August, 2017

EIAD AMENDMENT TO THE MINA JUSTA PROJECT

SECTION 1.0
EXECUTIVE SUMMARY

Submitted to:

Marcobre SAC
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San Borja
Lima - Perú

REPORT

Project Number: 159-415-2219

Distribución:

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01 copy: Golder Associates Perú S.A.

Golder Associates

INFORMATION ACCESS AND SUBMISSION OF COMMENTS OR SUGGESTIONS

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Av. Bolognesi s/n, distrito de Marcona.
M – F from 9:00 am to 1:00 pm and from 2:00 pm to 6 pm
http://www.marcobre.com/gestion-ambiental/

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Executive Summary (RE) of the Amendment to the detailed Environmental Impact Assessment (EIAd Amendment) of the Mina Justa Project describes the results of the assessment process of the environmental and social impacts in compliance with the provisions of Supreme Decree No. 040-2014-EM Regulations for the Protection and Environmental Management of the Exploitation, Beneficiation, General Labor, Transport and Storage Mining Activities. The EIAd Amendment will be evaluated by the *Servicio Nacional de Certificación Ambiental para las Inversiones Sostenibles* (SENACE) (National Service of Environmental Certification for Sustainable Investments).

Marcobre S.A.C. (Marcobre), is the proponent company of the Mina Justa Project (hereinafter the Project), which is located in the District of Marcona, province of Nasca, Ica Region, at an altitude of 800 masl approximately, in a desert zone located approximately 400 km southeast of Lima (Figure RE-1).

The EIAd Amendment consists of the optimization of most components already approved in the EIAd of Mina Justa Project (Vector 2010), considering mining of oxide and sulfide copper ore with silver content. Likewise, a multi-buoy terminal is incorporated in Bahía San Juan, for the reception of process supplies and seawater collection as new source of water supply instead of Jahuay aquifer.

This study has been prepared by the consulting company Golder Associates Perú S.A. (Golder), which is registered as authorized company for the preparation of environmental impact assessments (EIA) according to Directorial Resolution No. 451-2015-MEM/DGAAM. Golder is an independent company specialist in environmental and social areas.

The complete report of the EIAd Amendment can be consulted in the following institutions, which also receive comments and suggestions: SENACE, Regional Directorate of Energy and Mines of Ica (DREM Ica), Provincial Municipality of Nasca, District Municipality of Marcona and Permanent Information Office of Marcobre.

1.2 Project Description

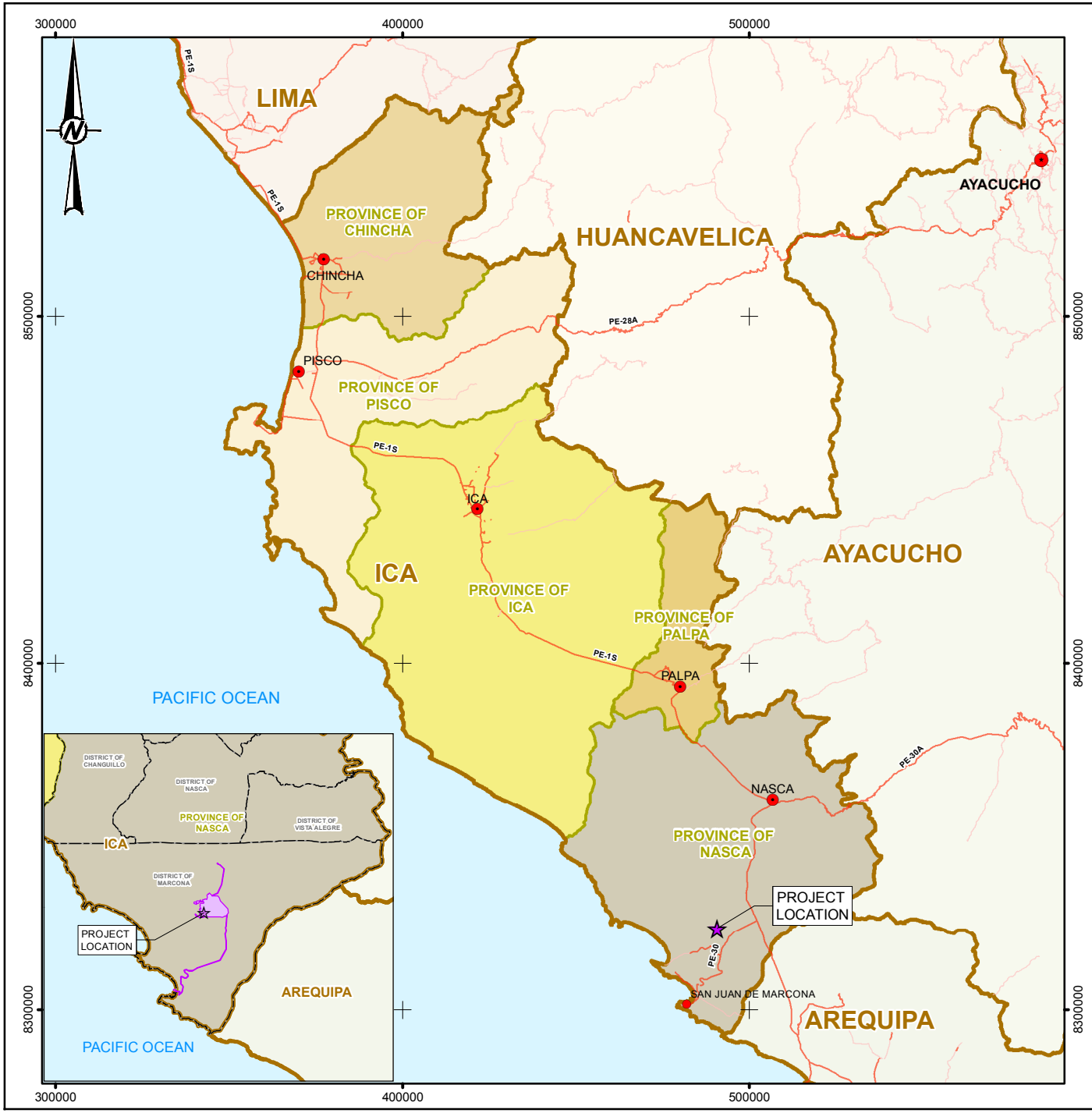
1.2.1 Background

The Mina Justa Project comprises an open pit copper mine, which will be mined to extract copper oxide and sulfide ore with silver content, which will be fed into the process plants to obtain cathodes and copper concentrate.

The Mina Justa Project holds an EIAd approved (D.R. No. 281-2010-MEM/AAM, dated September 8, 2010), validated for two more years (D.R. No. 337-2013-MEM/AAM, dated September 10, 2013); considering that most of the oxide and sulfide ore will be extracted from the main pit; and oxide-type ore from two satellite pits (North pit and South pit) and Manto Magnetita pit. The oxide ore will go through a leach process and the sulfide ore through a flotation process. In addition, a waste dump, a ripios dump, a Manto Magnetita dump, and ancillary components and facilities, which will allow the appropriate development of the Project, are considered.

Later, the optimization of the Project mining operations was approved through the First ITS (D.R. No. 102-2016-SENACE/DCA), for the modification, relocation, expansion, and addition of ancillary facilities. Modifications to the 220 kV (new route) and 22,9 kV PTLs, relocation of Mina Justa SS; as well as additions and modifications to ancillary facilities like mine services, communications antenna, among others, were approved through the Second ITS (D.R. No. 0139-2016-SENACE/DCA).

Ruta: G:\Project\2015\159-415-2219 Marcobre-LBAS-Ica\Mapas\MXD\MEIA\MEIA_INGLES\1_RE\RE_01_ProjectLocationMap_700k_A4.mxd. Fecha: 29/09/2017 Autor: LRamirez



LEGEND

- PROJECT LOCATION
- DEPARTMENTAL CAPITAL
- PROVINCIAL CAPITAL
- DISTRICT CAPITAL

ROAD SYSTEM

- PAVED
- UNPAVED
- REGIONAL BOUNDARY
- PROVINCIAL BOUNDARY
- DISTRICT BOUNDARY
- EFECTIVE AREA

0 50 100

1:1,700,000 KILOMETERS

REFERENCE

CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008 / ROAD SYSTEM: MTC, 2012
PROJECT AREA: VECTOR, EIA 2010.
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

MINA JUSTA PROJECT LOCATION

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-27
EXECUTED	VM
DESIGN	MC
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219

Rev. 1

FIGURE **RE-01**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A4

25mm

0

1.2.2 Legal Framework

Peruvian regulations establish that public and private investment projects to be executed in national territory and that have the potential to cause significant negative environmental impacts, are required to submit an EIA and obtain approval thereof by the competent environmental authority; this requirement is extended to related modifications, expansions or diversification of the approved projects. The competent authority for the review and approval of this EIAd Amendment will be the Service of Environmental Certification for Sustainable Investments (SENACE), created by Law No. 29968.

The EIAd Amendment has been prepared based on the framework provided by the Common Terms of Reference for the Preparation of Detailed and Semi-detailed Environmental Impact Assessments of the Exploration, Beneficiation, General Labor, Transport and Storage Mining Activities, approved by Ministerial Resolution No. 116-2015-MEM/DM.

Likewise, regulations related to the consultation and public participation process such as the Regulations for Public Participation in the Mining Subsector, approved by Supreme Decree No. 028-2008-EM, and its supplementary provisions approved by Ministerial Resolution No. 304-2008-MEM/DM, have been considered.

Table RE-1 summarizes the environmental regulations applicable to the Project and related regulating entities.

Table RE-1: Environmental Regulations Applicable to the Project

Field	Regulatory Entity
I. General Environmental Regulations	
Political Constitution of Peru (1993)	Several governmental authorities
National Policy on Environment (Supreme Decree No. 012-2009-MINAM)	MINAM and other authorities
General Law on Environment (Law No. 28611) and amendments	Several authorities
Organic Law on Sustainable Use of Natural Resources (Law No. 26821	Several authorities
Framework Law of the Environmental Management National System (Law No. 28245) and Regulations (Supreme Decree No. 008-2005-PCM)	MINAM and other authorities
Framework Law of the Environmental Impact Assessment System - SEIA (Law No. 27446) and Regulations (Supreme Decree No. 019-2009-PCM)	MINAM and other authorities
Law for the Creation of the National Service of Environmental Certification for Sustainable Investments - SENACE (Law No. 29968) and Implementation Schedule (Supreme Decree No. 003-2013-MINAM)	MINAM and other authorities
Special provisions for the execution of administrative procedures (Supreme Decree No. 054-2013-PCM) and Criteria to regulate the modification of mining components or expansions and technological improvements in the mines of exploration and exploitation projects with negligible environmental impacts that have environmental certification (Ministerial Resolution No. 310-2013-MEM/DM)	MINEM
Cases of Environmental Impact Assessments and Environmental Adequacy and Management Programs that require technical opinion of Agriculture Sector (Supreme Decree No. 056-97-PCM) and amendments	MINAGRI
Title XIII of the Penal Code, Environmental Crime (Legislative Decree No. 635, amended by Law No. 29263)	Public Ministry / Judicial System
Law that establishes the obligation to prepare and submit contingency plans (Law No. 28551)	Several authorities

Field	Regulatory Entity
Regulations for reporting environmental emergencies of the activities under the OEFA competence (Resolution No. 018-2013-OEFA-CD)	OEFA
II. Environmental Legislation for the Mining Subsector	
Consolidated Amended Text of the Mining General Law (Supreme Decree No. 014-92-EM)	MINEM
Regulations for the Protection and Environmental Management of the Exploitation, Beneficiation, General Labor, Transport and Storage Mining Activities (Supreme Decree No. 040-2014-EM).	MINEM
Approval of the Environmental Evaluation System On Line (SEAL) for the submission, evaluation, and issuance of the Environmental Certification for the medium and large-scale Mining (Ministerial Resolution No. 270-2011-MEM/DM.	MINEM
Guidelines for preparing contingency plans for the mining and metallurgical activities related to cyanide handling and other toxic or hazardous chemicals (Directorial Resolution No. 134-2000-EM-DGM)	MINEM
Law for Mine Closure (Law No. 28090) and Regulations (Supreme Decree No. 033-2005-PCM)	MINEM
Common Terms of Reference for preparing Detailed and Semi-detailed Environmental Impact Assessments of Exploration, Beneficiation, General Labor, Transport and Storage Mining Activities and others, in compliance with Supreme Decree No. 040-2014-EM (Ministerial Resolution No. 116-2015-MEM/DM).	MINEM
III. Other Aspects Specifically Regulated in the Environmental Legislation Applicable to the Project	
Information and Public Participation	
Unique Ordered Text of Law No. 27806 for Transparency and Access to Public Information (Supreme Decree No. 043-2003-PCM) and its Regulations (Supreme Decree No. 072-2003-PCM).	Several authorities
Regulations for Public Participation in the Mining Subsector (Supreme Decree No. 028-2008-EM) and norms Ruling the Public Participation in the Mining Subsector (Ministerial Resolution No. 304-2008-MEM/DM).	MINEM
Regulations on Transparency, Access to Public Environmental Information and Public Participation and Public Consultation in Environmental Affairs (Supreme Decree No. 002-2009-MINAM).	Several authorities

1.2.3 Brief Description about the Project EIAd Amendment

The EIAd Amendment consists of the optimization of most components already approved in the Mina Justa Project EIAd (Vector 2010), First ITS (Golder 2016b), and Second ITS (Golder 2016b); considering mining of oxide and sulfide copper ore with silver content. That is, mining components like pits, dumps, process plants, and ancillary components will be maintained. Likewise, as part of the modifications proposed, a multi-buoy terminal in Bahía San Juan will be incorporated to the Project, for the reception of process supplies (sulfuric acid), and seawater collection as new source of water supply instead of Jahuay aquifer (see Figure RE-2 and Figure RE-3).

The objective of the Project will continue consisting of the production of silver-content copper concentrates and production of copper cathodes, based on a mineral resources estimation of approximately 180 Mt of oxides and 182 Mt of sulfides.

For the Project development, the optimization of the exploitation in only two pits (main pit and Manto Magnetita pit) is proposed, and the process is maintained for the two types of mineralization composed of oxides and

sulfides that will be treated in different process plants, while barren material will be disposed of in waste dumps. Oxide ore will be processed in the oxide plant at a production rate of 12 Mt/year, and the sulfide ore will be processed in a flotation plant at a production rate of 6 Mt/year, followed by the tailings disposal.

The Project main components will be two (2) pits, two (2) waste dump, a ripios dump (waste material from the leach process), two (2) process plants (oxide plant and sulfide plant), a tailings storage facility, and a multi-buoy terminal placed in Bahía San Juan (Figure RE-2), where an seawater intake system and a seawater supply pipeline towards the mine site will be implemented. The Project will also include facilities for domestic effluent and solid waste management, and a seawater desalination plant. As well as other ancillary facilities like camp for personnel accommodation, administrative offices and facilities for equipment and machinery maintenance.

A detailed description of the Project components and proposed modifications is included in Section 1.2.4 Project Description, of this Executive Summary.

483200 483600 484000 484400

8304000 8303600

MB1 MB2 MB3 MB4

PACIFIC OCEAN

0 200 400
1:4,000 METERS

TO THE WATER COMPARTMENT FROM SEAWATER INTAKE
SERVICE PLATFORM
ACCESS BRIDGE
ROAD TO ACCESS BRIDGE
CENTRIFUGAL PUMP
LOAD CHAMBER
GATE
EMERGENCY POND AT THE PORT
SEAWATER CONVEYANCE PIPELINE
SULFURIC ACID IMPULSE PUMP
SULFURIC ACID PUMP, TANK AND HOSE REEL
SULFURIC ACID TANKS
150 THK CONCRETE SLAB
CONTAINMENT SPILL PLATFORM IN LIQUID TRANSFER STATIONS
SPILL CONTAINMENT EARTHFILL BERM AROUND TANKS (2m HIGH, LATERAL SLOPE 2H:1V)
SECURITY BOOTH
PLANT OFFICE
CUSTOMS OFFICE
TANK TRUCK ROAD ENTRANCE
TRUCK SCALE
SLIDING GATE
POTABLE WATER TANK
PERIMETER FENCE
SULFURIC ACID PIPELINE
POWER SUBSTATION
SEAWATER IMPULSION PUMP STATION
BURIED SEAWATER PIPELINE
FIRE FOAM STORAGE TANK
EXISTING ROAD

20 30 40

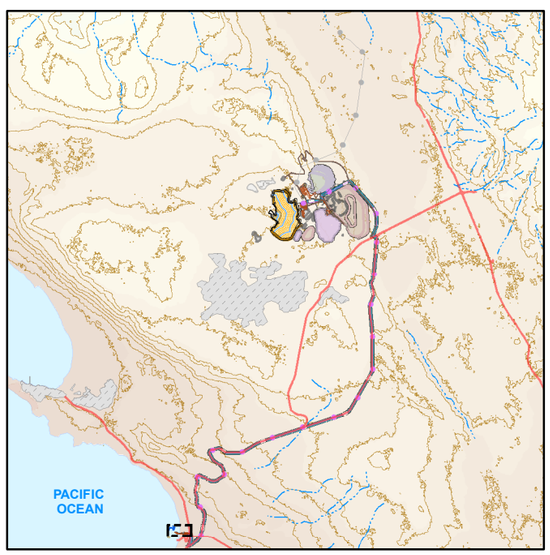
LEGEND

- (100 m) MAIN CONTOUR (100 m)
- (2 m) SECONDARY CONTOUR (2 m)

ROAD SYSTEM

- NATIONAL ROAD
- UNPAVED
- POWER TRANSMISSION LINE - 220 kV
- SEAWATER SUPPLY PIPELINE
- PERIMETER FENCE

NOTE:
MOORING BUOY: MB



REFERENCE

TOPOGRAPHIC BASE: IGN,1998 / AUSENCO,2014
SOURCE: EIA FOR THE CONSTRUCTION AND OPERATION OF A PETROCHEMICAL COMPLEX IN SAN JUAN DE MARCONA. ANNEX K OCEANOGRAPHY BASELINE. GOLDER 2010.
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT
MARCOBRE S.A.C

PROJECT
DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE
MULTI-BUOY TERMINAL COMPONENTS

CONSULTING COMPANY
Golder Associates

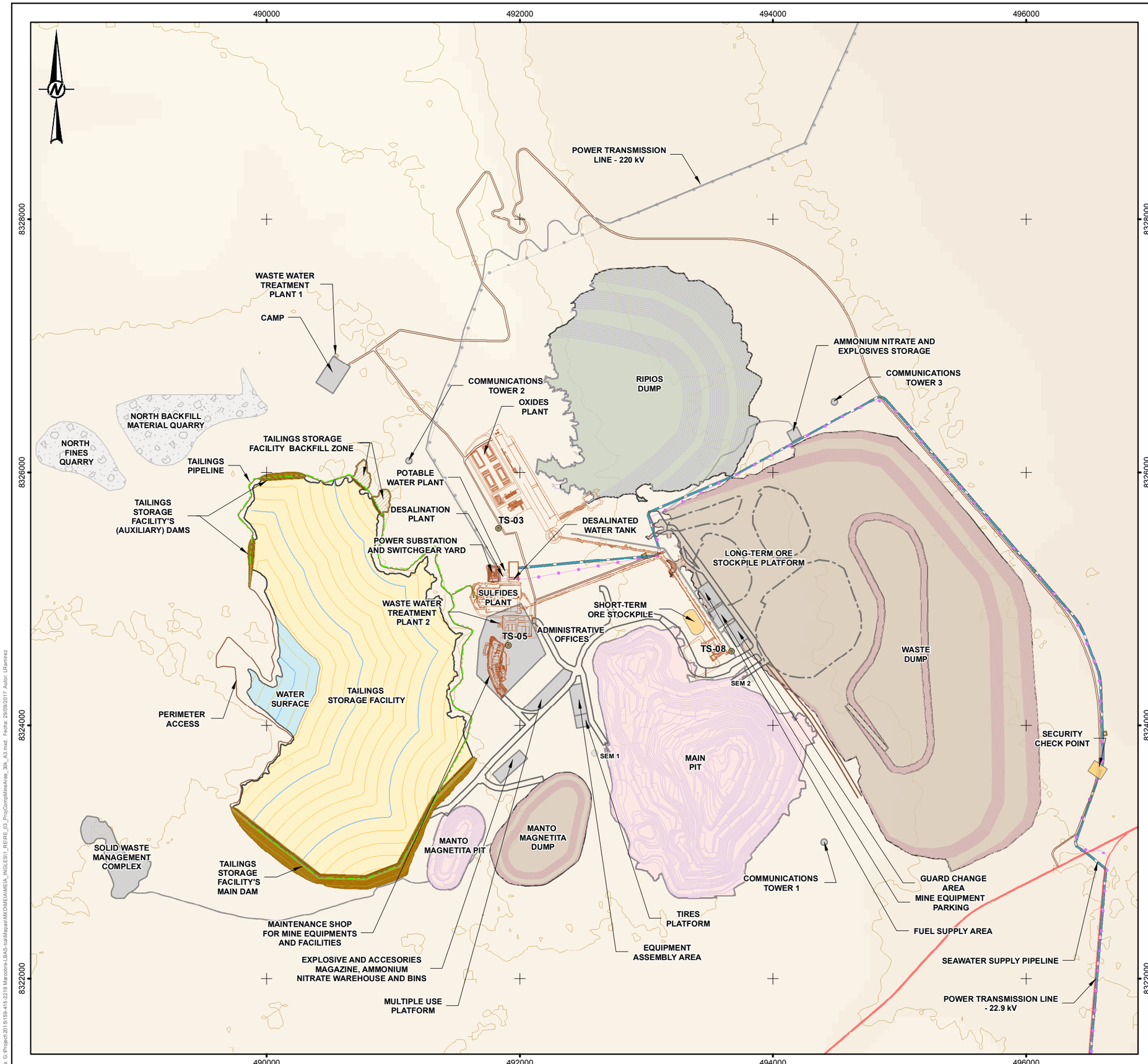
YYYY-MM-DD	2017-04-24
EXECUTED	YD
DESIGN	RH
REVIEW	RH
APPROVED	DG

PROJECT No. 159-415-2219
Rev. 1
FIGURE **RE-02**

Ruta: G:\Project\2015\159-415-2219 Marcobre\LBAS-Ica\Mapas\MXD\MEIAMEIA_INGLES\1_RE\RE_02_Terminal\MultiBuoyComp_4K_A3.mxd. Fecha: 27/09/2017 Autor: LRamirez

SI LA MEDIDA NO SE CORRESPONDE CON LA INDICADA DEBE TENERSE EN CUENTA QUE EL TAMAÑO DE LA HOJA ORIGINALES A3

25mm 0



LEGEND

- (100 m) MAIN CONTOUR

ROAD SYSTEM

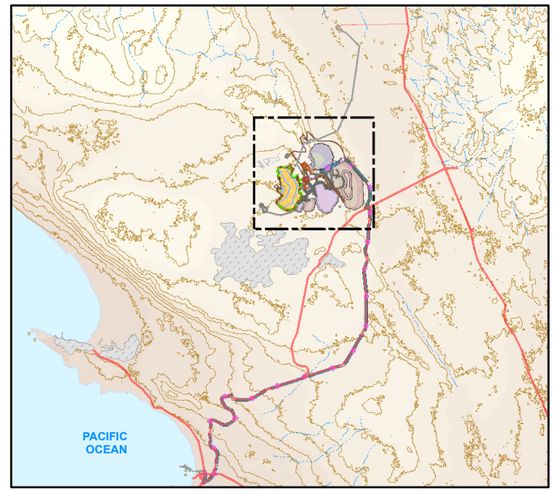
- PAVED

APPROVED COMPONENTS

- APPROVED COMPONENTS
- QUARRIES
- MOBILE POWER SUBSTATION
- POWER TRANSMISSION LINE - 220 kV
- ACCESSES
- HAUL ROADS

PROPOSED COMPONENTS

- PITS
- RIPIOS DUMP
- WASTE DUMP
- ORE STOCKPILES
- TAILINGS STORAGE FACILITY
- TAILINGS STORAGE FACILITY DAM
- AUXILIARY COMPONENTS
- SEPTIC TANK (ST)
- INFRASTRUCTURE
- POWER TRANSMISSION LINE - 22,9 kV
- SEAWATER SUPPLY PIPELINE
- ACCESSES
- HAUL ROADS



0 1 2

1:30,000 KILOMETERS

REFERENCE

BASE DATA: IGN 2006 /APPROVED COMPONENTS: EIA MINA JUSTA 2010 (VECTOR) AND ITS 2016 (GOLDER) /COMPONENTS OF DETAILED EIA AMENDMENT: GOLDER 2016
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

PROJECT MINE SITE COMPONENTS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-11-15
EXECUTED	VM
DESIGN	GM
REVIEW	RH
APPROVED	DG

PROJECT No. 159-415-2219 | Rev. 1 | FIGURE **RE-03**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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1.2.3.1 Delimitation of the Effective Area and the Areas of Influence

1.2.3.1.1 Effective Area

As part of the establishment and delimitation of the effective area for the EIAd Amendment, a new determination of the areas previously approved was outlined considering the new Project layout, i.e., the optimization of the mine site components, incorporation of the corridor for the seawater supply pipeline and multi-buoy terminal. Due to the proposed modifications, two areas of mining activity and three areas of mining use, that together conform the new effective area of the Project (according to M.R. No. 209-2010-MEM/DM) were established, which cover an area of 3,755 ha. Figure RE-4 shows the Project effective area.

1.2.3.2 Areas of Environmental Influence

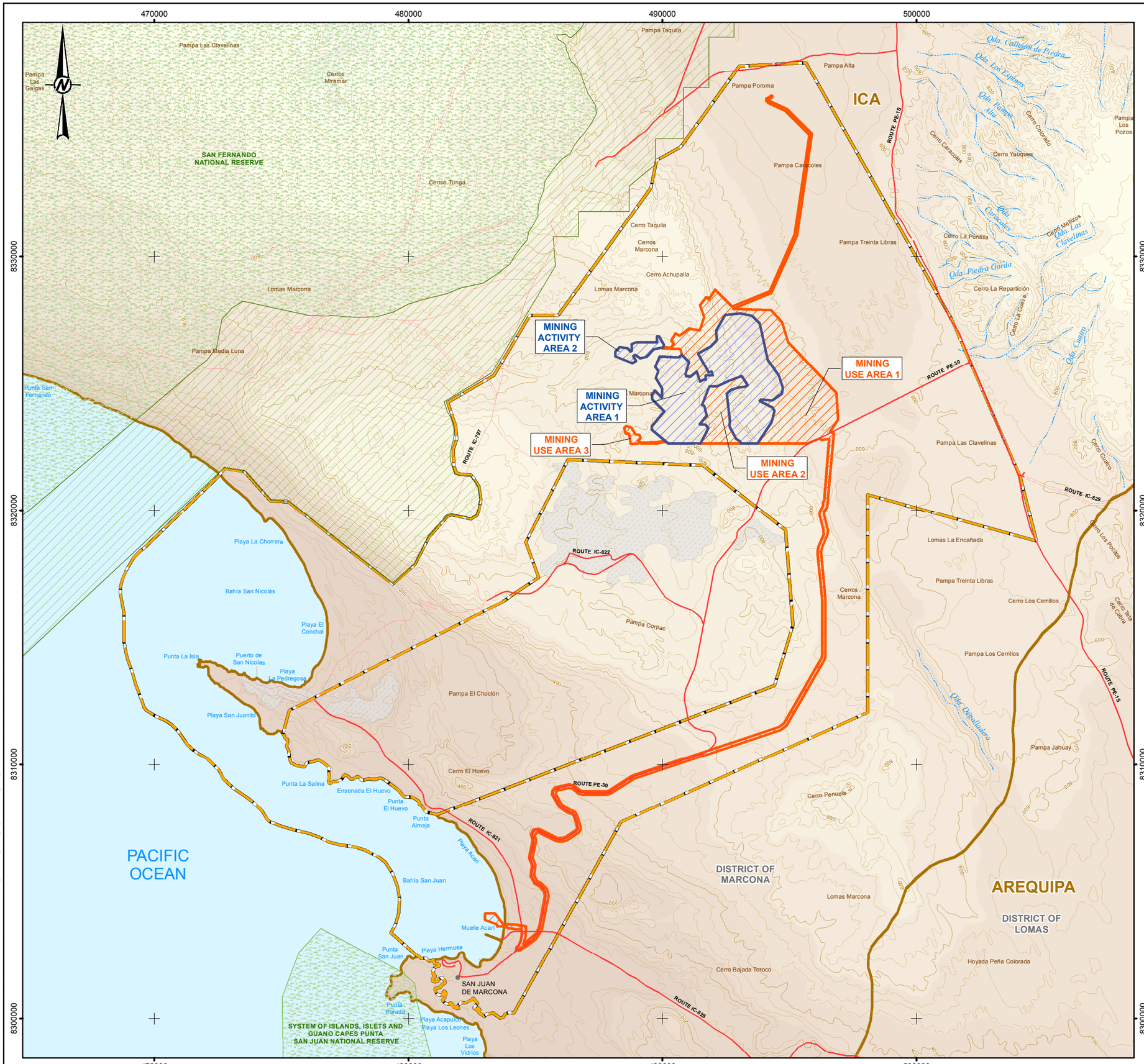
The setting of the areas of influence was based on the environmental impact assessment results, according to the projection of the area where direct and indirect, significant and negligible environmental impacts would occur due to the Project activities as a whole, meaning the project approved initially and the modifications proposed. The areas of influence are defined in compliance with the national guidelines, modeling results for impact prediction and professional experience in similar projects.

Based on the environmental consequence related to the environmental impacts projected and the requirements provided in the Common Terms of Reference (Ministerial Resolution No. 116-2015-MEM/DM), two types of areas of environmental influence were defined.

1.2.3.2.1 Area of Direct Environmental Influence (ADEI)

It is the area where most direct and significant impacts are expected to occur due to the Project construction and operation activities. Hence, the main mitigation and management measures to be implemented by the Project will focus on the ADEI.

The ADEI covers approximately 49.4 km^2 and comprises a land located between 0 masl and 800 masl, in an area of a dry portion of the Rio Grande Basin and Interbasin 13719 (Pfafstetter coding), both in the Pacific watershed. Most of the area of influence (generated by the components of the Mine site and the 220 kV Mina Justa - Poroma PTL) is located in the Rio Grande Basin (43.1 km^2), while the corridor of the seawater supply pipeline and the multi-buoy terminal components are placed mainly in the interbasin 13719 (5.4 km^2); also, a portion of the ADEI is in the temporary aquatic reserve area (0.3 km^2). The ADEI considers a buffer area of approximately 70 m of the right-of-way axis of the linear components (buried seawater supply pipeline and 220 kV Mina Justa – Poroma PTL and maintenance access, and 22.9 kv Mina Justa – multi-buoy terminal PTL) (See Figure RE-6 and Figure RE-7). The ADEI considers conservatively all the temporary aquatic reserve area, established by the multi-buoy terminal for the Project, and granted by the National Port Authority, and a buffer area of 15 m approximately.



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC NETWORK

- QUEBRADA SECA

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- AREA FOR MINING ACTIVITY
- AREA FOR MINING USE

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHIC BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
POPULATION CENTERS: INEI, 2007
HYDROGRAPHY: IGN,1998 / AUSENCO,2014
ROAD SYSTEM: MTC, 2012 / AUSENCO,2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

EFFECTIVE AREA

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2017-04-24
EXECUTED	VM
DESIGN	TS
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219 | Rev. 1 | FIGURE **RE-04**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

25mm

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1.2.3.2.2 Area of Indirect Environmental Influence (AIEI)

The AIEI covers approximately 110.4 km^2 and comprises a land located between 0 masl and 800 masl, in an area of a dry portion of the Rio Grande Basin and Interbasin 13719, both in the Pacific watershed. Most of the AIEI at this stage (generated by the components of the Mine site and the 220 kV Mina Justa - Poroma PTL) is located in the Rio Grande Basin (97.4 km^2), while the corridor of the seawater supply pipeline and the multi-buoy terminal components are placed mainly in the interbasin 13719 (11.9 km^2); also, a portion of the AIEI is in the temporary aquatic reserve area (0.4 km^2). The AIEI, like in the construction stage, considers a buffer area of approximately 70 m of the ADEI boundary (buried seawater pipeline and 220 kV Mina Justa – Poroma PTL and maintenance access, and 22.9 kv Mina Justa – multi-buoy terminal PTL) of the linear components, therefore, they represent the same area for both stages (See Figure RE-6 and RE-7). The ADEI considers conservatively a buffer area of 70 m from the ADEI to the multi-buoy terminal zone.

470000
480000
490000
500000
8330000
8320000
8310000
8300000

Pampa Las Clavelinas
Pampa Las Galgas
Cerros Miramar
SAN FERNANDO NATIONAL RESERVE
Cerros Tunga
Pampa Taquila
Pampa Alta
Pampa Poroma
ICA
Pampa Caracoles
ROUTE PE-1S
Oda. Callejón de Piedra
Oda. Los Espinos
Oda. Tampa Alta
Cerro Colorado
Cerro Caracoles
Cerro Yauques
Pampa Los Pozos
Oda. Caracoles
Cerro Melizos
Oda. Las Clavelinas
Cerro La Pontilla
Oda. Piedra Gorda
Cerro La Repartición
Cerro La Cuarta
Oda. Cuarta
Cerro Taquila
Cerros Marcona
Cerro Achupalla
Lomas Marcona
Pampa Treinta Libras
Pampa Media Luna
Punta San Fernando
ROUTE PE-30
ROUTE IC-837
Pampa Las Clavelinas
Cerro Cuarto
ROUTE IC-829
Playa La Chorrera
ROUTE IC-822
Lomas La Encañada
Bahía San Nicolás
Playa El Conchal
Cerros Marcona
Pampa Treinta Libras
Cerro Los Cerrillos
Pampa Corpac
Cerro Pata de Cabra
Punta La Isla
Puerto de San Nicolas
Playa La Pedregosa
Pampa Los Cerrillos
ROUTE PE-1S
Qda. Descalladera
Pampa El Choclón
Playa San Juanito
Pampa Jahuay
Cerro El Huevo
ROUTE PE-30
Punta La Salina
Ensenada El Huevo
Punta El Huevo
Cerro Penuela
Punta Almeja
ROUTE IC-821
Playa Acarí
PACIFIC OCEAN
DISTRICT OF MARCONA
AREQUIPA
DISTRICT OF LOMAS
Bahía San Juan
Lomas Marcona
Muelle Acarí
Punta San Juan
Playa Hermosa
Hoyada Peña Colorada
Cerro Bajada Toroco
SAN JUAN DE MARCONA
ROUTE IC-828
Punta Parada
Playa Acapulco
Playa Los Leones
SYSTEM OF ISLANDS, ISLETS AND GUANO CAPES PUNTA SAN JUAN NATIONAL RESERVE
Playa Los Vidrios

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC NETWORK

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH
- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- AREA OF INDIRECT ENVIRONMENTAL INFLUENCE
- AREA OF DIRECT ENVIRONMENTAL INFLUENCE

0 5 10
1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHIC BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
POPULATION CENTERS: INEI, 2007
HYDROGRAPHY: IGN,1998 / AUSENCO,2014
ROAD SYSTEM: MTC, 2012 / AUSENCO,2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

AREAS OF DIRECT AND INDIRECT ENVIRONMENTAL INFLUENCE FOR CONSTRUCTION AND OPERATION

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2017-04-24
EXECUTED	VM
DESIGN	TS
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219
Rev. 1
FIGURE **RE-05**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

Ruta: G:\Project\20151\159-415-2219 Marcobre\4-BAS-ha\Mapas\MXD\MEJIAMEIA_INGLES\1_RE\RE_05_AreaEnvironmentalInfluence_150k_A3.mxd Fecha: 29/09/2017 Autor: YDelaCruz

1.2.3.3 Area of Social Influence

The Area of Social Influence (ASI) of the Project was defined in the Mina Justa Project EIAd (Vector 2010). The changes proposed in the EIAd Amendment do not modify, as a whole, the areas previously defined and approved in the Mina Justa Project EIAd (Vector 2010) (See Figure RE-6).

1.2.3.3.1 Area of Direct Social Influence (ADSI)

The Area of Direct Social Influence (ADSI) is defined based on the potential direct impacts that may occur and their magnitude within a determined geographic unit. For the EIAd Amendment, the Project ADSI is comprised by the district of Marcona, in the province of Nasca, Ica Region; which is the same as the one defined previously in the EIAd (Vector, 2010). The definition and continuity of the district of Marcona as the Project ADSI for the EIAd Amendment, are supported by the following:

- It is the producer district, where all the project components will be placed.
- The district is considered a coastal desert where a *centro poblado* (village), San Juan de Marcona Village, and the Justo Pastor Ramírez Legua Association were identified. In this regard, the Justo Pastor Ramírez Legua Association is located in the intersection of the Pan-American Highway with the Project access road, becoming a pass-through commercial locality, but it does not have the basic services and most population inhabits the San Juan de Marcona Village.
- It is the geographic space where direct impacts related to the Project activities occur. Therefore, it is home to the population directly affected and frequently exposed to potential direct impacts from the Project activities.
- Revitalization of local economy, employment opportunities and local trade, investment opportunities in social and economic development, saturation of utilities, and so forth, are among the direct impacts from the Project in the ADSI. All of them, implicitly, disturb or modify the socioeconomic order in the district, for the benefit or detriment of its population.
- Although there are no physical or biological impacts that disturb the well-being of the inhabitants in the district, the population expresses its concern about the changes on the environment that might affect its economic activities and well-being.
- Finally, Marcobre maintains a community liaison strategy with the district, both with local authorities, and stakeholders and general population. All reflected in the social investment efforts by Marcobre and captured in the Social Management Plan of the EIAd Amendment.

1.2.3.3.2 Area of Indirect Social Influence (AISI)

The Area of Indirect Social Influence (AISI) is defined based on the potential indirect impacts that might occur and their magnitude within a determined geographic unit. For the EIAd Amendment, the Project AISI is comprised by the districts of Marcona and Vista Alegre, in the province of Nasca, Ica Region; which are the same as the previously ones defined in the EIAd (Vector, 2010).

The definition and continuity of both districts as the Project AISI for the EIAd Amendment, are supported by the following:

- They are the geographic space over which indirect impacts might occur on a secondary or minor and/or sporadic manner. In this regard, it is worth mentioning that none of the impacts assessed, related to the physical or biological components, will occur in those districts.
- Both districts are home to population that benefits from or is circumstantially or eventually affected, and are located far from the Project. Thus, although both districts will not be affected by the socioeconomic dynamics, their population could eventually be benefited by the job opportunities, trade, project social investment and mining canon.
- Finally, Marcobre maintains a community liaison strategy with both districts, with local authorities and stakeholders.

460000 480000 500000 520000 540000

8380000 8360000 8340000 8320000 8300000

DISTRICT OF LLIPATA

DISTRICT OF EL INGENIO

ICA

TAMBO QUEMADO

DISTRICT OF LEONCIO PRADO

DISTRICT OF CHANGUILLO

DISTRICT OF SANTIAGO

AYACUCHO

NASCA

VISTA ALEGRE

DISTRICT OF NASCA

AREA OF INDIRECT SOCIAL INFLUENCE

DISTRICT OF VISTA ALEGRE

SAN FERNANDO NATIONAL RESERVE

DISTRICT OF SANTA LUCÍA

AREA OF DIRECT SOCIAL INFLUENCE

DISTRICT OF MARCONA

Punta Gallinazo

Puerto de San Nicolas

Punta La Isla

Punta La Salina

Punta San Juan

Muelle Acarí

SAN JUAN DE MARCONA

DISTRICT OF BELLA UNIÓN

DISTRICT OF LOMAS

PACIFIC OCEAN

SYSTEM OF ISLANDS, ISLETS AND GUANO POINTS NATIONAL RESERVE PUNTA SAN JUAN

AREQUIPA

BELLA UNIÓN

ACARÍ

DISTRICT OF ACARÍ

DISTANCE OF VILLAGES LOCATED IN THE AREA OF SOCIAL INFLUENCE TO THE MINA JUSTA PROJECT (km)

SAN JUAN DE MARCONA	25,05
VISTA ALEGRE	37,02
NASCA	39,11
ASOCIACIÓN JUSTO PASTOR	10,53

LEGEND

- DISTRICT CAPITAL

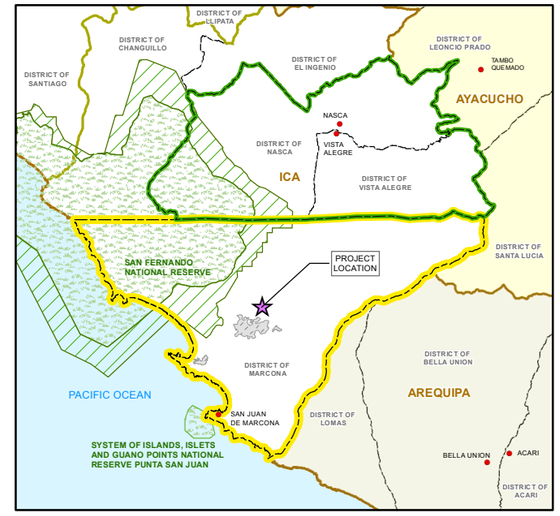
ROAD SYSTEM

- PAVED
- UNPAVED

- REGIONAL BOUNDARY
- PROVINCIAL BOUNDARY
- DISTRICT BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- SHP OPERATING AREA

AREAS OF SOCIAL INFLUENCE

- AREA OF INDIRECT SOCIAL INFLUENCE
- AREA OF DIRECT SOCIAL INFLUENCE
- APPROVED COMPONENTS
- PROPOSED COMPONENTS



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1:350,000 KILOMETERS

REFERENCE

CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
POPULATION CENTERS: INEI, 2007
HYDROGRAPHY: IGN,1998 / AUSENCO,2014
ROAD SYSTEM: MTC, 2012 / AUSENCO,2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

AREA OF DIRECT AND INDIRECT SOCIAL INFLUENCE

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2017-04-24
EXECUTED	YD
DESIGN	MC
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219

Rev. 1

FIGURE **RE-06**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

25mm

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1.2.4 Project Description

The EIAd Amendment of Mina Justa Project consists of the optimization of most components already approved in the EIAd of Mina Justa Project (Vector 2010), First ITS (Golder 2016a), and Second ITS (Golder 2016a); considering mining of oxide and copper sulfide ore with silver content; and later processing thereof.

The Mina Justa Project plans to carry out mining activities at two pits (main pit and Manto Magnetita pit) and oxide and sulfide processing in two different process plants, while barren materials will be disposed of in waste dumps. Oxide ore will be processed in the oxide plant at a production rate of 12 Mt/year, whereas sulfide ore will be processed in a flotation plant at a production rate of 6 Mt/year; the latter process will also have a tailings disposal system. Likewise, a multi-buoy terminal will be incorporated in Bahía San Juan, and will aim at the reception of process supplies (sulfuric acid) and seawater collection as new source of water supply instead of Jahuay aquifer.

The Project components for the operation stage in the mine site are shown in Figure RE-3, and the multi-buoy terminal components in Figure RE-2. Figure RE-7 shows the Project components approved and proposed.

Table RE-2 lists the Project components and the environmental management instruments through which they were approved and modified; components that will be incorporated or modified through this EIAd Amendment are also identified.

Table RE-2: Approved and Proposed Components

Component/Facility	EIAsd (Exploration)	Mina Justa EIAd (Vector 2010)	First ITS (Golder 2016a)	Second ITS (Golder 2016b)	Proposal (EIAd Amendment)
Main Components					
Main Pit	-	Approved	-	-	Proposed modification
Manto Magnetita Pit	-	Approved	-	-	Proposed modification
Waste Dump	-	Approved	-	-	Proposed modification
Manto Magnetita Dump	-	Approved	-	-	Proposed modification
Ripios Dump	-	Approved	-	-	Proposed modification
Ore Stockpiles	-	Approved	-	-	Proposed modification
Oxide Plant	-	Approved	-	-	Proposed modification
Sulfide Plant	-	Approved	-	-	Proposed modification
Tailings Storage Facility	-	Approved	-	-	Proposed modification
Multi-buoy Terminal	-	-	-	-	Proposed
Power Supply (electric power generators)	-	Approved	-	-	Proposed modification
Power Supply (220 kV PTL)	-	Approved	-	Modified	-
Power Supply (22.9 kV PTL)	-	Approved	-	Modified	Proposed modification
Power Substation Mina Justa	-	Approved	-	Modified	-

Component/Facility	EIAsd (Exploration)	Mina Justa EIAd (Vector 2010)	First ITS (Golder 2016a)	Second ITS (Golder 2016b)	Proposal (EIAd Amendment)
Power Supply System for mine equipment (mobile substations)	-	-	-	Approved	-
Power Substation (Multi-buoy Terminal)	-	-	-		Proposed
Seawater Supply Pipeline	-	Approved	-	-	Proposed modification
Seawater Desalination Plant	-	-	-	-	Proposed
Seawater Pond	-	-	-	-	Proposed
Desalinated Water Tank	-	-	-	-	Proposed
Seawater Temporary Supply Station	-	-	-	-	Proposed
Water Supply Stations		Approved	Modified	-	Proposed modification
Main Camp	-	Approved	Modified	-	Proposed modification
Waste Water Treatment Plant 1 (of the camp)		Approved	Modified		Proposed modification
Waste Water Treatment Plant 2	-	Approved	-	-	Proposed modification
Septic Tank	-	-	-	-	Proposed
Mine Equipment Maintenance Shop (MEMS)	-	Approved	Modified	-	Proposed modification
Fuel Supply and Storage Area	-	Approved	Modified	Modified	-
Ammonium Nitrate Warehouse and Magazine	Approved	Approved	Modified	-	-
Solid Waste Management Complex	-	Approved	-	-	-
Security Check Point Explorations	Approved	-	-	-	-
Project Security Check Point	-	Approved	-	-	Proposed modification
Quarries	-	Approved	-	-	-
Temporary Construction Platforms	-	-	Approved	Modified	Proposed modification
Exploration Components and Facilities	Approved	-	-	-	-
Concrete Plants	-	Approved	-	-	Proposed modification
Exploration Accesses	Approved	-	-	-	-
Non-Hazardous Solid Waste Storage Area (Temporary)	Approved	-	Approved	-	-

Component/Facility	EIAsd (Exploration)	Mina Justa EIAd (Vector 2010)	First ITS (Golder 2016a)	Second ITS (Golder 2016b)	Proposal (EIAd Amendment)
Communications Antennae (Towers)	-	-	-	Approved	-
Mine services: **- Guard change area** **- Equipment assembly area and temporary workshop** **- Mine equipment parking** **- Multiple use platform** **- Tires Platform**	-	-	-	Approved	-
Administrative Offices	-	Approved	-	-	Proposed modification
Internal Accesses	-	Approved	Modified	Modified	Proposed modification
Haul Access Roads	-	Approved	Modified	-	Proposed modification

Notes:
Approved: component or facility approved that was proposed for modification through the corresponding *Instrumento de Gestión Ambiental* (IGA) (Environmental Management Instrument).
Modified: component or facility which was somehow modified after the IGA was approved.
Modification proposed: modification of a component or facility previously approved.
Proposed: new component or facility proposed.

