Environmental and Social Impact Assessment for Medusa submarine cable system: main trunk (and selected Phase 1 landings)

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[MEDUSA España]

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Acronyms

2WD	Two times the water depth
3WD	Three times the water depth
AB	Algerian Basin
ABF	Architects of buildings of France
ABV	Adventure Bank Vortex
AFB	French Agency for the Biodiversity
AIS	Atlantic-Ionian Stream
AP	Adventure Plateau
APA	Portuguese Environment Agency
APAL	Coastal Protection and Planning Agency
AMC	Asia Minor Current
AMN	National Maritime Authority
ANCC	National Agency for Climate Change
ARERA	Regulatory Authority for Energy, Networks and the Environment
ARPA Sicilia	Regional Environmental Protection Agency
ARS	Regional Health Agency
AS	Alboran Sea
ASN	Alcatel Submarine Networks
ATS	Local Health and Safety Agencies
AW	Atlantic Water
BAS	Burial Assessment Survey
BFS	Burial feasibility study
BH	Backhaul
BMH	Beach Manhole
BU	Branching Unit
CAP	Primary Care Centers
CBOs	Community-based organizations
CPCE	Postal and Electronic Communications Code
CPT	Cone penetration tests
CCAA	Autonomous Communities
CCDR	Regional Spatial Planning Commissions
CDNPS	Department Commission of Nature Landscapes Sites
CG3P / CGPPP	General Code of Property of Public Persons
CLS	Cable Landing Station
CMS	Lisbon City Hall
CSIC	Superior Council of Scientific Investigations

CSO	Civil Society Organization
DA	Doble Armored cable
DC	Data Centers
DDFIP	General Directorate of Public Finances
DDT	Departmental Direction of the Territories
DDTM	Departmental Directorate of Territories and the Sea
DGALN	General Directorate for Planning, Housing and Nature
DGE	General Directorate of Strategies
DGEG	General Direction of Energy and Geology
DGPC	General Direction of Cultural heritage
DGRM	General Direction of Natural Resources, Security and Maritime Services
DRAC	Regional Directorate of Culture of Alentejo
DREAL	Regional Directorates for the Environment, Planning and Housing
DTS	Desktop Study
EEARD	Wastewater pumping stations
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EDAR	Wastewater treatment plant
EIB	European Investment Bank
EMEP	European Monitoring and Evaluation Programme
EMODnet	European Marine Observation and Data Network
EMT	Eastern Mediterranean Transient
EPAL	Empresa Portuguesa Das Aguas Livres
EPCI	Other territorial entities
EPIC	Public Establishments of Industrial and Commercial nature
EPST	Public Establishments of Scientific and Technological nature
ERSAR	Water and waste Regulatory Authority
ESAP	Environmental and Social Management Plan
ESIA	Environmental Impact Study
ETAP	Drinking water treatment stations
EU	European Union
EUNIS	European Nature Information System
FAO	Food and Agriculture Organization of the United Nations

FH	Fronthaul
FIT	Feed-in tariff
FPC	Community Fishing Fleet
GDP	Gross domestic product
GEM	Global Earthquake Model
GFCM	General Fisheries Commission of the Mediterranean
GIS	Geographic information system
GNR	National Republican Guard
GRM	Grievance Redressal Mechanism
GSA	Geographic Sub Areas
HDD	Horizontal Directional Drilling
IBAs	Important Bird and Biodiversity Areas
ICNF	Institute for Nature Conservation and Forests
ICPC	International Cable Protection Committee
ICT	Information and Communication Technology
ICZM	Protocol on Integrated coastal Zone Management
IDAPES	Andalusian information system on fish marketing and production data
IGAMAOT	General Inspection of the Environment, Spatial Planning, Agriculture and Sea
ILO	International Labor Organization
IMO	International Maritime Organization
INED	French Institute for Demographic Studies
Ineris	French National Institute for Industrial Environment and Risks
IPPC	Integrated Pollution Prevention Control
ISPRA	Superior Institute for Environmental Protection and Research
ISS	Superior Health Institute
Istat	Italian National Institute of Statistics
ISV	Ionian Shelf-break Vortex
IUCN	International Union for Conservation of Nature
LiS	Libyan Sea
LIW	Levantine Intermediate Water
LPG	Liquefied petroleum gas
LS	Levantine Sea
LW	Lightweight cable
LWP	Lightweight protected cable
MAPAMA	Ministry of Agriculture and Fisheries, Food and the Environment

MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder System
MEDDTL	Ministry of Ecology, Sustainable Development, Transport and Housing
MIBEL	Iberian Electricity Market
MIJ	Mid-Ionian Jet
MITECO / MITERD	Ministry for Ecological Transition and the Demographic Challenge
MTPD	Marine-Terrestrial Public Domain
MMJ	Middle Mediterranean Jet
MMO	Marine mammal observers
MVC	Mazara del Vallo Channel
NMVOC	Non-methane volatile organic compounds
NGO	Non-governmental organizations
NOAA	National Oceanographic and Atmospheric Organization of the USA
OECD	Organisation for Economic Co-operation and Development
OFB	French Office of the Biodiversity
OSPAR Convention	Convention for the Protection of the Marine Environment of the North-East Atlantic
PB	Provençal Basin
PGA	Peak Ground Acceleration
PiPs	Permits in Principles
PNM	Natural maritime parcs
POEM	Physical Oceanography of the Eastern Mediterranean
POP	Point of Presence
PPE	Personal protective equipment
PPS	Purchasing Power Standards
PS	Pelagian Shelf
PV	Photovoltaic
RC	Route Clearance
RD	Royal Decree
REDIAM	Environmental Information Network of Andalusia
ROV	Remotely Operated Vehicle
R&D	Research and Development
SA	Single Armored cable
SAC	Special Areas of Conservation
SAS	Andalucian health Service
SBP	Sub-Bottom Profiler
SCI	Spaces of Community Interest

SCS	Catalan Health Service
SDAGE	Master Plan for Water Development and Management
SEP	Stakeholder Engagement Plan
SICA	Noise Pollution Information System
SIH	Fisheries Information System
SML	Sea and Coastal Service
SNCZI-IPE	National Floodplain Mapping System - Inventory of Dams and Reservoirs
SNS	National Health Service
SOLAS	International Convention for the Safety of Life at Sea
SPA	Special Protection Areas
SPAMI	Specially Protected Areas of Mediterranean Importance
SSS	Side Scan Sonar
T	Period return
TDS	Total Dissolved Solids

TDW	Tyrrenian Dense Water
TUPEM	Title of Private Use of Maritime Space
TURH	Title for the Use of Water Resources
UCH	Underwater cultural heritage
UNCLOS	United Nations Convention on the Law of the Sea
UNCLOS III	Third United Nations Conference of the Law of the Sea
USD	United States dollar
UXOs	Unexploded Ordnances
VHF	Very High Frequency
VT	Valencia Through
WDMW	Western Deep Mediterranean Water
WHYMAP	World-wide Hydrogeological Mapping and Assessment Programme
WWF	World Wide Fund for Nature

1 Environmental and Social Impact Assessment

1.1 Introduction

The Medusa submarine cable system project consists of the installation of a fiber optic submarine cable across the Mediterranean Sea promoted by Medusa Submarine Cable System S.L. The project will involve 9 different countries. The system is composed by a main cable going from Lisbon, in Portugal, to Port Said, in Egypt. The main trunk will connect Lisbon to Zahara de los Atunes (Spain). Then, in order to avoid the crossing of the Gibraltar Strait by sea (strong marine currents, high marine traffic, high number of submarine cables already laid in the area), in this zone Medusa submarine system will also include a terrestrial cable connecting Zahara, on the Atlantic Coast of Southern Spain, with Torreguadiaro, on the Mediterranean side. This terrestrial segment of the fiber optic cable is out of the scope of the present document. At Torreguadiaro, the system will become again a submarine cable and the main trunk will then cross the entire Mediterranean Sea up to the final point in Egypt. Several Branching Units (BU) from the main cable pathway will be adopted to reach the other landing sites: Barcelona (Spain), Marseille (France), Tetouan and Nador (Morocco), Bizerte (Tunisia), Mazara del Vallo (Sicily, Italy), Yeroskipou (Cyprus) and optionally also Collo and Algiers (Algeria), Heraklion (Crete, Greece) and several point in Libya and Turkey.

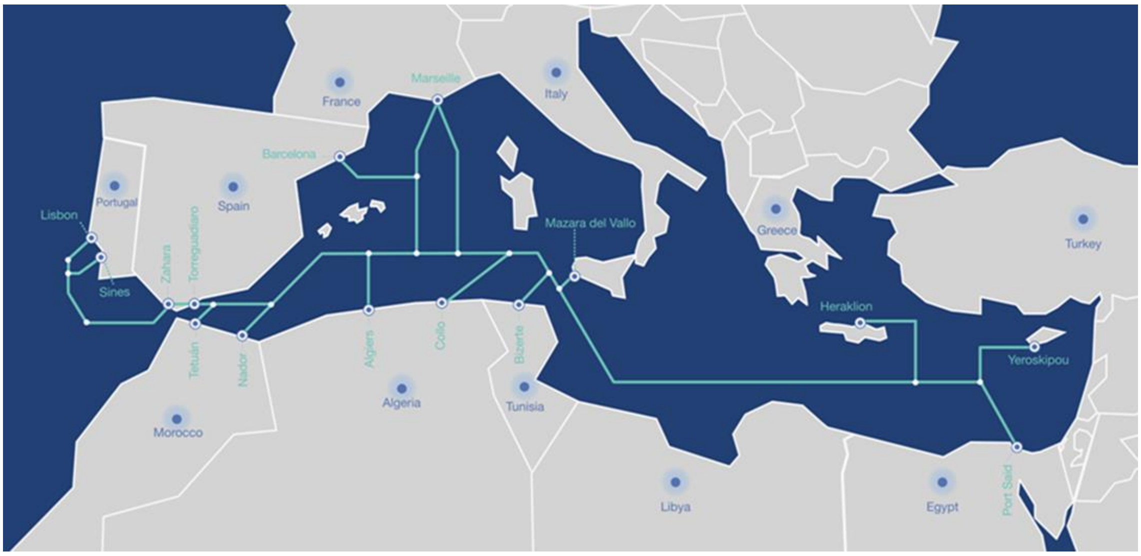

Figure 1. Schematic route of the Medusa subsea system across the Mediterranean Sea.

The installation of the cable in the Western Mediterranean Sea is expected for 2024, while the installation in the Eastern Mediterranean is expected for 2025. The installation will be executed by Alcatel Submarine Networks (ASN).

Due to the different deadlines of the project and the different definition and progress stages for the landings, the present document analyzes only the main trunk of the cable between Lisbon and Port Said, as well as landings of the Atlantic Sea and Western Mediterranean basin: Lisbon, Zahara, Torreguadiaro, Barcelona, Marseille and Mazara.

The permitting process for the landing of the Medusa submarine system in the different countries has been started in some of the mentioned landings, while in other is still green. For this reason, the availability of information about any of the landings depends on the stage of the permitting process. This version of the document presents more detailed information for Lisbon, Zahara, Torreguadiaro, Barcelona and Marseille landings. Additional details can be added for Mazara landing once the permitting process will reach a more advanced stage for those landings too.

1.2 Project Description

1.2.1 Submarine cable system features

The installation of a submarine fiber optic cable is composed by two main elements:

- The terrestrial segment, that is the segment between the Cable Landing station (CLS) where the electronic equipment for the treatment of the optical signal is installed, to the Beach Manhole (BMH), which is an infrastructure located next to the beach, where the transition between the marine cable and terrestrial cable occurs;
- The marine segment, that is the segment from the BMH up to the open sea waters.

The connection between BMH and CLS is referred as Fronthaul (FH). CLS is then connected to Data Centers (DC) or Point of Presence (POP) through the Backhaul (BH).

The following picture is a schematic representation of terrestrial and marine segments for a submarine fiber optic cable.

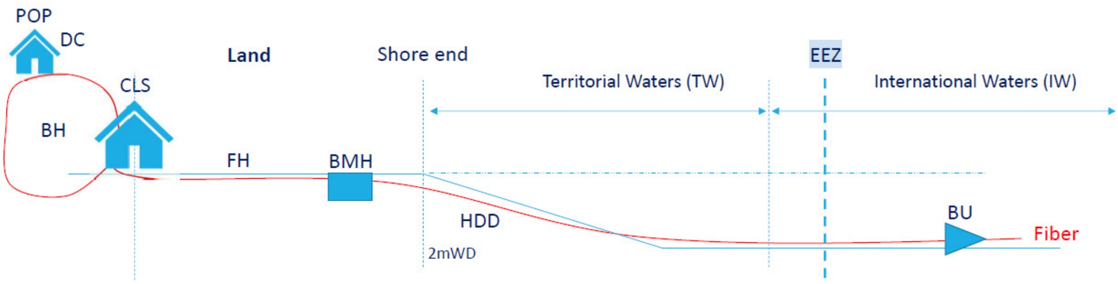

Figure 2. Schematic representation of terrestrial and marine segments for a submarine fiber optic system. POP= Point of Presence; DC= Data Center; BH= Backhaul; CLS= Cable Landing Station; FH= Fronthaul; BMH= Beach Manhole; HDD= Horizontal Directional Drilling; BU= Branch Unit.

A submarine fiber optic cable is composed by a core where are located the fiber optic cable for the information transmission and some external protection layers, whose number and thickness depend on the zone where the cable will be installed and the potential breakdown risk.

The main design function of a cable is indeed to protect the optical fiber transmission path over the entire service life of the system. A secondary function is that its metallic elements are used either to feed electric current to the repeaters or to monitor on a permanent basis the status of the transmission system and to localize cable breaks (ASN, cable product description).

Cables that will be used for the project are OALC-4 and OALC-7, designed and qualified by Alcatel Submarine Networks (ASN) using international submarine cable standards (ITU-T Recommendation G976) for optical systems operating around 1.55 µm as a reference. Both OALC-4 and OALC-7 design can accommodate up to 24 pairs of fibers, but the first one is used with a resistance of 1.6/1.0/0.85 ohm/km while the second one is used with a resistance of 0.7 ohm/km. This depends on actual system requirements. OALC-4 and OALC-7 differ also in several technical characteristics as well as outer diameter.

The fibers are housed in a jelly filled steel tube surrounded by two layers of steel wires that form a protective vault against pressure and external aggressions and provide tensile strength. This vault is enclosed in a hermetically sealed conductor tube and insulated with a layer of polyethylene. This is the simplest fiber optic cable and is generally used for deep sea. In shallow waters, external layers of steel armor wires are added.

Two types of deep-sea cables exist: Lightweight cable (LW), characterized by an outer diameter of 17-20 mm (Figure 3), and Lightweight protected cable (LWP), which has an additional coasted metallic tape formed around the insulated sheath, covered by a second sheath of black high-density polyethylene (Figure 4), obtaining an outer diameter of 23-27.5 mm. This design provides an additional protection against abrasion, fishing hook penetration and fish-bite damage. LW cable may be used at any sea depth down to 8000 m; LWP cable is generally used between 1000 and 3500 m.

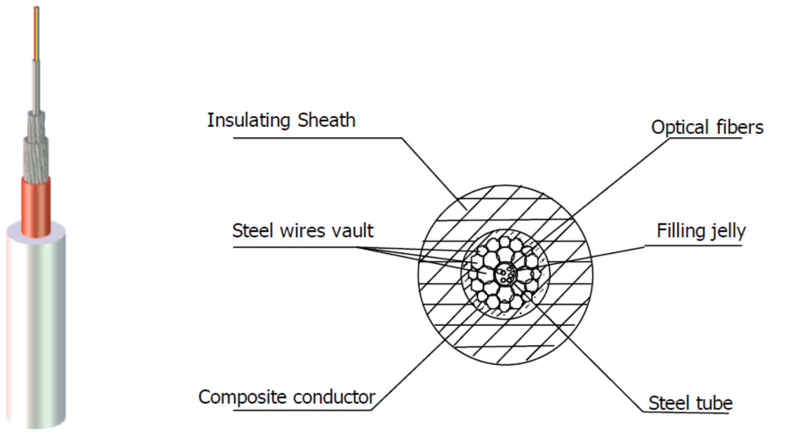

Figure 3. Lightweight cable (LW). Source: ASN.

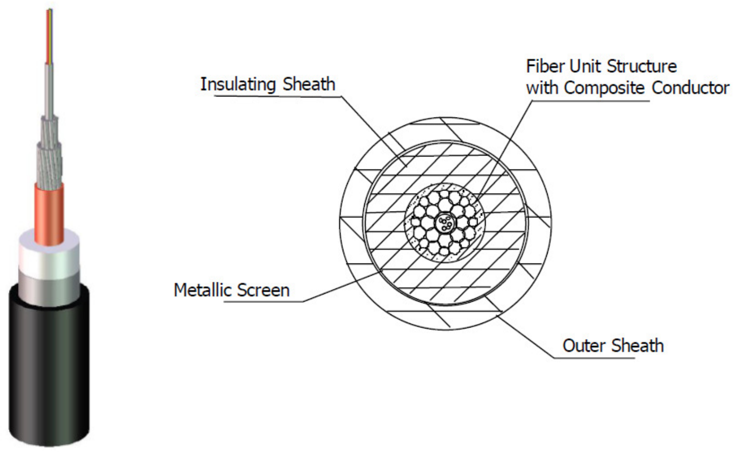

Figure 4. Lightweight Protected cable (LWP). Source: ASN.

Armored cables use the LW deep sea cable as central core structure, with additional external protection provided. Two types of armored cables exist: Single Armored (SA) cable, made by stranding a single layer of high strength galvanized steel wires (outer diameter of 29-35.5 mm), and Doble Armored (DA), made by adding a second layer of galvanized steel wires around the SA cable (outer diameter of 37.5-53 mm). The first one is normally used when full protection by burial is possible and may be used at any depth between 0 and 2000 m. The second one is normally used for surface laying in shallow water where burial is not possible. It may be used at any depth between 0 and 500 m, but is generally used up to 200 m.

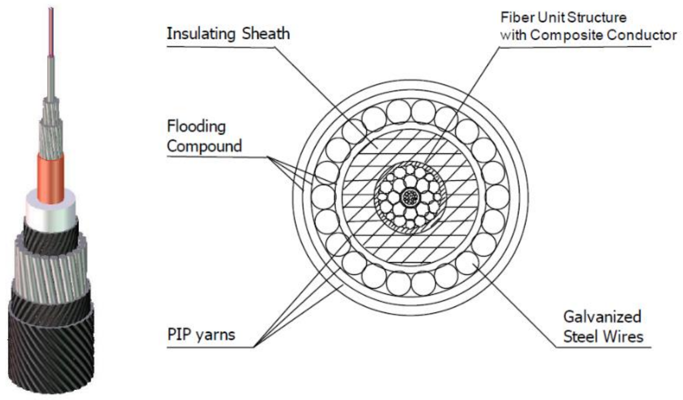

Figure 5. Single Armored cable (SA). Source: ASN.

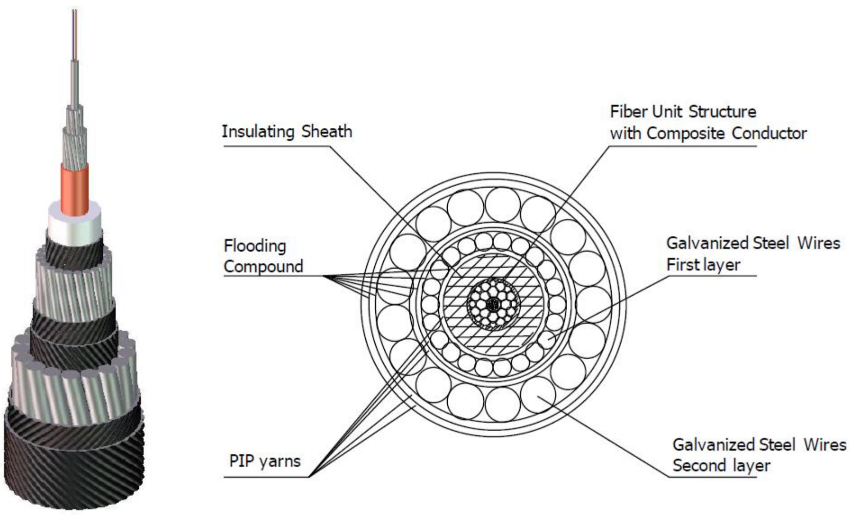

Figure 6. Doble Armored cable (DA). Source: ASN.

Where route conditions require the use of different cable types, transitions from one type to the other are made, usually during the manufacturing process.

Cable jointing can be realized by means of jointing boxes (Figure 7), which should ensure optical and mechanical continuity, pressure resistance, high voltage insulation and storage of fiber.

Figure 7. Jointing Box for deep-sea cables (on the left) and for armored cables (on the right). Source: ASN.

Approximately every 75 km, it is necessary to install repeaters that amplify the optical signal (Figure 8). Repeaters are equipped with multiple pairs of amplifiers. Each pair of amplifiers consists of the necessary components to amplify the optical signal of each of the fiber optic pairs. Repeaters are designed to function continuously without maintenance for a minimum system life of 25 years. They are provided with a sea case corrosion protection system, which is an organic electrically insulating barrier coating with additional mechanical reinforcement. Repeaters have a maximum working voltage of 15 kV.

Figure 8. Repeater external view. Source: ASN.

The cable junction to a repeater is ensured via a coupler, sufficiently robust to preserve the mechanical, electrical and optical integrity of the system. It consists of a jointing box, similar to the box used for the cable joint, connecting the cable elements to the repeater tail tube that provide electrical and optical continuity between cable and repeater.

Branched Units (BU) are used as optical and electrical nodes in submerged optical telecommunication systems, fulfilling requirements for multiple landing points or branch-to-branch configurations (Figure 9). BU has a maximum working voltage of 15 kV. For the branching unit, the couplers are identical to the standard repeater coupler.

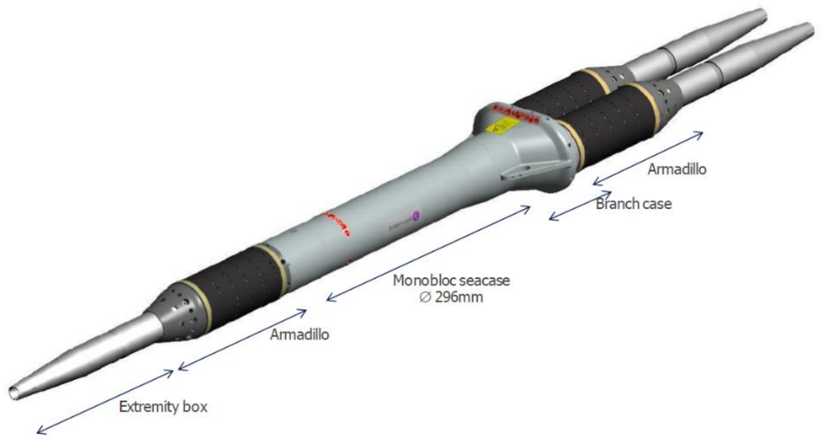

Figure 9. External view of a branching unit. Source: ASN.

The design of fiber optic cables and their elements make them not subjected to environmental effects such as radiation, temperature, hydrogen sulfide, etc. during manufacturing process, a filling gel is continuously injected inside the tube and a water blocking material is intermittently injected inside the vault, ensuring negligible water penetration in the case of cable damage.

A submarine cable project requires the installation of some infrastructures in landing areas. The first of these infrastructures is Beach Manhole (BMH), located above water mark, generally behind the beach. This is a concrete box that represents the final point of the marine segment and the connection to terrestrial segment. BMH should be accessible for maintenance and repair of the cable, but is usually buried, avoiding the affection to beach landscape. The second infrastructure to be built is border pipe or concrete foot, with the aim to tie up the marine cable. This infrastructure can be buried on the beach or below low water level, depending on environmental conditions of the landing site. Marine cables are connected between border pipe and BMH through beach ducts that represent a higher protection for the cable itself in the beach area.

The following pictures show some examples of these infrastructures.

Figure 10. Example of prefabricated BMH infrastructure. Source: AFR-IX Telecom.

Figure 11. Example of border pipe infrastructure where several cables will be landing. Source: AFR-IX Telecom.

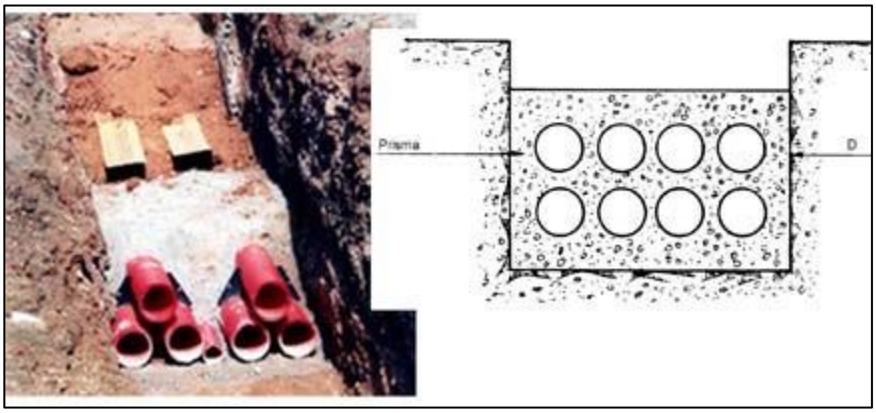

Figure 12. Example of conduits connecting the BMH with the border pipe. Source: AFR-IX Telecom.

A schematic representation of beach infrastructures is included below.

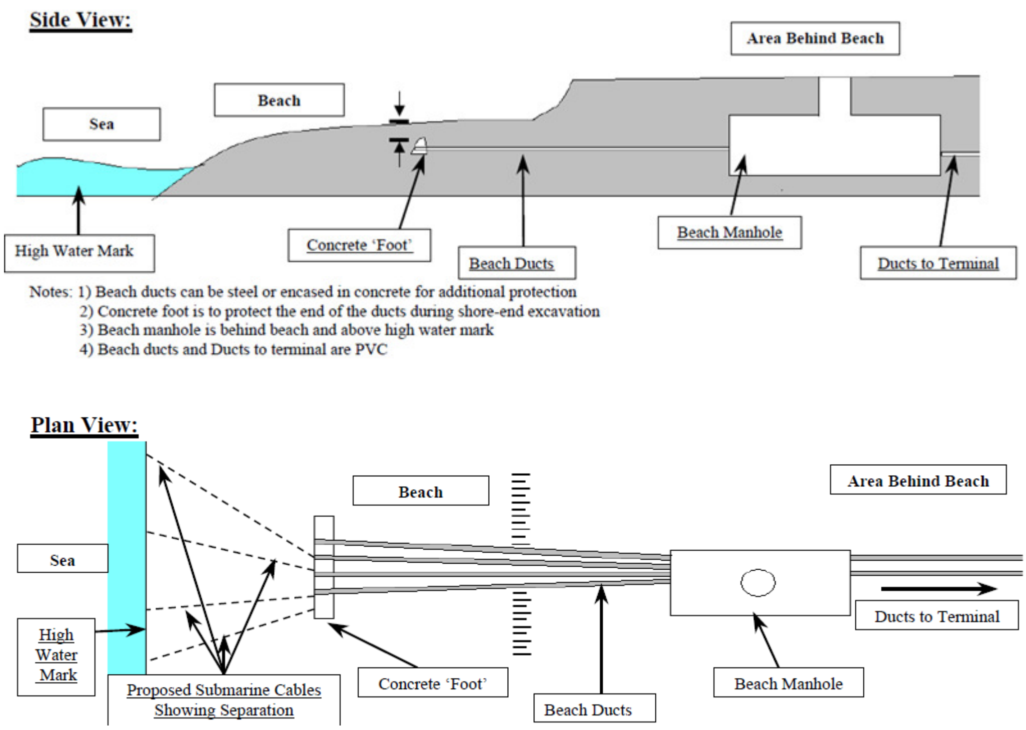

Figure 13. Side view and plan view of landing infrastructures for the marine segment of a fiber optic cable.

1.2.2 Submarine cable system installation

This section describes the general procedure for cable installation in open sea waters as well as at landing points.

The installation of a submarine fiber optic cable consists of the following different phases:

- Preliminary study for the planning of the cable route
- Permitting process for cable landings
- Analyses of the route and the potential for burial of the substrate (pre-installation survey)
- Installation of BMH and border pipe
- Route Clearance
- Shore End and Post Shore End operation
- Plough Burial Operation
- Surface Lay Operation
- Post Lay Inspection and Burial Operation

1.2.2.1 Preliminary study for the planning of the cable route

For the planning of the preliminary cable route, a Desktop Study (DTS) has been carried out that includes the bibliographic analysis of the environmental characteristics of the study area: climatology, oceanography, bathymetry, bottom materials and morphology, seabed habitats, protected natural spaces, areas of nursery, fishing grounds, underwater archaeological heritage, existing infrastructures (including cables, artificial reefs, anchorages, etc.) and maritime traffic.

The DTS permitted to determine a preliminary route that minimize as far as possible the environmental and social impact of the project, implying at the same time a more secure settlement for the cable.

In addition to environmental and socio-economic analyses through DTS, a study of the viability of the landings is also done on the base of the following criteria:

- The commercial interest to have connectivity and/or fiber capacity of Medusa system by potential clients (operators and corporation) in the landings.
- The "*End of Life*" state that will reach soon several strategic cables operating in the Mediterranean area. This obliges to look urgently for alternatives.
- The limitation of fiber/capacity in the current operating cables, which limits the growth and development of communication (society) in most of North Africa countries.
- The instability of some existing cables, with fall of services in relation to cuts and deteriorations of fibers. This brings to the interest in finding more trustworthy alternatives.

1.2.2.2 Permitting process for cable landings

Once landing sites have been established, permits in principles (PiPs) must be obtained for each of these landings, both for the marine installation of the cable and for the infrastructures that should be built at the shore, following the legislation of the respective countries (see chapters 1.3.1 and 1.3.2). Permitting process is ongoing in Spain, Portugal and France, while it has not been started yet in the other landings.

1.2.2.3 Analyses of the route and the potential for burial of the substrate (pre-installation survey)

Prior to the installation of the cable, geophysical and geotechnical investigations will be carried out by specialized staff as critical decisions concerning the design and armoring of the cable and its placement on the ocean bottom cannot be made without the critical information obtained from the survey.

Equipment used should be multibeam echosounder system (MBES) for bathymetric data acquisition, side scan sonar (SSS) for geomorphologic data acquisition and sub-bottom profiler (SBP) for stratigraphic and seismic data acquisition. Cone penetration tests (CPT) shall also be carried out. MBES, SSS, SBP and CPT data are usually acquired up to 1000 m depth in a 500 m wide corridor (250 m on each side of the cable preliminary route axis). At depth higher than 1000 m, usually only MBES investigations are conducted in a corridor with a width equal to 3 times the depth of the water.

Burial Assessment Survey (BAS) should be conducted to provide most precise indication of the areas where burial by plough is feasible and also give the expected depth of burial. Burial feasibility study (BFS) must be done after the marine survey, seabed assessment and the route refinement, in order to have the required information to design the final route and burial program to maximize tools performance.

The results of the pre-installation surveys make it possible to adjust the planned cable route in detail, in order to reduce the effects on the marine environment and the vulnerability of the project itself.

1.2.2.4 Installation of BMH and border pipe

Beach Manhole is a concrete infrastructure than can be prebuilt or built in site, whose dimensions depends on the quantity of cables that are planned to be hosted inside. In this project a general dimension of 4,0x3,0x2,0 m is considered, but this can vary depending on the different landing sites. BMH is where the marine segment of the fiber optic cable is connected to the terrestrial one.

BMH is finally buried and not visible, excluding to a manhole cover that permit the access to the infrastructure for repairing and maintenance works.

Figure 14. Example of BMH infrastructure. Source: AFR-IX Telecom.

Concrete conduits connect BMH with the border pipe, being buried at the beach through a trench. These conduits must be straight and without interior curves of any kind, due to the torsional rigidity of submarine cables.

The conduits end in a buried border pipe, where marine cables are landed and tied up.

Figure 15. Example of border pipe infrastructure. Source: AFR-IX Telecom.

In some case such as for example the landing in Zahara, the conduits connecting BMH and border pipe will be buried through horizontal directional drilling (HDD) instead of by open trench. This methodology allows to cross an environment without carrying out any intervention on the surface to preserve it. Through the execution operations of a first guide bore with a subsequent widening of it in the reverse direction and the introduction of the main pipe, the canalization is executed having made only one attack and one extraction well. In Zahara landing, the attack well will serve for the placement of the BMH and the exit well for the execution of the border pipe.

HDD can be used also for other landings, when environmental conditions require it for the preservation of high-value baseline conditions, depending also on authority's requirements exposed during PIPs process.

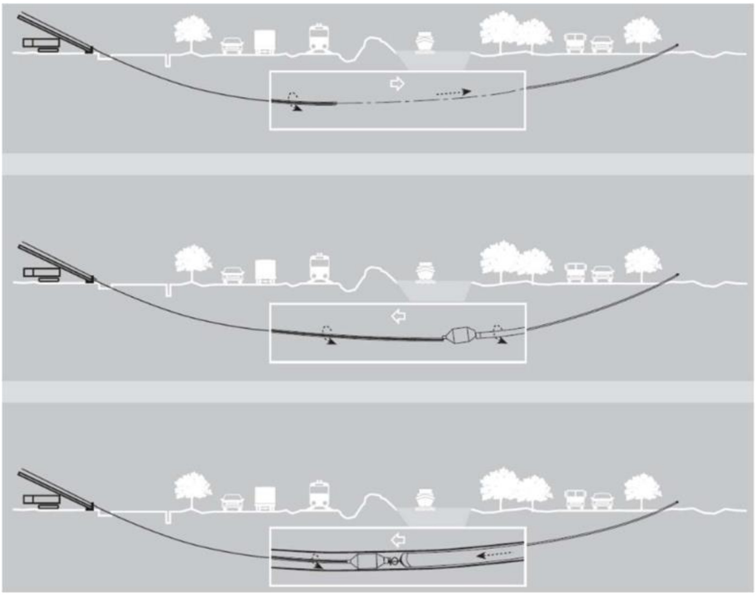

Figure 16. Diagram of execution of a horizontal directional drilling (HDD). Source: AFR-IX Telecom, 2021.

1.2.2.5 Route Clearance/Pre-Lay Grapnel Run

Route Clearance (RC) and Pre-Lay Grapnel Run are operations done just before the marine cable installation by the cable ship or a working vessel with the aim of ensure that the planned route where the cable will be buried (usually up to 1000 m) is free of obstacles that can threaten the laying and burial operations.

A grapnel anchor is used to pull out-of-service cables and other debris that can be present on seabed. Old cables and debris are stowed on board and will be discharged at port following the current legislations.

1.2.2.6 Shore End and Post Shore End operation

Cable landing is an operation coordinated between cable ship and beach team, with the participation of support boats and divers. When cable ship cannot reach very shallow depths to land directly the cable because of security issues, a shallower ship will be used for landing. so that a cable pulling boat can be necessary to successfully complete the landing.

The general procedure described below could undergo some modifications depending on the weather conditions present on the day of the landing operations.

The cable will be pulled from the cable ship towards the shore. A cable pulling line will be released to the supporting boat and will be brought up to the shore. Connected to a pull backhoe, the cable pulling line will be used to pull enough marine cable to the beach. During traction, for security reasons, the cable pulling line and cable will be provided with floating elements every 3-5 m, with rollers placed on the beach to limit friction.

Once the cable has reached the beach (enough cable longitude to enter the border pipe and arrive up to BMH), pulling is stopped and the floating elements begin to be removed from land to sea. Divers will be in charge of checking that the cable is positioned on the seabed without being suspended, although in the case of rocky bottoms, this suspension cannot be totally eliminated.

On the beach the cable has to be connected to the terrestrial cable installed in the conduits of the BMH (previously built). Conducts are usually previously placed among BMH and border pipe. Traction is normally done manually from the beach camera itself. If the ducts are very long, a crane will have to be used to pull the cable.

Once the laying of the cable in the landing area has been completed, articulated pipes can be installed to protect the cable itself on the beach and in the shallowest marine area. These pipes are laid from land to sea, until reaching the predetermined length.

When the articulated pipes are correctly installed, they will be buried. On the beach, burial is done by closing the trench previously opened by means of a backhoe. At the end of the cable burial phase, the initial conditions will be restored in the beach area.

In the submerged shallow, the landing cable will be buried by means of a pressurized water jet system (jetting), operated by divers or by a machine from a portable pontoon, lowered from the support ship, depending on the depth. In all cases the operations will be monitored by divers. The jetting method basically consists of an injection of pressurized water into the sea bed, which fluidizes the sediment and therefore allows the cable to be buried under its own weight up to approximately the desired burial depth.

1.2.2.7 Plough Burial Operation

Plough operation usually permits simultaneous cable laying and burial. The plough is deployed with the cable laid through the plough itself. The cable lands on the seabed just ahead of the plough. As the plough advances, it lifts the cable from the seabed and buries it in the furrow it creates. Plough is usually employed up to 1000 m depth, starting from the maximum depth that can be reached by the cable ship, excluding local areas with unsuitable bottom conditions and/or slopes that can damage the plough itself. The speed of the plough depends on the topography of the seabed, being normally 600 m/h.

1.2.2.8 Surface Lay Operation

In rocky areas, as well as at depths greater than 1000 m, the cable will not be buried in the seabed, but will be laid on its surface. This operation is done without the use of the plough, directly from the cable ship. The precise positioning of the vessel and the controlled speed of the cable ship will ensure that the cable is laid as close as possible to the pre-selected route.

1.2.2.9 Post Lay Inspection and Burial Operation

After the installation and burial of the cable, the visual inspection is carried out by means of a ROV (Remotely Operated Vehicle) operated and monitored from the cable ship. This inspection makes it possible to verify the correct installation of the cable, as well as to detect possible errors in the installation or potential risks to the integrity of the cable.

It is preferable to carry out an inspection in the direction of the bottom current to give better visibility to the cameras and the control of the vehicle.

ROVs incorporate precision positioning systems and some even have articulated arms, as well as equipment to carry out repair or maintenance operations.

The ROV also includes pressurized water jet injection tools (jetting), which allows for better burial of the cable in areas where it has not been possible to reach the predetermined burial depth.

1.2.3 Medusa system phases

Due to the high number of landing sites implied in the project object of study in this document and the several steps necessary for establishing a landing site as well as for permitting process, Medusa submarine fiber optic cable system will be executed in 3 different main phases (phase 1, 2, 3). Each of these phases can be divided in steps, obtaining the following list:

- Phase 1.A: it is the first phase of the project and involves three European landings, Torreguadiaro and Barcelona in Spain and Marseille in France, and three African landings, Tetouan and Nador in Morocco and Bizerte in Tunisia, and other two optional, that is Algiers and Collo in Algeria. In the case of Marseille, two segments are planned, one of these (Segment 1) is optional.
- Phase 1.B: this phase involves Lisbon in Portugal and Zahara in Spain.

- Phase 2: this is the first phase for the eastern sector of the project; it involves Mazara del Vallo in Sicily (Italy), Port Said in Egypt and Yeroskipou in Cyprus; in addition, there are optional landings such as Heraklion in Crete (Greece) and Libyan landings.
- Phase 3.0: this is the last phase of the project; connection to Istanbul in Turkey and optionally to Izmir and Marmaris will be made.

The following table shows the current landing status of Medusa project (updated in November 2022).

Step	Country	Landing Site	Land Lord	Land Lord Liability	Status CLS	Status BMH	PiPs
1.A	Spain	Barcelona	AFR-IX	CLS, FH, BMH, PIP, RPL	Built	Built	Ongoing
1.A	France	Marseille Segment 2	Orange FR	CLS, FH, BMH	Built	Built	Ongoing
1.A (optional)	France	Marseille Segment 1	Orange FR	CLS, FH, BMH	Built	Built	Ongoing
1.A (optional)	Algeria	Alger	Algeria Tel	CLS, FH, BMH, PIP	Built	Built	Not started
1.A (optional)	Algeria	Collo	Algeria Tel	CLS, FH, BMH, PIP	Pending	Pending	Not started
1.A	Tunisia	Bizerte	Orange TU	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
1.A	Morocco	Nador	Orange MR	PIP, BH	Pending	Pending	Not started
1.A	Morocco	Tetouan	Marroc Tel	CLS, FH, BMH, PIP	Pending	Pending	Not started

1.A	Spain	Torreguadiaro	AFR-IX	CLS, FH, BMH, PIP, RPL	Pending	Pending	Ongoing
1.B	Spain	Zahara	AXENT	CLS, BMH	Built	Pending	Ongoing
1.B	Portugal	Lisbon	MEO	CLS, FH, BMH, BH	Built	Built	Ongoing
2	Italy	Mazara	AFR-IX	CLS, FH, BMH, PIP, RPL	Pending	Pending	Not started
2 (optional)	Libya	Tripoli	LITC	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
2 (optional)	Libya	Darnah	LITC	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
2 (optional)	Libya	Misurata	LITC	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
2 (optional)	Libya	Bengasi	LITC	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
2 (optional)	Greece	Heraklion	AFR-IX	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
2	Cyprus	Yeroskipou	Primetel	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started

2	Egypt	Port Said	Egypt Tel	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
3	Turkey	Istanbul	Turkcell/TTI	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started
3	Turkey	Izmir	Turkcell/TTI	CLS, FH, BMH, PIP, BH	Pending	Pending	Not started

Table 1. Up-to-date status of Medusa project (November 2022). CLS= Cable Landing Station; FH= Fronthaull; BMH= Beach Manhole; PIP= Permits in Principles; BH=Backhaul.

1.2.4 Scope of the study

The present document is focused on the trunk of the Medusa submarine fiber optic cable system and on the European landings of phase 1 (1.A and 1.B) and Mazara landing, which belong to phase 2.

The document considers the marine segment of Medusa submarine system, from open sea waters to BMH. Considering European landings of phase 1, BMH already exists in Barcelona, Marseille and Lisbon landings. Therefore, for these landings, installation works to be taken into account do not include installation of BMH, but just its connection with Medusa submarine optic system.

1.3 Legal and Administrative Framework

This chapter discusses the legal and administrative framework of environmental and social issue relevant to the Medusa project. As previously detailed, the project will have landings in several countries. Therefore, a description of relevant national institutions and legislation has been included for each of the countries. Then, EIB Policy, EU Environmental and Social Principles and Standards and International Labor Organization (ILO) Standards have been detailed. Finally, regional and international agreements signed or ratified by the countries have been mentioned.

1.3.1 Law of Sea Convention

The Law of Sea Convention, also named Law of Sea Treaty or United Nations Convention on the Law of the Sea (UNCLOS), is an international agreement that defines the rights and responsibilities of the nations in the use of the ocean, establishing rules and guidelines for all uses of the oceans and their resources. This international law resulted from the work of the third United Nations Conference of the Law of the Sea (UNCLOS III), which started in 1973 and concludes in 1982. More than 150 countries, representing all the regions of the world, were involved in this effort.

The Law of Sea Convention replaced 4 previous treaties of 1958 and is in effect since 1994. It is currently the global recognized regime dealing with all matters related to the law of the sea.

The Convention comprises 320 articles and 9 annexes, which consider all aspects of ocean space, such as delimitation, environmental regulation, marine scientific research, economic and commercial activities, transfer of technology and the settlement of disputes relating to ocean matters.

According to this convention, each coastal State may claim the waters within 12 nautical miles (NM) of its baseline as a Territorial Sea (***article 3***), followed seaward by a 12-NM belt called the Contiguous Zone (***article 33***), where coastal State may exercise its territory/territorial sea regulations for prevent and/or punish infringement of its customs, fiscal, immigration and sanitary regulations in its territory or territorial sea. Foreign vessels are allowed innocent passage through the territorial sea.

Furthermore, coastal States may lay claim to natural resources and certain economic activities within an Exclusive Economic Zone (EEZ), which (nominally) extends 200 NM from its baseline (as determined from the mean low-water mark) (***article 57***). In the EEZ, coastal States exercise jurisdiction over marine science research and environmental protection.

All the other States can navigate and overflight in the EEZ, as well as lay submarine cables and pipelines (***article 58***).

Coastal States have sovereign rights over the continental shelf (the national area of the seabed) for exploring and exploiting it; the shelf can extend at least 200 NM from the shore, and more under specified circumstances.

All marine scientific research in the EEZ and on the continental shelf is subject to the consent of the coastal state, but, in most cases, they are obliged to grant consent to other states when the research is to be conducted for peaceful purposes and fulfils specified criteria.

