in Data Sheet SM-4 “Monitoring of the Noise Levels, Chapter V of the EIA 2002-2003.

4.1.3 Water Resources

Construction Phase

Construction of the rock load-out jetty will cause a temporary increase in the water turbidity. The modification to the dredging of the navigational channel will cause increased water turbidity also, as was indicated in Section 4.1.4, Chapter IV of the EIA 2002-2003. Considering that there are artisanal fishing areas adjacent to the project site, hydrological monitoring is required during the construction phase. It is considered that this activity will contribute to the temporary increase of the suspended particulate matter in the sea water and to the alteration of aquatic habitat, thus a slightly negative impact is expected to occur on these receptors which may extend beyond the directly affected Project area but remain within the boundaries of the evaluation study area. It is predicted that the turbidity levels may be above the typical existing conditions but without reaching levels that can cause significant impacts on biological parameters as these levels will be monitored during construction according to Data Sheet SM-2R.

Data Sheet SM-2R ‘Water Quality Monitoring’ included in Section IV of this document indicates the procedures and locations for daily monitoring of sea water turbidity during the dredging operations with the aim of protecting the fishing zones adjacent to the work areas.

During the rock hauling activity and in general during the construction stage, water that will be used for dust control will be obtained from the sea, the Cañete River and/or a well, so a slightly negative temporary impact can be caused by the extraction of this water. Water from the sewage treatment system or an environmentally friendly dust suppressor agent may also be used. If water from the Cañete River is not used for dust control during water shortage periods, this will be considered a slightly positive impact.

PLNG is evaluating methods for extracting sea water. Among these methods, the filtration through wells in the beach area or by suction through a pipe directly from the sea were considered, as indicated in the EIA of 2002-2003 for the water desalinizing plant (see Section 2.3.10.1 “Sea water supply system”, Chapter II of the EIA 2002-2003).

Effluent from the construction camp water treatment plant may be used in dust control. This would produce a positive impact by reducing the need to apply other types of dust suppressors. Also, using the effluent would provide an energy savings since there would be no need to transport water from another location or pump water from the beach to the work area.

The possible alteration of the physical and chemical quality of the sea water caused by accidental spills of fuel and grease during construction is considered a slightly negative potential impact. For this reason, strict control will be applied during fueling operations and equipment or ship maintenance activities.

Operation Phase

It is considered that the operation of the marine facilities (i.e., the interaction of the rock load-out jetty, the trestle and the breakwater with the marine currents, waves and sediment transport) will cause an intermittent slightly negative effect on the turbidity levels of the sea water. It is foreseen that this effect will be confined to the area directly disturbed by the project.

The company Sandwell with more than 50 years of experience in marine and coastal engineering conducted a modeling exercise predicting the behavior of marine sediments dragged by the currents and the waves as a result of their interaction with the Project marine structures. Also, the Peruvian company Sehidro, authorized by DICAPI to conduct EIAs, with 6 years experience in the preparation of marine EIAs, has interpreted the results of the modeling exercise and analyzed the probable effects that these structures might cause on marine sediment transport dynamics and the geomorphology of the coastline.

The report on sediments and marine currents prepared by Sandwell is presented in Appendix G “Modeling of Sediment Transport and Wave Power”. Also, Sehidro interpreting this data in the EIA to be submitted to DICAPI, draws the following conclusions:

“With regard to the presence of the dock, the pier breakwater and the main breakwater; the first is permeable meaning it will not obstruct the sediment transport and therefore, the marine dynamics would not produce any change in the coast morphology. On the other hand, the other two structures, although they would not obstruct sediment transport, may cause an area of lower energy from the waves and therefore would produce either more calm or turbulence, facilitating somehow the deposition of the sediment at the diffracted wave fields. However, the effects from this process, mainly due to the distance of the breakwater, will not be significant, causing changes mainly between the coast and the first 5 meters of depth, with a tendency to the formation of a tombolo effect at the diffracted wave fields.” (Section 3.1.4 Processes of Erosion and Sedimentation).

For the reasons explained above, an intermittent and slightly negative effect is expected to occur on water quality as a result of changes in current direction, speed and sediment transport patterns that may extend beyond the immediate area of the project but remaining within the boundaries of the area of direct influence for the project.

4.1.4 Soils and Landforms

Construction Phase

Construction of the underpasses and the rock hauling activity will cause a slightly negative effect on soil structure in the project area of direct influence, due to soil mixing and compaction. However it is necessary to consider that the current and future use of these soils is not for agriculture and that they do not have significant organic soils that may be affected by the construction works. The work area for the underpasses comprises a 1,600-m long by 100 m-wide strip, parallel to the Panamerican highway, as can be observed in Figure 2.11 of Section II.