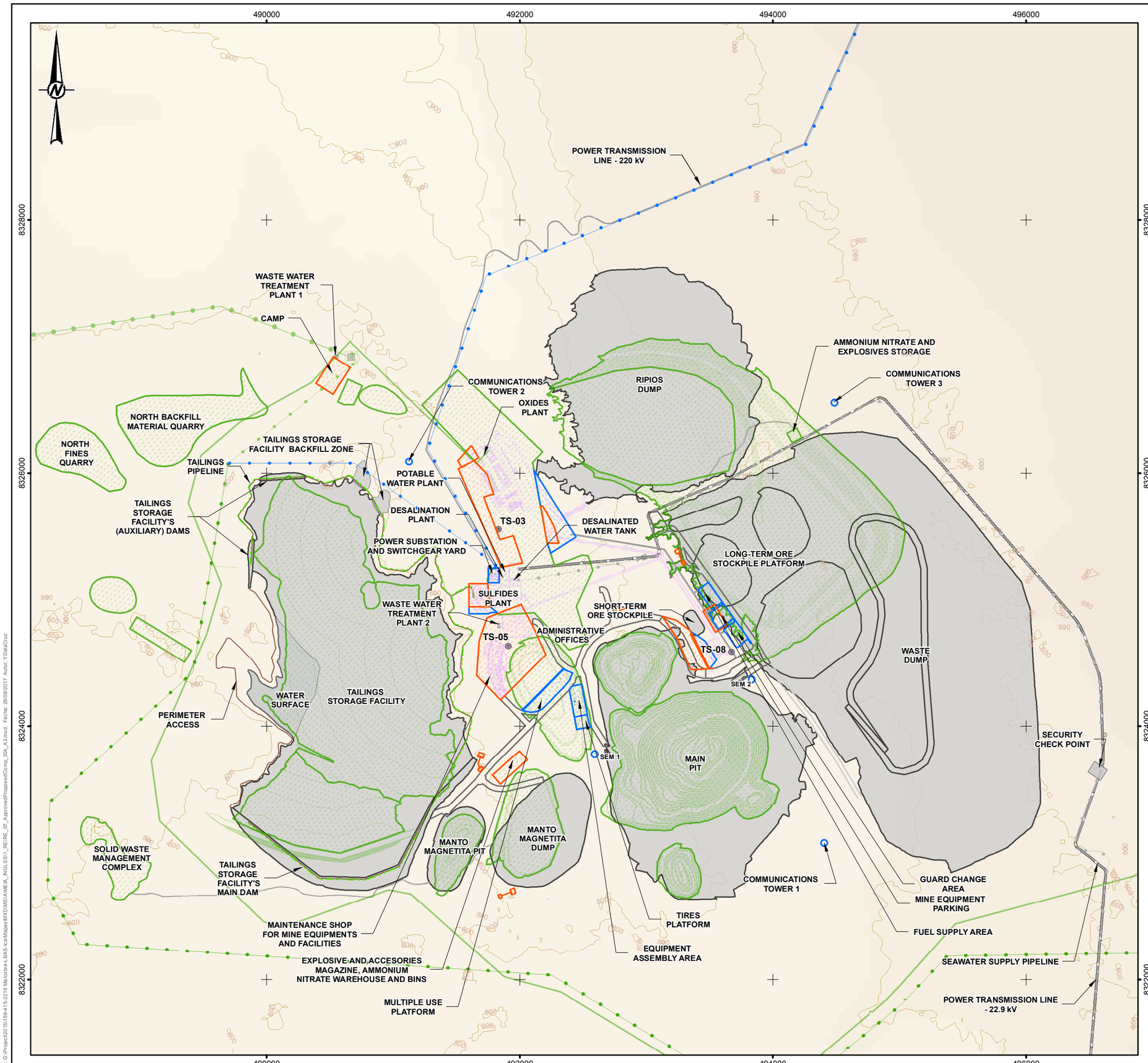
1.2.4.1 Mina Justa Pit and Manto Magnetita Pit

The Mina Justa ore deposit is composed of the Mina Justa (Main) and Manto Magnetita ore deposits, which are located in the volcanic sedimentary formation Río Grande of the Upper Jurassic. This ore deposit has a strong structural control and is mainly delimited by regional faults of Andean strike (SE-NW).

This ore deposit is a hydrothermal deposit of iron - copper - gold oxide type. The Mina Justa ore deposit extends over an oval area comprised of 2.1 km x 1.5 km with a depth of up to 150 m; while the Manto Magnetita ore deposit of copper oxides, has a tubular shape of 700 m x 350 m and 25 m and 35 m thick.

The mineral resources estimate of this ore deposit add up 180 Mt of oxides, above the cut-off grade of 0.2% of copper soluble acid, and 182 Mt of sulfides, above a cut-off grade of 0.2% of total copper. A 53% of the estimated resources correspond to the measured resources, 41% to indicated resources, and 6% to inferred resources, the latter are located in the deepest sections of the ore deposit.

In the final layout, the main pit will comprise an area of 244 ha approximately; and will be 2 km long by 1.5 km wide, and 500 m deep. The Manto Magnetita pit will comprise an area of 21 ha approximately; and will be 700 m long by 300 m wide, and 120 m deep. The two pits will have 12 m high benches and 22 m wide ramps. None of the pits intersects groundwater; in this sense, no mine water inflows are expected in the pits, if so, no related management measures are needed.



LEGEND

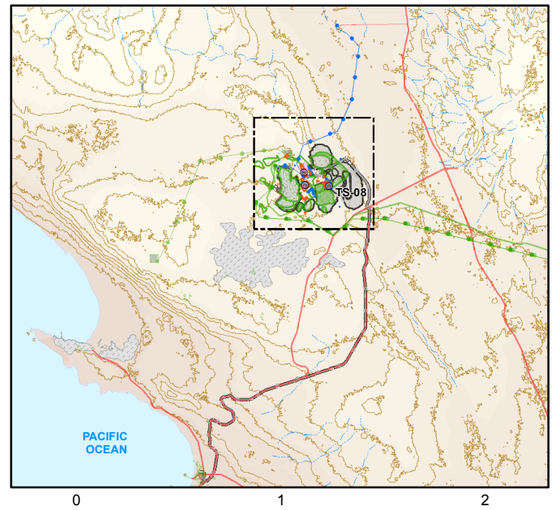
- (100 m) MAIN CONTOUR

APPROVED COMPONENTS

- EIA COMPONENTS (Vector, 2009)
- FIRST ITS COMPONENTS (Golder, 2016)
- SECOND ITS COMPONENTS (Golder, 2016)

PROPOSED COMPONENTS

- PROPOSED COMPONENTS
- INFRASTRUCTURE
- POWER TRANSMISSION LINE - 22.9 kV
- SEAWATER SUPPLY PIPELINE
- HAUL ROADS



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1:30,000 KILOMETERS

REFERENCE

BASE DATA: IGN 2006 /APPROVED COMPONENTS: EIA MINA JUSTA 2010 (VECTOR) AND ITS 2016 (GOLDER) /COMPONENTS OF DETAILED EIA AMENDMENT: GOLDER 2016
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

PROJECT APPROVED AND PROPOSED COMPONENTS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-11-15
EXECUTED	VM
DESIGN	GM
REVIEW	RH
APPROVED	DG

PROJECT No. 159-415-2219

Rev. 1

FIGURE **RE-07**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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1.2.4.1.1 Preliminary Mine Plan

Pits will be mined with the traditional open pit mining method and 14 operational phases have been considered, 13 in the main pit and one in the Manto Magnetita pit; all these pit mining phases will be conducted over a period of 18 years (two years of pre-mining and 16 of mining); additionally, the Project estimates one year of stockpile processing.

Table RE-3 includes the preliminary ore mine plan of the Project.

Table RE-3: Preliminary Ore Mine Plan of the Project

Year	Oxide Ore from Main Pit	Oxide Ore from Manto Magnetita Pit	Sulfide Ore from Main Pit	Oxide Ore to ST Stockpile	Sulfide Ore to ST Stockpile	Oxide Ore to LT Stockpile	Sulfide Ore to LT Stockpile	Oxide Ore to Oxide Plant	Sulfide Ore to Oxide Plant
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1[a]	2,843	-	-	-	-	2,843	-	-	-
2[a]	18,620	-	8	-	-	18,620	8	-	-
3	24,819	-	3,809	574	1,607	19,075	2,202	9,570	1,945
4	15,293	-	8,817	818	5,547	7,114	3,270	12,000	5,840
5	15,950	279	5,078	719	4,279	9,038	798	12,000	5,999
6	8,858	1,356	10,427	627	6,000	3,941	4,427	12,000	6,000
7	8,715	3,721	3,173	1,067	3,068	1,768	105	12,000	6,000
8	15,211	-	4,356	1,128	3,852	3,932	503	12,000	6,000
9	20,180	-	5,199	1,125	4,834	8,930	365	12,000	6,000
10	10,658	-	5,981	1,066	5,066	-	915	12,000	6,000
11	5,834	-	3,330	583	3,330	-	-	12,000	6,000
12	4,304	-	7,248	430	6,000	-	1,248	12,000	6,000
13	4,251	-	6,823	425	5,999	-	823	12,000	5,999
14	1,471	-	6,283	147	5,426	-	857	12,000	6,000
15	897	-	10,723	90	5,996	-	4,727	12,000	6,000
16	-	-	6,950	-	5,936	-	1,014	9,690	6,000
17	-	-	6,363	-	5,767	-	596	-	6,000
18	-	-	1,048	-	1,017	-	31	-	6,000
19	-	-	-	-	-	-	-	-	3,830
TOTAL	**157,904**	**5,356**	**95,615**	**8,800**	**73,725**	**75,262**	**21,890**	**163,261**	**95,614**

[a] Pre-mining.
ST: Short term.
LT: Long term
Source: Marcobre 2016.

1.2.4.2 Waste Dump

The final layout of the waste dump will comprise an area of 684 ha approximately, and a storage capacity of 867 Mt. This waste dump has been designed with a maximum height of 180 m, a bench height of 80 m, a bench face angle of 38° and an overall slope angle of 24°.

The waste rock to be stored into this waste dump will be non-acid generating material from the main pit. For the waste rock hauling, 220 t haul trucks will be used and the waste rock will be dumped into platforms through vertical unloading. Due to the absence of surface water and groundwater, no hydraulic or subdrainage structures are necessary in the waste dump.

The Project components will be placed in Río Grande Basin, which is a drainage area with no surface water. Likewise, since the Project will be located in a zone with scarce precipitation and high evaporation, no net precipitation accumulation will be in the zone, i.e., runoff and infiltration on the soil resulting from rainfall will be null. Thus, no surface water that needs hydraulic structures for the waste dump is expected.

1.2.4.3 Manto Magnetita Dump

The final layout of this waste dump will comprise an area of 35 ha approximately, and a storage capacity of 32 Mt. The Manto Magnetita dump has been designed with a maximum height of 60 m, a bench maximum height of 60 m, a bench face angle and an overall slope angle of 38°.

The waste rock to be stored into this waste dump will be non-acid generating material. For the waste rock hauling, 220 t haul trucks will be used. The waste rock will be dumped into platforms through vertical unloading. Due to the absence of surface water and groundwater, no hydraulic or subdrainage structures are necessary in the waste dump.

1.2.4.4 Oxide Plant

This plant will be placed over an area of 16 ha approximately, and will have a nominal process capacity of 12 Mt/year, and a design capacity of 13 Mt/year.

The process includes unit processes of crushing, leaching, solvent extraction and electrowinning. The final product of this process will be a maximum estimate of 58,000 t/year of copper cathodes.

The bulk ore will be hauled by trucks to the crushing area, where it will be fed to the primary rotary crusher (design capacity: 2,144 t) and the crushed ore will be sent to the coarse mineral stockpile, from this point the secondary, tertiary and quaternary crushing processes will follow. The product will be sent to the rotary drum to treat ore before moving on the leaching process. Dust generated from this process will be controlled through dust suppression and intake systems, and sprinklers.

The crushed ore will be treated previously in a rotatory drum with sulfuric acid and raffinate or hydrometallurgical process water to facilitate agglomeration and optimization of the leach process. This pre-treated ore will be loaded into 15 vats for the leaching process; the final product will be the enriched leach solution (rich in copper) that will finally go through copper solvent extraction. Solid waste or ripios will be transported in conveyor belts to the ripios storage area and, subsequently, to the ripios dump.

The solvent extraction process will consist of the selective extraction of copper from the PLS solution to produce high purity copper sulfate solution; finally, this solution will go through an electrowinning process, where the copper will be adhered to the cathodes in each electrowinning cell.

This electrowinning process will produce copper cathodes, which will be clarified and separated from the copper layers, the cathode will be sent again to the cells and the copper layers will be transferred to the collection boxes, later they will be packed before dispatching.

Reagents like sulfuric acid, flocculant, diluent, extractant, cobalt sulfate, cathode smoothing agent, among others will be used in the oxide plant.

1.2.4.5 Ripios Dump

The final layout of the ripios dump will cover an area of 240 ha approximately, with a storage capacity of 187 Mt, and a maximum height of 150 m. In regard to acid generating potential, the ripios samples indicate that no acid generation is expected.

Like in the waste dump, no surface water that need hydraulic structures is expected. Also, according to the evaluation of potential filtration in this dump, no filtration is expected in natural conditions, hence, a subdrainage system is not necessary.

Ripios will be hauled from the oxide plant to this dump using conveyor belts that will unload into 220 t capacity trucks. Ripios will be disposed at platforms over which the mine trucks will unload the ripios at a distance of 15 m to 20 m from the dump border. Two dozers will push the ripios along the platform surface conforming benches of 60 m berms and bench height of 50 m. Waste material from the open pits will also be dumped into the ripios dump.

1.2.4.6 Sulfide Plant

It will be placed in an 8 ha area and it will have a nominal process capacity of 6 Mt/year. The process includes unit processes of crushing, grinding, flotation, thickening, and filtration of copper concentrate.

The bulk ore will be hauled from the mine in a front-end loader or truck, to the primary crusher, where fine material will be obtained that will pass through a crushing circuit, and later to the tertiary crusher. The tertiary crushing will move on the grinding circuit, that is composed of a ball mill and regrinding cyclones; the fine material resulting from the grinding will sent to the flotation circuit.

The material type that will enter the mining process will be sulfides from the grinding process. The process material outcome will be copper concentrates with silver content and tailings that will be stored in the tailings storage facility.

The mining process will begin with the flotation of the ore resulting from grinding. The copper flotation circuit will consist of a rougher flotation circuit, a regrinding circuit, a flotation stage of pneumatic cell cleaning, two stages of cleaning flotation, and a flotation stage with cleaning scavenger. The copper concentrate from the flotation circuit will be thickened using a high capacity thickener and filtered later. Tailings will be mixed and thickened before being disposed of at the tailings storage facility.

Reagents that will be used in the sulfide plant will be lime, primary and secondary collectors, frother and flocculants.

1.2.4.7 Tailings Storage Facility

The tailings storage facility will have a storage capacity of approximately 103 Mt for thickened tailings, a period of 18 years of service life and it will occupy an area of approximately 390 ha. The main components that will form the tailings storage facility will be the containment dams (main, north ancillary, and west ancillary), a storage area for tailings disposal, transportation and tailings disposal system, and access roads.

Tailings will be dumped from unloading points located at the main dam crests and ancillary dams. The main dam will be gravity dam located south of the tailings storage facility; it will have an extension of 2.60 km approximately, crest width of 25 m, 6 m wide benches, which will allow the geomembrane installation. This dam will be divided into three parts (west, south and west). Its design considers the rising method downstream, in four stages: I, II, III, and IV, which will allow tailings storage of approximately 13.2 Mt, 42.3 Mt, 71.5 Mt, and 103 Mt, respectively. In the last stage, the dam will reach a maximum height of 35 m approximately, with a crest length of 2,595 m.

North ancillary and west ancillary dams will be placed north of the tailings storage facility; their final lengths will be about 366 m and 385 m, respectively; and will be constructed during stages III and IV of the tailings storage facility. These dams will have a 12 m wide crest for each stage, a free border in each raising stage of 2.5 m at least and 6 m wide benches to facilitate the construction of the following stage.

In the tailings storage facility, no surface water that need hydraulic structures is expected. Moreover, for Stage IV, the moistened zone will reach a depth of about 70 m to 80 m, with a saturation of 97%, and a flow downstream the dam; also, the groundwater levels are below 500 m of depth and will not affect the foundation of the tailings storage facility dams. According to the water balance discharges from the tailings storage facility will not occur.

1.2.4.8 Multi-buoy Terminal

The multi-buoy terminal is proposed for the reception of sulfuric acid and for the seawater supply to the Project.

During the operation stage, the sulfuric acid will be unloaded in the multi-buoy terminal. This reagent will be delivered using tankers and sent through a retractable floating hose to three land storage tanks, from this point it will be hauled in trucks to the Project mine site.

Likewise, the terminal will provide support to the seawater intake system, which will be supplied through a supply pipeline to the Project mine site.

The multi-buoy terminal will have the following marine components:

- Access Trestle: The access trestle will be approximately 240 m long, it will be constructed on piles with capacity to support the hose for sulfuric acid reception and seawater intake system. According to the underwater sounding results and the stratigraphic profile, there is no rocky seabed in the zone where the access trestle will be built; therefore, no blasting for rock fracturing or dredging works are foreseen.
- Mooring system: composed of four buoys connected by some chains to two anchors with high holding capacity located on the seabed.
- Reception of sulfuric acid: a floating hose will be used for the sulfuric acid transport from the tankers to the storage tanks, and a reel placed in the platform to store the hose.
- Seawater intake system: this system will allow a 900 m^3/hour seawater flow and include a water intake chamber located at a depth of 10 m, two HDPE pipes, a pumping platform, two pumps, and a steel pipeline; this system will convey water to the vertical pumps and then to the steel pipeline.

The terrestrial area will comprise 8.8 ha approximately and extend over the river bank border granted by *Dirección de Capitanía y Puertos* (General Directorate of Aquatic Control Board and Coastguards of Peru), and the San Juan de Marcona - San Nicolás road. This area will comprise the following ancillary components:

- Tank yard: it will store sulfuric acid in three tanks of 10,000 t of capacity each, which will be surrounded by a 2 m high spillage containment berm; this yard will also have an office building.
- Other facilities: seawater pumping station, sulfuric acid transfer stations, offices, paths, and access roads.

1.2.4.9 Seawater Supply Pipeline

The seawater supply system will consist of a steel pipeline of 16”-18” in diameter and total length of 40 km approximately; its route will begin in the pumping station placed in the multi-buoy terminal up to the discharge in the seawater storage pond in the mine site. The pipeline will be buried along the whole layout, except for the sections located on the ground. Seven minor intersections in the supply pipeline with the PE-30 route have been identified, since there are pipelines, power lines, optical fiber, existing signposting, and creeks. For intersections with any existing facility or condition, the pipeline assembly will be adapted. Interferences will be developed at construction stages out of the regular phase of construction. To not interfere the vehicle transit or affect the asphalt concrete layer, the tunnel liner type method will be adopted, which is a system aimed at construction of intersections in urban zones that eliminates impacts on trenches or transit intervention on surface.

This system will have a pumping station, which will allow seawater conveyance for the multi-buoy terminal. This station will have three parallel-placed centrifugal pumps.

Additionally, this supply system will have a terminal station, where discharges will be checked; three emergency ponds; cathodic protection; a pipeline control system; and a communication system.

1.2.4.10 Desalination Plant

This plant will have a nominal treatment capacity of 180 m^3/h, and will supply desalinated water to the sulfide plant at a ratio of 17.3 m^3/h; to the oxide plant, at a ratio of 51.5 m^3/h; and to the potable water treatment plant at a ratio of 4.4 m^3/h. It will also provide desalinated water to the camp, mine services, and fuel station. It will also be used in the event of fires, among others.

The brine, which results from the desalinization process, will be 99 m^3/h; out of this, 59 m^3/h will be used for irrigation of access roads (dust suppression), and approximately 40 m^3/h will be taken to the tailings storage facility.

1.2.4.11 Effluents and Emissions Facilities and Management

The project does not foresee the generation of liquid effluents or runoffs towards any surface water source, including the sea, at any stage. The industrial liquid wastes will be recirculated to the process. As mentioned above, the brine (40 m^3/h), resulting from the desalination process, will be sent to the tailings storage facility and the domestic effluents will be treated in a waste water treatment plant (WWTP) with moving bed bioreactor technology; after treatment, the effluents will be reused for irrigation and dust control in the Project. Furthermore, while the WWTP is implemented during the construction stage, the treatment system in the Project will consist of 8 septic tanks, with 20 m^3/day-capacity.

In regard to the emissions generated by the Project during the construction stage, these will be generated mainly by transport activities, earthworks, blasting, among others; and during the operation stage, they will be generated by blasting, mineral and waste transport, hauling activities, among others. These sources, including gas emissions and particulate matter parameters, and the related production volume expected are described in detail in Annex XXV of the EIAd Amendment, Air Quality Modeling.

1.2.4.12 Waste Management and/or Disposal Facilities and Activities

The project activities will generate hazardous and non-hazardous wastes, which will be managed in the complex for waste management, that will function through all the Project stages. The main facilities in this complex are: the sanitary landfill, recycling areas, temporary storage areas for hazardous waste, and an area for the biological treatment of soils (land farming).

This solid waste will be removed later by a solid waste service provider (EPS-RS) registered in the *Dirección General de Salud Ambiental* (DIGESA) (General Directorate of Environmental Health), for final disposal. If appropriate, a solid waste trading company (EC-RS) could be used to remove the solid waste.

Additionally, the Project considers temporary platforms for non-hazardous waste management during the construction stage; from this point, waste will be removed through an EPS-RS for final disposal while the complex is being constructed.

1.2.4.13 Quarries

To develop the Project construction activities, borrow material of different kinds will be needed: rockfill, fines, drainage, concrete, among others. Additional quarries to the ones approved are not considered in the Project:

- North Backfill Material Quarry, Drainage Material and Concrete
- South Backfill Material Quarry
- North Fines Quarry
- South Fines Quarry

During the operation stage, borrow material from these quarries will be used to continue the construction of the tailings storage facility dams. During the operation stage, north, north fines and south backfill quarries will be exploited, the south backfill quarry will be used until it gets covered with tailings.

1.2.4.14 Ancillary Components

1.2.4.14.1 Fuel Station

The fuel supply station will be located close to the construction temporary area No. 4 and it could store up to 450,000 gallons (1,703.4 m^3) of B5 diesel fuel, during the construction and operation stages. No modifications to the approve fuel station are considered.

1.2.4.14.2 Mine Equipment Maintenance Shop (MEMS) and Supplementary Facilities

The Project includes the modification to the approved layout of the mine equipment maintenance shop (MEMS) and supplementary facilities, approved in the EIAd (Vector 2010), and amended in the first ITS (Golder 2016a). The changes proposed in this EIAd Amendment only consider the contouring of the final platform of the maintenance shop, without modifying the projected and approved facilities. The shop area will be 4.6 ha approximately.

1.2.4.14.3 Camp

The camp was approved in the EIAd (Vector 2010) and modified through the first ITS (Golder 2016a), it will be operating during the construction and operation stages.

The camp will have a temporary building that will be used during the construction stage and a permanent building for the operation stage. The camp constructed area will be 1.4 ha and the total area will be 4 ha, approximately. During the construction stage maximum peak, the camp may reach a maximum extension of 12 ha, including the temporary areas. The camp characteristics were defined in the first ITS (Golder 2016a) and the Project does not include any modifications in this regard. The main internal facilities in the camp are bedrooms, offices, training room, food service area, among others.

1.2.4.14.4 Ammonium Nitrate Warehouse and Magazine

The magazine and accessories, ammonium nitrate warehouse, and silos, approved in the first ITS (Golder 2016a), will operate during the construction and operation stages. This facility comprises four areas: the explosive storage area (magazine), accessories storage area, ammonium nitrate storage area, and bins that will be placed in only one platform. Another warehouse is located north of the waste dump.

1.2.4.14.5 Potable Water Supply System

The Project will include a potable water plant, which will be located north of the desalination plant. The potable water treatment plant will have the capacity to treat up to 9.4 m^3/h and will be supplied with water from the desalinated water pond. The potable water will be distributed to the oxide plant, sulfide plant, and the mine services.

1.2.4.14.6 Waste Water Management

The Project has two WWTP approved in the EIAd (Vector 2010), the Project considers relocation of both treatment plants over an area of about 8 ha and 2 ha, respectively. These plants will work with a mobile bed bioreactor technology.

Water treatment plant 1 will collect water from the camp zone and could treat up to 120 m^3/day, while treatment plant 2 will recollect waste water from the sulfide plant, offices, collection tanks from the maintenance shop, oxide plant, and other services; and will have capacity to treat up to 90 m^3/day. Effluents treated in the WWTP will be reused for irrigation and dust control.

1.2.4.15 Power Supply

During the operation stage, power will be supplied by the *Sistema Eléctrico Interconectado Nacional* (National Interconnected Power System) through a power transmission line (PTL) of 220 kV and 14.7 km long, lined from the Poroma power substation to the Mina Justa power substation, located south of the sulfide plant. The Mina Justa power substation will be placed over an area of 1 ha approximately. Additionally, the Project will have a power supply system that will be composed of two mobile power substations, which will supply power to the mine equipment.

The characteristics of the Mina Justa substation, power transmission line, and the power supply system were approved in the second ITS (Golder 2016b) and the Project does not consider any modifications to these characteristics. In addition, the Project will have a power supply system for emergencies, composed of two power generators. For the multi-buoy terminal, a power substation will be installed over an area of 400 m^2 approximately. This substation will be connected to the Mina Justa substation through a power transmission line of 22.9 kV, parallel to the seawater supply pipeline.

For the construction stage, the Project has proposed the installation of power generators in the most important work fronts in the mine area.

1.2.4.16 Water Availability and Demand

1.2.4.16.1 Water Availability

Seawater will be the water supply source for the Project operation activities, which will replace the groundwater collection from the Jahuay aquifer. Seawater will be the water resource for industrial and domestic use. The multi-buoy terminal will allow the collection of 900 m^3/hour of seawater, seawater will be mainly used for the mineral processing; also, a reverse osmosis plant will be used in the mine area for water supply for domestic use.

For water supply during construction of the Project facilities, two water sources are foreseen: the Jahuay aquifer (D.R. No. 685-2015-ANA-AAA-CH.CH) and a temporary seawater supply point located in the multi-buoy terminal zone; which will be active up to completion of the seawater supply pipeline for supplying water to the Project. Figure RE-8 shows the seawater source locations in the Project during the construction and operation stages.

If at the beginning of the construction stage, the freshwater from the before-mentioned source is not available yet, an authorized EPS for water supply will be used, in addition to bottled water.

In regard to the availability of Jahuay aquifer for the Project, this was authorized by Jefatural Resolution No. 067-2014-ANA, by the *Autoridad Nacional del Agua* (ANA) (National Water Authority) that established an annual water availability of 1,570,000 m^3, equivalent to 50 L/s from the said aquifer. The aquifer characteristics and its associated facilities were approved in the EIAd (Vector 2010).

1.2.4.16.2 Water Demand

The total water demand during the construction stage will be 306,819 m^3 in the first year (23.4 L/s) and 256,887 m^3 during the second year (19.6 L/s); of which, 14.5 L/s on average will be used for irrigation of haul roads.

During the operation stage the water demand will be 7,601,855 m^3/year (241 L/s); of which, 37 L/s will be for the oxide plant, 124 L/s for the sulfide plant, 50 L/s for the desalination plant, and 16 L/s for the irrigation of access roads.

For the water transport tanker-type trucks of 5,000 gallons (approximately 18 m^3) will be used to cover a trip of 31 km approximately in existing public paths between Jahuay aquifer (progressive 0+000) and the approved water supply station (progressive 31+100).

1.2.4.17 Construction Activities

The construction activities will consist of the grading of the areas where the components will be built, construction of the structures that will be part of those components, and equipment assembly that will enable the functioning of the components during the Project operations. This Project stage will take two years.

To develop these activities, the Project considers implementing ancillary components to provide support to the construction, most of them will be temporary and will not stay up to the operation stage. Also, some ancillary components from the Project exploration activities will be used to provide support to early construction activities of the mining Project.

Before the construction stage begins, Marcobre will be carrying out pre-mining activities and early works, which were approved in the EIAd (Vector 2010), and the Informes Técnicos Sustentatorios (ITS) (Technical Supporting Report) of the ancillary facilities. Early works will begin in 2017.

480000 490000 500000 510000 520000

8330000 8320000 8310000 8300000 8290000

SAN FERNANDO NATIONAL RESERVE
Cerros Tunga
Cerro Taquila
Cerros Marcona
Cerro Achupalla
Lomas Marcona
Pampa Media Luna
Pampa Caracoles
Cerro Caracoles
Cerro Colorado
Cerro Yauques
Pampa Las Treinta Libras
Cerro La Puntilla
Cerro La Repartición
Cerro Melizos
Quda. Las Carbonales
Quda. Piedra Gorda
Quda. Las Carretillas
Cerro La Cuesta
Quda. Cuesta
Quda. La Cuesta
Pampa Los Pozos
Cerro Los Pozos
Pampa Lagunal
LAGUNAL GRANDE
Cerro Lagunal Grande
Cerro Lagunal Chica
Loma Qutaloma
Cerro Media Luna
Quda. Carbonera
Quda. Peligrosa
Pampa Lagunal Grande
TO ICA / LIMA
TO MINA JUSTA PROJECT
TO SAN JUAN DE MARCONA
TO AREQUIPA
ACCESS TO THE CAMP
DETOUR TO JAHUAY
Lomas Marcona
Pampa Las Clavelinas
Cerro Cuarto
Loma Cachiloma
Cerro Blanco
Pampa Colorada
Pampa del Inca
IRHS - 04.03.05-238
Quda. Tranca Pata
Lomas La Encañada
Pampa Treinta Libras
Cerros Marcona
Cerro Los Cerritos
Cerro Los Pocitos
Cerro Teta de Cabra
JAHUAY AQUIFER
Pampa Corpac
Pampa Los Cerrillos
Pampa Pajayuna
Cerro Romerillo
Quda. Los Colorados
Pampa El Choclón
Pampa Jahuay
Pampa Romerillo
Cerro Romerillo
Cerro El Quemado
Cerro Pajayuna
Cerro La Muña
Quda. Yungo
Quda. La Muña
Cerro El Huevo
Cerro Penuela
Lomas Marcona
Cerro Bajada Toroco
Lomas Marcona
Hoyada Peña Colorada
Cerro Tres Hermanas
Pampa Pongo
Quda. La Encantada
Pampa Cadillo
Pampa Mata Caballo
Pampa Totoral
Pampa Colorada
Quda. Jahuay
Isla Lobos
TRES HERMANAS
Playa Yanyarina
Punta Blanca
Playa Yanyarina
Playa Libertad o Lobera
Playa Libertad o Lobera
YANYARINA
ICA
AREQUIPA
PACIFIC OCEAN
Bahía San Nicolás
Playa La Chorrera
Punta La Isla
Playa El Chocnal
Playa San Juanito
Punta La Salina
Ensenada El Huevo
Playa Acarí
Bahía San Juan
Playa Hermosa
SAN JUAN DE MARCONA
Punta San Juan
Playa Acapulco
Playa Los Leones
SYSTEM OF ISLANDS, ISLETS AND GUANO CAPES PUNTA SAN JUAN NATIONAL RESERVE
Punta El Cenicero
Playa Barranquito
Punta Lobo Fino
Playa Los Vidrios
Ensenada Chaviña
Punta Colorada
Ensenada Tres Hermanas

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH
- REGIONAL BOUNDARY
- SHP OPERATING AREA
- PROTECTED NATURAL AREA
- BUFFER ZONE
- MINE JUSTA PROJECT COMPONENTS
- JAHUAY AQUIFER
- JAHUAY WATER INTAKE

ROUTE: PROJECT - JAHUAY

- ACCESS ROUTE TO THE CAMP
- NATIONAL ROUTE PE-30
- NATIONAL ROUTE PE-1S
- ROUTE TO JAHUAY

ROUTES FROM JAHUAY TO THE PROJECT

SECTION	NAME	TYPE
0+000 - 9+400	UNPAVED PATH (WITHIN THE PROJECT AREA)	ACCESS ROUTE TO THE CAMP
9+400 - 14+100	PAN-AMERICAN HIGHWAY	NATIONAL ROUTE PE-1S
14+100 - 20+100	MARCONA HIGHWAY	NATIONAL ROUTE PE-30
20+100 - 31+100	UNPAVED PATH (OUTSIDE THE PROJECT AREA)	ROUTE TO JAHUAY

0 5 10

1:175,000 KILOMETERS

NOTAS

1. JAHUAY AQUATIC SURFACE, EIA PROJECT MINA JUSTA VECTOR 2009

REFERENCE

DATABASE: IGN 2006
APPROVED COMPONENTS: EIA MINA JUSTA 2010 (VECTOR) AND ITS 2016 (GOLDER)
COMPONENTS OF DETAILED EIA AMENDMENT: GOLDER 2016
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

WATER SOURCE LOCATIONS AND WATER TRUCKS ROUTE - CONSTRUCTION STAGE

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2017-06-27
EXECUTED	VM
DESIGN	GM
REVIEW	RH
APPROVED	DG

PROJECT No. 159-415-2219 | Rev. 1 | FIGURE **RE-08**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

0 25mm

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The following construction activities will be developed as part of the Project activities:

- The preparation of the area that includes earthworks and access implementation:
- Clearing and construction of the main components.
- Installation of the temporary camp and use of the exploration camp, and construction of the main camp.
- For fuel supply, the fuel station approved in the second ITS (Golder 2016b) will be used.
- For power supply, power generators will be set in the most important work fronts, early installation of power supply is considered, which comprises the Mina Justa power substation, power transmission lines, and mobile substations for mine equipment. For the multi-buoy terminal, installation of a power substation connected to Mina Justa power substation through a power transmission line of 22.9 kV is proposed.
- Installation of two concrete Plants to meet the construction requirements of the mine components.
- Installation and construction of the main components of the multi-buoy terminal: access trestle, tanks farm, seawater intake system, seawater supply pipeline, and seawater desalination plant.

1.2.4.18 Water Management during Operation Stage

For water management, the following infrastructure will be used:

- In the oxide plant:
  - Two pregnant leach solution ponds, which together have a storage capacity of 21,600 m^3.
  - Two raffinate ponds, which together have a storage capacity of 21,600 m^3.
  - One solvent extraction pond, to respond in the event of failures of the mixer settlers and possibly to collect the overflow from the solvent extraction area.
- In the sulfide plant:
  - A desalinated water tank, with a storage capacity of about 81 m^3/h and supplied with water from the desalination plant.
  - A process water tank, to collect 1,585 m^3/h and supplied by the seawater pond.

The following infrastructure will be used for freshwater management:

- An in-port seawater pond that will be placed in the multi-buoy terminal and will have a capacity of 4,250 m^3 approximately.
- A seawater pond in the mine site that will have a capacity of 30,000 m^3 and will supply seawater for the process of the sulfide plant, oxide plant, among others.
- A desalination plant that will be located north of the sulfide plant, and will have a nominal capacity of 180 m^3.
- A desalinated water tank that will have a nominal capacity of 950 m^3 and will supply the necessary water to cover the water demand of the potable water plant, mine, camp, fuel station, and operations.

1.2.4.19 Labor

Construction

For the construction stage, the contractors participating in the Project will require qualified and non-qualified personnel, priority will be given to personnel search both in the Area of Direct Influence (ADSI) and in the Area of Indirect Influence (AISI). If there is lack of local personnel with the required skills and availability (unemployment low rate), the personnel search will be expanded outside the ADSI and AISI.

The estimated workforce might be a maximum of 1,400 workers during some months of the Project development; so, during the selection process, for condition and skills equity purposes, locals will be given priority. Local will be defined as the person that has lived for at least three (3) years and can prove it through the identity card, as resident of the localities of the ADSI and AISI on December 31, 2016.

The workforce requirement will be 55% of the total required, for basically construction equipment handling, earthworks, mechanical installation assemblies, pipelining, power supply systems, among others. The required non-qualified workforce will perform works related to lookouts, manual support in civil works, manual activities in maintenance, among others, and it is estimated that it accounts for 45% of the total workers required.

Operations

For the Project operations and maintenance stage, the estimated personnel required is about 1,059 persons, out of which 10% will be non-qualified personnel. As mentioned above, Marcobre will preferably carry out personnel selection process and search in the ADSI and in the ASI. If there is lack of local personnel with the required skills and availability (unemployment low rate), the personnel search will be expanded outside the ADSI and AISI.

During the selection process, for condition and skills equity purposes, Marcobre will establish local priority. Local will be defined as the person that has lived for at least three (3) years and can prove it through the identity card, as resident of the localities of the ADSI and AISI on December 31, 2016.

1.2.4.20 Demand and Suppliers of Local Goods and Services

Locals and inhabitants from Project surrounding districts will be priority for employment opportunities. During the procurement and bidding process for the construction, specifications on identification, evaluation and training to local workforce will be determined, along with the Project granting, and additional scores will be given during the evaluation to contactors that meet the requirements established by the Project in regard to local workforce hiring.

1.3 Baseline

1.3.1 Physical Environment Description (Soil, Water, and Air)

1.3.1.1 Meteorology, Climate and Life Zones

The monthly average wind speeds of the local meteorological station Mina Justa and regional meteorological station Copara show a constant trend throughout all the months of the year, with values of 2.3 m/s to 3.1 m/s and 4.4 m/s to 5.1 m/s, respectively. The wind speed of the local meteorological station Mina Justa has a strong southeast predominance, present the whole day of all the seasons of the year. Figure RE-9 shows the locations of the meteorological stations and wind roses of each meteorological station.

In general, the lowest air temperatures in the Project area occur during June, July, August, and September, and the minimum temperatures occur in July (6.7°C and 9.3°C) in the meteorological stations Mina Justa and Copara, respectively). Maximum temperatures reach 26.8°C in the local station Mina Justa and 33.4 °C in the regional station Copara in April. The average temperature ranges from 12.9 °C to 21.1 °C and 17.6 °C to 25.9 °C, in the local meteorological station Mina Justa and regional meteorological station Copara, respectively.

During the annual cycle, relative humidity fluctuation presents maximum values between June and August, and the highest degree of environmental saturation is recorded in July, reaching 81.3% in the local station Mina Justa. The minimum values of relative humidity are recorded in January and March; the lowest saturation occurs in February with ranges of 70%.

For the Project area, the highest levels of average daily solar radiation are recorded during February (5.5 kwh/m^2 to 7 kwh/m^2); and in November (6 kmh/m^2 to far above 7.5 kwh/m^2). The lowest levels are recorded during May (5.0 kwh/m^2 to 4.5 kwh/m^2); and in August (5.5 kmh/m^2 to less than 4 kwh/m^2).

No rainfall occurs during most of the year in the zone, rainfall is recorded between December and March. The regional meteorological station Copara recorded annual average precipitation ranges of 6.0 mm for the period of January 1999 to December 2015. However, in the Project area, fog is observed during the whole year due to the high water vapor content in the atmosphere, mainly during winter. On the other side, there is no relationship between variations in the rainfall and the occurrence of the events of El Niño Phenomenon and La Niña.

The annual average evapotranspiration proposed for the Project area is 1,934.3 mm, considering the local meteorological station Mina Justa as reference. The average annual evapotranspiration applicable to Mina Justa is 1,827.6 mm; with monthly average values ranging from 114.2 mm in June to 178.6 mm in March.

According to the Thornthwaite Classification System, the Project area has a representative climate of arid zones, with lack of rainfall throughout all seasons of the year, and with relative humidity classified as humid. This type of climate is present in most part of provinces of Chincha, Pisco, and Ica.

1.3.1.2 Geology and Morphology

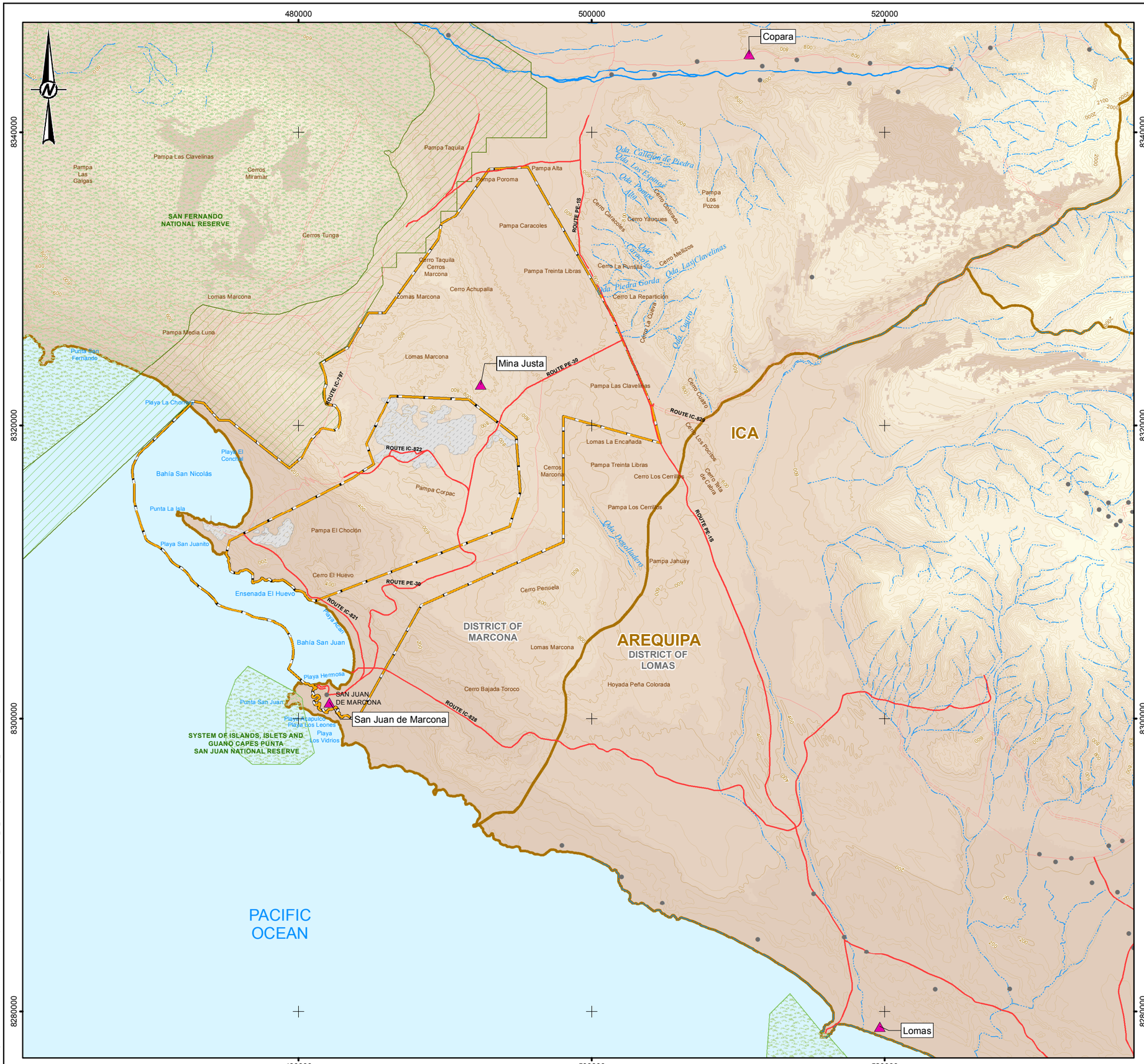
The Project is located in the plain of the Central Coast of Peru. The region is located east of one of the most active plate borders, that is part of the Ring of Fire, and where a large number of destructive earthquakes have been recorded, many of them having occurred less than 20 years ago.

The ore deposit has a strong structural control; it is delimited between the regional faults Lechuza, Tunga, and Treinta Libras, with Andean strike (SE-NW), and normal-dextral displacement. Among these faults, there is a fault and fracture system with SW-NE strike, with a preferred dip to southeast, known as the Mina Justa fault system. These structures are usually of reverse type, with medium to low or up to subhorizontal angles, and their displacement ranging from a few centimeters to some tens of meters. Mineralized bodies (Main and Upper mantles) are interrupted by longitudinal faults parallel to the Lechuza and Tunga faults (Huaca fault system), which generate dislocations on said mineralized bodies.

Iron mineralization in the Marcona zone has a pattern of iron oxides copper-gold mantles. It comprises two deposits named Mina Justa and Manto Magnetita Oeste (Western Magnetite Mantle) that are placed in the Río Grade volcanic-sedimentary formation of the Upper Jurassic, which includes mainly andesitic lavas and pyroclastic flows, with thin interbedded arch sandstone and siltstone sequences. Large extensions of sulfide bodies and some oxide lenses have been subject to an intense hydrothermal alteration, which basically consisted of secondary iron oxides, actinolite, and chlorite, with albite, potassium feldspar, apatite, scapolite, and calcite. The economic mineralization of the Mina Justa deposit is closer to the surface to the north and west of the deposit, and reaches a depth of 550 m below the surface southeast of the deposit, the prevailing sulfides consist of bornite and chalcocite in the upper area of the ore deposit, and chalcopyrite in the lower part. On the other side, copper oxides characterize the mineralization of the Manto Magnetita Oeste deposit. Figure RE-10 shows the Project geological characteristics.

There are two main geomorphological features within the study area. The first one is the Coastal Mountain Range and the second one is the Pre-Andean Depression. Both are located on the coastal strip, between the Pacific Ocean and the western foothills from the Western Range of the Andes. The interaction between these areas, their extension, morphology and geology determine the physiography characteristic of the study area.

Geomorphological units like hills, mountains, and coastal plains are predominant. Hills are characterized by undulated and elongated relieves, height below 200 m. Coastal plains, to the east and west of the study area, are related to deposits from the Neogene and non-consolidated or semiconsolidated soil material, like marine terraces have flat relieves with slopes below 5°. Mountains are mainly located west of study area, conforming the foothills of the Coastal Mountain Range. They are elongated and steep, and up to 800 m high over their base.



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- RIVER
- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- METEOROLOGICAL STATION

Station	Type	UTM Coordinates Grid Zone 18S WGS84 Datum		Elevation (m)
		East	North	
Mina Justa	Local	492 444	8 322 802	834
Copara	Regional	509 139	8 343 577	600
San Juan de Marcona	Regional	485 135	8 302 918	30
Lomas	Regional	489 976	8 338 512	20

0 10 20

1:260,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

METEOROLOGICAL STATIONS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	YD
DESIGN	MC
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219 | Rev. 1 | FIGURE **RE-09**

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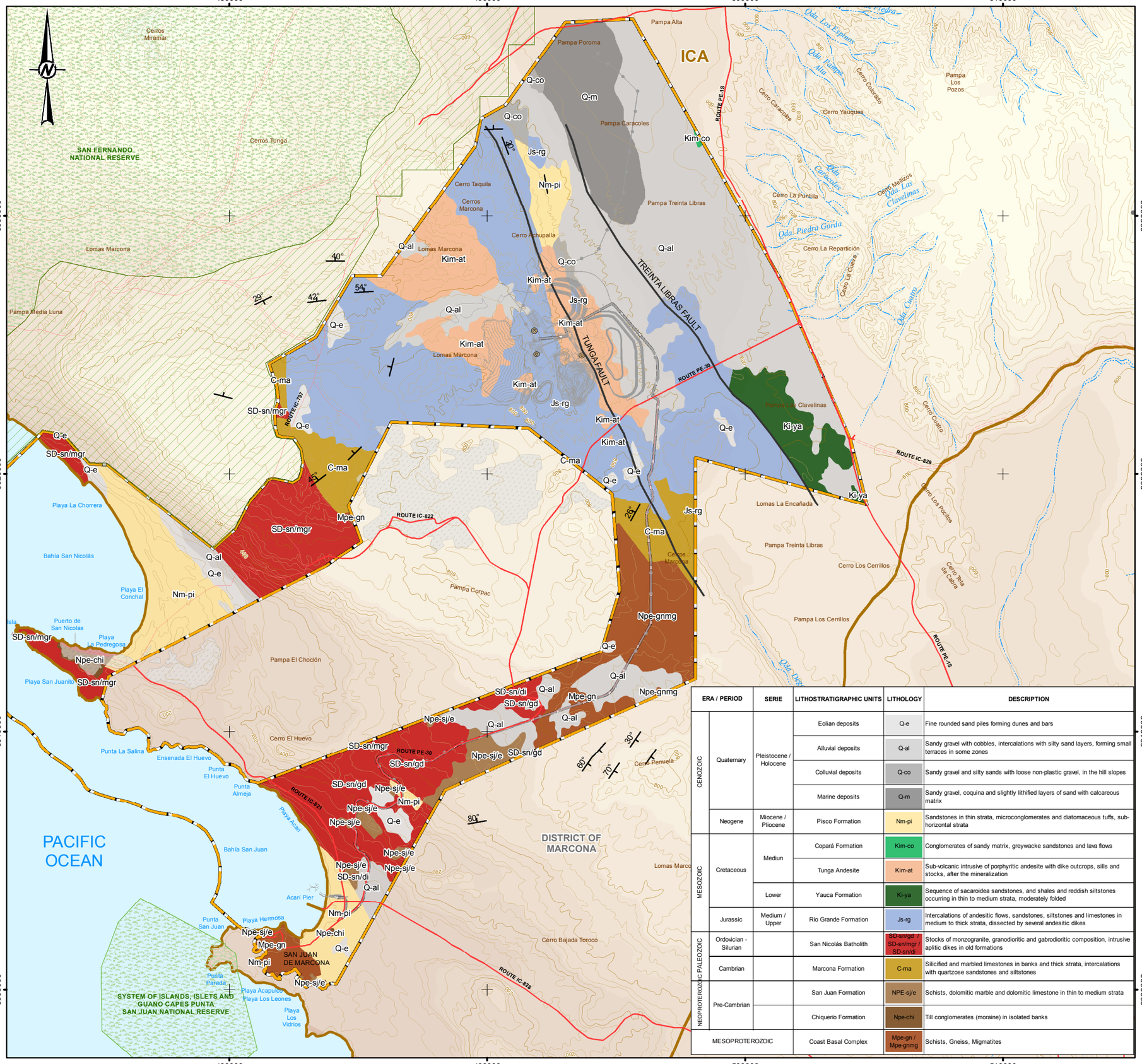

ERA / PERIOD		SERIE	LITHOSTRATIGRAPHIC UNITS	LITHOLOGY	DESCRIPTION
CENOZOIC	Quaternary	Pleistocene / Holocene	Eolian deposits	Q-e	Fine rounded sand piles forming dunes and bars
			Alluvial deposits	Q-al	Sandy gravel with cobbles, intercalations with silty sand layers, forming small terraces in some zones
			Colluvial deposits	Q-co	Sandy gravel and silty sands with loose non-plastic gravel, in the hill slopes
			Marine deposits	Q-m	Sandy gravel, coquina and slightly lithified layers of sand with calcareous matrix
	Neogene	Miocene / Pliocene	Pisco Formation	Nm-pi	Sandstones in thin strata, microconglomerates and diatomaceous tuffs, sub-horizontal strata
MESOZOIC	Cretaceous	Mediun	Copará Formation	Kim-co	Conglomerates of sandy matrix, greywacke sandstones and lava flows
			Tunga Andesite	Kim-at	Sub-volcanic intrusive of porphyritic andesite with dike outcrops, sills and stocks, after the mineralization
		Lower	Yauca Formation	Ki-ya	Sequence of sacaroidea sandstones, and shales and reddish siltstones occurring in thin to medium strata, moderately folded
	Jurassic	Medium / Upper	Río Grande Formation	Js-rg	Intercalations of andesitic flows, sandstones, siltstones and limestones in medium to thick strata, dissected by several andesitic dikes
PALEOZOIC	Ordovician - Silurian		San Nicolás Batholith	SD-sn/gd / SD-sn/mgr / SD-sn/di	Stocks of monzogranite, granodioritic and gabrodioritic composition, intrusive aplitic dikes in old formations
	Cambrian		Marcona Formation	C-ma	Silicified and marbled limestones in banks and thick strata, intercalations with quartzose sandstones and siltstones
NEOPROTEROZOIC	Pre-Cambrian		San Juan Formation	NPE-sj/e	Schists, dolomitic marble and dolomitic limestone in thin to medium strata
			Chiquerío Formation	Npe-chi	Till conglomerates (moraine) in isolated banks
MESOPROTEROZOIC			Coast Basal Complex	Mpe-gn / Mpe-gnmg	Schists, Gneiss, Migmatites

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH
- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- MINA JUSTA PROJECT COMPONENTS

SYMBOLOGY

- 45° STRATA STRIKE AND DIP
- DEFINED GEOLOGIC FAULT

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

GEOLOGICAL MAP

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	TS
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219 | Rev. 1 | FIGURE **RE-10**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

25mm

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Route: G:\Project\2015\159-4-15-2219 Marcobre-LBAS-Ica\Mapas\MXD\MEIA\MEIA_INGLES\1_RERE_10_Geologic_150k_A3.mxd Date: 29/09/2017 Author: YDialiCruz

1.3.1.3 Geochemistry

The geochemical characteristics in terms of acid rock drainage and metal leach potential of the waste rock, ripios, tailings, quarry material, and subsoils in the tailings storage facility, and ripios dump are the following:

1.3.1.4 Waste Rock

- Most samples are non-acid generating, on the contrary they have neutralization potential sufficient to neutralize any generated acid. These results confirm the geochemical characterization carried out in 2008.
- Overall, the results of the metal leach potential test through the synthetic precipitation leaching procedure reported average and maximum values below the reference criteria.