In the high seas all States have freedom of navigation, overflight, scientific research and fishing (***article 87***), being obliged to adopt measures for manage and conserve living resources.

A schematic view of administrative limits is shown in the following figure.

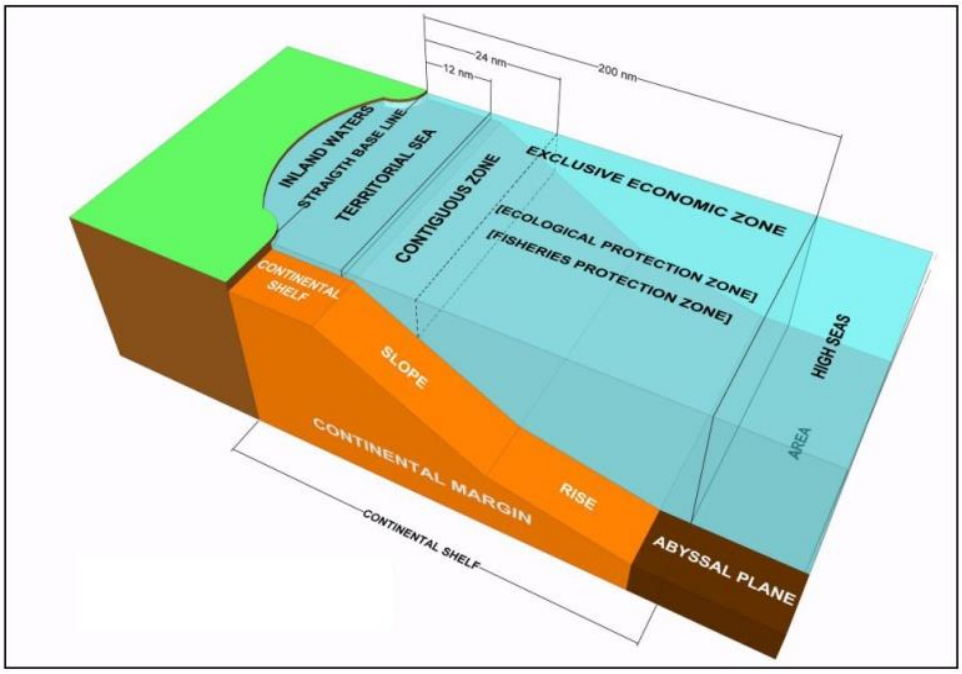

Figure 17. UNCLOS Maritime Boundaries. Source: European Parliament (2010).

With respect to submarine cables, the main articles of the Law of Sea convention to be taken into account are:

- ***Article 58***: In the EEZ, all States enjoy the freedom of laying of submarine cables (subject to the relevant provisions of this Convention);
- ***Article 79***: (i) All States are entitled to lay submarine cables on the continental shelf, in accordance with the provisions of this Convention. (ii) Coastal States have the right to take reasonable measures for the exploration and exploitation of the continental shelf, as well as for the prevention, reduction and monitoring of pollution. However, they may not impede the laying or maintenance of cables. (iii) The delineation of the cable route on the continental shelf is subjected to the consent of the coastal State. (iv) The coastal State has the right to establish conditions for cables entering its territory or territorial sea. (v) All States should take into consideration other cables and pipelines already existing when planning the laying of a new cable, so that the possibility to repair the existing infrastructures is not prevented.

- ***Article 87***: All States have the freedom to lay submarine cables in the high seas, subject to Part IV of this Convention. This freedom shall be exercised with due regard for rights under this Convention with respect to activities in the area.
- ***Article 112***: All States are entitled to lay submarine cables on the bed of high seas beyond the continental shelf.
- ***Article 113***: The breaking or injury of submarine cables and pipelines, done deliberately or through culpable negligence, beneath the high seas shall be a punishable offence. To this aim, every State shall adopt necessary laws and regulations when the injury is done by a ship flying its flag or a person subject to its jurisdiction. This provision shall not apply in case the break or injury has been caused with the merely objective of saving their lives or their ships, after the necessary precautions have been taken.
- ***Article 114***: If the owners of a submarine cable or pipeline cause a break or injury to another cable or pipeline, they have to bear the costs of the repairs. To this aim, every State shall apply the opportune laws and regulations to person subject to its jurisdiction.
- ***Article 115***: In case that the owners of a ship have sacrificed an anchor, a net or any other fishing gear to avoid injuring a submarine cable and can prove it, they shall be indemnified by the owner of the cable. To this aim, every State shall apply the opportune laws and regulations to ensure this compensation.

In the case of Mediterranean Sea, the determination of EEZ is more controversial than what indicated by the Law of Sea Convention (see Section 1.3.1), as the limited extension of the basin does not allow to guarantee an area of 200 NM as EEZ to the coastal states. Maritime boundary delimitation issues arise when the maritime zones of neighboring States overlap.

The European Community indicates that the area between 12 and 220 NM is of free access for any fishing boat belonging to a state member. Spain established a Fishing Protected Zone between Cabo de Gata and the maritime boundary with France with the RD 1315/1997, modified by the RD 431/2000. Part of this area has been then declared EEZ in 2013. France established a marine Ecologic Protected Zone in 2003 and claimed for the proclamation of EEZ in 2015. Italy declared a marine Ecologic Protected Zone around its territory in 2006 and established the EEZ with the Law 91/2021. Tunisia planned to promote a law for the institution of the EEZ in 2005.

In the Western Mediterranean Sea, disputed claims exist between Spain and France in the NW sector, as a partial overlap of the claimed EEZ exist. Another controversial situation about EEZs in the Western Mediterranean Sea is currently related to Algeria: this country has proclaimed unilaterally a new EEZ in 2018, extending the old Fishing Protected Zone from 40 NM to 180, invading the Spanish-Italian continental platform and annexing a zone contiguous to the Spanish Territorial Waters near Cabrera Island (Balearic Archipelago) and a zone contiguous to Italian Territorial Waters next to the Western Coast of Sardinia, belonging to the Italian Ecologic Protected Zone. These areas were previously claimed by Spain and Italy, respectively, and the controversy is still open. However, according to the UNCLOS III, a country can modify its maritime borders only if there is an agreement between the affected states.

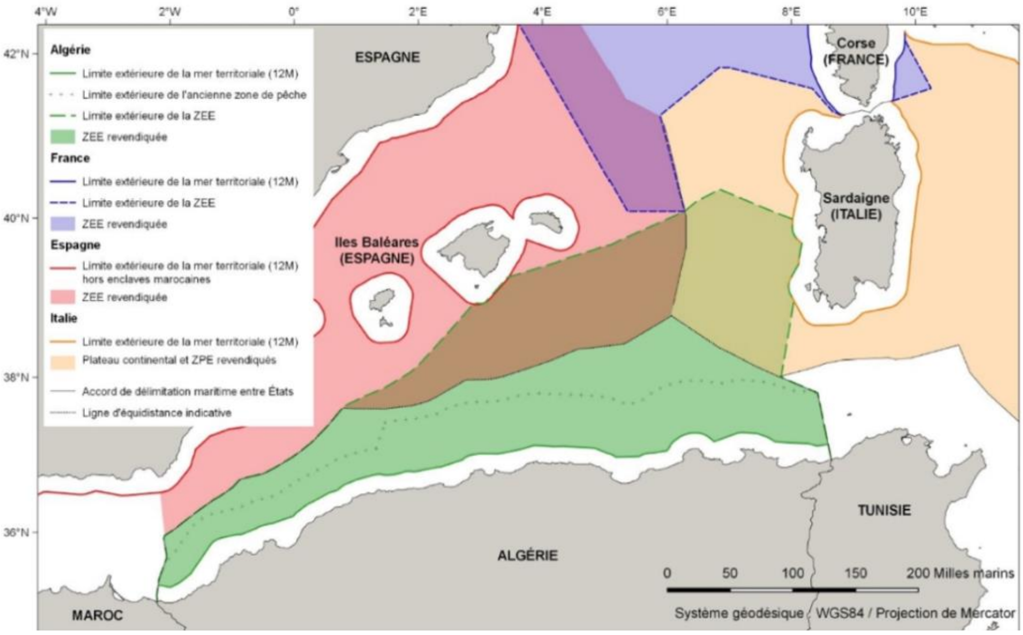

Figure 18. Distribution of Economic Exclusive Zones in the Western Mediterranean Sea. Source: affarinternazionali.it.

In the Eastern Mediterranean Basin controversial for the EEZ are mainly related to Greece, Turkey and Libya. Greece tried to enforce EEZ rights around its many tiny islands in the Aegean Sea. This left Turkey with a tiny offshore stretch and almost nothing in the eastern Mediterranean. In late 2019, the situation reached a maximum crisis when Turkey and Libya signed a controversial deal dividing the sea (a supposed diagonal maritime boundary between the two countries) and Greece sent warships to Crete. Greece, Cyprus and other regional actors denounced the Turkish-Libyan agreement as "illegal". Both Greece and Turkey announced military exercises on 25 August 2020 in sections of a broad area between Crete and Cyprus. Interests in the Eastern Basin are strictly related to gas exploration. In 2021 Greece, Israel and Cyprus signed a memorandum of understanding on the construction of the EuroAsia Interconnector, raising the protest of Turkey for its exclusion from the planning.

Unresolved disputes over the delimitation of EEZ for Greece, Turkey and Cyprus still exist.

1.3.2 EU Directives

The main EU Directive to be considered for ESIA assessment of the Medusa project is the EIA Directive (Directive 2014/52/EU, amending the Directive 2011/92/EU), which aims to ensure that projects that are likely to have a significant impact on the environment are identified and assessed, within an appraisal process, before these projects proceed to development. Neither submarine nor terrestrial fiber optic network projects are explicitly mentioned in Annex I and Annex II of this directive, so that Medusa project in European countries is not strictly subjected to ESIA assessment. However, the promoter must present information about environmental and social aspects that can be affected by the project as part of the permitting process for all the cable landings on the European side, based on national legislations. In addition, fiber optic network projects become subjected to ESIA when the infrastructures occupy Nature 2000 protected area, as is the case for the Medusa cable system in some sections of its route (e.g., Portugal, France, Greece).

Other EU Directives to be considered for the Medusa project are the following:

- Environmental legislation:
    - Habitats Directive (92/43/EEC): the aim of this directive is to ensure biodiversity through the conservation of natural habitats and of wild fauna and flora in the territories of the Member States.
    - Birds Directive (2009/147/EC): the aim is to protect all of the 500 wild bird species naturally occurring in the European Union, establising a network of Special Protection Areas (SPAs) including all the most suitable territories for these species.
    - Marine Strategy Framework Directive (2008/56/EC): the directive establishes a legal framework for the protection and management of European seas and ensures their long-term sustainable use. The main objective is to achieve and/or maintain Good Environmental Status (GES) by 2020.
    - Maritime Spatial Planning Directive (2014/89/EU): this directive establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources.
    - Water Framework Directive (2000/60/EC): this directive aims to protect and improve water quality in all waters so that good ecological status is achieved by 2015 or, at the latest, by 2027.

- Regulation on Invasive Alien Species (1143/2014): this regulation sets out rules to prevent and manage the introduction and spread of invasive alien species in the EU.
- Environmental Noise Directive (2002/49/EC): the aim is to define a common approach intended to avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to exposure to environmental noise.
- Air Quality Framework Directive (96/62/EC): the aim of this directive is to define the basic principles of a common strategy in order to: (a) define and establish objectives for ambient air quality in the Community designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole; (b) assess the ambient air quality in Member States on the basis of common methods and criteria; (c) obtain adequate information on ambient air quality and ensure that it is made available to the public; (d) maintain ambient air quality where it is good and improve it in other cases.
- Access to environmental Information Directive (2003/04/EC): the aim of this directive is guaranteeing the right of access to environmental information held by or for public authorities and ensuring that such information is progressively made available and disseminated to the public.
- Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (2006/11/EC): the directive requires community member states to take the appropriate steps to eliminate pollution of inland surface waters, territorial waters and internal coastal waters by certain dangerous substances.
- EU floods Directive (2007/60/EC): the objective is to establish a framework for the assessment and management of flood risks to reduce the negative consequences of flooding on human health, economic activities, the environment and cultural heritage in the European Union.
- Environment Air Quality Directive (2008/50/EC): the aim is the protection of human health and the environment against air pollution.
- Directive on the protection of the environment through criminal law (2008/99/EC): the aim is to achieve the effective protection of the environment through more dissuasive penalties for environmentally harmful activities, which typically cause or are likely to cause substantial damage to the air, including the stratosphere, to soil, water, animals or plants, including to the conservation of species.

- Waste Framework Directive (2008/98/EC): the directive establishes a legal framework for treating waste in the EU to protect the environment and human health by emphasizing the importance of proper waste management, recovery and recycling techniques to reduce pressure on resources and improve their use.
- Environmental Quality Standards Directive (2008/105/EC): the directive lays down environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Article 16 of Directive 2000/60/EC. The aim is to achieve good surface water chemical, in accordance with the objectives specified in article 4 of the directive above-mentioned.

- <u>Gender equality legislative and policy framework:</u>
  - Equal Treatment Directive (2000/78/EC): the directive set up a general framework for equal treatment in employment and occupation, empowering it to combat discrimination based on religion or belief, age, disability and sexual orientation on the labor market.
  - Equal Opportunities Directive (2006/54/EC): the objective is to simplify, modernize and merge existing Community legislation in the area of equal treatment for men and women in employment and occupation.
- <u>Labor legislation:</u>
  - Occupational Health and Safety Directive (89/391/EEC): the aim of this directive is to introduce measures to encourage improvements in the safety and health of workers at work. It applies to all sectors of activity, both public and private, except for specific public service activities.
  - Workplace requirements Directive (89/654/EEC): the aim of this directive is to lay down minimum requirements for safety and health at the workplace.
  - Use of personal protective equipment Directive (89/656/EEC): the objective of this directive is to lay down minimum requirements for personal protective equipment (PPE) used by workers at work.
  - Manual handling of loads Directive (90/269/EC): this directive aims to lay down minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.
  - Safety and/or health signs Directive (92/58/EEC): this directive aims to lay down minimum requirements for the provision of safety and/or health signs at work.
  - Informing and Consulting employees Directive (2002/14/EC): this directive establishes a general framework setting out minimum requirements for the

right to information and consultation of employees in undertakings or establishments within the Community.

- Occupational exposure limit values Directive (2009/161/EU): according to this directive, Member States shall establish national occupational exposure limit values for the chemical agents listed in the Annex, taking into account the Community values.
- Major-accident hazard Directive (2012/18/EU): the aim is controlling major chemical accident hazards.

- Other directives:

  - Non-financial Reporting Directive (2014/95/EU): the aim of this directive is providing stakeholders, investors, and consumers with non-financial information to assess the value creation and risks regarding sustainability of a company and encouraging the social, environmental and governance responsibility of the European companies.
  - Taxonomy, framework to facilitate sustainable investment Regulation (2020/852/EU): this regulation establishes a framework to facilitate sustainable investment. It aims to create a 'green list' of environmentally sustainable economic activities.
  - Proposal for a Directive on corporate sustainability due diligence (23 February 2022): the proposal aims to foster sustainable and responsible corporate behavior throughout global value chains. Companies will be required to identify and, where necessary, prevent, end or mitigate adverse impacts of their activities on human rights, such as child labor and exploitation of workers, and on the environment, for example pollution and biodiversity loss.

Most of the national laws listed in the following sections for the European countries are the ratification of the above-mentioned EU Directives.

1.3.3 National Regulations

1.3.3.1 Portugal

In Portugal, permits and regulatory issues for the Medusa system are related to the Environmental Basic Law (Law nº19/2014), the Environmental Impact Assessment Regime (Decree-Law nº 152-B/2017, amending the Decree-Law nº 151-B/2013), the Sea Management and Planning Law (Law nº 17/2014), the Law Decree 38/2015 and its modification (Law Decree 125/2018), adopting the Law nº17/2014, and the Single Environmental Licensing Regime (Law nº 75/2015). In the transposition of European Directives about EIA in national laws/regulations, Portugal have not mentioned explicitly submarine cable projects. However, in the Decree-Law nº11/2023 of 10th February, it is specified that "*A procedure for environmental analysis of alternatives of linear infrastructure corridors is created, applicable to public service infrastructure projects that involve "corridors" (e.g. […] electronic communications infrastructures), which allows the EIA to be carried out in the execution project phase".* Therefore, it is interpreted that EIA may be required for fiber optic submarine cables.

The national authorities in charge of the environment are the Ministry of Environment and Energy Transition and the Portuguese Environment Agency (APA), while the main authority responsible for release concession of occupation of public domain is the General Direction of Natural resources, Security and Maritime Services (Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos (DGRM)).

Occupation of the terrestrial domain and terrestrial installation works require the authorization by local authorities.

The following list includes other key pieces of environmental legislation to be taken into account:

- Criminal Code (Decree-Law 48/95).
- Environmental Misdemeanour Law (Law 50/2006).
- Environmental Liability Regime (Decree-Law 147/2008).
- Water Law and Water Resources Use Regime (Law 58/2005 and Decree-Law 226-A/2007).
- Industrial Emissions Regime (Decree-Law 127/2013).
- Regime of Prevention and Control of Pollutant Emissions into Air (Decree-Law 39/2018).
- Waste management Regime (Decree-Law 102-D/2020).
- Noise Regulation (Decree-Law 9/2007).
- Nature and Biodiversity Conservation Regime (Decree-Law 142/2008).
- National Ecological Reserve Regime (Decree-Law 166/2008).

Main authority in charge of the environment:

- Ministry of Environment and Energy Transition: responsible for public land planning, fire prevention, climate change policy, mobility and energy

Other national regulatory authorities:

- General Direction of Natural resources, Security and Maritime Services (DGRM)

- Portuguese Environment Agency (APA): its aim is to propose, develop and monitor public policies for the environment and sustainable development, in close cooperation with other sectoral policies and public and private entities.
- Water and waste Regulatory Authority (ERSAR): Regulation of the drinking water supply services, urban wastewater management services and municipal waste management services; National authority for drinking water quality.
- General Inspection of the Environment, Spatial Planning, Agriculture and Sea (IGAMAOT): central service of the state, with administrative autonomy; its direction is exercised jointly by the Minister for the Economy and the Sea, the Minister for the Environment and Climate Action, the Minister for Territorial Cohesion and the Minister for Agriculture and Food.
- Institute for Nature Conservation and Forests (ICNF): responsible governmental body for the nature and forest policies, including the management of Protected Areas and State managed national, municipal and communal forests of mainland Portugal.
- Regional Spatial Planning Commissions (CCDR): public institution that works towards the integrated and sustainable development of Portugal.
- Ministry of Economy and Sea: responsible for the development policies aimed at the economy's growth, competitiveness, investment and innovation, companies' internationalization, the promotion of industry, trade, services and tourism, consumer protection and the cross-cutting coordination of maritime affairs.
- Ministry of Culture: responsible for issues related to the Portuguese culture.
- Ministry of Infrastructure and Home: responsible for the policies on infrastructure, in the fields of construction, real estate, transport and communications, including the regulation of public bids, as well as housing, urban rehabilitation and sea transport policies, and ports.
- Ministry of Health: responsible for the national health policy.

Gender equality legislative and policy framework:

- Decree-Law No. 485/77 for the integration of gender in all policy areas.
- National equality plans (PNIs).
- National Strategy on Gender Equality 2018-2030.

Main labor legislation:

- Labor Code (Law nº7/2009).
- Modifications of the Labor Code (Law 53/2011, Law 23/2012, Law 69/2013, Law 27/2014, Law 55/2014, Law 28/2015, Law 120/2015, Law 8/2016, Law 93/2019, Law 18/2021, law 83/2021, Law 1/2022).

- Occupational Safety and Health Law (Law 102/2009, amended and consolidated by Law 3/2014).

Main heritage legislation:

- Decree 19/2006 on Classification of Goods of National Interest
- Decree Law 270/99 on Archeological Works
- Decree Law 164/97 on Underwater Archeological Activity

1.3.3.2 Spain

In Spain, permits and regulatory issues for the Medusa system are mainly related to the Environmental Impact Assessment Laws (Laws 21/2013 and 9/2018) and the General Coast Regulations (RD 876/2014). In the transposition of European Directives about EIA in national laws/regulations, Spain have neither interpreted nor mentioned explicitly submarine cable projects. Therefore, the need to submit a fiber optic system project to EIA is limited to the case of interference with Nature 2000 protected sites.

The national authority in charge of the environment is the Ministry of Ecological Transition and Demographic Challenge (MITERD). Atlantic Andalusia (Cadiz) Coast Demarcation and Cataluña Coast Demarcation (Coast and Sea General Direction, MITERD) are the authorities in charge of releasing marine-terrestrial public domain (MTPD) concessions for the Medusa system.

The following list includes other key pieces of environmental legislation to be taken into account:

- Criminal Code (Law 48/95).
- Environmental Liability Law (Law 26/2007).
- Water and National Hydrological Plan Laws (RDL 1/2001 and Law 10/2001).
- Prevention and Control of Contamination Law (RDL 1/2016).
- Industrial Emissions Regime (RD 815/2013).
- List of Wild Species under Special Protection Regime and the Spanish Catalog of Endangered Species (RD 139/2011).
- State Ports and Merchant Marine Law (Decree-Law 2/2005).
- Sea Protection Law (Law 41/2010).
- Air Quality Regulation (Law 34/2007).
- Green House Gas Emission Regulation (Law 1/2005).
- Waste management and Contaminated Soils (Law 7/2022).
- Noise Regulation (Law 37/2003).
- Nature and Biodiversity Conservation (Decree-Law 42/2007).
- Climate Change Regulation (Law 7/2021).

Main authority in charge of the environment:

- Ministry of Ecological Transition and Demographic Challenge: responsible for climate change and contamination policies, for the protection of biodiversity, forests, sea, water and for the transition towards a more sustainable model.

Other national regulatory authorities:

- Ministry of Economic Affairs and Digital Transformation: responsible for proposing and executing the Government's economic policy and reforms to improve competitiveness, telecommunications and the information society; responsible for digital transformation and promotion of artificial efficiency.
- Ministry of Agriculture, Fishing and Food: responsible for the proposal and execution of the Government's policy on agricultural, livestock and fishing resources, the agri-food industry, rural development and food.
- Ministry of Culture and Sports: responsible for issues related to culture and sports.
- Ministry of Health: responsible for the national health policy.
- Ministry of Social Rights and Agenda 2030: responsible for policies on social rights and social welfare, and the implementation of the 2030 Agenda.
- Ministry of Equality: responsible for the Government's policy on equality and of the policies aimed at making equality between women and men real and effective, the prevention and eradication of the different forms of violence against women and the elimination of all forms of discrimination for reasons of sex, racial or ethnic origin, religion or ideology, sexual orientation, gender identity, age, disability or any other personal or social condition or circumstance.
- Ministry of territorial policy: responsible for the Government's policy in terms of territorial policy, territorial organization of the State and relations with the autonomous communities and the entities that make up the local administration.

Regional authorities:

- Department of Agriculture, Fisheries, Water and Rural Development, Autonomous Community of Andalusia.
- Department of Sustainability, Environment and Blue Economy, Autonomous Community of Andalusia.
- Department of Tourism, Culture and Sports, Autonomous Community of Andalusia.
- Department of Territory and Sustainability, Autonomous Community of Catalonia.
- Department of Climate Action, Food and Rural Agenda, Autonomous Community of Catalonia.

- Department of Culture, Autonomous community of Catalonia.

Gender equality legislative and policy framework:

- Equality Law (organic Law 3/2007).
- National Equal Opportunities Strategic Plan (2014-2016).
- Action Plan for Equal Opportunities of Women and Men in the Information Society (2014-2017).
- Plan for Rural Women (2015-2018).
- Plan for Equality within the State Administration (2015).
- Equal Opportunities Strategic Plan (2018-2021).

Main labor legislation:

- Workers Status (Real legislative Decree 2/2015).
- General Law of Social Security (Real legislative Decree 8/2015).
- Social jurisdiction regulation (Law 36/2011).
- Labor Risk prevention Law (Law 31/1995).

Main heritage legislation:

- Law 16/1985 on Spanish Historical Heritage, implemented by the Royal Decree 1680/1991.
- Law 9/1993, Cultural heritage of Catalonia.
- Decree 78/2002, regulation for the protection of the archaeological and paleontological.
- Decree 168/2003, Regulation of Archeological Activities.
- Law 14/2007 on Historical Heritage of Andalusia.
- BOE 55, 5th March 2009, ratification of UNESCO Convention.

1.3.3.3 France

Concerning France, the reference legislation for the project is the Environmental Code of 2005, continuously updated. The Environment Code includes regulations on the realization of EIA (Art. L122) and on the integrated management of maritime and coastal areas (Art. 219) (https://www.legifrance.gouv.fr). Some fundamental principles are also included in the French Environmental Charter. In the transposition of European Directives about EIA in national laws/regulations, France refers directly to submarine cables: according to the annex of article R122-2 of the Environmental Code (modified by the Decree nº2022-970 of 1st July), fiber optic submarine cables (category 34, “other cables in the marine domain”) must be subjected to examination case by case to determine if EIA should be conducted. In addition, the interpretation of articles L.214.3 and L.181-1 of the Environmental Code indicates that the laying of a cable in territorial sea should be accompanied by environmental authorizations. A simple declaration of environmental protection can be sufficient for projects between 160,000 euros and 1,9 million of euros, while obtaining the environmental authorization is necessary for projects with costs exceeding this number. Then, environmental impact assessment can be required, depending on the route of the cable, in particular protected species and habitats impact assessment for Nature 2000 sites.

The national authority for environmental matter is the Ministry for the Ecological Transition. The Ministry is represented throughout the country by the prefects of the departments (local subdivisions of the French regions), which are the main regulatory authorities. The prefect relies on local administrative services, such as the Regional Directorates for the Environment, Planning and Housing (DREAL) in the region as well as the Departmental Direction of the Territories (DDT).

Other significant articles of the Environmental Code for the project are:

- Article L.411-1: Habitat conservation.
- Articles L.414-1 to L.414-11: Natural protected sites.
- Article L.411-5: invasive species.

The General Code of Property of Public Persons (CG3P or CGPPP) provides general principles for the occupation of the public domain but specific rules introduced by the Postal and Electronic Communications Code (CPCE) clarify the regime applicable to fiber optic networks.

The following list includes other key pieces of environmental legislation to be taken into account:

- Penal Code.
- Environmental Liability Law (Law 757/2008).
- Water Act relating to water resources and their distribution and controlling their pollution (Act 1245/64).
- Water Act (Act 3/92).
- Water and Aquatic Environments Act (Law 1772/2006).
- Climate and Resilience Law (Law 1104/2021).
- Regional Plan for Sustainable Development and Territorial Equality (Decree 762/2022).
- Anti-waste for a circular economy Law (AGEC Law, 2020).
- Energy Transition Law (Law 992/2015).
- Energy and Climate Law (1147/2019).

Main authority in charge of the environment:

- Ministry for the Ecological Transition: responsible for preparing and implementing the government's policy in the fields of sustainable development, climate, energy transition and biodiversity.

Other national regulatory authorities:

- French Office of the Biodiversity (OFB): it is under the control of both the Ministry of the Ecological Transition and Ministry of Agriculture and Food. It conducts research and enforces government policies on wildlife and the environment.
- Ministry of Agriculture and Food: preparation and coordination of the Government's policies in the fields of agriculture, agri-food business, forest and wood industry, fisheries and aquaculture.
- Ministry of Economy, Finance and the Recovery: responsible for laws on taxation, employment policies, development, regulation and control of economics, including industry, tourism, small business, competition, and consumer security.
- Ministry of Health and Solidarities: oversight of the health care public services and the health insurance part of the French Social Security.
- Ministry of Labour, Employment and Economic Inclusion: responsible for employment, labour legislation as well as the integration of foreigners.
- Ministry of Culture.
- Ministry of Marine Affairs.
- Ministry Delegate for Gender Equality, Diversity and Equal Opportunities.

Regional authorities:

- Regional Directorates for the Environment, Planning and Housing (DREAL): Direction régionale de l'environnement, de l'aménagement et du logement, region Provence-Alpes-Côte d'Azur: participation in the implementation and coordination of public policies in terms of sustainable development and planning, ecological and energy transition, fight against climate change, preservation of the quality of the environment, biodiversity and landscapes, prevention of pollution, etc.
- Regional Health Agency (ARS).

Gender equality legislative and policy framework:

- Law on equal pay, 1972.
- Transversal Policy Document on Gender Equality, 2010.
- Law No. 2014-873 of 4 August 2014.
- Act on Equality between Men and Women, 2014.
- Inter-ministerial Plan for gender equality at work, 2016-2020.
- Sectoral plan to develop gender diversity in the digital sector, 2017-2020.
- Memorandum of Understanding for gender equality at work, 2018.
- Roadmap for gender equality 2019-2022

- Roadmap for gender equality 2022.

Main labor legislation:

- Labor Code (Law 2016-1088).
- Social Security Code, continuously updated.

Main heritage legislation:

- Heritage Code.

1.3.3.4 Italy

In Italy, permitting for the laying of the cable are mainly related to the law *D.Lgs. 152/2006, Environmental Code, the D.Lgs 104/2017, which is the transposition of the European Directive 2014/52/UE about EIA,* and the law *D.Lgs 190/2010* about Marine Strategies. The Environmental Code sets out the rules that refers to EIAs, the integrated pollution prevention control (IPPC), soil and water protection, air pollution and reduction of emissions, waste management and remediation of contaminated sites and claims for environmental damage. In the transposition of European Directives about EIA in national laws/regulations, Italy has neither interpreted nor mentioned explicitly submarine cable projects.

The state has exclusive competence in environmental regulation (Italian Constitution). At the peripheral level, the main bodies responsible for developing environmental policies and legislation are the regions but they have to exercise their powers in compliance with national legislation. Regional legislation delegates to the provinces and metropolitan cities extensive administrative functions, in particular in the field of environmental control and supervision, as well as in the areas of waste management, water pollution and air pollution. Minor and specific competences remain within the municipalities.

In the case of concession for the occupation of the marine domain, the legal reference is the Navigation Code of 1952, with the following modifications. On the base of D.P.R. 684/77, the competence on the maritime public domain is given by the State to regions. Following the entry into force of Legislative Decree no. 112/1998, the Regions and local bodies are responsible for the functions and responsibilities regarding the issue of concessions of maritime state property and territorial sea areas and consequently falls within the competence of the municipal administration and not of the Ministry of Infrastructure and Transport, the adoption of the relative acts. In particular, as the concession will be for a period of time higher than 15 years, the competency lies with the Department of the Territory and the Environment of Sicily.

However, concession for the occupation of the marine domain is still a controversial matter in Italy and European Community has warned the country about the necessity to make order in the relative legislation.

The following list includes other key pieces of environmental legislation to be taken into account:

- Penal Code.
- Presidential Decree 357/1997 concerning the conservation of natural and seminatural habitats, and wild flora and fauna, modified by Presidential Decree 120/2003 (Last update on 28/02/2022).
- Promotion of renewable energy Decree (D.Lgs. 28/2011).
- Ship-source pollution Decree (D.Lgs. 202/2007).
- Environmental Liability Law (D.Lgs. 231/2001 and 121/2011).
- Simplification Law (Law 108/2021 and Decree 77/2021).
- Waste Decree (D.Lgs. 116/2020).
- Emissions Decree (D.Lgs. 102/2020 and D.Lgs. 183/2017).
- Climate Law (Law 141/2019 and Decree 111/2019).
- Air Pollution control Decree (D.Lgs. 155/2010).
- National Plan for investments in the water sector (Law 205/2017).
- Protection of groundwater decree (D.Lgs. 30/2009).
- Management of bathing water quality (D.Lgs. 116/2008).
- General Framework for Climate Neutrality (Regulation 1119/2021).

Main authority in charge of the environment:

- Ministry of Ecological Transition

Other national regulatory authorities:

- Ministry of Infrastructures and sustainable mobility.
- Ministry of Health.
- Ministry of Economic Development.
- Ministry of Cultural and Landscape Heritage.
- Interministerial Committee for Ecological Transition.
- Superior Institute for Environmental Protection and Research (ISPRA).
- Superior Health Institute (ISS).
- Regulatory Authority for Energy, Networks and the Environment (ARERA).

Local authorities:

- Region of Sicily; Province of Trapani, City Council of Mazara del Vallo.

- Integrate Hydric Service Ambit Authority (ATO 7 – Trapani).
- Regional Environmental Protection Agency (ARPA Sicilia).
- Local Health and Safety Agencies (ATS).

Gender equality legislative and policy framework:

- National Code of Equal Opportunities between Women and Men (Legislative Decree No. 198 of 2006).
- Budget Law, 2017.

Main labor legislation:

- Workers Charter (Law 300/70).
- Labor Market reform (Law 92/2012).
- Jobs Act (Law 183/2014 and D-Lgs. 151/2015).
- Health and Safety Decree (D.Lgs. 81/2008).

Main heritage legislation:

- Instructions for Underwater Archeological Activity (1997).
- Code of Cultural and Landscape Heritage (2004).
- Law 157/2009, ratification of UNESCO 2001 Convention.

1.3.4 International Texts and Protocols

1.3.4.1 Portugal

Convention	Status
Ramsar Convention of Wetlands of International Importance (1971)	Entry date: 1981
Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	Ratification date: 1980
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973/1978)	Entry into force (accession): 1988
International Convention for the Safety of Life at Sea (SOLAS) (1974)	Entry date (ratification): 1984
Convention on Biological Diversity (1992)	Ratification date: 1993
OSPAR convention on the Protection of the Marine Environment of the Northeast Atlantic (1992)	Date of effect (ratification): 1998
UN Framework Convention on Climate Change (1992)	Ratification date: 1993

Law of Sea Convention (UNCLOS) (1982)	Ratification date: 1997
The United Nations Convention to Combat Desertification (1994)	Ratification date: 1996
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (1996)	Accession date: 2004
Convention on the Protection of the Underwater Cultural Heritage (2001)	Date of deposit (ratification): 2006
Stockholm Protocol on Persistent Organic Pollutants (2001)	Date of effect (acceptance): 2004
Kyoto Protocol (1997)	Ratification date: 2002
Paris Agreement (2015)	Entry into force: 2016

Table 2. Relevant International Treaties and Conventions.

1.3.4.2 Spain

Convention	Status
Ramsar Convention of Wetlands of International Importance (1971)	Entry date: 1982
Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	Ratification date: 1982
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973/1978)	Entry into force (ratification): 1984
International Convention for the Safety of Life at Sea (SOLAS) (1974)	Entry date (ratification): 1980
Barcelona Convention on Protection of the Mediterranean Sea Against Pollution (1976)	Entry into force: 1978
Convention on Biological Diversity (1992)	Ratification date: 1993
OSPAR convection on the Protection of the Marine Environment of the Northeast Atlantic (1992)	Date of effect (ratification): 1998
UN Framework Convention on Climate Change (1992)	Ratification date: 1993
Law of Sea Convention (UNCLOS) (1982)	Ratification date: 1997
The United Nations Convention to Combat Desertification (1994)	Ratification date: 1996
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (1996)	Accession date: 1999
Convention on the Protection of the Underwater Cultural Heritage (2001)	Date of deposit (ratification): 2005
Stockholm Protocol on Persistent Organic Pollutants (2001)	Date of effect (ratification): 2004
Kyoto Protocol (1997)	Ratification date: 2002

Protocol on Integrated coastal Zone Management (ICZM) in the Mediterranean (2008)	Ratification date: 2010
Paris Agreement (2015)	Entry into force: 2017

Table 3. Relevant International Treaties and Conventions.

1.3.4.3 France

Convention	Status
Ramsar Convention of Wetlands of International Importance (1971)	Entry date: 1986
Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	Ratification date: 1975
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973/1978)	Entry into force (approval): 1983
International Convention for the Safety of Life at Sea (SOLAS) (1974)	Entry date (approval): 1980
Barcelona Convention on Protection of the Mediterranean Sea Against Pollution (1976)	Entry into force: 1978
Convention on Biological Diversity (1992)	Ratification date: 1994
OSPAR convection on the Protection of the Marine Environment of the Northeast Atlantic (1992)	Date of effect (ratification): 1998
UN Framework Convention on Climate Change (1992)	Ratification date: 1994
Law of Sea Convention (UNCLOS) (1982)	Ratification date: 1996
The United Nations Convention to Combat Desertification (1994)	Ratification date: 1997
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (1996)	Accession date: 2003
Convention on the Protection of the Underwater Cultural Heritage (2001)	Date of deposit (ratification): 2013
Stockholm Protocol on Persistent Organic Pollutants (2001)	Date of effect (approval): 2004
Kyoto Protocol (1997)	Ratification date: 2002
Protocol on Integrated coastal Zone Management (ICZM) in the Mediterranean (2008)	Approval date: 2009
Paris Agreement (2015)	Entry into force: 2016

Table 4. Relevant International Treaties and Conventions.

1.3.4.4 Italy

Convention	Status

Ramsar Convention of Wetlands of International Importance (1971)	Entry date: 1977
Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	Ratification date: 1978
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973/1978)	Entry into force (accession): 1983
International Convention for the Safety of Life at Sea (SOLAS) (1974)	Entry date (accession): 1980
Barcelona Convention on Protection of the Mediterranean Sea Against Pollution (1976)	Entry into force: 1979
Convention on Biological Diversity (1992)	Ratification date: 1994
UN Framework Convention on Climate Change (1992)	Ratification date: 1994
Law of Sea Convention (UNCLOS) (1982)	Ratification date: 1995
The United Nations Convention to Combat Desertification (1994)	Ratification date: 1997
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (1996)	Accession date: 2006
Convention on the Protection of the Underwater Cultural Heritage (2001)	Date of deposit (ratification): 2010
Stockholm Protocol on Persistent Organic Pollutants (2001)	Date of effect (ratification): 2022
Kyoto Protocol (1997)	Ratification date: 2002
Protocol on Integrated coastal Zone Management (ICZM) in the Mediterranean (2008)	Signature date: 2008
Paris Agreement (2015)	Entry into force: 2016

Table 5. Relevant International Treaties and Conventions.

1.3.5 Policies and standards of international donors involved

The EIB Statement on Environmental and Social Standards sets the policy context for the protection of the environment and human well-being. To achieve this, the EIB has established the following standards (version of 2 February 2022):

- Standard 1: Environmental and Social Impacts and Risks
- Standard 2: Stakeholder Engagement
- Standard 3: Resource Efficiency and Pollution Prevention
- Standard 4: Biodiversity and Ecosystems
- Standard 5: Climate Change
- Standard 6: Involuntary Resettlement

- Standard 7: Vulnerable Groups, Indigenous People and Gender
- Standard 8: Labour Rights
- Standard 9: Health, safety and Security
- Standard 10: Cultural Heritage
- Standard 11: Intermediated Finance

Standard 1 promotes an integrated approach to impact assessment and risk management by ensuring that environmental, climate, social and human rights considerations are addressed and taken into account in the decision-making processes. This standard is applied through the entire Environmental and Social Impact Assessment section.

Standard 2 recognizes the importance of stakeholder engagement as a way to ensure that the following rights are respected: access to information, public participation in decision-making processes and access to justice. This standard is taken into account by the promoter from the first steps of the project development and is the specific matter of Section 3 in the present document.

Standard 3 is focused on the promoter's responsibilities to ensure an integrated approach to resource efficiency, pollution prevention and control of emissions, ensuring consistency with the "Do Not Significant Harm" principle and contributing to the achievement of the zero pollution European target. The attention to resource efficiency and pollution prevention is a key factor for the Medusa project and is evaluated through the ESIA.

Standard 4 recognizes the significance of protecting ecosystems and biodiversity and outlines the promoter's responsibilities with regard to the identification, assessment, management and monitoring of the risks affecting ecosystems and biodiversity. This standard is applied in the ESIA of the project, from delineating the biological environment baseline of the study area to quantifying biological impacts and proposing mitigation measures.

Standard 5 recognizes the significance and urgency of combating climate change and sets out the promoter's responsibilities with respect to climate change mitigation and adaptation, in alignment with the principles of the Paris Agreement and the Sustainable Finance Action. The vulnerability of the project to Climate Change will be assessed during the ESIA.

Standard 6 may have a link with the project in case some landing sites of the projects could involve land acquisition and/or restrictions on land use. However, it has to be taken into account that public property is preferred, when possible, for the location of terrestrial infrastructures. When private property has to be contemplated, the nature of the land to be acquired is taken into account in order to avoid involuntary resettlements.

Standard 7 recognizes that sometimes certain individuals or groups are vulnerable, marginalized, systematically discriminated or excluded on the basis of their socioeconomic characteristics (sex, sexual orientation, gender, gender identity, caste, racial, ethnic, indigenous or social origin, genetic features, age, birth, disability, religion, political opinion, membership of a national minority, etc.). This standard is applied in the project ESIA, starting from a detailed characterization of the socio-economic baseline.

Standard 8 outlines the promoter's responsibilities with regard to the assessment, management and monitoring of labour-related impacts and risks associated with the project. This standard will apply to any of the project workers and is taken into account in the ESIA.

Standard 9 recognizes the need to safeguard the safety and health of workers, as project activities, equipment and infrastructures may expose workers and community to hazards, risks and impacts in terms of occupational and public health, safety and security. This standard is a solid basis for the Medusa project and is taken into account in the ESIA.

Standard 10 outlines the promoter's responsibilities with regard to identifying, assessing, managing and monitoring cultural heritage-related impacts and risks associated with the project. This standard is considered and carefully analyzed in the ESIA.

Standard 11 does not apply to the project of study.

1.3.6 International Labor Organization

The International Labor Organization (ILO) core Labor standards include the following:

- Forced Labor Convention, 1930
- Right to Organize and Collective Bargaining Convention, 1949
- Equal Renumeration Convention, 1951
- Abolition of Forced Labor Convention, 1957
- Discrimination (Employment and Occupation) Convention, 1958
- Minimum Age Convention, 1973
- Worst Forms of Child Labor Convention, 1999

These conventions are fundamental and shall be taken into account during the implementation of the Medusa submarine cable system.

1.4 Analysis of Project Alternatives

Submarine fiber optic cables are the means of communication for the transmission of large volumes of Internet data at high speed between different continents, countries and island areas.

The connection of a submarine cable to a specific country or region has historically been linked to geographical constraints and economic relations. Thus, the main submarine connection cables between America and Europe reach mainly England, with some exceptions in Portugal and France, while connections with Asia and North Africa are currently concentrated in Marseille and Sicily.

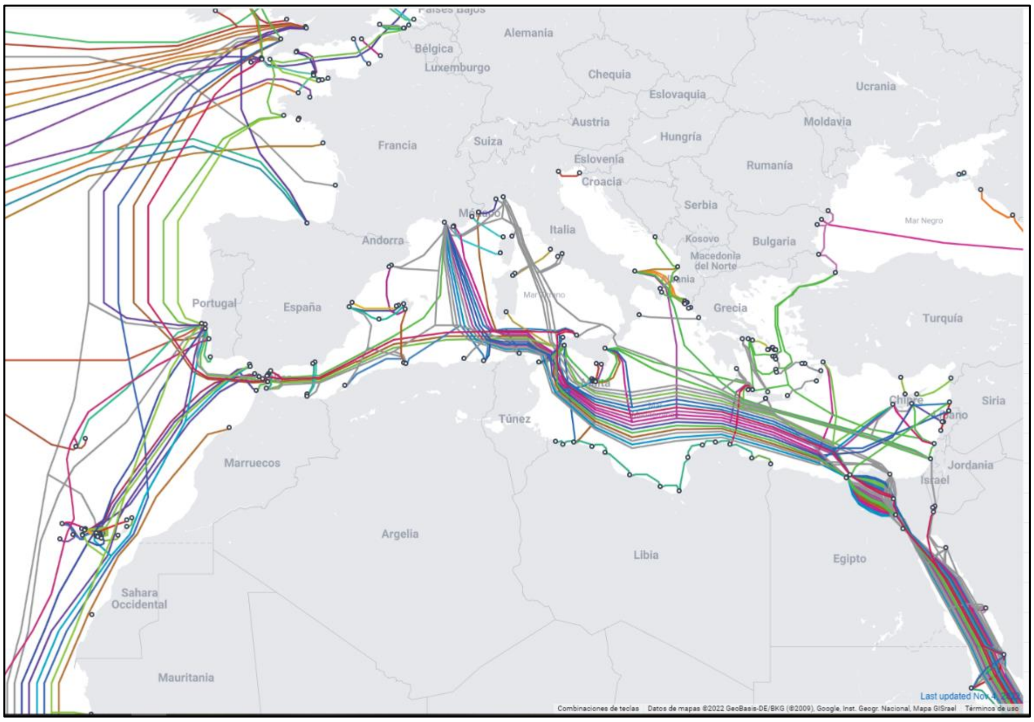

Figure 19. Map of submarine cables in Mediterranean area. Source: https://www.submarinecablemap.com/

The dependence of the modern world on the Internet has become even more evident with the events of 2020 and the consequent worldwide spread of teleworking and virtual conferences and meetings. The ICPC (International Cable Protection Committee) estimated that internet traffic increased between 25 and 50% since November 2019 and the first phase of confinement during the covid-19 pandemic. At the end of July 2020, conferences through Zoom Video Communications had registered an increase of 350% compared to the previous year.