It was predicted that the rock haulage activity may cause a slight negative effect on soil physical and chemical properties if sea water is used for dust control along the beach access road instead of water obtained from the Cañete river, wells, sewage treatment effluent or other dust suppressing agents. If sea water is used, this may cause an increase in the salt content of the soil which is already high due to the marine breeze carrying salt particles (marine spray) on shore. The salinity of the soils analyzed in the project area is high ranging from 16 to more than 25 dS/m. (see Chapter III Baseline Studies, Section 2.3 Soils of the EIA 2002-2003). The salinity of the sea water ranges from 34.9 to 35.3 UPS (Salinity Practical Unit) on surface and 35.4 UPS at the bottom, as can be seen in Appendix C “Update of the Environmental Baseline”, Section 3.1 “Marine-Oceanography Component”.

Construction of the underpasses, the rock load-out jetty and modification to the dredging of the navigational channel will have a slightly negative effect on landforms in the project area of influence. The marine works will permanently modify the sea bottom which has a flat relief.

During the construction period of the rock load-out jetty, it is considered there will be a slightly negative impact on the geomorphology of the coastline, according to the modeling performed by Sandwell, which could extend beyond the area directly affected by the project but remain within the boundaries of the study area.

These changes shall be monitored through the program identified in datasheet SO-7R ‘Monitoring of the Coast Line’. This program should begin in the construction phase prior to the start-up of the mentioned works.

Operation Phase

Due to the incorporation of the rock load-out jetty into the Project and its interaction with the breakwater, the trestle and overall sediment transport changes a slightly negative impact is expected to occur on the coastline morphology

The rock load-out jetty will be approx. 220 m long by 100 m wide, and will be located along the 10 m depth contour of the sea floor immediately north of the trestle and approx. 800 m off-shore.

It is estimated that the combined action of the rock load-out jetty and the breakwater will be cumulative on the current speed, wave height and sediment transport, which could cause changes in the sea bottom located close to these structures and changes on the morphology of the coastline.

The company Sandwell modeled the wave diffraction fields in the area around the trestle, rock load-out jetty and breakwaters to assess their influence on sediment transport patterns and as consequence, the morphology and dynamics in the areas close to the beach. The fields of diffracted waves were estimated for two cases: (1) with the original breakwater designed for the project and (2) with the combined action of the jetty and the breakwater. The quantitative and qualitative differences between the fields of diffracted waves were used as guidelines for the analysis and interpretation of the impact on the transport of sediments of the rock load-out jetty.

The information used for this investigation included real bathymetry data around the rock load-out jetty, including the navigational channel to be dredged. The parameter investigated was the water speed near the sea bottom, induced by the field action of the diffracted waves. The results presented show the cases and the differences obtained by subtracting the base case (breakwater) from the rock load-out jetty, showing the alteration (or incremental change) due to the presence of the rock load-out jetty.

Figures 4.3.3, 4.4 and 4.5, obtained from Appendix G ‘Transport of Sediments and Wave Energy’, show the results. Figures 4.3 and 4.4 show the fields of diffracted waves for the base case and for the rock load-out jetty corresponding to the same wave conditions. Figure 4.5 is the difference between the two diffracted fields, where it is observed that in the resulting diffracted field the waves are reduced by 10%. This results show the net effect of the rock load-out jetty.

With regard to changes in current speed near the sea floor, as a result of existing wave energy without the presence of the rock load-out jetty , Sehidro indicates that the figures (Figures 4.3, 4.4 and 4.5 of this document) included in the text of the report (Appendix G 'Transport of Sediments and Energy from Waves') show the results for the case of the waves coming from 210º.