1.3.1.5 Ripios

- All the ripios samples were classified as non-potential acid generating.
- The mineralogical results indicated that ripios samples have calcite in concentrations between 3 wt% and 5 wt%. No pyrite was detected.

1.3.1.6 Tailings

Bn/Cc Tailings

- All Bornite-Chalcocite (Bn/Cc) tailings samples were classified as non-acid generating and with high neutralization potential.
- The mineralogical analysis did not report pyrite for any of the three Bn/Cc tailings samples; however, they have calcite between 3.5 to 5.1 wt%, confirming this material is non-acid generating.

Cpy Tailings

- Chalcopyrite (Cpy) tailings were classified as PAG, due to their high sulfide sulfur content. Similarly, the pH NAG test and the depletion calculations prove their PAG classification.
- The mineralogical analysis reported very high concentrations of pyrite in the cleaner scanverger tailings of up to 57 wt%; while the rougher scavenger samples recorded the lowest pyrite contents (between 1.8 wt% and 3.1 wt%). However, carbonate is present as calcite between 2.7 wt% and 5.1 wt%.

1.3.1.7 Quarries and Subsoils

- Quarries, based on their estimated values, two samples were classified as non-acid generating, one sample as uncertain, and one sample as acid generating. However, the low sulfur content as sulfide in these samples, indicate that acid generation is not expected in the long term.
- The short-term leaching results indicate that maximum and average concentrations meet the reference criteria for environmental quality standards and maximum permissible limits. Thus, these samples have limited metal-leaching potential, which indicates that there are no restrictions for using them as construction materials from the geochemical point of view.

- In regard to the tailings storage facility, the results of the sample analysis indicate that they have low to moderate neutralization potential to attenuate the acid generation and some metal leaching potential.
- Samples from the ripios dump, resulted to be non-potential acid generating.

1.3.1.8 Hydrography

The main Project components to be modified are located in the Río Grande basin, a drainage area where no surface flow has been identified (desert area).

Lack of surface water and clear runoff patterns allow confirming that it is not possible to estimate some hydro-geomorphological parameters (i.e., shape factor, current order, concentration time, among others), required by the Ministry of Energy and Mines in the Common Terms of Reference for Detailed Environmental Impact Assessment (Category III) of Mining Projects at Feasibility Level, and as a result, they are not applicable to the study.

1.3.1.9 Hydrogeology

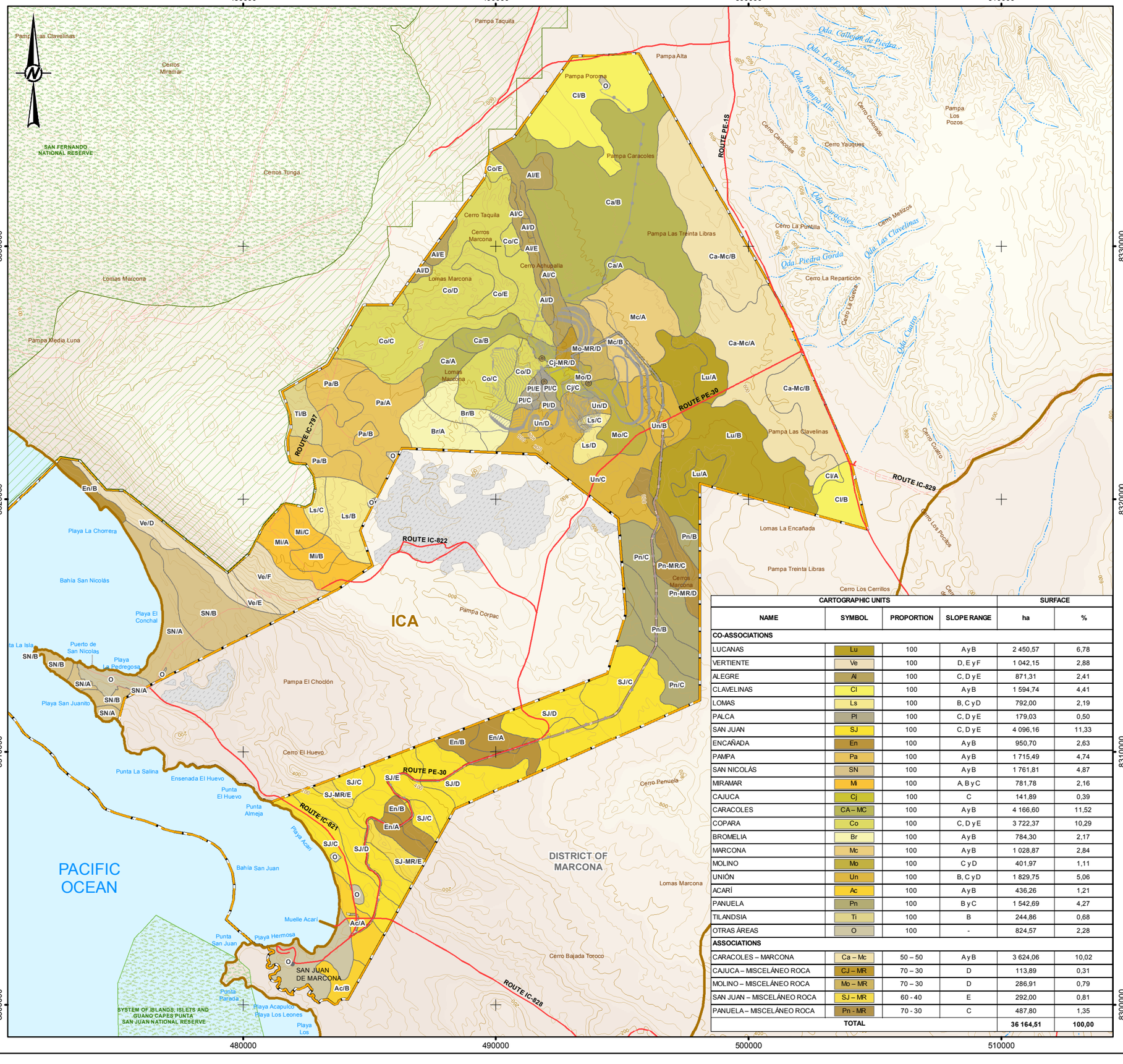
The Project area is controlled by diverse regional and local fault systems, which have controlled the local flow confining the groundwater deeply. Water levels identified are between elevations 198 masl and 233 masl, below 500 m of depth, and would correspond to compartmentalization levels or hanged levels; therefore, at a conceptual level, there would not be continuity on the piezometric surface. As a local or regional recharge source or spring has not been identified, these hydrogeological units may not have the capacity to belong to any system of underground flow. The groundwater recorded sodium sulfate chloride quality, this type of water has high salinity due to fossil waters subject to old evaporation processes.

1.3.1.10 Soil, Land Use Capability and Current Land Use

Soils are only of mineral type and come from the following two types of parent material: residual and borne; the latter presents two subtypes: alluvial and eolian. They have limited genetic development, with C horizon sequences, with subdivisions and sub-indexes. They belong to Entisols orders, poorly developed mineral soils with ochric epipedon, and Aridisols that belong to arid zone soils. In the study area, a total of three taxonomic units at a subgroup level and 11 edaphic units were identified. These units were identified in 11 consociations and three associations in a soils map.

According to the classification of the land use capability (S.D. No. 017-2009-AG), a group of land use capability, protected Land (X), was identified that due to its restrictions do not allow agricultural, livestock, or forest activities.

The following current land use categories have also been identified: Category 1: Urban areas, governmental and private facilities (~ 2% of the study area), and Category 9: Land with any use or unproductive land (~ 98% of the study area), with five soils classes. Figure RE-11 shows the soils type in the study area.



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- MINA JUSTA PROJECT COMPONENTS

CARTOGRAPHIC UNITS				SURFACE	
NAME	SYMBOL	PROPORTION	SLOPE RANGE	ha	%
CO-ASSOCIATIONS					
LUCANAS	Lu	100	A y B	2 450,57	6,78
VERTIENTE	Ve	100	D, E y F	1 042,15	2,88
ALEGRE	Al	100	C, D y E	871,31	2,41
CLAVELINAS	Cl	100	A y B	1 594,74	4,41
LOMAS	Ls	100	B, C y D	792,00	2,19
PALCA	Pl	100	C, D y E	179,03	0,50
SAN JUAN	SJ	100	C, D y E	4 096,16	11,33
ENCAÑADA	En	100	A y B	950,70	2,63
PAMPA	Pa	100	A y B	1 715,49	4,74
SAN NICOLÁS	SN	100	A y B	1 761,81	4,87
MIRAMAR	Mi	100	A, B y C	781,78	2,16
CAJUCA	Cj	100	C	141,89	0,39
CARACOLES	CA – MC	100	A y B	4 166,60	11,52
COPARA	Co	100	C, D y E	3 722,37	10,29
BROMELIA	Br	100	A y B	784,30	2,17
MARCONA	Mc	100	A y B	1 028,87	2,84
MOLINO	Mo	100	C y D	401,97	1,11
UNIÓN	Un	100	B, C y D	1 829,75	5,06
ACARÍ	Ac	100	A y B	436,26	1,21
PANUELA	Pn	100	B y C	1 542,69	4,27
TILANDSIA	Ti	100	B	244,86	0,68
OTRAS ÁREAS	O	100	-	824,57	2,28
ASSOCIATIONS					
CARACOLES – MARCONA	Ca – Mc	50 – 50	A y B	3 624,06	10,02
CAJUCA – MISCELÁNEO ROCA	CJ – MR	70 – 30	D	113,89	0,31
MOLINO – MISCELÁNEO ROCA	Mo – MR	70 – 30	D	286,91	0,79
SAN JUAN – MISCELÁNEO ROCA	SJ – MR	60 - 40	E	292,00	0,81
PANUELA – MISCELÁNEO ROCA	Pn - MR	70 - 30	C	487,80	1,35
	TOTAL			36 164,51	100,00

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

SOILS MAP

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	TS
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219 | Rev. 4 | FIGURE **RE-11**

Ruta: G:\Project\2015\159-415-2219 Marcobre\4-BAS-ka\Maps\MXD\MEIA\MEIA_INGLES\1_RE\RE_11_Suelos_150k_A3.mxd - Fecha: 29/09/2017 Autor: YDelaCruz

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1.3.1.11 Air Quality and NIR

For air quality characterization, data from 13 monitoring stations was considered (see Figure RE-12). The parameters measured were particulate matter (PM-10 and PM-2.5)[1], metals (arsenic, lead), and gases (SO_2, NO_2, CO, H_2S y O_3). Likewise, meteorological parameters recorded in each station were also considered to interpret the air quality parameter trend for air quality.

Monitoring were conducted following the technical guidelines provided in the Protocol for Air and Emission Quality Monitoring in the Mining Subsector of the Ministry of Energy and Mines (DIGESA, 2005). Results of each parameter were compared to the current National Environmental Quality Standards (EQS) for air.

Maximum concentrations of PM-10 ranged between 6.0 µg/m^3 (PMA-03 air quality monitoring station), and 359.0 µg/m^3 (PMA-04). 96.3% of the daily average concentrations of PM-10 were below the EQS for air (150.0 µg/m^3), while 3.7% exceeded the EQS for air during the months of January 2008 (PMA-04), July 2013 (PMA-07), March 2014 (PMA-04), August 2014 (PMA-02), and September 2015 (PMA-3). Exceeding values were related to strong winds that reached 16.0 m/s speeds, and to natural conditions of desert zones with no vegetation cover.

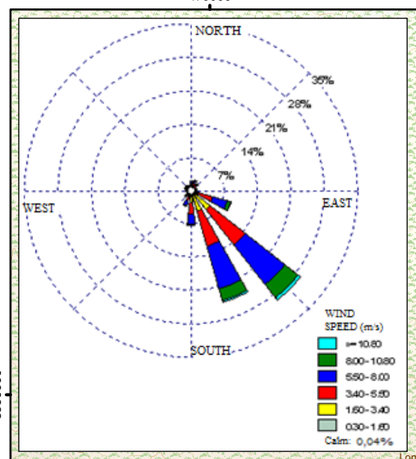
Maximum concentrations of PM-2.5 ranged between 2.0 µg/m^3 (PMA-03) and 118.4 µg/m^3 (PMA-02). 90.9% of the daily average concentrations of PM-2.5 were below the EQS for air (50.0 µg/m^3), valid until 2013, exceeding the record in 9.1%, specifically during July 2013 in PMA-05 and PMA-07 stations, at least once. According to the EQS for air (25.0 µg/m^3) in force since 2014, 63.4% of the daily concentrations of PM-2,5 were below the EQS, while 36.6% exceeded it at least once in six monitoring stations (PMA-1, PMA-3, PMA-02, PMA-04, PMA-01 and PMA-07), out of nine monitored stations where current EQS was applied. As for PM-10, exceeding values were related to strong winds that reached 16,0 m/s speeds, possibly coinciding with the occurrence of Paracas winds, most frequent between June and September (75% of the occurrence in relation to one year), and to natural conditions of the study area, a desert zone with no vegetation cover.

Metal concentrations did not record trace levels and, in some records, they were below the detection limit of the analysis method; all records were below the current EQS for air.

Overall, environmental gas concentrations were below the current EQS for air, except for SO_2 that recorded two exceeding values in March 2014, in PMA-04 and PMA-07 monitoring stations, related to higher vehicle traffic.

Non-ionizing radiation (NIR) evaluation considered electromagnetic field characterization in the ESAt. To this effect, data provided by Marcobre (2014), that considered the monitoring in three stations, in the Poroma power substation, and along the proposed 220 kV power transmission line, was used (see Figure RE-12). The parameters measured in the three monitoring stations considered as reference of the population-type exposure, ranged values below the EQS for NIR.

[1] PM-10: Particulate matter with diameter smaller than 10 microns; PM-2.5 particulate matter with diameter smaller than 2.5 microns.



470000 480000 490000 500000

8330000 8320000 8310000 8300000

Cerros Tunga
Pampa Taquila
Cerros Miramar
SAN FERNANDO NATIONAL RESERVE
Pampa Alta
Qda. Callejón de Piedra
Qda. Los Espinos
Qda. Pampa Alta
Cerro Colorado
Cerro Caracoles
Cerro Yauques
Pampa Caracoles
ROUTE PE-1S
Gold1
CEM-01
Pampa Poroma
RNI-01
RNI-02
Gold2
AIR-01
Cerro Taquila
ICA
Cerros Marcona
CEM-02
Pampa Las Treinta Libras
Qda. Caracoles
Cerro Mellizos
Cerro La Pontilla
Qda. Piedra Gorda
Cerro La Repartición
Cerro La Cuarta
PMA-04
Cerro Achupalla
Lomas Marcona
Gold3
PMA-3
Gold5
PMA-03
Gold8
Gold7
PMA-07
Qda. Cuatro
Pampa Media Luna
Gold4
PMA-1
PMA-02'
Punta San Fernando
CEM-03
ROUTE PE-30
Gold6
PMA-2
ROUTE IC-797
Pampa Las Clavelinas
PMA-02
Cerro Cuatro
PMA-08
AIR-02
ROUTE IC-829
Playa La Chorrera
ROUTE IC-822
Lomas La Encañada
Cerro Los Pocitos
Bahía San Nicolás
Cerros Marcona
Pampa Treinta Libras
Cerro Los Cerrillos
Playa El Conchal
Pampa Corpac
PMA-05
Cerro Tetas de Cabra
Punta La Isla
Puerto de San Nicolas
Playa La Pedregosa
Pampa Los Cerrillos
ROUTE PE-1S
Qda. Digoalladero
Playa San Juanito
Pampa El Choclón
Pampa Jahuay
Cerro El Huevo
ROUTE PE-30
Punta La Salina
Ensenada El Huevo
Punta El Huevo
Punta Almeja
Cerro Penuela
ROUTE IC-821
Playa Acarí
Lomas Marcona
PACIFIC OCEAN
DISTRICT OF MARCONA
AREQUIPA
DISTRICT OF LOMAS
Bahía San Juan
PMA-01
Muelle Acarí
Punta San Juan
Playa Hermosa
Hoyada Peña Colorada
Cerro Bajada Toroco
SAN JUAN DE MARCONA
ROUTE IC-828
Punta Parada
Playa Acapulco
Playa Los Leones
SYSTEM OF ISLANDS, ISLETS AND GUANO CAPES PUNTA SAN JUAN NATIONAL RESERVE

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGION AL BOUN DARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATIN G AREA
- MIN A JUSTA PROJECT COMPON EN TS

AIR QUALITY MONITORING STATIONS

- EIA EMP
- EIAsd EMP
- MARCOBRE INTERNAL MONITORING
- GOLDER

NONIONIZING RADIATIONS STATIONS

- AUSENCO 2013

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

AIR QUALITY MONITORING STATIONS AND NIR

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	MM
REVIEW	LS
APPROVED	LS

PROJECT No. 159-415-2219 | Rev. 4 | FIGURE **RE-12**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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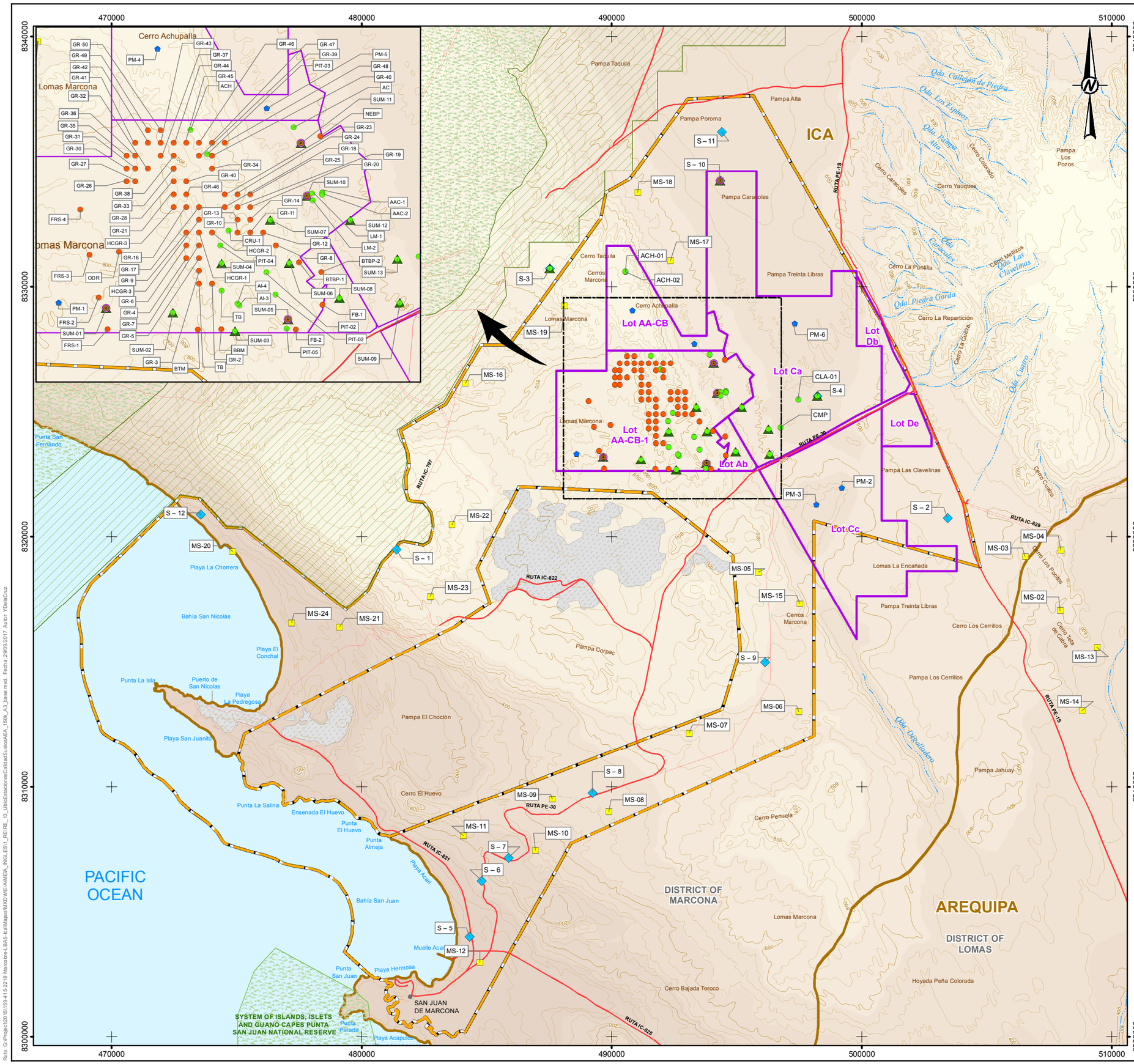
1.3.1.12 Soil Quality

The evaluation of the soil quality was undertaken based on the review and collection of the resulting data from a total of 139 test pits (see Figure RE-13). For the interpretation of the sampling results, the current Environmental Quality Standards (EQS) for soil of industrial/extractive use were taken into consideration; for background levels, results were compared with the EQS for soil of industrial/extractive use; and, for non-regulated parameters, results were compared with reference values (CCME 2015)[2]: additionally, records from stations located out of Marcobre's property were compared with soils standards for agricultural use.

According to the sampling results, organic parameters reported values below the detection limit, and below the EQS for soil of industrial/extractive use. Regarding inorganic parameters, values were also below the EQS for soil of industrial/extractive use. Arsenic values ranged 3.87 mg/kg to 22.8 mg/kg; barium values ranged 21.91 mg/kg and 131.8 mg/kg; cadmium reported values below detection limit and 1.84 mg/kg; hexavalent chromium reported undetectable values; mercury reported values below the detection limit and 0.02 mg/kg; and lead reported values below detection limit and 9.7 mg/kg.

In regard to the values for the background level, the organic parameters were analyzed in stations located within Marcobre's property and values were below the detection limit, which meant they were below the EQS for soil of industrial/extractive use, or industrial reference values for the parameters not regulated by the current EQS for soil. Inorganic parameters also recorded values below the EQS for soil of industrial/extractive use; in stations located outside Marcobre's property border, concentrations were also below the EQS for soil of agricultural use. Arsenic values reported values below the detection limit and 47.6 mg/kg; barium values ranged 8.9 mg/kg and 339 mg/kg; cadmium reported values below the detection limit, and 2.7 mg/kg; hexavalent chromium reported values below the detection limit; mercury reported values below the detection limit and 0.02 mg/kg; and lead reported values below the detection limit and 42 mg/kg. On the other side, some records for inorganic parameters not regulated by EQS, like copper, selenium, thallium, and vanadium, exceeded reference values (CCME 2015); and iron concentrations, with no reference standards, varied from 3,866.53 mg/kg to 58,300 mg/kg.

[2] Canadian Soils Quality Guidelines.



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- MARCOBRE SURFACE PROPERTY
- SHP OPERATING

SOIL QUALITY MONITORING STATIONS

- FIELDWORKS (AUSENCO, 2012-2013)
- FOURTH AMENDMENT TO EIAsd MINA JUSTA EXPLORATION PROJECT (INSIDEO, 2014)
- MINA JUSTA ENVIRONMENTAL SOILS QUALITY MONITORING REPORT (CERTIMIN, 2014)
- SOILS QUALITY CHARACTERIZATION IN THE MINA JUSTA EXPLORATION PROJECT SITE (INSIDEO, 2015)
- REPORT FOR IDENTIFICATION OF CONTAMINATED SITES - MINA JUSTA EXPLOITATION PROJECT (INSIDEO, 2015)
- EIAsd AMENDMENT (GOLDER, 2016)
- FIFTH AMENDMENT TO EIAsd MINA JUSTA EXPLORATION PROJECT (GOLDER, 2016)
- MONITORING SOILS REPORT (GOLDER 2016)

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

SAMPLING STATIONS FOR SOIL QUALITY

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-11-29
EXECUTED	YD
DESIGN	MC
REVIEW	DG
APPROVED	ML

PROJECT No. 159-415-2219 | Rev. 4 | FIGURE **RE-13**

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1.3.1.13 Marine Surface Water Quality

In Bahía San Nicolás and Bahía San Juan, 66 seawater quality monitoring stations were set, distributed in 17 monitoring stations set in the intertidal zone and 49 monitoring stations set in the subtidal zone (see Figure RE-14 and RE-15). In Bahía San Nicolás, 25 seawater quality monitoring stations were placed, and in Bahía San Juan, 41 monitoring stations. Field survey records were taken during field campaigns: winter 2013, summer 2013, and summer 2014.

Overall, seawater characteristics are similar in both bays, except for some specific concentrations reported by the seawater monitoring stations.

Hydrogen potential (pH) records had a neutral to alkaline trend in both bays, with records from 7.46 to 8.10 in Bahía San Nicolás, and 7.18 to 8.15 in Bahía San Juan. These are typical characteristics of seawater. All pH records were within the ranges of EQS Cat. 1- B1[3] and Cat. 2-C3[4].

In both bays, the electrical conductivity values (40,785 µS/cm and 52,900 µS/cm), and total dissolved solids (between 31,485 mg/L to 45,221 mg/L) were relatively constant over time; there are no EQS for these parameters. All total suspended solids concentrations were below the EQS. These are characteristic values of seawater.

Dissolved oxygen values were variable (between 2.7 mg/L and 8.4 mg/L), that might be related to turbulence conditions of sea environment or phytoplankton presence. At the water column level, the dissolved oxygen decreases at depth levels, recording the lowest values at the bottom and the highest at the surface, as shown in Graphs 3.2.5-1 and 3.2.5-2.

Chloride concentrations (17,195 mg/L and 19,940 mg/L) and sulfate concentrations (between 2,213 mg/L and 3,907 mg/L) were alike in both bays; they are typical for seawater.

Organic substance concentrations like biochemical oxygen demand, oils and grease, total petroleum hydrocarbons and detergent were below the applicable EQS. However, biochemical oxygen demand concentrations (between 160 mg/L and 1,599 mg/L) in summer 2014 exceeded the EQS Cat. 1-B1 (30 mg/L).

Cyanide concentrations (WAD cyanide and free cyanide), nutrients (nitrates, phosphates and silicates), and microbiological concentrations (total coliform and fecal coliform) recorded values below the applicable EQS.

Metal concentrations in the seawater samples from both bays were alike in all the monitoring periods, and generally below the EQS.

In Bahía San Nicolás, metal concentrations that were above the EQS are aluminum, cadmium, copper, and iron.

Most aluminum concentrations that exceeded the applicable EQS were reported by stations of the intertidal zone along Bahía San Nicolás, and the B-SNIC-20 station located in the subtidal zone 1 km northeast of San Nicolás Port.

Regarding cadmium concentrations, EQS was exceeded only in B-SNIC-16 station, located in the intertidal zone of Playa Pedregosa, close to SHP operations, and approximately 2.2 km of San Nicolás Port; this station recorded also cadmium concentrations in sediments above the PEL guideline value (Section 3.2.6.6).

The only copper value (0,061 mg) above the EQS Cat. 2-C3 (0.05 mg/L) was recorded in the B-SNIC-21 station (background sample), located in the subtidal zone, northeast of San Nicolás Port, in summer 2013. However, it should be considered that EQS are applicable to surface water.

[3] Population and Recreation – Primary Contact.
[4] Extraction and Coastal Marine and Continental Cultivation Activities - Other Activities

39% of iron concentrations (0.35 mg/L to 1.65 mg/L) were above the EQS Cat. 1-B1 (0.3 mg/L), and were recorded in most stations located in the intertidal zone, along Bahía San Nicolás, except for B-SNIC-12 station located in the subtidal zone.

In Bahía San Nicolás, concentrations that were above the EQS are aluminum, iron, and lead.

In Bahía San Nicolás also aluminum concentrations that were above EQS, were recorded by stations located in the intertidal zone along Bahía San Juan.

Regarding iron concentrations, the only value (0.49 mg/L) that slightly exceeded the EQS Cat. 1-B1 (0.3 mg/L) was reported by B-SJUA-2 station, located in the intertidal zone at Ensenada El Huevo.

Additionally, the only lead value (0.026 mg/L) that slightly exceeded the EQS Cat. 1-B1 (0.01 mg/L) was reported by B-SJUA-30 station, located in the intertidal zone, 2.3 km northeast of Acarí Pier.

In general, boron concentrations recorded in both bays varied from 1.7 mg/L to 5.0 mg/L; these values are common in seawater; however, they exceed the EQS Cat. 1-B1 (0.5 mg/L).

SEAWATER QUALITY MONITORING STATIONS

ZONE	SOURCE	STATION	UTM COORDINATES GRID ZONE 18S WGS84 DATUM	
			EAST	NORTH
Intertidal	Ausenco 2014	B-SNIC-1	473 361	8 320 714
	Ausenco 2014	B-SNIC-2	474 316	8 319 623
	Ausenco 2014	B-SNIC-4	476 309	8 316 864
	Ausenco 2014	B-SNIC-6	476 181	8 313 516
	Ausenco 2014	B-SNIC-7	475 949	8 313 227
	EIA SHOUXIN	B-SNIC-3	475 358	8 318 588
	EIA SHOUXIN	B-SNIC-5	476 767	8 315 335
	EIA SHOUXIN	B-SNIC-8	475 800	8 313 094
Subtidal	Ausenco 2014	B-SNIC-9	473 049	8 320 478
	Ausenco 2014	B-SNIC-10	472 367	8 320 013
	Ausenco 2014	B-SNIC-11	471 585	8 319 443
	Ausenco 2014	B-SNIC-12	474 022	8 319 473
	Ausenco 2014	B-SNIC-13	473 552	8 319 141
	Ausenco 2014	B-SNIC-14	472 802	8 318 583
	Ausenco 2014	B-SNIC-15	473 615	8 317 587
	Ausenco 2014	B-SNIC-17	474 370	8 316 133
	Ausenco 2014	B-SNIC-18	475 768	8 314 984
	Ausenco 2014	B-SNIC-21	474 215	8 314 195
	Ausenco 2014	B-SNIC-24	470 824	8 314 629
	EIA SHOUXIN	B-SNIC-16	475 360	8 316 473
	EIA SHOUXIN	B-SNIC-19	474 746	8 315 142
	EIA SHOUXIN	B-SNIC-20	475 028	8 313 629
	EIA SHOUXIN	B-SNIC-22	472 256	8 314 802
	EIA SHOUXIN	B-SNIC-23	471 142	8 314 469
	EIA SHOUXIN	B-SNIC-25	474 545	8 318 102

468000 472000 476000 480000

8324000 8320000 8316000 8312000

SAN FERNANDO NATIONAL RESERVE

PACIFIC OCEAN

Bahía San Nicolás

Punta La Isla

Playa La Chimenea

Playa El Conchal

Puerto de San Nicolás

Playa La Pedregosa

Playa San Juanito

B-SNIC-1 B-SNIC-9 B-SNIC-10 B-SNIC-11 B-SNIC-2 B-SNIC-12 B-SNIC-13 B-SNIC-3 B-SNIC-14 B-SNIC-25 B-SNIC-15 B-SNIC-4 B-SNIC-16 B-SNIC-17 B-SNIC-5 B-SNIC-19 B-SNIC-18 B-SNIC-22 B-SNIC-24 B-SNIC-23 B-SNIC-21 B-SNIC-20 B-SNIC-6 B-SNIC-7 B-SNIC-8

200 400

LEGEND

(200 m) MAIN CONTOUR
(50 m) SECONDARY CONTOUR

ROAD SYSTEM

PAVED
UNPAVED

REGIONAL BOUNDARY
PROTECTED NATURAL AREA
BUFFER ZONE
ENVIRONMENTAL STUDY AREA (ESA)
SHP OPERATING AREA

SEAWATER QUALITY MONITORING STATIONS

INTERTIDAL

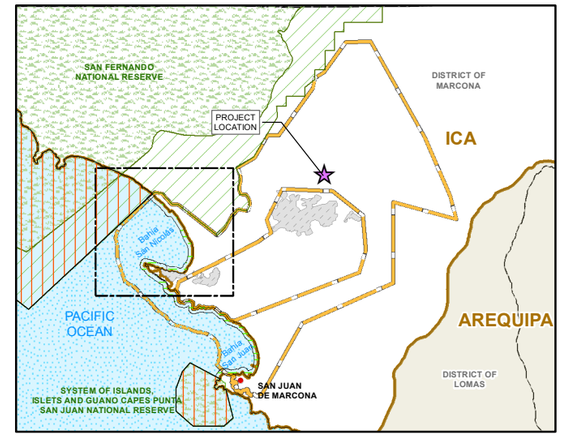
EIA SHOUXIN
AUSENCO 2014

SUBTIDAL

EIA SHOUXIN
AUSENCO 2014

CLASIFICATION OF MARINE - COASTAL WATER BODY

Cat 1-B1 POPULATION AND RECREATION - PRIMARY CONTACT.
Cat 2-C3 COASTAL AND CONTINENTAL MARINE EXTRACTION AND CULTURE - OTHER ACTIVITIES
Cat 4-E3 AQUATIC ENVIRONMENT CONSERVATION - MARINE-COASTAL ECOSYSTEM



0 2 4

1:50,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

SEAWATER QUALITY IN BAHÍA SAN NICOLÁS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	LA
REVIEW	DG
APPROVED	DG

PROJECT No. 159-415-2219 | Rev. 4 | FIGURE **RE-14**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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CODE	ZONE	UTM COORDINATES GRID ZONE 18S WGS84 DATUM		SOURCE
		EAST	NORTH	
B-SJUA-1	Intertidal	476 763	8 309 952	EIA Shouxin
B-SJUA-2	Intertidal	478 020	8 309 445	Ausenco 2013 y 2014
B-SJUA-3	Intertidal	482 247	8 307 227	EIA Shouxin
B-SJUA-4	Intertidal	483 005	8 306 269	EIA Shouxin
B-SJUA-5	Intertidal	483 644	8304645	EIA Shouxin
B-SJUA-6	Intertidal	483 754	8 303 587	Ausenco 2013 y 2014
		483 721	8 303 572	
B-SJUA-7	Intertidal	483 658	8 303 328	EIA Shouxin
B-SJUA-8	Intertidal	483 573	8 302 967	Ausenco 2013 y 2014
B-SJUA-9	Intertidal	481 701	8 302 282	Ausenco 2013 y 2014
		481 698	8 302 292	
B-SJUA-10	Subtidal	472 266	8 312 417	EIA Shouxin
B-SJUA-11	Subtidal	471 683	8 311 118	EIA Shouxin
B-SJUA-12	Subtidal	473 720	8 310 475	EIA Shouxin
B-SJUA-13	Subtidal	473 120	8 309 749	EIA Shouxin
B-SJUA-14	Subtidal	475 362	8 308 944	EIA Shouxin
B-SJUA-15	Subtidal	477 662	8 308 993	Ausenco 2013 y 2014
B-SJUA-16	Subtidal	477 392	8 308 402	EIA Shouxin
B-SJUA-17	Subtidal	477 191	8 307 875	Ausenco 2013 y 2014
B-SJUA-18	Subtidal	479 163	8 307 994	Ausenco 2013 y 2014
	Subtidal	479 163	8 307 994	EIA Shouxin
B-SJUA-19	Subtidal	478 573	8 307 053	EIA Shouxin
B-SJUA-20	Subtidal	481 030	8 307 587	Ausenco 2013 y 2014
		481 049	8 307 599	
B-SJUA-21	Subtidal	480 837	8 307 083	Ausenco 2013 y 2014
B-SJUA-22	Subtidal	481 807	8 305 871	Ausenco 2013 y 2014
B-SJUA-23	Subtidal	482 017	8 305 764	EIA Shouxin
B-SJUA-24	Subtidal	481 160	8 305 109	EIA Shouxin
B-SJUA-25	Subtidal	483 577	8 304 497	Ausenco 2013 y 2014
		483 566	8 304 541	
B-SJUA-26	Subtidal	482 277	8 304 529	Ausenco 2013 y 2014
B-SJUA-27	Subtidal	480 852	8 304 464	Ausenco 2013 y 2014
B-SJUA-28	Subtidal	483 257	8 302 565	Ausenco 2013 y 2014
B-SJUA-29	Subtidal	482 405	8 302 802	EIA Shouxin
B-SJUA-30	Subtidal	482 267	8 302 934	Ausenco 2013 y 2014
B-SJUA-31	Subtidal	481 429	8 303 097	EIA Shouxin
B-SJUA-32	Subtidal	481 127	8 303 515	Ausenco 2013 y 2014
B-SJUA-33	Subtidal	474 822	8 303 515	EIA Shouxin
B-SJUA-34	Subtidal	477 074	8 307 415	EIA Shouxin
B-SJUA-35	Subtidal	480 861	8 306 957	EIA Shouxin
B-SJUA-36	Subtidal	480 316	8 306 041	EIA Shouxin
B-SJUA-37	Subtidal	482 655	8 304 355	EIA Shouxin
B-SJUA-38	Subtidal	481 678	8 304 207	EIA Shouxin
B-SJUA-39	Intertidal	481 229	8 302 290	Ausenco 2013 y 2014
B-SJUA-40	Subtidal	470 823	8 313 249	EIA Shouxin

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

ROAD SYSTEM

- PAVED
- UNPAVED

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA

SEAWATER QUALITY MONITORING STATIONS

INTERTIDAL

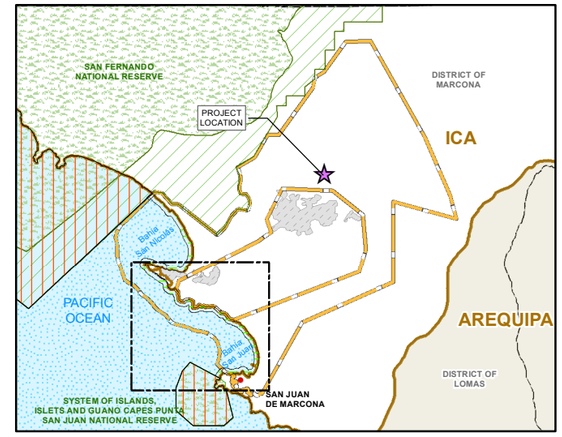
- EIA SHOUXIN
- Ausenco 2014

SUBTIDAL

- EIA SHOUXIN
- Ausenco 2014
- MEL: MINING ENVIRONMENTAL LIABILITIES

CLASIFICATION OF MARINE - COASTAL WATER BODY

- Cat 1-B1 POPULATION AND RECREATION - PRIMARY CONTACT
- Cat 2-C3 COASTAL AND CONTINENTAL MARINE EXTRACTION AND CULTURE - OTHER ACTIVITIES
- Cat 4-E3 AQUATIC ENVIRONMENT CONSERVATION - MARINE-COASTAL ECOSYSTEM



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1:50,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

SEAWATER QUALITY IN BAHÍA SAN JUAN

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	LA
REVIEW	DG
APPROVED	DG

PROJECT No. 159-415-2219

Rev. 4

FIGURE **RE-15**

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1.3.1.14 Groundwater Quality

For this assessment purposes, a monitoring campaign in piezometers MJ-01, MJ-02 and MJ-03A, placed by MWH in 2016, was performed. Samples were processed and compared to Environmental Quality Standards for water[5] Category 1 - Population and Recreation - Surface water for the production of potable water A1, regarding water that can be purified through disinfection, and Category 3 - Vegetation irrigation and livestock consumption.

Based on the results, these waters are classified as calcium sulfate-sodium chloride water, i.e., highly salty. According to their concentrations, these waters can be considered as highly mineralized and would be related to ancient marine environments subject to strong evaporation.

During the sampling, sulfate, chloride, and dissolved metals in boron, magnesium, manganese, molybdenum, and nickel concentrations were above the reference EQS.

Figure RE-16 shows the locations of the piezometers installed, considered in the evaluation.

According to the results of the hydrogeological evaluation, the existence of an aquifer in the study area is not considered, the type of water in the saturated zone is sulfated sodium chlorate water with high salinity and not suitable for human, industrial or agricultural use. The hydrogeological system does not receive direct local or regional recharge, its nature and occurrence is not influenced by recharges from local or regional precipitation or local or regional surface water flows; therefore, the groundwater quality is not influenced by the hydrological cycles (seasonal changes), and it is representative of the hydrogeological environment.

Based on the hydrogeological conditions and the fact that there is no aquifer, groundwater recharge and discharge in the Project area, the seasonal monitoring required by the MEM in the common ToR for the EIAd of Mining Projects at a feasibility level, are not applicable to the study.

1.3.1.15 Environmental Noise

The acoustic environment was characterized from the records of 10 monitoring stations (see Figure RE-17), surveyed between months of June 2006 and November 2015, as part of the various environmental management instruments; and using the information of a campaign in two additional stations carried out by Golder in September 2015. The environmental noise description was based on a network consisting of 12 monitoring stations, including the Project area, and it extends to the south up to Acarí Pier, and, to the east, up to the intersection of the Pan-American Highway with the access road to San Juan de Marcona.

The monitoring stations were categorized according to the application zones established by S.D. No. 085-2003-PCM; 10 monitoring stations were categorized as industrial zone, one as commercial zone, and one as residential zone, referentially.

In general, the day and night noise values were below the environmental quality standards for noise, according to the applicable zone for each station; except for an isolated record of 60.5 decibels in station PMR-07, located in Justo Pastor Ramirez Legua Association, that was slightly above the standard for noise in commercial zone (60 dBA) during nighttime. This exceedance might be caused by the heavy vehicle traffic at night on the Pan-American Highway. When compared to the EQS for noise in residential area (60 dBA), three out of five LAeqT records were above the EQS for residential zone, mainly due to the commercial activity and traffic of light and heavy vehicles circulating by the Pan-American highway and the detour to San Juan de Marcona.

[5] Approved by the Supreme Decree No. 015-2015-MINAM.

490000
492000
494000
496000
8328000
8326000
8324000
8322000

POWER TRANSMISSION LINE - 220 kV
WASTE WATER TREATMENT PLANT 1
CAMP
AMMONIUM NITRATE AND EXPLOSIVES STORAGE
COMMUNICATIONS TOWER 2
COMMUNICATIONS TOWER 3
RIPIOS DUMP
OXIDES PLANT
NORTH BACKFILL MATERIAL QUARRY
NORTH FINES QUARRY
TAILINGS STORAGE FACILITY BACKFILL ZONE
TAILINGS PIPELINE
POTABLE WATER PLANT
TAILINGS STORAGE FACILITY'S (AUXILIARY) DAMS
DESALINATION PLANT
DESALINATED WATER TANK
POWER SUBSTATION AND SWITCHGEAR YARD
MJ-01
LONG-TERM ORE STOCKPILE PLATFORM
SULFIDES PLANT
WASTE WATER TREATMENT PLANT 2
SHORT-TERM ORE STOCKPILE
ADMINISTRATIVE OFFICES
MJ-03B
MJ-03A
WASTE DUMP
SEM 2
WATER SURFACE
TAILINGS STORAGE FACILITY
PERIMETER ACCESS
SECURITY CHECK POINT
SEM 1
MAIN PIT
MJ-02
SOLID WASTE MANAGEMENT COMPLEX
MANTO MAGNETITA PIT
MANTO MAGNETITA DUMP
TAILINGS STORAGE FACILITY'S MAIN DAM
COMMUNICATIONS TOWER 1
GUARD CHANGE AREA
MINE EQUIPMENT PARKING
TIRES PLATFORM
FUEL SUPPLY AREA
MAINTENANCE SHOP FOR MINE EQUIPMENTS AND FACILITIES
EQUIPMENT ASSEMBLY AREA
SEAWATER SUPPLY PIPELINE
EXPLOSIVE AND ACCESORIES MAGAZINE, AMMONIUM NITRATE WAREHOUSE AND BINS
MULTIPLE USE PLATFORM
POWER TRANSMISSION LINE - 22.9 kV

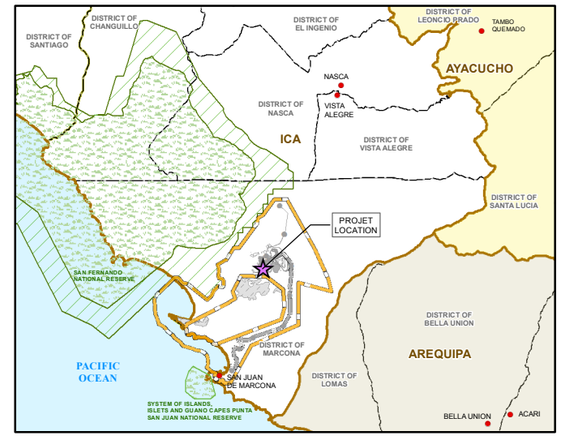
LEGEND

- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

ROAD SYSTEM

- PAVED
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- MINA JUSTA PROJECT COMPONENTS
- DRILLINGS MWH 2016

DRILLINGS	PIEZOMETERS	UTM COORDINATES GRID ZONE 18S WGS84 DATUM		ELEVATION (masl)
		EAST	NORTH	
MJ-01	MJ-01	8 325 287	491 575	825
MJ-02	MJ-02	8 323 060	489 531	775
MJ-03	MJ-03A	8 324 447	494 089	734
	MJ-03B	8 324 447	494 089	734



0 1 2
1:30,000 KILOMETERS

REFERENCE

BASE DATA: IGN 2006 /APPROVED COMPONENTS: EIA MINA JUSTA 2010 (VECTOR) AND ITS 2016 (GOLDER) /COMPONENTS OF DETAILED EIA AMENDMENT: GOLDER 2016
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

DRILLING AND INSTALLED PIEZOMETERS LOCATION MAP

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-11-15
EXECUTED	VM
DESIGN	GM
REVIEW	RH
APPROVED	DG

PROJECT No. 159-415-2219
Rev. 1
FIGURE **RE-16**

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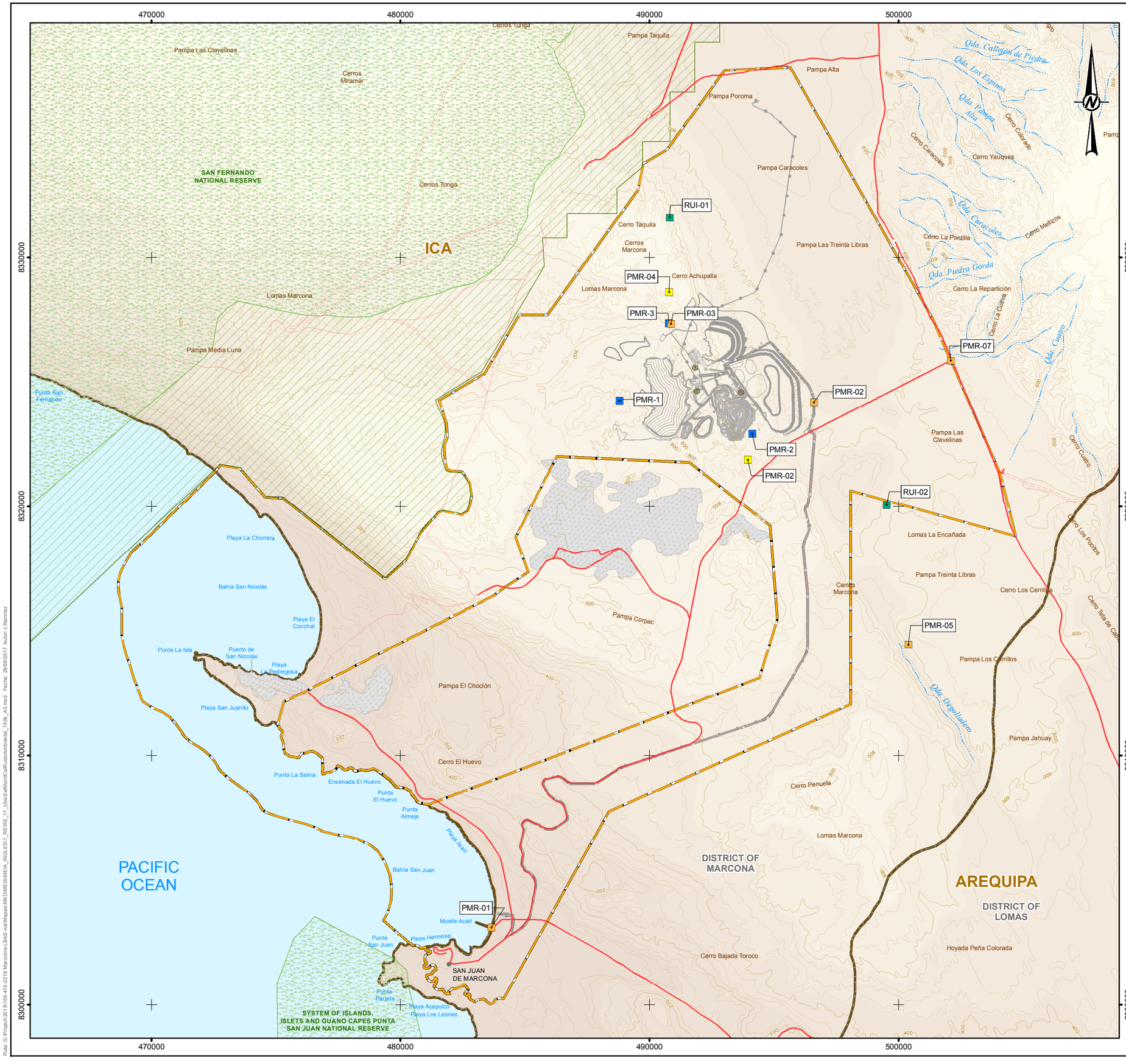

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGION AL BOUN DARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATIN G AREA
- MIN A JUSTA PROJECT COMPON EN TS

MONITORING STATIONS

- EIA EMP
- EIAsd EMP
- MISCELLANEOUS MONITORING
- GOLDER (2015)

STATION	UTM COORDINATES GRID ZONE 18S WGS84 DATUM		ELEVATION (masl)
	EAST	NORTH	
PMR-1	488 798	8 324 245	865
PMR-2	494 126	8 322 913	789
PMR-3	490 781	8 327 355	786
PMR-02	493 944	8 321 865	789
PMR-04	490 793	8 328 600	913
PMR-01	483 651	8 303 105	12
PMR-05	500 395	8 314 448	789
PMR-07	502 097	8 325 842	650
PMR-02'	496 606	8 324 172	637
PMR-03	490 862	8 327 330	860
RUI-01	490 811	8 331 598	862
RUI-02	499 525	8 320 050	611

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

ENVIRONMENTAL NOISE MONITORING STATIONS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2017-01-27
EXECUTED	LR
DESIGN	LL
REVIEW	CS
APPROVED	ML

PROJECT No. 159-415-2219

Rev. 4

FIGURE **RE-17**

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1.3.1.16 Underwater Noise

The description of the current conditions of underwater noise was based on the results of the monitoring carried out by Golder on June 17, 2016, when eight monitoring stations were set subject to the temporary aquatic area, in the proposed area for the installation of the Project multi-buoy terminal (see Figure RE-18), local marine currents trend towards the coast and prevailing wind direction, and the existing marine activities in the ESAm, like artisanal and military vessels.