The Medusa fiber optic system project offers a notable increase in connectivity between different countries in Europe and North Africa by means of a single system of submarine cables made up of a main route and several branches, capable of bringing the Internet to a high number of Mediterranean and East Atlantic locations, located in 9 different countries.

1.4.1 Alternative 0

The first alternative that has been analyzed is Alternative 0, that is the no execution of the project. This alternative is for sure the most favorable in terms of environmental impact, as it does not change the environmental baseline conditions of the area of study.

However, alternative 0 is not the most advantageous in terms of socio-economic impacts, as it will not imply any increase in the transmission networks capacity, and, consequently, will not enable a faster digital transformation in North African countries across different sectors and will not stimulate innovation-related business activities by increasing collaboration opportunities among research centers on both sides of the Mediterranean.

In addition, the no actuation project will deprive the possibility to entail socio-economic benefits with regard to the creation of new employment in several countries of the Mediterranean area.

Taking into account the possibility of planning a submarine fiber optic cable system compatible with the protection of the environment, the conservation of biodiversity, the use of the territory, the planning of the marine space, the observance of human rights and of community health and safe, the preservation of cultural heritage, etc., the alternative 0 is not considered to be the best possible option.

1.4.2 Other Alternatives

The laying of submarine cables in high seas, EEZ of different countries, as well as contiguous zones and territorial waters must fulfill the Law of Sea Convention (see Chapter 1.3.1).

In the case of a submarine cable project, the evaluation of the most convenient alternative from an environmental and socio-economical point of view is a key factor in order to guarantee the success of the project. Therefore, a preliminary identification of the main conditions and critical aspects to be considered for the installation of the cable on the seabed and for the determination of landing points has been conducted in the Desktop Study (DTS) (also known as Cable Route Study), following the recommendations of the International Cable Protection Committee (ICPC) (ICPC Recommendation No.9). The application of well-known industry standard mitigation measures is also taken into account at the time of planning the cable system route, in order to minimize the cable footprint and guarantee the cable integrity.

Factors affecting route definition can be summarized into the following categories:

- Geological hazards
- Environmental constraints
- Socio-economic constraints, including ICPC Protocols and recommendations

- Route optimization

With respect to geological hazards, seabed steepness and roughness represent the most significant obstacle for a submarine cable project, both during the installation step (hazard to the plow equipment and the cable itself) and during operational phase (high stress and sediment slumping). The ICPC guideline recommends slopes of the seabed lower than 20º Rocky outcrops and hard seafloor represent also a high risk for submarine cables as they are an obstacle for burial, leaving the cable more exposed to external aggression (anchoring, bottom trawling fishing, etc.). In deep sea, areas of rocky outcrops are mainly associated with seamounts, fault scarps and ridges, producing very steep gradients. Other potential geological hazards for a submarine cable are emissions (e.g., volcanic seamounts, pockmarks, salt brine pools, mud mounds), seismic activity and areas of sand waves and mega-ripples (which indicate potentially intense bottom currents).

Concerning environmental constraints, the main factors to be taken into account are the presence of natural protected areas and sensitive seabed habitats, such as seagrass meadows, coralligenic concentrations and reefs. Natural protected areas are zones characterized by significant flora and fauna species or significant habitats. The influence of a submarine cable project on these areas depends on the environmental features to be protected. As an example, in the case of natural protected areas established for the protection of bird species, the interference of the project is minimal and exclusively related to the installation and decommissioning phases. On the contrary, when protected areas are characterized by the presence of significant benthic communities, the interference of the project can be high and related not only to the installation and decommissioning phases, but also the operational phase. Sensitive seabed habitats may be affected by direct physical destruction, sediment resuspension and physical occupation of sea bottom.

Socio-economic constraints are related to possible conflicts that can be generated with other seabed users during installation and operational phases, as well as risks associated to man activities. Fishing is one of the most significant socio-economic factors for the planning of the cable route. Bottom trawling activity and dredge fishing can affect the integrity of submarine cables. Therefore, attempts are made to minimize the installation of a submarine cable in areas where this type of fishing is widespread. Additionally, cable installation works have a temporary impact on fishing activity in relation to the presence of the cable vessel and ancillary crafts, which impede the normal progress of fishing during a short period of time.

Other socio-economic factors that influence the planning of the cable route are the presence of anchoring areas, which should be avoided for the installation of a cable, as boat anchors can hook and damage the cable and maritime traffic. Indeed, during the installation of a submarine cable, authorities responsible for navigation declare an exclusion zone to navigation, normally at least 1 Nm, to avoid interaction with cable laying operations. Consequently, the cable route is normally planned to avoid the affection to the main maritime routes. Archaeological easement zones and the presence of wrecks represent additional socio-economic aspects to be considered: the declaration of these zones is related to the historical importance of a place and the finding of archaeological remains and these areas must be avoided, as the installation of a submarine cable, especially its burial, affects directly the seabed and could therefore have significant negative consequences on the archaeological heritage that may be present.

Finally, submarine cables coexist on the seabed and in submerged beach areas with other infrastructures such as pipes, outfalls, artificial reefs, other electrical or telecommunications cables. The presence of these infrastructures must be taken into account when planning the cable route, as they can affect the installation stage of the project and may condition the cable burial. In the case of other submarine cables present at the seabed, ICPC guidelines recommends an ideal distance of three times the water depth (3WD) between cables or at least a minimum distance of two times (2WD) the water depth to allow safe cable repairs if necessary. At the same time, crossing angles between cables are ideally engineered at 90º, discouraging in any case crossing angles lower than 35º.

With respect to route optimization, the two main criteria that has been followed in the planification of the Medusa submarine cable system are shortening the route as far as possible and proceed into deep water as quickly as possible, in order to minimize the route that should be buried and therefore the risk of external aggression for the cable (lower risk water deeper than 1000 m).

Following the criteria cited above for the different categories of features that can affect the imprint and the security of the Medusa project, a first approximated route was planned in 2020, after a DTS study. Up to the moment, the route has been continuously updated on the base of emerging critical points in several sectors of the route. Twenty-two versions of the cable route have been studied in the past 2.5 years, gathering environmental and engineering criteria as well as the viability of Medusa landings.

The viability of the landings is mainly related to the following criteria:

- The commercial interest to have connectivity and/or fiber capacity of Medusa system by potential clients (operators and corporation) in the landings.
- The “End of Life” state that will reach soon several strategic cables operating in the Mediterranean area. This obliges to look urgently for alternatives.
- The limitation of fiber/capacity in the current operating cables, which limits the growth and development of communication (society) in most of North Africa countries.

- The instability of some existing cables, with fall of services in relation to cuts and deteriorations of fibers. This brings to the interest in finding more trustworthy alternatives.

Therefore, during the planning of Medusa system, landings have been included and excluded on the base of the feasibility of the project and interest/agreements found in the different countries.

In this document we will not discuss in detail every alternative that has been effectively analyzed during the development of the project, being the process of elaborating a final route very elaborate. However, we present in the following table a summary of the most important changes done in the planning of the preliminary route of the cable.

Nº of revision	Main changes	Motivation
REV02	Dismissing Malta landing	Lack of potential clients in Malta Presence of many Nature 2000 sites in the area
REV04	Terrestrial cable between Zahara and Torreguadiaro, instead of marine cable crossing the Gibraltar strait Dismissing Gibraltar landing	Many cables already cross Gibraltar Strait and the zone is characterized by strong currents Presence of rocky marine habitats. Low security of the cable in Gibraltar Strait due to currents and maritime traffic Lack of potential clients in Gibraltar
REV05	Considering a landing near Rome, Italy	Expand the connection to continental Italy
REV06	Considering a landing in Asilah, Morocco	Improving the internet connection in this zone of Morocco
REV09	Modifying the route in the Gulf of Cadiz zone Considering a landing in Nador Dismissing Rome and Cagliari landings in Italy	Presence of Nature 2000 site “Mud Volcanos in Cadiz Gulf”. Improving the internet connection in this zone of Morocco Lack of favorable conditions in Rome and Cagliari

	Planning of developing the Medusa cable also in the Eastern Mediterranean Sea (Libya and Egypt added as landing countries)	Improving the internet connection in other countries of North Africa.
REV10	Considering a landing in Sines, Portugal Dismissing Balearic Islands landings Dismissing Annaba landing, Algeria Planning a landing in Skikda, Algeria Planning additional landings in Greece and Turkey	Expand the connection to this zone of Portugal Lack of favorable conditions in Balearic Islands. Many Nature 2000 sites present. Low security for the cable due to strong storms in this area. Finding an alternative to Annaba landing Expand the connection to other two countries of the Mediterranean area
REV11	Planning additional landings in Calabria region, Italy	Finding an alternative to the crossing of the shallow area between Sicily and Libya, in the Pelagian Shelf
REV13	Planning a landing in Cypre Dismissing the landing in Calabria	Expand the connection to an additional country in the Mediterranean area Improving the security of the cable, avoiding very geologically active zones
REV15	Planning a landing in Alicante, Spain	Expand the connection to this zone of Spain
REV17	Modifying preliminary route of Marseille branch	Improving the security of the cable
REV18	Dismissing landings in Casablanca and Asilah	Lack of interest of clients in this area
REV20	Dismissing one of the two routes planned for Marseille branch	Need to accomplish with requirements indicated by permitting authorities

REV22	Dismissing for the moment the landings in Sines and Alicante Modifying landing point in Nador Proposing a new route for a second segment of Marseille branch	Uncertainty with respect to client interests in these areas Agreement with Orange Morocco Trying to find a solution about requirements of permitting authorities without renouncing to a second segment in Marseille

Table 6. Summary of Medusa subsea system route reviews.

The alternative analyzed in details in this ESIA is the latest one, which has been modified from previous versions with the aim is to minimize critical points of the routes that have emerged at the time of integrating more specifical geological data (Barcelona-CSI geological and geophysical database), as well as during the permitting process that has been started in several landings of the system (additional criteria established by authorities and results of benthic studies).

The RPL considered in the present ESIA represents the most adapted alternative route planned on the base of all available data. However, as a normal practice in the field of submarine cables, it has to be taken into account that the route may be subjected to further moderate changes on the base of detailed geophysical and geotechnical information that are acquired during pre-installation surveys and that have the aim to provide precise indications for the engineering of the cable, which will ensure the safest route for the life time of the cable (25 years). In addition, possible modifications of branch routes may be asked by authorities in charge of releasing laying permits for any of the landings. These modifications cannot be envisaged at the present stage of the project, as, when already started, the permitting process for the landing points is still in progress.

1.5 Environmental and Social Baseline

1.5.1 Physical Aspects

1.5.1.1 Bathymetry

Study area: trunk of Medusa submarine system and branches.

1.5.1.1.1 Main trunk

The area of study is mainly located in the Mediterranean Sea, although the initial stretch is in the Atlantic Sea, next to the Portugal’s coast. The bathymetry shows that the study area ranges from

0 m, or coastline, to more than 5000 m. The deepest areas, up to 5000 or 5200 m, are those that belong to the Atlantic Ocean and the eastern basin of the Mediterranean Sea (in the Calypso Deep, in the Ionian Sea).

The average depth of the Mediterranean Sea is 1500 m and the abyssal plains are between 2500 and 3000 m. The western basin of the Mediterranean Sea is smaller than the eastern one, and is characterized by a maximum depth up to 3000 m.

The communication with the Atlantic Ocean is done at the western basin through Strait of Gibraltar, with a depth of just over 900 m.

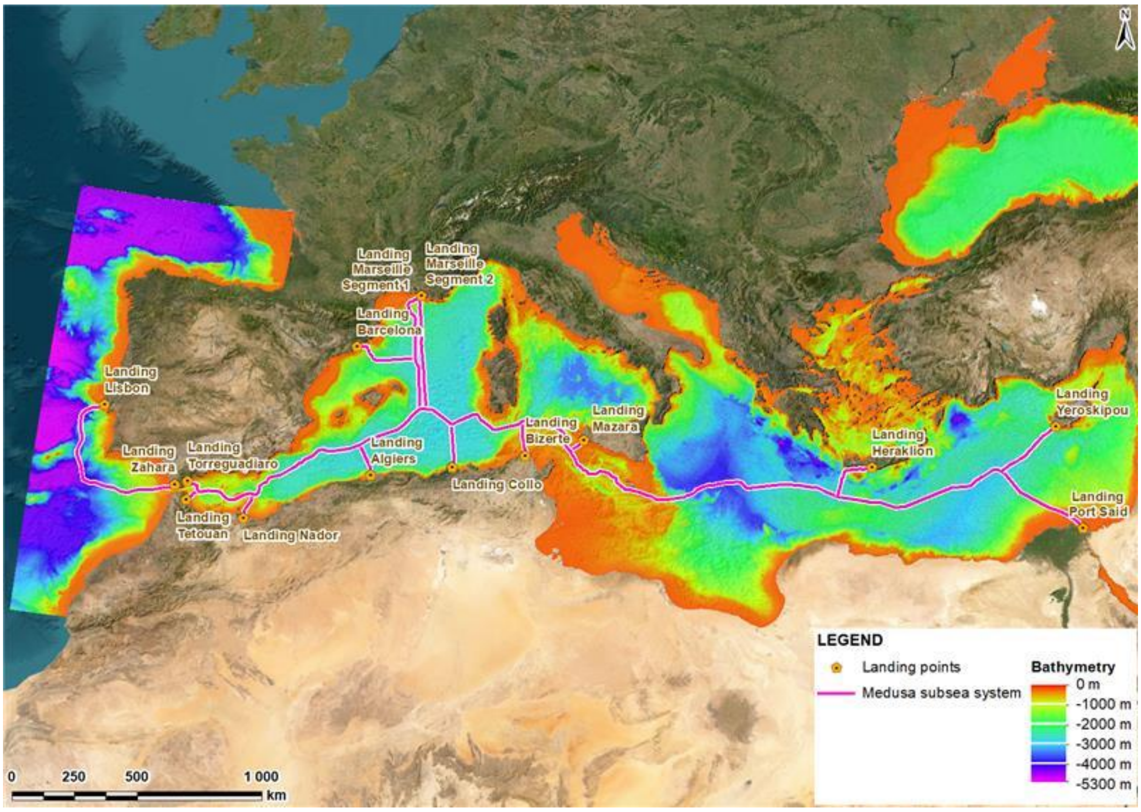

Figure 20. Bathymetry of the study area. Source: Elaborated with data from EMODnet-Bathymetry.

The highest depth is reached by the main cable in the Atlantic Ocean, offshore to Portugal Coast, while the offshore section in the Mediterranean Sea lay at lower depth. Depths are significantly lower in some sections of the offshore system, that is near the Gibraltar Strait, in the western part of the Alboran Sea and in the Pelagian Shelf.

Slopes are lower than 20° in most of the Medusa system main cable route. However, due to the geology of the sea bottom in the area of study and the requirements of the system, higher slopes are occasionally present in the route. Lower slopes have been preferred during the planning of the route as far as possible, avoiding the crossing of orange-red portions of the slope maps (see following figures). The most critical points for the route of the main trunk are (i) the area offshore Lisbon, (ii) the Torreguadiaro landing (closeness to a submarine canyon) and (iii) the section in the Alboran Sea passing in the proximity of ridges.

1.5.1.1.2 Portugal: Lisbon landing

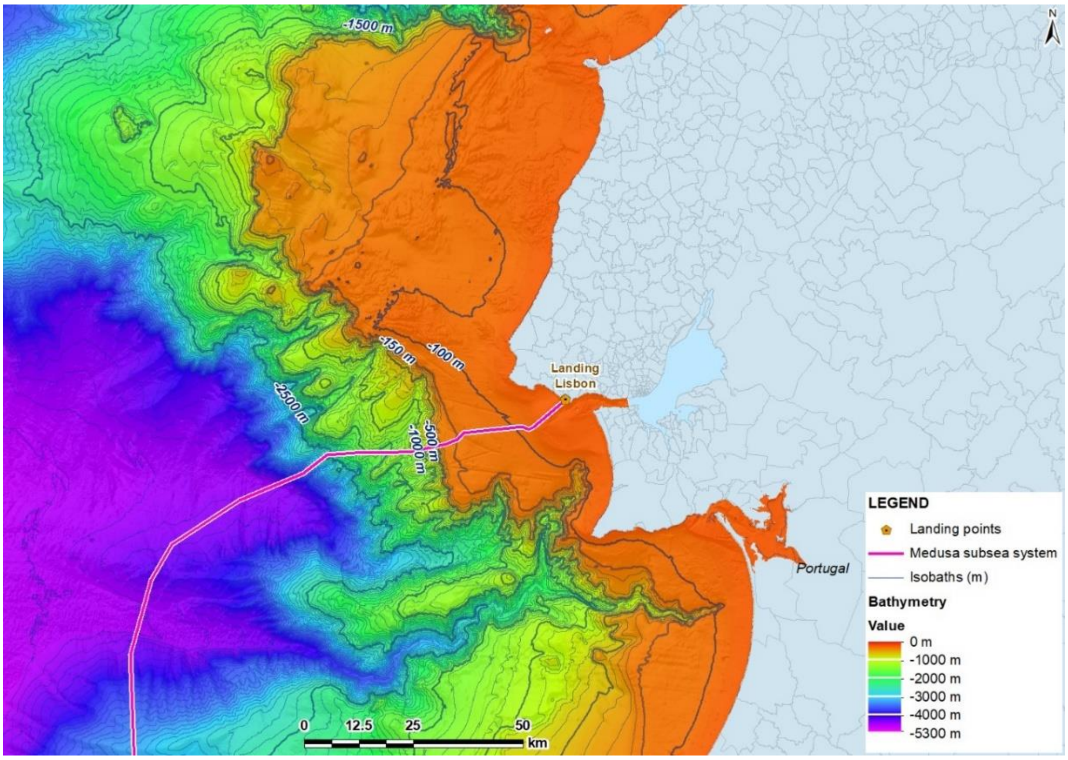

Figure 21. Bathymetry at Lisbon landing. Source: Elaborated with data from EMODnet-Bathymetry.

The bathymetry shows a continental platform for about 15–30 km, although it can become much wider at other points of the Portuguese coast, and a maximum depth of more than 5100 m. This maximum depth coincides with the Tagus Abyssal Plain.

The Lisbon landing passes north of two submarine canyon systems, the Cascais and the Lisbon-Setúbal. The cable that reaches Lisbon settles on the continental shelf for the first 30 km, with a depth from 0 to 200 m and a steady drop of this depth. From a depth of 200 m and over about 40 km, the presence of the continental slope causes a very abrupt fall, with a steep slope, where the depth goes from these 200 m to 4600 m.

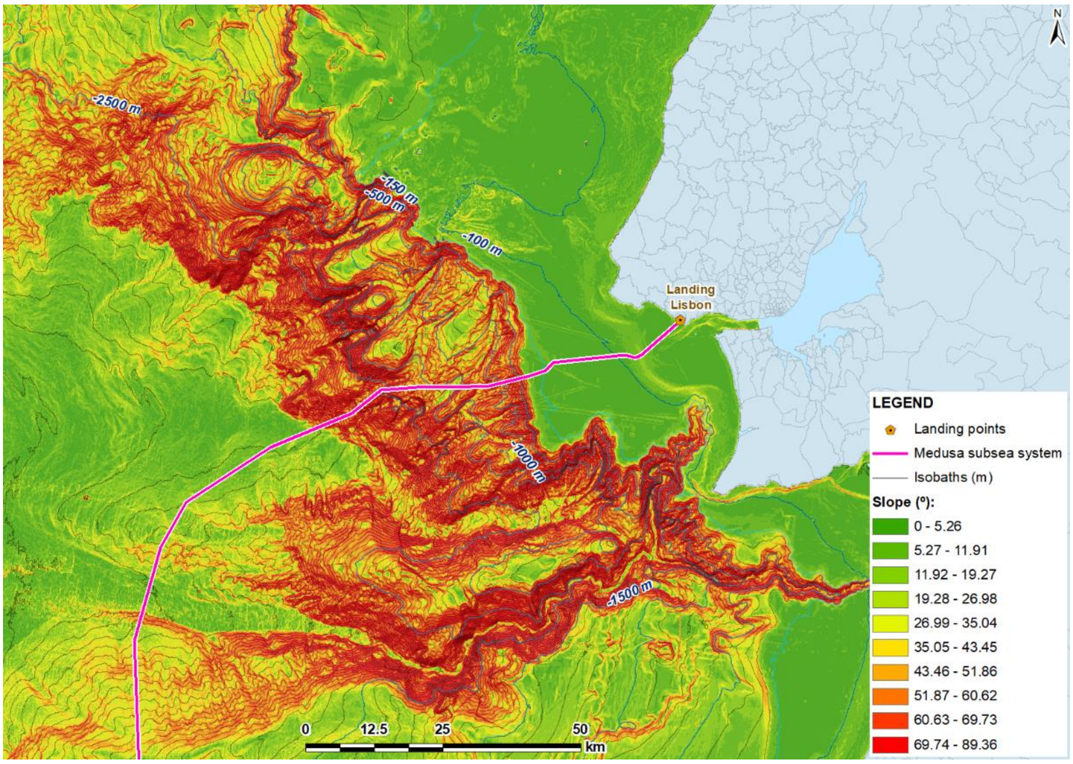

Figure 22. Slopes at Lisbon landing. Source: Tecnoambiente 2023.

1.5.1.1.3 Spain: Zahara, Torreguadiaro and Barcelona landings

The Zahara and Torreguadiaro landings are located close to the Strait of Gibraltar, one of the shallowest areas where the cable runs through and connecting the Atlantic Ocean with the Alboran Sea.

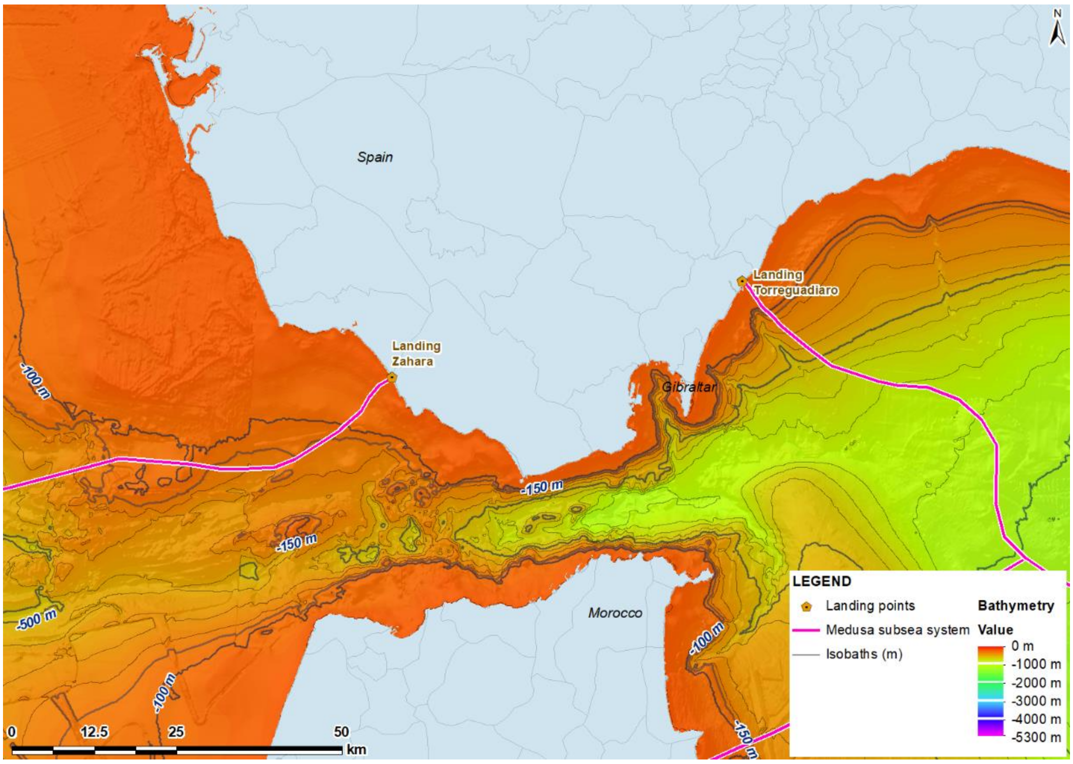

Figure 23. Bathymetry at Zahara and Torreguadiaro landings. Source: Elaborated with data from EMODnet-Bathymetry.

Concerning Zahara landing, at 9 km from the coast the depth reaches the bathymetric -100 m, while the 200 m are reached after about 24 km. The slope in the area is very smooth and gradual, making the depth not reach up to 1500 m to beyond about 175 km away from the coast.

The area of Torreguadiaro landing has a narrow continental shelf: only about 5 km from the coast the depth already reaches 100 m and after less than 8 km the bathymetric -200 m is reached. The route of Medusa system avoids the highest depths corresponding to submarine canyons, but slopes are higher than 30 in some sections.

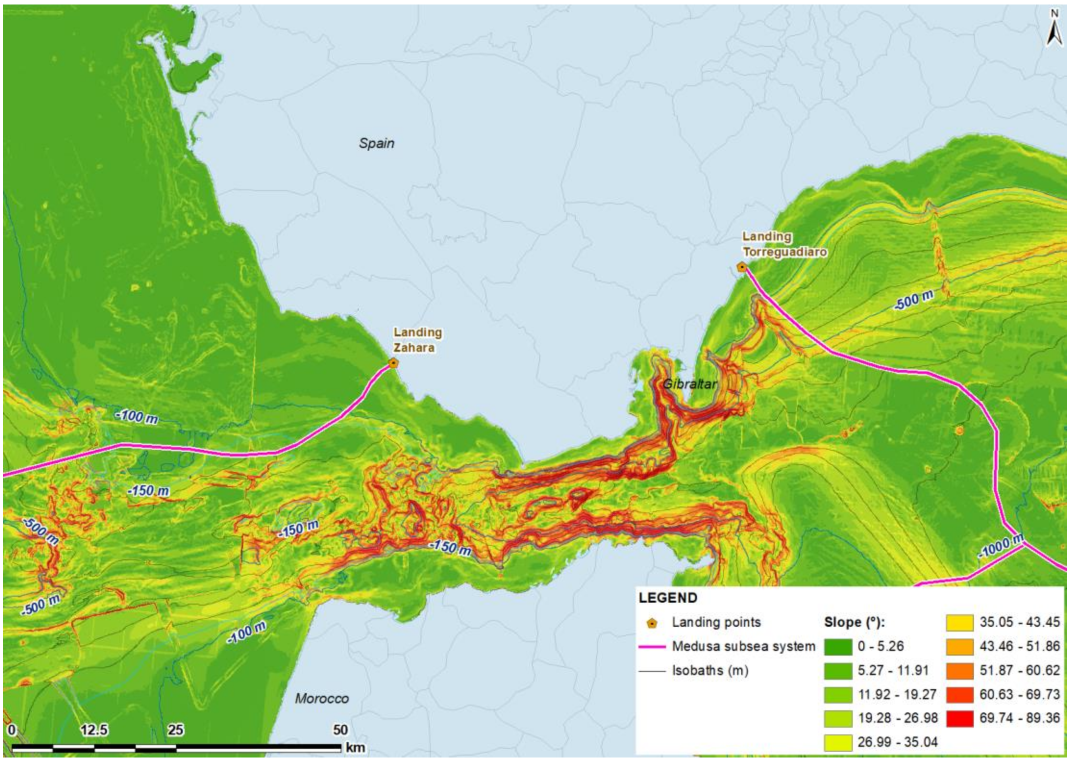

Figure 24. Slopes at Zahara and Torreguadiaro landings. Source: Tecnoambiente 2023.

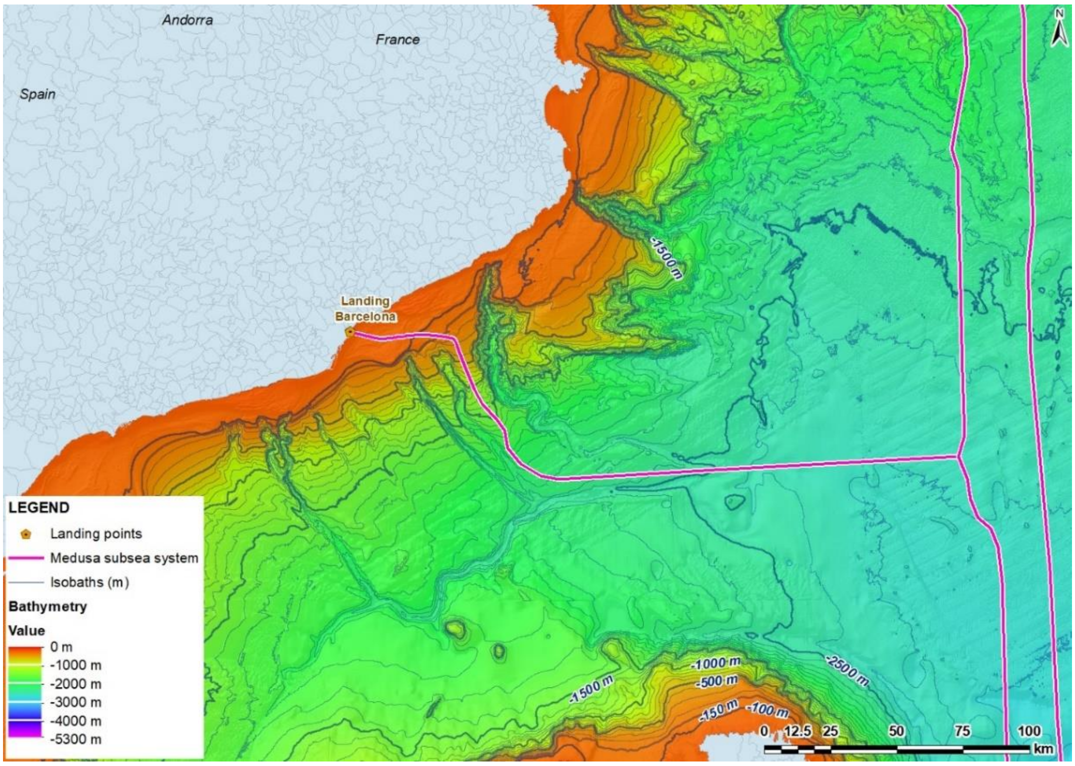

Figure 25. Bathymetry at Barcelona landing. Source: Elaborated with data from EMODnet-Bathymetry.

The Barcelona branch has an extension of about 260 km, starting from a depth of 2600-2700 m, where the BU will be located. On the coast of Catalonia, along the continental slope there are several submarine canyon systems, those that are closer to the cable are the Arenys and Besòs Canyons. Like all canyons, these are characterized by a steeper slope compared to the adjacent area. The continental slope has a very variable extent depending on whether or not a submarine canyon is present: in those areas where it does not exist, the slope has an extension of up to 80 km. The cable passes through the continental slope for a large section, being the 100 m of depth located 25 km from the landing point and the 200 m at almost 40 km.

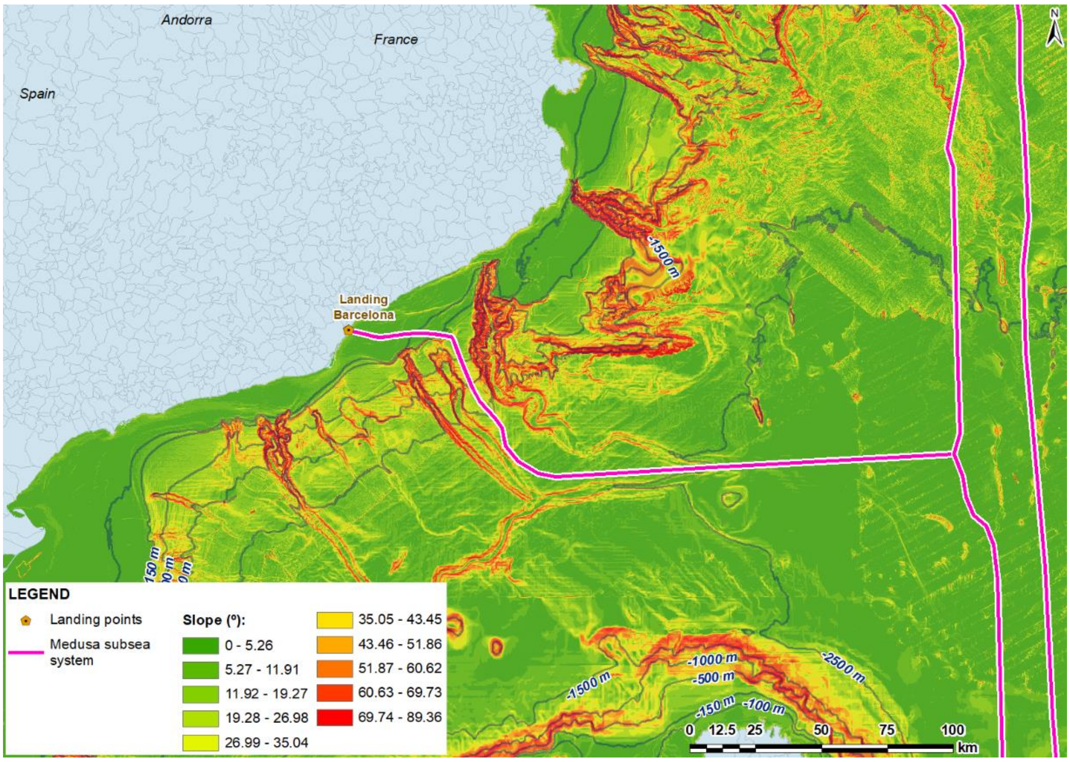

Figure 26. Slopes at Barcelona landing. Source: Tecnoambiente 2023.

1.5.1.1.4 France: Marseille landing

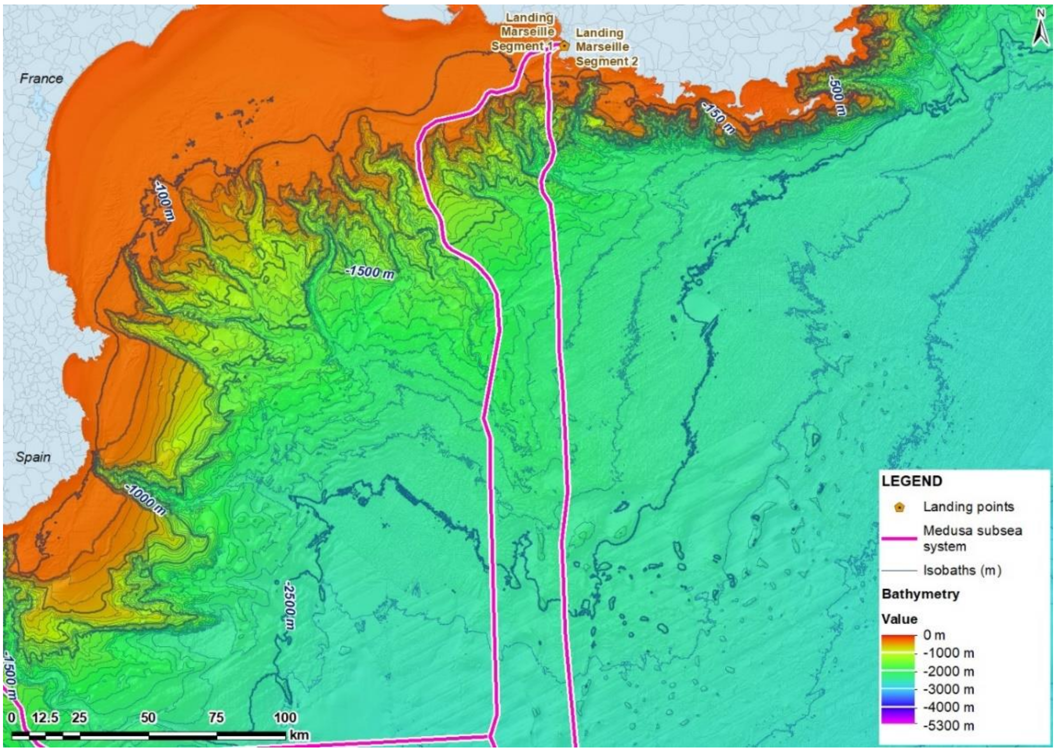

Figure 27. Bathymetry at Marseille landing. Source: Elaborated with data from EMODnet-Bathymetry.

The Segment 1 of Marseille is approximately 510 km long. The portion of continental shelf crossed is extensive and the cable will lay on the continental platform for about 80 km. This is due to the attempt of avoid the crossing of important submarine canyon systems going toward the west, where the platform of the Gulf of Lion is wider. From 200 m depth the route falls down the continental slope for about 45 km, up to 2000 m depth. At this point the cable reaches an abyssal plain, although the depth gradually increases from 2000 m to about 2700–2800 m, where the BU is located. This last stretch across the abyssal plain is about 360–380 km long.

The Segment 1 of Marseille will mainly lay on smooth zones, reaching medium slopes in some cases.

The Segment 2 of Marseille branch is approximately 460 km long. The continental shelf is quite extensive, at some points extending over 20 km. The initial stretch of this Marseille branch runs along this continental shelf, in the east part of the Gulf of Lion, where at 23 km distance from the coast reaches the depth of 200 m. From 200 m depth it falls down the continental slope for about 50 km, crossing the Marseille and Grand-Rhone ridges, up to 2000 m depth. At this point the cable reaches an abyssal plain, although the depth gradually increases from 2000 m to about

2800–2900 m, where the BU is located. This last stretch across the abyssal plain is about 380–400 km long.

The Segment 2 of Marseille branch will cross inevitably a steep zone, as it is possible to see in the slope picture.

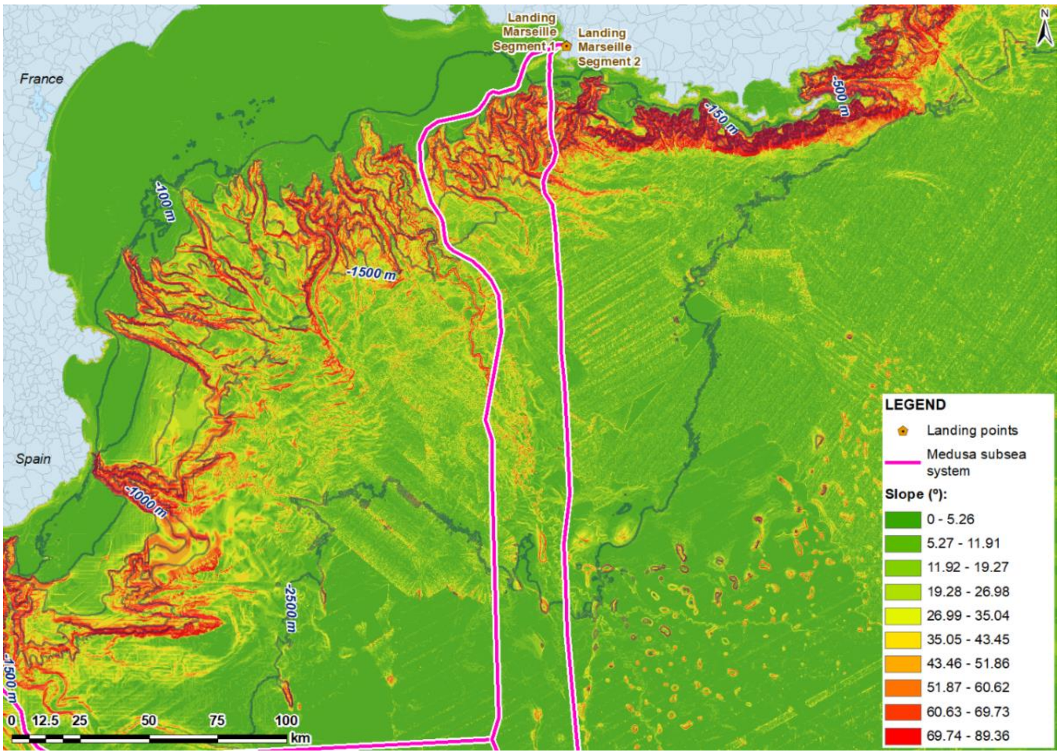

Figure 28. Slopes at Marseille landing. Source: Tecnoambiente 2023.

1.5.1.1.1 Italy: Mazara del Vallo landing

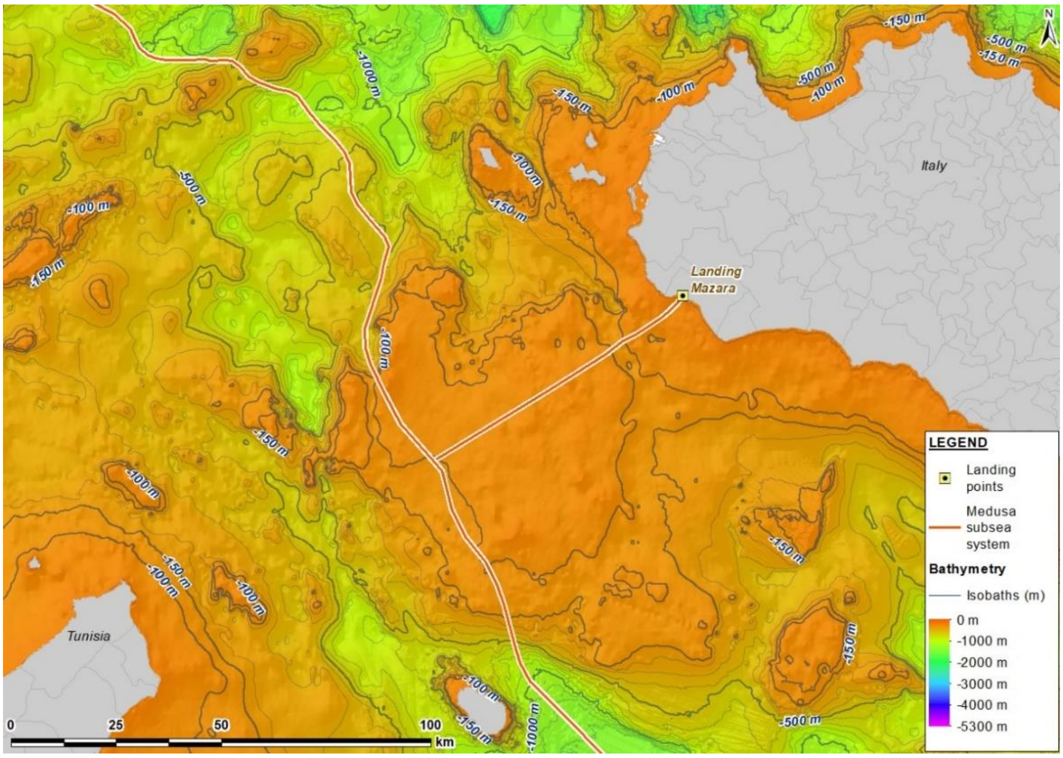

Figure 29. Bathymetry at Mazara landing. Source: Elaborated with data from EMODnet-Bathymetry.

The Mazara branch connects the main trunk with Mazara del Vallo city and is approximately 72 km long, all located in the Sicily Channel. The profundity doesn't vary greatly along the landing route because most of the route runs through the Adventure Plateau (also called Adventure Bank), with a practically constant depth of 100 m.

The seafloor in the proximity of the coast also maintains a rather shallow profundity (from the shoreline to 100 m of depth there are about 17 km). The maximum depth along this branch is 200 m, just where the Adventure Plateau connects to the Sicily platform.

Slopes along Mazara branch are very low.