Figure 4. 3 Case Base: Wave Diffraction with the Breakwater

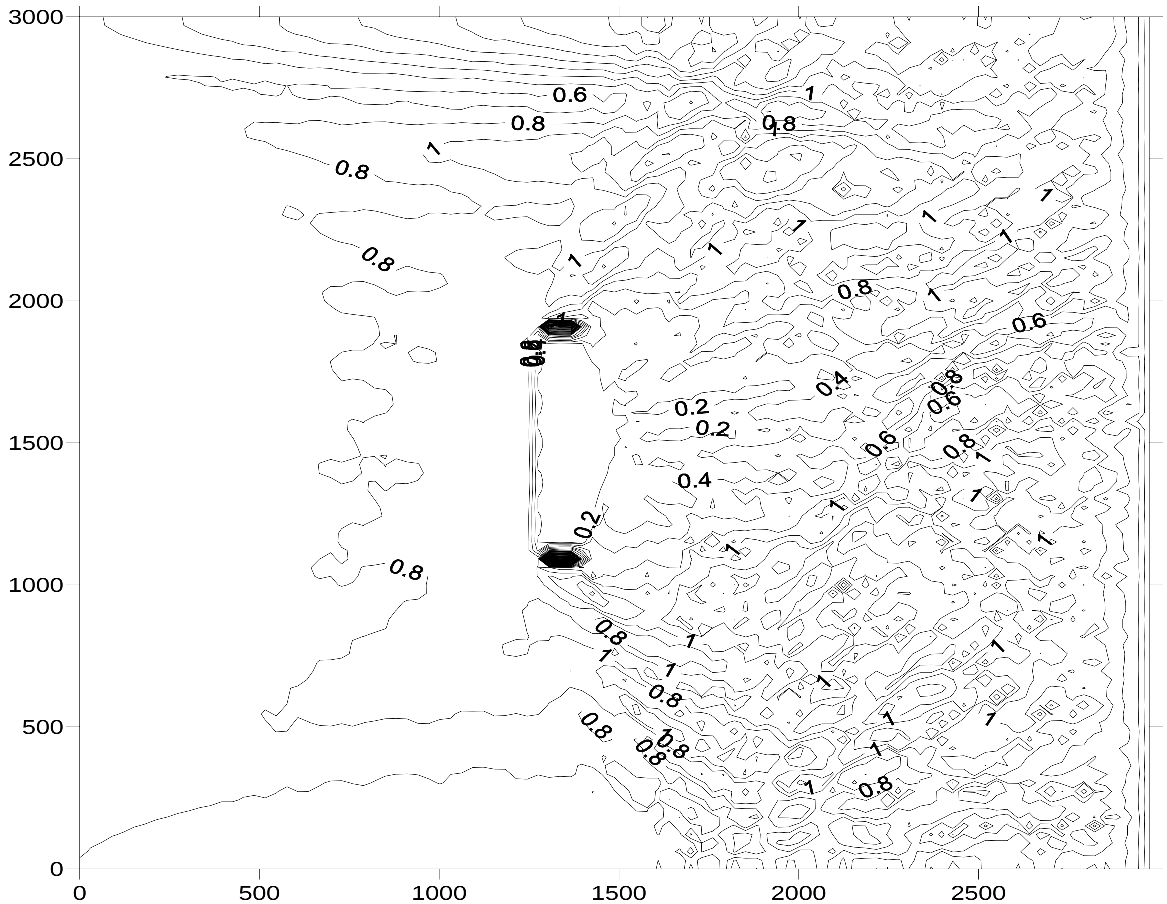


Figure 4. 4 Wave Diffraction with the Breakwater and the Rock Load-out Jetty

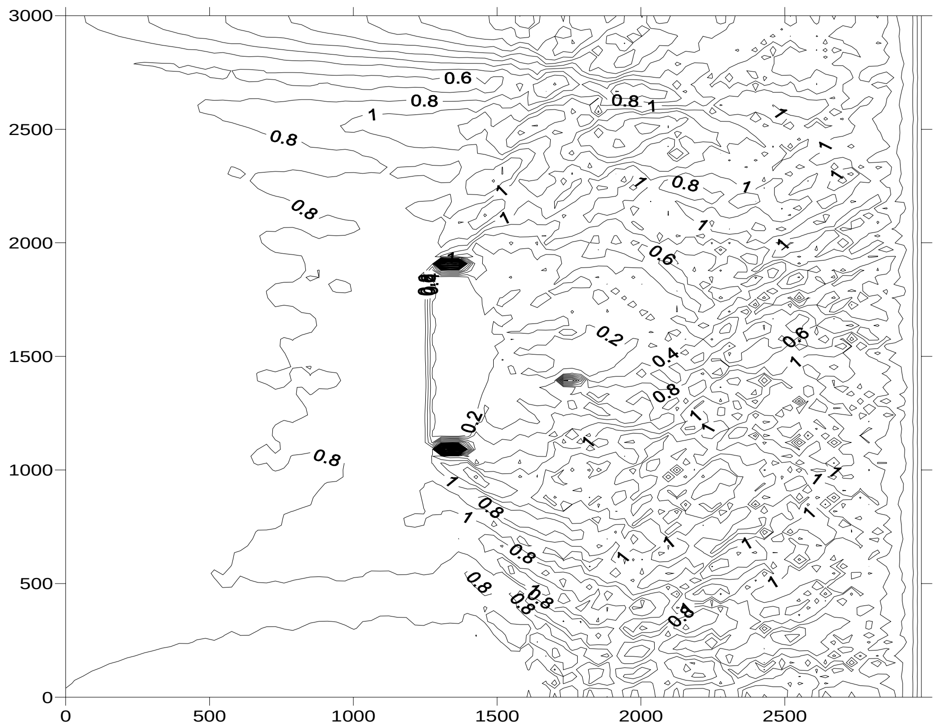
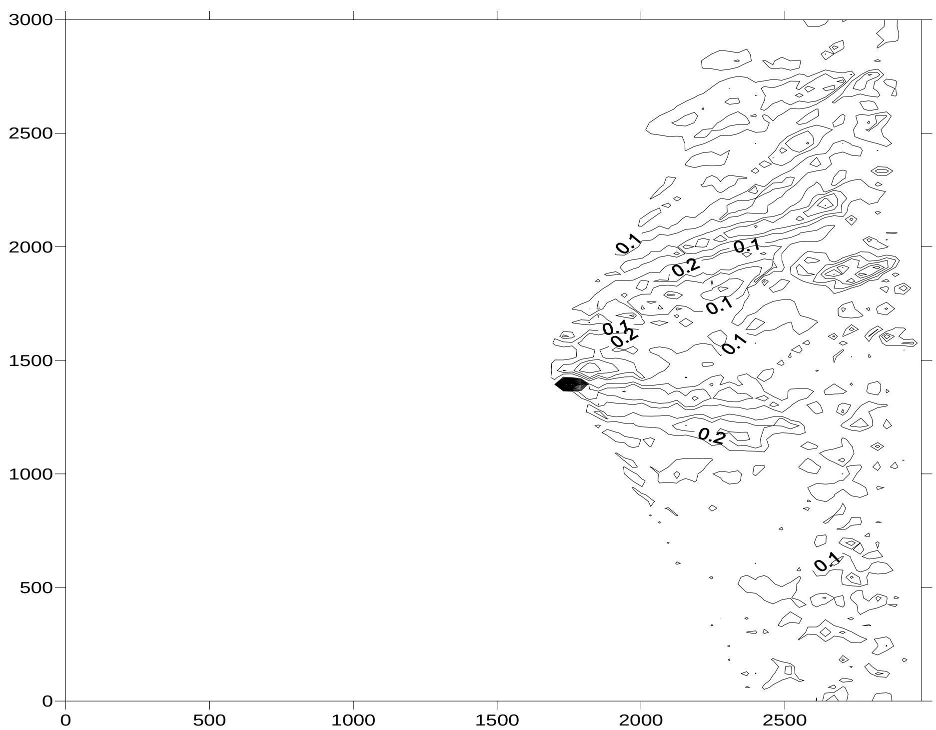


Figure 4. 5 Field Altered by the Wave Diffraction Due to the Loading Platform



The company Sehidro presents the following conclusions as interpretation of the study prepared by Sandwell:

- “The climatology of the waves 750 m north and 750 m south of the trestle remain unchanged in response to effects of the rock load-out jetty.”
- “At the central axis of the jetty the mean wave height (height occurring 50% of the time) decreases from 0.4 m to 0.3 m.”
- “There are no changes 375 m north of the trestle, since in this zone there is no impact caused by the jetty on the waves coming from 240º and 225º. Waves coming from 210º are fully protected by the breakwater so the jetty has a minimal impact.”
- “375 m south from the trestle, the mean wave height (heights that occur 50% of the time), decreases from 0.8 m to 0.7 m. This change is caused by the additional protection provided by the jetty to the waves coming from 240º occuring 15% of the time.”

It is considered that the joint action of the jetty and the breakwater could cause an area with lower wave energy which facilitates the deposition of sediments in the diffracted wave field. Construction of the marine facilities in Melchorita would help the sedimentation in areas where there is calm sea due to the lower wave energy, but it is also estimated that sea bottom erosion effects will occur in areas where there is greater turbulence due to the action of the water on the marine facilities.

As mentioned in the EIA of 2002-2003, due to the distance of the breakwater from the coast (1,600 m), its effect would be insignificant towards the formation of a tombolo on the diffracted wave field produced by the breakwater. According to the Coastal Protection Manual of the US Army Corp of Engineers, this situation generally occurs in cases in which the distance from the beach to a breakwater located parallel to the beach is lesser or equal than the length of the breakwater (see Volume V, Chapter 3, Page V-3-50 of the Manual). It indicates that there are more possibilities of sand accumulation producing a tombolo effect on the beach when the breakwater has the following characteristics: it is close to the beach, relatively long with regard to the incident wave length and is relatively impermeable.