Considering the noise pressure criteria for fish and marine mammals, established in various scientific researches, the eight monitoring stations recorded values below the underwater noise pressure threshold.

The underwater noise highest average values were recorded in RS-08 station, located 450 m southwest of the multi-buoy terminal, due to the sound produced by artisanal vessel engines sailing by the zone; while the lowest values were recorded in RS-07 station, characterized by slight movement of the seawater.

1.3.1.17 Environmental Liabilities

In the study area, 114 unrehabilitated workings within Marcobre's mining concessions have been identified. The classification of these unrehabilitated workings according to their type, includes the existence of 45 adits, 19 mine shafts, 18 trenches, 11 pits, 10 waste dumps, 7 platforms, 3 infrastructures, and 1 quarry.

In addition, an identified environmental liability (PAM, by its initials in Spanish) was classified as industrial waste, located in the ESAt. This PAM is included in the list approved by MINEM (M.R. No. 102-2015MEM/DM), and published on MINEM website.

The unrehabilitated workings found within Marcobre's mining concessions are located in the Rio Grande Basin, and the PAM included in the MINEM inventory is located in Jahuay Interbasin.

1.3.1.18 Vibrations

Vibrations levels were characterized after monitoring in six stations (five within the study area and one outside the study area). For the selection of the monitoring stations location, leeward and windward Project receivers, and the location of the potential vibration sources, such as vehicle traffic in the access roads, were taken into account.

Vibration levels were measured according to the criteria provided by the Vibrations Regulations ISO 2631-1, and parameters like acceleration, peak acceleration, crest factor, and speed were recorded. The time period was 20 minutes in each monitoring station.

Vibration acceleration levels in the study area meet the acceptable values of <0.315 m/s^2 (not uncomfortable) of the Peruvian Technical Standard ISO 2631-1: 2011, since there are no significant vibration sources; except for PMV-7 (El Cruce), located in Justo Pastor Ramirez Legua Association, which recorded acceleration levels above the acceptable value, during months of March to October 2014. Figure RE-19 shows the locations of the vibrations monitoring stations considered in the baseline.

474000
477000
480000
483000
8310000
8307000
8304000
8301000

Punta La Salina
Ensenada El Huevo
Punta El Huevo
Punta Almeja
Cerro El Huevo
ICA
ROUTE IC-821
Playa Acari
Bahía San Juan
PACIFIC OCEAN
Punta San Juan
Playa Hermosa
Muelle Acarí
SAN JUAN DE MARCONA
SYSTEM OF ISLANDS, ISLETS AND GUANO CAPES PUNTA SAN JUAN NATIONAL RESERVE
RS-01
RS-02
RS-03
RS-04
RS-05
RS-06
RS-07
RS-08

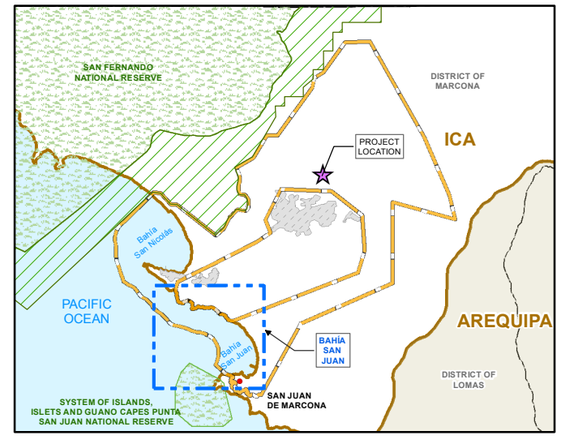
LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

ROAD SYSTEM

- PAVED
- REGION AL BOUN DARY
- PROTECTED NATURAL AREA
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING
- AREA OF INDIRECT ENVIRONMENTAL INFLUENCE
- AREA OF DIRECT ENVIRONMENTAL INFLUENCE
- UNDERWATER NOISE STATIONS

STATION	UTM COORDINATES GRID ZONE 18S WGS84 DATUM	
	EAST	NORTH
RS-01	483655	8303652
RS-02	483402	8303665
RS-03	483168	8303675
RS-04	483014	8303497
RS-05	482879	8303729
RS-06	483117	8304049
RS-07	482998	8303342
RS-08	482666	8303216



0 1.5 3

1:40,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

UNDERWATER NOISE MONITORING

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	JA
REVIEW	RB
APPROVED	DG

PROJECT No. 159-415-2219
Rev. 4
FIGURE **RE-18**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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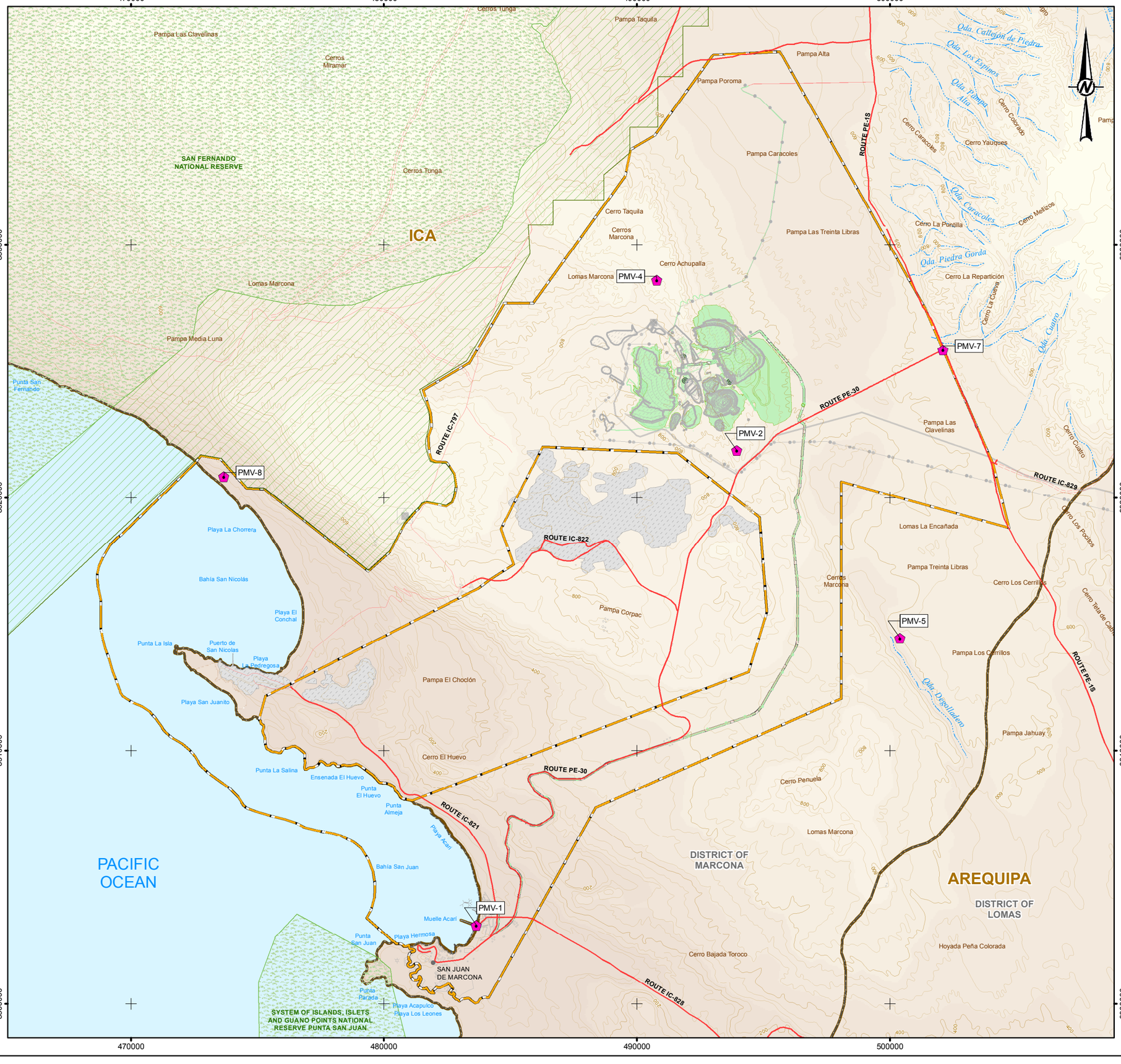

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGION AL BOUN DARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATIN G AREA
- APPROVED COMPONENTS
- PROPOSED COMPONENTS
- VIBRATION STATIONS

CODIFICATION	STATION	UTM COORDINATES GRID ZONE 18S WGS84 DATUM		ELEVATION (masl)
		EAST	NORTH	
PMV-1	Muelle Acarí	483651	8303105	12
PMV-2	Barlovento	493944	8321865	789
PMV-4	Sotavento	490793	8328600	913
PMV-5	Control	500395	8314448	789
PMV-7	El Cruce	502097	8325842	650
PMV-8	San Nicolás	473668	8320843	75

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

VIBRATION MONITORING STATIONS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-11-28
EXECUTED	VM
DESIGN	MM
REVIEW	DG
APPROVED	DG

PROJECT No. 159-415-2219 | Rev. 4 | FIGURE **RE-19**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

25mm

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1.3.1.19 Seismicity

The historical seismicity indicates that intensities of up to VII in the Modified Mercalli Intensity Scale have occurred in the study area, associated mainly to earthquakes originated by subduction processes. For the determination of seismic hazards, subduction (interphase and interplate) and continental earthquakes with their corresponding attenuation laws have been considered.

A probabilistic study of seismic threat was conducted, and peak acceleration values were recorded in Class B soils (rock), 0.32 g, 0.51 g, 0.77 g and 1.05 g, for 100, 475, 2,475, and 10,000 years of return period, respectively.

1.3.1.20 Oceanography

Temperature and salinity were measured in Bahía San Nicolás and Bahía San Juan, during November 2013 and June 2014, records indicate a homogeneous distribution of sea temperature and salinity. No mixed layer or changes in the internal temperature is observed, but a gradually slight temperature decrease from the surface to the bottom resulting from the intense process of coastal upwelling.

Tides in Bahía San Nicolás and Bahía San Juan regularly occur as two high tides and two low tides, which is a typical tidal characteristic in the Peruvian coast.

Waves in Bahía San Nicolás have a predominant north-northeast direction and northeast direction, to a lesser extent; waves in Bahía San Juan have an east direction. The predominant wave height range was greater in Bahía San Nicolás (between 0.86 m and 3.22 m) than in Bahía San Juan (between 0.4 m and 0.6 m). Likewise, the wave height and period have a direct relation, the highest wave occur in high periods.

The marine current system in Bahía San Nicolás and Bahía San Juan is mainly influenced by wind action. This flow has an average magnitude of 15 cm/s. The marine current system within the two bays occurs at depths below 40 m, and has a greater variation of the currents direction.

Bahía San Nicolás has a predominant southern direction, and Bahía San Juan has a predominant southeastern direction. The predominant wind speed ranges 1 m/s to 7 m/s, in both bays. The wind direction predicted by the numerical model for the open sea and the records from the equipment set on field are alike.

1.3.1.21 Bathymetry

In regard to bathymetry, depth in Bahía San Nicolás reaches 80 m, while in Bahía San Juan, it reaches 72 m. The seabed of both bays varies in southwestern direction and has two rocky significant formations that cause current variations.

1.3.1.22 Marine Sediments Quality

56 sediment stations were placed in Bahía San Nicolás and Bahía San Juan, dispersed in eight stations located close to the seashore (intertidal zone) and 39 stations located offshore (the subtidal zone). However, no samples were collected in five stations due to the total dominance of the substrate hardness. Field survey records were taken during field campaigns: winter 2013, summer 2013, and summer 2014.

Both bays, Bahía San Nicolás and Bahía San Juan, recorded values that exceeded the guidelines value at Probable Effect Level in Aquatic Organisms at least in one monitoring recording. These values correspond to cadmium, silver, and zinc. In Bahía San Nicolás, higher metal concentrations than in Bahía San Juan were recorded. Monitoring stations in Bahía San Nicolás are located in the subtidal zone, except for B-SNIC-6 station in the intertidal zone.

Some mercury and silver concentrations were below the detection limit. However, the recorded data show different detection limits for the different campaigns and, in some cases, these values are averagely above the values of the Canadian Soils Quality Guidelines (CCME 2002).

1.3.2 Biological Environment Description

1.3.2.1 Biological Diversity

Habitat diversity was surveyed and estimated based on types of vegetation of the terrestrial environment and the marine biota of the aquatic environment, considering the criteria of Habitat Area (ha), Habitat Fragmentation (number and size of patches of habitat types) and Habitat Isolation (distance between patches). In general, a larger number of habitat types would point out to a larger complexity in the ecosystem, while the presence of uncommon habitats could indicate habitats with special features regarding their flora and fauna diversity.

The total area of the study area was 45,854.61 ha. The habitat with no or limited vegetation cover (Coastal Desert) occupied an extension of 23,100.83 ha (50%), while habitats with vegetation cover (Desert-Tillandsial Association, Lomas, Tillandsial and Rockland Vegetation) occupied a total area of 11,816.57 ha (26%). Out of this total, the Desert-Tillandsial Association with 7,618.09 ha prevailed.

Tillandsial was the type of habitat with a higher degree of fragmentation (30 patches). However, its connectivity among patches was high, with low values for distance among patches. Tillandsial distribution in the study area is closely regulated by the influence and displacement of relative humidity, as well as by the physiography in each zone, which favors the growth of this type of habitat.

The Coastal Desert (CD) and the Desert-Tillandsial Association (DTA) have seven patches, each one with the highest averages of patch sizes (3,300.12 ha for CD and 1,088.39 ha for DTA); however, average distances among patches were the largest distances. This means both types of habitats are large and discontinuous in the ESA and, due to the scarcity of vegetation cover, probably they are transit areas for fauna.

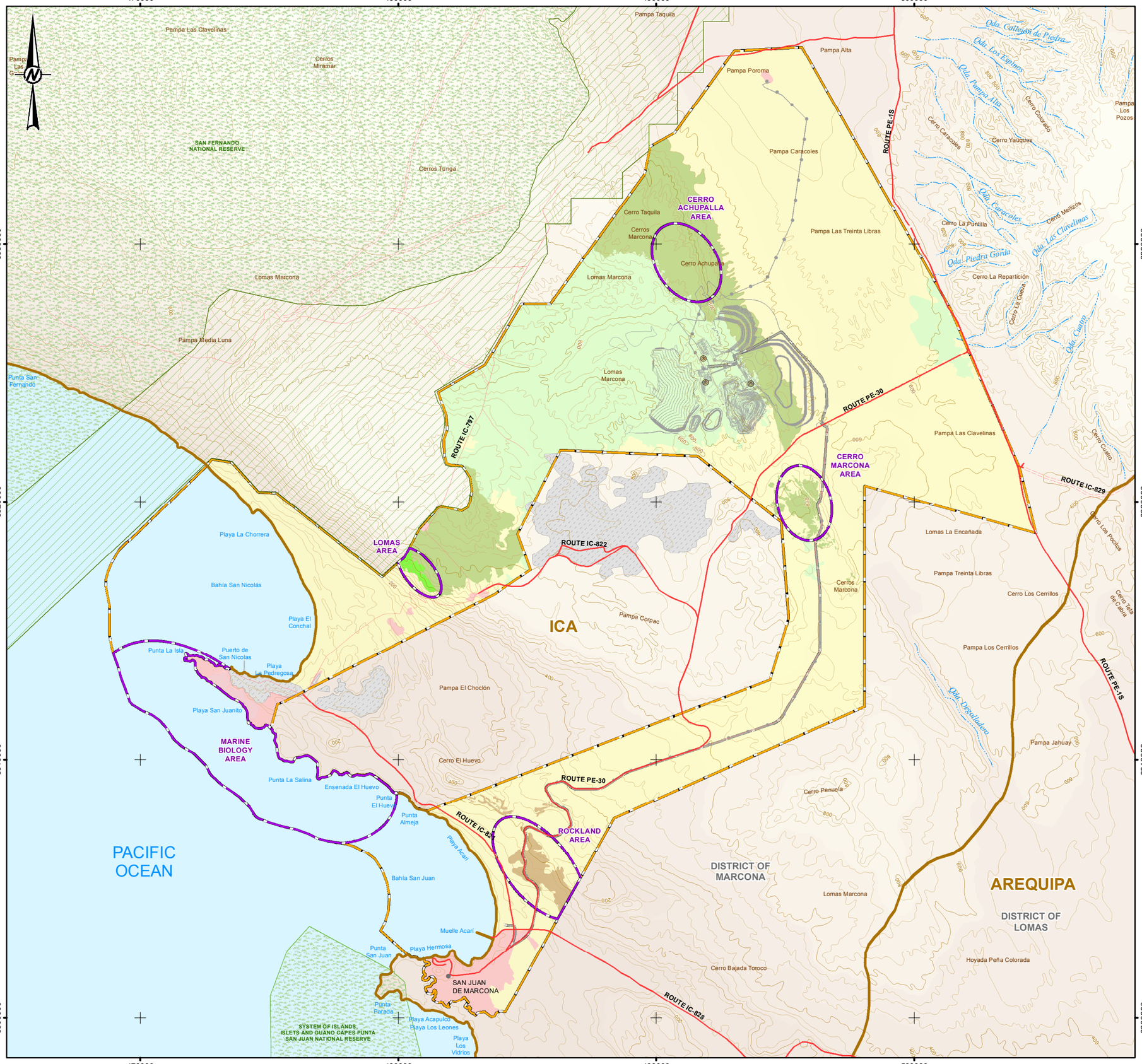
Lomas is represented by just one patch of 69.16 ha. It is located close to the sea and far from the operation facilities of Mina Justa.

The Disturbed Area comprises 3% of the study area and mainly includes the San Juan de Marcona Village and San Nicolás small inlet.

The Marine Area occupied 21% of the study area and as it is a marine ecosystem, it represented just one patch. It is a continuous habitat.

Areas of biological importance were determined mainly by their relationship with specific habitats, limited distribution along the study area, and monitoring habitats for flora and fauna. Areas of biological importance are associated with representative types of habitats recorded in the study area. For selection and delimitation, richness of species, number of endemic species, and flora and fauna species categorized according to the Peruvian legislation and UICN were considered[6]. In addition, habitat quality indicator species were recorded (Table RE-4). Figure RE-20 shows areas of biological importance for each terrestrial flora and fauna group, as well as for marine biology.

[6] International Union for the Conservation of Nature (IUCN).



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- MINA JUSTA PROJECT COMPONENTS
- AREA OF BIOLOGICAL SIGNIFICANCE IN THE ESA

VEGETATION

- DESERT-TILLANDSIAL ASSOCIATION
- COASTAL DESERT
- LOMAS
- TILLANDSIAL
- ROCKY AREA VEGETATION
- DISTURBED AREA

MEIA Marcobre Project	National Vegetative Cover Map (MINAM 2015)
Vegetatios Types	**Coverage Units**
Costal Desert (DCO)	Costal Desert
Rockland Vegetation (VRO)	
Tillandsia Desert Association (ADT)	Tillandsia
Tillandsia (TIL)	
Lomas (LOM)	Loma
Disturbed Area	Urban Area / Infrastructure

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

AREAS OF BIOLOGICAL IMPORTANCE IN THE STUDY AREA

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	AC
REVIEW	AC
APPROVED	DG

PROJECT No. 159-415-2219

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FIGURA **RE-20**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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Table RE-4: Areas of Biological Importance in the ESA

Area	Description
Terrestrial Environment	
Cerro Achupalla	This area presented mainly Tillandsial Vegetation. This area hosts most of the tillandsial vegetation cover and endemic flora species (annual herbs), as well as the largest records of guanaco.
Cerro Marcona	It comprised Tillandsial Vegetation and Rockland Vegetation patches. High cover of the Tillandsia genus species, and tracks of guanacos and foxes.
Marcona Rockland	This area presented mainly Rockland Vegetation and comprised the largest area of this type of vegetation. This area shelters Critically Endangered flora species like *Ephedra rupestris* and CITES species like *Neoporteria islayensis*.
Lomas	It comprised Lomas vegetation. Records included flora endemic species and fauna protected species.
Aquatic Environment	
Area of Biological Importance	This area presents a greater diversity and richness of marine species (birds, mammals, and fish). In addition, a greater presence of selected species of biological importance was recorded within this area, *Spheniscus humboldti* and *Sula variegata*. The endemic species, *Cinclodes taczanowskii* Surf Cinclodes, and the protected species, *Lontra felina* Marine Otter, were also recorded.

1.3.2.2 Flora and Vegetation

In the Terrestrial Environmental Study Area (ESAt), 37 sampling stations were set, which recorded 46 species, distributed in 18 families (See Figure RE-21). Out of this total, four taxa that were not confirmed at the species level were recorded: one at the genus level and three with unconfirmed species (to confront or related). According to the growth form, 39 species are herbaceous, five of them are cactoid herbs, one subshrub and one shrub.

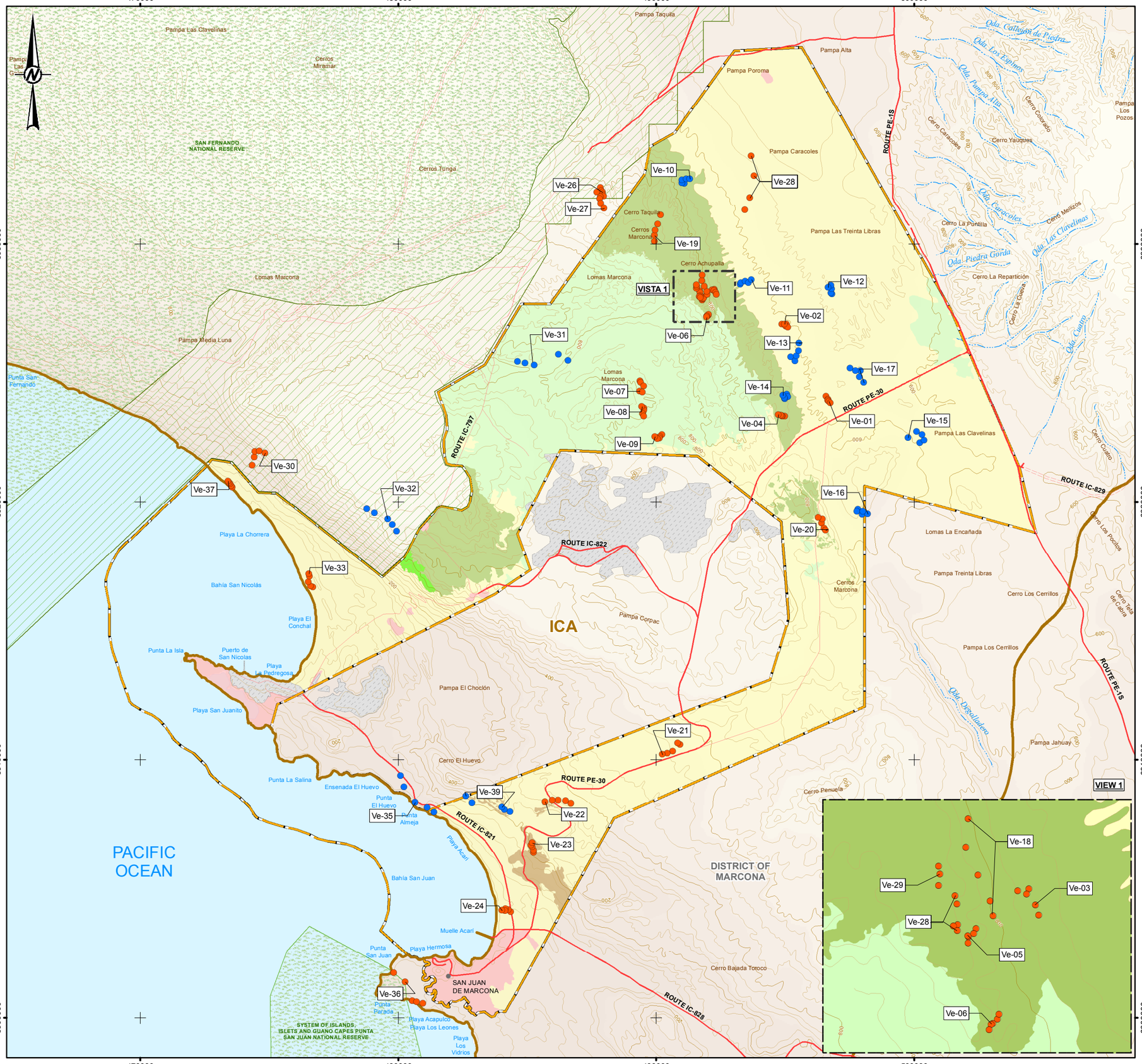
Five types of vegetation were described in the Study Area: Coastal Desert, Rockland Vegetation, Desert-Tillandsial Association, Tillandsial, and Lomas, which were determined based on the field observations, species composition, and similarity analysis. The highest number of species was recorded in Rockland Vegetation (27 species), followed by Tillandsial (25 species), Lomas (8 species), Desert-Tillandsial Association and Coastal Desert with three recorded species each.

Coverage per specie was estimated evaluating circular plots, which were set throughout all types of vegetation. The largest coverage was recorded in the Tillandsial vegetation with 16.8% in winter and 12.4% in summer, the dominant species were *Tillandsia latifolia* var. *divaricata* and *Tillandsia purpurea*; followed by the Rockland Vegetation with 0.1% in winter and 5.2% in summer, being the dominant specie *Tillandsia latifolia* var. *divaricata.* The vegetation cover for the remaining types of vegetation was below 5%.

According to the plot data, the highest diversity index was recorded in the Rockland Vegetation, Tillandsial, and Lomas; these records are influenced by the number of recorded species and distribution homogeneity in the density values. Diversity in Coastal Desert and Desert-Tillandsial Association was lower due to the poor richness of species recorded.

20 species of conservation interest were taken into consideration; out of which four species belong to one of the categories provided by S.D. No. 043-2006-AG of the Peruvian Legislation (*Tiquilia dichotoma*, *Ephedra rupestris*, *Weberbauerella raimondiana*, *Krameria lappacea*), six species are listed in the Appendices of CITES (2015), which regulates wildlife trafficking, and 16 species are categorized as endemic species in Peru. The Rockland Vegetation with 13 species and the Tillandsial vegetation with 9 species, showed the highest number of conservation species.

In regard to species with socioeconomic value, there was no evidence related to the use of plants by inhabitants close to the ESAt.



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA

FLORA MONITORING STATIONS

SEASON

- WINTER
- SUMMER

VEGETATION

- DESERT-TILLANDSIAL ASSOCIATION
- COASTAL DESERT
- LOMAS
- TILLANDSIAL
- ROCKY AREA VEGETATION
- DISTURBED AREA

MEIA Marcobre Project	National Vegetative Cover Map (MINAM 2015)
Vegetatios Types	**Coverage Units**
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Rockland Vegetation (VRO)	
Tillandsia Desert Association (ADT)	Tillandsia
Tillandsia (TIL)	
Lomas (LOM)	Loma
Disturbed Area	Urban Area / Infrastructure

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

FLORA AND VEGETATION SAMPLING STATIONS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	AC
REVIEW	AC
APPROVED	DG

PROJECT No. 159-415-2219 | Rev. 4 | FIGURE **RE-21**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

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1.3.2.3 Terrestrial Fauna

The terrestrial fauna was surveyed in the ESAt during winter and summer. For mammals, 92 stations were set (38 for small terrestrial mammals, five for small flying mammals, and 49 for large mammals), 36 stations with 555 count points for birds, 41 stations with 157 sighting points for amphibians and reptiles, and 10 stations for insects.

In the mammals group, five species were recorded, out of which two were small terrestrial mammals, and three were large mammals. No small flying mammals were recorded. The types of vegetation with the highest records were Tillandsial with four records, followed by Coastal Desert, and Rockland Vegetation with three records. In regard to abundance, 20 individuals were recorded for small terrestrial mammals (five in the Tillandsial vegetation and 15 in the Rockland Vegetation), and for large mammals were recorded in all types of vegetation. They were abundant in the Tillandsial vegetation with 31 records.

For the bird group, 14 species were recorded. By type of vegetation, the Tillandsial and Lomas recorded the highest number of species (seven and six species, respectively), followed by Coastal Desert and Desert-Tillandsial Association, with four species each, and the Rockland Vegetation with three species. Regarding the survey season (winter and summer), 10 species were recorded in each season. However, only six species were recorded in both seasons. Lomas vegetation showed the highest abundance of birds with 117 individuals, followed by Tillandsial vegetation with 38 individuals, Desert-Tillandsial Association with 28 individuals, Coastal Desert with 21 individuals, and Rockland Vegetation with 19 individuals. In regard to diversity, all types of vegetation recorded similar values for the Shannon-Wiener's Index and Pielou's evenness index.

For the reptiles group, eight species were recorded and only one for the amphibians in the ESAt. Of the total reptiles, six species were recorded in the Coastal Desert, four species in the Rockland Vegetation and Tillandsial vegetation, two species in Lomas, and one in the Desert-Tillandsial Association. In regard to the abundance, 28 individuals were recorded in the Coastal Desert vegetation, 16 individuals in the Rockland Vegetation, and 14 individuals in the Tillandsial vegetation, three species were recorded in Lomas, and one individual in the Desert-Tillandsial Association. About the diversity indexes, the highest values were recorded in the Rockland Vegetation, this was similar in the remaining types of vegetation, except for the Desert-Tillandsial Association where it was zero since only one species was recorded.

For the insect group, 41 species were recorded. Regarding the analysis per vegetation type, Tillandsial was the most diverse with 21 species, followed by Lomas with 12 species and Coastal Desert with 11 species. Rockland Vegetation recorded five species of coleoptera and hymenoptera, and Desert-Tillandsial Association recorded five species with absence of Coleoptera. Lomas was the vegetation type with the highest abundance (537 individuals). However, it had the lowest diversity because of the predominance of Cerambicinae families. Coastal Desert reported the highest diversity, since the records per species were more homogeneous; the Tillandsial, Rockland Vegetation, and Desert-Tillandsial Association reported similar diversity indexes, showing more homogeneity in the distribution of individuals per species.

Of the total species recorded, 16 are of conservation interest: three mammals, eight birds, and five reptiles. Out of them, six are endemic species: two bird species and four reptile species. According to S.D. No. 004-2014-MINAGRI, five species are listed in the threatened category, two mammals, one bird, and two reptiles. Finally, seven species are recorded in CITES and four in CMS. The species that have the highest conservation categories are Guanaco, *Lama guanicoe* in Critically Endangered category (D.S. No. 004-2014-MINAGRI); Peruvian booby, *Sula variegata*, and desert lancehead, *Bothrops* cf. *pictus* (species pending to confirm), in Endangered category (D.S. No. 004-2014-MINAGRI

In regard to species with socioeconomic value, there was no evidence related to the use of species by inhabitants near the ESAt.

1.3.2.4 Marine Flora and Fauna

The biological characterization of marine flora and fauna was carried out in Bahía San Nicolás and Bahía San Juan, which are located within the marine environmental study Area (ESAm). The marine biological communities surveyed for the characterization were phytoplankton, zooplankton, macroalgae, fish, seabirds, and marine mammals.

1.3.2.4.1 Bahía San Nicolás

A total of 74 taxa were identified for the phytoplankton, among which the diatoms were the most diverse group, their representative species were *Thalassiosira mendiolana* and *Thalassionema nitzschioides*. Other recorded groups were dinoflagellates, silicoflagellata, and microflagellates. Diatoms prevailed during winter and microflagellates during summer.

In regard to zooplankton, 54 taxa were identified, among which arthropods prevailed due to their abundance with their representative species *Acartia tonsa* and *Paracalanus parvus*. As part of zooplankton, ichthyoplankton was recorded, which was composed of fish and invertebrate eggs and larvae. The highest records of ichthyoplankton corresponded to species of *Engraulis ringens* “anchovy” and *Odonthestes regia* “Peruvian silverside”.

The macrobenthos was characterized in the intertidal zones (sandy and rocky) and subtidal zones of the study area. In the sandy intertidal zone, 17 taxa were reported, “sand crab” *Emerita analoga*, was the most abundant species. The highest diversity and richness of macrobenthos were recorded during summer. In the rocky intertidal zone, 45 taxa were recorded, species like *Echinolittorina peruviana* and *Perumytilus purpuratus* prevailed. The macrobenthos diversity in this zone was higher during summer.

Macrobenthos in the subtidal zone was characterized by 93 taxa, of which *Magelona phyllisae* and *Paraprionospio pinnata* were the most abundant species. Richness and diversity were similar among the sampling campaigns.

Three areas of algae prairies, identified in the ESA, were characterized to evaluate economically important species of macroalgae. The *Lessonia trabeculata* species was recorded in all the surveyed areas, while the species *Macrocystis integrifolia* was reported only in two surveyed areas.

As a result of the underwater census in the sampling zones, 11 fish species were identified. The most representative species in both sampling campaigns were “Pacific chromis” *Chromis crusma*. The density of species recorded higher in winter than in summer. No species under conservation category was recorded.

The analysis of metal concentrations in plant tissues carried out in the *Macrocystis integrifolia* algae indicated that cadmium and lead concentrations exceeded the European Union standards for marine algae of human consumption. The analysis of metal concentrations in animal tissues indicated that copper concentrations in samples of *Fissurella cumingi* and *Concholepas concholepas*, exceeded the FAO standards. The analysis in fish tissues indicated that no metal concentration recorded exceeded the international guidelines.

The characterization of the seabird community was carried out in winter 2013, summer 2014, and summer 2016. During the seabird characterization, 28 seabirds species were recorded in the beach zone and offshore. The predominant species during the surveys were Sandpiper *Calidris sp* and gray gull *Leucophaeus modestus*. Likewise, 10 species recorded in Bahía San Nicolás are listed under some conservation category. The species that presented the highest categories of conservation were Peruvian booby *Sula variegata*, Red-legged Cormorant *Phalacrocorax gaimardi* and Peruvian pelican *Pelecanus thagus*; all considered Endangered (EN) species. Similarly, the Guanay cormorant *Phalacrocorax bougainvillii*, and the Inca tern *Larosterna inca* are considered as Vulnerable species (VU) according to the Peruvian legislation.

The marine mammals community was surveyed during winter 2013, summer 2014, and summer 2016 in Bahía San Nicolás. In total, three species of marine mammals were recorded; the sea lion, *Otaria byronia*, prevailed in terms of frequency and abundance. The three species reported are listed in some conservation category: the marine otter *Lontra felina* as Endangered (EN), the sea lion *Otaria byronia* as Vulnerable (VU), and the bottlenose dolphin *Tursiops truncatus* as Less Concern.

1.3.2.4.2 Bahía San Juan

A total of 115 taxa were identified for the phytoplankton, among which the diatoms were the most diverse group, their representative species were *Thalassiosira mendiolana* and *Thalassionema nitzschioides*. Other recorded groups were dinoflagellates, microflagellates, and silicoflagellata. The phytoplankton diversity was higher in summer than in winter.

In regard to zooplankton, 70 taxa were identified, among which arthropods prevailed due to their abundance with their representative species *Acartia tonsa* and *Paracalanus parvus*. As part of zooplankton, ichthyoplankton was recorded, which was composed of fish and invertebrate eggs and larvae. Among the recorded species, eggs of species like *Engraulis ringens* "anchovy" and *Odonthestes regia regia* "Peruvian silverside" were found.

The macrobenthos was characterized in the intertidal zones (sandy and rocky) and subtidal zones of the study area. In the sandy intertidal zone, 18 taxa were reported, *Emerita analoga* and *Excirolana braziliensis* were the most abundant species. The highest density, richness, and diversity of macrobenthos were recorded during winter. In the rocky intertidal zone, 50 taxa were recorded, species like *Chthamalus cirratus, Perumytilus purpuratus*, and *Echinolittorina peruviana* prevailed. The macrobenthos diversity in this zone was higher in winter than summer.

Macrobenthos in the subtidal zone was characterized by 94 taxa, of which *Spiophanes sp*. and *Prionospio peruana* were the most abundant species. Richness and diversity were similar among the sampling campaigns.

Characterization of seven algae prairie areas identified in Bahía San Juan was carried out. *Lessonia trabeculata* and *Macrocystis integrifolia* species were identified as economically important and were recorded in four surveyed areas.

As a result of the underwater census in the sampling zones, 13 fish species were identified. The most representative species in both campaigns was the "Peruvian chromis" Chromis *crusma*. Species richness was alike in winter and summer.

Among the species of artisanal fishing in 2013, *Galeorhinus galeus* "school shark", listed by IUCN as Vulnerable (VU), was recorded. However, due to the lack of information about this species in Peru and Chile (Eastern Pacific), deeper researches are recommended (Walker et al. 2016).

The analysis of metal concentrations in plant tissues carried out in *Macrocystis integrifolia* indicated that most cadmium and lead concentrations in the samples exceeded the European Union standards for marine algae of human consumption. The analysis of metal concentrations in animal tissues indicated that copper concentrations in samples of *Fissurella cumingi* and *Concholepas concholepas*, exceeded the FAO standards[7]. Standards for cadmium concentrations were also exceeded in the *Loxechinus albus* sample. Likewise, the analysis of fish tissues in two tissue samples of "Peruvian morwong" indicated that cadmium concentrations exceeded the international guidelines.

The characterization of the seabird community was carried out in winter 2013, summer 2014, and summer 2016. During the seabird characterization, 28 seabirds species were recorded in the beach zone and offshore. The prevailing species during the survey were Peruvian booby *Sula variegata*, Guanay cormorant *Phalacrocorax bougainvillii*, and Franklin's gull *Leucophaeus pipixcan*. Likewise, 12 species recorded in Bahía San Juan are listed under some conservation category. The species with the highest categories of

[7] Food and Agricultural Organizations of the United Nations (FAO).

conservation were: Humboldt penguin, *Spheniscus humboldti*, Peruvian booby, *Sula variegata,* Red-legged cormorant, *Phalacrocorax gaimardi*, and Peruvian pelican, *Pelecanus thagus*; categorized as Endangered (EN) species. Likewise, the Peruvian diving petrel, *Pelecanoides garnotii*, the Cormorant Guanay, *Phalacrocorax bougainvillii*, and the Inca tern, *Larosterna inca,* are considered as Vulnerable (VU) Species by Peruvian legislation.

The marine mammals community was surveyed during winter 2013, summer 2014, and summer 2016 in Bahía San Nicolás. In total, three species of marine mammals were recorded in Bahía San Juan; the South American fur seal, *Arctocephalus australis*, prevailed in terms of frequency and abundance. The three species reported are listed under a conservation category: The South American fur seal *Arctocephalus australis,* and the Marine otter, *Lontra felina,* as Endangered (EN), and the South American sea lion, *Otaria byronia,* as Vulnerable (VU).

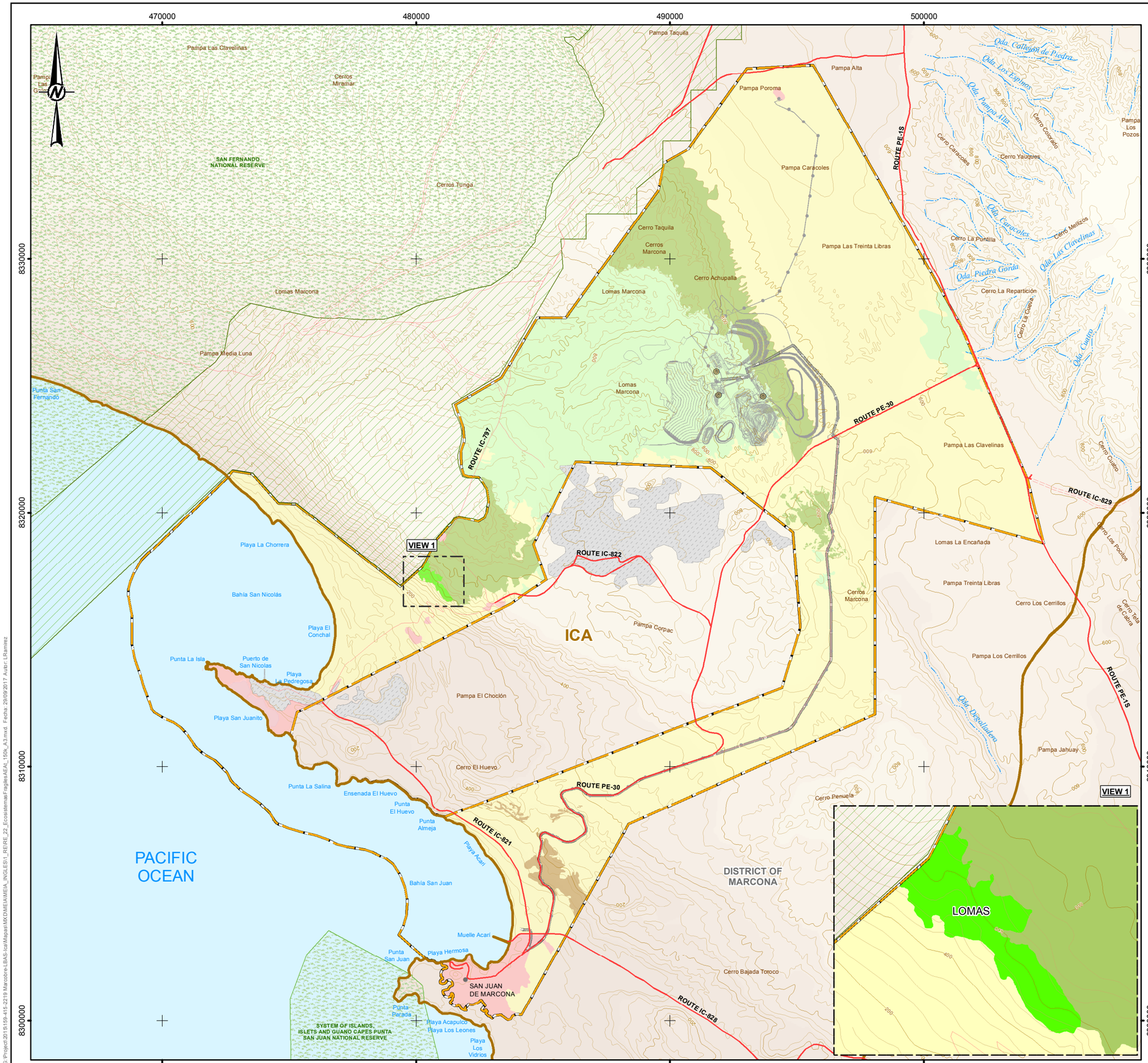
1.3.2.5 Fragile Ecosystems

For the characterization of lomas, the information available for the study area was reviewed. This review included a review of the flora and vegetation baseline. For the vegetation analysis, qualitative data from the transects established in the lomas and recorded during the baseline was considered, thus identifying the existing species.

In the ESAt, Lomas covered 0.15% (69.16 ha) and does not overlap the Project footprint. This type of vegetation was recorded near the sea and was characterized by the presence of different types of species of annual plants, which usually bloom in spring.

Five sampling plots of 250 m^2 were surveyed in the lomas, in a total surveyed area of 1,250 m^2. The methodology used was the circular plot method, which was described in Section 3.3.2. Lomas vegetation was recorded in a small area near the sea and is characterized by the presence of different types of species of annual plants, which usually bloom in spring. Their seeds are a bank for the next winter season, waiting for the required humidity conditions for germination.

A total of eight species, seven genera and seven families were recorded. Of the total number of species, four were annual herbs influenced by winter humidity; three were perennial herbs that can tolerate the least humid period with strategies such as succulence (*Haageocereus decumben*) and leaf loss (*Tiquila dichotoma* and *Weberbauerella raimondiana*), and one perennial subshrub (*Atriplex rotundifolia*).



LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

HYDROGRAPHIC SYSTEM

- DRY CREEK

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

- REGIONAL BOUNDARY
- PROTECTED NATURAL AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATING AREA
- MINA JUSTA PROJECT COMPONENTS

VEGETATION

- DESERT-TILLANDSIAL ASSOCIATION
- COASTAL DESERT
- LOMAS
- TILLANDSIAL
- ROCKY AREA VEGETATION
- DISTURBED AREA

MEIA Marcobre Project	National Vegetative Cover Map (MINAM 2015)
Vegetatios Types	**Coverage Units**
Costal Desert (DCO)	Costal Desert
Rockland Vegetation (VRO)	
Tillandsia Desert Association (ADT)	Tillandsia
Tillandsia (TIL)	
Lomas (LOM)	Loma
Disturbed Area	Urban Area / Infrastructure

Habitat Type	Habitat Area	
	Area (ha)	Proportion Area (%)
Coast Desert	23 100,83	50,38
Tillandsia Desert Association	7 618,09	16,61
Lomas	69,16	0,15
Tillandsia	3 802,12	8,29
Rockland Vegetation	327,2	0,71
Disturbed Area	1 247,12	2,72
Marine Area	9 690,09	21,14

0 5 10

1:150,000 KILOMETERS

REFERENCE

TOPOGRAPHY BASE: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGES: INEI, 2007
HYDROGRAPHY: IGN, 1998 / AUSENCO, 2014
ROAD SYSTEM: MTC, 2012 / AUSENCO, 2014
PROJECTION: WGS 1984 UTM ZONE 18S

CLIENT

MARCOBRE S.A.C.