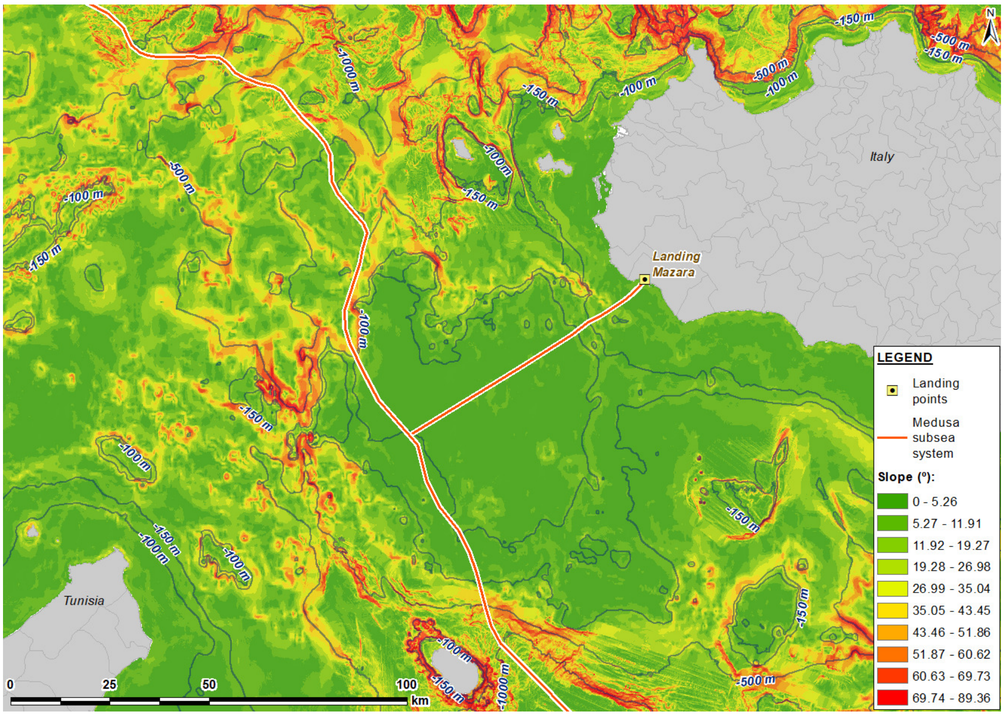

Figure 30. Slopes at Mazara landing. Source: Tecnoambiente 2023.

1.5.1.2 Geology

<u>Study area:</u> trunk of Medusa submarine system and branches.

1.5.1.2.1 Main trunk

Regional geology of the area of study is mainly related to the Mediterranean Sea domain. The Mediterranean Sea is a marginal microtidal sea connected to the Atlantic Ocean through the Gibraltar Strait. It is divided into Western and Eastern basins by a submarine ridge between the island of Sicily and the African Coast, at the Strait of Sicily.

The Western Mediterranean Sea is the younger part of the Mediterranean, as it has been formed from late Oligocene to present. It is divided into several sub-basins such as the Alboran Sea, the Algerian Basin, the Valencia Through, the Provençal Basin and the Tyrrhenian Sea (Carminati et al., 2012). The main trunk of Medusa submarine cable system will cross many of these sub-basins: from the Gibraltar Strait the cable will lay on the Alboran Basin, then it will go eastward, crossing the Algerian Basin.

The Eastern Mediterranean Sea is characterized by the presence of older oceanic crust and includes several sub-basins such as the Pelagian Shelf, the Adriatic Sea, the Ionian Sea, the

Aegean Sea, the Libyan Sea and the Levantine Sea. The main trunk of Medusa submarine cable system will cross the Pelagian Shelf (main cable), the Libyan Sea (main cable) and the Levantine Sea (main cable).

The distribution of the Mediterranean Sub-basins is reported in the following picture.

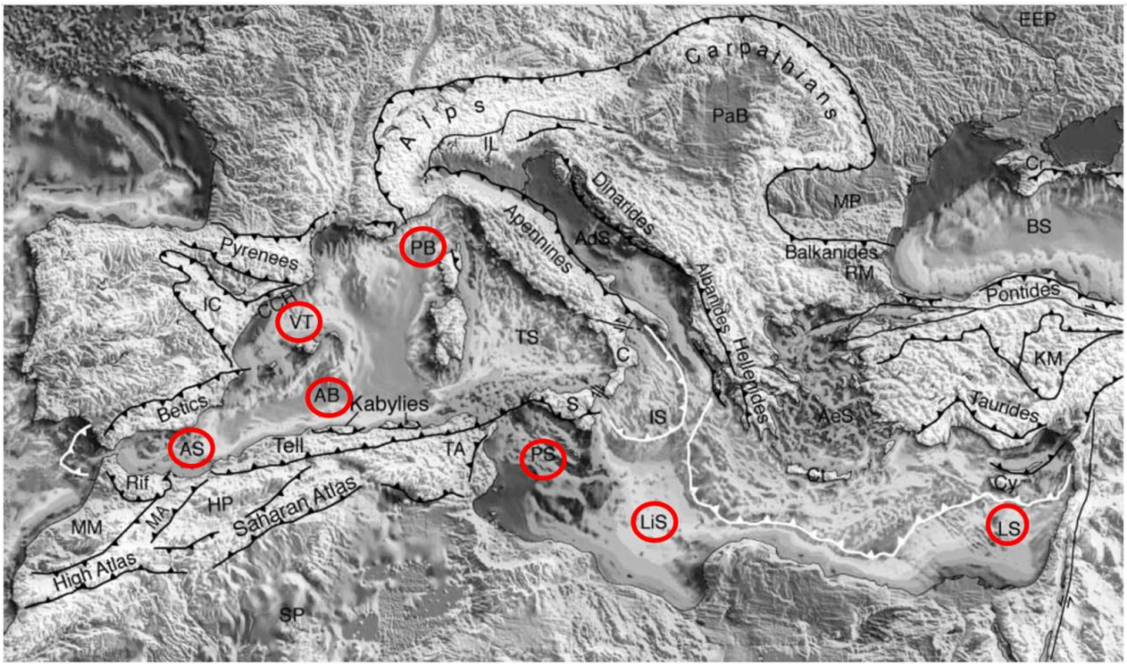

Figure 31. Mediterranean Sub-basins (from Cavazza and Wezel, 2003). AS = Alboran Sea; AB = Algerian Basin; PB = Provençal Basin; VT = Valencia Through; PS = Pelagian Shelf; LiS = Libyan Sea; LS = Levantine Sea.

A summary description of the sub-basins crossed by the main trunk can be found in Cavazza and Wezel, 2003. The Alboran Sea is floored by thinned continental crust; the basement is composed by methamorphic rocks similar to those of the Internal Zone of the Betic Cordillera and the Moroccan Rif that bounded the sub-basin. The Algerian Basin is floored by oceanic crust that has a thickness similar to the one of the Provençal Basin, while the sediment cover is strongly reduced; the basin probably started to open when widening of the Provençal basin stopped (Mauffret et al., 2004). Geophysical data and reconstruction on the Eastern Mediterranean point to the presence of old oceanic crust underneath a thick pile of Mesozoic and Cenozoic sediments. The oceanic domains are currently being subducted beneath the Calabrian and the Crete-Cyprus arcs (Cavazza and Wezel, 2003).

The current configuration of the Mediterranean Sea resulted from the creation and consumption of the Paleotethys and Neotethys, two major oceanic basins, in relation to the interaction between the Eurasian and African-Arabian plates. Because of the closure of these oceanic domains, a system of orogenic belts different in time, structure and setting has been created. Then, during the Neogene, a general extension phase in the region brought to the thinning of continental crust and the formation of small oceanic basins. The Neogene period in the Mediterranean domain is also characterized by the extended deposition of evaporites due to the Messinian salinity crisis, when the sea became isolated by the world oceans (Cavazza and Wezel, 2003).

1.5.1.2.2 Portugal: Lisbon landing

Carcavelos is located on land on the Western Rim formed by sedimentary deposits from the Lusitanian Basin.

Sedimentary sequences from the Upper Cretaceous (C2 Limestones and marls, Belasian) to the Miocene (M2 Limestones of Entre-Campos, Banco Real) occur at the site, formed by series of limestones, marl limestones and marls. This stratigraphic sequence is interspersed with volcanic rocks (Basalts) and volcanic-sedimentary formations of the Lisbon Volcanic Complex. The entire set is covered by Quaternary deposits (A Alluvium, A Beach sands).

The sedimentary sequence has a NE-SW structure, constituting the flank of an anticline with a gentle dip to the south. There is an NNE-SSW tectonic accident in the area, evidenced by the ascent of the southeast block.

Figure 32. Geological map of the area. Source: Proyecto básico de infraestructura por un cable de fibra óptica en Carcavelos (Lisboa). Source: AFR-IX Telecom, 2022.

1.5.1.2.3 Spain: Zahara, Torreguadiaro and Barcelona landings

Zahara and Torreguadiaro are located in the Province of Cadiz, where the dominance of Flysch formations emerges extensively. These units (Aljibe unit, Bologna and Algeciras) are mainly organized as a distorted belt of folds and thrusts belonging to an arc accretionary prism. The materials of these units are mainly of turbiditic character: various clay and sandy (terrigenous and carbonate) formations that were deposited by sediment gravitational flow processes in a deep-sea basin, with rhythmic stratification, because the deposit occurred in a tectonically active environment (synorogenic).

The entire formation of the coast of Cadiz province covers a vast period from the Jurassic to the Quaternary. Thus, we can distinguish two groups of materials: pre-orogenic, deposited in millenary marine basins, and post-orogenic materials whose deposits come from the Upper Miocene.

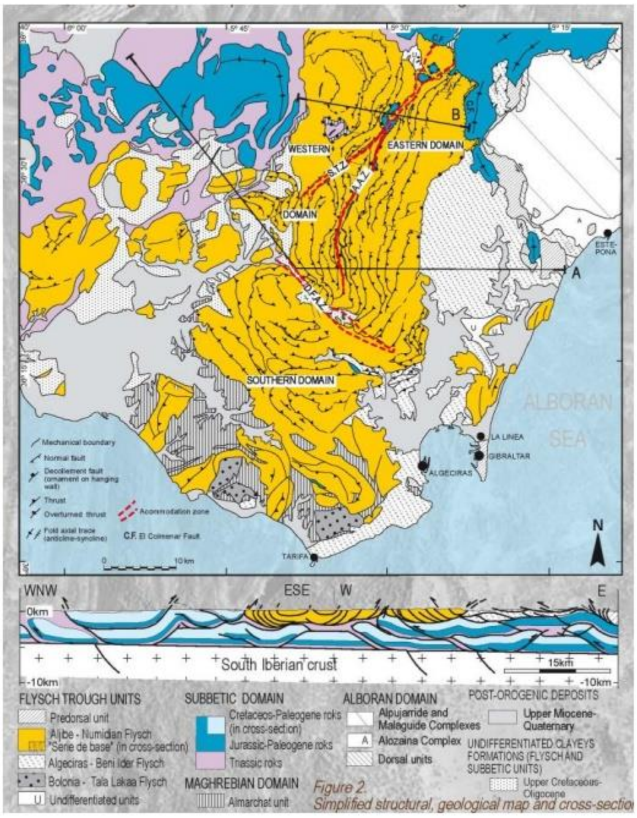

Figure 33. Geological map of Cadiz province. Source: Gutiérrez-Mas et al., Geología del Campo de Gibraltar.

In Zahara landing zone the pre-orogenic group is recognized, with the coastline that consists on alternating reliefs and lowlands. These give rise to the typical orography through capes, inlets and wide sandy ridges that form the beaches.

Torreguadiaro landing zone is characterized by the limit between Aljibe- Numidian flysch and post-orogenic deposits.

Barcelona branch of Medusa cable will cross the Valencia Trough, a sub-basin of the Mediterranean Sea considered as a SW prolongation of the Provençal Basin. It is floored by thinned continental crust covered by Mesozoic sedimentary deposits and displays younger syn-rift deposits indicating a SW rift propagation from southern France.

The geology of the Barcelona landing area is dominated by the presence of Besòs delta, which is located at the foot of the southern slope of the Serralada Litoral Catalana. This forms part of the NE-SW oriented set of coastal chains known as Catalanids. This mountain range is crossed by the Besòs river, leaving the Serra de Collserola to the southwest formed by paleozoic slates and the Marina mountain range formed by granites from the Paleozoic to the north-east. Then the river flows over a fluvio-deltaic plain formed by Pleistocene materials. Properly speaking, the delta corresponds to materials deposited by the Besòs river during the Holocene epoch, which goes from the last 10,000 years to the present, within the Quaternary period.

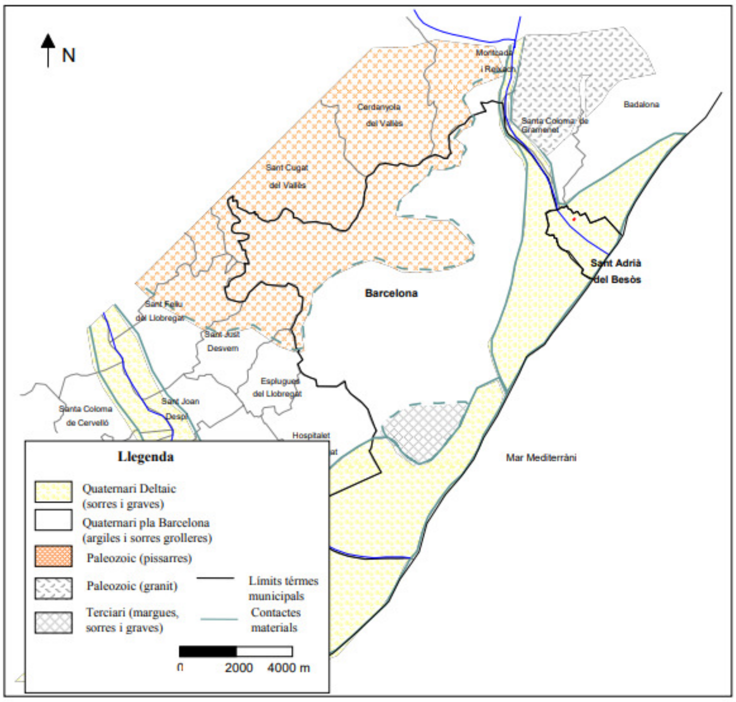

Figure 34. Geological map of Barcelona landing area. Source: Ondiviela, M., 2002.

1.5.1.2.4 France: Marseille landing

Marseille branches of Medusa cable will cross the Provençal sub-basin, which is floored by Neogene oceanic crust and opened in the Burdigalian. This rifting has induced the developments of graben inshore and offshore in France.

Geology of Marseille landing is mainly characterized by the presence of Oligocene materials, delimited at the SE with mainly Cretaceous (and minorly Jurassic) compact limestone that dominate the Marseilles coast of Calanques National Park.

During the latest Eocene and Early Oligocene, the E-W extension in the West-European platform led to the formation of the West-European rift system. During the Late Oligocene a second extensional phase was initiated as a result of the opening of the Liguro-Provençal back-arc basin. Oligocene-Early Miocene extensional phases were responsible for the reactivation of NNE-trending faults and for the formation of grabens such as the Marseille basins that is filled with thick continental to shallow-marine successions.

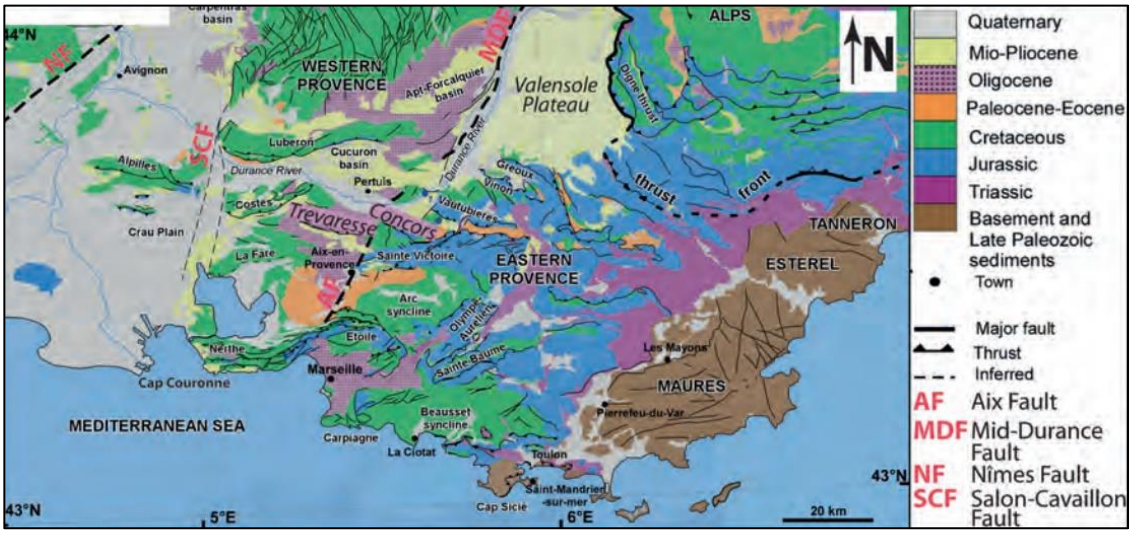

Figure 35. Geological map of Marseille area. Source: Fournier et al., 2016.

1.5.1.2.5 Italy: Mazara del Vallo landing

Mazara Branch of Medusa cable will lay on the Pelagian Shelf sub-basin,

The geology of Mazara area is the result of deformations that have interested the zone from Lower Miocene to Lower Pleistocene, with the formation of the actual chain derived from the deformation of the carbonatic platforms such as *Trapanese*, *Panormide* and partially *Saccende*, as well as silico-carbonatic deposits of *Sicano* basin and *Belice Valley* satellite basin.

Mazara del Vallo area is dominated by Late and Post-Alpine Orogeny marine and continental deposits, as well as Plio-Quaternary continental deposits. In particular, the landing point of Medusa subsea system is located in a zone of continental deposits which are categorized as Holocene deltaic, alluvial and coastal plain deposits, together with aeolian deposits from the same age. Then, in the proximity, there are also marine deposits from Pliocene-Pleistocene and locally up to Middle Miocene: the detrital and organogenic limestones, pelites, sands and conglomerates, locally terraced.

At the east of Mazara, Syn-Alpine Orogeny deposits are present (wedge top and undifferentiated wedge top deposits, as well as internal foredeep deposits.

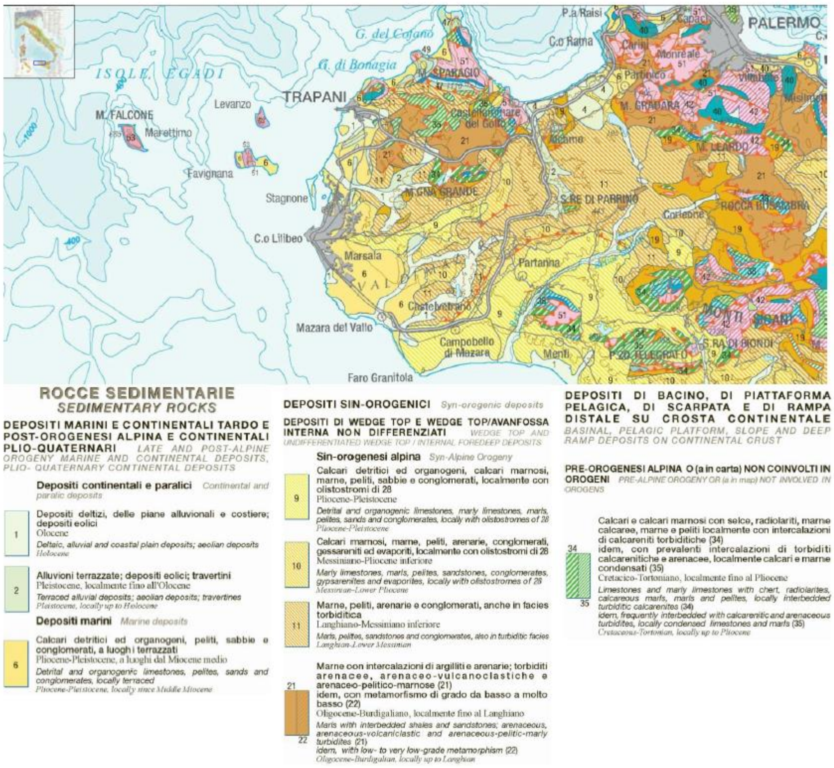

Figure 36. Geological map of Mazara area. Source: Italian Geological Service.

1.5.1.3 Geomorphology and seabed sediments

Study area: trunk of Medusa submarine system and branches.

1.5.1.3.1 Main trunk

The seabed morphology of the area of study is quite complex and represents an obstacle at the time of defining the optimal cable route.

The placement of submarine cables should avoid as far as possible the crossing of submarine canyons, as well as the laying along their axis, as they are characterized by strong slopes and are subjected to movements of large masses of sediments that can negatively affect the stability of the cables. Unfortunately, several submarine canyons are located in some areas of the main trunk of the Medusa system. That is at the continental margin of the East Atlantic Ocean, and the Alboran rift.

The submarine canyons (and marine gullies) of the Alboran rift are Al-Borani Canyon-Fan System, Piedra Escuela Canyon and Castor gullies (Vazquez et al.,2015). They are far away from the Medusa trunk.

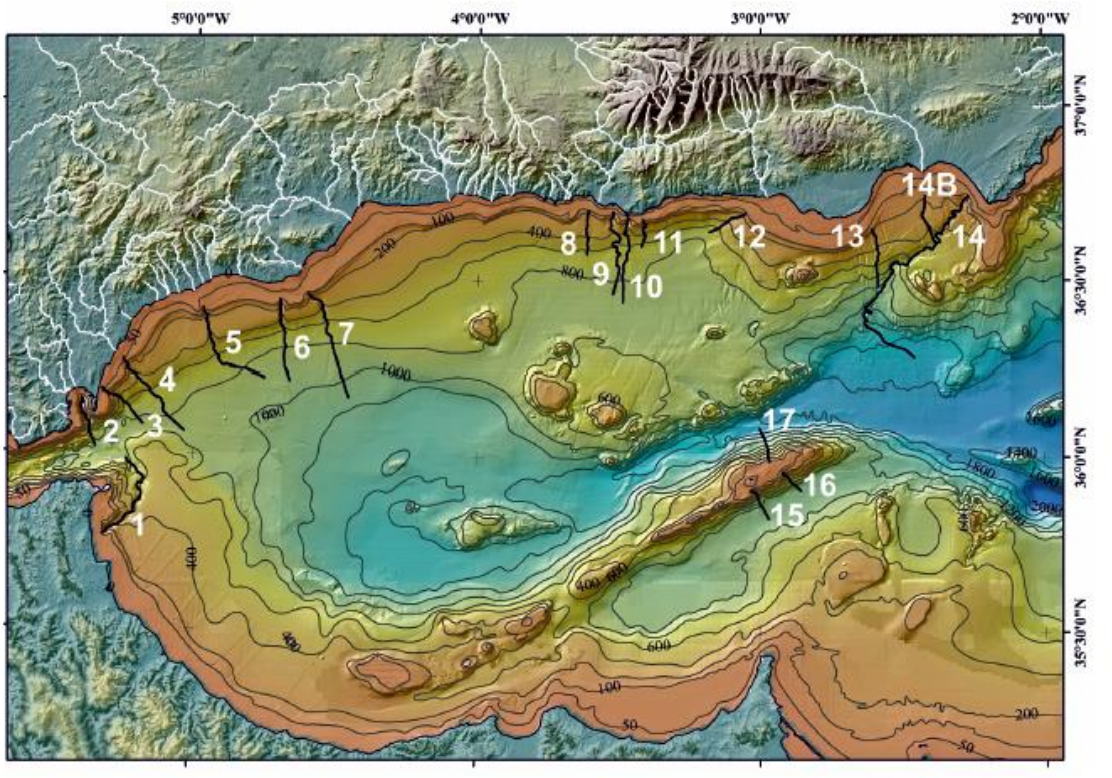

Figure 37. Location of Submarine Canyons and Gullies on the Alboran Sea margins and Northern Alboran Ridge. The fluvial drainage pattern is represented by white lines on the south-iberian onshore. 1, Ceuta Canyon; 2, Algeciras Canyon; 3, La Linea Canyon-Fan; 4, Guadiaro Canyon-Fan; 5, Banos Canyon-Fan (also called Placer de las Bovedas Canyon); 6, Torrenueva Canyon-Fan (also called Calahonda Canyon); 7, Fuengirola Canyon-Fan; 8, Salobrefia turbiditic ramp system; 9, Motril Canyon; 10, Carchuna Canyon; 11, Calahonda turbiditic system; 12, Adra Valley; 13, Campo de Dalias gullies; 14, Almeria turbiditic system; 15, Al-Borani Canyon-Fan System; 16, Piedra Escuela Canyon; 17, Castor gullies area. Source: Vazquez J.T., et al. (2015).

Then, when the main cable goes towards the Eastern Mediterranean basin, it passes next to several submarine canyons, such as Taulada, Spartivento and Bizerte canyons. The long Bizerte canyon cuts the channel northward between Sardinia and Tunisia, while its eastward branch reaches Rass Sidi el Mekki (Cape Farina, near Bizerte).

A strip of deeper water of approximately 96 km wide (200–1700 m deep) stretches in the middle of shallow Tunisian waters on one side and the banks of Sicily and Malta on the other side, linking the deeper waters of the two main western and eastern Mediterranean basins through this passage. In turn, this passage has narrower, deeper troughs and canyon-like grabens that may channel the deepest waters down to a 600-1700 m depth. The deepest water passages in the Sicilian Channel appear to link to the Bizerte Canyon and the Ustica trough in the Western basin, and to the Heron Valley in the Eastern basin.

The section of Medusa cable that runs through the Eastern Mediterranean Sea mainly lies in the abyssal plain. In the Eastern Mediterranean Sea only Calabria, Cyrenaica and Western Egypt continental slopes show significant canyon networks. The final stretch of the Medusa system (the Port Said landing of the cable, in Egypt) crosses the Egyptian passive margin, which is incised by 12 canyons: Damietta (a system with at least 7 branches), Rosetta (a system with at least 9 branches), Alexandria, Ras Alam er Rum, Solum, Habu Ashafa, etc.

Off the Nile delta, the Egyptian continental margin contains a unique and wide canyon, seen just at the mouth of the Rosetta branch of the Nile River. This canyon, the Rosetta canyon, feeds a complex turbidite and meandering channel system, through which most of the erosion products from the Nile drainage are dispersed into the deep abyssal plain.

Other seabed structures that should be avoided by submarine cables are seamounts. These are defined as geological structures that rise more than 1000 m from the surrounding sea bottom, without reaching the surface (https://oceanexplorer.noaa.gov/facts/seamounts.html). They usually have a volcanic origin. These structures are also considered a hotspot for biodiversity, providing also substrate where organisms can settle. Several seamounts are present in the area of the main trunk of Medusa system, in particular, in the Atlantic Ocean at the SW of Portugal (Ormonde, Gettysburg and Hirondelle II Seamounts) and in the Alboran Sea (El Mansour Seamount). Some seamounts are also present in the Pelagian platform, between Sicily and Tunisia.

Any of these seamounts has been considered during the planning of the preliminary route of the Medusa system and the cable has been maintained at a minimal security distance from these structures.

Submarine ridges are also present around the area of study, complicating the route of the Medusa system. The ridges located near the cable are the Gorridge ridge in the Atlantic Ocean and the

Alboran and the Yusuf ridges in the Alboran Sea. The preliminary route has been planned in order to avoid the highest slopes in the zone as far as possible.

Rocky and sandy banks are other submerged elevations of the seafloor; banks that are close enough to the surface becoming dangerous for shipping are named shoals. In the region of interest for the Medusa system, banks are present in the Alboran Sea (Dijibouti, Vile de Djibouti and Cabliers Banks), near the north Tunisian coast (Le Sec bank) and between Tunisia and Sicily (Le Sentinelle, Estafette and Sherki Banks; Talbot Shoal). The cable will lay next to some of these banks, without directly crossing them.

Finally, other geomorphological features of the seabed are submarine landslides, which are in particular located in the Alboran Sea in the case of the main trunk of Medusa system.

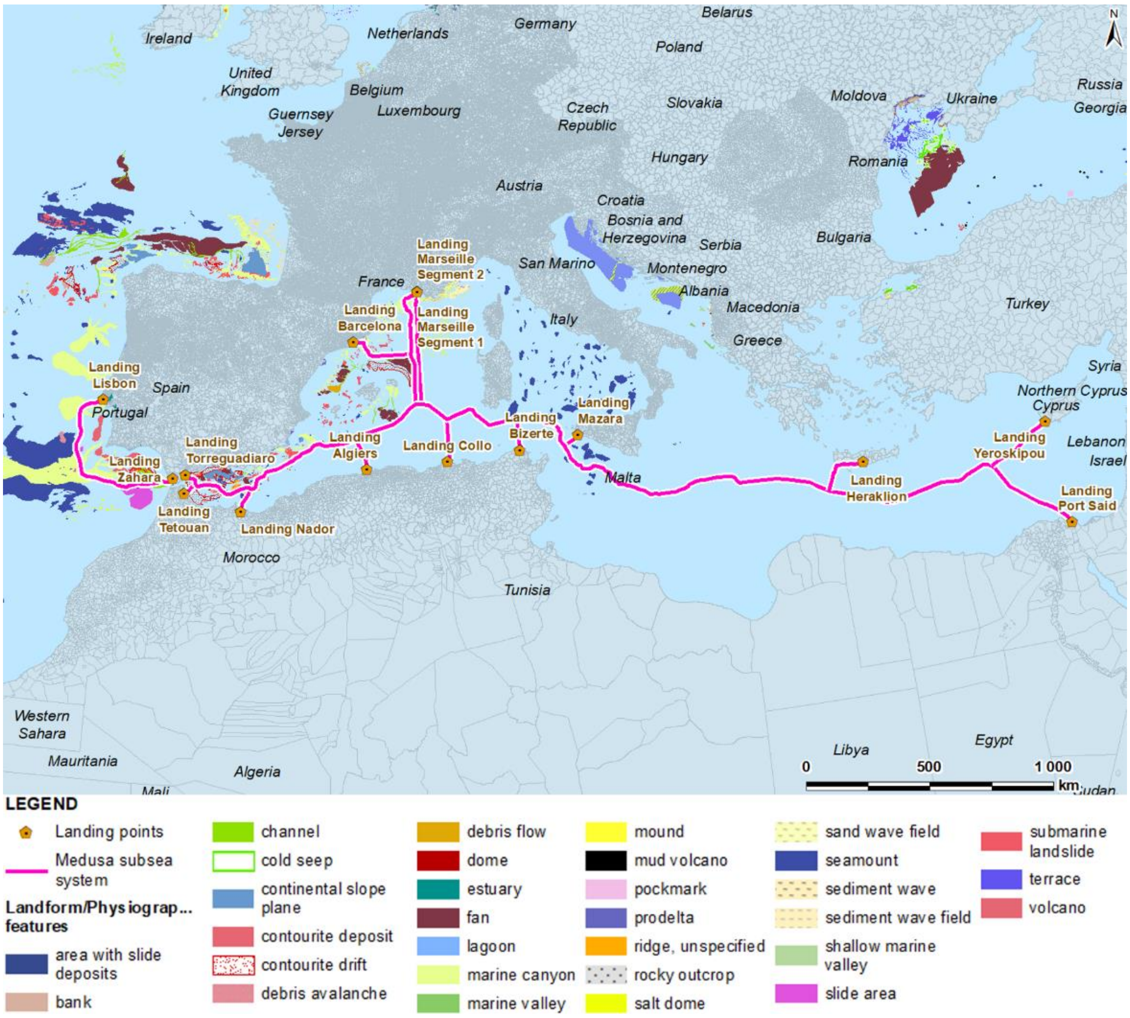

Figure 38. Seabed structures in the study area. Source: Elaborated with data from Emodnet Geology.

Concerning the typology of seabed materials, the Medusa system will lay on mud to muddy sand in most of its main trunk route, being these sediments the most common ones in the offshore areas. Some zone of rock and boulders are present offshore, in particular near the Gibraltar Strait and in the Alboran Sea.

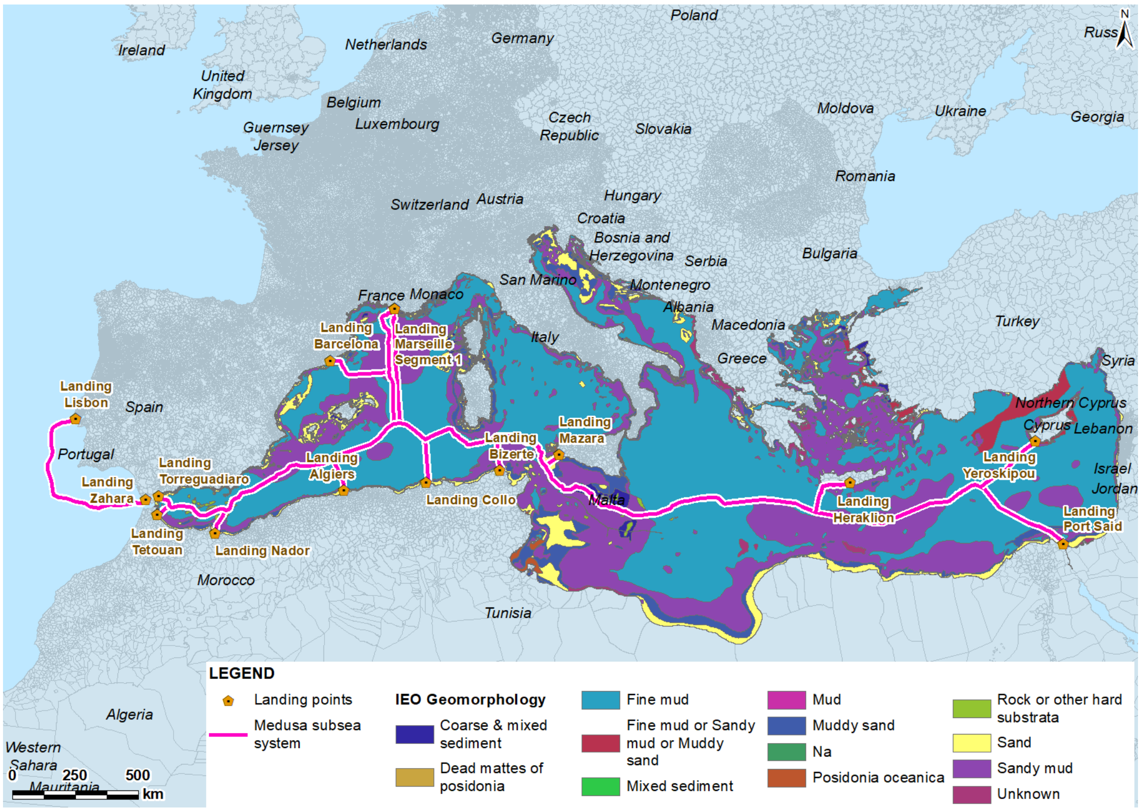

Figure 39. Seabed materials in the study area. Source: Elaborated with data from the Spanish Institute of Oceanography (IEO).

Data on the bottom sediments along the main trunk of Medusa system are not enough detailed to determine the most suitable seabed in each point of the preliminary route. It would be only with the pre-laying survey that the seabed geology can be effectively evaluated along the entire route of the cable. This means that the preliminary cable route proposed in this document can be modified and improved after survey data.

1.5.1.3.2 Portugal: Lisbon landing

In the proximity of Lisbon landing three submarine canyons are situated: Cascais canyon, Lisbon canyon and Setubal canyon. Thus, in this zone the planning of the cable route is complicated, as slopes are really strong.

Another critical point would be at the south of Portugal, where other 4 canyons are met. These are Sao Vicente, Portimao, Lagos and Faro canyons. However, in this area, south of Portugal, the Medusa route manly goes through the deepest zone, near the 4000 m deep, avoiding the biggest slopes of the canyons.

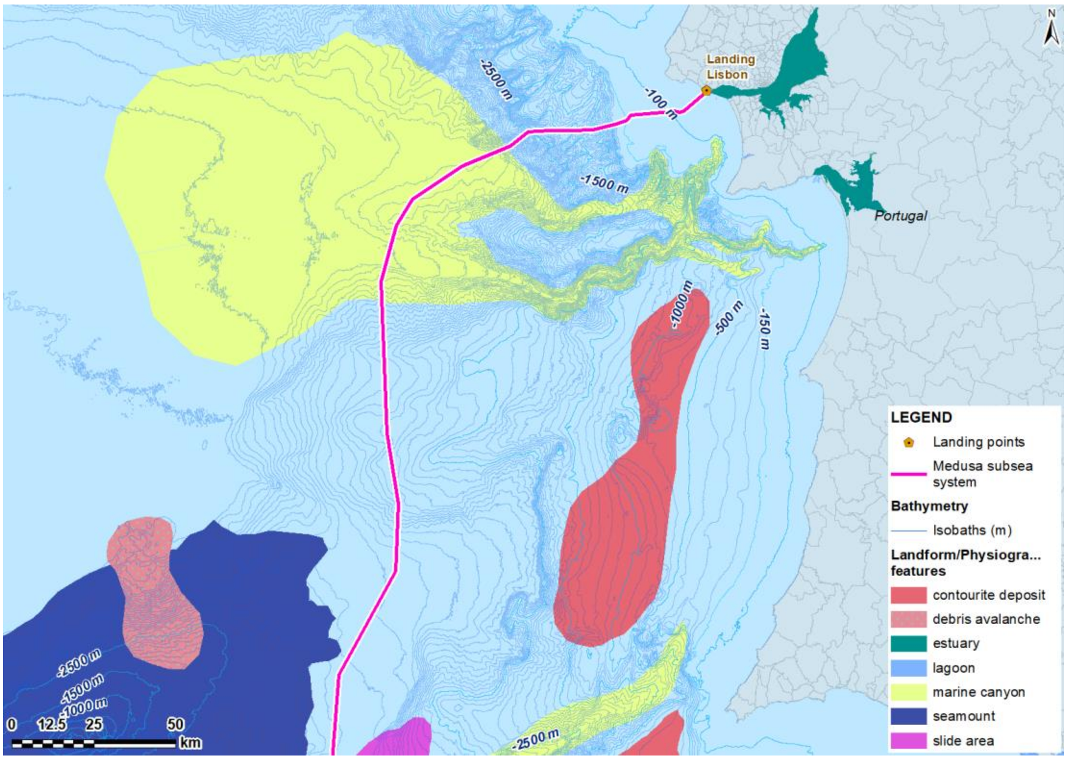

Figure 40. Seafloor geology at the south of Portugal. Source: Elaborated with data from Emodnet Geology.

In correspondence to Lisbon landing, sediments in the nearshore zone are mainly sandy (sand, muddy sand and sandy mud), with the presence of limited rock and other hard substrata. Then, at the distance of around 9 km from the coast, the sediments are manly composed by a 14 km-wide strip of fine muds. The next 14 km are again mainly muddy sand and sand, with also a zone of fine mud. Around 40 km distance from coastline, the abyssal mud is prevalent.

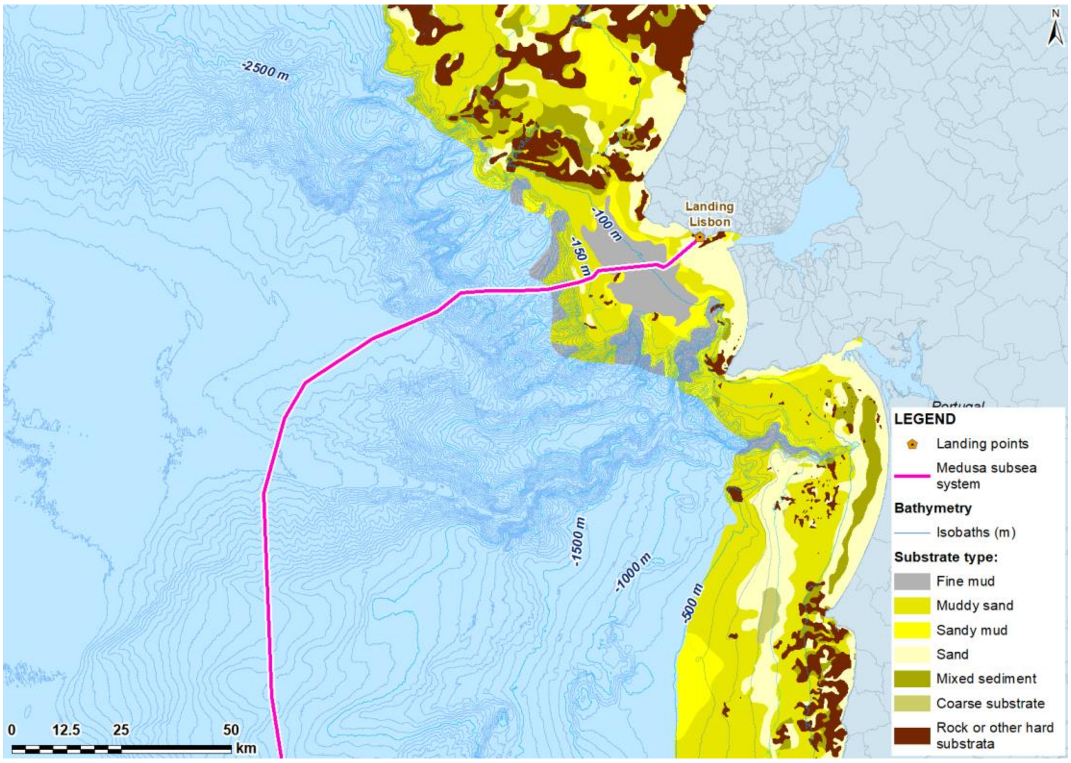

Figure 41. Substrate type at Lisbon landing. Source: Elaborated with data from Emodnet Geology.

1.5.1.3.1 Spain: Zahara, Torreguadiaro and Barcelona landings

At Zahara landing, sandy sediments prevail nearshore, while some zones of coarse sediments are recognized starting from about 14 km from the coast. On the contrary, the nearshore and offshore area at the SE of Zahara is dominated by rocks and boulders interposed to sandy areas. In the route of the cable, the rocky sediments are near to it only at about 20 km distance from the coastline. Offshore, starting from 95 km away from the coast, the type of sediment that dominates on the seafloor is fine mud.

In the proximity of Torreguadiaro landing the following canyons are located: Algeciras Canyon, La Linea Canyon, Guadiaro Canyon-Fan and Bañons Canyon-Fan. The nearest submarine canyon, and therefore the one that can interfere more with the Medusa system, is Guadiaro Canyon. The Medusa system is planned to lay at least at 400 m distance or more from this canyon, in order to reduce the possible influence. The highest proximity of the cable is in the zone of the head of the cable.

Torreguadiaro landing seems to be characterized by a sandy band in the first 3.5 km and from about 16.5 km away from the coast, along 26 km approximately. Near the coast there are two more bands, a rocky band (at 4 km distance from coastline) and fine mud band (at 5.5 km), the second with a considerable width (around 10 km). About 43 km (around 900 m deep) the seabed is mainly fine mud.

Actually, the distribution of rocky bottom in Torreguadiaro area seems to have some differences with respect to what indicated by data EMODNET geology. A sonar survey conducted in the area by Tecnoambiente in 2013 has showed as rocky outcrops are more irregular in the zone and only partially characterize the supposed rocky band.

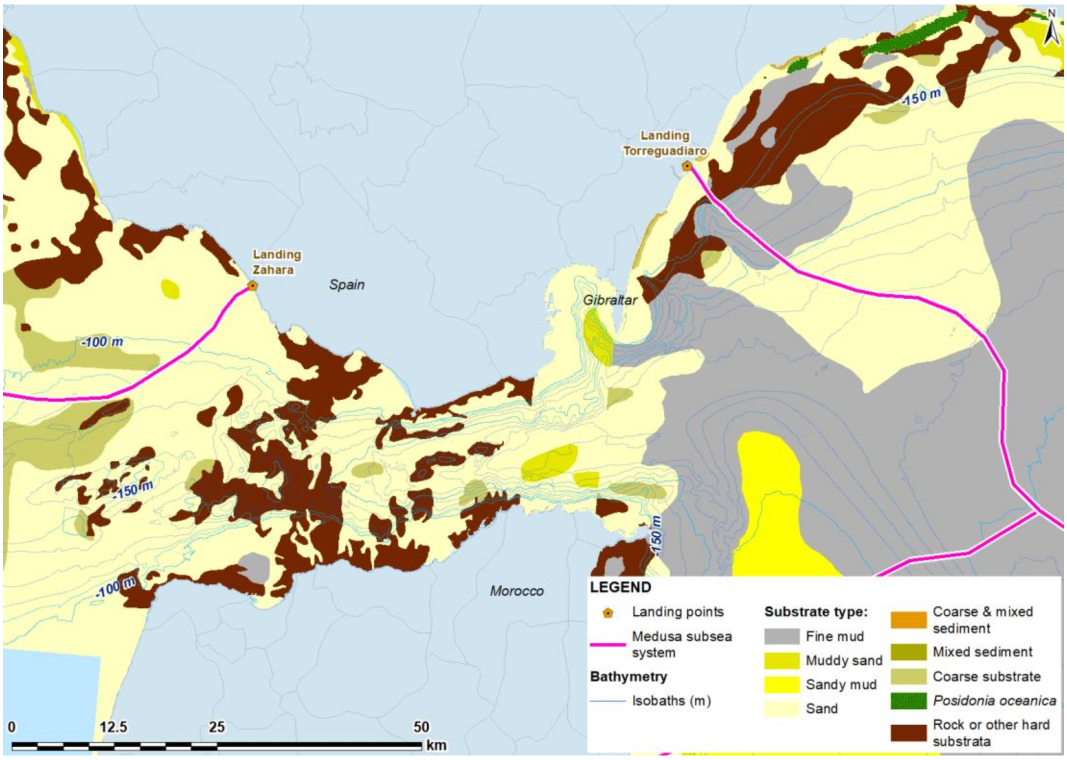

Figure 42. Substrate type at Zahara and Torreguadiaro landings. Source: Elaborated with data from Emodnet Geology.