The Coastal Protection Manual presents the variables that were used to develop empiric relationships in breakwaters located parallel to the coast. For the formation of a tombolo effect, the key variables are:

Y : Distance of the breakwater to the coastline

Ls : Length of the breakwater

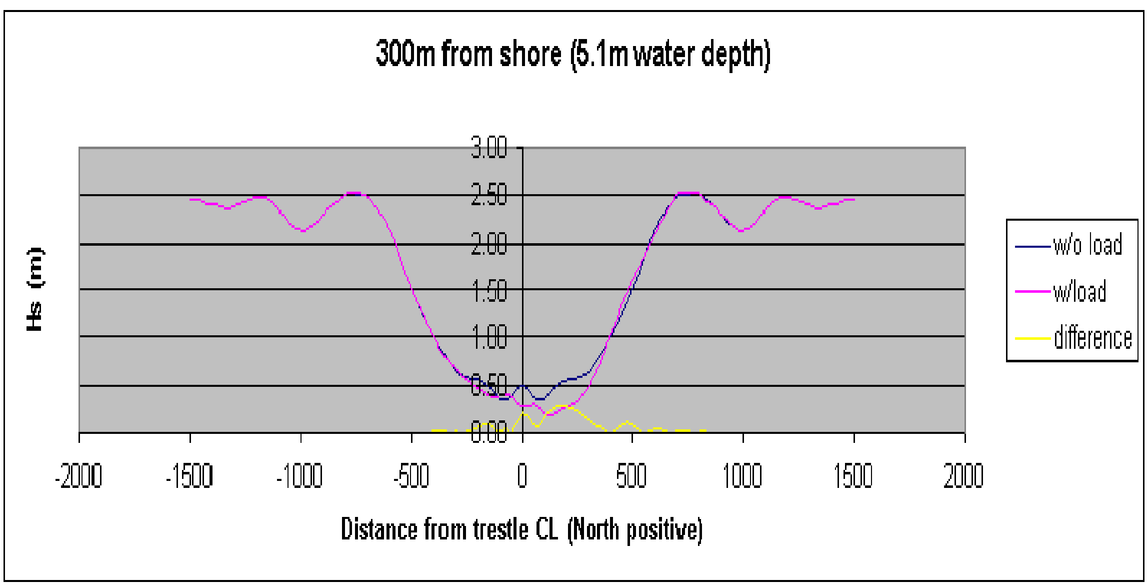
ds : (average) Depth of the breakwater under the sea level

Table V-3-6 of the Coastal Protection Manual describes the non-dimensional parameters, Y/ds and Ls/Y used in the engineering design to predict and control the formation of a tombolo effect on the coastline.

Sehidro considers that due to the depth at the location of the breakwater (14m) and the jetty (10 m) and to the separation distance of 600 m between both structures, they will allow for the transport of sediments and no significant accumulations are expected. Also, the company informs that the erosive effect that occur north from Melchorita beach during the period of rough seas, could compensate for any tendency towards formation of a tombolo effect on the beach.

The Sandwell modeling in Figure 4.6 shows that the wave height at a depth of 5.1 m will be significantly reduced due to the presence of the marine structures and this effect will extend up to a distance of approximately 750 m south and north from the trestle. So it is foreseen that this area will have less wave energy and a greater tendency to accumulate sediment..

Figure 4. 6 Height of the Waves Due to the Action of the Marine Structures



The Coastline Monitoring Program, outlined in Datasheet SO-7R of Chapter IV of this document considers topographical surveys and/or initial evaluations through satellite images to be conducted on an area of approximately 7 Kms of coastline which comprises the area of the PLNG property and coastline to the south and north of the property boundaries. Datasheet SO-7 "Monitoring of the Coastline" of the EIA of 2002 – 2003 indicated that: "The follow-up of the coastline monitoring will cover an area from one kilometer south to three kilometers north from the PERU LNG SRL boundary property.", equivalent to the 7 km length indicated above.

Section IV of this document includes the revised Datasheet SO-7R "Coastline Monitoring Program".,.

4.2 Biological Environment

4.2.1 Terrestrial and Marine Flora and Fauna

Construction Phase

The construction of underpasses are expected to cause a slight negative impact as a result of the removal of the typical vegetation of the zone, composed of *Tillandsias*. However, considering that the density of this specie in the area is very low and that the survival pattern of *Tillandsias* is to form isolated patches that appear and disappear depending on the availability of humidity and nutrients in the soil and air, the probability that these species are present during the construction period is very low.