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

LOCATION OF FRAGILE ECOSYSTEMS

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2016-12-01
EXECUTED	VM
DESIGN	AC
REVIEW	AC
APPROVED	DG

PROJECT No. 159-415-2219

Rev. 4

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1.3.2.6 Landscape Units

The landscape units were classified based on the integration of biophysical factors, like land forms and vegetation cover, and cultural factors, including production areas (SHP[8]) and various constructions. In total, 15 landscape units were identified, grouped into coastal plains (4), depressions (2), hills and knolls (4), and mountains (5).

The visual quality was assessed considering the valuation of the geomorphology, water, color, scenic background, and human activities. The results of this assessment indicate that 98.85% of the study area has poor visual quality, while 1.15% of the remaining area has medium visual quality. The main components to be modified in the Project will be placed in zones of poor visual quality.

In addition, an assessment of the landscape visual absorption capability and fragility was also carried out. To define the landscape visual absorption capability, slopes, ground stability, vegetation regeneration potential, vegetation diversity, and contrast between soil and rock were considered. According to the results, the study area is mostly represented (84,99%) by a medium low visual absorption capability and medium high fragility, since it is mainly covered by desert, a prevailing characteristic in the study area, lack of vegetation, and low contrast and vegetation regeneration potential. Most of the zone where the Mina Justa components will be placed in has these characteristics. The remaining study area, 15.01%, has medium to high visual absorption capability and medium to low fragility, due to the existing vegetation that accounts for the moderate contrast and stability of the soil.

1.3.2.7 Aspects or Factors Threatening the Conservation of Habitats or Ecosystems Identified

Data of a meteorological station (Copara) near the Project area, which belongs to the SENAMHI's station network, was analyzed. Wind speed and air temperature trends were compared with global scenarios of climate change proposed by IPCC[9] (2007) and the analyses of regional scenarios regarding temperature, carried out by SENAMHI[10] (2009) for year 2030.

The dispersion analysis shows some modeling uncertainty for the area where Mina Justa is located regarding the variation of the air temperature. As for the wind speed, most models predict higher speeds for the area where Mina Justa will be located.

Projections for air temperature, according to global scenarios of IPCC (2007), expect increments of up to 1.8 ºC for year 2050. For the southern coast, SENAMHI (2009) predicts increments between 0.4 ºC and 1.2 ºC. For wind speed, models predict intensification of winds most of the year, except for summer months.

Considering the ecological amplitude by life zones of flora species (*Tillandsia latifolia, Tillandsia landbeckii,* and *Corryocactus brachypetalus*), the temperature variation is highly unlikely to cause changes in the distribution of representative species in the types of vegetation identified.

The population growth and urban area expansion factors may have low probability to cause changes in the Coastal Desert, characterized as a habitat with scarce vegetation.

8 Shougang Hierro Perú.
9 Intergovernmental Panel on Climate Change (IPCC).
10 Servicio Nacional de Meteorología e Hidrología (National Meteorology and Hydrology Service).

In relation to economic activities (fishing and algae harvesting), the increase of these activities may cause changes in the marine environment if not developed in a sustainable manner. The tourism activity is also occasional and under the supervision of the National Service of Protected Natural Areas. It is estimated that these economic activities will not generate changes in the ecosystems identified.

1.3.2.8 Protected Natural Areas

The Protected Natural Areas (PNA) nearest to the Project site, are Reserva Nacional San Fernando (San Fernando National Reserve) (RNSF), located 11 km from the Project site; the second nearest area is Reserva Nacional Sistema de Islas, Islotes y Puntas Guaneras (Punta San Juan) (System of Islands, Islets and Guano Capes National Reserve), located 25 km from the Project site; and the third one is System of Islands, Islets and Guano Capes National Reserve (Punta Lomas), 49 km from the Project site.

1.3.3 Description of Population's Social, Economic, Cultural and Anthropological Environment

The socioeconomic baseline includes the description of the social, economic, cultural, and anthropological environment of the Area of Social Influence (ASI) of Mina Justa Project. The results of this survey will help identify and assess potential socioeconomic impacts in the ASI, as well as prepare the Social Management Plan and the Valuation of Environmental Impacts with significant potential to affect the population's well-being.

The methodology used to prepare this socioeconomic baseline enables the characterization of social, economic, political and cultural aspects of the ASI. The methodology defined for each area of influence (direct or indirect) varies according to the required depth level, as follows:

- For the Area of Direct Social Influence, qualitative information (semi-structured interviews, focus groups, health and education fact sheets, reconnaissance visits, and non-participant observation) collected in the field through relevant instruments (in two campaigns January 25 to 29 and May 5 to 7, 2016), as well as quantitative information, were systematized and analyzed by means of the analysis of the surveys conducted during fieldwork carried out by Ausenco[11]. Local information was also requested through letters addressed to different public institutions and local organizations.
- For the Area of Indirect Social Influence, available secondary information from public and private institutions, as well as information provided by Marcobre, was collected, reviewed and systematized. In addition, interviews to officials in charge of the Provincial Municipality of Nasca and the District Municipality of Vista Alegre were carried out.

[11] Ausenco applied a socioeconomic characterization and perceptions survey in November 2012 to a sample of 385 statistically representative households in the district of Marcona, with a confidence level of 95% and a margin of error of ±5%. The sample was obtained from all the private households located in the urban area of the district of Marcona, based on the information of the National Census of Population and Housing 2007. To select the sampling units, a probabilistic selection process in two-level basis was followed: (i) Primary sampling unit: Identified blocks within San Juan de Marcona Village, and (ii) Secondary sampling unit: Private houses located in the selected blocks within the primary sampling unit.
The survey analysis unit were the households at San Juan de Marcona Village, where the head of household had lived for more than 5 years in this city. According to the study, a household is defined as the group of people that have some kinship and share the preparation of food. The survey consists of 53 questions including sociodemographic variables, household characteristics, education, health, employment, income, and economic activities and perceptions.

The results of the socioeconomic baseline study are summarized below.

1.3.3.1 Area of Social Influence

The area of social influence defined for this EIAd Amendment comprises the Area of Indirect Social Influence (AISI), composed of the districts of Nasca and Vista Alegre, and the Area of Direct Social Influence (ADSI), composed of the district of Marcona, in the province of Nasca and Ica Region. The ASI was determined based on reference criteria like proximity to Mina Justa, land distribution of population, political-administrative division, and potential indirect impacts (in the AISI), and potential direct impacts (in the ADSI) regarding socioeconomic and environmental aspects.

1.3.3.2 Area of Indirect Social Influence

The AISI comprises the district of Nasca and the district of Vista Alegre. The total population estimated, according to the INEI's population projections for year 2015 is 26,719 inhabitants in the district of Nasca and 15,419 inhabitants in the district of Vista Alegre; of which more than 87% live in the urban area. The population composition according to sex, in both districts, shows that male population is slightly higher than the female population. The population structure according to age groups also indicates that the most population is under the age group of 15 to 64 years of age (over 64%), which belongs to the economically active population (EAP).

The educational indicators in the AISI districts are above the national average. The illiteracy rate reaches 3.9% of the population of 15 years of age and over in the district of Nasca and 5.1% in the district of Vista Alegre. The prevailing educational level in the population of 15 years of age and over is the secondary school (above 45%). The health care personnel rate per 10,000 inhabitants (including doctors, nurses, and obstetricians) in the districts of Nasca and Vista Alegre, is 20.9/10,000 inhabitants and 8.6/10,000 inhabitants, respectively, which are below the rate recommended by World Health Organization (23/10,000 inhabitants). Likewise, the most frequent diseases in children under five years old are the acute respiratory infections (ARI, non-pneumonic) and the acute watery diarrhea (AWD).

The main economic activities in the AISI are agriculture and livestock farming, which concentrates most of the employed EAP, 14.7%, in the district of Nasca and 20% in the district of Vista Alegre. The main cultivations are white potato, cotton, corn maize and hard yellow maize, and chickpea. Livestock farming is characterized by the breeding of small animals or poultry. The trade activity employs 20% of the employed EAP in the district of Nasca and 15,9% in the district of Vista Alegre. Most commercial establishments are dedicated to wholesale and retail trade, accommodation and food services. In regard to tourism, one of the main tourism attractions are the Nasca Lines, located in Pampas de San Jose, 25 km of the city of Nasca, which attracts 20% of the tourists that visit the province of Nasca.

The districts of Nasca and Vista Alegre have a large supply of interurban public land transportation. The reason is that both districts are directly connected to one of the main national transportation roads, the South Pan-American Highway. The fluent traffic is related to the proximity to the province of Nasca with neighboring provinces like Ica and Palpa, and the district of Marcona, and because it is part of the arterial road along Lima, Arequipa and Tacna regions. The same happens with the District of Vista Alegre, because it is adjacent to the district of Nasca. The main communication and information media in the AISI are the written media, radio and television. The most-read local newspaper in both districts, Nasca and Vista Alegre, is La Opinión; the national most-printed newspapers are also available. The cable television service is provided by Cable Sur, Movistar, Claro and Direct TV.

In the AISI, municipal governments are the most relevant public institutions for the local population, because they are in charge of carrying out activities for the promotion of local development, provision of utilities, investment management and municipal administration. In addition, there are civil society organizations that perform different tasks such as meal preparation, public safety support, and water use management. The following are among the main organizations: *comités de vaso de leche* (Glass of Milk committees), *comedores populares* (Community kitchens), *juntas vecinales* (Neighborhood committees) and *comisiones de regantes* (Irrigation commissions). There are also agricultural producers associations, mainly in the district of Nasca.

The main issues perceived in the AISI are related to housing conditions and utilities, water shortage, illegal occupation of lands, public safety, and health care services (Interviews with Key Actors, Golder 2016). In regard to housing and utilities, the population growth in the last years has raised a gap in the services supply. On the other hand, water shortage is a widespread problem, since the population only has this service between eight and nine hours a day. Public safety is also another issue, during 2015 there was an increase in the number of extortions and homicides, mainly in the district of Vista Alegre, related to informal mining activity. Regarding to health care services, the main problem is the lack of specialist personnel and the restricted capability of the Hospital of Nasca for emergency cases.

1.3.3.3 Area of Direct Social Influence

The ADSI comprises the district of Marcona, whose capital is San Juan de Marcona. The Project components are located in this district, and where the direct impacts (positive and negative) are expected to occur resulting from the Mina Justa operations.

1.3.3.4 Social Variables

1.3.3.4.1 Demography

According to the INEI's population estimates and projections for year 2015, the estimated population in the ADSI is 12,403 inhabitants, of which 99% live in the urban area and more than a third part is composed of migrant population from, mainly, the Apurímac, Arequipa, Ayacucho, Cusco, Puno, and Huancavelica regions. Most of the migrant population arrived during the 50s attracted by the employment opportunities in the extractive activities of the ADSI (mainly mining and fisheries, to a lesser extent). The population ratio per sex is alike (difference of 1%) and the population structure per age groups suggest that most population is in the age group of 15-64 years old, which corresponds to the economically Active Population (EAP), and reaches 67.8%.

1.3.3.4.2 Health

There are two health care service MINSA[12] locations that are under the management of the Micronetwork of Health Nasca: Centro de Salud José Paseta Bar (José Paseta Bar Health Center) and the Puesto de Salud Túpac Amaru (Túpac Amaru Health Care Station), which provide care to low complex health problems. The *Hospital María Reiche Neuman* under EsSalud[13] management also provides health care to enrolled workers and their families. The rate of health care providers (including doctors, nurses and obstetricians) is 33.9/10,000 inhabitants. This value is above the minimum rate recommended by the WHO (23/10,000 inhabitants) to provide basic health care services. The main reasons for outpatient consultation are related to acute respiratory infections, both in adults and children. Furthermore, in 2015 cases of chronic child malnutrition, tuberculosis, and decompression sickness in skin divers were reported. Finally, it is worth mentioning that 80% of the ADSI families are enrolled to a health insurance.

[12] Ministry of Health of Peru.
[13] Seguro Social del Perú (Social Security Health Insurance of Peru).

1.3.3.4.3 Education

The educational institutions are located in the urban area and most of them include the regular basic educational levels, and mostly the preschool level. There are some higher education institutions like Instituto de Educación Superior Tecnológico (IESTP) Luis Felipe de las Casas Grieve in the district of Marcona, IESTP Nasca and IESTP Agustín Bocanegra y Prada in the district of Nasca and Universidad Nacional San Luis Gonzaga de Ica. In general, the educational indicators in the ADSI are better than the national average. The illiteracy rate is 1.8%. The prevailing educational level in the population of 15 years of age and over is the secondary school (above 47.3%). Likewise, a significant rate of population with higher technical education (24.2%) and university education (16%) is recorded. The main technical careers taken are mechanics, electricity, computer systems, and welding; and among the university careers, engineering (mining, systems, chemical, metallurgical, and others), administration and accounting, education and nursery.

1.3.3.4.4 Housing and Infrastructure

A significant number of houses are granted by the employer (54.5%), and are within the camp area, where the houses of SHP[14] workers are located. Building materials used for house construction are bricks or concrete blocks for walls and polished concrete for floors. Likewise, it was proved that houses are not overcrowded. Water is supplied mainly through the public network inside the households; however, a number of households are supplied through water tanks. Although 82% of the households receive water supply through the public network, the water is not supplied on a 24-hour basis. Most of the households are connected to the sanitation public network and have electricity connection. Some houses are possessed by means of land invasions, which have access to partly or limited utilities.

1.3.3.4.5 Transportation and Communications

The ADSI is connected to the South Pan-American Highway, one of the main national routes, that connects the district of Marcona to the Interoceanic Highway. The commercial transport flow generated on the roads is positive for the local economy and contributes to the dynamics of goods and services transactions with adjacent districts and provinces. However, the urban population in the district of Marcona lacks a public transportation system. The transport service in the urban area is limited to the use of taxis and motorcycle-taxis, while rural vans are used to travel to adjacent districts. Additionally, there are no bus terminals for interprovincial transportation; therefore, the means of transport are boarded on public roads.

Television, written press, and radio are the communication media mainly used by the ADSI population to be informed. In regard to the information through the broadcast signal, there is free-to-air television broadcasting, as well as four companies that provide cable television: Direct TV, Movistar, Claro and Cable Sur. There are five radio stations with varied programming: Radio Satélite, Radio Studio Éxitos 92, Radio Mix, Radio Stereo 2000 and Radio San Juan de Marcona. As for the written media, a magazine called Imágenes de Marcona is issued on a monthly basis. Its content addresses the current political and social situation in the district of Marcona. There are no local newspapers, but readers have access to the main newspapers of national circulation that reach the ADSI from noon onwards.

[14] Shougang Hierro Perú.

1.3.3.4.6 Social Development

The social development indicators are related to the monetary poverty level, households that lack the basic needs, and the human development index. From the monetary poverty approach, the district of Marcona is within the group of districts with less poverty incidence (16%) and does not have any household under extreme poverty. From the non-monetary poverty approach, the households considered as poor reach 10.1%. Based on the human development index, out of a total of 1854 districts at the national level, the district of Marcona stands out because it is in the 91st position of the national ranking.

1.3.3.5 Economic Variables

1.3.3.5.1 Economic Activities

The main economic activities are mining, trade, tourism, and fisheries. Agriculture and livestock farming are not activities developed in the ADSI.

- Mining employs 40.6% of the employed EAP. SHP, dedicated to mining, processing, and commercialization of iron, is the company with the highest direct and indirect employment offer in this sector.
- In regard to commerce, there are two markets of goods: The Municipal Market and La Paradita that congregates 400 sale stands. Also, there is a municipal slaughterhouse for cattle and pigs, mainly for human consumption, as well as a market for hydrobiological resources sale.
- The artisanal fishing is the main economic activity for fishermen in Bahía San Juan, who are dedicated to the extraction of fish, shellfish, mollusks, and crustacean, as well as algae harvesting. These activities are performed by fishermen offshore, using fishing boats, boats, and barges, and by non-embarked fishermen or fishermen onshore.
- In regard to tourism, the main attractions are the natural reserves of San Fernando and San Juan, which harbor diverse guano birds, sea lions, and Humboldt Penguin, as well as the beach circuit, composed of 18 beaches along the coastline, where stone figures are likely to be seen.

1.3.3.5.2 Use of Natural Resources

The main ecosystem services identified in the ADSI are limited to the marine ecosystem, and are related to: (i) provision of food and raw material, through domestic, commercial fishing, and algae harvesting in the coastline of Bahía de Marcona; and (ii) cultural service, from the recreational use with tourism purposes identified in the natural reserves of San Fernando and San Juan. Additionally, to the regulating and supporting services that provide general ecosystem services, related to climate conditions and marine habitat, respectively.

In the ADSI there is no hydrographic basin that supplies surface water for population or agricultural use, and along with the unproductive soil conditions, make the environment unsuitable for agricultural or livestock farming uses. The nearest freshwater source to San Juan de Marcona Village is the aquifer of Jahuay creek, located 40 km east of the village, in the province of Caravelí, Arequipa. This aquifer has a saturated area of 93.7 km^2, with a total recoverable volume of stored water of 1,340 million m^3. The identified users of this aquifer are Shougang Hierro Perú S.A.A (SHP), the Municipality of Marcona, and Marcobre.

1.3.3.6 Cultural Variables

1.3.3.6.1 Social and Political Organizations

In the ADSI, the municipal government is the most relevant public institution for the local population, because it is in charge of promoting and conducting the socioeconomic development. In addition, there are various associations of fishermen and mariculturists, which act as organizations and protection of the extractive activities in Bahía San Juan, Bahía San Nicolás, and Bahía San Fernando. Among them, the *Comunidad Pesquera Artesanal de Marcona* (COPMAR) (Artisanal Fishing Community of Marcona), founded in the 90s and brings together 18 associations of (onshore and offshore) artisanal fishermen of the district of Marcona, with a total of 600 members approximately.

1.3.3.6.2 Tradition and Culture

The tourism potential in the ADSI consists of its natural environment, represented by the San Fernando and Punta San Juan Natural Reserves, as well as the beach circuit. Among the main festivities, the foundation anniversary and the saint feast in honor of San Pedro de Marcona. The ADSI has a varied gastronomy, fish and shellfish-based dishes prevail, such as ceviche in all its varieties, *parihuela, jaleas, picantes*, and *sudados*.

1.3.3.6.3 Perceptions

The main local issues perceived by the ASI population are related to the limited water supply to the households, illegal possession of lands, increased crime occurrence, and poor health care services, due to medicine shortage and specialist health providers and poor infrastructure. Regarding the mining activity, authorities, leaders, and local organizations representatives have both positive and negative perceptions. On one side, the mining activity is considered positive because it is the main source of employment and development opportunities for the population through the mining canon. On the other side, the mining activity is related to negative impacts, in the past, as the decrease of hydrobiological resources of the San Juan, San Nicolás, and San Fernando bays.

1.3.3.7 Maritime Traffic

The maritime traffic (departure and arrival) was characterized using the information provided by DICAPI/San Juan Harbor Master (from September 2017 to mid of July 2016), as well as the data collected on field by Golder during five days of continuous monitoring (July 22 to 26, 2016).

During the monitoring carried out by Golder, two monitoring stations near Diomedes Vente Lopez Artisanal Dock, were established to watch vessels departures and arrivals; among the main artisanal vessels like boats (75.2%), barges (24.3%), and fishing boats (0.5%) were recorded.

Based on DICAPI/San Juan Harbor Master (2014-2016), southbound departures (95.5%) prevail; the highest maritime Traffic was observed in October and December 2014, and October 2015. The hourly southbound trend has two peak hours for departures, between 05:00 h and 07:00, and 17:00 h and 18:00 h; with an average of four to five vessels.

In regard to the data collected by Golder on the departures recorded, 76.7% are southbound and 23.3% are northbound, which confirms the observed trend based on the secondary information analysis. The hourly trend of the southbound departures was observed between 07:00 h and 08:00 h (six to seven vessels on average); while regarding the arrivals, the hourly trend was observed between 16:00 h and 17:00 h (three to four vessels on average), and in some specific hours like 04:00 h, 07:00 h, and 11:00 h, an average of two vessels arrive.

1.3.3.8 Archaeology

The archaeological baseline describes the findings of the archaeological survey carried out in the archaeological study areas defined for the baseline, terrestrial archaeological assessment area and marine archaeological assessment area. The terrestrial archaeological assessment area comprises the area where the Mina Justa components will be located, including the water supply system; and the marine archaeological assessment area comprised by the area where the multi-buoy terminal and the seawater intake system will be located.

In the terrestrial archaeological assessment area, the compilation and description of 15 Certificates of Non-Existence of Archaeological Remains (CIRA), which cover the total area where the terrestrial components of Mina Justa will be located, was carried out. According to the CIRAs, there are no archaeological remains on the surface of the area surveyed. However, five CIRAs include adjacent archaeological sites. On the other side, Marcobre is conducting the "Archaeological Rescue Project of 20 Sites in the Mina Justa Exploration Project", which includes 18 archaeological sites and two archaeological cultural landscapes. It is worth mentioning that this archaeological rescue project has been declared of national interest by the Ministry of Energy and Mines (MINEM) through M.R. No. 015-2010-MEM/DM, dated January 14, 2010.

Additionally, in October 2016, the "Archaeological Diagnosis, Archaeological Supplementary Studies of Mina Justa Project - Seawater Impulsion Pipeline Prospection" was conducted. Although this is not an official study for file processing before the Ministry of Culture, 11 archaeological evidences and areas with fossil material have been identified, which should be confirmed during permitting process of the CIRA. Additionally, the presence of three archaeological sites with a physical delimitation in the terrain was verified. These are located west of the seawater supply pipeline.

The marine archaeological assessment area was described based on two studies, the Archaeological Diagnosis of the Cultural Component in the Underwater Marine Surface, which consisted of the study of the underwater marine surface selected for the construction of the multi-buoy terminal component and the seawater intake system in Bahía San Juan; and the Archaeological Assessment of the Non-Intrusive Survey Project of the Petrochemical Complex of CF Industries in San Juan de Marcona.

The water survey method described did not include underwater excavations of any kind, nor the collection of seabed materials. As a result of the seabed survey work, no cultural good was identified.

1.3.3.9 Identification of Vulnerability to Natural and Anthropogenic Hazards

In the study area, geoforms or physiographic landscape elements (Coastline, Marine Plains, Continental Plans, Tectonic Plains, Sedimentary Hills, Igneous- metamorphic hills, and Igneous Mountains) have been identified, whose modeling is the result of the dynamic action of different agents and phenomena that have acted on the physical environment, expressed by the interaction of tectonic, orogenic, lithologic factors and by erosive and depositional processes. In these geoforms, some vulnerability and hazard aspects are recorded like steep surfaces on capes, islets and cliffs; gullies on strongly inclined sedimentary and igneous metamorphic hillsides; or steep rock faces and cliffs of 30 m to 100 m of height on igneous very steep igneous hillsides.

In regard to natural hazards caused by the external geodynamics, the main vulnerability to hazards existing in the study area due to external geodynamics identified and classified were the morphodynamic processes of marine erosion, wind, and occasionally water, slope erosion, rockfall and sanding.

In the internal geodynamics, the main aspects of vulnerability and hazards inventoried are originated by earthquakes and tsunamis. Due to its location southwest of Peru, the Project site is under a high seismic activity related to the interaction between the continental place with the subduction zone of the Nazca plate; based on the analysis of the spatial distribution of the intermediate and shallow seismicity, in the southern region of Peru, as well as considering the high-magnitude earthquake occurrence, which is evidence of high seismic potential.

Regarding tsunamis hazards, based on the probabilistic and deterministic analysis considered for the coastline zone with return periods of 75 and 475 years, the zones potentially to be affected by this phenomenon are Punta San Nicolás and Punta San Juan. This hazard is mitigated partly by the deep bathymetry of San Nicolás and San Juan ports, which will prevent a strong wave height increase in the event of tsunamis. In other zones of the coastline of the study area, inundations would not result from potential tsunamis given that the surface of the terrain rises up in cliffs, from 15 m to 60 m above the tidal line.

1.4 Public Participation Plan

Public participation is a public, dynamic, and democratic process to clear the population's worries, concerns and fears through the identification and implementation of adequate and efficient participation mechanisms and thus favor the transparency of community relations actions. In addition, it seeks to document opinions, expectations and concerns in order to handle them, take them into account, and promote future solution.

In that sense, the main objective of the Public Participation Plan (PPP) of this assessment is to present and explain the selection of public participation mechanisms to be implemented during the evaluation stage of the EIAd Amendment and during the execution of the Mina Justa Project.

To achieve the said objective, it is essential to have into account the areas of social influence, which are as follows:

- Area of Direct Social Influence (ADSI): It comprises the district of Marcona, Ica Region, as the producer district, and where all of the Mina Justa Project components are built. Its capital is San Juan de Marcona Village, the urban core closest to the Project and the most important in the district. The potential direct impacts resulting from the Project implementation will occur in the district of Marcona.
- Area of Indirect Social Influence (AISI): It comprises the districts of Nasca and Vista Alegre, in the province of Nasca, Ica Region, defined because of its geographical proximity to the Mina Justa Project and due to social, economic and political relationships established with the district of Marcona. Additionally, these are the districts along which most of the Project mobile units will circulate. Both districts would register low significance indirect potential impacts, mainly related to economic impacts, due to the effect of the canon allocations.

Likewise, it is necessary to have in mind the actors and stakeholders related to the Project development. The resulting actors and stakeholders mapping, according to action field, and type of organization or institution they belong to, is presented in Table RE-5.

Table RE-5: Actors Mapping

Field	Type	Organization and institution
National	Public Institutions	*Servicio Nacional de Certificación Ambiental para las Inversiones Sostenibles* (National Service of Environmental Certification for Sustainable Investments) (SENACE)
		Ministry of Energy and Mines
		Ministry of Environment
		Organismo de Evaluación y Fiscalización Ambiental (Agency for Environmental Assessment and Enforcement) (OEFA)
		Ministry of Production
		Ministry of Health
		Servicio Natural de Áreas Protegidas (National Service of Protected Natural Areas) (SERNANP)
Regional, Provincial, and Area of Indirect Social Influence	Public Institutions	Ica Regional Bureau of Production
		Organismo Nacional de Sanidad Pesquera (Fish Health National Agency) (SANIPES), Pisco Office
		Fondo Nacional de Desarrollo Pesquero (Fish Development National Fund)
		Instituto del Mar del Perú (Peruvian Marine Research Institute) (IMARPE) Pisco Office
		Justice of the Peace of Nasca and Vista Alegre
		Provincial Municipality of Nazca
		District Municipality of Vista Alegre
		Provincial Government of Nazca
		District Government of Vista Alegre
		National Police of Peru - Police Station of Nasca, Police Station of Vista Alegre and Police Station of Highway Protection
		Ica-Palpa-Nasca Health Service Network
		Unidad de Gestión Educativa Local (Local Education Management Unit) (UGEL) Nasca
		Social Programs: Juntos, Qali Warma, Pensión 65, Trabaja Perú and Techo Propio
	Social Organizations	Union of Workers of Nasca and Vista Alegre
		Sindicato Único de Obreros y Empleados de Electro Sur Medio de Nasca y anexos (Electro Sur Medio Workers and Employees Sole Union of Nasca and Annexes)
Area of Direct Social Influence	Public Institutions	District Municipality of Marcona
		District Government of Marcona
		Ministry of Production (PRODUCE) - San Juan Office
		Port Authority and Coast Guard - San Juan de Marcona
		José Paseta Bar Health Center
		National Police of Peru - Police Station of San Juan de Marcona
	Public Institutions	Navy Base of San Juan de Marcona
		Instituto Superior Tecnológico Público (Public Higher Education Technological Institute) "Luis Felipe de las Casas Grieve"
		"Almirante Miguel Grau" Educational Institution
		"Ricardo Palma" Educational Institution
		"Elena Francia Ramos" Educational Institution
		Social Programs: Juntos, Qali Warma, Pensión 65, Trabaja Perú and Techo Propio

Field	Type	Organization and institution
	Producer Organizations	*Asoc. Gremio de Pescadores Artesanales del Puerto San Juan de Marcona* (Artisanal Fishermen Trade Association of the San Juan de Marcona Port)
		Mariculturists Association El Almejal
		Asoc. Proyecto Mar de Marcona (Marcona Sea Project Association) (APROMAR)
		Association of Mariculturists El Arca de Noé de Marcona
		Association of Mariculturists Cristóbal Colón
		Association of Mariculturists Los Hijos de Jacob
		Asoc. de Pulmoneros de Marcona (Marcona Skin Divers Association) (APUMAR)
		Asociación de Maricultores Hidrobiológicos (Hydrobiological Mariculturists Association) (BUZMAR)
		Asoc. de Maricultores San Pedro del Puerto San Juan de Marcona (San Pedro Mariculturists Association of San Juan de Marcona Port) (ASMASPEMAR)
		Association of Mariculturists José Olaya Balandra
		Association of Mariculturists Pacífico del Sur
		Association of Mariculturists Mundo Marino
		Association of Mariculturists San Nicolás
		Asoc. de Jóvenes Pescadores y Transformadores Artesanales para el Desarrollo del Puerto San Juan de Marcona (Association of Young Fishermen and Artisanal Processors for the Development of the San Juan de Marcona Port)
		ACAEMP Association
		Asociación de Maricultores Hijos de Extrabajadores de Marcona (Association of Mariculturists Children of Former Workers of Marcona)
		Asociación de Pescadores Artesanales La Cueva (Association of Artisanal Fishermen La Cueva)
		Asociación Cultivos Marinos de Marcona (Marcona Marine-Farming Association) (ACUMAR)
		Diomedes Vente López Association
		Juventud del Mar Association
		Comunidad Pesquera Artesanal de Marcona (Artisanal Fishing Community of Marcona) (COPMAR)
		Agremiación Asociación de Recolectores de Algas (Association of Algae Harvesters) (REALMAR)
	Social Organizations	*Asociación de Padres de Familia* (Parents Association) (APAFA)
		Comités de vaso de leche de Marcona (Glass of Milk Committees of Marcona) (CVL)
		Community kitchens of Marcona
		Mothers' club
		Fellow citizens organization
		Asoc. De Vivienda San Pedro
		Asoc. Vec. Zona Industrial
		Asoc. Vec. La Esmeralda
		Asoc. De Vivienda Zona Libre
		Asoc. De Vivienda Nuevo Amanecer (Hondonada)
Area of Direct Social Influence	Social Organizations	Asoc. Milagritos (Hondonada)
		Asoc. De Vivienda Villa Verde
		Asoc. De Vivienda Tierra Prometida
		Asoc. De familias desplazadas hijos de Parinacocha

Field	Type	Organization and institution
	Civil Associations	Sindicato de Empleados de Shougang Perú (Workers Union of Shougang Perú)
		Sindicato de Empleados de Shougang Perú (Union of Employees of Shougang Perú)
		Sindicato Independiente de Empleados de Shougang Perú (Independent Union of Employees of Shougang Perú)
		Sindicato de Trabajadores de Construcción Civil (Union of Civil Construction Workers) (CTP).
		Sindicato Único de Trabajadores en Construcción Civil Hombres y Mujeres de Marcona (Single Union of Civil Construction Workers Hombres y Mujeres de Marcona)
		Sindicato de Trabajadores en Construcción Civil "Pedro Huilca Tecse" (Union of Civil Construction Workers "Pedro Huilca Tecse")
		Sindicato Único de Trabajadores de la Educación - Base Marcona (Single Union of Education Workers - Marcona Base)
		Frente de Defensa de los Derechos del Distrito de Marcona (Defense Organization of Marcona District Rights) (FREDDMAR)
		Frente de Defensa de los Derechos y Desarrollo de Marcona (Defense Organization of Marcona Rights and Development)
	Neighborhood Associations	PP.JJ. (Shantytown) Túpac Amaru
		Justo Pastor Ramirez Legua Association
		AA.HH (Human Settlement) Ruta del Sol
		AA.HH 28 de Julio
		AA.HH Villa Hermosa
		AA.HH Victor Raúl Haya de la Torre
		AA.HH Micaela Bastidas
		AA.HH San Juan Bautista
		AA.HH San Martín de Porres
		AA.HH Bellavista
		AA.HH Saúl Cantoral
		AA.HH Señor de los Milagros

Source: Section 3.4 Social Baseline of the EIAd Amendment of the Mina Justa Project prepared by Golder (2016).

First, public participation mechanisms for this EIAd Amendment have been selected, considering the social and cultural characteristics of the area of influence of the Mina Justa Project, and the particular characteristics of the stakeholders identified. Second, the selection of the public participation mechanisms is associated with the mechanisms proposed in the EIAd (Vector 2010), defined for the Project operations stage. The objective is to provide continuity to the public participation process, maintaining communication and dialog spaces in the process.

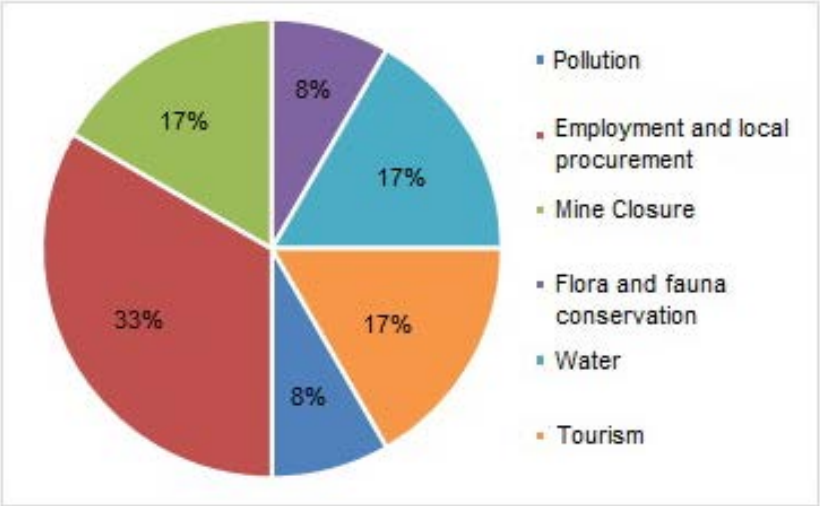
The public participation mechanisms of this EIAd Amendment are as follows:

- Stage before the preparation of the EIAd Amendment:
  - Participation Workshop: it took place on November 23, 2012, from 6:31 p.m. to 8:12 p.m., in the establishment of Cooperativa de Ahorro y Crédito "La Esperanza de Marcona," located at Av. Los Incas s/n, district of Marcona.
- Stage during the preparation of the EIAd Amendment:
  - Oficina de Información Permanente (OIP) (Permanent Information Office) The OIP aims at providing information to the population interested in the Project progress and works, and provide administrative, logistic, and management support to the Social Responsibility Area of Marcobre. Opening hours are

from Monday to Friday, from 9:00 a.m. to 1:00 p.m. and from 2:00 p.m. to 6:00 p.m., in their establishment at Av. Bolognesi s/n, district of Marcona.

- Distribution of Information Material: The information material was prepared based on Marcobre's corporate communication standards and following MINEM's guidelines, proposed in the Public Participation Guide in the Mining Subsector. It was prepared and designed in Spanish, using colloquial and everyday language to present, graphically and educationally, the Mina Justa Project information. The distribution of this information material was channeled mainly through the OIP.
- Digital information channels: To facilitate stakeholders and general population's access to the information, Marcobre has developed three digital information channels with diverse contents (web page, social networks, and Marcobre Youtube channel), according to the population's current needs and characteristics. This mechanism seeks to inform the majority of the population in the Project area of influence.
- Focus groups: as part of the public participation process, a focus group mechanism was implemented to create a space for discussion and exchange of information; and, based on that, gather opinions and impressions about the information provided. The objective of the focus groups was to present the advances of the social and environmental baselines, using informational and educational material.
- Information Workshop: There were 61 attendees, among local authorities and representatives and population in general. A total of 12 questions were asked. The audience's interventions focused mainly on the following topics:
  - **Employment and Local Procurement:** Questions regarding the employment opportunities that Marcobre will provide through the Project at its different stages and regarding the goods and services acquisition process in the zone.
  - **Mine Closure:** Questions regarding the development, activities and environmental contingency plans that will be implemented during mine closure.
  - **Water:** Concerns and worries regarding potential alterations to the water quality and quantity due to the development of the Project since the resource is scarce in the zone. The speakers explained that the Mina Justa Project will not use potable water for the operations stage. On the contrary, the use of seawater was explained to prevent any conflict due to the water resource.
  - **Contamination:** Questions regarding health problems and ecosystem degradation that may arise due to the Project in the area of influence.
  - **Flora and Fauna Conservation** Questions regarding the management plans for the flora and fauna conservation in the zone, and how they will be implemented and developed.
  - **Tourism:** The population is very interested in tourism, as it is one of the main aspects promoted by Marcobre. Attendees asked about the impact and the activities the company will develop to promote tourism and about the authorities and local population's involvement.
  - Graph RE-1 shows the frequency of the consultation topics in the Information Workshop:

Graph RE-1: Topics of Concern in the Information Workshop



Source: Information Workshop 2016:

- Informational meetings: This mechanism seeks to create direct communication spaces with the population to inform the population interested about the concern topics that Marcobre has identified in the other mechanisms implemented. Thus, Marcobre calls the population to several informational meetings to discuss a topic of recurrent concern, which is then addressed in depth. In total, four informational meetings were carried out, where topics about health and safety, infrastructure, multi-buoy terminal, procurement and contracts, geology and explorations were addressed. Meetings were held between October 11 and December 6.

- Public Participation Mechanisms during the evaluation of the EIAd Amendment:
  - Dissemination of the Public Participation Plan: Once the corresponding authority approves the PPP, Marcobre will begin the dissemination process of the participation mechanisms that will be implemented during the evaluation stage of the EIAd Amendment to promote the participation of the local population at this Project stage.
  - Access to executive summaries and Environmental Studies: The mechanism proposed is mandatory, in compliance with M.R. No. 304-2008-MEM/ DM, and aims at promoting and disseminating the EIA among the corresponding public entities identified in the regulations, local authorities and the population in the area of influence.

    Marcobre will submit twenty (20) copies of the Executive Summary and a hard copy and a soft copy of the EIAd Amendment of the Mina Justa Project to the following entities:
    - Two hard and soft copies to the National Service of Environmental Certification for Sustainable Investments (SENACE).
    - Two hard and soft copies to the General Directorate of Environmental Affairs (DGAAM) of the Ministry of Energy and Mines (MINEM).
    - Two hard and soft copies to the Regional Directorate of Energy and Mines Ica (DREM).
    - Two hard and soft copies to the Ministry of the Environment (MINAM).
    - One hard and soft copy the National Water Authority (ANA)
    - One hard and soft copy to the General Directorate of Environmental Affairs of the Ministry of Agriculture and Irrigation (MINAGRI).
    - One hard copy to the municipalities of Nasca and Vista Alegre.
    - One hard copy of the EIAd Amendment and 20 hard copies of the Executive Summary to the District Municipality of Marcona.

In addition, the Marcobre Permanent Information Office, located in the city of San Juan de Marcona will also have a printed copy of the Executive Summary and a digital version of the EIAd Amendment, so that the population interested can have access to further information on the assessment.

- The implementation of this mechanism seeks to facilitate the right to participate by presenting contributions, comments or observations on the EIAd Amendment before the corresponding authority. Marcobre will implement a letterbox and will have a form for the presentation of contributions, comments or observations on the EIAd Amendment. This can be picked up only in writing. The letterbox with all the contributions, comments or observations submitted will be sent to the competent authority for its consideration, within the term established.
- Participation Workshop Marcobre will voluntarily organize a participation workshop to keep a transparent and direct dialog with its stakeholders. This will be a space for communication where authorities, local representatives and the general population will be informed about the submission of EIAd Amendment of the Mina Justa Project to the corresponding authorities, and also for the presentation of the assessment results.
- Permanent Information Office (OIP): The OIP seeks to provide the population interested information regarding the activities during the evaluation stage of the EIAd Amendment and the Project development. It will continue to be the administrative, logistics and management support to Marcobre's Social Responsibility Area. The OIP opens during the schedule established and performs the following activities:
  - The OIP opening hours are from Monday to Friday, from 9:00 a.m. to 1:00 p.m. and from 2:00 p.m. to 6:00 p.m., in their office located at Av. Bolognesi s/n.
  - Service is in charge of Community Relations staff, responsible for assisting visitors and solving their doubts and/or questions.
  - Information material on the evaluation stage of the Project EIAd Amendment and progress will be delivered.
- Information Material: allows informing and reinforcing messages in a simple and educational manner. It will present information on the Project development, the activities performed, and mainly on the evaluation stage of the EIAd Amendment by the corresponding authorities.

- Public Participation Mechanisms during the Project Execution
  - Permanent Information Office: Information will continue being provided to the population interested, mainly about the Project execution progress, and will continue being the administrative, logistic and management support to the Social Responsibility Area of Marcobre. OIP's service will be in charge of Marcobre's specialist staff in community relations.
  - Distribution of Information Material: Marcobre will continue with the delivery and publication of information material as it is an effective tool to disseminate and inform the population and workers, in a direct, simple and graphic manner, about the activities regarding the Project execution stage and the benefits it generates.
  - Monitoring and participative environmental surveillance: It is a tool to guarantee the information transparency in connection with the environmental management, and to create confidence in the population regarding an environmentally responsible management. Such mechanism corresponds to a continuous process in which environmental information is systematically recorded and thought about taking management actions in response to what has been learned, which permits capitalizing on the different stakeholders' participation.
  - Information Sessions for the Population: The mechanism to be implemented seeks to maintain direct communication spaces with the population and, through them, inform mainly about the Project execution stage progress, the development of the commitments, and activities that Marcobre carries out voluntarily.

    This voluntary public participation mechanism is additional to the 13 ones defined in M.R. No. 304-2008-MEM/DM, "Regulations for the Public Participation Process in the Mining Subsector."

- Information Sessions for workers: Information sessions addressed to workers are spaces where Marcobre will communicate its institutional activities, and will provide information mainly on matters such as health and safety, environment and Project progress. Marcobre will use this space also to collect concerns and contributions by workers.

  This voluntary public participation mechanism is additional to the 13 ones defined in M.R. No. 304-2008-MEM/DM, "Regulations for the Public Participation Process in the Mining Subsector."
- Guided Visits: Guided visits to the operation facilities will take place to show *in situ* the operation aspects and preventive, control and mitigation measures available to keep the adequate national standards for environmental quality in accordance with Marcobre's corporate standards.

1.5 Social and environmental impacts characterization

The impact assessment mainly aims at predicting effects or changes in the environmental and social conditions that will result from the development of the modifications to the Project activities and facilities. The Project EIAd Amendment is oriented to assess the environmental and social project impact as a whole, i.e. it will assess impacts generated by the original project, initially approved (Vector 2010), approved ITS amendments (Golder 2016a and 2016b) and modifications to activities proposed in the Project description (Section 2.0). In this regard, prevention, control and mitigation measures for negative impacts will be determined and positive impacts deriving from their implementation will be enhanced.

The methodology used for the impact assessment considers national and international best practices, and uses the following tools to analyze and address potential impacts:

- Quantitative and qualitative information about the environmental and socioeconomic conditions (Project baseline).
- Prediction tools (models) and methods to describe quantitatively and qualitatively environmental and socioeconomic conditions expected in the future.
- Quantitative and qualitative assessment of the environmental aspects probability and relevance, including references to management objectives, current environmental conditions, and the holder and stakeholders' perspectives.
- Environmental assessment resulting from the design characteristics proposed in the Project and from the management plans for potential adverse impacts.
- Characterization of residual impacts and their consequences on the environment, as well as socioeconomic and cultural conditions.

In general, the impact assessment is based on three main foundations:

- Project description in terms of feasibility engineering, identifying the activities and environmental aspects associated.
- Updated environmental and social baseline of the study area which identifies relevant environmental features that may potentially be impacted by the Project, pointing out those playing an important role in the conservation of the ecosystem balance in the area, and those subject to specific legal regulations.
- Technical consistency of the adopted model to assess these alterations, i.e. the magnitude of the alterations to determine the environmental consequence of the Project environmental impacts.

These three points determine the environmental conditions and restrictions that will have to be assessed to support the Project environmental and social viability, which are translated into impact management actions.

The methodology for the physical and biological environmental impact assessment developed by Golder is based on the fundamental concepts of environmental management systems and the modified Leopold matrix (Leopold et al. 1971). For the Mina Justa Project impact assessment, scope and technical matters characteristic of the environmental and socioeconomic components have been considered. Likewise, considering the recommendations of the best practices by the World Bank and IFC, the Project potential to

cause cumulative impacts on environmental and socioeconomic components over which other existing and future projects could have negative effects has been assessed. Therefore, the methodology for the impact assessment is divided in three sections:

- Environmental Impact Assessment Methodology.
- Socioeconomic Impact Assessment Methodology.
- Cumulative (Additive and Synergistic) Impact Assessment Methodology.

The identification or diagnosis of environmental aspects allows characterizing the occurrence of an impact in order to analyze the time and approach of the actions to be adopted in each case.

Environmental aspects are understood as project activities, products, and services that can interact with the environment.

Occurrence of environmental aspects can be:

- Real: every element of the project activities, products and services, whose occurrence does not depend on exceptional conditions. For instance, if a truck drives along an unpaved road, it will cause emission of particulate matter (dust).
- Risk: is every element of the project activities, products or services, which may occur according to specific features of the area where the project is located, and is associated with exceptional occurrence conditions. For instance, if a truck drives along an unpaved road, it could cause a fuel spill if an unexpected system failure occurs.

Environmental impact indicators are intrinsically associated with the definition of environmental consequence or impact significance, and their qualification depends on the application of criteria defined according to the potentially impacted environmental component under assessment.

Four environmental impact indicators have been considered for the impact assessment:

- Direction, which can be positive or negative;
- Magnitude, which can be categorized as negligible, low, moderate and high;
- Extension, which can be immediate, local and wide; and
- Reversibility, which can be reversible in the short, medium or long term or irreversible.

In addition, complementary indicators for environmental impacts which encourage the incorporation of additional impact management actions are being considered:

- Duration, which may be short, medium or long term; and
- Frequency, which may be continuous or discontinuous.

The criteria for the environmental impact indicators have been established by Golder considering criteria like environmental regulations, environmental quality standards, specialized literature thresholds, ecological concepts, knowledge of the Environmental Study Area (ESA) baseline, and professional expert judgment of Golder specialists. Thus, the criteria of duration, geographical extension, reversibility, duration and frequency are applicable to every environmental component assessed, and they are based on the nature of change of the assessed parameters (direction), the limits of the terrestrial and marine ESA (geographical extension), and the development of activities and the Project, and the response of the environment (reversibility, duration and frequency).

In this context, the determination of the impact magnitude constitutes the main indicator directly influencing the environmental consequence or impact significance on the assessed environmental components. These criteria for magnitude determination may vary according to the characteristics of each environmental component.

The impact environmental consequence or significance refers to the degree of the environmental quality disturbance of the environment under assessment. The value is obtained by multiplying the referential values of each of the three environmental impact criteria.

Environmental Consequence = (±) Magnitude x Extension x Reversibility

As a result, the environmental consequence is expressed by the following categorization:

- Very Low;
- Low;
- Moderate; and
- High.

Table RE-6 shows the possible combinations for the environmental consequence calculation and its classification.

Table RE-6: Possible Combinations for the Impact Environmental Consequence or Significance

Magnitude	Extent	Reversibility	Environmental Consequence or Impact Significance
Negligible	Any extension	Any reversibility	Very Low
Low	Immediate	Reversible in short term	Low
Low	Immediate	Reversible - medium-term	Low
Low	Immediate	Reversible - long-term /Irreversible	Low
Low	Local	Reversible in short term	Low
Low	Local	Reversible - medium-term	Low
Low	Local	Reversible - long-term /Irreversible	Low
Low	Wide	Reversible in short term	Low
Low	Wide	Reversible - medium-term	Low
Low	Wide	Reversible - long-term /Irreversible	Moderate
Moderate	Immediate	Reversible in short term	Low
Moderate	Immediate	Reversible - medium-term	Moderate
Moderate	Immediate	Reversible - long-term /Irreversible	Moderate
Moderate	Local	Reversible in short term	Moderate
Moderate	Local	Reversible - medium-term	Moderate
Moderate	Local	Reversible - long-term /Irreversible	High
Moderate	Wide	Reversible in short term	Moderate
Moderate	Wide	Reversible - medium-term	High
Moderate	Wide	Reversible - long-term /Irreversible	High
High	Immediate	Reversible in short term	Moderate
High	Immediate	Reversible - medium-term	Moderate
High	Immediate	Reversible - long-term /Irreversible	High
High	Local	Reversible in short term	Moderate
High	Local	Reversible - medium-term	High
High	Local	Reversible - long-term /Irreversible	High
High	Wide	Reversible in short term	High
High	Wide	Reversible - medium-term	High
High	Wide	Reversible - long-term /Irreversible	High

Residual environmental impacts (positive and negative) are classified as significant or negligible based on the environmental consequence results.

The methodology for the socioeconomic impact assessment follows the same procedure as that for the physical and biological components, based on the definition of quantitative indicators and incorporating a qualitative balance of the context. However, the criteria and assessment levels are adapted to the socioeconomic aspects. Four indicators have been thus considered:

- Direction, which can be beneficial (positive) or adverse (negative);
- Magnitude, which can be categorized as negligible, low, moderate and high;
- Extension, which can be at a local, district, region or national level; and
- Duration, which can be short, medium or long term.