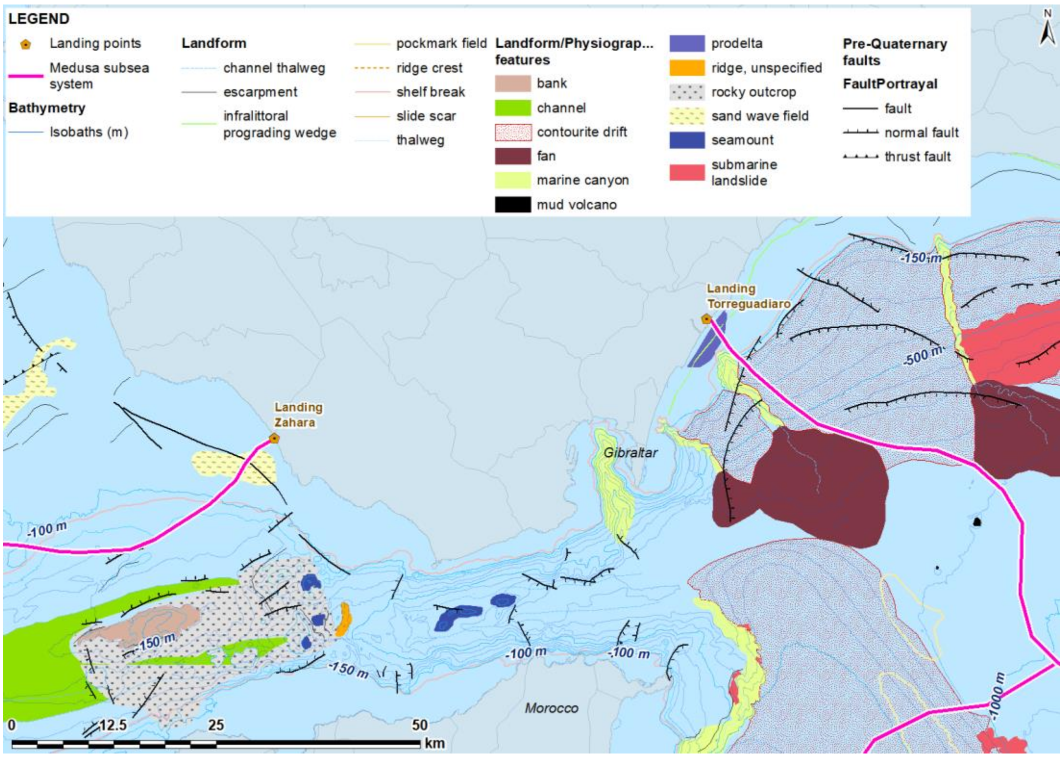

Figure 43. Seafloor geology at Zahara and Torreguadiaro landings. Source: Elaborated with data from Emodnet Geology.

In the proximity of Barcelona landing many canyons are located: Mataró, Blanes, Morrás, Besòs and Arenys Canyons. The route of Medusa system has been planned to cross the ridge located between Mataró and Blanes canyons, in order to minimize the interference with these submarine structures. Barcelona branch passes also near some seamounts (Spartacus and Brutus Hills), but their crossing has been accurately avoided during the planning of the cable route.

In Barcelona landing area, the bottom is mainly featured by the presence of muddy sediments (fine mud and muddy sand), which starts at only 1 km or less from the coastline. In the first 1 km from the coast and at a distance between 5 and 10 km, there is also present a band of sandy sediments (sand and muddy sand). Just a few meters away from the coast that runs from Badalona to Calella *P. oceanica* meadows may be present. These will not be crossed by the planned cable route according to available data. Between 30 and 40 km from the coast, the bottom is finally dominated by abyssal mud (fine mud and sandy mud).

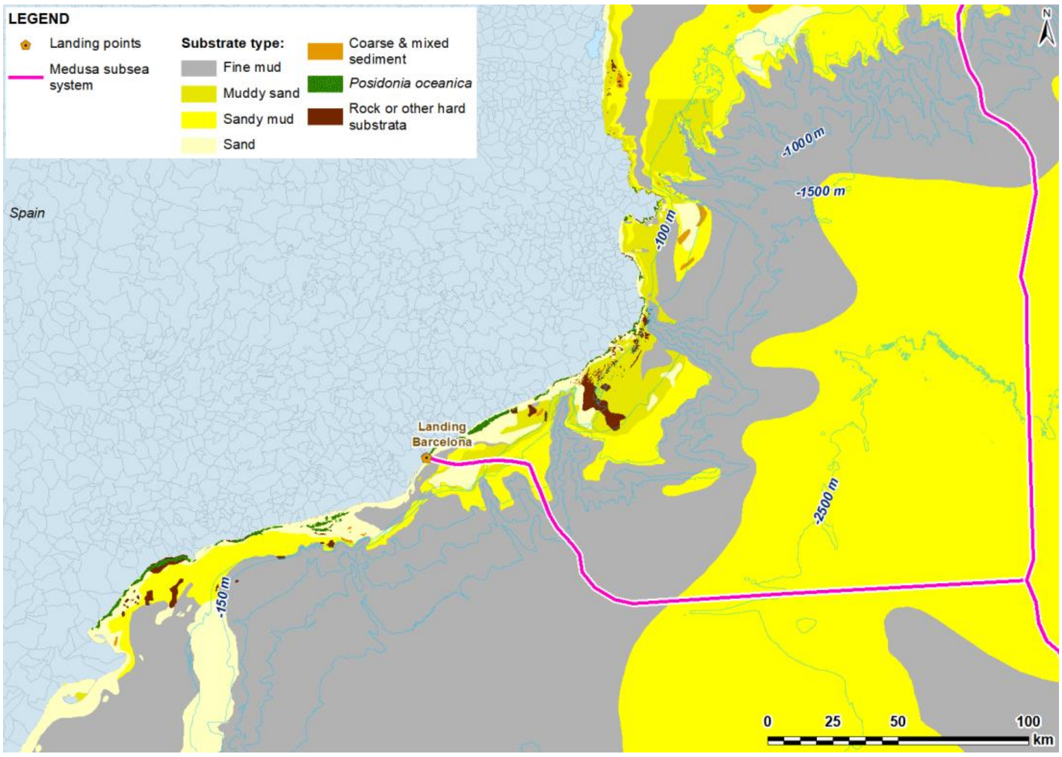

Figure 44. Substrate type at Barcelona landing. Source: Elaborated with data from Emodnet Geology.

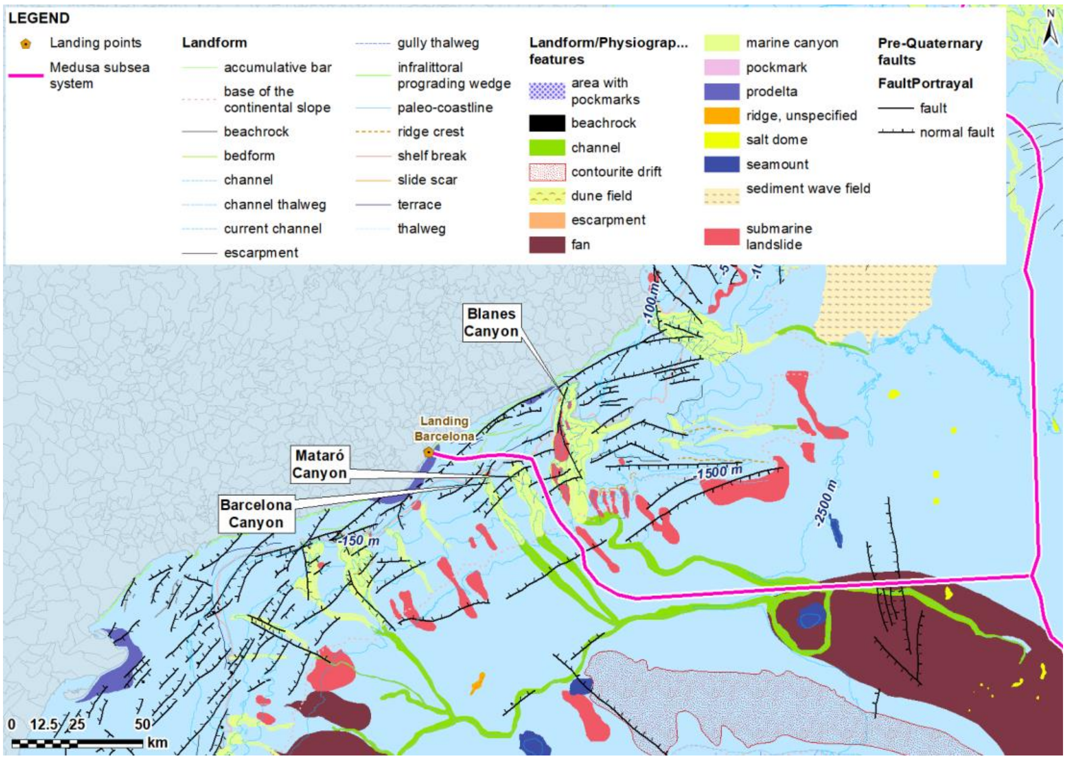

Figure 45. Seafloor geology at Barcelona branch. Source: Elaborated with data from Emodnet Geology.

1.5.1.3.1 France: Marseille landing

In Marseille zone, three main submarine canyons are located: Cassis, Marseille and Gran Rhône canyons. As in the other cases, the preliminary route of the branches has been planned in order to minimize their crossing and therefore reduce the high slopes of the cable as far as possible.

Marseille branches pass also near a seamount (Renaixença Hills), but its crossing has been accurately avoided during the planning of the cable route.

In Marseille, near the coastline the sediments are sand and muddy sand, and zones of coarse and mixed sediments are present too. Between 0.5 and 1 km from the coastline the sediment is manly composed by coarse and mixed sediments with some spots of *P. oceanica* meadows and, behind these, there are a dead matters of *P. oceanica* band. Around 2 km away from coast, the seabed is manly characterized by muddy sand. However, there is a large patch of coarse sediments extending in front of the south of the city of Marseille. The coarse sediments patch is located starting from a distance of 4 km from the shore and will be present in particular along the route of segment 1, for about 17 km. Once this patch ends, segment 1 will cross other 50 km of sandy mud, as the cable here assumes a general E-W direction. On the contrary, segment 2 will lay only for 1 km on coarse and mixed sediments, crossing then muddy sand for 15 km and sandy mud for 1 km.

The seabed of the northern half of the Marseille city as well as the bottom beyond the 200 m depth is manly composed by fine mud and sandy mud.

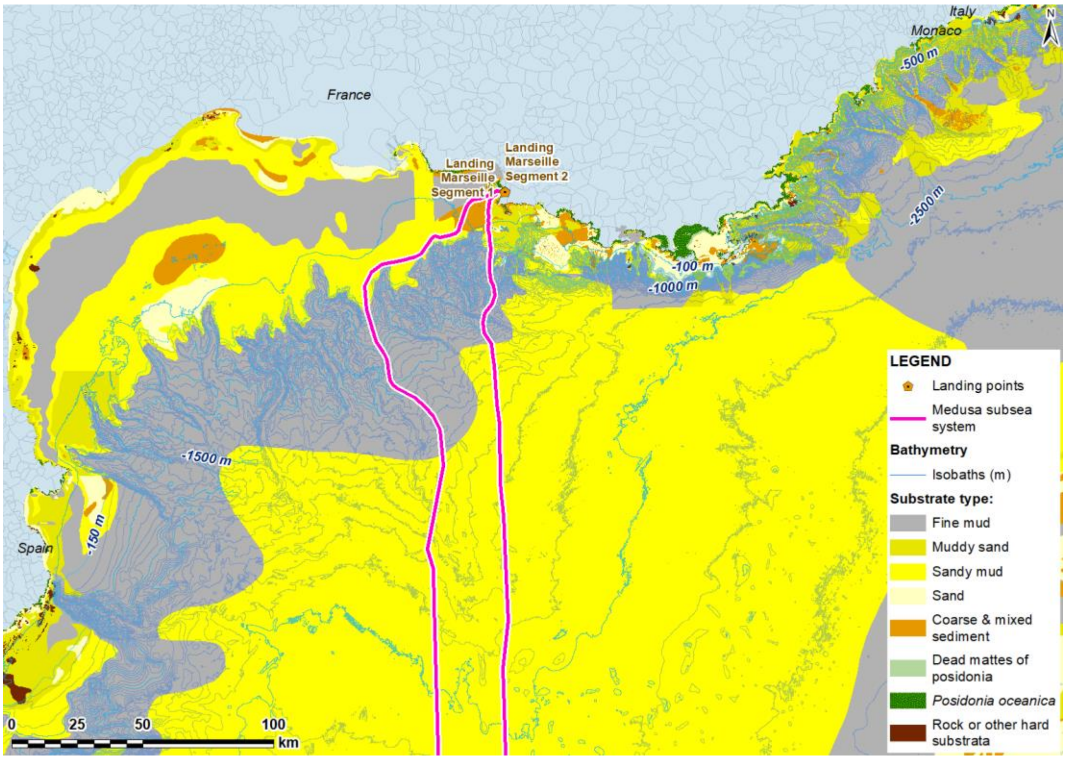

Figure 46. Substrate type at Marseille landing. Source: Elaborated with data from Emodnet Geology.

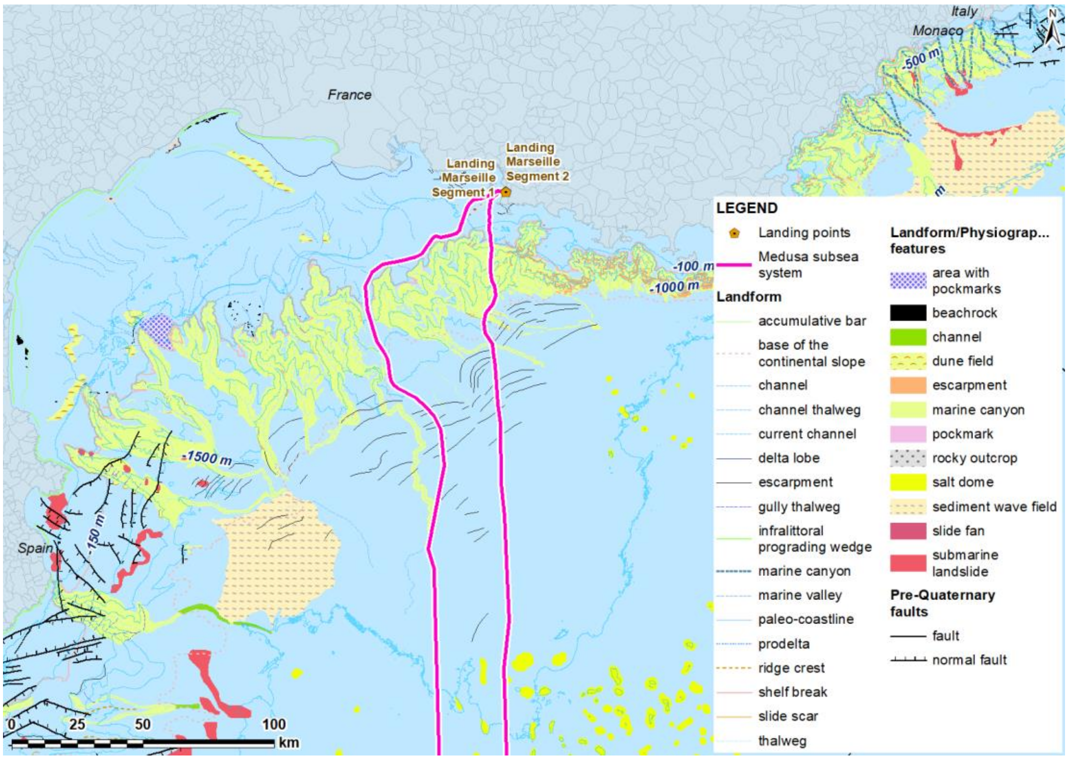

Figure 47. Seafloor geology at Marseille landing. Source: Elaborated with data from Emodnet Geology.

1.5.1.3.2 Italy: Mazara del Vallo landing

In Mazara del Vallo landing, there are no submarine canyons nearby, but some volcanic banks. These volcanic banks are located in the Adventure Plateau and are Tetide, Anfitiitre, Galatea, Ferdinandea and Cimotoe. Close to this landing there are too sedimentary banks like Nereo, Panope and Pantelleira Vecchia. All of these submarine structures are shown in the next figure. The preliminary route in this landing has been planned in order to avoid crossing these banks and keep a depth as constant as possible.

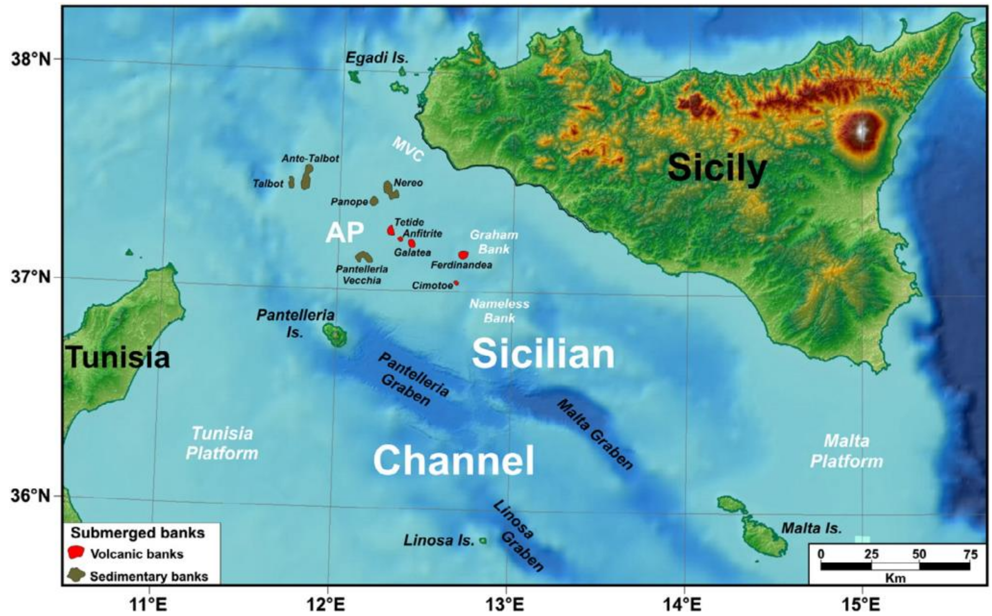

Figure 48. Morpho-bathymetric map of the Sicilian Channel and surrounding regions. AP: Adventure Plateau; MVC: Mazara del Vallo Channel. system. Source: Civile, D., et al. (2015).

At Mazara del Vallo, bottom sediments are mainly sand. The nearshore, from coastline to 3.5 km away seems to be covered by *Posidonia oceanica*, at the east of the landing site. This marine phanerogam plants form a continuous band, extending from Capo Granittola lighthouse to the locality of San Vito Lo Capo. There is also a small area where the bottom is covered by dead matters of Posidonia. Near to the Medusa cable, but without interfering with the route, there is a rock substratum, located behind the *P. oceanica* bed. At higher distance from the coast, the seafloor is sandy.

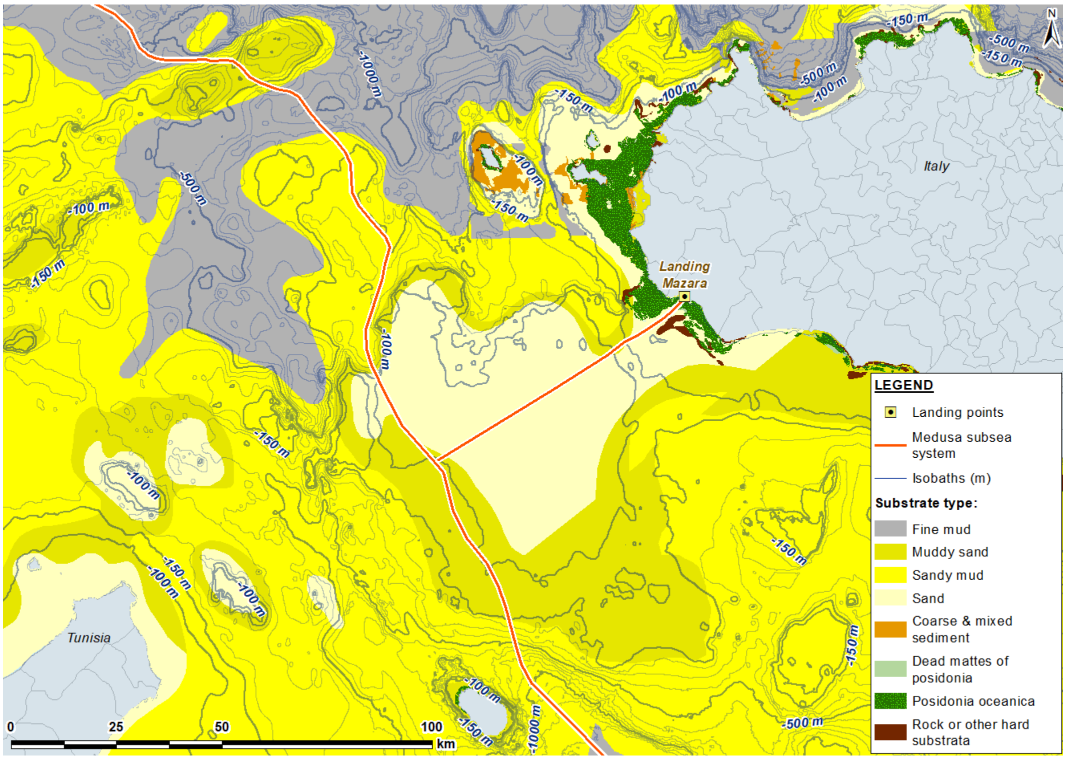

Figure 49. Substrate type at Mazara branch. Source: Elaborated with data from Emodnet Geology.

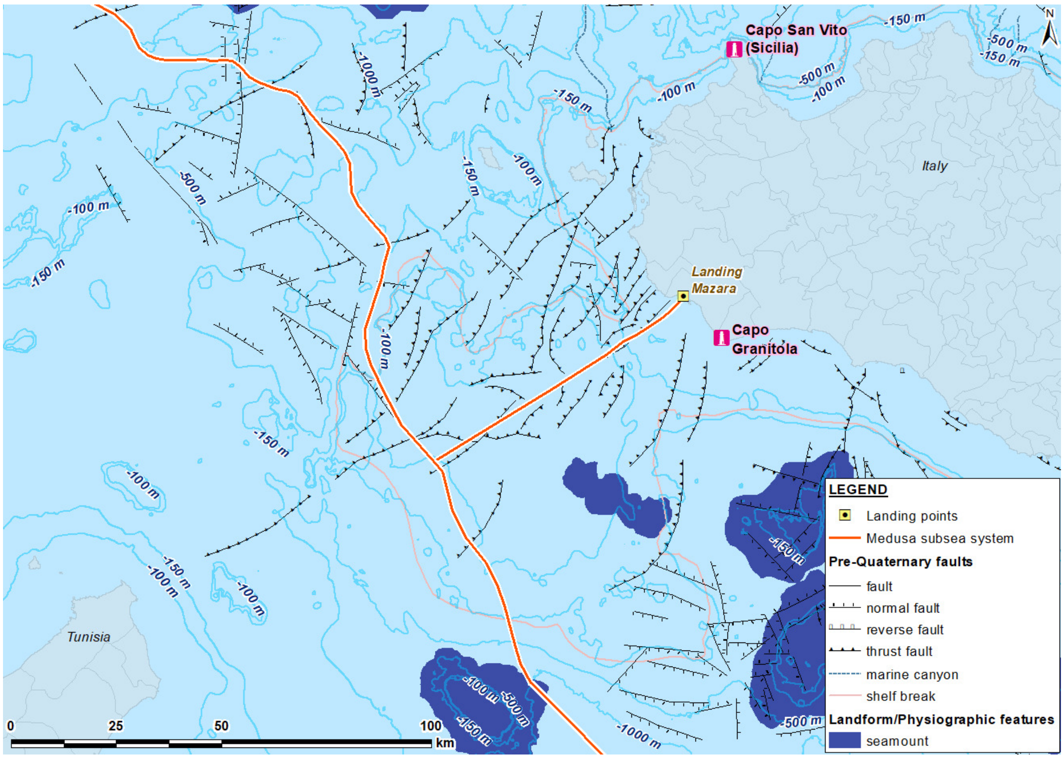

Figure 50. Seafloor geology at Mazara branch. Source: Elaborated with data from Emodnet Geology.

1.5.1.4 Climate and Weather Parameters

Study area: Mediterranean Sea and landing sites.

1.5.1.4.1 Main trunk

The study area is characterized by a Mediterranean climate, with hot, dry summers and mild, relatively wet winters. During the summer, the presence of subtropical, high-pressure cells prevents rainfall, as dry sinking air covers the marine layer. These high-pressure dissipate during winter, when the polar jet stream moves to the south and bring storms and wetness.

Some differences in the climate throughout the basin can be found, in particular in relation to the mean rainfall, which can vary from 300 to more than 1500 mm depending on the zone and the year. In addition, summer droughts can have a very different duration, ranging from 2 to about 5 months.

On the Mediterranean Sea, tropical-like storms or Medicanes with a surrounding asymmetric cloud and a clear eye develop only occasionally. These storms do not reach the intensity of tropical hurricane but represent a threat to vessel and coastal communities. In the period between 1948 and 2014 approximately 100 of these storms have been recorded (Luque et al., 2007). Medicanes can affect both the European Coast and the North African Coast of the Mediterranean Sea.

The Western Mediterranean also experiences the Cold Drop phenomena, which usually occurs during autumn and mainly affect the Spanish Eastern Coast and Balearic Islands. This storm is related to a sudden cooling of the upper jet stream overseas, warmed by the summer. The Cold Drop can bring rainfall of more than 500 L/m^2 in a very short period and winds with a speed up to 150 km/h.

In the Eastern Mediterranean, the extratropical cyclone Cyrus Low is responsible for about 90% of the annual rainfall. The second most frequent cold front of mid-latitude cyclones is the Syrian Low which produces major floods over the southern part of the region. Both synoptic-scale cyclone types occur in winter, being December-January-February the rainy season (Dayan et al., 2015).

1.5.1.4.2 Portugal: Lisbon landing

Historical data from https://en.climate-data.org/ (period 1991-2021) for the city of Lisbon show monthly mean temperatures between 11.5ºC in January and 22.4ºC in August. Maximum mean temperatures varied from 13.7ºC in January to 26.9ºC in August, while minimum mean temperatures were 9.4ºC and 19ºC in January and August, respectively. Lisbon is clearly characterized by a rainy season in the period October-January, with medium values of rainfall between 73 and 87 mm and a very dry season in July and August (3 and 5 mm of rain, respectively). The other months are characterized by medium rainfall (12-58 mm).

Month	T (ºC)	TM (ºC)	Tm (ºC)	R (mm)
January	11.5	13.7	9.4	73
February	11.8	14.4	9.5	55
March	13.5	16.5	11	58
April	15.2	18.3	12.6	56
May	17.6	21.1	14.7	45
June	20.3	24.3	17.1	12
July	21.6	25.9	18.3	3
August	22.4	26.9	19	5
September	21.2	25.1	18.3	30
October	18.7	21.7	16.4	84
November	14.6	17	12.6	87
December	12.3	14.6	10.3	83

Table 7. Historical data of climate during 1991-2021 for the city of Lisbon. From climate data.org. T = mean temperature; TM = mean maximum temperature; Tm = mean minimum temperature; R = mean rainfall.

1.5.1.4.3 Spain: Zahara, Torreguadiaro and Barcelona landings

In the case of Zahara landing, historical data for the period 1991-2021 (https://en.climate-data.org/) for the town of Tarifa are used in this report. Monthly mean temperatures vary between 12ºC in January and 23.8ºC in August. Maximum mean temperatures varied from 14.4ºC in January to 27.7ºC in August, while minimum mean temperatures were 9.8ºC and 20.7ºC in January and August, respectively. Rainfall is concentrated between October and March, with values in the range of 75-114 mm. During April and September rainfall has medium values, while it is very scarce between June and August, with values in the range of 1-5 mm.

Month	T (ºC)	TM (ºC)	Tm (ºC)	R (mm)
January	12	14.4	9.8	90
February	12.1	14.6	9.9	79
March	13.5	16.2	11.1	75
April	15	17.9	12.5	57
May	17.6	20.9	14.9	28
June	21	24.7	17.9	5
July	23.3	27.5	19.9	1
August	23.8	27.7	20.7	5

September	21.6	24.8	19.3	35
October	18.9	21.5	16.8	81
November	15	17.2	13	96
December	13.1	15.2	11.2	114

Table 8. Historical data of climate during 1991-2021 for the town of Tarifa. From climate data.org.

With respect to Torreguadiaro, historical data (period 1991-2021) for the town of San Roque are used (https://en.climate-data.org/). The data show monthly mean temperatures between 12.1ºC in January and 24.3ºC in August. Maximum mean temperatures varied from 14.6ºC in January to 27.9ºC in August, while minimum mean temperatures were 9.8ºC and 21.3ºC in January and August, respectively. As in the case of Zahara, Torreguadiaro is clearly characterized by a rainy season in the period October-March, with medium values of rainfall between 81 and 126 mm. The wettest month is December, while the driest are June, July and August.

Month	T (ºC)	TM (ºC)	Tm (ºC)	R (mm)
January	12.1	14.6	9.8	93
February	12.3	14.9	9.9	81
March	13.7	16.5	11.2	85
April	15.3	18.2	12.6	68
May	18	21.1	15.1	34
June	21.4	24.9	18.3	7
July	23.9	27.8	20.5	2
August	24.3	27.9	21.3	6
September	21.9	24.9	19.6	38
October	19.1	21.5	17	92
November	15.1	17.3	13	101
December	13.2	15.3	11.1	126

Table 9. Historical data of climate during 1991-2021 for the town of San Roque. From climate data.org.

Historical data (period 1991-2021) for the town of Barcelona (https://en.climate-data.org/) show monthly mean temperatures between 7.9ºC in January and 23.9ºC in August. Maximum mean temperatures varied from 12.3ºC in January and 27.6ºC in July-August, while minimum mean temperatures were 4ºC and 20.2ºC in January and August respectively. Therefore, the coldest month is January while the warmest are July and August. Rainfall varies from a mean value of 27 mm for the month of July to a mean value of 94 mm in October.

Month	T (ºC)	TM (ºC)	Tm (ºC)	R (mm)
January	7.9	12.3	4	39

February	8.5	12.9	4.3	39
March	10.9	15.5	6.5	43
April	13.5	17.6	9.1	54
May	17	20.9	12.7	48
June	21.3	25.3	17	37
July	23.8	27.6	19.8	27
August	23.9	27.6	20.2	43
September	20.9	24.2	17.5	82
October	17.4	20.7	14.2	94
November	12.1	15.9	8.5	64
December	8.6	12.9	5	44

Table 10. Historical data of climate during 1991-2021 for Barcelona. From climate data.org.

1.5.1.4.4 France: Marseille landing

Historical data (1991-2021) from https://en.climate-data.org/ for the city of Marseille show mean temperatures between 7.3ºC and 23.5ºC in January and July, respectively. Maximum mean temperatures vary from 10.3ºC in January to 27.3ºC in July and August, while minimum mean temperatures are 4.2ºC and 19.5ºC in February and August, respectively. The coldest month in Marseille is January-February while the warmest are July and August. Rainfall in Marseille varies from a mean value of 10 mm for the month of July to a mean value of 96 mm in November.

Month	T (ºC)	TM (ºC)	Tm (ºC)	R (mm)
January	7.3	10.3	4.6	61
February	7.4	10.9	4.2	44
March	10.3	14	6.7	39
April	13.3	16.8	9.6	60
May	16.9	20.4	13.1	42
June	21.2	24.9	17.2	21
July	23.5	27.3	19.4	10
August	23.4	27.3	19.5	14
September	19.9	23.6	16.4	66
October	16.4	19.5	13.4	89
November	11.4	14.3	8.9	96
December	8.3	11.3	5.7	60

Table 11. Historical data of climate during 1991-2021 for the city of Marseille. From climate data.org.

1.5.1.4.5 Italy: Mazara del Vallo landing

Historical data from https://en.climate-data.org/ (period 1991-2021) for the town of Mazara del Vallo show monthly mean temperatures between 11.5ºC in February and 26.2ºC in August. Maximum mean temperatures varied from 13.7ºC in February to 29.7ºC in August, while minimum mean temperatures were 9.2ºC and 22.7ºC in February and August, respectively. The coldest months are January and February while the hottest is August. Rainfall is concentrated between October and March, with values in the range of 52-82 mm. During April and September rainfall has medium values, while it is very scarce between June and August, with values in the range of 2-7 mm.

Month	T (ºC)	TM (ºC)	Tm (ºC)	R (mm)
January	11.7	13.8	9.6	72
February	11.5	13.7	9.2	67
March	13.2	15.7	10.7	52
April	15.4	18.2	12.5	45
May	18.7	21.8	15.6	22
June	22.8	26.2	19.1	5
July	25.7	29.1	21.9	2
August	26.2	29.7	22.7	7
September	23.3	26.1	20.6	44
October	20.2	22.8	17.8	81
November	16.5	18.5	14.4	82
December	13.2	15.1	11.2	75

Table 12. Historical data of climate during 1991-2021 for the town of Mazara del Vallo. From climate data.org.

1.5.1.5 Water resources

This section presents the main water resources in the landing areas, including rivers, lagoons, streams and groundwater water resources.

Surface water resources are explained in the subsections of each landing, as a local scale is required to be able to correctly identify such resources.

For groundwater water resources, World-wide Hydrogeological Mapping and Assessment Programme (WHYMAP) has been consulted. In the following figure, it can be seen the cartographic layer of Groundwater resources and recharge (mm/a) of the WHYMAP in the Mediterranean zone. The countries around the Mediterranean Sea and nearby, like Portugal, have groundwater resources formed by major basins (North African countries), complex hydrogeological structures (in areas around the Mediterranean Sea) and local and shallow aquifers (countries close to the Atlantic Ocean and some parts of North Africa).

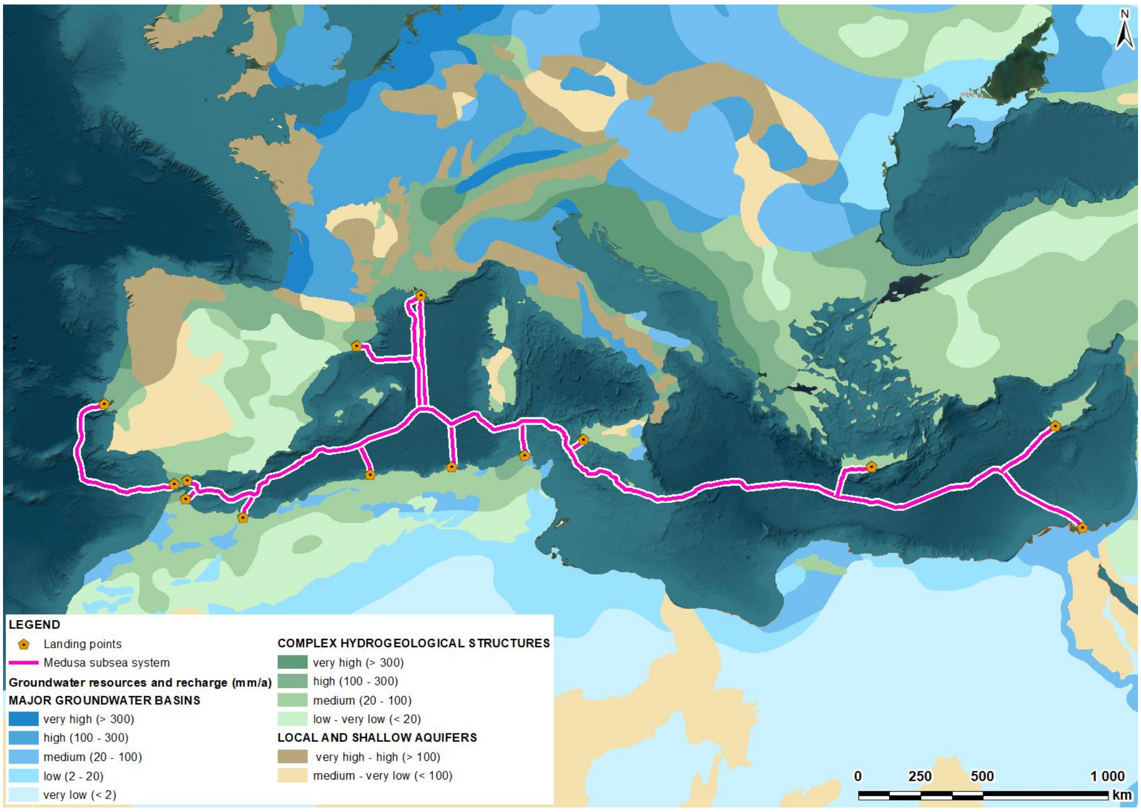

Figure 51. Types of groundwater resources and their recharge (mm/a) in the Mediterranean area. Source: WHYMAP.

The majority of the landing areas of Medusa system considered in this document are characterized by complex hydrological structures, except for Port Said landing in Egypt, where groundwater resources come from a major groundwater basin.

Concerning the values of the groundwater recharge, the landings in Portugal (Lisbon), Spain (Zahara, Torreguadiaro and Barcelona), France (Marseille), Morocco (Tetouan), Tunisia (Bizerte) have a high capacity to recharge their resources, around 100 and 300 mm/a. In Italy (Mazara del Vallo), Morocco (Nador) and Algeria (Algiers and Collo) and Egypt the capacity of recharge is medium (around 20 and 100 mm/a).

WHYMAP's cartographic information also shows that the landing of Medusa system in Egypt corresponds to an area with saline groundwater, with a Total Dissolved Solids (TDS) > 5 g/l.

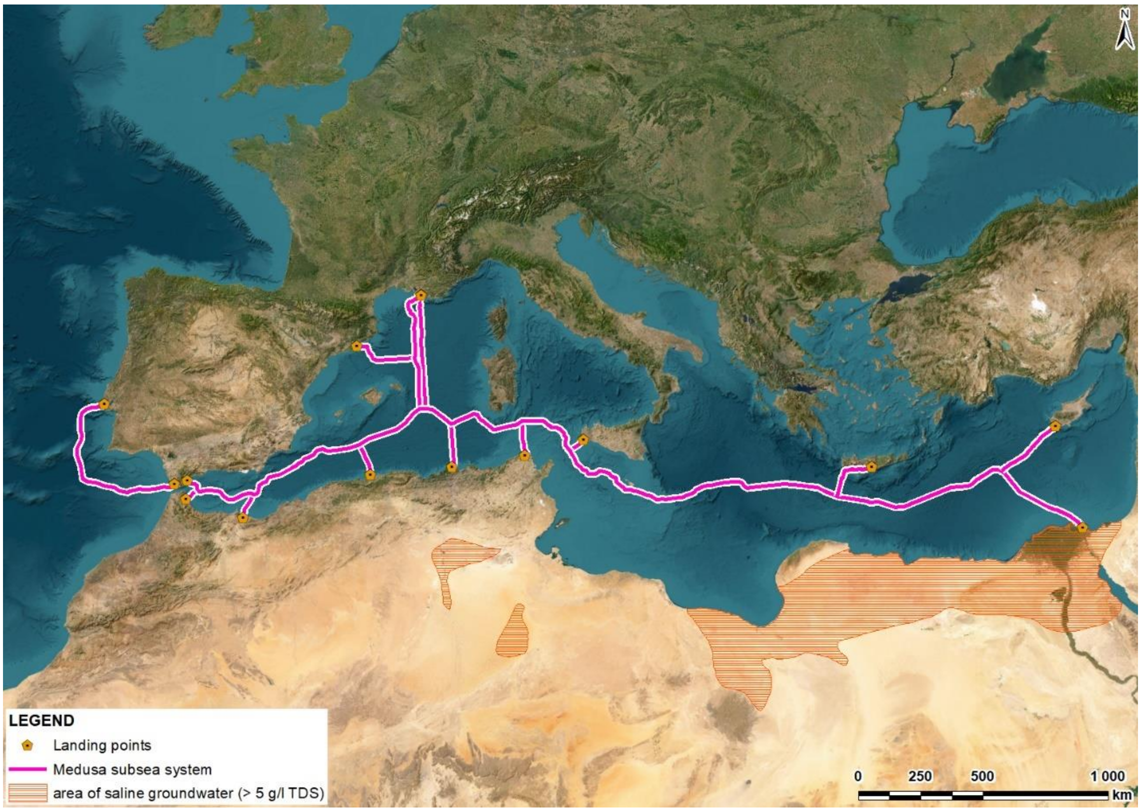

Figure 52. Areas of saline groundwater (> 5 g/l TDS). Source: WHYMAP.

1.5.1.5.1 Portugal: Lisbon landing

The main river located close to the landing areas in Lisbon is the Tajo River, which flows into the city of Lisbon. The Lisbon landing of Medusa system is located right next to this river's mouth.

1.5.1.5.2 Spain: Zahara, Torreguadiaro and Barcelona landings

In the area of Zahara landing, there is a hydrography network formed by several streams that connect and form the Cachón River. This river is the most important superficial water resource in this area, and it passes through Zahara de los Atunes village to the sea, at the NE of the landing point. Some of the streams that formed this river are: Acebuchal, Candalar, La Zarzuela, La Calera, Pozo de los Pilancones, Los Horquillos, etc. In the area of Zahara landing there are also small streams that are very short-lived and flow directly into the ocean: Moral O Abejera stream, Agua del Enmedio stream, and a few others with no name.

The closest surface water resources to the landing point are Cachón river (1.2 km) and a small stream that flows into de the sea (1.3 km).

In Torreguadiaro the mainly surface water resource is the Guadiaro River, that flows into the Mediterranean Sea at approximately 1.6 km from the Medusa cable landing point. Also, there is a stream network that flows into small lagoons and Sotogrande harbor, at the south of the landing point.

One of the closest hydrological resources to the landing point is the La Charca lagoon (around 400 m, south of the landing).

For the Barcelona landing site (Sant Adrià del Besòs), there is only one superficial water resource, the Besòs River. The Medusa landing point is very close to the mouth’s river, a little more than 200 m away. Other superficial water resources in this area are quite far, more than 15 km, as for example the Llobregat River.

1.5.1.5.3 France: Marseille landing

In the Marseille landing, the closest surface water resource is the Huveaune River. The landing point is located 1 km away from this river’s mouth. Apart from this river, there is the Marseille Canal, but is 1.5 km away from the landing point.

1.5.1.5.4 Italy: Mazara del Vallo landing

In Mazara del Vallo landing, the closest surface water resource is the Mazaro River, that flows across the city. The landing point is located 1.7 km away from this river’s mouth. Apart from this river, there are no other superficial water resource close to this area.

1.5.1.6 Oceanography

<u>Study area:</u> Mediterranean Sea and landing sites.

In the following subsections tides and currents are described at a general level for the main trunk of Medusa system, while detailed data of wind and waves are presented for landing sites.

For the characterization of wind and waves, the data available on the Spanish Port Authority website have been used for all the landing sites except for Mazara del Vallo, for which other sources have been used. The data presented hereafter are SIMAR data, that is temporal sequences of wind and wave parameters obtained through numerical modelling. SIMAR points cover a high portion of the western Mediterranean Sea and the Eastern Atlantic Ocean (Spain, Portugal, Morocco, France, Algeria, Tunisia), but do not reach the zone of Sicily and for this they cannot be employed for Mazara del Vallo.