There will be a moderately negative impact on the benthic community located in the area where the rock load-out jetty will be constructed. The affected area located 800 m from the coastline, will be approx. 220 m long x 100 m wide and will be located immediately north of the trestle. This impact will be permanent. However, after the initial impact, new benthic communities will develop in the habitat created by this structure.

The access restriction to the area of the marine facilities will prevent fishing in this area. However, it is important to indicate that fishermen will have access north and south of the restricted area. The restricted area is 1,320 m in total length measured along the coastline and encompasses all the marine facilities. For this reason it is considered that the impact is neutral since the usual activities of the artisanal fishing in the neighboring areas will not be affected.

The activity of the rock load-out jetty is considered a slightly negative impact on the marine fauna, confined to the area directly disturbed by the project, the effects are temporary and of low magnitude.

Operation Phase

As indicated in Chapter IV, Section 4.2.1, of the EIA 2002-2003, changes will occur to the structure and composition of benthic and planktonic communities as a consequence of a new substrate, which will be reflected as well in local artisanal fishing catches. These impacts are considered slightly negative in the first stages of ecological succession. However, once ecological stability is reestablished, these impacts could be considered as positive once the new communities establish themselves in the new habitat created by the marine facilities. The EIA of 2002-2003 states: “the most significant impact on the marine ecosystem are the new substratum conditions, established around the breakwater, dock and the navigational channel, and its re-colonization by an opportunistic biota adapted to the new conditions. This impact, previously mentioned, is considered positive since it will provide new habitats and hatcheries for fish and species of interest to the local fishing activity”.

For the reasons mentioned above, the final impact evaluated is considered neutral, that is to say, no net damage and no net benefit for the resource. It will be necessary to establish a program for monitoring the hydro-biological conditions in the areas around the project site.

4.3 Social, Economic and Cultural Environment

4.3.1 Social

Construction

Construction of the underpasses will cause some temporary nuisance to the public due to interruption of the road infrastructure and obstruction of normal vehicle flows along the Panamerican South highway. This is considered a slightly negative impact. Provisional accesses and proper signage will be implemented during the construction activity in order to prevent vehicle accidents and facilitate traffic flows through the sections under construction. Once the underpasses are constructed, the impact on public safety and traffic flows in this area will be positive since vehicles crossing the Panamerican highway will be reduced.

Construction of the jetty will cause an intermittent, temporary, and slightly negative impact on local fishermen due to the noise produced by the ships and cranes during construction and also due to the navigation restrictions near the project site.

4.3.2 Economic

The construction phase of the underpasses and the rock load-out jetty will have a positive impact on job creation since there will be more demand for workers during the construction period. The development of the construction works will generate direct jobs and lead to a decrease in local unemployment and underemployment rates. It will also create indirect jobs as a result of the increased demand for local goods and services.

4.3.3 Cultural

Although two CIRAS have been completed for the construction zone of the underpasses, there is the possibility of alteration or destruction of as yet undiscovered archaeological resources so this activity is considered a slightly negative impact. Construction of the plant access road will affect a strip of land approximately 1600 m long X 100 m wide east of the Panamerican highway, between Km 167 and Km 169. Both places where the underpasses cross the highway require excavations of up to 4 m depth, so the possibility of finding archaeological remains is present.

PLNG is making all the required consultations with the INC to verify if both CIRAS prepared for the area cover the total area to be intervened. These CIRAS include: CIRA No. 2003-01 (on the west of the highway) and CIRA No. 2003-210 (on the east zone of the highway). Should any part of the area to be intervened not be covered by these CIRAS, it will be necessary to obtain all the necessary approvals from the INC.

As requested by the INC, all earthworks conducted at the project site will require the presence of an archaeologist and in the event of finding archaeological remains during the works these shall be suspended and reported to the INC.

5.0 COMPARATIVE ANALISIS OF IMPACTS

In order to conduct a comparative analysis of the impacts predicted in the EIA of 2002-2003 (see Tables 6 and 7 of Chapter IV, EIA 2002-2003) and the impacts predicted by the present EIA modification (see Table 4.4,) the following aspects should be considered:

- The modifications to the EIA introduce mainly: (a) changes in equipment and relocations inside the installation and (b) new elements such as the construction of underpasses and a rock load-out jetty.

- These modifications introduce new activities to the environmental evaluation of the project but do not introduce new impacts.

- 16 of the 22 change indicators evaluated for each project activity in the EIA of 2002-2003 were considered relevant in the evaluation of impacts associated with new activities introduced as part of the project modifications. It is important to clarify that for the preparation of the matrix of impact identification (Table 4.2), not all the indicators previously identified interact with the new activities introduced by the changes to the original design. Therefore, it is not considered necessary to evaluate all the indicators identified in the EIA of 2002-2003.