The socioeconomic impact assessment considers the duration indicator, referred to the time where the Project impacts take place or occur.

1.5.1 Potential Physical Impacts

The following list presents the main environmental components of interest that may be related to the Project potential impacts on the physical environment at the different stages. Due to the interaction among the environmental components, not every environmental component mentioned will be assessed separately.

- Air: activities for earthworks, land preparation or material movement for pit mining may potentially generate dust or particulate matter and gases during the Project construction, operations and closure stages.
- Noise: several activities will be carried out for the development of the Project. The noise generated by some of these activities may be perceived in the Project surrounding areas.
- Vibrations: the main pit exploitation and mining activities could cause a change in vibration levels in the Project surroundings.
- Underwater Noise: the multi-buoy terminal construction will include the establishment of a trestle in part of the marine zone of the study area, thus activities in the sea will be carried out, for example, pile driving, which may potentially generate underwater noise.
- Geology: environmental impacts are not expected to occur on the geological conditions in the Project Area of Environmental Influence. Thus, the impact valuation of geology was not considered.
- Geomorphology: the environmental consequence of changes in geomorphology or in landforms can be seen in other environmental components such as in the landscape, in the greater soil use capacity, in the habitat quality or value, and in the risks related to natural hazards (instability, Paracas winds occurrence, among others). Thus, this study did not consider the valuation of impacts on geomorphology.
- Non-Ionizing Radiations: the transmission line may cause a potential impact due the increase of non-ionizing radiation; however, in the area adjacent to this infrastructure, there are no receivers that may be affected. Thus, the impact valuation of non-ionizing radiation was not considered.
- Soils: Project components and further associated infrastructure location may possibly affect surface soil quantity and quality. During the baseline studies, all soils in the Area of Environmental Influence have been identified as Protected Land (X) not suitable for cultivation (S.D. No. 017-2009-AG, Regulations for Land Use Capability Classification), and it is considered this condition will be maintained during every Project stage. Consequently, the change in the land use capability is not considered a soil environmental impact.
- Groundwater: within the area of the terrestrial environmental assessment, the groundwater level is more than 500 m deep in relation to the ground level, indicating a deep groundwater system. The precipitation rate is very low and the potential evaporation rate is greater than the precipitation. This is the reason there is no natural recharge source toward the groundwater system. Groundwater discharge sources such as springs, wetlands or groundwater supply wells have not been identified. The deep groundwater system is not connected to any local groundwater system. Chemically, the type of water is sodium

chloride with high sulfate and salinity concentrations due to chemical concentrations and depths found. The water identified is not usually usable for water resources as potable water or industrial or agricultural purposes.

According to the results obtained from the studies conducted, impacts on groundwater are not expected and, therefore, this study did not consider impact valuation for such component.

- Hydrology: The study area did not report surface water flows, so impacts on this component as a consequence of the Project development are not expected.
- Seawater Quality: Due to the fact that discharges will not be occurred on the marine environment, carrying out an impact valuation for this component was not considered. Likewise, pile driving may remove sediment from the seabed and increase total suspended solids. However, this activity will be local and short-term. With the implementation of mitigation measures, no substances are expected to be introduced into the marine environment, which could alter water quality. It should be noted that the potential impact on marine species due to habitat alterations will be assessed in the marine flora and fauna section.

The multi-buoy terminal is located 4 km from the System of Islands, Islets and Guano Capes Punta San Juan National Reserve and 17 km from RNSF; these areas are not part of the Project area of influence during the construction and operation activities.

A description of the environmental factors that may potentially be environmentally impacted due to the Project activities is below.

1.5.1.1 Soils

In the soils assessment, the changes and variations on the soil will be analyzed for the construction, operation and closure stages of the Project.

Edaphic characteristics, life and relief zones jointly intervening in a certain land unit and which are the dynamic soil properties will be considered for the analysis. In addition, inherent soil properties will also be analyzed. These properties are determined by formation factors, climate, topography, geological material and by soil properties such as organic matter, apparent density, texture, among others.

Assessment indicators for soil impacts consider soil loss and the variations of the parameter concentrations for soil quality. Due to soil limitations[15] (desert soil, no water) agricultural, livestock farming or forest activities cannot be established; therefore, the change in the land use capability is not considered an environmental soil impact. This condition is expected to remain during all Project stages.

1.5.1.1.1 Soil Loss

The soil loss assessment method is based on estimating the extension that the Project components will take up during the construction and operation stages, and the percentage variation in relation to the baseline conditions, considering the study area surface extension. To this end, the surface extension (ha) of the Project footprint during the construction and operation stages, and of the disturbed area during the closure stage were determined. Later, the percentage variation related to the area extension established in the updated baseline was estimated.

[15] All soils in the study area have been identified as Protected Land (X) not suitable for cultivation (S.D. No. 017-2009-AG Regulations for Major Land Use Capability Classification).

The results obtained show that the study area comprises an extension of 36,164.14 ha. From this total, an extension of 3,105.16 ha, accounting for 8.58% of the ESAt, will be affected by construction activities. During the operation stage, the Project final footprint will take up an extension of 4,128.66 ha, equivalent to 11.42% of the study area. Finally, during the closure stage, after the application of reclamation measures, an area of 1,509.71 ha, representing 4.17% of the study area, will remain disturbed.

The residual impact direction for soil loss will be negative because the natural soil surface extension will decrease in relation to the updated baseline conditions. The magnitude is considered low because there will be a 4.17% surface extension variation during the closure stage, in relation to the updated baseline conditions. The geographical extension is considered immediate because it is limited to the Project footprint, and the impact will be irreversible. The combination of these features results in a low environmental consequence impact.

1.5.1.1.2 Changes in Soil Quality

The soil quality analysis considers mainly the inherent soil properties that may be impacted by the Project activities, particularly the soil quality parameters that are part of the Environmental Quality Standards for Soils (EQSs for soils) established by S.D. No. 002-2013-MINAM.

The future and cumulative (year two of construction and year 14 of operation) concentrations of EQS regulated metals (arsenic, barium, cadmium and lead) caused by soil deposition of these metals contained in the particulate matter (PM-10) generated by the Project were estimated to assess soil quality changes upon completion of the Project operation stage (including the construction stage). Only these metals were assessed taking into account their presence in the rock types existing in the Project area. In this sense, chrome VI, mercury and cyanide were not considered because, even if they are regulated by the soil EQSs, they will not be generated by the mining activities.

The results of the analysis of soil quality changes are summarized below:

- During the construction and operation stages, the metal concentrations in the soil particulate matter are expected to vary in average, considering the contribution in the 2 years of the construction stage and in the 18 years of the operation stage together, between 0.00002 mg/kg and 0.00013 for arsenic; 0.00176 mg/kg and 0.01101 mg/kg for barium; 0.00011 mg/kg and 0.00066 mg/kg for lead and negligible for cadmium.

  According to results, in general, the metal concentrations in PM-10 on soils would not increase the concentrations of the soil quality inorganic parameters determined in the quality parameter results of the updated baseline for soils, and would not exceed the EQSs for agriculture or industrial soils of the assessed parameters.
- In the closure stage, the metal concentration contributions in PM-10 to be deposited on the soil are expected to decrease, because concentration contributions are mainly related to the activities of the Project construction and operation stages, according to the air modeling.

The residual impact assessment was performed in the monitoring stations outside the Project footprint, and which must comply with the EQSs for agricultural soils. The results of the residual impact assessment for the Project stages are presented below:

- In the construction and operation stages, residual impacts will have a negative direction, a negligible magnitude, a local geographical extension and a medium-term reversibility. Hence, the environmental consequence is very low.
- In the closure/post-closure stage, a negative impact direction, a negligible magnitude, a local geographical extension and irreversibility are expected. Hence, the environmental consequence is very low.

1.5.1.2 Air Quality

The development of the air quality assessment is based on the Project Description and the results of the baseline, which were interrelated to the results from the predictive modeling of atmospheric pollutants. It was established that air quality alteration may be caused by the development of activities during the Project construction, operation and closure stages due to particle and gas emissions.

1.5.1.2.1 Changes in Air Quality by Particulate Matter Emission

As per the changes in air quality by particulate matter emission, the maximum impacts of particulate matter generated by the Project activities were estimated, and 33 potential receivers were identified close to the Project. The resulting emissions and changes in air quality during the construction stage are expected to be greater than those anticipated for the operation and closure/post-closure stages, as a result of the increased movement of machinery and equipment along the different routes that will be developed for the construction.

The results for the different Project stages are presented below:

- In the construction stage, estimated average concentrations of PM-10 and PM-2.5 for the construction stage in Justo Pastor Ramirez Legua Association, the only sensitive receiver, would be below the EQSs for all parameters assessed. During the construction scenario, the highest impacts of PM-10 and PM-2.5 are expected to occur within the Project footprint.
- During the operation stage, model predictions for the operation did not show any exceedance in relation to the EQS-Air for PM-10 and PM-2.5. Similar to the construction scenario, the largest impacts of PM-10 and PM-2.5 are expected to occur within the Project footprint.
- During the closure stage, overall, the emissions resulting from closure activities in the relevant components are expected to be lower than those predicted for the operation stage.

The residual impact assessment is described below:

- During the construction and operation stages, the moderate environmental consequence for PM-2.5 is assessed considering the Project activities together with other current or potential sources of particulate matter, such as the emissions resulting from vehicle traffic on the Pan-American Highway, which is the main contributor to the total PM-2.5 concentration in the receiver, Justo Pastor Ramírez Legua Association.
- Since the activities associated with the closure stage will be fewer and less intense than those in the operation stage, the maximum PM-10 and PM-2.5 concentrations during the closure stage are expected to be lower than during the operation stage and, at the same time, below the EQS for air. Hence, the environmental consequence for particulate matter will be very low.

1.5.1.2.2 Changes in Air Quality by Gas Emission

As in the air quality change assessment for particulate matter, the updated air quality baseline information and air quality modeling were used to determine the impact by gas emissions.

The predictions of air quality associated with the Project operation and closure/post-closure stages together were estimated by using the mass balance method, with the software AERMOD version 15181.

The results of the air quality predictions for gas emissions during the different Project stages are presented below:

- During the construction stage, all concentrations for the gases analyzed in the receiver identified do not exceed the EQS for air. The estimated concentrations for NO_2[16], CO[17], and SO_2[18] mainly result from the emissions from trucks transporting different types of material that will be handled during construction, as well as from the exhaust emissions from the machinery and equipment engines that will be used in the different work fronts, and from the blasting in the pit. However, these emissions generated as a result of the Project construction activities are low when compared to the baseline concentrations recorded in the receiver Justo Pastor Ramirez Legua Association.
- In the operation stage: concentrations for the gases analyzed in the receiver identified do not exceed the EQS for air. The estimated concentrations of NO_2, CO, and SO_2 result mainly from the emissions from trucks transporting ore and waste rock during the operations, as well as from the exhaust emissions from the machinery and equipment engines that will be used in the different work fronts, and from the blasting in the pit. However, these emissions generated as a result of the Project construction activities are low when compared to the baseline concentrations recorded in the receiver Justo Pastor Ramirez Legua Association.
- In the closure stage: The main sources of gas emission identified in this stage are the emissions from the diesel engines of the mining trucks on the hauling roads, the fleet of the closure stage, and the emissions from various support vehicles, which will be smaller in number compared to the mining fleet of construction and operation stages. Since during the closure stage the activities are not expected to be as intensive as during the construction and operation stages, the gas emissions resulting from the closure activities are expected to be lower than those predicted for the construction and operation stages, and at the same time to be below the current EQS for air.

For the residual impact assessment, the only receiver, Justo Pastor Ramirez Legua Association, located within the study area has been considered; the residual impact assessment results are described below:

- Both for the construction and the operation stages, the SO_2 impact magnitude is considered moderate, while it is very low for NO_2 and CO. For SO_2, the impact of the Project activities is assessed together with other current or potential sources of SO_2 generation, such as the exhaust emissions from the engines of the vehicles on the South Pan-American Highway, which are the main contributors to the total SO_2 concentrations in the receiver Justo Pastor Ramirez Legua Association.
- In the closure stage, the maximum NO_2, CO and SO_2 concentrations are expected to be lower than those predicted for the construction and operation stages, and, at the same time, to meet the EQS for air as a result of the low activity of the emission sources, such as vehicles and equipment. Therefore, a very low environmental consequence is predicted in relation to these parameters.

1.5.1.3 Environmental Noise

For this assessment, the noise levels associated with the Project construction and operation stages as well as the possible changes in the noise levels compared to the baseline levels were considered. The noise level prediction was developed based on sound wave attenuation and propagation models.

[16] Nitrogen dioxide.
[17] Carbon monoxide.
[18] Sulfur dioxide.

According to the Project Description, the construction scenario involves earthworks, operation of two concrete plants, power supply, transport of materials for construction and waste rock, and pre-mining of the main pit. The operation stage involves ore mining and processing activities for export as ore concentrate and cathodes. These activities and those to be carried out during the Project closure have the potential to cause changes in the environmental noise levels. Noise modeling associated with the construction and operation stage activities was performed with a prediction model called Computer Aided Noise Abatement (CadnaA), developed by DataKustik GMBH. During the construction and operation stages, a receiver was relevant to assess the changes associated with the noise levels.

Due to the nature of the Project activities, it is considered that the effects of the increased noise levels during the construction and operation stages, will be greater near the sources assessed, while at further distances from these sources, the noise levels will decrease. The results for each Project stage are presented below.

- Construction stage: The range of noise levels as a result of the construction activities ranged between 16.6 and 16.2 noise decibels for daytime and nighttime hours, respectively. The noise levels estimated in the sensitive receiver are below the EQS-Noise for daytime and nighttime hours considering the commercial area. The main noise sources identified in that location were vehicle traffic (heavy vehicles, light trucks, buses, among others), and the permanent sound generated by the local businesses located along the South Pan-American Highway.
- Operation stage: The noise levels, for daytime and nighttime hours, due to the activities of the Project operations were 22.3 noise decibels in the receiver Justo Pastor Ramirez Legua Association. This level estimated in the sensitive receiver is below the EQS for noise, considering the commercial area. The main sources include operations in the main pit, such as blasting, ore and waste rock hauling, use of machinery and equipment on the different work fronts in the pit. In addition, ore processing is a significant noise source during the operation stage. As a result, noise generating activities during the Project operation would not have influence on the receiver identified as sensitive, since the anticipated noise levels are null.
- Closure stage: The noise emissions resulting from the closure activities in the relevant components are expected to be lower than those predicted for the construction and operation stages. Hence, the noise levels in the receiver are anticipated to be even lower compared to the levels obtained during those stages.

The residual impact assessment results for daytime and nighttime environmental noise are described as follows:

- During the construction stage, the impact direction will be negative, with a negligible magnitude, and a local geographical extension. Therefore, impacts would have a very low environmental consequence.
- During the operation stage, the impact direction will be negative, with a negligible magnitude, and a local geographical extension. Therefore, impacts would have a very low environmental consequence.
- During the closure stage, it is expected that the Project impacts decrease significantly compared to the construction and operation stages. For this reason, the noise levels resulting from the closure activities will be of very low environmental consequence. Although during the closure stage there will be a small mining fleet to complete earthworks, the frequency and amount of material to be moved will be lower compared to the construction and operation activities.

1.5.1.4 Underwater Noise

The potential effects of the Project identified in relation to underwater noise were determined on the basis of the activities associated with each stage of the Project located in the multi-buoy terminal area (marine area). The main aspect concerning underwater noise is the noise levels increase during the Project construction, operation and abandonment stages. Most of the Project potential effects on underwater noise are expected to occur during the construction and operation stages. This could increase the levels of environmental underwater noise in some specific areas of Bahía San Juan, which in turn could potentially affect the marine biota.

During the construction of the multi-buoy terminal, activities for the installation of the access trestle that will support the reception system for sulfuric acid (retractable hose and reel) and pipes of the seawater intake system for the Project will be carried out. The trestle will rest on steel piles, which will be installed by using the cantitravel method, which involves pile-driving on the seabed.

For the operation of the multi-buoy terminal, vessels with products (sulfuric acid) are expected on an average frequency of 2 to 3 vessels per month. These vessels will enter the multi-buoy terminal with the aid of a tugboat. These vessels have the potential to generate underwater noise. A continuous activity in the multi-buoy terminal is related to the discharge of sulfuric acid from the vessels to the tanks, by deploying a retractable hose. The operation of the hose reel, as well as the noise that vessel couplings and nipples could produce, can be considered as environmental aspect issues related to underwater noise. Another continuous activity includes seawater pumping, which would be a permanent underwater noise source.

Closure activities related to the decommissioning of the facilities of the multi-buoy terminal are the removal of piles, concrete slabs, trestle, seawater intake system, among other infrastructure; these activities involve the generation of underwater noise.

The estimates of the sound pressure levels that could be reached as part of the installation of the multi-buoy terminal are provided below:

- Pile-driving and drilling: The changes in sound pressure levels referred to in the literature vary according to the type of marine environment (inlet, estuary, bay, open coast, etc.), and especially to the type of seabed, as a rocky bottom tends to produce higher values of underwater noise than a soft bottom. According to the geophysical studies conducted in the area where the multi-buoy terminal will be installed, the bottom is soft and, therefore, values even below those referred to in the literature are expected.
- Noise from sea vessels: For the assessment of underwater noise produced by sea vessels, vessels approaching or leaving the multi-buoy terminal are expected to reach a maximum SPL of 136 dB (re µPa at 1 m). This assumption also applies to the prediction of noise levels during the closure stage.
- Pipe installation: There is little literature on the sound pressure levels that can be reached by the installation of pipes along the piers or marine facilities. However, the closest reference is the baseline readings recorded in Bahía San Juan, at the stations closest to the Diomedes Vente López Artisanal Fishing Dock (located 1 km NNE). In these facilities, maintenance works are performed on boats, products are loaded and unloaded, and outboard motor vessels are used. Therefore, it can be conservatively assumed that the sound pressure levels that can be reached by the installation of pipes related to the multi-buoy terminal may reach 136 dB.

- Hose deployment and seawater pumping: According to the literature reviewed, the increase in basal noise at low frequencies could have effects on fish and invertebrates. For example, in an experiment conducted with equipment, a 'Rena' air pump was used and generated broadband sound on one side of the experimental tanks to simulate the natural background sound levels in an aquarium with brown shrimps (*Penaeus aztecus*). The source level was higher at about 50 Hz, approaching 130 dB, and the source levels were 30-40 dB higher than the ambient sound, between 80 and 400 Hz (Lagardère 1982). The operation of the air pump can be considered similar to the operation of the hose reel and the seawater pumping system, so levels of 130 dB can be expected.

The residual impact assessment results for daytime and nighttime environmental noise are described as follows:

- Construction stage: The residual impact assessed in the receivers identified is negative in direction and moderate in magnitude within the Project footprint, that is, they are restricted to the construction area of the multi-buoy terminal and do not have the potential to affect Punta San Juan or another colony of pinnipeds. Therefore, the impact on underwater noise is anticipated to be of low environmental consequence.
- Operation stage: Although during the operations the impacts of underwater noise can be medium term, the magnitude is expected to be low as they will slightly exceed the values recorded in the baseline. The underwater noise levels predicted are not expected to cause disorders in or injuries to marine species. Therefore, the impact on underwater noise is anticipated to be of low environmental consequence.
- Closure stage: The decommissioning of the multi-buoy terminal and, especially, the removal of piles have the potential to generate underwater noise values in the lower threshold which cause disorders in marine mammals. However, it is considered a specific activity that with appropriate mitigation its effect can be attenuated. Therefore, the impact on environmental noise is anticipated to be of low environmental consequence.

1.5.1.5 Vibrations

The Project potential effects on vibration levels were determined from the identification of the vibrations sources, such as the emissions associated with blasting activities. The estimate of the vibration levels was developed based on models of the vibration wave attenuation.

The Project activities will produce a change in the vibration levels in the ground and in the air within the study area. These impacts are associated with the blasting activities in the open pit, which will take place during the construction and operation stages. It should be noted that during the closure stage, earthworks will be carried out for the reclamation and revegetation of the land impacted. Therefore, the potential effects on vibration levels have not been assessed for the closure stage as it does not include blasting activities, and these are the largest source contributing to vibration levels.

1.5.1.5.1 Changes in Soil Vibration Levels

According to the description of the Project activities, the generation of vibrations in the ground was determined to be a factor with potential to cause impacts during construction and operation stages.

The speed at which vibrations in the ground attenuate away from the blasting source depends on the specific area in which these activities take place. In that regard, a predictive model was conducted to determine the characteristics of this attenuation in the receiver, Justo Pastor Ramirez Legua Association.

The ground vibration model was estimated on the basis of the Australian standards applied to blasting in open pits (JKMRC[19] 1996), through which the propagation of particles across the ground are estimated, considering the blasting activities as the source.

Results indicate that the soil vibration levels in the potential receiver, with or without blasting, and at 8,100 m from the operation, have remained below the annoying level for people (0.3 mm/S) and below the maximum limits indicated by the General Directorate of Mining Environmental Affairs.

The residual impact assessment shows a negative direction, a negligible magnitude, an immediate geographical extension, reversible in the short term, and a discontinuous frequency. Hence, the environmental consequence would be very low for the construction and operation stages.

1.5.1.5.2 Changes in Air Vibration Levels

The air vibration assessment method was the same as that for ground vibrations, as theoretical models were also developed for the estimation of air vibration levels in the receivers.

For the air vibration modeling, the blasting to be carried out in the main pit are considered the only source of vibration.

The results of the air vibration estimate conducted in the receiver with and without blasting during the construction and operation stages have remained below the annoying level for people. Vibration levels predicted do not exceed the current maximum levels (133 dBL) and are approximately 95.2 dBL.

The residual impact assessment for the construction and operation stages would have a negative direction, a low magnitude, an immediate geographical extension, short-term reversibility and a discontinuous frequency. Therefore, the environmental consequence would be low.

1.5.2 Potential Biological Impacts

1.5.2.1 Terrestrial Flora and Fauna

The potential biological impacts on biological diversity are described below.

1.5.2.1.1 Change in Vegetation Cover

The terrestrial environmental study area covers 36,164.14 ha, and for the impact assessment during the construction stage, a project footprint of 3,105.16 ha was considered, which includes as main activities earthworks for the main components and the construction of the multi-buoy terminal, clearing of the area where the seawater supply pipeline will be installed, access roads, camp, borrow quarries and other ancillary components. The variations in the types of vegetation between baseline and the construction stage are presented below:

- Reduction of 35.98 ha (11.0%) of Rockland Vegetation;
- reduction of 2,266.31 ha (19.8%) of Tillandsial-DTA;
- reduction of 802,00 ha (3.5%) of Coastal Desert; and
- No reduction of Lomas.

When comparing the results between the construction stage and baseline, it is observed that the greatest reduction in areas will occur for Tillandsial-DTA, while the Lomas-vegetation type will not be affected by the placement of the Project facilities or infrastructure.

[19] Julius Kruttschnitt Mineral Research Centre, University of Queensland Australia.

During the operation stage, the footprint covers 4,128.66 ha, which is approximately 12% of the terrestrial environmental study area. The main activities and components during this stage correspond to the pit mining; placement of the tailings storage facility, dumps, multi-buoy terminal, seawater supply pipeline, camps, water and solid waste management structure, and other ancillary components. The variations in the types of vegetation between baseline and the operation stage are presented below:

- Reduction of 35.98 ha (11.0%) of Rockland Vegetation;
- reduction of 2,825.05 ha (24.7%) of Tillandsial-DTA;
- reduction of 1,266.76 ha (5.5%) of Coastal Desert; and
- No reduction of Lomas

It is observed that, similarly to the construction stage, the greatest reduction in areas by type of vegetation will occur for Tillandsial-DTA. On the other hand, the Lomas-vegetation type will not be affected by the placement of the Project facilities or infrastructure.

Reclamation of the areas in which the main components–such as dumps, tailings storage facility, process plants, multi-buoy terminal, camp areas, offices, workshops, water supply pipelines, access roads and quarries–are located is considered during the Project closure stage. During the closure stage, there will be changes in the types of vegetation, such as:

- The Rockland Vegetation and Tillandsia-DTA will maintain the same estimated reduction for the operation stage (Table 5.4.6-5), with 11.0% and 24.7% changes compared to the updated baseline.
- The Coastal Desert will increase by 11.2%, due to the reclamation activities on the land where the Project components will be located.

The Disturbed Area will increase by 21.1% compared to the updated baseline. This increase corresponds to the footprint area left by the pits at the end of the operation stage, which will not be reclaimed.

In regard to the residual impact analysis:

- During the construction stage, changes in the vegetation types within the terrestrial environmental study area in connection with habitat alteration will have a negative direction. The changes in the Rockland Vegetation and Tillandsial-DTA will be low and moderate in magnitude, respectively, as the variation will be less than 15% and 25% compared to the baseline conditions. The changes in the Coastal Desert will be less than 5% compared to the baseline conditions, so they will be negligible in magnitude. All changes for the types of vegetation assessed will be immediate in geographic extent, as they will be restricted to the Project footprint, and will be irreversible for the Rockland Vegetation and Tillandsial-DTA, and reversible in the long-term for the Coastal Desert. As a result of this assessment, the environmental consequence of the change during the construction stage is predicted to be low for the Rockland Vegetation, moderate for Tillandsia-DTA and very low for the Coastal Desert.
- During the operation stage, changes in the vegetation types within the ESAt in connection with habitat alteration will have a negative direction. It should be noted that the Project activities during the construction and operation stages will not affect the Lomas area identified within the ESAt. The magnitude of the changes in the Rockland Vegetation and Coastal Desert will be low, as the variation will be less than 15% compared to the baseline conditions. The changes in the Tillandsia-DTA will be less than 25% compared to the baseline conditions; therefore, they will be moderate in magnitude. All changes for the types of vegetation assessed will be immediate in geographic extent, as they will be restricted to the Project footprint, and will be irreversible for the Rockland Vegetation and Tillandsial-DTA, and reversible in the long-term for the Coastal Desert. As a result of this assessment, the environmental consequence of the change during the construction stage is predicted to be low for the Rockland Vegetation and Coastal Desert, and moderate for the Tillandsial-DTA.

- For the closure stage, changes in the vegetation types within the ESAt related to habitat alteration will have a negative direction. In the case of the Coastal Desert, after land reclamation, this area will increase, whereupon the residual impact will be positive in direction. It should be noted that upon the Project closure, the Lomas area identified within the ESAt will not be affected. The magnitude of the changes in the Rockland Vegetation and Coastal Desert will be low, as the variation will be less than 15% compared to the baseline conditions. The changes in the Tillandsial-TDA will be lower than 25%; therefore, they will be moderate in magnitude. All changes for the types of vegetation assessed will be immediate in geographic extent, because they will be restricted to the Project footprint, and they will be irreversible. As a result of this assessment, the environmental consequence of the change during the construction stage is predicted to be low for the Rockland Vegetation and Coastal Desert, and moderate for the Tillandsial-DTA.

1.5.2.1.2 Impact on Species of Ecological Importance

The impact on species of ecological importance related to habitat alteration will have a negative direction. In the construction stage, the Project impact on terrestrial flora and fauna species of interest will cause the following changes:

- For *Nolana pallidula* vell aff., *Tillandsia landbeckii* and *Corryocactus brachypetalus*, there would be a 19.8% reduction in their respective habitats, a result mainly related to the reduction of tillandsials reduction in the ESAt and the preference of these species for this habitat.
- For the *Tillandsia latifolia* var. *divaricate* species, there would be a 13.3% reduction in its habitat, which is mainly tillandsials. However, this species also prefers the Coastal Desert, and for this reason the reduction of its habitats is smaller compared to the other species that inhabit tillandsials.
- For the remaining species of flora, the reduction of their habitats would be 11.0%. For the *Weberbauerella raimondiana* species, no changes are predicted in its habitat units (HU), since its habitat (Lomas) will not be affected during the Project construction stage.
- For mammal, bird and reptile species, the reduction of their habitats is expected to be less than 10% of that identified during the baseline.

In the operation stage, the Project impact on terrestrial flora and fauna species of interest will cause the following changes:

- For *Nolana pallidula* vell aff., *Tillandsia landbeckii* and *Corryocactus brachypetalus*, there would be a 24.7% reduction in their respective habitats, a result mainly related to the reduction of tillandsials reduction in the terrestrial study area and the preference of this species for this habitat.
- For the *Tillandsia latifolia* var. *divaricata* species there would be a 17% reduction in its habitat, which is mainly tillandsials. However, this species also prefers the Coastal Desert, and for this reason the reduction of its habitats is smaller compared to the other species that inhabit tillandsials.
- For the remaining species of flora, the reduction of their habitats would be 11.0%, similar to that estimated for the construction stage. It should be noted that for the *Weberbauerella raimondiana* species, no changes are predicted in its HU, since its habitat (Lomas), as in the construction stage, will not be affected during the Project operation stage.
- For most species of mammals, birds and reptiles, the reduction of their habitats is expected to be less than 10% of that identified during the baseline. However, the habitat of *Lama guanicoe* and *Geosita peruviana* is expected to decrease by 11.8% during the operation stage compared to the baseline. In the case of guanaco (*Lama guanicoe*), since it is a species typical of high Andean zones that comes to the terrestrial study area in between seasons, the reduction of its HU focuses on the impact on its displacement routes.

In the closure stage, once reclamation measures have been taken, the Project impact on terrestrial flora and fauna species of interest will cause the following changes:

- For *Nolana pallidula* vell aff., *Tillandsia landbeckii* and *Corryocactus brachypetalus*, the impact on their habitats would remain after the operation stage, with a reduction of 24.7%, which is directly related to the reduction of the Tillandsial-TDA vegetation type within the terrestrial study area.
- For the *Tillandsia latifolia* var. *divaricata* species there would be a 10.3% reduction in its habitat, which is mainly tillandsials. However, this species also prefers the Coastal Desert, and for this reason, the reduction of its habitats will be smaller compared to other species with a greater preference for tillandsials.
- For the remaining species of flora, the reduction of their habitats would remain 11.0% during the closure stage, similar to that estimated for the construction and operation stages. It should be noted that for the *Weberbauerella raimondiana* species, no changes are predicted in their HU, since its habitat (Lomas), as in the construction and operation stages, will not be affected during the closure stage of the Project.
- For bird species and for *Lama guanicoe*, the reduction of their habitats is expected to be less than 10% from that identified during the baseline. In addition, it is estimated that there will be an increase in habitat for *Lycalopex griseus* and *Microlophus theresiae, Microlophus thoracicus*, since these species have a greater preference for the Coastal Desert, which will also have a larger area during the Project closure stage.

1.5.2.2 Marine Flora and Fauna

The assessment of impacts on marine flora and fauna is based on the knowledge of the species of the marine hydrobiological communities existing in the marine zone of the Environmental Study Area.

For the marine flora and fauna during the Project construction, operation and closure stages, the habitat alteration related to the installation and operation of the Multi-buoy Terminal was identified as an environmental issue, which could lead to a change in the habitat availability and in the structure of hydrobiological communities.

1.5.2.2.1 Change in the Quantity of Marine Habitat

To assess the Project impact on the amount of available marine habitat, the extension of the Environmental Study Area marine zone (ESAm) and the area of the Project marine footprint (associated with the multi-buoy terminal facilities) were considered.

Conservatively, for assessment purposes, the entire area within the project marine footprint will be changed with regard to the updated baseline conditions. The magnitude of this change was evaluated in terms of the changed percentage of the area with regard to the total area of the ESAm during the construction, operation and closure stages.

The results indicate that during the Project construction and operation stages, the marine habitat within the ESAm will have an extension of 9,665.3 ha. This change represents a decrease in the marine habitat of 0.25% (24.3 ha) regarding the baseline conditions, and it will be mainly related to the multi-buoy terminal installation and operation. It also considers the potential marine habitat impact due to the installation of the multi-buoy terminal access trestle and to the seawater intake system, related to sediment removal and increased suspended solids, which will be restricted to the Project marine footprint within the ESAm.

During the closure stage, the areas will be reclaimed, so the conditions of the site are expected to improve over time. The closure measures consider the decommissioning and disassembling of the multi-buoy terminal infrastructure; therefore, the baseline conditions are expected to be reestablished.

As per the residual impact assessment, during the Project construction and operation stage, the change in the extension of the marine habitat related to the habitat alteration will have a negative direction because there will be a decrease in the marine habitat in terms of marine surface due to the placement of the multi-buoy terminal. This decrease will be negligible because the variation will be less than 5% compared to the baseline conditions. The change will have an immediate extension because it will be limited to the Project footprint and it will be reversible in the long term. As a result of this assessment, the change in the extension of the marine habitat during the Project construction and operation stages is expected to have a very low environmental consequence.

1.5.2.2.2 Impact on Species of Interest

The concepts of Habitat Suitability Index (HSI) and Habitat Units (HUs) were used to assess the Project impact on the marine species, which considers the geographic extension of the different areas in the ESAm and the habitat quality for the marine communities that inhabit each zone.

The methodology for determining the HSI is a simplified version of the US Habitat Assessment Procedures (U.S Fish and Wildlife Service), which uses the HSI to quantify the habitat. HSIs are analytical tools used to determine the relative potential of a given area to provide an ideal habitat for species.

For the current impact assessment, the HSI estimation is based on the potential ideal habitat within the marine area of the Environmental Study Area (ESAm), divided into eight assessment zones, and considering the sandy intertidal macrobenthos communities, rocky intertidal macrobenthos, subtidal macrobenthos, macroalgae, invertebrates, fish, seabirds and marine mammals.

Later, to obtain the Habitat Units (HUs), the HSI estimated for each biological community assessed were multiplied by each zone area.

The results of the impact on the assessed communities are presented as the variation of the habitat quality for these species, by analyzing the change in the number of Habitat Units (HUs) at each Project stage. The HUs were calculated for each biological community and for each sub-area of evaluation, by multiplying the HSI (estimated for each biological community) by the area (ha) of the respective sub-area. Then, the HUs of each sub-area belonging to the same biological community were added together to obtain the total HU within the ESAm.

For the current assessment, the analysis conservative approach considers that the impact on marine species as a consequence of the Project development during the construction stage will continue having the same magnitude in the operation stage.

The results indicate that during the Project construction and operation stages there will be changes in the HU available to the evaluated biological communities, with regard to the baseline. As mentioned above, these changes are related to the installation and operation of structures associated with the multi-buoy terminal.

- For the sandy intertidal macrobenthos, subtidal macrobenthos, invertebrates, fish and seabirds, there would be a decrease in their respective habitats, equivalent to less than 2% of the estimated HUs in the ESAm during the baseline.
- For the macroalgae, the HU decrease would be 2.13% regarding the estimation for the baseline within the ESAm.

The final residual impact assessment was conducted by applying a series of environmental impact indicators criteria, which are detailed in section 5.4.7 of the EIAd Amendment.

Based on the application of these criteria, it was determined that during the Project construction and operation stages, the impact on the marine species, related to the habitat alteration and the change in the extension of the aquatic habitat will have a negative direction because there will be a decrease of the HU in terms of habitat quality for the biological communities assessed due to the installation of the Multi-buoy Terminal. This decrease will be negligible for the biological communities evaluated within the ESAm, as the change will be less than 5% in comparison to the baseline conditions. Likewise, this change will have a specific extension

because it will be limited to the marine footprint of the Project and will be reversible in the long term. As a result of this assessment, it is predicted that the impact on marine species during the construction and operation stages of the Project will have a very low environmental impact.

1.5.2.3 Fragile Ecosystems

Within the Environmental Study Area terrestrial zone (ESAt), the lomas were identified as fragile ecosystems. However, Lomas are located approximately 10 km from the Mina Justa Project. After the corresponding assessment, it was determined that the Project development and its related activities will not impact the Lomas.

1.5.2.4 Landscape

The baseline studies determined that the landscape within the Area of Environmental Influence presents two levels of visual quality: medium and low. These levels were established according to the consideration of the criteria that include the analysis of their geomorphology, vegetation, water, color, scenic background, singularity and human activities on the ground.

Activities during the Project construction stage include earthworks for the main components and the pre-mining of the main pit, access road clearing, camps and quarries, as ancillary components, which cause less than 1% of variation in the landscape visual quality regarding the evaluated conditions without the intervention of the Project (baseline). The change in the landscape visual quality is expressed with the reduction of landscape with average visual quality that is reflected in the increase of landscape with low visual quality.

As in the construction stage, the reduction of the landscape area with average visual quality is reflected in the increase of the landscape with low visual quality, because the latter represents the conditions of the Project operation stage and both correspond to the Area of Environmental Influence that was assessed during the baseline. The main activities and components during this stage include the pit mining, operation of the tailings storage facility and dumps, seawater supply pipeline, camps, water and solid waste management facility, and other ancillary components, which represent less than 1% variation in the landscape visual quality with regard to the conditions evaluated during the baseline.

The impact on the landscape visual quality during the closure stage is lowest in regard to the previous two Project stages (construction and operation). This variation is reflected in a low visual quality landscape represented by a very small area in relation to that of the baseline (0.00%).

During this stage, the areas will be reclaimed and provided with physical stability, and the conditions of the place are expected to improve over time. The reclamation and physical stabilization will be carried out on the areas where the pits, dumps, tailings storage facility, process plants, camp areas, offices, workshops, water supply pipelines, access roads, and quarries were placed, according to the measures established in the Closure Plan (section 6.8 of the EIAd Amendment).

1.5.3 Potential Socioeconomic Impacts

The purpose of this section is to identify residual, direct, positive and negative socioeconomic impacts related to the potential change in the society and the economy as a result of the Mina Justa Project activities. Given the differences in the nature of the environmental and socioeconomic impacts, the methodology for the socioeconomic impact assessment is an adaptation of the methodology used for the environmental impacts. Section 5.3.3 of the EIAd Amendment shows further details of the methodology used.

The impact assessment is performed based on direction, magnitude, extension and duration criteria, which determine the impact consequence. It should be noted that the assessment implicitly contains the cumulative and synergistic nature of the impacts, since they cannot be detached from the socioeconomic aspects.

The effects regarding the archaeological component have not been considered in the assessment because, according to the current national regulations, the minor buildings and archaeological remains found in the Project area should be rescued and made available to the competent authority for its conservation. Marcobre will define the recovery, protection and conservation of minor archaeological remains with the Ministry of Culture.

Table RE-7 summarizes the assessment of the socioeconomic impacts identified for the construction, operation and closure stages that the Project development involves.

Table RE-7: Socioeconomic Impact Assessment Matrix for the Project Construction, Operation, and Closure Stages

Potential Impact	Direction	Magnitude	Extent	Duration	Consequence
Construction Stage					
Increase of Mining Investment	Positive	Moderate	National	Short term	Low
Creation of Local Employment Opportunities	Positive	Moderate	Local	Short term	Moderate
Local and National Commercial Opportunities	Positive	Low	National	Short term	Low
Increase of Local Investment for the Strengthening and Development of the Community in the Area of Influence	Positive	Moderate	Local	Short term	Moderate
Saturation of the Public Services due to the Effects of Immigration	Negative	Moderate	Local	Medium Term	Moderate
Population's Fears about Environmental Damage	Negative	Low	Local	Short term	Low
Operation Stage					
Increase of Regional and Local Government Budgets due to the Mining Canon Allocations	Positive	High	Regional	Medium Term	High
Creation of Employment Opportunities	Positive	Moderate	Local	Medium Term	Moderate
National Commercial Opportunities	Positive	Moderate	National	Medium Term	Low
Increase of Local Investment for the Strengthening and Development of the Community in the Area of Influence	Positive	Low	Local	Medium Term	Low
Population's Fears about Environmental Damage	Negative	Low	Local	Medium Term	Low
Closure Stage					
End of Economic Benefits at the National Level	Negative	Low	National	Short term	Low
End of Economic Benefits at the Regional Level	Negative	Moderate	Regional	Short term	Low
End of Economic Benefits at the District Level	Negative	Moderate	Local	Short term	Moderate
End of Employment	Negative	Low	Local	Short term	Low

Potential Impact	Direction	Magnitude	Extent	Duration	Consequence
End of Local Investment for the Strengthening and Development of the Community in the Area of Influence	Negative	Low	Local	Short term	Low
Population's Fears about Environmental Impacts	Negative	Low	Local	Short term	Low

Construction Stage

From the socioeconomic impact assessment, it can be concluded that the impact caused by the increase in mining investment has a positive direction, as it contributes to the trade balance and Gross Domestic Product (GDP) in Peru. The magnitude of the impact is high because the average annual value of the investment in the Project is equivalent to 4.7% of the mining investments registered at the national level during 2015, and places Marcobre among the five mining companies with the highest investment in Peru. The impact has a national extent and short-term duration, which means that the impact will last during the Project construction stage.

As for the creation of employment opportunities, there is a positive direction, as it contributes to closing the few unemployment gaps and improving the population employability conditions. The magnitude of the impact is moderate because, although the level of employment required by Marcobre is equivalent to 16.6% of the economically active population (EAP) in the district of Marcona, only 4% of unemployment has been identified and the largest part of the employed EAP of the district is working in the mining sector, which could involve high levels of immigration in search of employment. Since hiring priority is given to the population residing in the district of Marcona, the extent of the impact is local; however, the population of the districts of Vista Alegre and Nasca, which are part of the area of indirect influence, will also be considered. The impact has a short-term duration as this demand for labor will appear during the Project construction stage.

The impact of the commercial opportunities at the national and local level has a positive direction, since it contributes to the local, regional, and national economy. The magnitude of the impact is low, given that the average annual amount (S/. 49.3 million approximately) allocated for the procurement of goods and services at the national level is equivalent to 0.085% of the declared national mining purchases registered by SUNAT, and to 0.031% of the net sales of goods and products at the national level, based on the National Economic Census (CENEC 2008) data. The importance of the mining activity with respect to the indirect effects generated by the employment and development of domestic demand variables is clear. The extent of the impact is national, as there is no priority regarding the procurement of goods and services, and is based on the available supply that Marcobre will promote. The impact is short term because it occurs while the Project activities are being implemented during the construction stage.

The impact on local investment for the community strengthening and development is positive, as it contributes to the district's development, under a sustainable approach, not one of dependency. Regarding the magnitude, it is considered moderate, since the Marcobre investment through the Social Management Plan in the district of Marcona is equivalent to 1.64% of the district Modified Investment Budget (MIB) in 2015. The investment in community development is expected to be sustained over time, and not to be reversed. The extent of the impact is local, since the district of Marcona is the main focus of the Social Management Plan's Local Economic Development Programs. All the efforts made to strengthen the local capacities and the local suppliers; the contribution to health, education, and tourism; and the productive development for the extraction of hydrobiological resources are directed towards the district. Finally, the impact has short-term duration, considering that this level of investment is expected for the construction stage. Based on the above, the impact of the local investment increase to strengthen and develop the community in the area of influence is positive and has a moderate environmental consequence.

During the construction stage, the Project will require a significant amount of labor (1,400 workers approximately) to perform the work at the mine, at the plant, and in the administrative area. Based on the Project staff requirements and the high employment level in the district of Marcona, it is probable that the job

positions will not be fully occupied by local workers. The influx of external workers, added to the probable increase in the migration flow due to the expectation of employment and business opportunities generated by the mining activity, will exert greater pressure on the utilities of the district of Marcona (such as water, sanitation, and electricity) and also a potential saturation of the educational and health services. As a result, the impact of the saturation of public services is negative and has a moderate environmental consequence.

The population's fears about the environmental impact are considered to have a negative direction, but low magnitude, since no negative impacts of a moderate or high environmental consequence on air, noise, vibrations, flora and fauna, soil, and water quality affecting human well-being and health are expected. In addition, Marcobre will implement an environmental management plan that will include participatory environmental monitoring and the population will be informed about the environmental management measures. These actions are expected to reverse or reduce the negative perceptions about Marcobre's environmental performance, and to avoid misinformation and speculation. The extent of the impact is local, due to the fears showed mainly by the population of the district of Marcona. The impact has short-term duration because the intensity of the negative perceptions is expected to be higher during the construction stage due to the soil removal activities and the multi-buoy terminal construction.

Operation Stage

At the regional level, it can be concluded that the impact caused by the increase of the regional government budget due to the effects of the mining canon allocations has a positive direction, as it contributes to the Regional Government revenues. The magnitude of the impact is high, because the average annual canon generated by the Project during the operation stage is equivalent to 59.6% of the mining canon, to 17.0% of the allocations corresponding to canon in general, and to 10.3% of the MIB of the Regional Government of Ica in 2015. The impact has regional extent and medium-term duration, because it will extend throughout the Project operation stage in the 2021-2034 period.

In the Marcona district, the impact caused by the regional government's budget increase as a result of the mining canon allocations is positive, as the annual budget of the district of Marcona will be favored by the mining canon allocations generated by the Project. The magnitude of the impact is high, because the projections of the total canon to be allocated annually are equivalent to 112.8% of the mining canon, and to 17.6% of the total canon received by the district in 2015, as well as to 14.3% of the district MIB. Therefore, it will have a favorable effect on its public budget. The impact has local extent and medium-term duration, because it extends throughout the Project operation stage in the 2021-2034 period.

The impact of the creation of employment opportunities has a positive direction, because even if employment is reduced by 24.4% compared to the construction stage, there is still a significant number of personnel to be hired. The magnitude of the impact is moderate because, even though the employment that will be generated by the Project will be reduced in the operation stage compared to the construction stage, it is still high with regard to the Employed EAP and to the unemployed population of the district of Marcona, which could imply high immigration of personnel in search of employment in the Project. The extent of the impact is local, because the hiring priority is given to the population residing in the district of Marcona, where the immigrant population in search of employment will settle down. The impact has medium-term duration as this demand for labor will be required during the Project operation stage.

The population's fears about the environmental impact are considered to have a negative direction, but low magnitude, since no negative impacts of moderate or high environmental consequence on air, noise, vibrations, flora and fauna, soil, and water quality affecting human well-being and health are expected. In addition, Marcobre will continue implementing its environmental management plan that includes participatory environmental monitoring procedures, and that will continue informing the population about the environmental management measures. With this, the negative perceptions about the Marcobre environmental performance are expected to be reversed or reduced, avoiding misinformation and speculation. The extent of the impact is local because it will affect the population of the Marcona Village. It has medium-term duration because, even if the fears continue during the operation stage, they are expected to be gradually reversed.

Closure Stage

The impact of the employment layoff has a negative nature, since the end of operations will result in the layoff of approximately 95% of the personnel hired during the operation stage. The magnitude of the impact is low, because not only must the layoff be considered, but also the multiplier effects of having been employed for 18 years, such as the work experience acquired during the operation stage, the benefits of having been employed (competitive wages, bonus, vacations, insurance, among others), and the training opportunities that Marcobre will provide through the Social Management Plan.

The population's fears about the environmental damage during the closure stage is considered to have a negative direction, because the population has negative perceptions regarding the project closure. The impact has a low magnitude, since no negative impacts of a moderate or high environmental consequence that imply a direct damage on the human health and well-being are expected as consequence of the closure activities. Likewise, Marcobre will continue informing the population about the environmental and social management measures to be implemented throughout the Project mine of life. By doing this, the negative perceptions about the environmental management of the closure process by Marcobre are expected to be reversed or reduced, and avoid misinformation and speculation. The extent of the impact is local, since it falls on the population of the district of Marcona. Finally, the impact has a short-term duration, because the negative perceptions are expected to reverse gradually through communication channels. Negative perceptions are also expected to be reduced or eliminated based on the Project good behavior in regard to the environment.

1.6 Environmental Management Strategy

1.6.1 Environmental and Surveillance Management Plan

The Environmental Management Plan (EMP) has been designed to provide environmental prevention and mitigation measures during the construction, operation and closure measures of the Project, in accordance with the environmental impacts identified in the Environmental Impacts Characterization and with Marcobre's Corporate Policy and current national legislation.

This section also includes a summary of the Environmental Management Plan designed to provide the environmental follow-up and control system implementation mechanisms to ensure fulfillment of the measures of the Environmental Management Plan, in compliance with Marcobre's Environmental Policy and the current national legislation.

1.6.1.1 Air

The EMP measures seek to control and mitigate atmospheric emissions generated by the Project activities and their associated environmental impacts, in order to guarantee they do not exceed the EQS for air quality receivers.

The general mitigation measures to be taken for dust control, combustion gases and gas emissions include prohibiting the use of material or equipment that contain polychlorinated biphenyl (PCB) or freon, implementing gas retrieving systems in the fuel storage tanks, carrying out the preventive maintenance of the machinery and vehicles on a frequency basis suggested by the manufacturer's specifications, maintaining and watering the access roads periodically to avoid the dust generation, implementing sprinklers in the production process, using sprinklers in the mineral unloading operations from the trucks, optimizing the vehicle movements toward the work fronts and establishing speed limits and road signposting.

The Environmental Surveillance Plan includes sampling of particulate matter (PM10 and PM 2.5), metals (arsenic and lead), gases and meteorological parameters in four stations during the construction and operation stages (Figure RE-23 and RE-24), whose results will be compared with the EQS for air quality. The monitoring frequency will be quarterly both for the construction and for the operation stages.

1.6.1.2 Noise and Vibrations

The EMP measures seek to control and mitigate the increase of noise and vibration levels generated by the Project activities and their associated environmental impacts during the construction and operation stages, to guarantee that these do not exceed the EQS in the receiver Justo Pastor Ramírez Legua Association located 8 km from the Project.