1.5.1.6.1 Main trunk

With respect to tides, the Mediterranean Sea is considered as semidiurnal, consisting of two tidal cycles a day: two high tides and two low tides. The gravitational force between the Moon, the Sun and the Earth and the tidal forcing from the Atlantic Basic through the Strait of Gibraltar result to the aforementioned identification. The Mediterranean has a microtidal regime. When the gravitational forces of the Sun and the Moon are aligned with the Earth (either in new moon or in full moon), the highest tides, called spring tides, occur; consequently, high tides are slightly higher and low tides, are lower than average. When the Sun and Moon are at right angles seven days later, the effect is opposite than previously discussed: high tides are slightly lower and low tides are slightly higher than average, the so-called neap tides. As a result, the overall tidal range can be between 20 cm and 30 cm and therefore is nearly negligible. However, the highest tides in the Mediterranean Sea have a tidal range of 1.5 m and occur in the Gulf of Gabes (Tunisia).

The Eastern Coast of the Atlantic Ocean has a semidiurnal tidal regime, with two tidal cycles for day, that is two high tides and two low tides. However, here the overall tidal range is significantly higher than in the Mediterranean: overall tidal range along the coast of Portugal can be more than 2 m.

The Strait of Gibraltar represents the transition between these two different tidal regimes, the Mediterranean and the North Atlantic ones. Within the Strait the tide is mainly semidiurnal and the overall tidal range is significantly higher than in the Mediterranean Basin. The semidiurnal tide at the Gibraltar strait increases water inflow and outflow by 30% (Sannino et al., 2004).

With respect to currents, the circulation in the Mediterranean Sea is defined at basin scale as thermohaline. The Mediterranean is a semi-enclosed basin where evaporation exceeds input via runoff and rainfall. This fact brings to high salinity values for the Mediterranean seawater, generally around 38 psu. The general circulation in the basin is counterclockwise.

The most important water input to the Mediterranean Sea is the inflow of less saline Atlantic Waters through the Gibraltar Strait. This inflow describes a clockwise gyre in the Alboran sea between Spain and Morocco, because of the morphology of the strait. Another clock wise gyre is generated in the east of the Alboran Sea, between Spain and Algeria. Then the AW (Atlantic Water) circulates at the surface along the African coast, forming the Algerian current, which moves eastwards and generates several eddies in the proximity of Algeria (Millot and Taupier-Letage, 2005). Algerian eddies change their dimensions during the year. In the proximity of Tunis, AW separates into two flows. One goes back up the Tyrrhenian coast and the Ligurian Sea, while the other continues toward the Eastern Basin, crossing the Strait of Sicily and forming the Lybio-Egiptyan current. This current generates eddies as in the case of the Algerian current. Moreover, this Atlantic water leaving the Sicily Channel forms a northward anticyclonic loop (Mid-Ionian Jet (MIJ)) and then continues towards the Levantine. In general, this basin is defined based on POEM (Physical Oceanography of the Eastern Mediterranean) observations and the study of Robinson and Golnaraghi (1993) as "sub-basin scale gyres interconnected by streams". This name is given by the presence of several gyres and jets. On the one hand, the gyres are the cyclonic Rhodes Gyre, the West Cyprus Gyre, and the Crete Gyre. On the other hand, the jets are the Atlantic-Ionian Current (AIS), the Middle Mediterranean Jet (MMJ) and the Asia Minor Current. At the Strait of Sicily AW coming back from the eastern basin is also flowing on the surface in western direction (Millot and Taupier-Letage, 2005). The branch of Atlantic Water returning to the west is now warmer and saltier than when entering through the Gibraltar Strait. This water keeps flowing on the surface through the Gulf of Lyon, the Catalan Sea and the Ibiza and Mallorca channels, reaching the Alboran Sea (Millot and Taupier-Letage, 2005).

Concerning intermediate water, the Levantine Intermediate Water (LIW) is the most important and recognizable water mass, clearly warmest and saltiest. It is generated at the south-southeast of Rhodes, in northern Levantine Basin. Most of LIW flows south of Crete and then along slope up to the Strait of Sicily, where LIW enters the western basin (Millot and Taupier-Letage, 2005). A part of LIW enters the Aegian and Adriatic Seas and contributes to the formation of deep waters. In the Western basin, LIW flows along the Tyrrenian Sea and divides into two branches: one crosses the Channel of Corsica and the other one the Channel of Sardinia, flowing along the western coast of this island. LIW participates, together with AW, to the formation of the Western Deep Mediterranean Water (WDMW) in the Ligurian and Provençal Basins. LIW also continue its flow along the Spanish slope and outflows through the Strait of Gibraltar (Millot and Taupier-Letage, 2005).

Upper parts of Aegean and Adriatic Deep waters formed in the Eastern Basin flow through the Tunisian Side of the Strait of Sicily. These waters are much denser so that they go to the highest depths and creates a gyre in the Tyrrenian. Then they enter the Channel of Sardinia, creating the Tyrrenian Dense Water (TDW) (Millot and Taupier-Letage, 2005). This water mass partially enters the Algerian Sea and partially flow along slope western Sardinia, getting to the zone where WDMW forms and mixing with it. WDMW creates a wide gyre in the Western Mediterranean Sea, but also creates some sub-gyres depending on its density and on the topography. This water mass partially skirts the Algerian Sea before coming back to the Ligurian and Provençal Basins and partially re-enters the Tyrrenian Sea. The dense WDMW is sucked by the Gibraltar Strait and outflows at the Morroccan side of the Strait (Millot and Taupier-Letage, 2005).

Finally, it is interesting to mention that in the early 1990s there was a climatic event in the circulation, the Eastern Mediterranean Transient (EMT), which generated few but important changes in the circulation pattern. Since then, the intrusion of the Asia Minor Current (AMC) that transported saline surface waters from the Levant to the Aegean has been reduced (Theocharis et al., 2002).

1.5.1.6.2 Portugal: Lisbon landing

For Lisbon landing, data point from SIMAR 1042054 have been used. The location of the SIMAR point is showed in the following picture.

Figure 53. SIMAR node place in the proximity of Lisbon landing.

Frequent and intense winds in the zone of Lisbon landing are mainly coming from NNW, N and NW directions. Winds from the SW-W zones, WNW and NNE can also have high velocities but are significantly less frequent. Most frequent wind speeds are between 3 and 9 m/s.

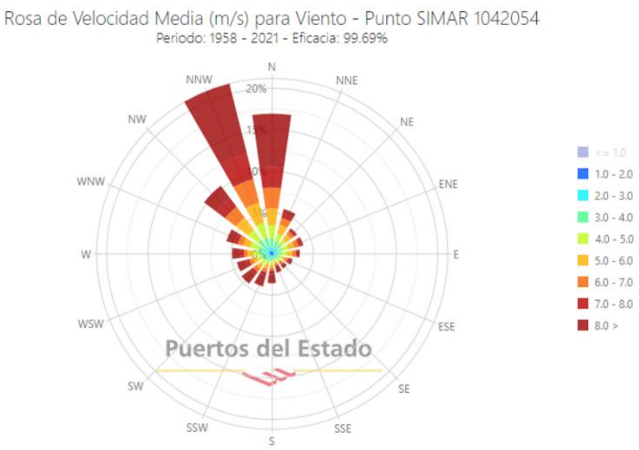

Figure 54. Wind rose for SIMAR node 1042054.

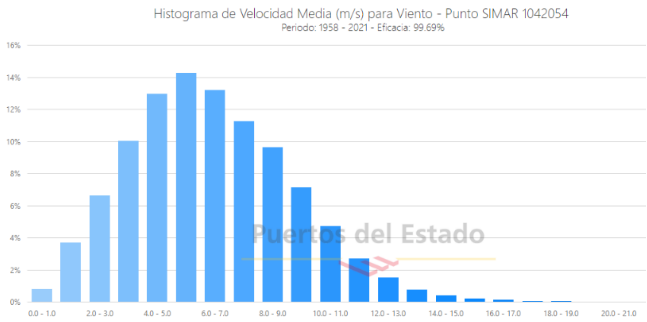

Figure 55. Wind speed frequencies for SIMAR node 1042054.

Waves in Lisbon landing come most of the times from NW and sometimes from NNW, WNW or W. Almost other directions are recognized but are significantly less frequent.

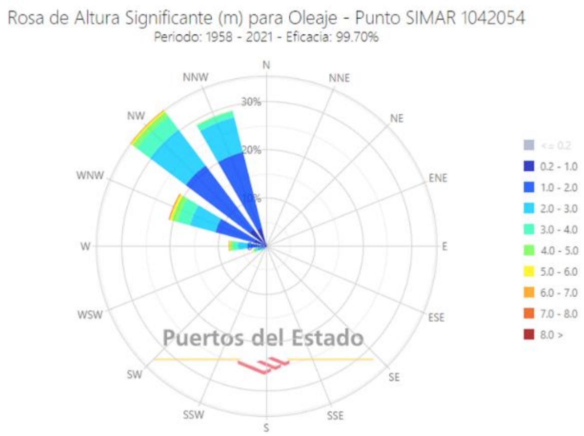

Figure 56. Wave rose for SIMAR node 1042054.

Considering the orientation of the coastline at the Lisbon landing point, we can suppose that the sediment transport generated by the waves will be high most of the time, considering that the prevalent direction of the waves is almost parallel to the coast.

Attending to height frequencies, the node taken as reference for Lisbon landing show a wave height between 1 and 1,5 m for about 23% of time, as well as a wave height between 1.5 and 2 m. Waves in the range of 2.0-2.5 m happen at 16% of time. Waves between 0,5 and 1 m occur less than 12% of time, while waves in the range of 2.5-3.0 m less than 10% of time. Waves of other height are less frequent.

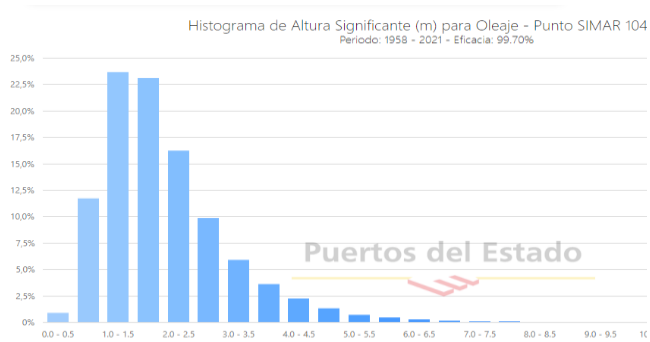

Figure 57. Significant wave height (Hs) for SIMAR node 1042054.

The most frequent periods for this SIMAR point are in the range of 7.5-12.5 s, but between these periods some are less frequent, for example, a period 11.5-12 s. Periods higher than 12.5 s and lower than 7.5 are shown in less than 4% of the time.

1.5.1.6.3 Spain: Zahara, Torreguadiaro and Barcelona landings

In the case of Zahara landing, data from point SIMAR 6038022 have been consulted. The location of this point is shown in the following picture.

Figure 58. SIMAR node place in the proximity of Zahara landing.

Most frequent and intense winds in the zone of Zahara landing come mainly from E direction. High velocity winds from ESE, W, WNW and WSW can also occur quite frequently. Winds from N, NNE, S and SSE are extremely rare. Most frequent wind speeds are between 2 and 7 m/s.

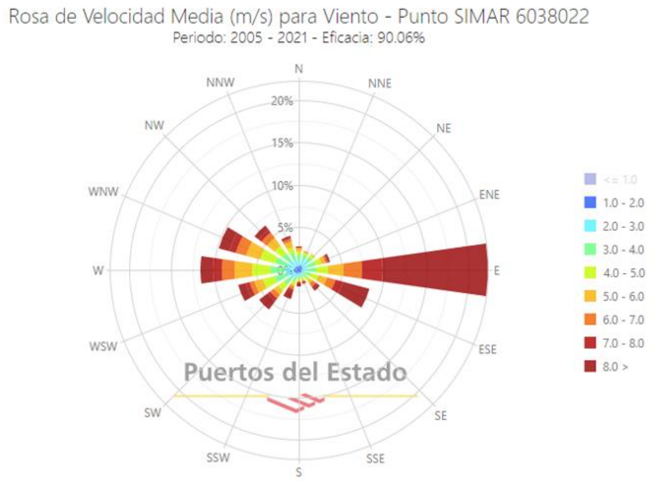

Figure 59. Wind rose for SIMAR node 6038022.

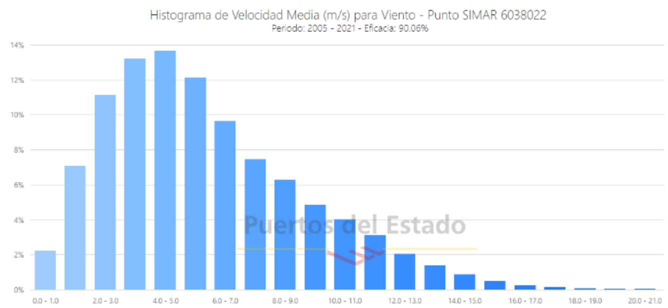

Figure 60. Wind speed frequencies for SIMAR node 6038022.

Waves near Zahara landing come mainly from W, WSW and N directions. Less frequently waves can also come from SW, SE and SSE directions.

Considering the orientation of the coastline, the sediment transport generated by the waves will be quite high most of the times, being the waves mainly oblique with respect to the coastline. Sediment transport is probably low only when there are waves from SW.

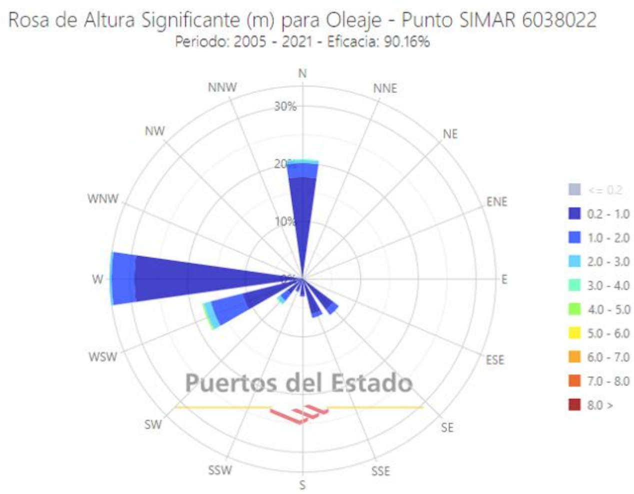

Figure 61. Wave rose for SIMAR node 6038022.

Attending to height frequencies, the node taken as reference for Zahara landing shows a wave height between 0.5 and 1 m for about 50% of time. A wave height between 0 and 0.5 m has a frequency of less than 28%. Waves higher than 1 are showed in less than 13% of time.

Figure 62. Significant wave height (Hs) for SIMAR node 6038022.

In the case of Torreguadiaro landing, data from point SIMAR 6072028 have been consulted. The location of this point is shown in the following picture.

Figure 63. SIMAR node place in the proximity of Linea de la Concepción landing.

Most frequent and intense winds in this SIMAR point are from W and E. Winds from WSW, ENE and WNW are also relevant. Wind from ESE are less frequent but intense. Wind speeds are generally variable in the range of 1-9 m/s.

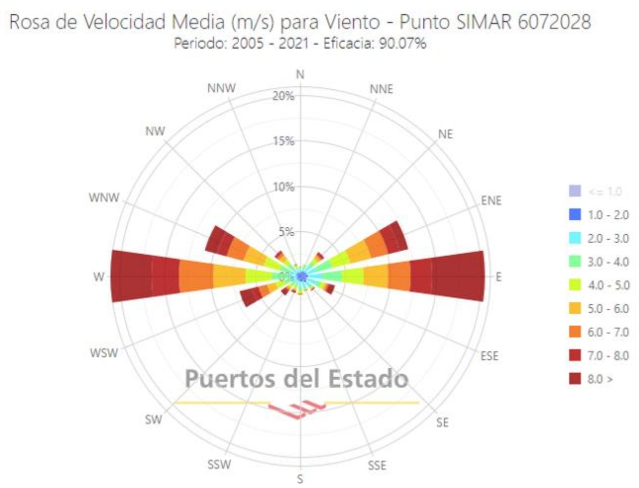

Figure 64. Wind rose for SIMAR node 6072028.

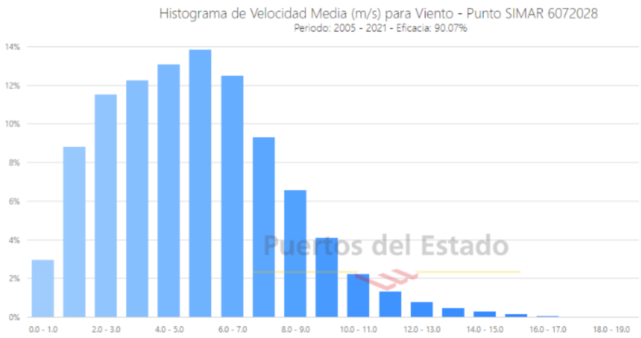

Figure 65. Wind speed frequencies for SIMAR node 6072028.

Waves near Torreguadiaro landing come mainly from two directions, that is E and N. Waves from SSW are present for about 7% of time, while other directions are rare. The highest waves are those from E.

The sediment transport generated by the waves along the coast will be probably medium-low in the case of waves coming from E and more relevant when waves are coming from N.

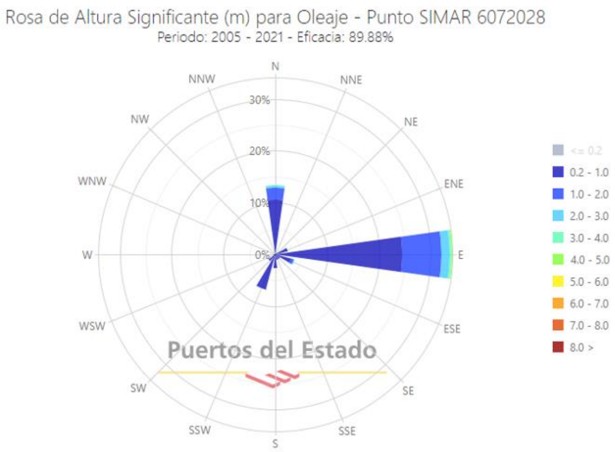

Figure 66. Wave rose for SIMAR node 6072028.

Attending to height frequencies, the SIMAR point taken as reference for Torreguadiaro landing shows a wave height between 0 and 0.5 m for about more than 65% of time and between 0.5 and 1 for about 20%. The other wave heights are less frequent.

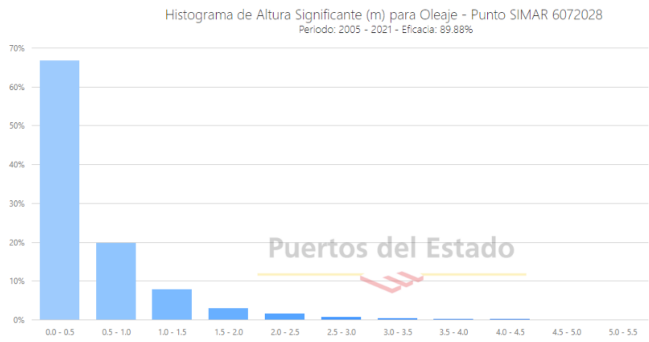

Figure 67. Significant wave height (Hs) for SIMAR node 6072028.

In the case of Barcelona landing, data from point SIMAR 2111137 have been consulted. The location of this point is shown below.

Figure 68. SIMAR node place in the proximity of the Barcelona landing.

Although there is a very varied directional distribution of the winds, the most intense and frequent winds in Barcelona landing are those from NE and ENE. Other main winds for intensity and frequency are those from W, WNW, WSW, SW, SSW and S.

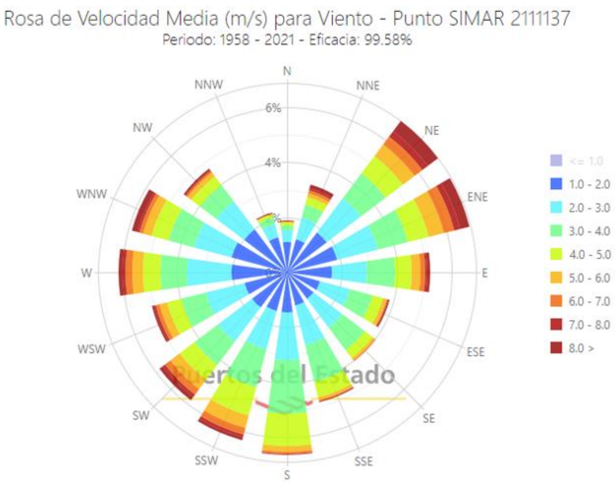

Figure 69. Wind rose for SIMAR node 2111137.

Most frequent wind speeds are between 0 and 4 m/s. The frequency of wind with a speed from 4 m/s to higher values decreases exponentially.

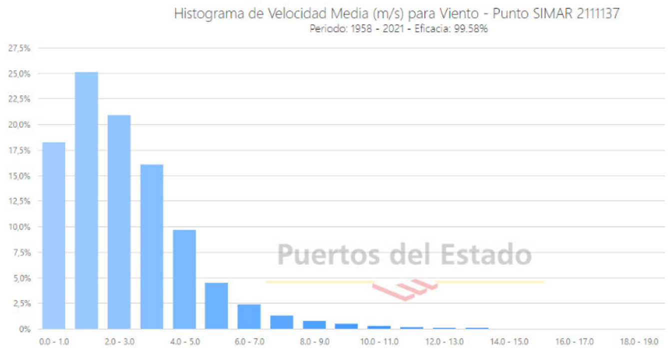

Figure 70. Wind speed frequencies for SIMAR node 2111137.

Waves near Barcelona landing come mainly from E, ESE, SE and S. Less frequent waves can also come from E, SSE and SSW directions. The highest waves are those from SE.

Considering the orientation of the coastline, it can be affirmed that the sediment transport generated by the waves will be quite variable, depending on the wave direction. When the SE direction prevails, the transport will be scarce since the waves reach practically perpendicular to the coastline. When the area is dominated by the other wave directions, the transport generated by the waves is relevant, since the waves are quite oblique with respect to the coastline.

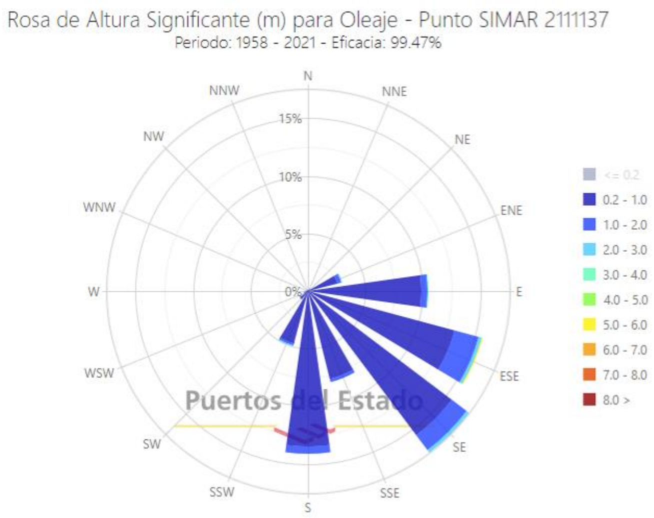

Figure 71. Wave rose for SIMAR node 2111137.

Attending to height frequencies, the SIMAR point taken as reference for Barcelona landing show a wave height between 0 and 0.5 m for about 70% of time. A wave height between 0.5 and 1 m has a frequency of less than 25%. The other wave heights are less frequent.

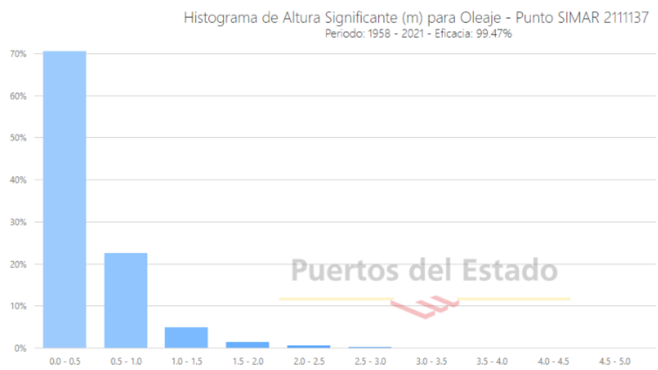

Figure 72. Significant wave height (Hs) for SIMAR node 2111137.

The most frequent periods for this SIMAR point are between of 2.5-7 s. Periods higher than 7s and lower than 2.5 s are showed in less than 5% of time, while periods lower than 1.5 s are almost inexistent.

1.5.1.6.4 France: Marseille landing

In the case of Marseille landing, data from point SIMAR 2146159 have been consulted. The location of this point is shown in the following picture.

Figure 73. SIMAR node place in the proximity of the Marseille landing.

The most frequent and intense winds are those from NW and NNW, followed by winds of WNW and ESE. Then, winds from W, SE and E can be quite intense but with lower frequency.

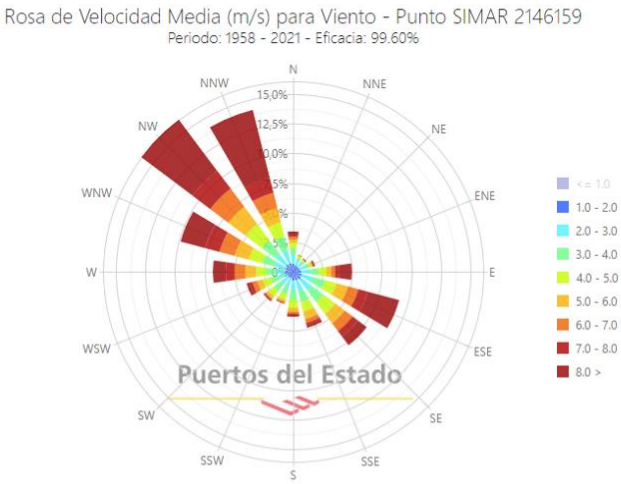

Figure 74. Wind rose for SIMAR node 2146159.

Most frequent wind speeds are between 1 and 7 m/s. The frequency of wind with a speed from 7 m/s to higher values decreases exponentially.

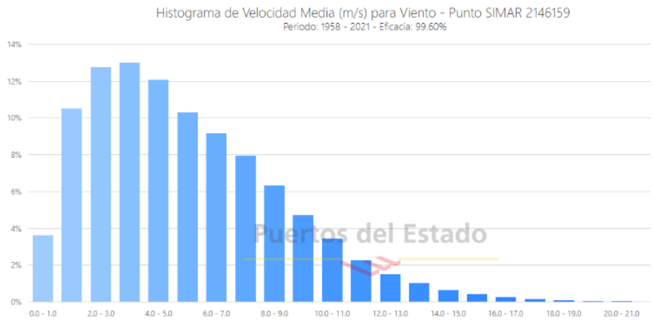

Figure 75. Wind speed frequencies for SIMAR node 2146159.

Waves in Marseille landing come from several directions: the most frequent waves are from W and WSW; then, waves can come from SSW, SSE and SE. Lastly, with less frequent waves can also come from NW, WNW, SW and S.

Due to the variability of wave directions, the sediment transport will be from low to high, depending on the obliquity of the waves with respect to the landing site.

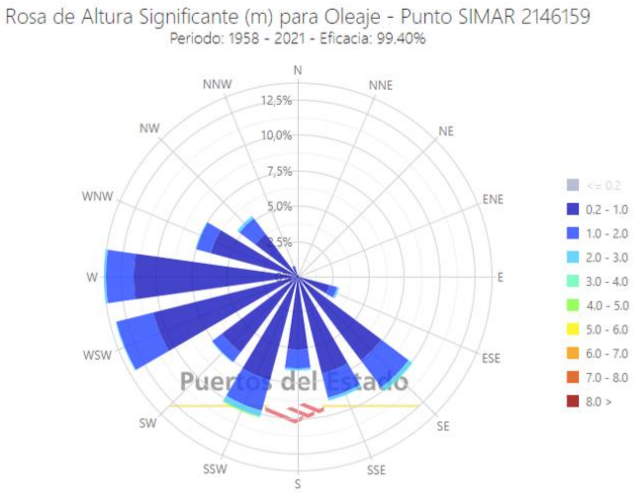

Figure 76. Wave rose for SIMAR node 2146159.

Attending to height frequencies, the node taken as reference for Marseille landing shows a wave height between 0 and 0.5 m for about 45% of time. A wave height between 0.5 and 1 m has a frequency of less than 36% while a wave height of 1-1.5 m is showed in 12% of time.

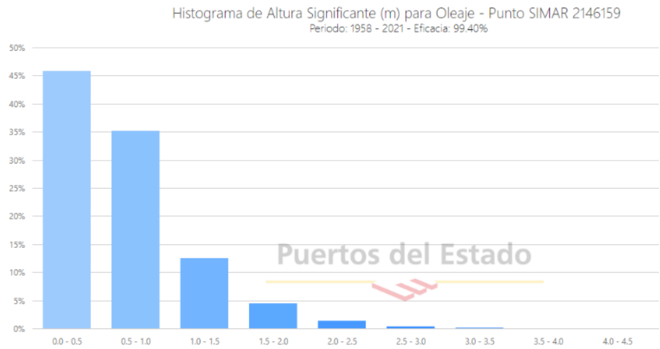

Figure 77. Significant wave height (Hs) for SIMAR node 2146159.

The most frequent periods for this SIMAR point are between 3 s and 6 s. The periods with values higher than 6 s decreases exponentially.

1.5.1.6.5 Italy: Mazara del Vallo landing

In the case of Mazara del Vallo, points of the SIMAR simulation are not present in the area. For this reason, information has been taken from other sources. Main winds in the area are generally from NW, while winds from SE can be present but are usually less common (https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/mazara_del_vallo_en.pdf).

Concerning waves, on the base of data collected from a buoy during 15 years (1989-2012), it is established that waves come mainly from three directions at Mazara, that is W, NNW and SE (Monforte et al., 2015). Based on the main wave directions and the orientation of the coastline, sediment transport will be generally high at Mazara.

Concerning heights, waves lower than 1 m occur for 60% of time (the highest probability of occurrence is for a peak period between 4.5 and 5.5 s) (Bozzi et al., 2017).

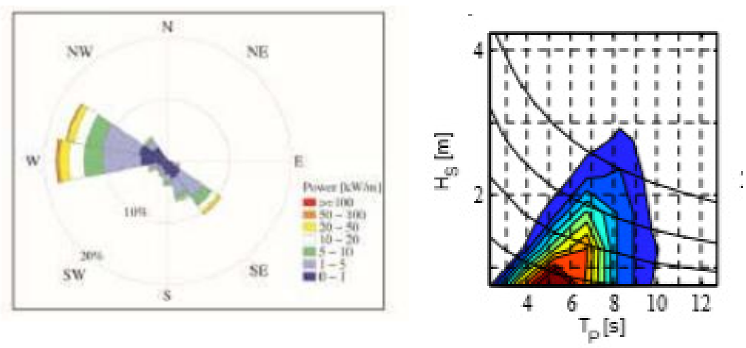

Figure 78. Annual wave direction occurrences (left) and annual sea state occurrences (right) for Mazara del Vallo, based on the period 1989-2012. Source: Monforte et al., 2015; Bozzi et al., 2017.

1.5.1.7 Natural Risks

Study area: Mediterranean Sea and landing sites.

The natural risk events that have been considered in this section are seismic activity, volcanic activity, tsunamis, submarine landslides and floods. First, a general description of the distribution of these risks will be made. Then, along the following subsections, the description will be focus in the landing areas of the Medusa cable system.

Seismic activity

The Mediterranean Sea is generally considered as a seismic area; earthquakes can be frequent and intense because of the movement of the African plate with respect to Eurasia. However, seismicity varies throughout the basin, being generally higher in the Central and Eastern Mediterranean with respect to the Western region. Seismicity is therefore mainly related to the Italic Peninsula, Sicily, the Southern part of Balkans, the Hellenic Peninsula, Crete, Cyprus, Turkey, the eastern coast of the Mediterranean Basin and North Africa, from Gibraltar to the eastern zone of Algeria. The coastline of North Africa is the only part of the Western Mediterranean characterized by medium to high seismicity.

The seismic hazard for the area of study can be deduced from the Global Earthquake Model (GEM) Global Seismic Hazard Map (version 2018.1) (Pagani et al., 2018). This map illustrates the geographic distribution of the Peak Ground Acceleration (PGA) with a 10% of probability of being exceeded in 50 years, computed for reference rock condition (shear wave velocity of 760-800 m/s). As it can be seen in the following picture, the PGA is not homogenous in the area of study. PGA is low, between 0.02 and 0.08 g for the most southern part of the Iberian Peninsula (Zahara and Torreguadiaro landings), the Catalan coast (Barcelona landing), the French coast (Marseille landing) and the zona of Port Said, in Egypt (final point of Medusa cable system). The range of PGA is medium, between 0.08 and 0.20 for the coast of Lisbon in Portugal, the zone of Mazara del Vallo in Sicily and for Bizerte in Tunisia. The Mediterranean Coast of Morocco is characterized by higher values (0.20-0.35 g), while the highest PGA for the area of study is registered on the Algerian Coast (0.35-0.55 g).

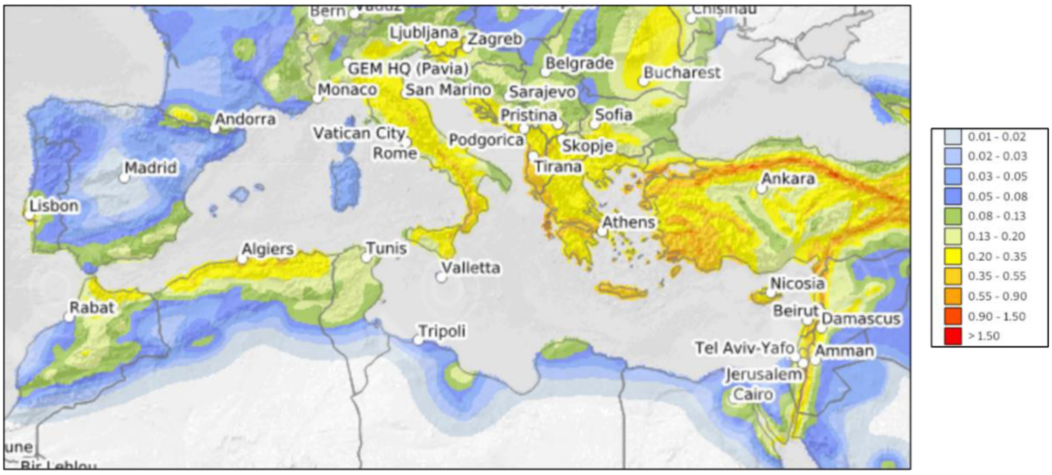

Figure 79. Global Earthquake Model (GEM) Global Seismic Hazard Map (version 2018.1). Source: https://maps.openquake.org/map/global-seismic-hazard-map/#2/39.5/26.0.

Volcanic activity

Volcanic hazard in the Mediterranean area is mainly related to Etna, Stromboli and Vesuvio volcanoes and Campi Flegrei caldera in Italy, in addition to Santorini volcano in Greece (https://maps.ngdc.noaa.gov/viewers/hazards/). The Medusa optic cable system will lay far enough from these volcanoes to consider that their possible volcanic activity will not directly compromise the integrity of the submarine optic cable. Sub-sea volcanoes and hydrothermal venting are also present in the Mediterranean Sea, in particular in the Tyrrhenian Sea and in the Strait of Sicily (Emodnet geology portal). Several mud volcanoes are situated in the Alboran Basin, the Levantine Basin and the Atlantic area near the Gulf of Cadiz. The ubication of these geological submarine features have been taken into account during the planning of the marine route of the cable, in order to reduce the risk for the system to be exposed to volcanic risk. The closest volcanic structures around the Medusa cable system are those located in the Strait of Sicily like Aceste/Tiberio (which was active 5 million years ago and has effusive type activity), Tetide, Anfitrite, Galatea, Euridice, Foerstner (with the last activity recorded in 1891), Angelina, Alfil, Linosa II, etcetera. All of these volcanos are located between 10 and 40 km from the Medusa system.

In addition, emerged and submarine volcanic activity can indirectly affect the integrity of the cable because of possible consequent earthquakes, tsunamis and submarine landslides.

Tsunami

Tsunami have affected the Mediterranean Sea in the past. In the western Mediterranean, tsunami events have been registered in particular along the Algerian coast, the Ligurian Sea, the Tyrrenian coast of Calabria (Italy), the northern and western coast of Sicily. Tsunami events have also interested the islands of the Strait of Sicily, as well as the eastern Mediterranean Sea, being registered along the coast of Greece (continent and islands, including Crete) and the coast of Cyprus (https://maps.ngdc.noaa.gov/viewers/hazards/). In the Mediterranean region, the main factor that causes tsunami is an earthquake. However, tsunami generated by earthquake-induced submarine landslides are possible too, as well as tsunami related to volcanic activity, in particular to sub-sea volcanoes. Due to the small area of the Mediterranean basin, tsunami events have not historically been as catastrophic as in other ocean basins. Tsunami events have also been registered at Lisbon, in the Atlantic Ocean.

Submarine landslides

Submarine landslides are widespread along Mediterranean continental margins. It seems that active margins are characterized by more frequent but less extended landslides, while passive margins display larger but fewer failures (Urgeles and Camerlenghi, 2013). In the Western basin, the largest slumps are concentrated in the Rhone-Ebro margins. The active Algerian and Ligurian margins also show submarine landslide activity, but with a smaller area extent. In the Eastern basin, the largest slump is located at the Nile margin. One of the extreme Mediterranean submarine landslides is the megaturbite that characterized the Balearic abyssal, between the Algerian and the Provençal Basins. Other megaturbidites are those of the Libyan and Levantine Basins, in the Eastern Mediterranean. More than half of Mediterranean submarine landslides originates on the continental slope, but the deposition is often beyond the slope (Urgeles and Camerlenghi, 2013). Seismic activity is the most common cause of offshore slope failures; other causes are high sedimentation rates and the consequent increase of pore pressures. Submarine landslides are also a possible cause of tsunamis. Several cable breaks in the Mediterranean because of submarine landslides have been registered. This is for example the case of the offshore Algeria landslide in 2003 or Nice airport landslide in 1979.

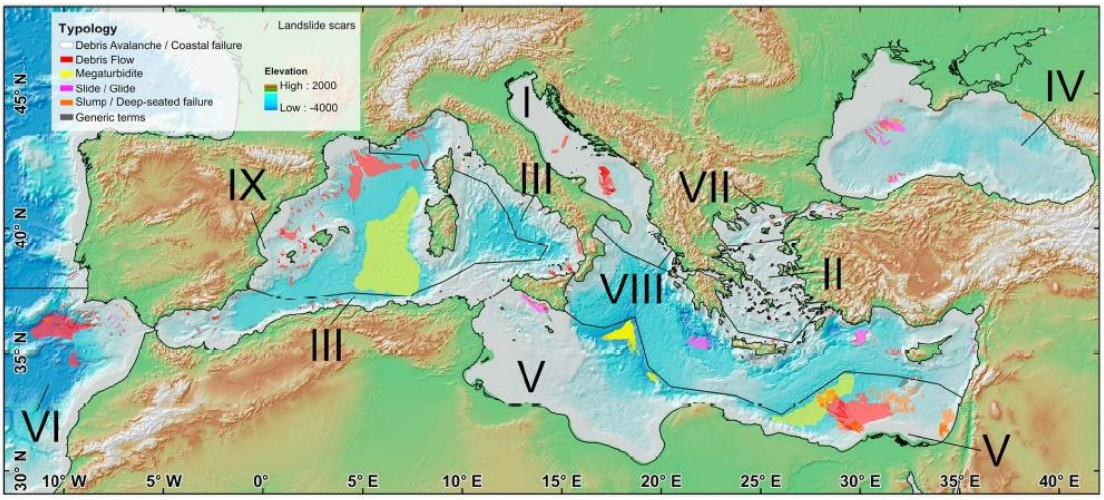

Figure 80. Submarine landslides in the Mediterranean Sea. Source: Urgeles and Camerlenghi, 2013.

<u>Coastal erosion</u>

The degree of coastal erosion depends on coastal dynamics acting over beaches (the difference between incoming and outgoing sediments, in other words, between those sediments that have been brought to the coast by different mechanisms and those that have been extracted by the waves). When we talk about erosion in the strict sense, it is because this balance is negative. For the study area, the data has been obtained from the EMODnet web portal. Currently, data is available only for European countries, no information has been found regarding the coastal erosion of the countries of North Africa.

The data show contradictory results depending on the source used: in general, the results generated from the field data show more variable coastline trends, with higher coastal erosion, than the results generated from satellite data (which show a more stable general trend). Generally, the coastline of the Mediterranean countries has a stable tendency according to the results obtained via satellite data. However, the results of the coastal dynamics according to field data show that there is an important part of coastline with erosion tendency. The Mediterranean coastlines that have more erosion trend are north Portugal, south and northeastern Spain, northeastern Gulf of Lion, east and south Greece and Cyprus.

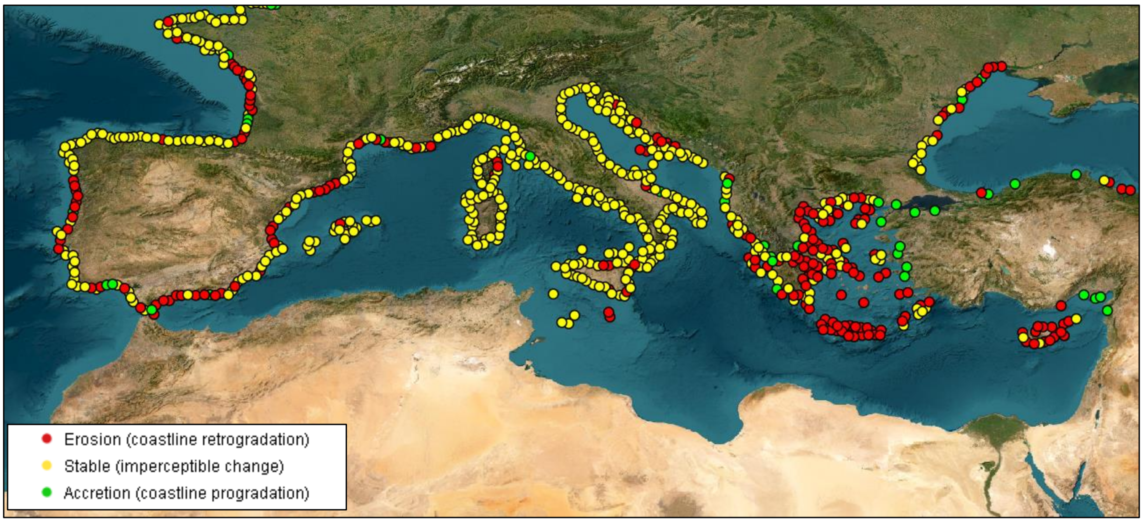

Figure 81. Coastal migration obtained from field data. Source: EMODnet.

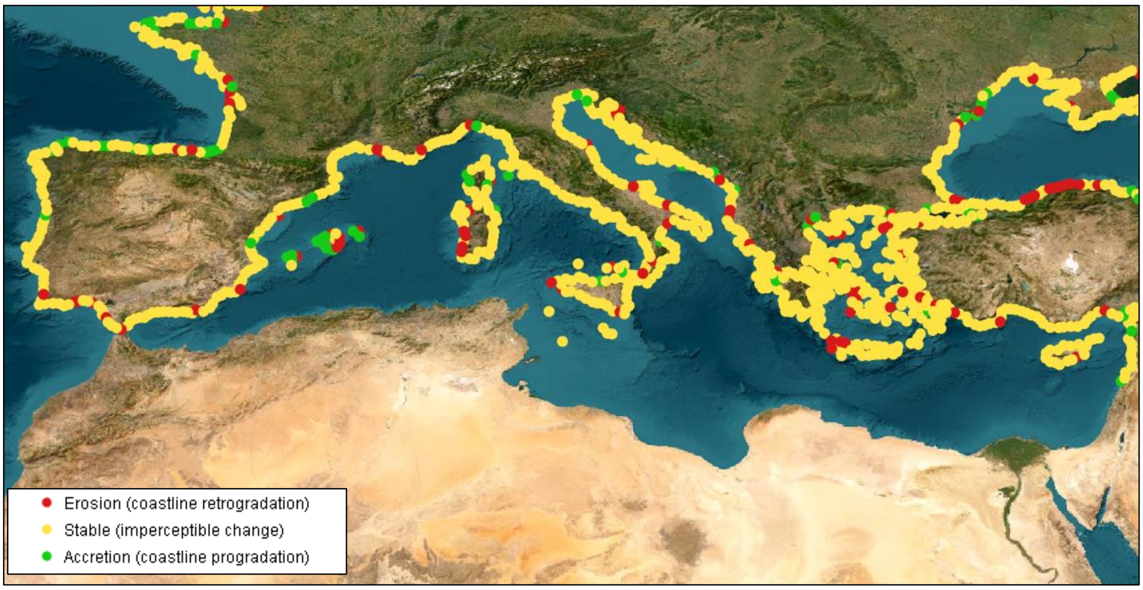

Figure 82. Coastal migration obtained from satellite data. Source: EMODnet.