- Only in the case of operation of the marine facilities, is it considered that the effect of the new structure (the rock load-out jetty) in conjunction with the other structures previously evaluated (i.e. the trestle and the breakwater), will cause a slightly cumulative effect on currents, wave and sediment transport dynamics within the project area (see ranking for change indicators in datasheets H-1, H-2 and SU-4).

The impacts predicted according to the development phases of the activities analyzed are discussed below.

<u>Construction Phase</u>

In comparing the results of the impact ranking presented in Table 6 of the EIA of 2002-2003 with the construction activities evaluated in Table 4.4., it may be observed that:

- The impacts on air quality produced by the new project activities are slightly negative compared to the impacts predicted for the activities evaluated before the modification. It is necessary to indicate that the main construction activities were evaluated during 2002-2003.

- Both new activities in the project such as the construction of the underpasses and the rock load-out jetty present a moderately negative impact on the soil component with regards to the changes introduced to the original landforms at the site. This ranking is similar to the activities evaluated during 2002-2003.

- All other impacts resulting from new activities associated with project modifications are assessed as slightly negative and have a lower ranking than the activities previously evaluated.

- There are no impacts caused by the new activities of the project or by the previously evaluated activities that can be considered as highly negative.

- Most of the impacts of construction on the physical, biotic and social components assessed as are slightly negative, of short duration and reversible in the short term.

Operation Phase

By comparing the results of the impact ranking presented in Table 7 of the EIA of 2002-2003 with the operational activities evaluated in Table 4.4, it is observed that:

- The change of equipment is considered a positive impact according to the emissions modeling performed during the EIA of 2002-2003. The new equipment will generate much lower emissions than the former equipment whose emissions were already two-thirds below the reference air quality standards used in the modeling. The former impact on air quality was considered slightly negative.

- Operation of the rock load-out jetty in combination with the other marine structures previously evaluated presents slightly negative impacts in the form of localized increases in sea water turbidity, changes in current direction, speed, and sediment transport dynamics which may combine to create potential alteration of the beach morphology. The impacts of the rock load-out jetty may interact in a cumulative way increasing the impacts predicted for the trestle and the main breakwater evaluated in the EIA of 2002-2003.

Table 4.11 presents a matrix that summarizes the ranking of impacts prepared during the EIA of 2002-2003 (see also the response 136b of the observations to report No.029-2003-EM-DGAA/OC/RM/FO/ML "Evaluation of the EIA of Pampa Melchorita LNG Peru Export Project") and the ranking of impacts prepared during this EIA modification (see Table 4.4), both of which consider the application of management measures.

An average ranking has been established for each impact predicted in each component of each phase of the project (construction/operation). Finally, based on the average of each impact predicted (with the application of management measures considered) a resulting average of the two phases of the project has been obtained (see the last right row of the matrix). As is shown in this table, the results foreseen are slightly negative, neutral and in some cases positive on the environmental and social component in the project area of influence.

Table 4. 11 Matrix of Comparative Impacts between the EIA of 2002-2003 and the Modification to the EIA

Tabla 3.11 Matriz de Calificación de Impactos Comparativos Entre el EIA 2002-2003 y la Modificación Al EIA