The general noise control measures will be: using acoustics barriers, deflector plates or protectors to isolate engine-driven equipment; implementing acoustic containers; reducing generation sources by applying intrinsic controls in the Project design; operating equipment according to technical specifications; checking that the noise attenuation devices are in good conditions; carrying out the preventive maintenance of noise buffering systems for machines and equipment; controlling vehicle speed limits; minimizing the use of horns; and keeping the access road surfaces in good conditions to reduce the noise caused by tires.

The mitigation measures that will be implemented to control vibrations will be: blasting planning (main pit and Manto Magnetita pit), maintaining signs and notifying (as required) the population close to the blasting activities.

The Environmental Surveillance Plan includes sampling environmental noise in five stations during the construction and operation stages (Figure RE-23 and RE-24), whose results will be compared with the EQS for noise quality. The frequency of this monitoring will be quarterly for both the construction and operation stages.

According to the results of the vibration model, the soil and air effect will be kept within the Project footprint, without affecting the receiver assessed (Justo Pastor Ramírez Legua Association) located at an 8 km distance; therefore, the Environmental Surveillance Plan does not include vibrations monitoring.

1.6.1.3 Soils

The EMP measures are limited to intervene in strictly necessary areas according to the designs, use previously disturbed areas (for example, existing access roads, areas intervened during exploration) if possible, and prioritize the progressive reclamation of the areas disturbed by the Project.

The monitoring program includes soil quality monitoring in nine stations (Figure RE-23 and RE-24) to control soil quality, considering those background parameters and the EQS for soils. This monitoring will be performed on an annual basis for both the construction and operation stages.

1.6.1.4 Surface Water

According to the meteorology, climate and life zones baseline, the Project area is characterized by a representative arid zone climate, with lack of rainfall all over the year seasons; as a result, the Project does not consider infrastructure for the management of contact and non-contact water.

Nevertheless, the Project specific objectives are to implement the necessary measures so as to not generate mining metallurgical effluents or domestic waste waters, both in the continental and marine zones (zero discharge); and maximize the recirculation and reuse of the treated and process water.

Hence, the monitoring plan includes seawater quality sampling in eight stations set in the multi-buoy terminal area (Figure RE-23 and RE-24). The program considers the EQS for water subcategory 1-B1 and 2-C3. It is worth noting that the Cat. 4-E3 area classification unit, applicable to Protected Natural Areas (ANP), is far from the multi-buoy terminal operation activities in Bahía San Juan and from the eight monitoring stations set; therefore, it this category was not considered for the monitoring program. The monitoring will be carried out on a quarterly basis for both the construction and operation stages.

1.6.1.5 Underground Water

According to the hydrogeological baseline, there are no underwater upwellings such as wetlands or springs. Water levels identified are between elevations of 198 masl and 233 masl, below the 500 m of depth.

In addition, the pits will be located in an unsaturated medium, free from seepages, given that the height of water level registered in piezometer MJ-03 is 233.8 masl, and it is more than 60 m below the deepest projected main pit bottom bank.

In that sense, mine waters are not expected in the main pit or in the Manto Magnetita pit; therefore, it is not necessary to propose control management measures.

However, monitoring underground water levels in six deep wells (600 m deep) and water quality in six shallow wells (80 to 100 m) is relevant to the Project (Figure RE-23 and RE-24).

1.6.1.6 Seawater

The prevention, mitigation and management measures to be implemented during construction consider not discharging effluents, oils and solid construction waste into the sea; giving maintenance to equipment and machinery to guarantee the good condition of the hoses that contain liquid substances like hydroline, oils, etc.; and installing portable toilets for the staff who work in the multi-buoy terminal construction. The waste generated will be managed by an EPS-RS authorized by DIGESA.

According to the underwater sounding results and the stratigraphic profile, there is no rocky seabed in the zone where the access trestle will be built; therefore, no blasting for rock fracturing or dredging works are foreseen. Thus, no impacts on the water resource are expected from this type of activities and it will not be necessary to implement specific management measures. However, if rocky seabed were found, Marcobre must establish specific management measures for these activities.

During the operation stage, the management plan considers necessary to operate as per the provisions of the International Convention for the Prevention of Pollution from Ships,1973, amended by the London Protocol (hereinafter, MARPOL 73/78), as established by the International Maritime Organization (IMO). This provision is applicable to Marcobre and its contractors. Marcobre must also comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004.

The monitoring program is the same as the surface water monitoring plan and comprises the seawater quality sampling in eight stations set in the multi-buoy terminal area (Figure RE-23 and RE-24) during construction and operation.

1.6.1.7 Mining Metallurgical and Domestic Effluents

The Project will not generate mining-metallurgical effluents; industrial water from the oxide plant will recirculate and industrial water from the sulfide plant will be sent to the tailings storage facility, and the tailings storage facility supernatant will not be discharged into any surface water body. Therefore, there are no specific measures considered for the environmental management of effluents nor monitoring or control stations for the supervision of mining-metallurgical effluents.

However, the Project considers the implementation of a desalination plant and as an environmental management measure, the brine generated (99 m^3/h) will be disposed of in two ways: 59 m^3/h will be used for the irrigation of access roads (dust suppression) and approximately 40 m^3/h will be taken to the tailings storage facility; in addition to combining and thickening cleaner scavenger tailings and rougher tailings before their disposal in the tailings storage facility.

Domestic effluents will be treated in two WWTPs and septic tanks for their subsequent use in access road irrigation; therefore, a monitoring program of the treated domestic waste waters is proposed.

The surveillance plan considers 10 effluent quality monitoring stations set in the WWTPs and septic tanks. The parameters to be assessed are the mining-metallurgical MPLs approved by S.D. No. 010-2010-MINAM (except for total CN) and referentially the MPLs for Domestic or Municipal Waste Water Treatment Plant Effluents approved by S.D. No. 003-2010-MINAM (Figure RE-23 and RE-24).

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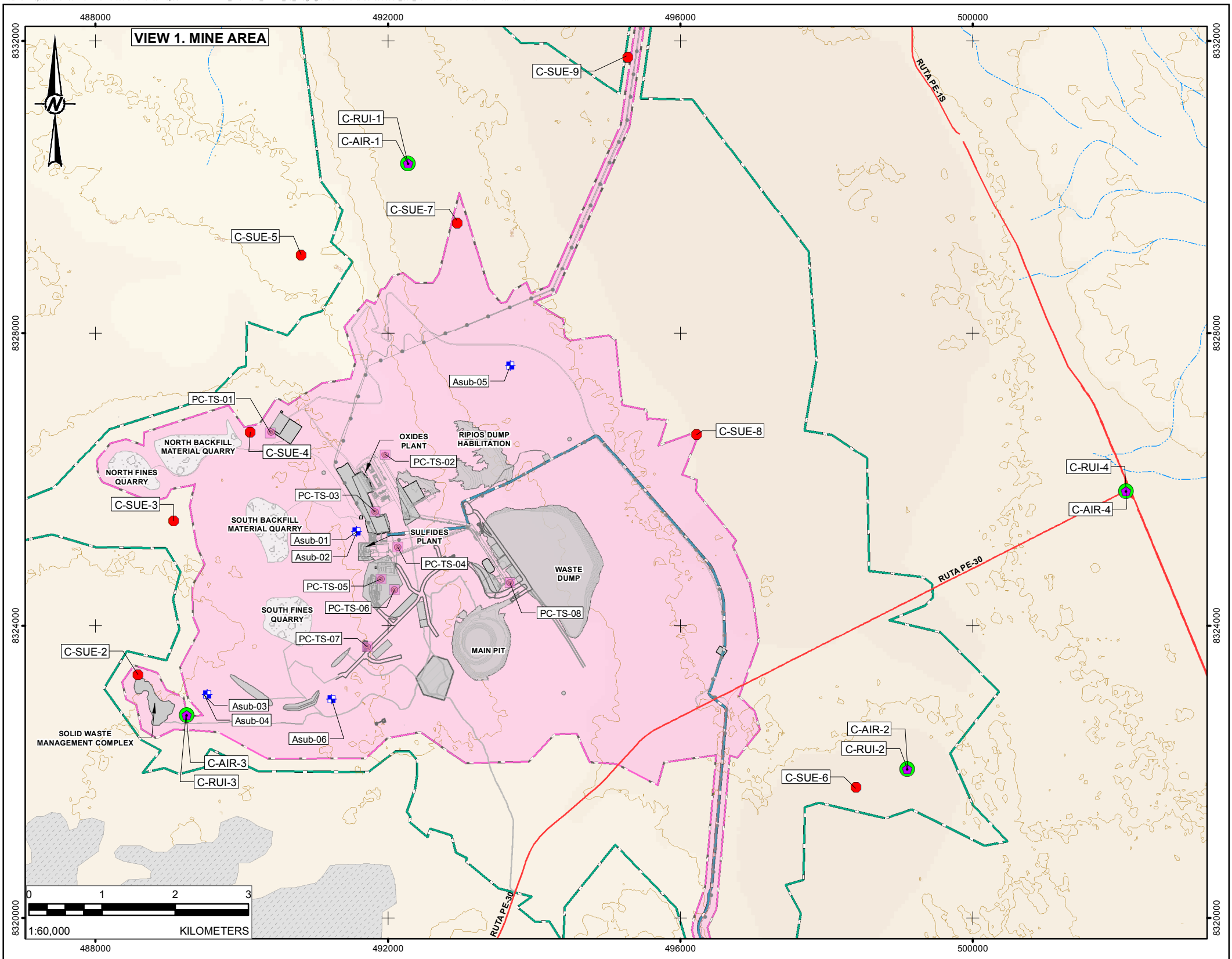
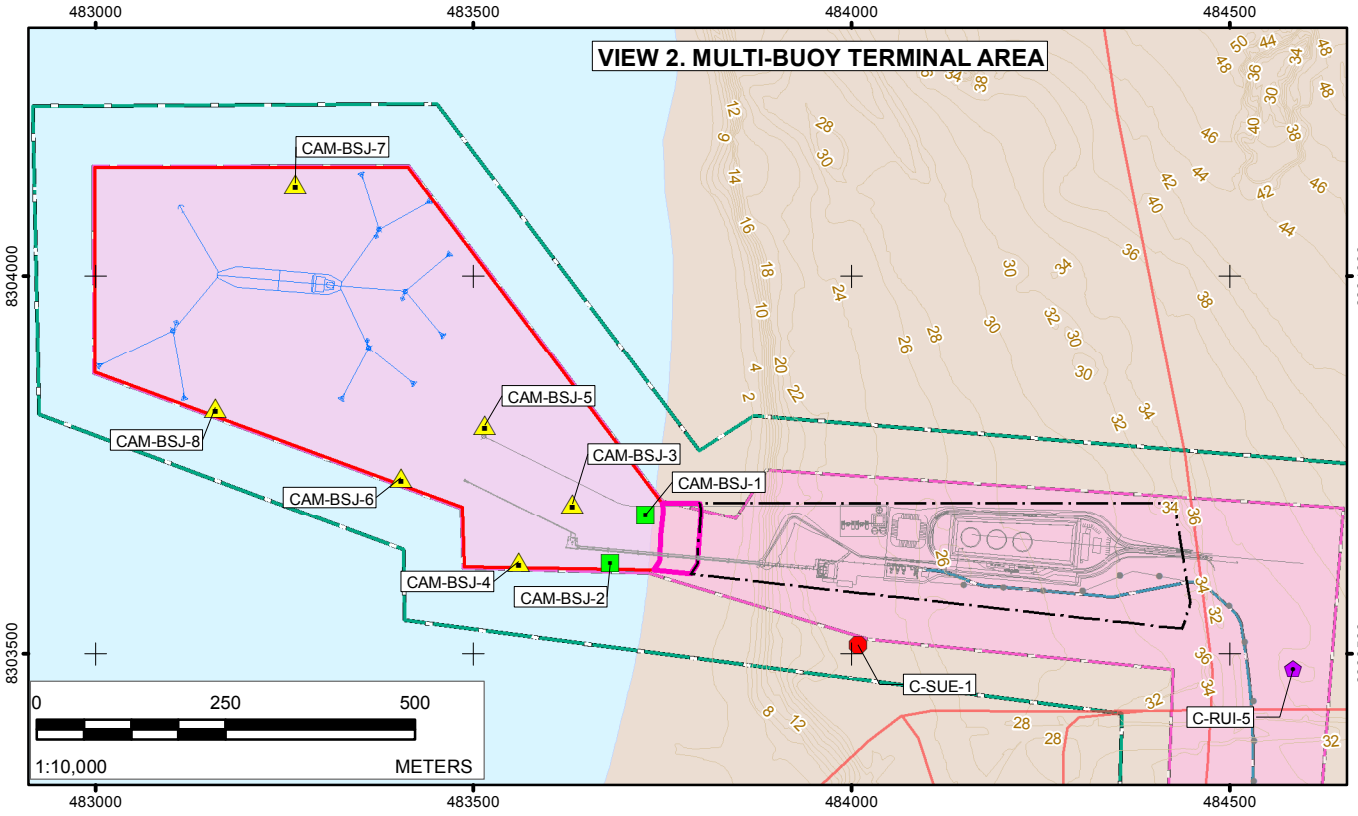
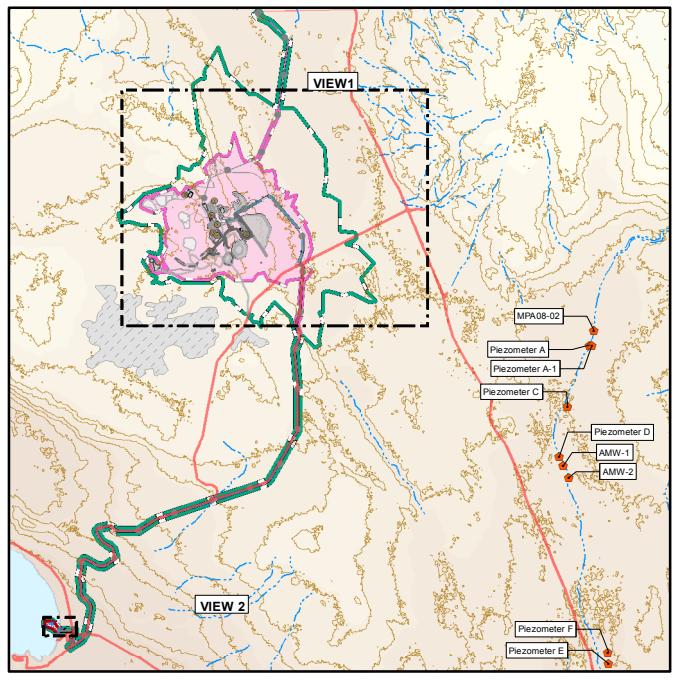
VIEW 1. MINE AREA



VIEW 2. MULTI-BUOY TERMINAL AREA





LEGEND

- MAIN CONTOUR (100 m)

ROAD SYSTEM

- PAVED
- UNPAVED
- PROJECT COMPONENTS
- POWER TRANSMISSION LINE
- SEAWATER SUPPLY PIPELINE
- GROUNDWATER MONITORING STATION

CONTROL STATION

- CONTROL STATIONS FOR TREATED DOMESTIC WASTE WATER MONITORING FOR INDUSTRIAL REUSE

MONITORING STATIONS

- AIR QUALITY
- ENVIRONMENTAL NOISE
- SOILS QUALITY

SEAWATER QUALITY MONITORING STATIONS

- INTERTIDAL
- SUBTIDAL
- GROUNDWATER CONTROL STATION
- AREA OF INDIRECT ENVIRONMENTAL INFLUENCE
- AREA OF DIRECT ENVIRONMENTAL INFLUENCE

REFERENCE

DATABASE: IGN 2006 /APPROVED COMPONENTS: EIA MINA JUSTA 2010 (VECTOR) E ITS 2016 (GOLDER) /COMPONENTS MEIAD: GOLDER 2016
PROJECTION: UTM ZONE 18S WGS 1984

CLIENT
MARCOBRE S.A.C.

PROJECT
DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE
ENVIRONMENTAL SURVEILLANCE PROGRAM - OPERATION STAGE

CONSULTING COMPANY
Golder Associates

YYYY-MM-DD	2017-01-27
EXECUTED	LR
DESIGN	RB
REVIEW	DG
APPROVED	DG

Nº PROJECT 159-415-2219 | Rev. 4 | FIGURE **RE-23**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS: A3
25mm
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VIEW 1. MINE AREA

RNI-02
C-SUE-9
C-RUI-1
C-AIR-1
C-SUE-7
C-SUE-5
Asub-05
PC-PTARD-1
WASTE WATER TREATMENT PLANT 1
C-SUE-8
RIPIOS DUMP
NORTH BACKFILL MATERIAL QUARRY
OXIDES PLANT
C-SUE-4
NORTH FINES QUARRY
PC-TS-03
C-SUE-7
Asub-01
Asub-02
C-SUE-3
SULFIDES PLANT
LONG-TERM ORE STOCKPILES PLATFORM
WASTE WATER TREATMENT PLANT 2
PC-PTARD-2
PC-TS-05
PC-TS-08
WATER SURFACE
DEPÓSITO DE RELAVES
WASTE DUMP FACILITY
MAIN PIT
C-SUE-2
MANTO MAGNETITA WASTE DUMP
Asub-03
Asub-04
MANTO MAGNETITA PIT
Asub-06
C-AIR-2
C-RUI-2
C-SUE-6
C-AIR-3
C-RUI-3
RUTA PE-30
C-RUI-4
C-AIR-4

VIEW 3

RNI-01
RNI-03
C-RUI-5

0 1 2 3
1:60,000 KILOMETERS

VIEW 2. MULTI-BUOY TERMINAL AREA

CAM-BSJ-7
CAM-BSJ-5
CAM-BSJ-8
CAM-BSJ-3
CAM-BSJ-6
CAM-BSJ-1
CAM-BSJ-4
CAM-BSJ-2
C-SUE-1
C-RUI-5
RNI-03

0 250 500
1:10,000 METERS

VIEW 1
VIEW 2

LEGEND

- (100 m) MAIN CONTOUR

ROAD SYSTEM
- PAVED
- UNPAVED
- PROJECT COMPONENTS
- POWER TRANSMISSION LINE
- SEAWATER SUPPLY PIPELINE
- GROUNDWATER MONITORING STATION

CONTROL STATION
- CONTROL STATIONS FOR TREATED DOMESTIC WASTE WATER MONITORING FOR INDUSTRIAL REUSE

MONITORING STATIONS
- AIR QUALITY
- ENVIRONMENTAL NOISE
- SOILS QUALITY
- NON-IONIZING RADIATIONS

SEAWATER QUALITY MONITORING STATIONS
- INTERTIDAL
- SUBTIDAL
- AREA OF INDIRECT ENVIRONMENTAL INFLUENCE
- AREA OF DIRECT ENVIRONMENTAL INFLUENCE

REFERENCE

DATABASE: IGN 2006 /APPROVED COMPONENTS: EIA MINA JUSTA 2010 (VECTOR) E ITS 2016 (GOLDER) /COMPONENTS MEIAD: GOLDER 2016
PROJECTION: UTM ZONE 18S WGS 1984

CLIENT
MARCOBRE S.A.C.

PROJECT
DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE
ENVIRONMENTAL SURVEILLANCE PROGRAM - OPERATION STAGE

CONSULTING COMPANY
Golder Associates

YYYY-MM-DD	2017-01-27
EXECUTED	LR
DESIGN	RB
REVIEW	DG
APPROVED	DG

Nº PROJECT 159-415-2219 | Rev. 4 | FIGURE **RE-24**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS: A3

1.6.1.8 Biology

The EMP measures seek to provide the environmental actions and measures necessary to prevent, reduce, mitigate and correct possible impacts on species, populations and areas of biological importance resulting from the Project activities and development in the Area of Environmental Influence. The main measures are as follows:

Terrestrial Biology

- Prioritize the works in areas with no vegetation cover or previously altered.
- Prohibit the burning, clearing or removal of any kind of wild vegetation.
- Prioritize, as soon as possible, the recovery of the zones affected.
- Prevent the introduction of invasive exotic flora and fauna which can alter the natural conditions.
- Ensure the appropriate management of hazardous waste and materials in all generating areas; prohibiting the circulation of Marcobre's vehicles outside the roads established.
- Minimize the use of vehicle and machinery horns, unless necessary for the staff or public's safety.
- Train and make Marcobre's personnel and contractors aware of the conservation and protection against impacts on the native flora and fauna species. Additionally, specific measures are proposed to manage the loss of vegetation cover, relocation of tillandsials, displacement management of wild fauna and Guanaco – *Lama guanicoe*.

The surveillance plan for biology considers six areas for terrestrial flora and fauna monitoring. Surveillance parameters include vegetation cover richness, abundance and diversity. The surveillance program will be carried out on a six-monthly basis for the Project construction and operation stages (See Figure RE-25).

Marine Biology

- Consider a historical record based on the water quality and marine biology data in the stations proposed in the Environmental Surveillance Plan (Section 6.2) to detect changes in the marine ecosystem.
- Strictly comply with the contingency procedures and measures regarding sulfuric acid transfer.
- Implement training programs for Marcobre's personnel and contractors in connection with the preventive care and management of the marine habitat, as well as the prohibition to catch fish.

The surveillance plan for marine biology considers nine monitoring stations and an area for the monitoring of marine flora and fauna. Surveillance parameters include richness abundance and diversity of phytoplankton, zooplankton, macrobenthos and fish. The surveillance program will be carried out on a six-monthly basis for the Project construction and operation stages (See Figure RE-25).

480000 490000 500000 510000

8330000 8320000 8310000 8300000

Pampa Las Clavelinas
Cerros Miramar
SAN FERNANDO NATIONAL RESERVE
Cerros Tunga
Pampa Taquila
Pampa Alta
Pampa Poroma
Pampa Caracoles
Pampa Las Treinta Libras
Pampa Media Luna
Lomas Marcona
Cerro Taquila
Cerro Marcona
Cerro Achupalla
Lomas Marcona
Lomas Marcona
Lomas Marcona
AREA 1 PAMPA CARACOLES
AREA 3 - CERRO ACHUPALLA
AREA 4 - LOMAS MARCONA
AREA 2 - PAMPA LAS TREINTA LIBRAS
AREA 5 CERROS MARCONA
AREA 6 MARCONA ROCKLAND
AREA 7 BAHIA SAN JUAN
ROUTE PE-1S
ROUTE PE-30
ROUTE IC-797
ROUTE IC-822
ROUTE IC-821
ROUTE IC-828
ROUTE IC-829
Qda. Callejon de Piedra
Qda. Los Espinos
Qda. Pampa Alta
Qda. Caracoles
Qda. Las Clavelinas
Qda. Piedra Gorda
Qda. Cuatro
Qda. Descalzados
Cerro Caracoles
Cerro Colorado
Cerro Yauques
Pampa Los Pozos
Cerro La Puntilla
Cerro Mellizos
Cerro La Repartición
Cerro La Cuesta
Cerro Cuatro
Pampa Las Clavelinas
Lomas La Encañada
Pampa Treinta Libras
Cerros Marcona
Cerro Los Cerrillos
Cerro Los Pocitos
Cerro Tetas de Cabra
Pampa Los Cerrillos
Pampa Jahuay
Cerro Penuela
Hoyada Peña Colorada
Cerro Bajada Toroco
Pampa Corpac
Pampa El Choclón
Cerro El Huevo
Lomas Marcona
ICA
DISTRICT OF MARCONA
AREQUIPA
DISTRICT OF LOMAS
PACIFIC OCEAN
Playa La Chorrera
Bahía San Nicolás
Playa El Conchal
Punta La Isla
Puerto de San Nicolas
Playa La Pedregosa
Playa San Juanito
Punta La Salina
Ensenada El Huevo
Punta El Huevo
Punta Almeja
Playa Acarí
Bahía San Juan
Punta San Juan
Playa Hermosa
Duelle Acarí
SAN JUAN DE MARCONA
Punta Perada
Playa Acapulco
Playa Los Leones
Playa Los Vidrios
SYSTEM OF ISLANDS, ISLETS AND GUANO CAPES PUNTA SAN JUAN NATIONAL RESERVE
SJ-10
SJ-20
SJ-25
SJ-09
SJ-02
SJ-19
SJ-03
SJ-18
CO-01
MPA08-02
Piezometer A-1
Piezometer A
Piezometer C
Piezometer D
AMW-1
AMW-2
Piezometer F
Piezometer E

LEGEND

- VILLAGE
- (200 m) MAIN CONTOUR
- (50 m) SECONDARY CONTOUR

ROAD SYSTEM

- PAVED
- UNPAVED
- VEHICLE AND BRIDLE PATH

HYDROGRAPHIC NETWORK

- DRY CREEK

- REGIONAL BOUNDARY
- NATURAL PROTECTED AREA
- BUFFER ZONE
- ENVIRONMENTAL STUDY AREA (ESA)
- SHP OPERATION AREA
- AREA OF INDIRECT ENVIRONMENTAL INFLUENCE
- AREA OF DIRECT ENVIRONMENTAL INFLUENCE
- MINA JUSTA PROJECT COMPONENTS
- FLORA AND FAUNA MONITORING AREA
- TERRESTRIAL FLORA AND FAUNA MONITORING AREA
- MARINE BIOLOGY MONITORING STATIONS
- GROUNDWATER CONTROL STATION

VEGETATION

- TILLANDSIA DESERT ASSOCIATION
- COASTAL DESERT
- LOMAS
- TILLANDSIAL
- ROCKLAND VEGETATION
- DISTURBED AREA

MEIA Marcobre Project	National Vegetative Cover Map (MINAM 2015)
Vegetatios Types	**Coverage Units**
Costal Desert (DCO)	Costal Desert
Rockland Vegetation (VRO)	
Tillandsia Desert Association (ADT)	Tillandsia
Tillandsia (TIL)	
Lomas (LOM)	Loma
Disturbed Area	Urban Area / Infrastructure

0 5 10

1:150,000 KILOMETERS

REFERENCE

BASE TOPOGRAPHY: IGN,1998 / AUSENCO,2014
CAPITALS AND ADMINISTRATIVE BOUNDARIES: INEI, 2008
VILLAGE: INEI, 2007
HYDROGRAPHY: IGN,1998 / AUSENCO,2014
ROAD SYSTEM: MTC, 2012 / AUSENCO,2014
PROJECTION: UTM ZONE 18S WGS 1984

CLIENT

MARCOBRE S.A.C

PROJECT

DETAILED EIA AMENDMENT
MINA JUSTA PROJECT

TITLE

TERRESTRIAL AND MARINE BIOLOGY MONITORING STATIONS - CONSTRUCTION AND OPERATION STAGES

CONSULTING COMPANY

Golder Associates

YYYY-MM-DD	2017-01-27
EXECUTED	LR
DESIGN	AC
REVIEW	AC
APPROVED	DG

Nº PROJECT 159-415-2219 | Rev. 4 | FIGURE **RE-25**

IF THE SIZE DOES NOT MATCH THE ABOVE MENTIONED, CONSIDER THAT THE ORIGINAL PAPER SIZE IS A3

25mm

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1.6.2 Solid Waste Management Plan

The Solid Waste Management Plan has been developed in accordance with the provisions in article 16 of Law No. 27314 General Law for Solid Waste, and Occupational Safety and Health Regulations (S.D. Nº 024-2016-EM).

The Solid Waste Management Plan seeks to minimize the waste generation and optimize the use of material by recycling; to prevent, manage and mitigate environmental impacts associated with the management, storage and disposal of waste; and to guarantee the geochemical and physical stability of the waste generated in the long-term, through appropriate disposal methods.

The monitoring program will include the control of the functioning authorizations and registrations, as well as all the required documentation to be presented to the competent authority.

1.6.3 Environmental Compensation Plan

According to the assessment results, considerable impacts on the terrestrial flora and fauna species are not expected. However, moderate impacts caused by the Mina Justa Project on the tillandsial community (Tillandsial-DTA) are expected. In that regard, the assessed study area limits to the northwest with the RNSF, and the tillandsial communities characterized within the study area extend up to the RNSF southeast side. According to the Master Plan of the RNSF 2015-2019 (SERNANP 2014), the terrestrial ecosystem known as tillandsial is located at the southeast of the ANP, and its name is due to being formed by species of the tillandsial genus. It is estimated to have a cover of three thousand hectares within the ANP. The RNSF tillandsial are very vast and are formed by 3 species, being the Tillandsia latifolia species the most abundant and widest distributed one.

Therefore, although there will not be considerable impacts on the tillandsial community caused by the Mina Justa Project development, and considering the structural importance of this community, as part of the EMP the tillandsials will be relocated in non-impacted areas of the Mina Justa Project only if the activities impact on this vegetation type. These non-impacted areas will be determined before the relocation and will be required to have natural tillandsial presence, area accessibility and previous assessment of moisture collection through dew meters and/or fog catchers. Likewise, species associated with the tillandsials that belong to some conservation category (endemic or protected) will be relocated; these species must be of a perennial condition and the annual or ephemeral species will not be considered (such as the species of the *Nolana, Spergularia, Hoffmannseggia* and *Nicotiana* genera).

This analysis result shows that it is not necessary to establish compensation measures for the terrestrial flora and fauna, within the Mina Justa Project framework.

1.6.4 Social Management Plan

The Social Management Plan (SMP) is a management proposal for the social management measures that Marcobre S.A.C. (Marcobre) will implement in the area of social influence of the Mina Justa Project (the Project) and that will strengthen the bonds of trust between the population and the company.

The SMP social management measures are organized in three plans: (i) Community Relations Plan, (ii) Social Agreement Plan and (iii) Community Development Plan, according to the Terms of Reference approved by Ministerial Resolution No. 116-2015-MEM/DM. At the same time, these plans comprise programs with general purposes or objectives, specific results or objectives and actions or activities that contribute to the achievement of the expected results.

The methodology employed in the SMP is that of the logical framework which proposes a hierarchy of objectives; i.e., defining the objective, purpose, results and actions. Its objective is to monitor and assess intervention in time.

The SMP has been prepared based on the guidelines of the Guide to Community Relations (MINEM 2001), the Social Management Instruments for Environmental Certification (SENACE 2016) and considering Marcobre's Corporate Social Responsibility Policy, the Social Management System and associated procedures; as well as the Community Relations Protocol, the Code of Conduct and the Communications Program.

It comprises a 20-year schedule, from which two correspond to the construction stage and 18 to the operation stage of the Mina Justa Project. Table RE-8 shows the schedule and the total budget for the programs and sub-programs proposed in the SMP.

Table RE-8: Social Management Plan Schedule and Budget

Programs	Sub-programs	Activities	Total Nuevos Soles (S/.)
Community Relation Plan			
Purpose: Inform stakeholders about the Project activities, the social and environmental management measures, and the investment activities for the sustainable development Marcobre promotes.			
Communications	Internal Communication [a]	Talks aimed at Project workers	0
	External Communication	Stakeholders update	400,000
		Provide service and information to visitors to the OIP.	
		Elaboration of informative material on the Project activities and progress.	
		Organization of informative talks with the population.	
SUB TOTAL			**400,000**
Social Agreement Plan			
Purpose: Establish social contingency or conflict prevention and contingency and response measures.			
Social Contingencies	Claims and complaints response [b]	Implementation of a claims and complaints record book	95,000
		Training for Marcobre's workers and contractors on the procedure for claims and complaints response.	
		Inform the local population about the procedure established for the claims and complaints response.	
		Implementation of a satisfaction survey on the subprogram.	
	Monitoring of Social Commitments [a]	Elaboration of a consolidated commitment matrix, according to the EIAd Amendment.	0
		Monitoring of commitments.	
		Follow-up of the claims and complaints record book in connection with the unfulfillment of commitments.	

Programs	Sub-programs	Activities	Total Nuevos Soles (S/.)
Social Contingencies	Monitoring of Situations and Conflict Prevention	Collection and follow-up of information referred to the Project social context.	254,000
		Mapping of actors, including characteristics, positions and perceptions.	
		Socioeconomic information update of the population in the Project area of direct influence.	
	Crisis Management [a]	Creation of a committee for crisis management and response.	0
		Adoption of measures in crisis situation.	
SUB TOTAL			**349,000**
Community Development Plan			
Purpose 1: Promote the generation of direct and indirect local employment in the Project area of social influence.			
Local Employment	Local Employment [c]	Information collection and update on the offer of local labor.	315,000
		Call for job vacancies for the Project.	
		Agreements with higher education institutes.	
		Internal training.	
Purpose 2: Maximize the sustainable development opportunities the Project presence and activities may generate on behalf of the population in the area of social influence.			
Local Economic Development	Acquisition of Local Products, Goods and Services [c]	Information collection and update on local businesses and suppliers.	158,000
		Dissemination of the call for local suppliers.	
		Agreement with higher education institutions for training in business management for local suppliers.	
		Training for Marcobre's local suppliers on the code of conduct, code of ethics, community relation protocol, among other corporate protocols.	
	Social Development in Education	Implementation of pedagogical workshops.	1,015,000
		Training in sanitary and environmental education.	
		Organization of the contest "Líderes de Cambio" (Leaders of Change) with the support of UGEL - Nasca.	

Programs	Sub-programs	Activities	Total Nuevos Soles (S/.)
Local Economic Development	Social Development in Education	Organization of the theater festival "Cuidemos Nuestra Casa: Protegiendo el Medioambiente" (Let's Take Care of Our House: Protecting the Environment)	
	Social Development in Health and Nutrition	Training on personal hygiene and taking care of water	1,190,000
		Training in nutrition and correct food manipulation	
		Support to health establishments in preventive health campaigns	
	Productive Development in Tourism	Preparation and dissemination of promotional material for tourist attractions	1,055,000
		Support in the organization of tourist or sports events	
		Beach clean-up campaigns	
	Productive Development for the Extraction of Hydrobiological Resources	Elaboration of a situational diagnosis of the fishing, seafood and algae extraction activities	240,000
		Agreements with higher education institutes for trainings	
		Training as per the needs identified in the diagnosis	
Purpose 3: Contribute to strengthening local capacities.			
Strengthening of Local Capacities	Strengthening of Local Capacities	Training aimed at officers in the municipalities of the SIA in the preparation of technical files	630,000
		Agreement with higher education institutes	
		Training for potential Project suppliers	
		Training aimed at inhabitants who wish to become involved in terms of work in the Project	
		Management training aimed at Hotels and Restaurants	
		Training in tourism for taxi companies and independent taxi-drivers	
		Agreement with higher education institutes	
SUB TOTAL			**4,603,000**
TOTAL			**5,352,000**

[a] The cost of implementing this program is included in the Project operation cost.
[b] The cost of implementing the Claims and Complaints Response Program is included in the Project operation cost, the budget assigned in the SMP corresponds to the dissemination of the program locally.
[c] The costs of hiring local labor and acquiring local products, goods and services are included in the Project operation costs, the budget assigned in the SMP corresponds to the training activities for local workers and suppliers.

1.6.5 Contingency Plan

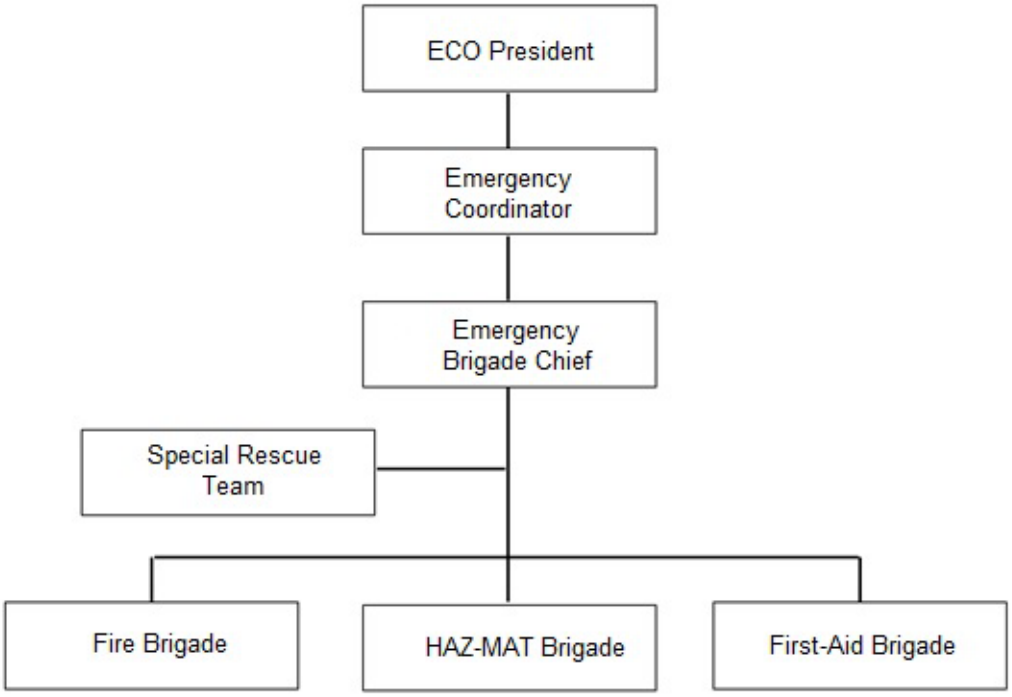
This Contingency Plan considers preventive and mitigation measures implemented in similar mine units. These actions mainly seek to minimize public and environmental safety risks as a consequence of the Project activities. In addition, it comprises response actions for natural disaster and emergency cases with implications on the environmental or social ambient, situations that may be the cause of the risk scenarios identified. The implementation of the Contingency Plan will be carried out based on the provisions in Marcobre's Management System.

The emergency response strategy corresponds to its magnitude and three "levels" described below have been taken into account:

- **Level I (Low)**: when the emergency may be controlled locally and immediately by the personnel working in the affected area, or by drivers (during the transportation of sulfuric acid from the multi-buoy terminal to the mine site). The Supervisor or person in charge of the area involved will prepare the reports required by the Safety and Environment Area.
- **Level II (Intermediate)**: when the emergency cannot be controlled by the personnel working in the affected area or by the drivers (during transportation). In this Level, the Contingency Plan activates, with the participation of the Emergency Committee (ECO) and the Emergency Brigade. The Supervisor of the area involved will prepare a report of the event and submit it to the Safety and Environment Area, so they send it to the Safety and Environment Management Office, who in turn will report to the General Management.
- **Level III (High)**: when the emergency cannot be controlled by the ECO or the Emergency Brigade, so external support is required (Peruvian National Police, Peruvian Fire Department, Civil Defense, Hospitals and others), prior authorization of the General Management. The ECO assesses the evacuation of the personnel affected or the evacuation of all personnel.

The ECO is in charge of coordinating emergency care, as well external aid, communications and actions to be carried out by the different brigades before, during and after an event. Figure RE-26 shows the ECO's organizational chart.

Figure RE-26: Emergency Committee Organizational Chart (ECO)



Source: Plan de Respuesta a Emergencia y Contingencia, Rev.B (Marcobre 2014).

The contingency plan considers care and response in case of risks and emergencies like:

- **Scenarios 1A.1)1.1 and 1B.1)1.1:** fuel spill from heavy mobile equipment during the construction and operation stages.
- **Scenario 4B.2)2.1:** failure of the tailings storage facility dam during operation.
- **Scenario 5A.1)1.1:** spills when installing the seawater supply pump during construction.
- **Scenario 5A.1)2.1:** fuel spill from the heavy mobile equipment during the construction of the seawater supply pipeline.
- **Scenario 5A.1)3.1:** breaking of the existing gas pipeline during the construction of the seawater supply pipeline, causing gas leak.
- **Scenario 5A.1)3.2:** breaking of the existing gas pipeline during the construction of the seawater supply pipeline, causing an explosion.
- **Scenario 5A.1)4.4:** traffic accidents during the construction of the seawater supply pipeline (buried), with fatal consequences for the public.
- **Scenario 5B.2)1.1:** fuel spill from the gas station supply tanks, trucks, or heavy equipment during operation.
- **Scenario 6A.1)2.1:** fuel spill from the heavy mobile equipment during the construction of the marine components.
- **Scenarios 6B.1)1.1, 6B.1)1.2:** sulfuric acid spill into the sea during sulfuric acid discharge activities from ships, causing a small or large spill.
- **Scenario 6B.2)1.3:** sulfuric acid spill on land because of sulfuric acid storage in tanks and while loading tank trucks, causing a large spill that reaches the sea.

- **Scenarios 6B.3)1.2, 6B.3)1.3, 6B.3)1.4:** traffic accidents during the transportation of sulfuric acid in tank trucks from the multi-buoy terminal to the mine site, with serious damage to the public, fatal consequences or a large sulfuric acid spill.

In addition, it includes events that increase failure risks, such as natural phenomena (earthquakes, fog, strong winds - Paracas winds and tsunamis).

1.6.6 Adequacy Plan of Maximum Permissible Limits for Industrial and/or Domestic Effluents and/or Emissions to the Quality Standard (EQS) of the Receiving Body

The Project does not contemplate the existence of industrial waste water discharges among its activities; therefore, an adequacy plan for maximum permissible limits (MPL) is not applicable. However, if required, the necessary permits will be processed and the MPLs in S.D. No. 010-2010-MINAM will be taken as assessment criteria for discharge. As per the recycled waters for the irrigation of the roads considered in the EMP, the assessment criteria will be the MPLs in S.D. No. 010-2010-MINAM and the MPLs in S.D. N° 003-2010-MINAM as a reference, according to the Environmental Surveillance Plan.

On the other hand, according to S.D. No. 015-2015-MINAM, which amends the EQS for water and establishes complementary provisions for their application, holders of mining projects that by December 19, 2015 (publication date of the regulation in reference) have approved environmental assessments and whose facilities are adapted for compliance with the EQS for water in S.D. No. 002-2008-MINAM, may express their intention to avail themselves to the adequacy process and submit an EMP amendment within the deadlines established in the regulation (article 6) or, otherwise, the new EQS for water are referred to automatically.

In this case, the Project has environmental management instruments approved prior to December 19, 2015; however, operations have not started to date, and Marcobre has not communicated the authority about this regard. Hence, the EIAd Amendment considers the EQS in S.D. No. 015-2015-MINAM, as assessment criteria for surface water quality for the applicable parameters, and thus represents the adequacy instrument to the new EQS for water.

1.6.7 Closure Plan

Mine closure is defined as the set of activities to be implemented throughout the mine service life to reach objectives that are closure-specific. Consequently, closure becomes a continuous process that starts with the elaboration of the conceptual closure plan at the start of the Project as part of the EIA and its amendments. It will continue with the progressive closure activities during the operation stage and will end with the final closure and the post-closure period at the end of the mine service life.

This conceptual closure plan will maintain the criteria defined in the Mine Closure Plan Update recently approved, and will update the corresponding sections according to the design of the Mina Justa Project as a whole; i.e. that which was approved by previous IGA and the proposals in this EIAd Amendment.

The relevant criteria for the Closure Plan are detailed below:

1.6.7.1 General

- Comply with the current legal requirements and the best international practices.
- Notwithstanding the closure activities for each particular component, as far as possible, closure solutions which do not require further maintenance (walk away) or minimal maintenance (passive care) will be prioritized.

- If possible, the transfer of usable components to communities and/or the government will be prioritized upon closure.
- If possible, a progressive component closure will take place during the operation stage for those components that were established for the construction stage of the Project.

1.6.7.2 Specific

- Safety Criteria.
- Physical Stability Criteria.
- Hydraulic Works Design Criteria.
- Chemical Stability Criteria.
- Water Quality Criteria.
- Biological Stability Criteria.
- Future Soil Use Criteria.

The Project is located in the desert life zone, with a temperate dry climate, absence of permanent water bodies, limited soil cover and absence of “productive” soils.

1.6.7.3 Closure Activities

Temporary, progressive and final closure activities considered during the design stage for the different Project components, according to the current legal framework, specifically the provisions in the “Mine Closure Regulations” (S.D. N° 033-2005), will be as follows:

- Dismantling;
- demolition, restoration and disposal;
- physical stability;
- geochemical stability;
- water management;
- landform shaping and habitat reclamation; and
- social programs.

1.6.7.3.1 Temporary Closure

Even if the Project does not plan for the suspension or temporary detention of the mining and processing activities, if this scenario arises due to unfavorable market conditions or others, authorities will be notified and the corresponding closure measures and actions will be submitted for approval, as per Chapter 5 Temporary Interruptions (articles 33, 34, 35, and 36) of the Mine Closure Regulations and its amendments. According to current legislation, temporary closure may not last more than three (3) years. In case such period is exceeded, the Ministry of Energy and Mines (MINEM) may proceed to implement the final closure measures approved.

Notwithstanding, in case of an eventual temporary closure, the following general preliminary measures may be taken:

- Maintenance of security checks and surveillance to restrict access to the site, allowing access only to authorized personnel.
- Closure of access roads and putting up warning signs, which may require perimeter fences to prevent access to the open pits and other potentially dangerous areas (for example, the process plant).

- Overall clean-up of facilities, including the removal of waste and substances that may represent a risk during the temporary closure period.
- Closure and protective measures for the mechanical and hydraulic systems.
- Water supply outage for processing.
- Maintenance of water collection and/or recirculation systems.
- Protective measures for hazardous materials or substances, including explosives and detonators, oil products and chemical in secure warehouses and under custody.
- De-energization of the major components and those that are not used during shutdown.
- Stabilization measures of unstable zones (tailings storage facility and dumps) that may represent a significant risk in the short-term or in the estimated shutdown period.
- Maintenance of physical, chemical and biological monitoring programs.
- Overall inspection and maintenance activities for relevant works to maintain the site conditions.
- Maintenance of environmental monitoring activities for the operation stage.
- Implementation of a communication program with the communities to inform them timely about the activities to be developed as part of the temporary closure process; continuing with sustainable development programs.

1.6.7.3.2 Progressive Closure

Progressive closure actions will be implemented during the Project operation stage for those components with due service life before final closure.

1.6.7.3.2.1 Borrow Quarries

It will be possible to implement a progressive closure for borrow quarries of different construction materials. Restoration works will include the following tasks:

- Earthworks, grading and contouring for suitability and adaptation of the altered surfaces.
- Some quarry zones are expected to contour again in a natural manner as a result of wind erosion.

For the rest of the components, most of the closure works will be carried out once the mine reaches the end of its service life. Such measures are described in detail in the final closure description and will be assessed in future closure plan revisions.

1.6.7.3.3 Final Closure

Final closure measures consider decommissioning and disassembling activities, physical stabilization, geochemical and hydrological stabilization, land form establishment and revegetation. The relevant components for the final closure stage are:

- Pits.
- Oxide and sulfide process plants.
- Mining waste management components.
  - Waste dump, Manto Magnetita dump and ripios dump.
  - Tailings storage facility.

- Water supply components.
- Borrow quarries.
- Other related infrastructures.
  - Power supply infrastructure.
  - Magazine and explosive storage and management infrastructure.
  - Fuel stations.
  - Solid waste management complex.
  - Access roads.
  - Workshops, support infrastructure, camps and offices.
- Multi-buoy terminal.

1.6.7.4 Social Programs

The social approach is based on the application of the Community Relations Plan (CRP) during the operation stage to improve the socioeconomic capacity of the populations in the Area of Direct Influence, so as to avoid dependency upon the end of operations. Therefore, social programs planning should be addressed as of the beginning of operations to mitigate these possible negative effects.

The development of the following programs is intended:

- Social Programs, which consider retraining so local workers and contractors are prepared to reentry the labor market.
- Communication Program, to minimize fears for possible impacts upon the closure process and population expectations regarding the possible future use and occupation of the land that was part of the mining project.

1.6.7.5 Post-Closure Maintenance and Monitoring

After the final closure, maintenance and monitoring activities will take place to reach closure objectives. Post-closure works will seek to confirm that reclamation measures have been appropriately implemented and comply with the objectives for which they were designed. These works will be carried out as per MINEM's Mine Closure Regulations (S.D. No. 033-2005-EM, Article 31).

1.6.7.5.1 Post-Closure Maintenance and Monitoring Activities

These refer to the maintenance of areas which have been reclaimed and of components which will stay in place, for example, pits, dumps, tailings storage facility. Maintenance of the coverage put will also be carried out.

Post-closure monitoring activities are aimed at assessing if the environmental variables monitored during the operation stage returned to their basal conditions, or if they reached the residual levels considered after applying mitigation measures. Inspections and sampling will take place, after which the data of the post-closure monitoring will be processed.

For those Project components in which risks are not anticipated, a preliminary post-closure monitoring is considered for an estimated minimum period of five (05) years, as per Peruvian regulations. This post-closure monitoring period may be extended for other components, depending on the monitoring results during the five (05) first years of the post-closure.

1.6.7.6 Schedule

The general schedule for the Mina Justa Project closure may be divided as follows:

- Progressive Closure: from year 1 to 5 (5 years), corresponding to the last 5 years of operation;
- Final Closure: from year 6 to 8 (3 years); and
- Post-Closure: from year 9 to 13 (5 years).

Table RE-9 shows the schedule for the different closure stages of the Project.