However, the coastal dynamic can differ depending on the scale, so more specific information is described in the next subsections for the landing sites of Medusa system.

<u>Flooding</u>

Coastal areas of the Medusa landings can be subjected to coastal flooding that may affect installation of the cable system at land. The risk of coastal flooding is also related to sea level rise due to climate change, and the projection of the sea rise is already included in the Climate change section (1.5.4).

River flooding can also constitute a risk for some landing sites.

Hereafter, in the next subsections, we report coastal and river flooding hazard maps for Medusa system landing sites for which information has been found. The information about river flooding has been obtained via the Centre Data Catalogue of European Comission. In the case of coastal landings in Spain, information from the SNCZI-IPE website of the MAPAMA have been used, with except for Barcelona landing, for which the Catalan Flooding Map has been consulted.

1.5.1.7.1 Main trunk

Seismic activity

On the base of data from the Natural Hazards Viewer of NOAA (National Oceanic and Atmospheric Administration), seismic activity with seismic epicentre located offshore near the route of the main trunk of Medusa cable have been registered in particular at the Atlantic Ocean, the Alboran Sea, the south of Crete and offshore the Nile Delta (https://maps.ngdc.noaa.gov/viewers/hazards/).

Volcanic activity

Sub-sea volcanoes and hydrothermal venting are present in the Strait of Sicily (Emodnet geology portal). Several mud volcanoes are situated in the Alboran Basin, the Levantine Basin and the Atlantic area near the Gulf of Cadiz. The ubication of these geological submarine features have been taken into account during the planning of the main trunk route. The closest volcanic structures around the Medusa cable system are those located in the Strait of Sicily, between 10 and 40 km from the Medusa system.

Submarine landslides

The main trunk of Medusa system passes near the megaturbidite deposit that characterized the Balearic abyssal, between the Algerian and the Provençal Basins, as well as other megaturbidites of the Libyan and Levantine Basins, in the Eastern Mediterranean. The largest slump of the Nile margin is located at the final section of the trunk (see Figure 80).

1.5.1.7.2 Portugal: Lisbon landing

Coastal erosion

Concerning the Portuguese coast, field data show a stable trend but with some regression points (where coastal erosion occurs), such as at the coastline of Lisbon city. Satellite data shows a similar trend.

Flooding

The coastal flooding expected in Portugal for the year 2100 has been obtained via the Sea Level Rise Viewer of the Faculty of Sciences of the University of Lisbon.

For the Lisbon landing, the beach where Medusa system arrives (Praia de Carcavelos) is expected to be flooded in 2100 along all the sand area (a bit more of 100 m with).

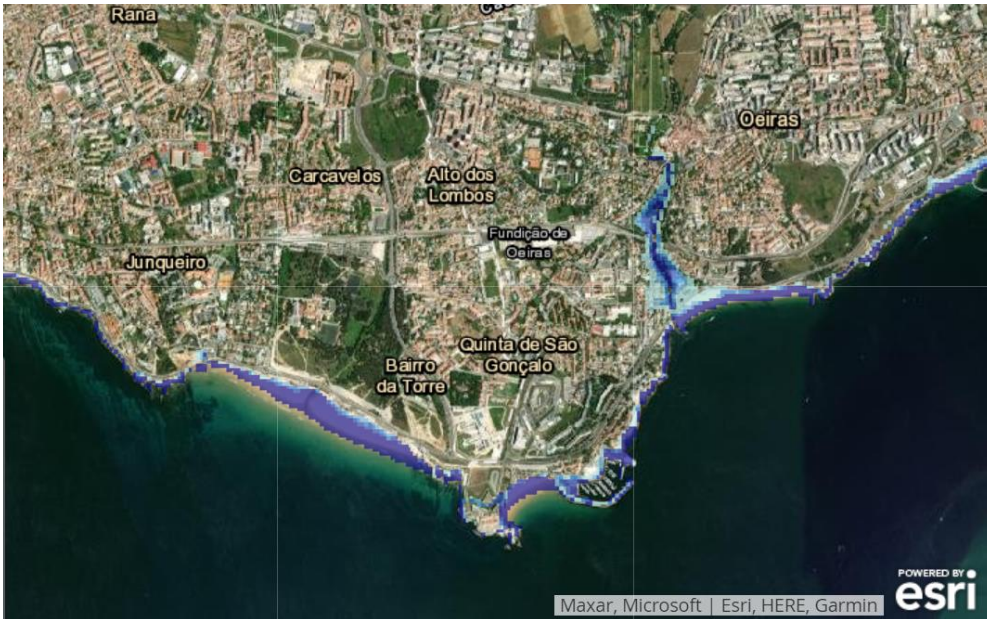

Figure 83. Extreme Coastal Flood Scenario in Lisbon landing for the period of 2100 (long-term future), with SLR according to the Mod.FC_2 projection and with maximum high-tide and storm surge (meteorological forcing) with return period of 100 years, in accordance with the requirements of Directive 2007/60 / EC. Source: FCUL, 2017.

1.5.1.7.3 Spain: Zahara, Torreguadiaro and Barcelona landings

Coastal erosion

In Spain, Zahara coastline has a predominantly erosive character according to field data and a stable-erosive character based on satellite data.

Torreguadiaro also has a mainly erosive coast trend according to field data (although in some points near the Medusa landing there has been accretion) and a tendency between stable and erosive according to satellite data.

The landing point of the Medusa System in Barcelona presents a mainly stable trend of the coastline in both data sources, with some tendency of accretion under satellite data.

Flooding

For Zahara landing, as can be seen in the following pictures, river flooding does not interest directly the landing point, even for a return period of 500 years. River flooding can affect the beach but north of the planned landing (about 2.8 km). The same is valid for coastal flooding with a return period of 100 years.

Figure 84. Coastal and river flooding map of Zahara de los Atunes. Period return (T) of 50 (left), 100 (right) and 500 years (bottom). Source: Elaborated with data from MITECO.

Concerning Torreguadiaro landing, coastal flooding is expected to affect the Medusa system cable with a return of 100 years. Around 100 m width of the beach where Medusa landing is planned will be flooded with this return of time, as is showed in the map below. River flooding will not directly affect the landing point, even for a return period of 500 years. The area affected for river flooding closest to the lands point is next to Sotogrande harbour (around 0.7-0.8 km away).

Figure 85. Coastal and river flooding hazard map of Torreguadiaro (T=100). Source: Elaborated with data from MITECO.

Figure 86. Coastal and river flooding hazard map of Torreguadiaro (T=500). Source: Elaborated with data from MITECO.

For the Barcelona landing site (Sant Adrià del Besòs) the coastal and river flooding maps with a return period of 100 and 500 years are presented below. As we can see in the following figure, the study area can be affected by river and coastal flooding, although the return period is quite high.

Figure 87. Coastal and river flooding map at Barcelona landing (T=100). Source: Elaborated with data from MITECO.

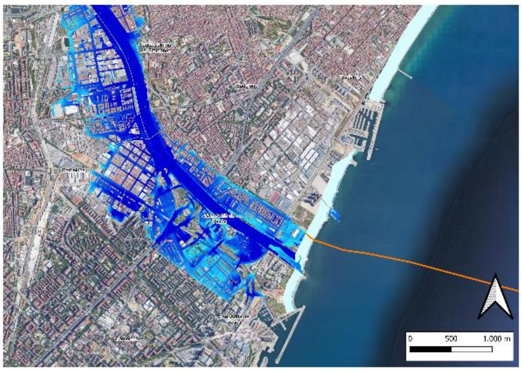

Figure 88. Coastal and river flooding map at Barcelona landing (T=500). Source: Elaborated with data from MITECO.

1.5.1.7.4 France: Marseille landing

Coastal erosion

In Marseille, we can find the three types of coastal line behavior: erosion, accretion and stable. The area closest to the landing point of the Medusa system cable shows an accretion trend according to field data, but a mainly stable trend according to satellite data.

Flooding

For the Marseille landing, there is a risk of river flooding at the Medusa landing point. As can be seen in the following pictures, river flooding can affect the landing point for all the return periods (50 and 500 years).

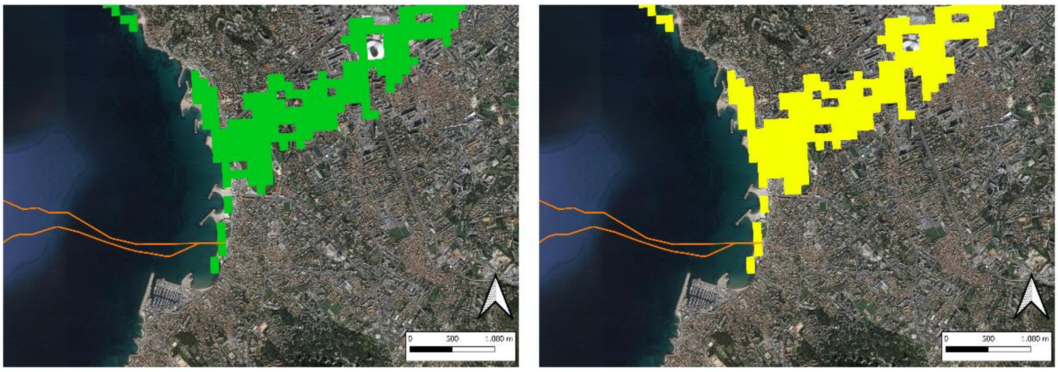

Figure 89. River flooding hazard map of Marseille. From left to right: period return (T) of 50 and 500 years, respectively. Source: Centre Data Catalogue of European Comission.

1.5.1.7.5 Italy: Mazara del Vallo landing

Coastal erosion

Concerning Mazara landing, the coastline shows a varied tendency. A stable tendency predominates in the area, but the point where the Medusa system will land have an erosive coast trend, according to field data. Satellite data shows a predominance of stability, but with several points where erosive processes act. However, the landing point is located in a stable coastal zone.

Flooding

For Mazara del Vallo landing, data consulted for river flooding hazard show that even for a return period of 500 year the river flooding does not directly affect the area where the Medusa system lands. In the next map, it is showed the closest area with a river flooding hazard, more than a 20 km away.

Figure 90. River flooding hazard map of Mazara del Vallo, period return (T) of 50 (green) and 500 years (yellow). Source: Centre Data Catalogue of European Comission.

1.5.2 Biological Aspects

The biodiversity in the area of study has been subjected to modifications throughout the history of the earth, due to changes in the distribution of the continents. During the Miocene, the connection (the Gibraltar Strait) with the Atlantic Ocean was closed as a consequence of a collision between Africa and the south-western segment Eurasian plate. This event caused a severe reduction in the original rich biota. Then, in the Pliocene, the Strait of Gibraltar reopened and the waters of the Atlantic Ocean flood the Mediterranean, repopulating it with species of Atlantic origin. Finally, during the Quaternary, the alternation of glacial periods with warm interglacial periods allowed the influx into the Mediterranean of Atlantic species of boreal or subtropical origin. Nevertheless, it is observed that between the two basins of the Mediterranean, exists a different biota composition. Whereas the western is influenced by the Atlantic Ocean, the zone of the Levantine Sea is strongly linked to the Red Sea (Mannino et al., 2017).

The Mediterranean Sea is considered a true hotspot of biodiversity as approximately 17,000 species have been reported, but the estimation is incomplete yet. Even though this sea represents a small part of the world's oceans, it hosts 4-18% of the world's marine biodiversity, and includes temperate, cosmopolitan, subtropical, Atlantic and indo-pacific taxa. High percentage (20–30%) of marine species in the Mediterranean is considered endemic. The western basin shows a higher rate of endemism than the eastern basin (Boudouresque, 2004; Tortonese, 1985).

At least 26% are prokaryotic (Bacteria and Archaea) and eukaryotic (Protists) marine microbes. Then, Animalia is represented by 55.2% (Crustacea, Mollusca, Annelida, Plathyhelminthes, Cnidaria, Vertebrata, Porifera, Bryozoa, Tunicata, and Echinodermata). Other invertebrate groups encompass 14% of the species, and Plantae includes 5% (Coll et al., 2010). Moreover, this sea has its own set of emblematic species of conservation concern, such as sea turtles (Goombrige, 1990), several cetaceans (Bearzi et al., 2004), and the critically endangered Mediterranean monk seal (*Monachus monachus*) (Reijnders et al., 1997). Finally, it represents the main spawning ground of the eastern Atlantic bluefin tuna (*Thunnus thynnus*) (MacKenzie et al., 2009).

1.5.2.1 Vegetation

<u>Marine environment</u>

Seaweeds are photosynthetic organisms, and therefore they need light for growth. For this reason, their development is limited to shallow areas, distributed between the medio-littoral zone and the deepest limit of the circalittoral zone, situated at 110 m in the Western Mediterranean and a bit deeper in the even more oligotrophic waters of the eastern part of the Mediterranean Sea (Ballesteros, 1990; Ballesteros, 2006).

Coll et al., (2010) described 854 species of Plantae, being most of these algae (red and green seaweed). However, they also comment that further exploration and taxonomic work on seaweeds is needed in the African countries (mainly in Libya and Egypt), the Levantine Sea (Israel, Lebanon, Cyprus, Syria), and the Aegean Sea (Greece and Turkey).

1.5.2.1.1 Portugal: Lisbon landing

The terrestrial vegetation upstream of Carcavelos beach is scarce and essentially consists of species of palm trees planted by humans (for example California Palm (*Washingtonia filifera*) and Canary Palm (*Phoenix canariensis*)) during the artificialization of this area.

Figure 91. Vegetation at Carcavelos beach. Source: AFR-IX Telecom, 2021.

The marine flora of Carcavelos beach is essentially composed of green (Chlorophytes), brown (Ochrophytes) and red (Rhodophytes) algae, the latter more abundant, which are distributed on the surface of the water column and/or attached to intertidal and subtidal rocky outcrops (including low tide pools) on the beach. These algae are most abundant during spring tides, especially in late summer and early autumn.

1.5.2.1.2 Spain: Zahara, Torreguadiaro and Barcelona landings

Zahara landing is characterized by a beach that contains a low-altitude dune system and where it grows an indigenous vegetation such as *Ammophila arenaria*, *Pancratium maritimum*, *Eryngium maritimum*, *Medicago marina*, *Lotus creticus* and species of the genus Trifolium. Protected species have not been found in the area.

Figure 92. Dune system in Zahara landing. Species like *Ammophila arenaria* and *Pancratium maritimum* can be seen. Source: AFR-IX Telecom-Tecnoambiente, 2021.

The area closest to the urbanized part contains an anthropic vegetation, with the presence of *Malva sp*., *Lantana camera*, *Fittosporum tobira*, *Trifolium sp.*. Other species can also be recognized, such as *Phragmites australis* (common reed), *Arundo donaz* (giant cane or also known as elephant grass) and *Oxalis pre-caprae*. This vegetation has no high ecological value.

Figure 93. Vegetation nearby the beach area. Species like *Arundo donax, Lantana camera* and *Pittosporum tobira* (left) and *Malva sp* (right) can be seen. Source: AFR-IX Telecom-Tecnoambiente, 2021.

Several marine species have been detected on the sea littoral: the algae *Gelidium sesquipedale*, *Fucus spiralis* and species of the Laminariales order. However, the cable route runs through a sandy bottom area where, according to the sources consulted, there are no large spots of algal community.

In Torreguadiaro, the Medusa system lands at the northern end of the beach of Torreguadiaro. The vegetation of this beach includes species like *Medicago marina*, *Lotus creticus*, *Reichardia*

Gaditana, Eryngium maritumum, Silene nicaeensis, Crithmum maritimum, Paronychia argentea, Centaurea sphaerocephala and plants of the *Poaceae* family (*Ammophila arenaria* and *Elymus farctus*). In general, the vegetation identified in the area of study has not high ecological value, having an annual character and being absent the protected species.

Figure 94. Vegetated area nearby the landing point system in Torreguadiaro beach. Source: AFR-IX Telecom-Tecnoambiente, 2021.

Figure 95. Some of the vegetal species in Torreguadiaro beach. Left to right are *Ammophila arenaria*, *Eryngium maritimum*, *Reichardia gaditana* and *Crithmum maritimum*. Source: AFR-IX Telecom-Tecnoambiente, 2021.

There are few marine species near this landing, only species of the Laminariales order. However, the presence of these algae is very occasional.

In Barcelona, the Medusa system lands at Sant Adrià del Besòs beach, a sandy beach characterized for having no vegetation or, in those areas farthest from the sea, having only sparsely dense settlements of nitrophilous plants, of summer development. In these few places where we find this vegetation, the species are annual and short-lived. They are mainly: *Salsola kali*, *Cakile maritima*, *Xanthium italicum*, *Glaucium flavum*, *Atriplex prostrata*, *Euphorbia peplis* and *Atriplex tornabenei*. The area behind the beach is almost all urban and industrial land without natural vegetation.

As for marine vegetation, the seabed is almost all sandy, so there is little presence of algae.

1.5.2.1.3 France: Marseille landing

Marseille landing is located at the Vielle Chapelle beach, a beach that mainly consists of sand, with practically no natural vegetation. In any case, the type of vegetation that dominates is grass, introduced artificially, which reaches the avenue Pierre Mendes.

Figure 96. Vegetation at the Vielle Chapelle beach. Source: AFRIX Telecom, 2021.

1.5.2.1.4 Italy: Mazara del Vallo landing

For vegetation information in Mazara del Vallo, the “Carta della Natura” viewer made by the “Istituto Superiore per la Protezione la Ricerca Ambientale” has been consulted. The Medusa cable lands in Coral Bay beach, a sandy urban beach. In this area there are mobile dunes, which are considered a high-value habitat. According to Pisco et al. (2013), in Italy the main species that make up the mobile dune community are *Ammophila arenaria, Calystegia sodanella, Cutandia maritima, Cyperus capitatus, Echinophora spinosa, Eryngium maritimum, Euphorbia paralias, Lotus creticus, Medicago marina, Pancratium maritimum*, etc. These species have been identified by using the Italian and the European interpretation manual of the Habitats Directive. Therefore, the presence of these species in the area is not confirmed.

1.5.2.2 Fauna

Ichthyofauna

Fish species in the Mediterranean Sea are about 650, but some controversy still exists on the exact number. Coll et al. (2010) named 116 exotic species, but the number can be even higher. Approximately 80 fish species are elasmobranchs, while 545 species are ray-finned fishes.

In particular, taking into account the area of interest of the Medusa system, the following table shows the total number of marine fishes for each landing country (www.seaaroundus.org; www.fishbase.se).

Country	Portugal	Spain	France	Italy	Morocco	Algeria	Tunisia
Marine fish	512	720	724	516	689	451	350

Table 13. Total number of marine fish for each landing country. From www.seaaroundus.org; www.fishbase.se.

Concerning the distribution along the Mediterranean Sea, the highest number of fish species is concentrated in nearshore waters, in particular in the Western basin, but in Adriatic Sea, Aegean Sea and Gulf of Gabes too. On the contrary the number is reduced in the open ocean environment, although, in general, more in the eastern basin than in the western basin. Ray-finned fish species are focused in nearshore waters of the entire area of study in the Mediterranean, while Elasmobranchs can be present also in open sea waters of the Alboran Sea, Valencia Through and Provençal Basin. The number of endemic fish species is higher in the nearshore waters of the Gulf of Lion, South Sardinia, SW Mallorca and the Adriatic Sea (Coll et al., 2010).

It is important to mention that some areas are considered critical for some elasmobranchs. For example, Tunisian waters provide a nursery area for *Carcharodon carcharias*; and north of Balearic, north of Adriatic and Tyrrhenian Sea are important feeding sites for the *Cetorhinus maximus* (Cavanagh & Gibson, 2007). In relation to species protection, there are 21 species of elasmobranchs that are protected in the Mediterranean under recommendation GFCM/36/2012/3 of the General Fisheries Commission of the Mediterranean (GFCM), listed in Annex II of the Protocol of the Barcelona Convention. Even so, the status of some elasmobranchs is uncertain because of infrequency or uncertain reporting.

Invertebrates (Animalia)

Crustaceans are the invertebrates with the highest number of species in the Mediterranean Sea (2239), followed by Mollusks (2113), Annelida (1172), Platyhelminthes (1000), Cnidaria (757), Porifera (681), Bryozoa (388) and Echinodermata (154) (Coll et al., 2010). Most of the invertebrates show a decreasing gradient of species richness from the NW Mediterranean to the SE. Most common crustaceans, bivalves and gastropods have generally a strong link with the sea bottom, and for this reason may be more affect by the cable project.

In the Atlantic Ocean, at the Portugal region, 176 species of mollusks are reported (mainly bivalves, gastropods and cephalopods), followed by 148 species of crustaceans and 19 of echinoderms (www.sealifebase.se). In the area of Morocco, the number of species registered for mollusks, crustaceans and echinoderms is 307, 139 and 12, respectively. Therefore, it seems that, differently from the Mediterranean Sea, mollusks are the invertebrates with the highest number of species in the Eastern Atlantic Ocean (from Portuguese to Moroccan coast).

Marine Mammals

- **Cetaceans:**

Cetaceans in the Mediterranean Sea can belong to local population or be part of migrating population. The Mediterranean Sea residents are *Tursiops truncates* (common bottlenose dolphin), *Delphinus delphis* (short-beaked common dolphin), *Stenella coerueoalba* (striped dolphin), *Grampus griseus* (Risso's dolphin), *Globicephala melas* (long-finned pilot whale), *Balaenoptera physalus* (fin whale) and *Ziphius cavirostris* (Cuvier's beaked whale), *Physeter macrocephalus* (sperm whale). Moreover, 12 other species of dolphins and whales have been observed in the basin, but they are considered vagrants or visitors. For example, in the Strait of Gibraltar there is a subpopulation of *Orcinus orca* (killer whale) (IUCN, 2012).

Cetaceans, both resident and visiting, are mainly concentrated in the Western Mediterranean. Not surprisingly the two protected areas for Cetacean of the Mediterranean are located in this part of the basin. In particular, the most common dolphin in the Mediterranean Sea is the striped dolphin, while the common bottlenose dolphin is only present nearshore. The short-beaked common dolphin lives in all of the Mediterranean, but vanished in some areas: Adriatic Sea, Levantine Sea (except the coast of Israel), Ligurian Sea and Gulf of Lion. The distribution of sperm whales is the same, although in this case is present in Ligurian Sea and the Gulf of Lyon. The rarely seen whale, Cuvier's beaked whale, lives in the deep open waters of all Mediterranean except the coasts of Libyan and Tunisia and the Adriatic Sea. The missing resident species, fin whale, Risso's dolphin and long-finned pilot whale have a smaller distribution area. The first two are present in the western and central Mediterranean, while the third is only in the western Mediterranean (especially in the Alboran Sea) (IUCN, 2012).

The following table shows species name of native cetaceans for each landing country, taking into account the area of interest of the Medusa system (www.seaaroundus.org; www.fishbase.se).

Family	Species name	Country						
		Portugal	Spain	France	Italy	Morocco	Algeria	Tunisia
Balaenopteridae	*Balaenoptera acutorostrata*	x	x	x	x	x		
	Balaenoptera borealis	x	x	x		x		
	Balenoptera edeni					x		
	Balaenoptera musculus	x	x	x		x		
	Balaenoptera physalus	x	x	x	x	x		
	Megaptera novaeangliae	x	x	x	x	x		
Balaenidae	*Eubalaena glacialis*	x	x					
Delphinidae	*Delphinus delphis*		x	x	x	x	x	X
	Feresa attenuata	x	x			x		
	Globicephala macrorhynchus	x	x	x		x		
	Globicephala melas	x	x	x	x		x	X
	Grampus griseus		x	x	x	x	x	X
	Lagenodelphis hosei					x		
	Lagenorhynchus acutus			x				
	Lagenorhynchus albirostris	x						
	Orcinus orca	x	x		x	x	x	X
	Pseudorca crassidens	x	x	x	x	x	x	X
	Stenella coeruleoalba	x	x	x	x	x	x	X
	Stenella frontalis					x		
	Steno bredanensis	x	x	x	x	x	x	X
	Tursiops truncatus	x	x	x	x	x	x	X
Kogiidae	*Kogia breviceps*	x	x	x		x		
	Kogia sima	x				x		
Ziphiidae	*Hyperodon ampullatus*		x	x				
	Mesoplodon bidens	x	x	x		x		
	Mesoplodon densirostris	x	x	x	x	x	x	
	Mesoplodon mirus		x	x				X
	Ziphius cavirostris	x	x	x	x	x	x	X
Phocoenidae	*Phocoena phocoena*	x	x	x		x		X
Physeteridae	*Physeter macrocephalus*	x	x	x	x	x	x	X
Nº TOTAL SPECIES		**22**	**24**	**22**	**14**	**24**	**11**	**12**

Table 14. Native mammal for each landing country. From www.seaaroundus.org; www.fishbase.se.

Concerning the conservation status of the 8 resident cetaceans of the Mediterranean, the common bottlenose dolphin, fin whale and striped dolphin are classified by the IUCN Red List as vulnerable, while the sperm whale and short-beaked common dolphin are defined as endangered. For the other three species (Risso's dolphin, long-finned pilot whale and Cuvier's beaked whale) there is not enough information to establish a status (IUCN, 2012).

- **Pinnipedia:**

There are 3 native species of pinnipeds in the Mediterranean Sea: *Halichoerus grypus, Monachus monachus* and *Phoca vitulina*. Also, 3 other species have been seen in Spain and France. In the other 4 landing countries (Italy, Morocco, Algeria and Tunisia) only the presence of *Monachus monachus* have been registered.

In the Atlantic Ocean, at the Portugal region, 6 species of pinnipeds are present, all of them seen on stray occasions and only one is native, *Phoca vitulina*. Furthermore, there is one species that does not appear in the Mediterranean Sea, *Pusa hispida*. The table below represents a resume of the presence of pinnipedian in Portugal, Spain and France (not including the other landing countries because they only present one species, *Monachus monachus*). (www.seaaroundus.org; www.fishbase.se).

Species name	Country		
	Portugal	Spain	France
Cystophora cristata	S	S	
Erignathus barbatus	S	S	S
Halichoerus grypus	S		N
Monachus monachus	S	N	S
Pagophilus groenlandicus			S
Phoca vitulina	N	N	N
Pusa hispida	S		

Table 15. Occurrence (S: stray; N: native) of pinnipeds in Portugal, Spain and France. From www.seaaroundus.org; www.fishbase.se.

Chelonians

The Mediterranean Sea usually hosts three of the seven living species of sea turtles, that is loggerhead (*Caretta caretta*), green (*Chelonia mydas*) and leatherback (*Dermochelys coriacea*). The first two species usually occur and nest in the basin (the green turtle only nests in the Eastern basin), while there is no evidence of nesting for the third one in the Mediterranean (Coll et al, 2010; Hochscheid et al., 2019). Other two species, *Eretmochelys imbricate* and *Lepidochelys kempi* have been observed in the Western Mediterranean Sea, but they are extremely rare and considered to be vagrants (Coll et al., 2010). Concerning the distribution of different species, at the North African shore, from Morocco to Tunisia, loggerheads have been mainly observed, followed by leatherbacks, while green turtles are rarer. The coastline of Morocco is primarily a foraging habitat for loggerheads. In Algeria coastline sea turtles reported are typically loggerheads (70 percent) and some leatherbacks (30 percent). In the case of Tunisia, the wide continental shelf in southern Tunisia, including the Gulf of Gabès, is one of the most important foraging areas for sea turtles in the whole Mediterranean. To date, no nesting has been confirmed, but rising temperatures may make nesting possible in Algeria; thus, authorities began to monitor beach temperatures in 2017 to evaluate potential nesting areas (Source: seaturtlestatus.org). Nesting of loggerheads has been registered along Tunisian coasts, especially on Kuriat island. All the species of marine turtles observed in the Mediterranean can cross Italian waters, while it is only in the last years that the Western coasts of the country are being selected again as nest sites. French Mediterranean waters can host mainly *Caretta caretta* and occasionally *Dermochelys coriacea*. The northernmost nesting sites of loggerheads have been found recently along the French coast. Five sea turtle species have been reported for Spain, but loggerheads are certainly the most common ones in the area. Several nests of *Caretta caretta* have been registered in the last two decades along the mainland coast and in the Balearic Islands. Cyprus and Turkey are nest sites for the loggerhead and green, but for the first, the largest single nesting site is in Greece, specifically in the beach of Zakynthos (UNEP IUCN, 1995).

The 1,622 km (1,007 mi) Algerian coastline is dominated by rocky shores and sandy beaches, and here too sea turtles have been reported since the 1800s as stranding and being caught accidentally by fishers.

Three sea turtle species are observed in the waters adjacent to Tunisia's 1,148 km (713 mi) coastline; greens are rare, leatherbacks are regularly observed, and loggerheads are the most common. The wide continental shelf in southern Tunisia, including the Gulf of Gabès, is one of the most important foraging areas for sea turtles in the whole Mediterranean. The number of accidental captures by trawlers, longlines, and gill nets suggests a high turtle density in that region. Tunisia has an active sea turtle stranding network and a rescue center based in Monastir. Loggerhead turtles also nest regularly in Tunisia, especially on Kuriat Island, which receives about 25 nests each year.

The conservation status of *Caretta caretta* and *Chelonia midas* in the Mediterranean, as established by the IUCN Red List, are least concern and critically endangered, respectively. Moreover, in the case of *Chelonia midas*, some beaches of Turkey and Cyprus have threatened populations.

Concerning the waters of the Atlantic Ocean around Portugal mainland, five of the seven living species of sea turtles are reported (www.sealifebase.se): *Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata* and *Lepidochelys kempii*. The last two are classified as critically endangered by the IUCN Red List Status. The same 5 species of sea turtles are also present in the Atlantic waters of Morocco area.

Seabirds

The diversity of seabird species in the Mediterranean, as well as the density of the population, is quite low compared to that of open oceans and upwelling regions (Coll et al., 2010).

The Mediterranean is the home of several hundred bird species, some of which occur exclusively in this climatic zone. In particular, Coll et a. (2010) classified 15 species of seabirds for the Mediterranean Sea. Ten of these species are gulls and terns (Charadriiformes), four are shearwaters and storm petrels (Procellariiformes), and one is a shag (Pelecaniformes). Moreover, the presence of some birds depends on the season. In autumn some birds migrate from Europe to Africa, and then in spring make their way back.

The number of marine bird taxa in the Western Mediterranean Sea is higher than in the Eastern one. Bird species mainly occurring in the W and S part of the basin, usually migrating to South Atlantic during winter, while bird species typical of the N and E of the Mediterranean are sedentary (Zotier et al., 1999). Also, in general terms, deep-water areas are poorer in the presence of seabirds with respect to coastal and nearshore areas (Carbonera and Requena-Moreno, 2010).

Most of the Mediterranean seabird species (except some large gulls) are protected by European laws. This is due to their small or declining populations or the small number of breeding sites. The list of endangered or threatened species, established under the SPA/BD Protocol, encompasses a total of 25 seabird species.

Concerning the Atlantic Ocean, 23 native species of seabirds are reported at the Portuguese region, of these, 13 form part of the Procellariformes. For Morocco area, 16 native species are registered, 8 of them Procellariiformes. The following table shows the number of seabirds for each landing country (www.seaaroundus.org; www.fishbase.se).

Occurrence	Country						
	Portugal	Spain	France	Italy	Morocco	Algeria	Tunisia
Native	23	29	32	15	16	11	13
Stray	7	10	7	13	4	0	0
Total	30	39	39	28	20	11	13

Table 16. Occurrence of seabirds in landing countries. From www.seaaroundus.org; www.fishbase.se.

Shorebirds

In terms of shorebirds in the landing areas, one of the most relevant species is Kentish plover (*Charadrius alexandrines*). The Kentish plover reproduce and nest in dune area of Zahara landing. The reproduction occurs between April and August and has two periods of nesting, the first between April and early May and the second between end-May and early June.

The Kentish plover is a protected by the Spanish legislation, specifically by the IV annex of the 42/2007 Law (species targeted by special conservation measures in terms of their habitat, with the aim of ensuring their survival and reproduction in their distribution area) and considered as Vulnerable by the 172/2022, Decree (Catalogue of endangered native wildlife and measures of protection and conservation of protected native wildlife).

1.5.2.3 Marine Habitats

One of the most important marine habitats are those characterized by the presence of seagrasses. Indeed, seagrasses are one of the most productive marine ecosystems and represent a major driving force for ecological processes in the coastal system. Its ecological functions range from, species refuge, coastal protection, and CO_2 collector. Therefore, their conservation is of primary concern, in particular in the Mediterranean Sea, where the decreasing of phanerogam seagrasses in the last decades has been noticed in relation to the increase of human activities.

In the Mediterranean area, the following seagrass species are present: *Posidonia oceanica*, *Cymodocea nodosa*, *Zostera noltii*, *Zostera marina*, *Halophila stipulacea* and species of the genus Ruppia. *P. oceanica* is the only endemic species and is the most abundant one on sandy and rocky bottom between 0.5 and 40 m. Its beds cover between 25,000 and 50,000 km^2 of the coastal areas, corresponding to 25% of the sea bottom at depths between 0 and 40 m. On the contrary, *C. nodosa* is less abundant and generally associated with shallow water and coastal lagoons, where it can form dense meadows. C. nodosa can reach more than 30 m of depth in areas not colonized by *P. oceanica* (Ruíz et al., 2009).

The abundance of *Z. noltii* and *Z. marina* is significantly lower with respect to the two seagrass species described above, and it is mostly related to shallow marine and lagoons environment. *H. stipulacea* spreads can be found in coastal marine areas of the Eastern Mediterranean down to 60 m, this is because it is an invasive species that originated in the Indic Ocean, introduced through the Suez Channel. The species of the genus Ruppia are often limited to salt marshes and brackish lagoons.

In the Atlantic Ocean, the Portuguese coast is an important zone for seagrass meadows, being the transition zone between two different basins. Portugal is the only location in the Atlantic Europe where the association of *Cymodacea nodosa*, *Zostera marina* and *Zostera noltii* can be found and represent the limit distributional zone for *Cymodacea nodosa* (north and western limit) and *Zostera marina* (south limit) (Henriques Cunha and Álvares Serrão, 2011).

Posidonia oceanica, *Zostera marina* and *Zostera noltii* are included in the Annex II of the Barcelona Convention for the Protection of the Marine Environment and the Coast Region of the Mediterranean, considered as a priority for conservation.

A first screening about marine habitats characterizing the area interested by the Medusa system are done on the base of the EUSeaMap (2021) –Broad-scale seabed habitat map for Europe (EUNIS 2019) found in EMODnet Seabed Habitats portal.

More detailed information about marine habitats, including seagrasses, are presented for some of the landing areas that have already been investigated for permitting process.

1.5.2.3.1 Main trunk

The Atlantic offshore section of the Medusa trunk will mainly lay on abyssal seabed (upper, mid and lower), followed by lower bathyal seabed and upper bathyal mud.

In the Mediterranean Sea the trunk of Medusa system will mainly lay on Mediterranean upper bathyal and lower bathyal mud (ME65 and MF65) in the Alboran Basin, the Pelagian Shelf and the Eastern Basin, and on Mediterranean abyssal mud (MG65) in the Algerian Basin and in a limited section of the Libyan Sea. In addition, seabed in a section of the Pelagian Shelf is composed by Mediterranean circalittoral coarse sediments (MC35).

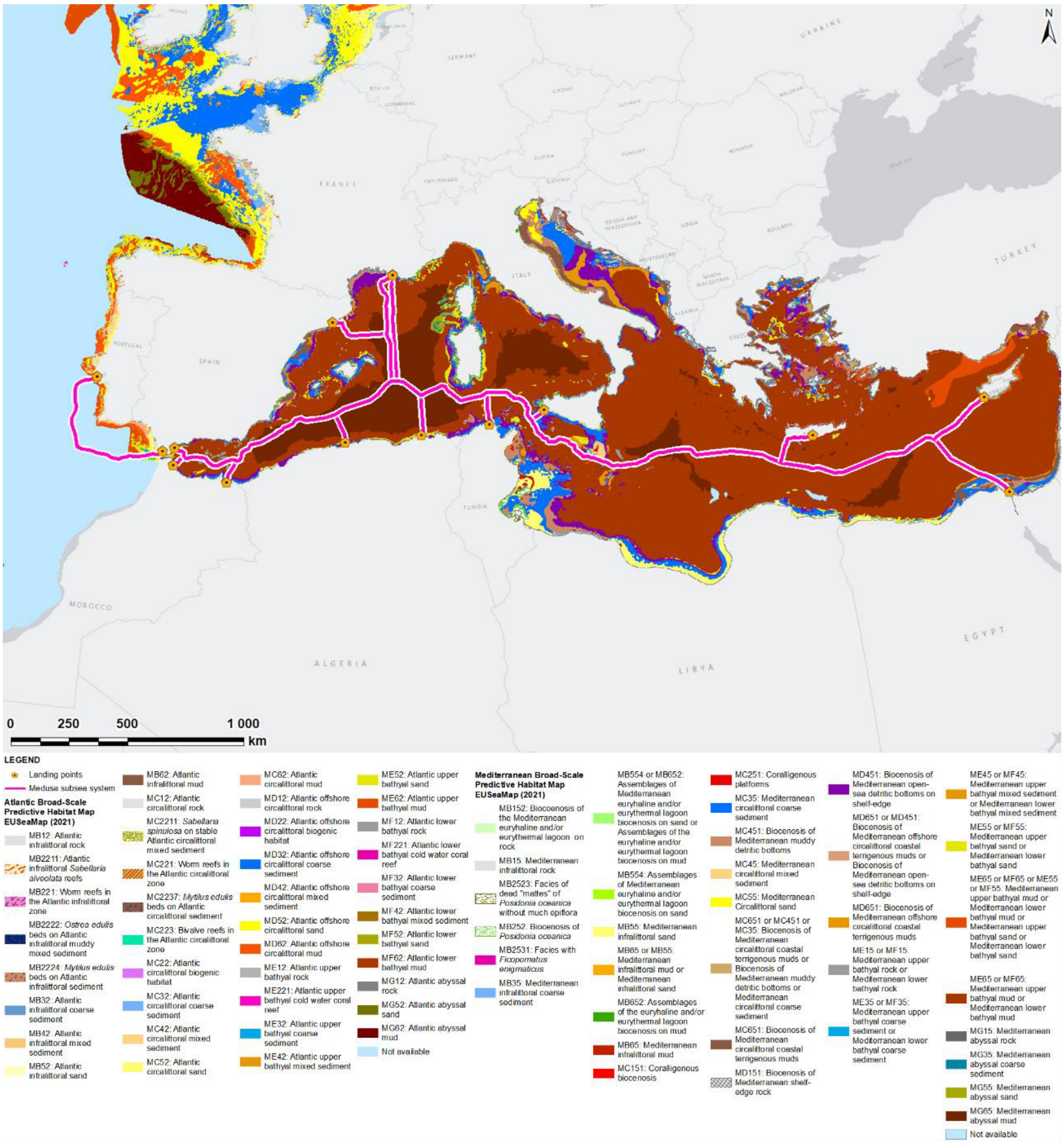

Figure 97. EUSeaMap (2021) Habitat types (EUNIS 2019). Source: Elaborated with data from EMODnet Seabed Habitats.

1.5.2.3.2 Portugal: Lisbon landing

According to the Broad-Scale Predictive Habitat Map (EUSeaMap (2021)) based on the EUNIS 2019 classification, marine habitats in the proximity of Lisbon landing are (from the coast seawards): Atlantic infralittoral sand (MB52), Atlantic circalittoral sand (MC52), Atlantic circalittoral mud (MC62) and Atlantic offshore circalittoral mud (MD62), where a patch of Atlantic offshore circalittoral sand (MD52) is also present. Then, Medusa subsea system continues on Atlantic upper bathyal mud (ME62) and Atlantic lower bathyal seabed. Concerning rocky habitats, near the coast, at the east and the west of the cable, Atlantic infralittoral rock (MB12) and Atlantic circalittoral rock (MC12) is recognized. Then, at higher depths, some areas of Atlantic offshore circalittoral rock (MD12) are also present in the zone. However, they are avoided by Medusa route.

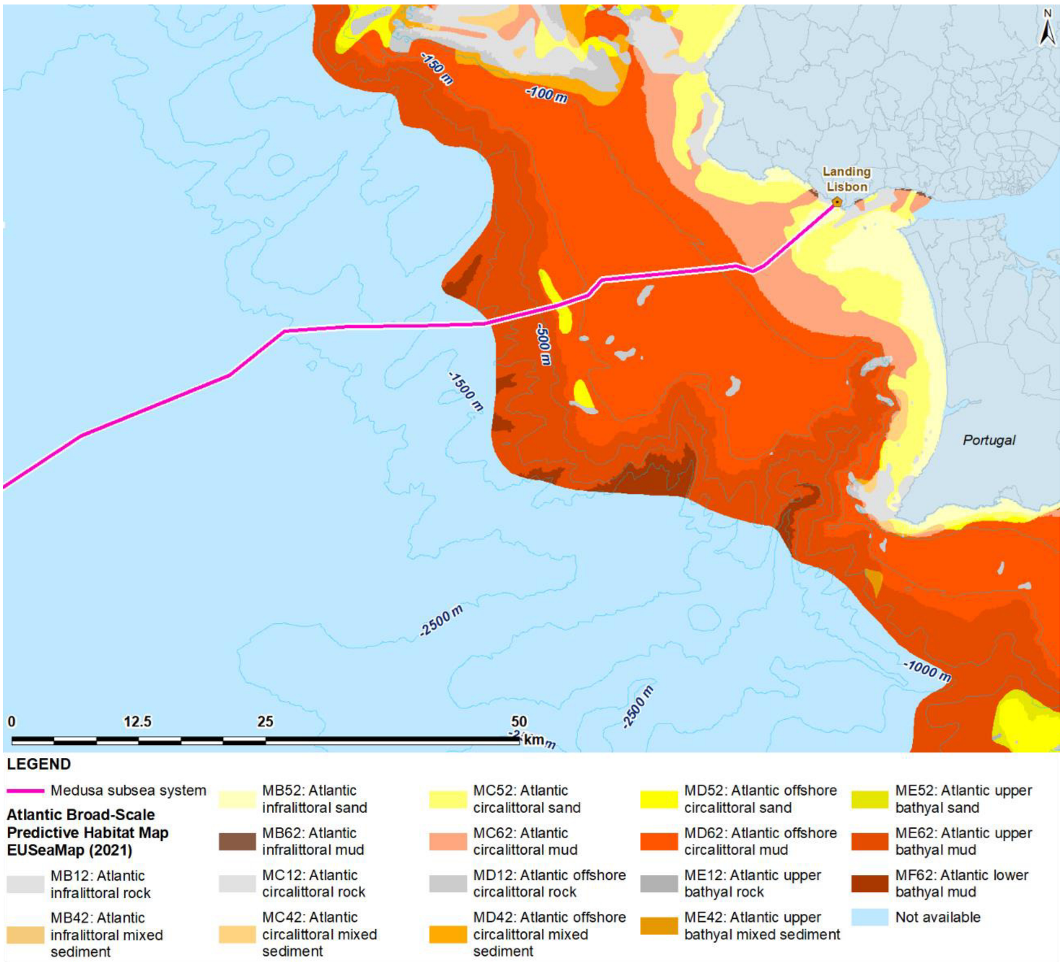

Figure 98. EUSeaMap (2021) Habitat types (EUNIS 2019) at Lisbon landing. Source: Elaborated with data from EMODnet Seabed Habitats.

1.5.2.3.3 Spain: Zahara, Torreguadiaro and Barcelona landing

Study area: trunk of Medusa submarine system, branches and landing sites.

Zahara

According to the Broad-Scale Predictive Habitat Map (EUSeaMap (2021)) based on the EUNIS 2019 classification, marine habitats in the proximity of Zahara landing are (from the coast seawards): Mediterranean infralittoral sand (MB55), Mediterranean circalittoral coarse sediment (MC35) and biocenosis of Mediterranean open-sea detritic bottoms on shelf-edge (MD451). Then

Medusa system cross a limited section of Atlantic upper bathyal coarse sediment (ME32) and a larger portion of Atlantic upper bathyal sand (ME52), entering finally the Atlantic upper bathyal mud (ME62).