COMPONENT	CHANGE INDICATORS	Code	PROJECT PHASES																			
			CONSTRUCTION										OPERATION									
			EIA 2002-2003						MODIFIC. TO THE EIA				EIA 2002-2003						MODIFIC. TO THE EIA			
			TRANSPORT AND MOBILIZATION	SITE PREPARATION	CONSTRUCTION OF INFRASTRUCTURE AND SERVICES	CONSTRUCTION OF PROCESS AND STORAGE AREA	CONSTRUCTION OF MARINE INSTALLATIONS	TESTS TO SYSTEMS AND EQUIPMENT	CONSTRUCTION OF UNDERPASSES	ROCK HAULAGE	CONSTRUCTION OF THE ROCK LOAD-OUT JETTY AND MODIFICATIONS TO THE DREDGING OF THE NAVIGATIONAL CHANNEL	**AVERAGE - CONSTRUCTION**	TREATMENT AND LIQUEFACTION OF NATURAL GAS	LNG LOADING OPERATIONS	OPERATIONS OF TUG BOATS AND SERVICE DOCK	PLANT MAINTENANCE	MAINTENANCE OF MARINE FACILITIES	OPERATIONS OF CLOSURE AND ABANDONMENT	CHANGES AND RELOCATION OF EQUIPMENT	OPERATION OF MARINE FACILITIES	**AVERAGE - OPERATION**	**AVERAGE CONSTRUCTION + OPERATION**
AIR	Alteration of air quality	A-1	-0.5	-1.4	-1.4	-1.4	-0.5		-3	-3	-3	**-1.8**	-1.2	-1.2	-0.5	-2.4	-0.5	-1.4	5.0		**-0.3**	**-1.0**
NOISE	Increase in noise levels	R-1	-1.4	-1.2	-1.2	-1.2	-1.2	-0.5	-2.5	-2.5	-3.5	**-1.7**	-1.0	-1.0	-0.5	-1.0	-1.0	-0.5			**-0.8**	**-1.3**
WATER	Increase in sea water turbidity	H-1	-0.5				-1.4				-4.9	**-2.3**		-1.2	-1.2		-1.2	-1.2		-4.5	**-1.9**	**-2.1**
	alteration of the physical and chemical quality of sea water/river water	H-2	-0.5	-0.6			-0.5	-0.5		-1.2	-3	**-1.1**		-0.5	-0.5		-0.5	-0.5		-5	**-1.4**	**-1.2**
SOIL AND LANDFORMS	Alteration of the soil structure	SU-1		-0.5	-0.5	-0.5			-1.6	-5		**-1.6**				-0.5		-0.5			**-0.5**	**-1.1**
	Alteration of soil physical and chemical quality	SU-2		-0.5	-0.5	-0.5			-2.5	-2.5	-3	**-1.6**	-0.5			-0.5		-0.5			**-0.5**	**-1.0**
	Alteration of landforms	SU-3		-9.0	-9.0	-9.0	-9.0		-6		-9	**-8.5**				-1.5	-1.5	-1.5			**-1.5**	**-5.0**
	Alteration of the beach morphology	SU-4					-0.5				-3.5	**-2.0**		-4.5						-5	**-4.8**	**-3.4**
TERRESTRIAL AND MARINE FLORA AND FAUNA	Loss of terrestrial vegetation cover	FF-1		-3.5	-3.5	-3.5			-1			**-2.9**				-2.5		-1.5			**-2.0**	**-2.4**
	Alteration of the structure and composition of the marine biotic communities	FF-2					-6.0				-8	**-7.0**					-1.5	-0.5		0	**-0.7**	**-3.8**
	Changes in fishing catches	FF-3					-0.5				0	**-0.3**		-0.5	-0.5		-0.5	-0.5		0	**-0.4**	**-0.3**
	Reduction of the marine fauna records	FF-4	-0.7	-0.6	-0.6	-0.6	-0.6				-4.2	**-1.2**	-0.5	-0.6	-0.6		-0.5	-0.5			**-0.5**	**-0.9**
SOCIAL	Alteration of the demographic composition	S-1		-3.0	-3.0	-3.0						**-3.0**	-1.0								**-1.0**	**-2.0**
	Alteration of local customs	S-2	-0.7	-0.7	-0.7	-0.7	-0.7					**-0.7**									**0.0**	**-0.4**
	Nuissance to the population	S-3	-2.1	-0.5	-0.5	-0.5	-0.5		-3		-3	**-1.4**		-0.5	-0.5		-0.5	-0.5			**-0.5**	**-1.0**
	Interruption and damage of the road infrastructure	S-4	-0.8	-0.4	-0.4	-0.4			-3			**-1.0**									**0.0**	**-0.5**
	Restriction of access to artisanal fishing zones	S-5		-3.0	-3.0	-3.0	-3.0	-3.0				**-3.0**	-0.7	-0.7							**-0.7**	**-1.9**
ECONOMIC	Increase in tax collection	E-1	7.0	6.0	6.0	6.0	6.0					**6.2**	15.0	15.0		6.0	6.0	-0.8			**8.2**	**7.2**
	Increase in the demand for goods and services	E-2	8.0	8.0	8.0	8.0	8.0	8.0				**8.0**	13.0	13.0	13.0	8.0	8.0	-0.8			**9.0**	**8.5**
	Job creation	E-3	9.0	8.0	8.0	8.0	8.0	8.0	7		7	**7.9**	12.0	12.0	12.0	6.0	6.0	-0.8			**7.9**	**7.9**
	Alteration in income obtained from artisanal fishing	E-4		-0.5	-0.5	-0.5						**-0.5**	-0.5	-0.5							**-0.5**	**-0.5**
CULTURAL	Alteration or destruction of archaeological heritage	AR-1		-0.5	-0.5	-0.5			-1			**-0.6**									**0.0**	**-0.3**

	15	A	+1	Positive
	0.9	A	-0.9	Neutral