Table RE-9: Mina Justa Project Closure Stages

Year/Closure Stage	1-13	14	15	16	17	18	1	2	3	1	2	3	4	5
	Operations						Final Cl.			Post-Closure				
Progressive Closure														
Final Closure														
Post-Closure														

1.6.8 Environmental Management Strategy Budget

Table RE-10 shows the general schedule for the implementation and the estimated budget for the implementation measures of the environmental management strategy proposed for the Project. Costs correspond to estimations based on operating costs of similar units in charge of Marcobre, which may vary according to the operating needs of the Project. Additionally, costs related to prevention, mitigation, monitoring and contingency management measures are also considered. Costs for engineering controls are not included because they are intrinsic mitigation measures; such costs are already included in the CAPEX (construction costs) and OPEX (operation and maintenance costs) described in Section 2 of the EIAd Amendment.

The schedule considers implementation lines and associated costs of the following plans as per the common terms of reference (ToR) approved by M.R. No. 116-2015-EM/DM:

- Environmental Management Plan (EMP).
- Environmental Surveillance Plan (ESP).
- Contingency Plan (CTP).
- Social Management Plan (SMP).
- Solid Waste Management Plan (SWMP).

Costs for the Environmental Management Strategy measures in the closure stage have not been considered. The costs and measures for the closure stage will be presented in the Mine Closure Plan at a feasibility level, which will be presented within a year upon approval of the corresponding EIA, according to Law No. 28090, which regulates mine closure, and S.D. No. 033-2005-EM which regulates it. Additionally, the compensation plan is not included, according to section 6.4.

Table RE-10: Approved and Proposed Components

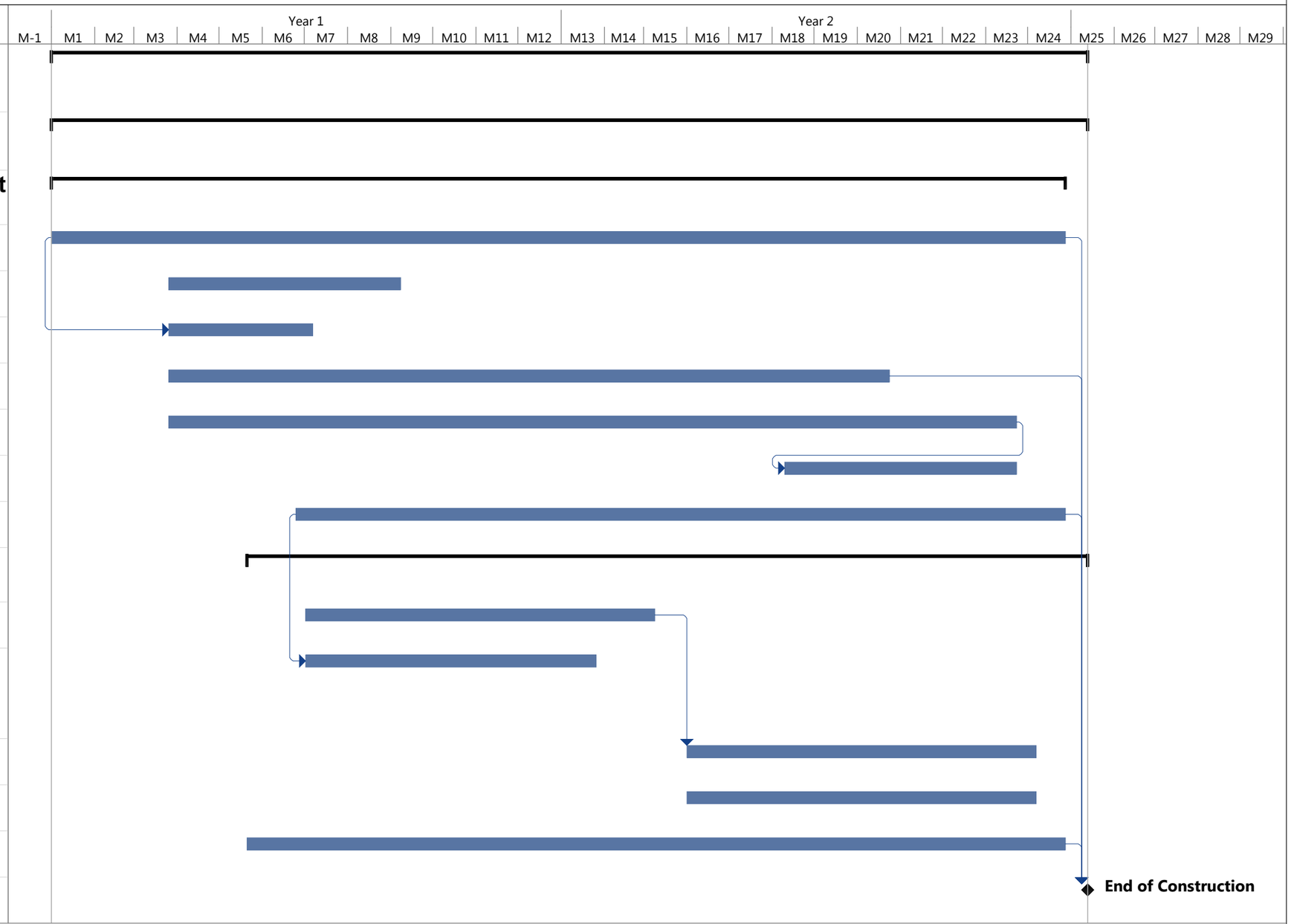
Environmental Management Strategy	Overall Schedule																		Overall Estimated Budget	
	Construction		Operation																Construction	Operation
	1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	16	17	18		
Environmental Management Plan																				
Air Quality																			280,320.0	2,382,720.0
Environmental Noise																			0.0	0.0
Vibrations Control																			0.0	0.0
Soil																			0.0	0.0
Surface Water																			0.0	0.0
Groundwater																			0.0	0.0
Seawater																			0.0	0.0
Metallurgical and Domestic Mining Effluents																			0.0	0.0
Biology																			182,200.0	109,800.0
Subtotal																			**462,520.0**	**2,492,520.0**
Environmental Surveillance Plan																				
Domestic Effluents Monitoring																			24,000.0	119,000.0
Seawater Quality Monitoring																			96,000.0	816,000.0
Groundwater Monitoring																			0.0	39,200.0
Air Quality Monitoring																			16,000.0	136,000.0
Noise Monitoring																			16,000.0	68,000.0
NIR Monitoring																			3,200.0	27,200.0
Soil Monitoring																			8,000.0	68,000.0
Terrestrial Biology Monitoring - flora																			72,000.0	612,000.0
Terrestrial Biology Monitoring - fauna																			72,000.0	612,000.0
Terrestrial Biology Monitoring - aquatic																			216,000.0	1,836,000.0
Subtotal																			**523,200.0**	**4,333,400.0**
Social Management Plan																				
Community Relations Plan																			18,181.8	103,030.3
Social Agreement Plan																			18,181.8	87,575.8
Community Development Plan																			290,303.0	1,104,545.5
Subtotal																			**326,666.7**	**1,295,151.5**
Contingency Plan																				
Risk Management																			150,000.0	250,000.0
Contingency Plan																			0.0	0.0
Subtotal																			**150,000.0**	**250,000.0**
Solid Waste Management Plan																				
Waste Management																			1,376,470.6	38,880,000.0
Subtotal																			**1,376,470.6**	**38,880,000.0**
TOTAL BUDGET FOR THE ENVIRONMENTAL MANAGEMENT STRATEGY BY PROJECT STAGE																			**2,838,857.3**	**47,251,071.5**
TOTAL BUDGET FOR THE ENVIRONMENTAL MANAGEMENT STRATEGY																			**50,089,928.8**	

1.6.9 Project Schedule and Total Investment

Figure RE-27 shows the general schedule of the Project construction stage and Figure RE-28 shows the activities schedule for the operation stage. The Project is expected to reach a service life of 19 years, including two years of pre-mining. The construction stage will have a duration of two years, and the operation stage a duration of 17 years, approximately. During the operation stage, the oxide ore processing will last 14 years, while the sulfides processing will last 17 years, approximately. The Project total investment (CAPEX) amounts to USD 1,348.4 billion and the operation budget (OPEX) will be USD 4,082.7 billion.

Figure RE-27 Construction Stage Schedule

ID	Activities
1	**Mina Justa Project**
2	**CONSTRUCTION**
3	**Massive Construction of the Amendment**
4	Pre-mining of the Pit
5	Dump and Ripios implementation
6	Stockpiles implementation
7	Oxide Plant Construction
8	Sulfides Plant Construction
9	Tailings Storage Facility
10	Multi-buoy Terminal
11	**Auxiliary Components**
12	Seawater Supply Pipeline
13	PTL SS Mina Justa - Multi-buoy Terminal (22,9kV)
14	Permanent Camp
15	Solid Waste Management Complex
16	Other minor and support facilities
17	End of Construction



Project: Figura_Cronograma Co
Date: Tue 10/01/17

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Figure RE-28 Operation Stage Schedule

ID	Activities
1	**Mina Justa Project**
2	**Operation**
3	**Processing**
4	Ore from Stockpiles to Plants
5	Pit Mining (Ore to Plants)
6	Main Dump Conformation
7	Manto Magne Dump Conformation
8	Ripios Dump Conformation
9	Oxide Plant Operation
10	Sulfide Plant Operation
11	Tailing Storage Facility Operation (Stages 2 to 4)
12	Multi-buoy Terminal (acid reception)
13	**Auxiliary Facilities**
14	Truck Shop Operation
15	Operation of the PTL SS Poroma - SS Mina Justa (220 kV)
16	Seawater Supply Pipeline
17	PTL SS Mina Justa - Multi-buoy Terminal (22,9kV)
18	Fuel Station
19	Permanent Camp
20	Solid Waste Management Complex
21	Other minor and support facilities
22	End of Operation

Project: Figura_Cronograma Co
Date: Tue 10/01/17

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

1.7 Economic Valuation of Environmental Impacts

The economic valuation developed in the EIA Amendment of the Mina Justa Project has followed the methodological steps provided in the Economic Valuation Guide for Cultural Heritage and the Common Terms of Reference approved by M.R. No. 116-2015-MEM/DM.

According to the Economic Valuation Guide for Cultural Heritage, economic valuations permit assigning a good and/or service an economic-monetary value, even if it is not part of a market or it does not have a price. Its objective is to visualize all those benefits and costs associated with the changes in the ecosystem and that affect the society's well-being, so these economic values may be included in decision-making.

It may be carried out using an array of methods (market prices, contingent valuation, changes in productivity, travel costs, hedonic prices, etc.). Economic valuation is used mainly in the following cases:

- Identification and assessment of investment project alternatives.
- Development of an EIA.
- Definition of compensation mechanisms due to environmental damages.
- Calculation of efficient rates that include the value in environmental goods and services for the conservation and preservation of natural resources.

Within the framework of EIA for mining, the Economic Valuation of Environmental Impacts (EVEI) permits identifying and quantifying those environmental goods and services that may be affected as a result of a mining project start-up. In economic terms, the EVEI reflects the economic value of the change in quantity or quality of an environmental good or service by estimating the well-being it produces upon society, expressed in units of currency. In that sense, in order to include externalities on the environment in the economic analysis, it is necessary to identify the relationship between the environmental component in question and the usefulness or well-being upon individuals, based on their preferences.

The methodology used for the EVEI followed these steps:

- Identification and selection of Potential Negative Impacts.
- Identification of the relation between the negative environmental impacts, in order to avoid double counting.
- Correlation analysis between the impact and the subject impacted for analyzing the population's well-being impact.
- Definition and rationale of the valuation methodology to be used.
- Determination of the economic value of the environmental good impacted.
- Total Economic Valuation (TEV): of the Mina Justa project.

According to the methodology used, Section 5.0 identifies negative impacts with a moderate environmental consequence, both in the construction and operation stages. Table RE-11 shows such impacts with a brief description and their relation to social well-being.

Table RE-11: Description of Impact and Implication in Social Well-being

Environmental Component	Residual Impact	Stage	Environmental Consequence	Description of Environmental Impact
Air	Change in the Air Quality by Particulate Matter PM-2.5 (24 h and annually)	Construction	Negative Moderate	**Description:** According to the impact assessment on the air quality by particulate matter emission, the construction stage is estimated to produce 18.7 µg/m^3 in 24 h and 13.9 µg/m^3 annually of PM-2.5, considering the emissions of the Project itself and the base or background concentrations recorded in the receiver (Justo Pastor Ramírez Legua Association).
				Implication: The potential impact is associated with current and potential particulate matter sources. These concentrations do not exceed the EQS for Air, so there is no evidence of changes in the population's well-being in the Justo Pastor Ramírez Legua Association, the main receiver. As a result, there are no implications for human health or well-being.
		Operations	Negative Moderate	**Description:** As during the construction stage, for the operation stage PM-2.5 emissions are estimated to be 20 µg/m^{3}in 24 h and 14 µg/m^3 annually. Additionally, the Project's own emissions and base or background concentrations recorded in the Justo Pastor Ramírez Legua Association are considered.
				Implication: The potential impact is associated with current and potential particulate matter sources. These concentrations do not exceed the EQS for air value, so there are no implications for human health or well-being.
	Change in the Air Quality by Gas Emission (SO_2)	Construction	Negative Moderate	**Description:** Regarding the impact assessment of the air quality by particulate matter emission during the construction stage, the SO_2 concentration estimate in the receiver is 17.76 µg/m^3 in 24 h, considering the emissions of the Project itself and base or background concentrations recorded in the receiver (Justo Pastor Ramírez Legua Association).
				Implication: The concentration estimate in the recipient ranges between 50% and 90% of the EQS value, mainly due to the bottom concentrations, which are approximately 80% of the EQS value. In other words, the estimated values are below those of the EQS for air. As a result, there are no implications for human health or well-being.
		Operations	Negative Moderate	**Description:** As during the construction stage, the SO_2 concentration estimate during the operation stage is 17.24 µg/m^3 in 24 h, considering the emissions of the Project itself and the base or background concentrations recorded at Justo Pastor Ramírez Legua Association.
				Implication: The potential impact is below the EQS for air value. The concentration estimate in the recipient ranges between 50% and 90% of the EQS value, mainly due to the bottom concentrations, which are approximately 80% of the EQS value. As a result, there are no implications for human health or well-being.

There are other environmental impacts (physical and biological) with a low or insignificant environmental consequence with no effects on human beings and which are not a part of this analysis. Additionally, two moderate environmental consequence impacts have been identified in relation to Change in the Vegetation Type (Tillandsial-DTA) and Impact on Species of Interest (Flora), for the construction, operation and closure stages; nevertheless, these impacts have an immediate extension, i.e. they are only present in the Project footprint. Complementarily, the reduction of both Tillandsials and Tillandsial-DTA cover does not exceed 25% in the terrestrial area of study. The use of Tillandsials or Tillandsial-DTA vegetation by the population of the district of Marcona is not recorded. Consequently, those impacts are not part of this valuation.

1.8 Cost-Benefit Analysis

Within the framework of an environmental management instrument and as indicated in the ToR EIA-Mining, the cost-benefit analysis is developed incorporating the results of the Economic Valuation. Next are the concepts of costs and benefits, which have a technical and economic support:

- Social Costs: the negative environmental impacts of the Project, with a moderate or high consequence and which imply a direct (harmful) change in the population's well-being.
- Social Benefits: the benefits of the Project, which imply a direct change (improvement) in the population's well-being.
- Cost-Benefit Analysis: the cost/benefit ratio denoting return in social terms of the budget invested.

Based on this definition, the Mina Justa Project social costs and benefits are:

- **Social Costs**: As its definition suggests, social costs are related to the negative environmental impacts of the Project, with a moderate or high consequence, which imply a direct (harmful) change in the population's well-being. This is directly related to the Economic Valuation results. According to the previous analysis, no moderate or high consequence environmental impacts that imply a harmful effect on the population's health or well-being have been determined; therefore, an EVEI for this EIAd Amendment has not been considered[20] (Section 7.4).
- **Social Benefits**: The SMP (Section 6.5) is defined as Marcobre's contribution to the benefit of the areas of social influence of the Mina Justa Project. The SMP for this EIAd Amendment amounts to S/ 4.9 million for a time horizon of 20 years, which imply the construction and operation stages of the Project. This amount, in current value, applying a social discount rate of 9% established by the Ministry of Economy and Finance (MEF), amounts to S/ 2.9 million (calculated as of the first year of construction).

Nevertheless, a referential estimation for the Mina Justa Project was carried out:

a) Costs refer to the costs of the Environmental Management Strategy during its two stages: (i) Construction, with a cost of USD 2,838,857.3; and (ii) Operation, with a cost of USD 47,251,071.5. Consequently, the total costs of the Mina Justa Project amount to USD 50,089,928.8, to be executed in an 18-year period, as per information in the Schedule and Budget for the Implementation of the Environmental Management Strategy of the Project (Section 6.9 of the EIAd Amendment).

b) In relation to the social and economic benefits associated with the Project, as per complementary considerations of the cost-benefit analysis (Section 7.5 of the EIAd Amendment), it is considered that, additionally to the benefits expected from the SMP investment —mainly focused on the district of Marcona— the new tax revenues from the 3rd Category Income Tax estimated at USD 780 million during the operation stage are of greater magnitude and significance. This will generate annual average incomes of USD 55.7 million.

The Benefit-Cost ratio was calculated with the benefits (USD 780 million) and costs (USD 50.09 million) results associated with the Project. The conclusion is that the benefits are 15.5 times higher in relation to the costs, i.e. that for each USD 1 of Project cost, USD 15.5 are generated in social and economic benefits. Hence, the cost-benefit analysis, following SENACE's methodology, justifies the Mina Justa Project investment.

[20] This disregard of an economic valuation does not imply an economic valuation equal to zero (0).

1.9 EIAd Assessment Sections

As part of the PPP, the persons interested in revising the complete file may do so in the locations identified as Ica Regional Government (DREM-Ica), Province Municipality of Nasca, Municipality of Vista Alegre, Municipality of the District of San Juan de Marcona and at Marcobre's OIP. To these purposes, Table RE-12 summarized the sections of the EIAd Amendment.

Table RE-12: Description of Impact and Implication in Social Well-being

Executive Summary Section		Section in the EIAd Amendment	
1.2	Project description	2.0	Project description
1.2.1	Background	2.1	Project General Background
1.2.2	Legal Framework	2.2	Legal and Administrative Framework
1.2.3	Brief Description of the Project EIAd Amendment	2.3	Objective of the Project and Assessment
		2.4	Political and Geographical Location of the Project
		2.5	Sequential Description of the Different Stages of the Exploitation Project and Estimated Schedule
1.2.3.1	Delimitation of the Effective Area and of the Areas of Influence	2.6	Effective Area of the Project
		2.7	Determination of the Area of Environmental Influence
1.2.3.2	Areas of Environmental Influence	2.7.1	Area of Environmental Influence (AEI)
1.2.3.3	Area of Social Influence	2.7.2	Area of Social Influence (ASI)
1.2.4	Project Description		
1.2.4.1	Mina Justa Pit and Manto Magnetita Pit		
1.2.4.2	Waste Dump		
1.2.4.3	Manto Magnetita Dump		
1.2.4.4	Oxide Plant		
1.2.4.5	Ripios Dump		
1.2.4.6	Sulfide Plant	2.8	Assessment of the Different Project Alternatives
1.2.4.7	Tailings Storage Facility		
1.2.4.8	Multi-buoy Terminal	2.9	Project Service Life
1.2.4.9	Seawater Supply Pipeline	2.10	Description of the Data Collection Stage
1.2.4.10	Desalination Plant		
1.2.4.11	Effluents and Emissions Facilities and Management	2.11	Description of the Construction Stage
1.2.4.12	Waste Management and/or Disposal Facilities and Activities		
1.2.4.13	Quarries	2.12	Description of the Operation and Maintenance Stages
1.2.4.14	Ancillary Components		
1.2.4.15	Power Supply		
1.2.4.16	Water Availability and Demand		
1.2.4.17	Construction Activities		
1.2.4.18	Water Management during Operation Stage		

Executive Summary Section		Section in the EIAd Amendment	
1.2.4.19	Labor		
1.2.4.20	Demand and Suppliers of Local Goods and Services		
1.3	Baseline	3.0	Baseline
1.3.1	Physical Environment Description (Soil, Water, Air)	3.2	Physical Environment Description
1.3.1.1	Meteorology, Climate and Life Zones	3.2.1	Meteorology, Climate and Life Zones
1.3.1.2	Geology and Geomorphology	3.2.2	Geology, Geomorphology, and Geochemistry
1.3.1.3	Geochemistry		
1.3.1.4	Waste Rock		
1.3.1.5	Ripios		
1.3.1.6	Tailings		
1.3.1.7	Quarries and Subsoils		
1.3.1.8	Hydrography	3.2.3	Hydrography, Hydrology, Hydrogeology, and Water Balance
1.3.1.9	Hydrogeology		
1.3.1.10	Soil, Land Use Capability and Current Land Use	3.2.4	Soil, Land Use Capability and Current Land Use
1.3.1.11	Air Quality and NIR	3.2.5	Air, Soil, Water, and Environmental Noise Quality
1.3.1.12	Soil Quality		
1.3.1.13	Marine Surface Water Quality		
1.3.1.14	Groundwater Quality		
1.3.1.15	Environmental Noise		
1.3.1.16	Underwater Noise	3.2.6	Other Aspects
1.3.1.17	Environmental Liabilities		
1.3.1.18	Vibrations		
1.3.1.19	Seismicity		
1.3.1.20	Oceanography		
1.3.1.21	Bathymetry		
1.3.1.22	Marine Sediments Quality		
1.3.2	Biological Environment Description	3.3	Biological Environment Description
1.3.2.1	Biological Diversity	3.3.1	Biological Diversity
		3.3.2	Field Assessment Criteria for Flora and Fauna
1.3.2.2	Flora and Vegetation	3.3.3	Biological Characterization of the Flora
1.3.2.3	Terrestrial Fauna	3.3.4	Biological Characterization of the Terrestrial Fauna
1.3.2.4	Marine Flora and Fauna	3.3.5	Biological Characterization of Marine Flora and Fauna
1.3.2.5	Fragile Ecosystems	3.3.6	Fragile Ecosystems
1.3.2.6	Landscape Units	3.3.7	Landscape Units

Executive Summary Section		Section in the EIAd Amendment	
1.3.2.7	Aspects or Factors Threatening the Conservation of Habitats or Ecosystems Identified	3.3.8	Aspects or Factors Threatening the Conservation of Habitats or Ecosystems Identified
1.3.2.8	Protected Natural Land		
1.3.3	Description of Population's Social, Economic, Cultural and Anthropological Environment	3.4	Description of the Population's Social, Economic, Cultural and Anthropological Environment
1.3.3.1	Area of Social Influence	3.4.3 3.4.5 3.4.6	Areas of Social Influence Area of Indirect Social Influence Area of Direct Social Influence
1.3.3.2	Area of Indirect Social Influence		
1.3.3.3	Area of Direct Social Influence		
1.3.3.4	Social Variables		
1.3.3.5	Economic Variables		
1.3.3.6	Cultural Variables		
1.3.3.7	Marine Traffic		
1.3.3.8	Archaeology	3.5	Existence of Archaeological, Historical and Cultural Remains in the Proposed Area of Use
1.3.3.9	Identification of Vulnerability to Natural and Anthropogenic Hazards	3.6	Identification of Vulnerability to Natural and Anthropogenic Hazards
1.4	Public Participation Plan	4.0	Public Participation Plan
1.5	Environmental and Social Impact Characterization		
1.5.1	Potential Physical Impacts		
1.5.1.1	Soils	5.4.1	Soils
1.5.1.2	Air Quality	5.4.2	Air Quality
1.5.1.3	Environmental Noise	5.4.3	Environmental Noise
1.5.1.4	Underwater Noise	5.4.4	Underwater Noise
1.5.1.5	Vibrations	5.4.5	Vibrations
1.5.1.6	Landscape	5.4.8	Landscape
1.5.2	Potential Biological Impacts	5.4.6	Terrestrial Flora and Fauna
1.5.2.1	Terrestrial Flora and Fauna		
1.5.2.2	Marine Flora and Fauna	5.4.7	Marine Flora and Fauna
1.5.3	Potential Socioeconomic Impacts	5.4.10	Socioeconomic Context
1.6	Environmental Management Strategy	6.0	Environmental Management Strategy
1.6.1	Environmental and Surveillance Management Plan	6.1 6.2	Environmental Management Plan Environmental Surveillance Plan
1.6.1.1	Air		
1.6.1.2	Noise and Vibrations		
1.6.1.3	Soils		
1.6.1.4	Surface Water		
1.6.1.5	Underground Water		
1.6.1.6	Seawater		
1.6.1.7	Mining Metallurgical and Domestic Effluents		

Executive Summary Section		Section in the EIAd Amendment	
1.6.1.8	Biology		
1.6.2	Solid Waste Management Plan	6.3	Solid Waste Management Plan
1.6.3	Environmental Compensation Plan	6.4	Environmental Compensation Plan
1.6.4	Social Management Plan	6.5	Social Management Plan
1.6.5	Contingency Plan	6.6	Contingency Plan
1.6.6	Adequacy Plan of Maximum Permissible Limits for Industrial and/or Domestic Effluents and/or Emissions to the Quality Standard (EQS) of the Receiving Body	6.7	Adequacy Plan of Maximum Permissible Limits for Industrial and/or Domestic Effluents and/or Emissions to the Quality Standard (EQS) of the Receiving Body
1.6.7	Closure Plan	6.8	Conceptual Closure Plan
1.6.7.1	General		
1.6.7.2	Specific		
1.6.7.3	Closure Activities	6.8.4	Closure Activities
1.6.7.4	Social Programs	6.8.5	Social Programs
1.6.7.5	Post-Closure Maintenance and Monitoring	6.8.6	Post-Closure Maintenance and Monitoring
1.6.7.6	Schedule	6.8.7	Schedule
1.6.8	Environmental Management Strategy Budget	6.9	Schedule and Budget for the Implementation of the Environmental Management Strategy
1.6.9	Project Schedule and Total Investment	6.10	Summary of Environmental and Social Commitments
1.7	Economic Valuation of Environmental Impacts	7.0	Economic Valuation of Environmental Impacts
1.8	Cost-Benefit Analysis	-	-
1.9	EIAd Assessment Sections	9.0	
1.10	Acronyms and Abbreviations	10.0	Acronyms and Abbreviations

1.10 Acronyms and Abbreviations

Acronyms and Abbreviations	Description
%	percentage
°C	Celsius degrees
AAA	*Autoridad Administrativa del Agua* (Administrative Water Authority)
AAHH	*Asentamiento Humano* (Human Settlement)
ADSI	Area of Direct Social Influence
AISI	Area of Indirect Social Influence
ALA	*Autoridad Local del Agua* (Local Water Authority)
ANA	*Autoridad Nacional del Agua* (National Water Authority)
ANP	Área Natural Protegida (Protected Natural Area)
ASI	Area of Social Influence
Ausenco	Ausenco Perú S.A.C.
Cat. 1-A1	Category for untreated potable water
Cat. 3-RV	Category 3 for irrigation of low-stem vegetables
Cat. 3-BA	Category 3 for animal consumption
CCME	Canadian Council of Ministers of the Environment
CIRA	*Certificado de Inexistencia de Restos Arqueológicos* (Certificates of Non-Existence of Archaeological Remains)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	centimeters
cm/year	centimeters per year
D.R.	Directorial Resolution
dB	decibel
DICAPI	*Dirección General de Capitanías y Guardacostas del Perú* (General Directorate of Aquatic Control Board and Coastguards of Peru)
DIGESA	*Dirección General de Salud Ambiental* (General Directorate of Environmental Health)
DTA	Desert-Tillandsial Association
EIA	Environmental Impact Assessment
EIAd	Detailed Environmental Impact Assessment
EMP	Environmental Management Plan
ENFEN	*Estudio Nacional del Fenómeno El Niño* (National Study of El Niño-Southern Oscillation) (NSENSO)
ESA	Environmental Study Area
ESAm	Environmental Study Area, marine zone
ESAt	Environmental Study Area, terrestrial zone
EsSalud	*Seguro Social de Salud del Perú* (Peruvian Social Security Health Insurance)
FAO	Food and Agricultural Organizations of the United Nations
FEN	*Fenómeno El Niño* (El Niño Phenomenon)
FRCGC	Frontier Research Center for Global Change
g	grams

Acronyms and Abbreviations	Description
G	gravity acceleration
g/L	grams per liter
GDP	Gross Domestic Product
Golder	Golder Associates Perú S.A.
ha	hectares
HDI	Human Development Index
Hz	hertz
IGA	*Instrumentos de gestión ambiental* (Environmental management instruments)
INEI	*Instituto Nacional de Estadística e Informática* (National Institute of Statistics and Data Processing)
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
ITS	*Informe Técnico Sustentatorio* (Technical Supporting Report)
IUCN	International Unión for the Conservation of Nature
kg	kilogram
km	kilometer
km^2	Square kilometer
kV	kilovolt
L	liter
L_{AeqT}	A-weighted Equivalent Continuous Sound Pressure Level)
m	meter
M.R.	Ministerial Resolution
m/s	Meters per second
Marcobre	Marcobre S.A.C.
masl	meters above sea level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MINAM	*Ministerio del Ambiente* (Ministry of Environment)
MINEM	*Ministerio de Energía y Minas* (Ministry of Energy and Mines)
MINSA	*Ministerio de Salud* (Ministry of Health)
mm	millimeter
MM	Modified Mercalli scale
mm/h	millimeters per hour
MTC	*Ministerio de Transportes y Comunicaciones* (Ministry of Transport and Communications)
NBI	*Necesidades Básicas Insatisfechas* (Unsatisfied Basic Needs)
No PAG	Non-Acid Generating Potential
NTP	*Norma Técnica Peruana* (Peruvian Technical Standard)
PAG	Potentially Acid Generating
pH	potential of hydrogen
ppm	parts per million

Acronyms and Abbreviations	Description
QA/QC	*Quality Assurance / Quality Control*
RNSF	*Reserva Nacional San Fernando* (San Fernando National Reserve).
SENACE	*Servicio Nacional de Certificación Ambiental para las Inversiones Sostenibles* (National Service of Environmental Certification for Sustainable Investments)
SENAMHI	*Servicio Nacional de Meteorología e Hidrología* (National Meteorology and Hydrology Service)
SERNANP	*Servicio Nacional de Áreas Protegidas* (National Service of Protected Natural Areas)
SHP	Shougang Hierro Perú S.A.A.
SIAM	*Sistema de Información Ambiental Minero* (Mining Environmental Information System)
SPL	Sound Pressure Levels
ToR	Terms of Reference
USDA	United States Department of Agriculture
VU	Vulnerable
WGS 84	World Geodesic System 1984

1.11 Glossary of Terms

Term	Description
Abundance	Number of individual per species present in a particular place (zone or vegetation type).
Agglomerate	Volcanic breccia or conglomerate, a chaotic set of pyroclastic materials, mainly rough, from angular to rounded.
Agricultural soil	Soil dedicated to the production of crops, forage and cultivated grass. It is also soil able for the growth of crops and livestock development. These includes land classified as agricultural, which is the habitat of permanent and transitory species, as well as of native flora and fauna, as in the case of protected natural areas.
Alluvial	Deposited conformed of heterogeneous material in shape, size and origin (from silts and clays to blocks and boulders) which have in common transportation and sedimentation through fluvial means, generally on the banks of fluvial channels.
Argillite	Colloquial denomination for rocks rich in clays (shales, siltstones).
Arrival	Vessel arrival to a port for loading or unloading.
Background level	Soil concentration of chemicals that were not generated by the activity under study, and that are naturally found in the soil or were generated by an anthropogenic source alien to the activity under study.
Bandwidth	The length, measured in Hz, of the frequency extension in which most of the signal power is concentrated. It may be calculated based on a temporary signal through the Fourier analysis. Frequencies in between these limits are also called effective frequencies.
Baseline	Situation of an area in its biotic, abiotic and sociocultural aspects, before the start of a project.
Basement	Rocky substratum of a particular zone.
Basin	Terrain delimited by the upper parts of a mountain where rain water concentrates and runs into a creek, river or lake.
Batholite	Great intrusive mass or discordant pluton. Denomination applied to great intrusive plutonic rock masses, generally formed in deep areas of the earth crust.
Bay (Bahía)	A sea inlet into the coast, with a considerable extension, closed in by two land capes that, given their morphological characteristics and the reduced length of the inlet into the bay in relation with the latter's dimensions, allows for water renovation, especially during rising and falling tides.
Bottom level sampling	That aimed at identifying the bottom level of the soil.
Calibration certificate	Document that revalidates the good functioning of measurement equipment.
Certificado de Inexistencia de Restos Arqueológicos (Certificates of Non-Existence of Archaeological Remains)	Official document issued by the *Instituto Nacional de Cultura* (National Culture Institute) or the Ministry of Culture to officially and technically make a statement about the existence or not of archaeological remains on a terrain.
Child mortality rate	The number of deaths of children younger than 1 in a particular year per 1,000 births.
Civil society	The term civil society refers to a vast array of non-governmental and non-profit organizations that are present in public life, express their interests and values of their members and others, according to ethical, cultural, political, scientific, religious and philanthropic considerations. Therefore, the term civil society embraces a large variety of organizations: community groups, non-governmental organizations, unions, indigenous groups, charity institutions, religious organizations, professional associations and foundations.
Clay-humic complex	Synonym to soil colloids.
Coefficient	Constant element in a multiplication.

Term	Description
Colluvial	Deposit formed by the accumulation of gravel sand and blocks in the lower parts of hills in the way of cones, produced as a result of gravity.
Concentration	The relation between weight and volume of the substance and the unit of volume of the medium in which it is contained.
Creek	Narrow and continued opening between two slopes which serves as a water runoff; generally caused by the erosion of the water flow on a sporadic or continuous basis.
Cretaceous period	A division in the geological temporal scale, and the third and last period of the Mesozoic Era. It started 145 million years ago and finished 66 million years ago.
Decibel	A decibel is an acoustic measurement logarithmic unit which, in general terms, is used to compare the sound pressure in the air with a reference pressure. This reference level approximates the minimum pressure level that enables the human ear to hear it.
Departure	Vessel operation upon weighing anchor and starting to move.
Depression	An area whose relief is lower than that of adjacent terrains. It occurs as a result of earth subsidence, which in turn may result from different factors such as sinking or collapse.
Diatomite	Volcanic or organic sedimentary deposits, composed of volcanic ash and sand, rich in silica or by the accumulation of diatomites (marine microorganisms rich in silica).
Dike	In geology, a dike is an intrusive igneous body of tabular geometry that intrudes a sequence of pre-existing rocks.
Diorite	Intrusive igneous rock composed principally of the calcium-sodium (plagioclase) and of iron-magnesium silicate minerals, with little orthoclase and no quartz. It is the intrusive equivalent of andesites.
Dock	Location destined to product unloading.
Dolomite	Sedimentary rock formed by the accumulation or precipitation of calcium carbonate and magnesium in an aqueous medium.
Economically Active Population (EAP)	It comprises people from 14 years of age and over who work (are employed) or are actively looking for a job (unemployed).
El Niño	Cyclic warming of the seawater temperatures in the east Pacific Ocean, off the western coast of South America, which may cause significant climate changes. This occurs when Equatorial waters displace the colder waters of the Humboldt current, interrupting the upwelling process.
Electrical conductivity	Electrical conductivity is a body's capacity to allow the transport of electrical current through itself. It is an indicator of soil salinity. It is defined as the ability to transport electrical current in the soil solution due to the presence of soluble ions. This means that the more soluble ions, the higher the electrical conductivity.
Elevation	Height of a point on the horizontal plane used as reference.
Environmental impact	It is the modification of the initial conditions of environmental quality due to human activities. It derives from different activities and is observed in natural environments, as those resulting from human intervention or creation.
Environmental Quality Standards (EQS)	The measure that establishes the degree or concentration of elements, substances or physical, chemical and biological parameters in the air, water or soil, in their receiving body condition, which do not represent a significant risk for human health or the environment. According to the particular parameter it may refer to, the concentration or degree may be expressed in maximums, minimums or ranges. For noise, those that consider the maximum noise levels in the outdoor environment, which must not be exceeded in order to protect human health. Such levels correspond to A-weighted equivalent continuous sound pressure levels.
Epicenter	Location on the earth surface directly above the hypocenter (focus), where the seismic rupture initiates.
Erosion	Set of external phenomena (climatic, geodynamic, etc.) which, upon acting on the earth's surface, result in the removal of loose material and its later deposit in a zone of lower geographical altitude.

Term	Description
Eustatic sea level	Local sea level in relation to adjacent land. The Eustatic sea level changes due to the ocean's thermal expansion, the melting of non-polar glaciers and the change in the volume of the ice layers in the Antarctic and Greenland.
Evaporation	Process that occurs gradually. In this process, the water on the earth surface goes into the atmosphere as vapor.
Fault	Soil and rock ruptured surface which has been displaced at some point. This displacement occurs along a surface known as fault plane.
Fauna	It is the set of animal species that may be found in a geographical area and inhabit a particular ecosystem. Fauna refers to a list of species.
Flora	It is the set of vegetation species that may be found in a particular area.
Formation	It is the set of rocks and rock outcrops with particular lithological, stratigraphic, structural and chronological characteristics that make them distinguishable from others.
Fossil waters	Underground water that has remained in an aquifer for thousands to millions of years, when geological changes sealed them, prevented their recharge and were kept locked inside, thus becoming fossil water.
Geology	Geology is the science that studies the terrestrial globe's interior, the matter that composes it, its formation mechanism, the changes and alterations it has been suffering since its origins, and its texture and structure in its current state.
Geomorphological unit	Group of soils or rocks with similar geomorphological characteristics which, in turn, are distinguished from other near geomorphological units.
Geomorphology	The science that studies the earth's surface forms, focused on describing, understanding its genesis and understanding its current behavior.
Gradient	The increased or decreased intensity of a variable magnitude.
Granodiorite	Intrusive rock composed of almost equivalent proportions of quartz, plagioclase feldspars, potassium feldspars and ferromagnesian, whitish gray in color and high hardness. It usually surfaces as massive bodies (stocks).
Gravel	Rock particles and fragments between 2 mm and 2 cm.
Gross Domestic Product (GDP)	GDP is defined as the value of all final goods and services produced in a geographical region in a determined period of time. More specifically, it is the sum of the gross added value and taxes.
Group	A set of geological formations with common age, origin, geographical distribution or lithology.
Habitat	The place or ambient where a plant or animal naturally live.
Hill	Ground elevation that generally does not exceed 100 m from the basis to the top.
Hillside	Any flank of a hill or mountain.
Home	The group of people, related or not, who totally or partially occupy a house, share main meals and take care of other common basic vital needs. Exceptionally, a single-person home is also considered home.
Horizon	Almost parallel surface soil layers with individual characteristics determined by the incidence of formation factors and the occurrence of edafogenetic processes. They are the following: **O** horizon, located on the soil surface and composed of organic matter; **A** horizon, first mineral horizon, its organic matter content is larger than in underlying horizons; **E** horizon, the typical elluviated horizon; leached of Fe and clay by fluvic acids, so it is white, with accumulation of quartz; **B** horizon, illuvial or accumulated horizon from the elluviated materials of the overlying horizons; and **C** horizon, which represents the parent material.
Human Development Index (HDI)	Defined as a way to measure human beings' quality of life in the ambient in which they develop. It is composed of three most essential and common measures for human development, namely: a long healthy life, measured by the life expectancy at birth; knowledge, measured by the adult illiteracy rate (with a two-thirds weighting) and the total elementary, secondary and higher education combined enrollment rate (with a one-third

Term	Description
	weighting); and a decent standard of living, measured by the family income per capita. If these essential opportunities do not occur, many other alternatives will continue to be unavailable.
Hydrogeology	Hydrogeology is one of the branches of geological sciences that studies underground waters in regard to their circulation, geological conditions and collection.
Identification sampling	That aimed to identify if the soil is polluted. It is to be understood that every reference to exploratory sampling in D.S. No. 002-2013-MINAM shall be understood as referring to identification sampling.
Illiteracy rate	The population of more than 15 years of age who cannot read or write. The illiteracy rate is calculated considering the population of 15 years of age and over who cannot read or write in the numerator, and the total population of 15 years of age and over in the denominator, expressed by 100.
Industrial soil	Soil in which the main activity developed includes the extraction or use of natural resources (mining activities, hydrocarbon, etc.) or the elaboration, transformation or construction of goods.
Infiltration	Process by which water penetrates from the ground surface into the soil.
Intertidal zone	Shallow marine areas, located from the low tide level down to depths of 30 m to 40 m off the coast. That which is covered, at least partly, during high tides, and is not covered during low tides.
La Niña	Cyclic cooling of the seawater temperatures in the east Pacific Ocean, off the western coast of South America, which may cause significant climate changes. This occurs when Equatorial waters displace the warmer Humboldt Current waters, favoring the upwelling process.
Leeward	The opposite side from where the wind is received.
Limestone	Sedimentary rock formed by the accumulation or precipitation of calcium carbonate in an aqueous medium.
Literacy (15 years to more)	The ability to read and write in any language. A literate person is that who is able to read and write correctly a simple and short account of facts about daily life.
Marine traffic	Quantity of load transported by vessels which arrives at and leaves from a port.
Meteorological station	Area where electrical-sensor measurement equipment for meteorological parameters are placed.
Meteorology	Science that studies the atmosphere and atmospheric phenomena. It comprises the study of weather and climate and addresses the physical, dynamic and chemical study of the earth's atmosphere.
Migration	According to INEI, migration is understood as the population's movement when temporarily or definitely leaving a place of residence to establish or work in another country or region, especially due to economic, political or social reasons. Thus, a person registered in one place different from their birth place would be considered a migrant.
Miscellaneous areas	They are essentially non-edaphic units because of unfavorable factors, for example, a severe active erosion, water washing, unfavorable soil conditions or human activities, which may or not stand some type of vegetation. Generally, these areas are not of agricultural or forest interest.
Monitoring	The action of measuring and obtaining data in a programmed manner from one or several parameters, with the purpose to get to know the variations of this parameter over time and space. In hydrogeology, this term is used to include wells and piezometers that have been used or are used to measure water levels and to carry out the sampling of underground water. For noise, it is the action of measuring and obtaining data in a programmed manner from the parameters that influence or modify the environmental noise quality, with the purpose to get to know the variations of this parameter over time and space.

Term	Description
Monitoring wells	In the hydrogeology section, this term is used to include wells and piezometers that have been used or are used to measure water levels and to carry out the sampling of underground water.
Mortality rate	The number of deaths by 1,000 inhabitants in a particular year.
Mortar	A mix of different material, like lime or cement, sand and water, used in construction to fix bricks and cover walls.
National Cultural Heritage	All manifestations of human activities (material or not) which, given their importance, value and paleontological, archaeological, architectonic, historical, artistic, military, social, anthropological or intellectual significance, is expressly declared as such or upon which there is a legal assumption.
Neighborhood councils	Social grassroots organizations in a territory which intervene in local management through neighborhood participation mechanisms.
Parameter	Factor that is quantified. For soil, any element or chemical substance that defines its quality and is regulated by the competent authority.
Particulate matter	Solid or liquid material suspended in the atmosphere, of varied composition, emitted or formed directly in the atmosphere, characterized by rough or fine fractions.
Pfastetter code	This is a methodology to assign identifiers (Id) to drainage units, based on the topology of the surface or land area; a hydrographic unit is assigned an Id to relate it to hydrographic units it contains and the hydrographic units with which it limits.
pH	Potential of hydrogen, indicating the water acidity or alkalinity degree.
Piezometer	Well with no pumping system, generally small in diameter, used to measure the water table.
Pit	Exploitation system characterized by the use of benches or stepped cuts, generally applied to extraction in great magnitude ore deposits located near the surface, which have a barren material layer of intermediate significance.
Port	Place on the coast or streambed for vessel reception and service.
Power substation	A facility to modify and establish the tension levels of an electric infrastructure to facilitate the transportation and distribution of electrical power.
Power transmission line	The physical means for the transmission of power energy at great distances.
Precipitation	Water coming from the atmosphere and that, in solid or liquid form, is deposited on the earth surface.
Public Participation	A public, dynamic and flexible process which seeks to provide the population involved with timely, truthful and appropriate information in regard to the mining activities through the application of different mechanisms.
Receiver	Generically, it is a water course, village, people, houses, among others, that receive effluents, discharges, emissions, vibrations, etc. as a result of anthropogenic or natural activities.
Relief	Form of the earth crust on the surface.
Richness	Number of species present in a particular place (zone or vegetation type).
Rural area	The territory comprising rural villages, rural settlements and rural localities. They are territories with 500 or fewer than two thousand inhabitants; their houses are usually grouped together forming blocks or streets; or with fewer than 500 inhabitants and one of their main characteristics is that houses are placed in a scattered manner.
Sampling station	Location (particular area) of the soil where samples are collected, be they superficial or deep.
Sandstone	Sedimentary rock composed mainly of compacted and lithified sand grains. According to the prevailing sand type, sandstone may be classified as quartz, arkose, and greywacke, among others.

Term	Description
Sediment	Solid material, accumulated on the earth surface, derived from the actions of phenomena and processes that act on the atmosphere, hydrosphere and biosphere.
Seism	Term used to describe both a sudden fault slide resulting from an earthquake and the seismic energy liberation caused by the slide, due to volcanic activity or other sudden changes on the crust.
Slope	Inclined surface extending from the basis to the top of a hill.
Social development	A change process in the profile of an economy, oriented towards channeling, in sufficient amounts, the benefits of national growth and income to social sectors. It is a permanent improvement process of social well-being, which is reached based on the equitable distribution of income and the eradication of poverty. When it happens, growing indexes in food, education, housing, environment, and justice may be observed in the population.
Social organizations	Collective denomination for all classes of government-independent organizations and associations that represent professions, stakeholders or segments of society. They include unions, signatory employer associations, environmental associations and groups that represent women, farmers and the handicapped.
Soil	Unconsolidated material composed of inorganic particles, organic matter, water, air and organisms, which is comprised by the topmost earth crust layer to the different levels of depth.
Soil organic matter	Organic matter found on the soil, in balance with environmental conditions. It is composed of all organic residues in different decomposition states.
Soil profile	Vertical exposure of soil horizons.
Solar incidence	The direction with which solar irradiance touches a surface.
Species	Group of organisms with similar genetic characteristics that may reproduce among themselves and produce fertile offspring.
Stability	The resistance of a structure, a slope or a containment wall to slide-faults or collapse under the normal conditions for which it was designed.
Stratigraphic column	Sequential graphic representation of a particular zone's stratigraphy, from the oldest to the most recent deposits.
Sub-basin	Terrain delimited by the upper parts of a mountain where rain water concentrates and runs into a creek, river or lake.
Subduction	A term used in plate tectonic theory to signal the penetration of the plate rock mass underneath another at convergent boundaries.
Subtidal zone	Tidal expanse, between the low and high tide limits.
Tailings	Material which is the product of the mineral concentration mining process.
Territorial organizations	Those that represent the interests of people who share a territory and whose objectives are usually generic, addressing different aspects of social, economic and political life.
Thornthwaite classification	Climate classification method. It employs indexes such as humidity and aridness to determine the humidity regime of an area based on its average temperature, average precipitation and average vegetation type. The lower the index value in a particular area, the higher the dryness in such area.
Tsunami	Sea wave of local or distant origin generated by large-scale shifts of the seabed in connection with earthquakes of great magnitude, large underwater slides, or violent eruptions of marine volcanoes.
Underwater Cultural Heritage	All remains of human existence of cultural, historical and archaeological nature, which have been totally or partially submerged in water, periodically or continuously, for at least 100 years.
Unsatisfied Basic Needs (UBN)	It is a direct method to identify critical lacks in a population and characterize poverty. It usually employs indicators directly related to four basic needs areas (housing, sanitary services, basic education and minimal wages), available in population and housing censuses. Particularly, UBN are homes in houses which have inadequate physical characteristics, homes in overcrowded houses, homes in houses with no sewage system,

Term	Description
	homes with children who do not attend school, and highly economically dependent homes.
Upwelling	Terrestrial surface zone with geological strata or ore deposits. Total area on which a particular rocky unit or structures appear on the ground surface or immediately below surface sediments, visible or not. See also spring.
Urban area	The territory occupied by urban villages. The urban area of a district may comprise one or more urban villages (territory inhabited by two thousand or more inhabitants, their houses are grouped together, forming blocks and streets).
Vessel	Any type of vessel or ship used to navigate.
Village (Centro Poblado)	All locations in the national territory, urban or rural, identified by a name and inhabited with the will to remain there. Its inhabitants are related by common economic, social, cultural and historical interests. Such villages may be classified by their attributes as hamlets, villages, towns, cities and metropolis. Houses may be grouped together forming blocks, streets and squares, as in the case of towns and cities. This definition is based on the Regulations of Law No. 27795, Law on Territorial Demarcation and Organization.
Water level	Underground water level variation, generally measured from a fix point on the surface.
Water supply	The manner in which water is supplied and the origin of the water, used for home consumption.
Water table	Surface that separates the undersoil zone flooded with underground water from the zone in which cracks are filled with water and air.
Weathering	Physical or chemical decomposition or disintegration process of solid materials (soils or rocks) on the earth surface or close to it.
Wind Rose	Diagram that represents the mean wind intensity.
Windward	Marine term indicating the opposite direction predominant winds follow; the direction from which the wind comes.

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