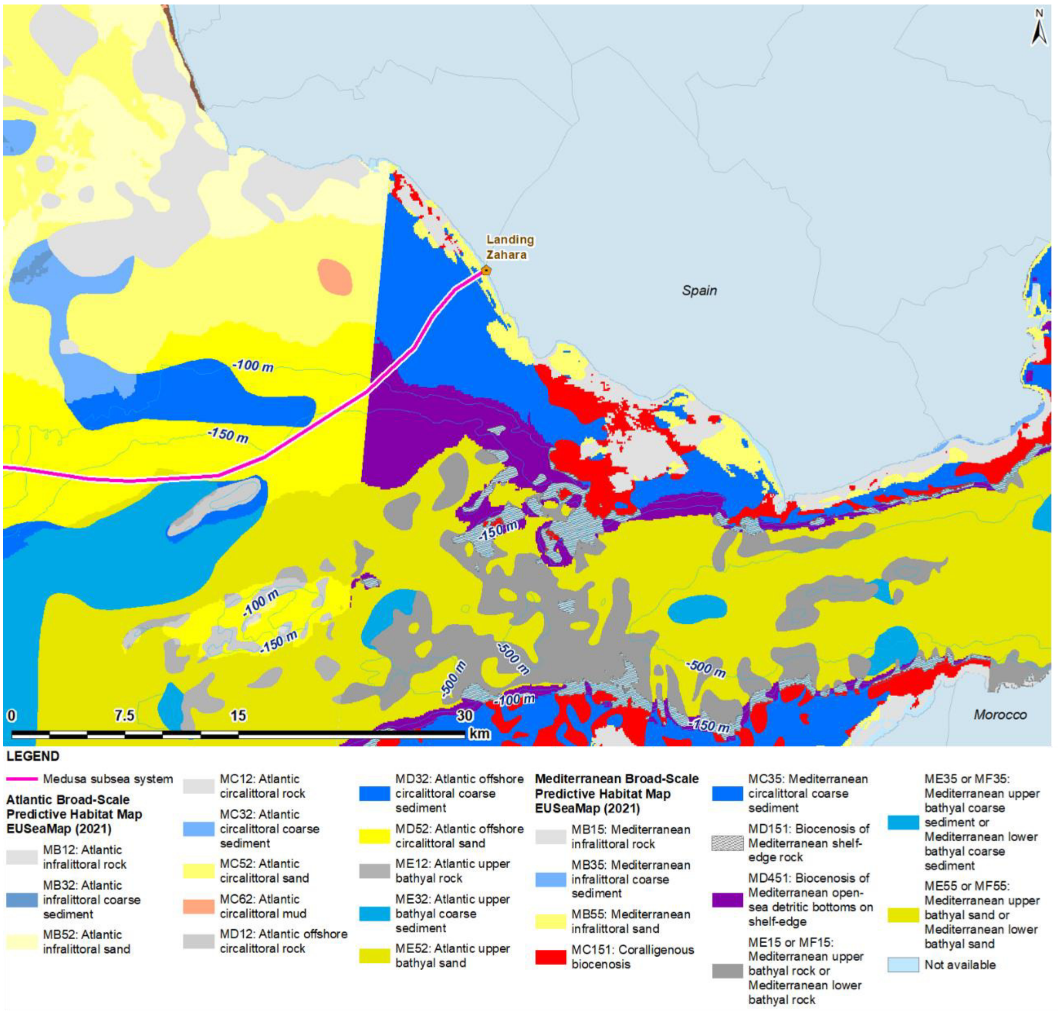

Figure 99. EUSeaMap (2021) Habitat types (EUNIS 2019) at Zahara landing. Source: Elaborated with data from EMODnet Seabed Habitats.

Regarding the continental shelf habitats, significative sensitive habitats that might be present in the area close to the Medusa cable are “Sandbanks permanently covered by shallow seawater”, “reefs” and “Submerged or semi-submerged sea caves”.

The first one is a habitat formed by shallow sandy accumulations linked to the open coastal area or developed within intermediate environments, preferably estuaries, estuaries and some type of tidal lagoons. Depending on this location, its characteristics are very different. In the sublittoral zone of the Atlantic and Mediterranean slopes, for example, sandy shallows are developed on the beach fronts, exclusively related to the action of the waves, in this case and due to their high mobility, they are devoid of vegetation. These structures are called external linear terraces or wave batter bars and are associated with dissipative beaches. On the Spanish coasts there are also sandy terraces that develop in more external areas. Lastly, the grasslands of the phanerogam *Cymodocea nodosa* can be associated with this habitat.

The elaboration of data from the Ecocartography of the province of Cadiz shows that the route of the cable would only interfere with the habitat associated with wave beat bars in the first 400 m from the coast, while the absence of *Cymodocea nodosa* meadows is evident in the area.

The habitat “reefs” is made up of all those compact hard substrates that emerge on the seabed in the sublittoral (submerged) or littoral (intertidal) zone, whether of biogenic or geological origin. The reefs can present a whole bathymetric zonation of benthic communities, including concretions of biogenic origin.

“Submerged or semi-submerged caves” habitat can be considered a special topology within habitat “reefs”. Caves are always located on rocky bottoms and their communities are characterized by low light. The lack of light prevents the development of photosynthetic organisms, relegated to the adjacent seabed. On the contrary, this type of habitat is a refuge for a rich fauna of high scientific interest. Its distribution usually coincides with calcareous mountain massifs, which often extend underwater, emerging sporadically in the form of archipelagos.

The elaboration of the data from the Ecocartography of the province of Cadiz, as well as of the data of the *Junta de Andalucía* (REDIAM data), show how the Medusa cable would not cross the habitats “reefs” and “Submerged or semi-submerged caves” present in the study area, since Medusa subsea system would lay only on soft bottoms, avoiding any rocky areas.

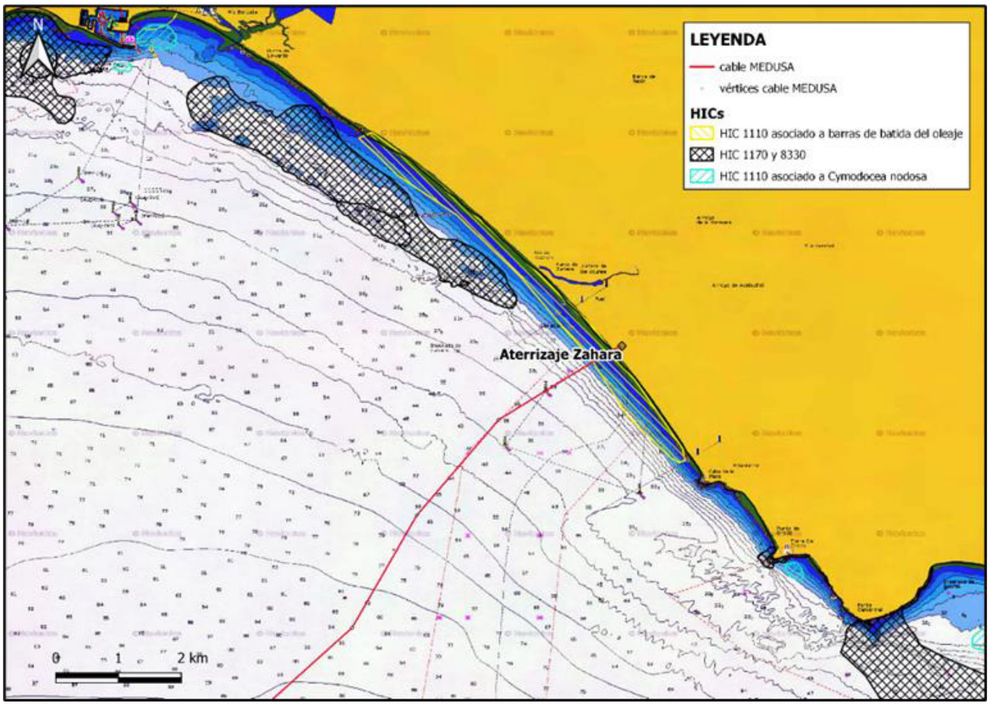

Figure 100. Habitats of Community Interest close to the Zahara de los Atunes landing. It is possible to recognize "Reef" areas (black squares) and habitat "Sandbanks permanently covered by shallow seawater" (oblique yellow lines). Source: AFR-IX Telecom-Tecnoambiente, 2021.

The following images show soft bottoms in the study area up to 17 m of depth. The photos have been obtained during a survey in the frame of PIPs in relation to Zahara landing site.

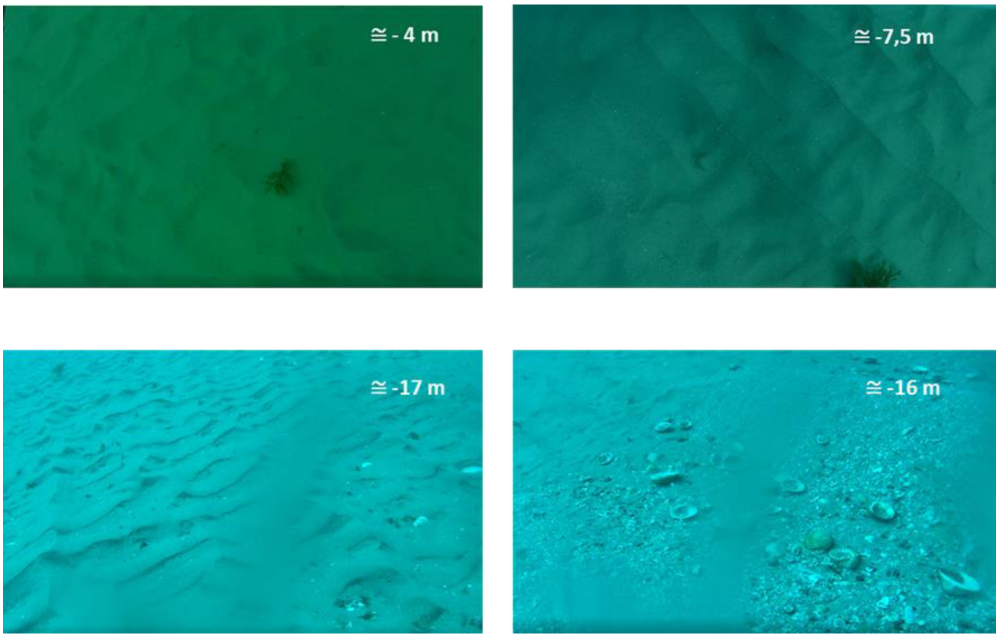

Figure 101. Photos of seabed at Zahara landing zone, from the coast up to a depth of 17 m. Source: Tecnoambiente, 2021.

Another habitat that might be theoretically present is that of maërl bottoms, developed on infralittoral or circalittoral coarse sand and gravel with moderate currents that remove fine sediment. On the Atlantic coast they are more frequently found at depths of 20 m, although they can reach depths of 40 m. there are no data about the presence of this habitat at Zahara landing zone.

Concerning deep-sea habitats, the most probable sensitive habitat that can be found on the cable route is that characterized by the presence of communities dominated by pennatulacean individuals. These communities are widely distributed in the area and can be found in circalittoral soft bottoms and deep bottoms, sometimes associated with structures produced by gas escape. The most common species are *Pennatula rubra* (60-300 m) and *Funiculina quadrangularis* (550-640 m), being the last one more limited in the Atlantic zone of the project.

Other deep-sea habitats that might be found are coral gardens, which can be found up to 800 m deep, mainly on rocky bottoms, but also on soft bottoms. As defined by OSPAR, this habitat is characteristic of deep water and does not include inshore or shelf habitats with pennatulaceans and octocoral communities. This habitat is usually associated to rocky bottoms, and for this it should not be present in Zahara study area.

Finally, aggregations of deep-sea sponges are found at depths of 350-1000 m in the Atlantic zone in relation to stable hard substrata of the bathyal floor, associated with submarine structures emitting gases, but also in muddy or sandy-muddy bathyal substrata. The information available on these communities comes from the study of the area of the Nature 2000 site “Mud Volcanoes of Cadiz Gulf”. Regarding the soft substrate species, the *Thenea muricata* species has been found in the mud vulcanos and their adjacent areas in the northern area of this Natura 2000 area, while a high-density aggregation of *Pheronema carpenteri* has been detected in the adjacent area to the Saint Petersburg volcano (depth between 900 and 1000 m), which is the closest volcano to the route of the cable, although it is located at a distance of 7.7 km from it. Regarding hard substrate sponges, different species have been found at different depths, between 366 and 730 m, at least, always in relation to the volcanic fields of the Red Nature 2000 cited site. Taking into account the distance from Medusa subsea system to mud volcanoes, no affection to this habitat is expected for the project.

Torreguadiaro

According to the Broad-Scale Predictive Habitat Map (EUSeaMap (2021)) based on the EUNIS 2019 classification, marine habitats in the proximity of Torreguadiaro landing are (from the coast seawards): Mediterranean infralittoral sand (MB55), Mediterranean circalittoral coarse sediments (MC35), Coralligenous biocenosis (MC151), biocenosis of Mediterranean open-sea detritic bottoms on shelf-edge (MD451), biocenosis of Mediterranean shelf-edge rock (MD151), biocenosis of Mediterranean offshore circalittoral coastal terrigenous muds (MD651). Then, Medusa system continues on Mediterranean upper or lower bathyal mud (ME65 or MF65) and Mediterranean upper or lower bathyal sand (ME55 or MF55).

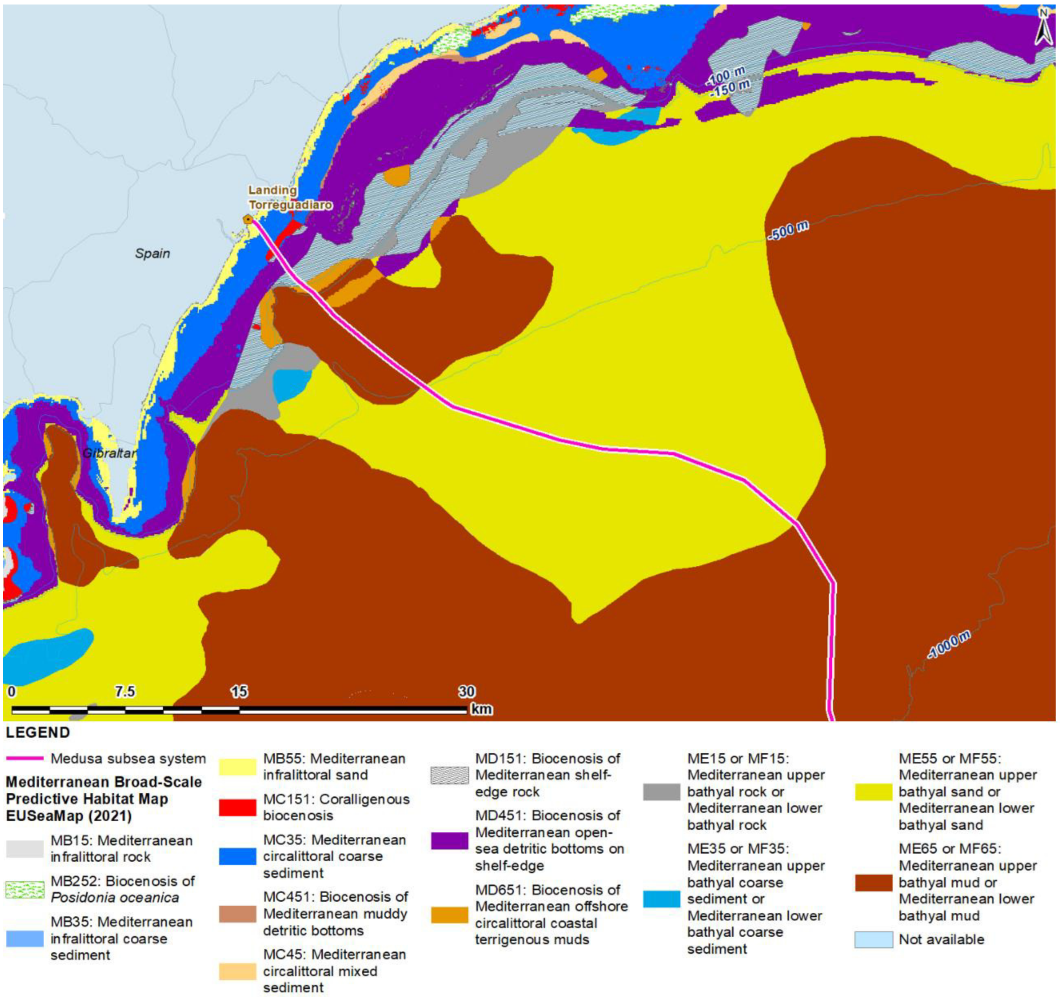

Figure 102. EUSeaMap (2021) Habitat types (EUNIS 2019) at Torreguadiaro landing. Source: Elaborated with data from EMODnet Seabed Habitats.

The sensitive habitats that might be present in the area of Torreguadiaro landing are “sandbanks permanently covered by shallow seawater”, “Reefs” and “Submerged or semi-submerged sea caves”.

According to data from the *Junta de Andalucía* (REDIAM), the first habitat is not present in the study area. The presence of *Cymodocea nodosa* meadows can also be completely excluded in the study area. The elaboration of the Ecocartography of Cadiz allows to establish the presence of a small sandy bar related to the beating of the waves in front of the Torreguadiaro landing. However, Medusa cable route will not cross this sandy bar.

Concerning the habitat “Reefs”, the habitat includes all those compact hard substrates that emerge on the seabed in the sublittoral (submerged) or littoral (intertidal) zone, whether of biogenic or geological origin. Data from the Ecocartography of the province of Cadiz, as well as the REDIAM data, show that the route of the cable would interfere with this habitat, associated with the infralittoral sciaphilous algae community of calm regime with gorgonian facies. Actually, sonar data from 2013 (Tecnoambiente, 2013), show that the rocky areas that emerge in this strip indicated by the Ecocartography of Cadiz are much more limited. However, crossing of reef habitat may potentially occur in the zone. Pre-installation geophysical and geotechnical survey will allow to analyze in the detail the distribution of this habitat; results from this survey will be used to do a micro-routing of Medusa subsea system with the aim to avoid or minimize the crossing of habitat “Reef”.

Finally, the habitat “Submerged or semi-submerged caves” is not present in the study area.

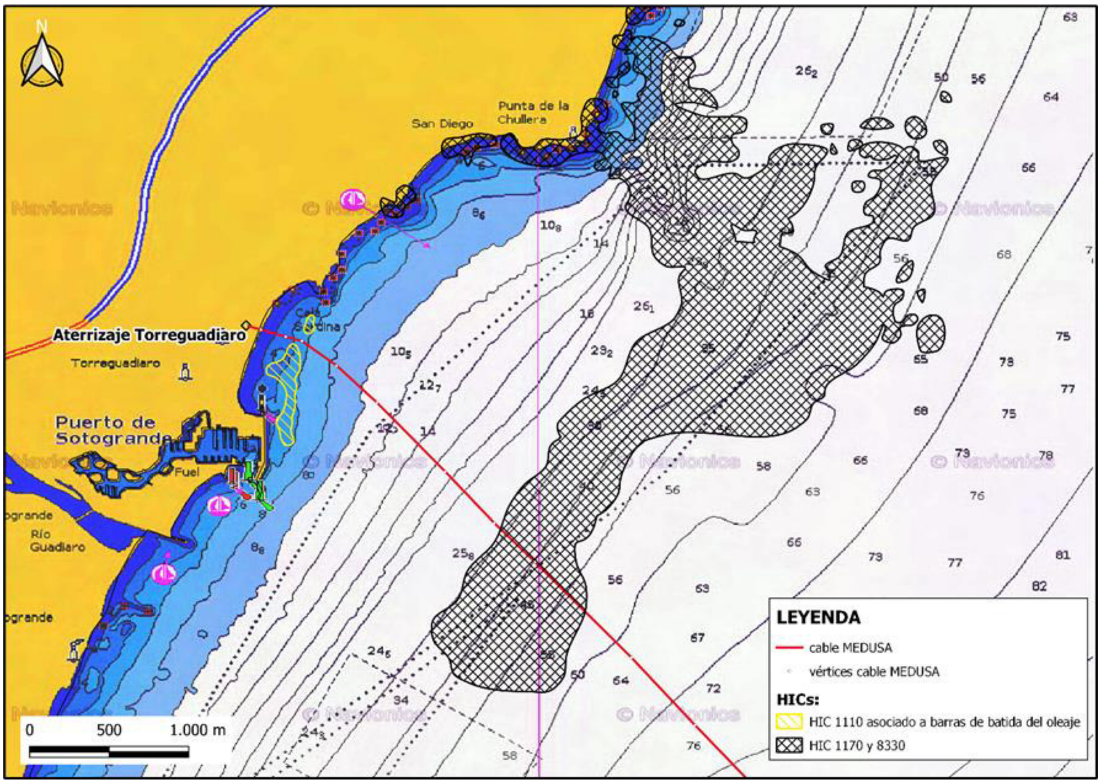

Figure 103. Habitats of Community Interest close to the Torreguadiaro landing. It is possible to recognize “Reef” areas (black squares) and habitat “Sandbanks permanently covered by shallow seawater” (oblique yellow lines). Source: AFR-IX Telecom-Tecnoambiente, 2021.

The following images show soft bottoms in the study area up to 7 m of depth. The photos have been obtained during a survey in the frame of PIPs in relation to Torreguadiaro landing site.

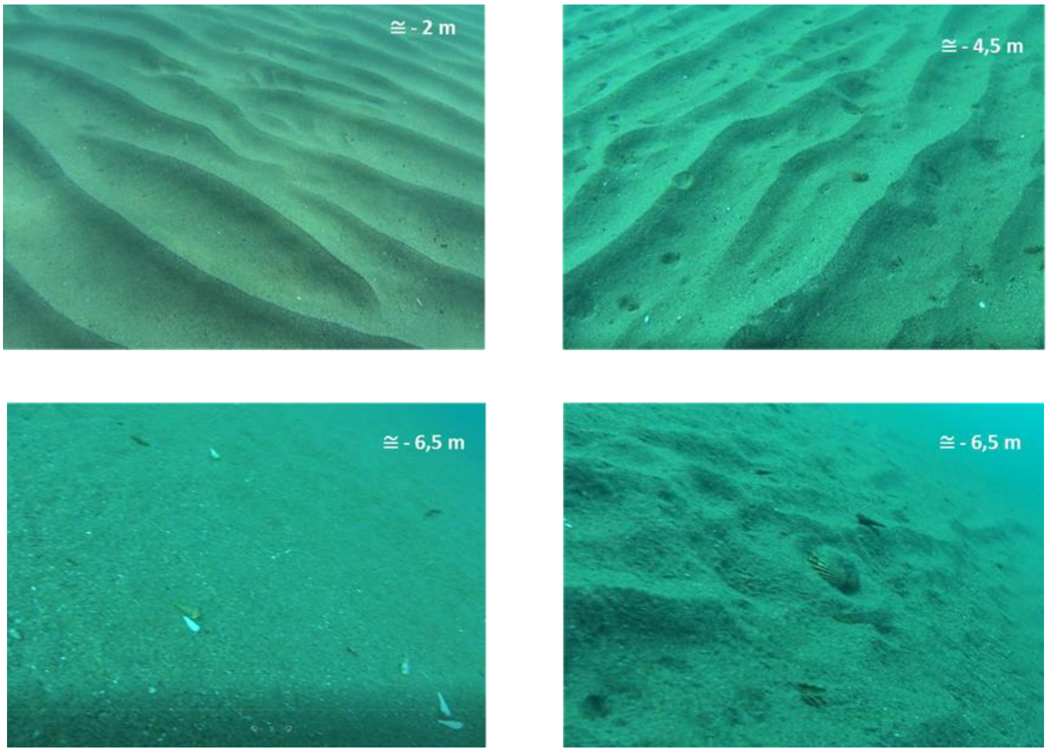

Figure 104. Potos of seabed from the coast up to a depth of 7 m. Source: Tecnoambiente, 2021.

In addition, in the frame of PIPs, videos have been obtained at depths of -29 and -45 m in an area located approximately 1000 m further north with respect to the route of the cable. Here the seabed is actually fine sand and mud. Characterized by the presence of specimens of the soft coral *Veretillium cynomorium*, with medium-low density depending on the area. This cnidarian can colonize different types of soft substrate, with a certain percentage of fines.

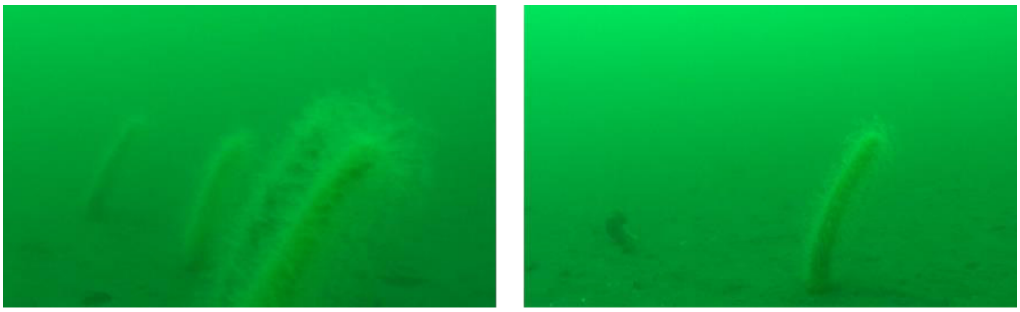

Figure 105. Individuals of *Veretillum cynomorium* at a depth of 30 m in the study area, Source: Tecnoambiente, 2021.

Another habitat that might theoretically be present is that of maërl bottoms, usually developed on infralittoral or circalittoral coarse sand and gravel with moderate currents that remove fine sediment. It is generally found in front of the capes, where the currents are adequate. The most common depth range at which they are found in the Alboran sea is 30-80 m. Maërl is mainly distributed in particular at the Alboran island, while there are not bibliographic data about its presence at Torreguadiaro landing zone.

Concerning deep-sea habitats, the most probable sensitive habitat that can be found on the cable route is that characterized by the presence of communities dominated by pennatulacean individuals. These communities are widely distributed in the area and can be found in circalittoral soft bottoms and deep bottoms, sometimes associated with structures produced by gas escape. The most common species are *Pennatula rubra* (60-300 m, optimal distribution between 75 and 90 m) and *Funiculina quadrangularis* (550-640 m).

Other deep-sea habitats that may be found are coral gardens, which can be found up to 800 m deep, mainly on rocky bottoms, but also on soft bottoms. As defined by OSPAR, this habitat is characteristic of deep water and does not include inshore or shelf habitats with pennatulaceans and octocoral communities.

Barcelona

According to the Broad-Scale Predictive Habitat Map (EUSeaMap (2021) based on the EUNIS 2019 classification, marine habitats in the proximity of Barcelona landing are (from the coast seawards): Mediterranean infralittoral coarse sediment (MB35), Mediterranean infralittoral mud (MB65), biocenosis of Mediterranean circalittoral coastal terrigenous muds (MC651), Mediterranean circalittoral coarse sediments (MC35), Mediterranean circalittoral mixed sediments (MC45) and biocenosis of Mediterranean open-sea detritic bottoms on shelf-edge (MD451). Then Barcelona branch of Medusa system continues on Mediterranean upper bathyal mud (ME65) or Mediterranean lower bathyal mud (MF65), finally reaching Mediterranean abyssal mud (MG65).

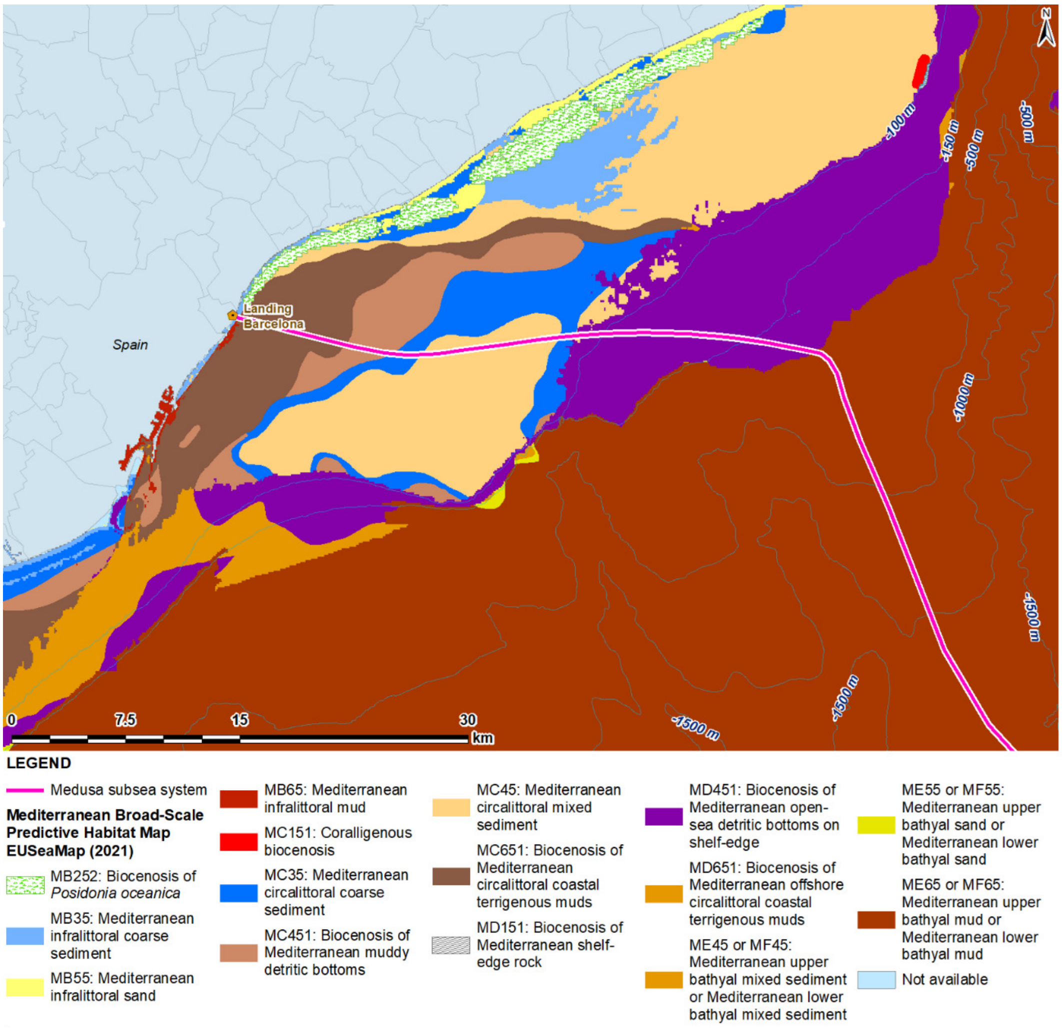

Figure 106. EUSeaMap (2021) Habitat types (EUNIS 2019) at Barcelona landing. Source: Elaborated with data from EMODnet Seabed Habitats.

Regarding the continental shelf area, most of the cable route runs over muddy bottoms, with an absence of relevant sessile communities and dominated by crustaceans and fish. It is in the area closest to the coast where there are suitable combinations of substrate and light for the development of the most relevant communities. This area coincides approximately with the first 10 km from the beach.

The first meters are characterized by communities of fine high sands, with species of bivalves, basically *Donax trunculus* and *Chamelea gallina*. This area was protected to allow the recovery of bivalve populations, as it was an important shell fishing zone. However, according to Orden APA/798/2022 on mollusks production areas, these bivalves are no more produced in the zone, indicating that these populations have not been recovered yet.

Next, the route of the cable runs through a community of fine, well-calibrated sands, dominated by bivalves (*Spisula subtruncata*), but throughout its route it avoids communities of sciaphilic algae and meadows of *Posidonia oceanica* and *Cymodocea nodosa* that are sensitive to laying and burial of cables.

The following map show the presence of *Posidonia oceanica* meadow and NE of Medusa landing site. No interference is expected between the cable and the meadow.

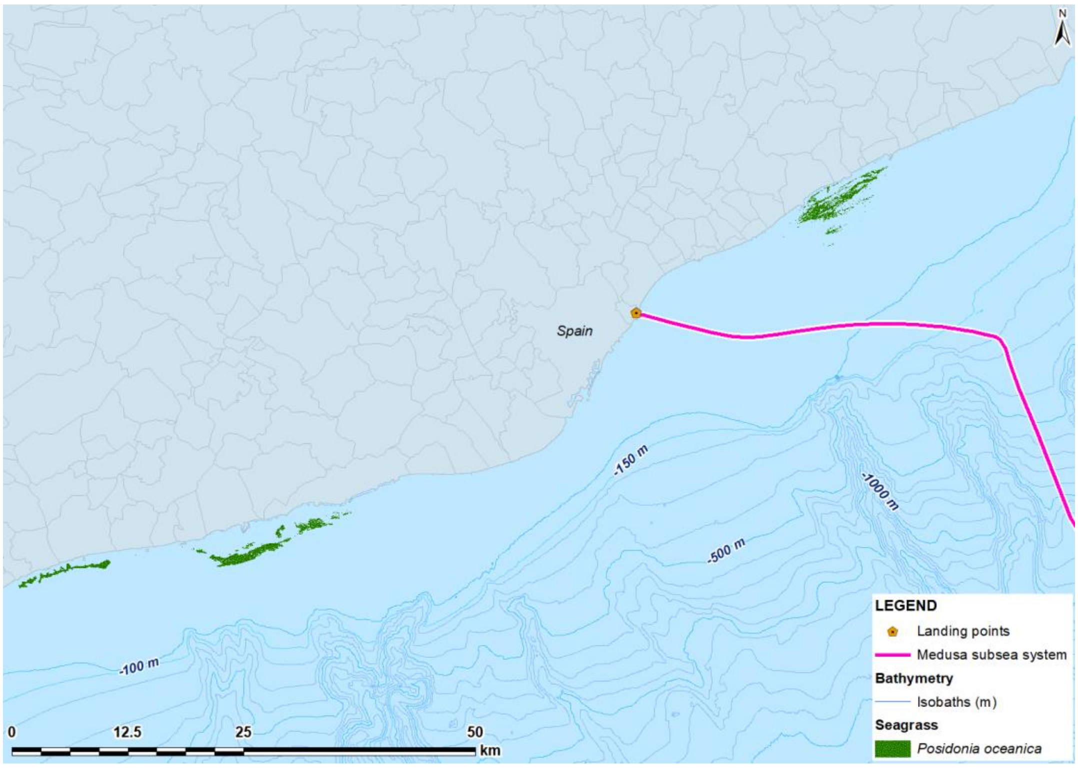

Figure 107. Distribution of *Posidonia oceanica* near Barcelona landing. Source: Elaborated with data from Atlas de praderas de fanerógamas marinas de España.

Concerning deep-sea habitats, the most probable sensitive habitat that can be found on the cable route is that characterized by the presence of communities dominated by pennatulacean individuals, such as *Funiculina quadrangularis* and *Pennatula rubra*, which are common at depths between 50 and 200 m. Although a direct interaction is to be expected for some individuals when laying the cable, the sensitivity of the biocenosis can be described as low to medium, given the small diameter of the cable and its immediate stability on these bottoms. The functionalities of the habitat will not be questioned.

Other sensitive deep-sea habitats are those of submarine canyons, dominated by sessile fauna, generally cnidarians (anemones and sea pens) as well as polycheates, and those of seamounts. Both of them are considered hot spots of biodiversity and are avoided as far as possible when planning submarine cables routes, as they represent also a high risk for the stability of the cable (high slopes). With respect to these habitats, adjacent muddy-bottoms are considered poor in terms of biodiversity.

Crossing of seamounts and submarine canyons is avoided for the Barcelona branch of Medusa submarine system. At the continental slope the cable will lay in the rift located between Mataró and Blanes canyons. This zone is characterized by steep slopes, generally forming an unstable habitat that gives rise to communities dominated by fish, crustaceans and mollusks (cephalopods) instead of sessile animals typical of more stable habitats such as those mentioned above.

1.5.2.3.4 France: Marseille landing

According to the Broad-Scale Predictive Habitat Map (EUSeaMap (2021)) based on the EUNIS 2019 classification, marine habitats in the proximity of Marseille landing are (from the coast seawards): Mediterranean infralittoral sand (MB55), Mediterranean infralittoral coarse sediment (MB35), Facies of dead "mattes" of *Posidonia oceanica* without much epifloral (MB2523) and Mediterranean circalittoral coarse sediment (MC35). Then, Segment 1 of Medusa system will cross the biocenosis of Mediterranean circalittoral coastal terrigenous muds (MC651) and a large section of the biocenosis of Mediterranean open-sea detritic bottoms on shelf-edge (MD451). On the contrary, Segment 2 will cross a more limited portion of the biocenosis of Mediterranean open-sea detritic bottoms on shelf-edge (MD451) and also the Mediterranean upper or lower bathyal sand (ME55 or MF55). From the end of the continental platform, both segments will lay on Mediterranean upper or lower bathyal (ME65 or MF65), finally reaching the Mediterranean abyssal mud zone (MG65).

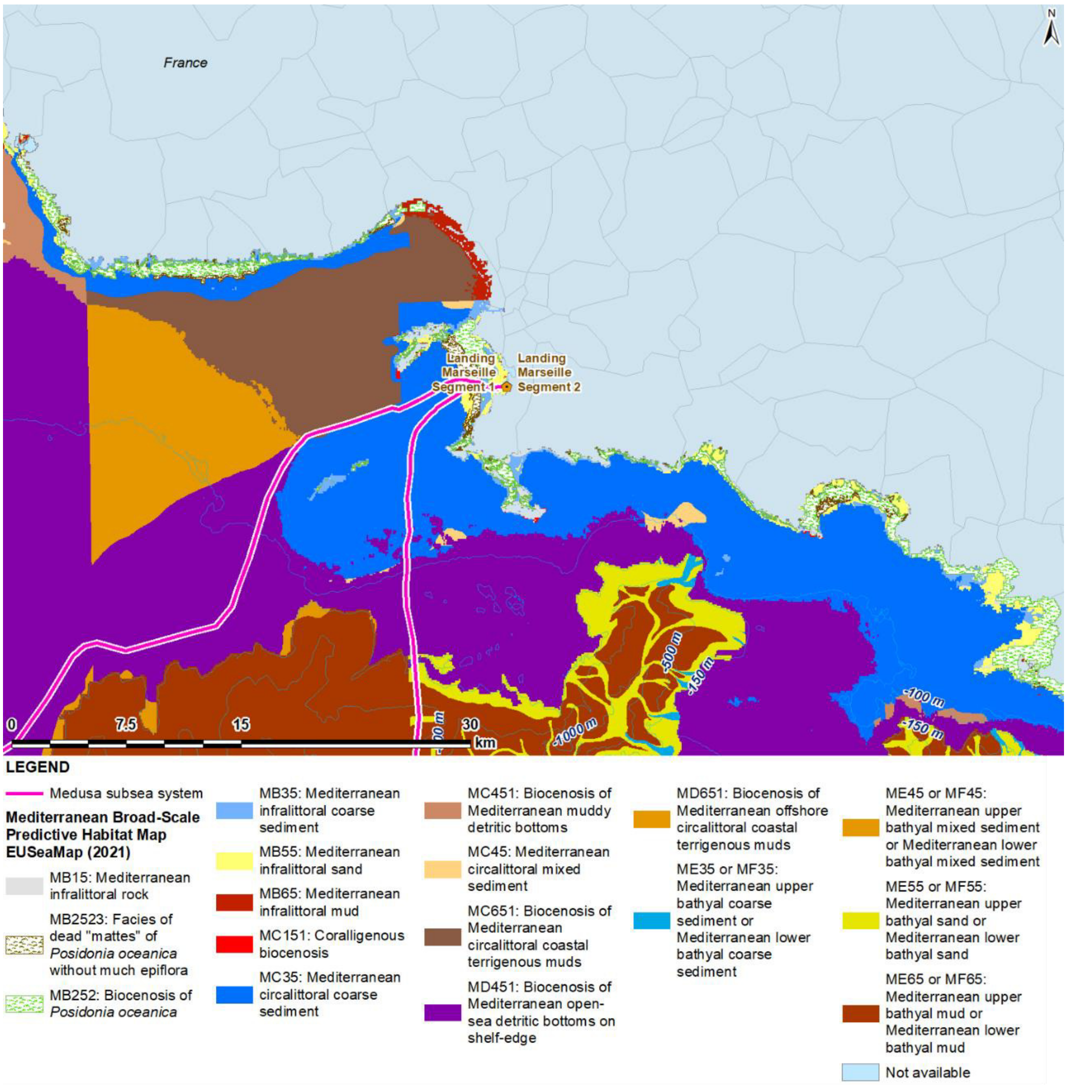

Figure 108. EUSeaMap (2021) Habitat types (EUNIS 2019) at Marseille landing. Source: Elaborated with data from EMODnet Seabed Habitats.

The sea floor of the Endoume Bay (all the coast of the southern half of the city of Marseille) is characterized by an extensive meadow of the *Posidonia oceanica* seagrass. Depending on the data source being consulted, this meadow is more or less extensive, being at the center of this area where the meadow is sparsely dense or, depending on the source, practically non-existent.

The following map represents marine habitats present in shallow water near Marseille landing. A plain meadow of *Posidonia oceanica* forming a strip parallel to the coast is present in the zone. Then, at the level of the Vieille Chapelle beach (landing site) the meadow is narrowest, more discontinuous and also dominated by dead matte of Posidonia. Then, at depths higher than 25 m, the coastal detrital biocenosis is present, followed by offshore detrital biocenosis at deep waters.

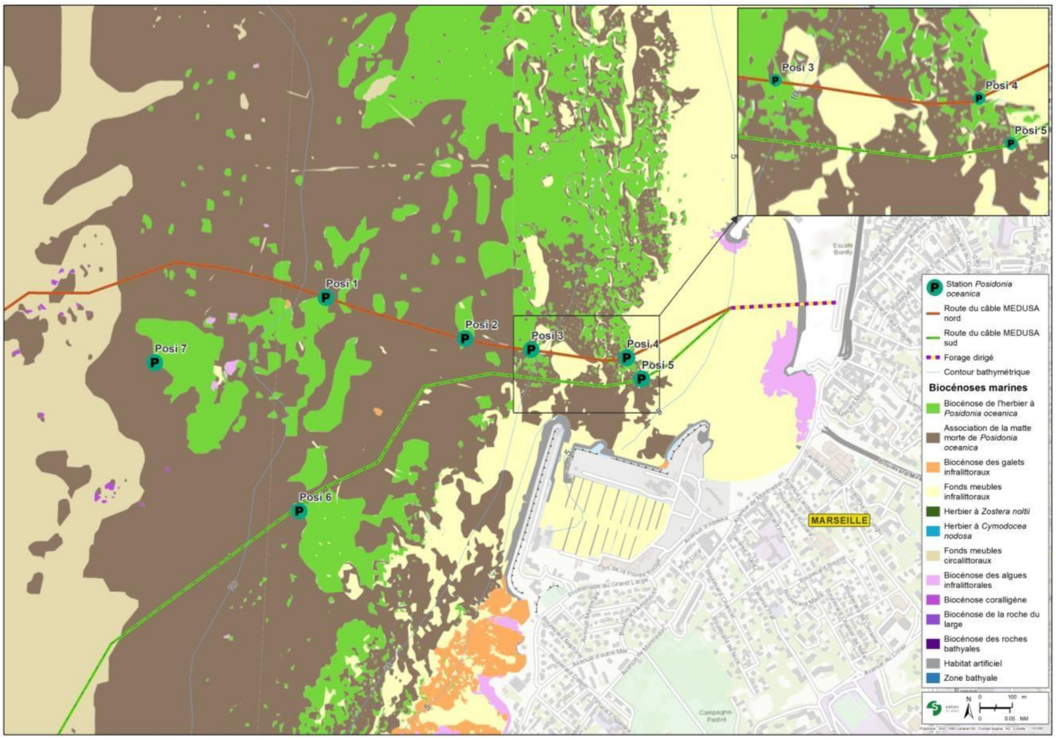

Figure 109. Seabed marine habitats map near Marseille landing. Green: Posidonia meadow; Brown: dead matte of Posidonia. Source: AFR-IX, 2021.

In the context of permitting process for Marseille landing, a marine biocenoses survey has been conducted in the zone between 0 and 90 m during spring 2021. The range depth where *Posidonia oceanica* has been found is 5-28 m.

At depths between 12 and 28 m, dead matte of Posidonia has been identified (Figure 110). Here seabed is mainly made up of sandy dead matte as well as coarse sand with shells. Individuals of calcareous red algae (rhodolites) and of green algae (species *Flabellia petiolate* and *Codium bursa*) are observed on the sediments covering the dead matte. Regarding benthic invertebrates, few species have been noticed: the sea cucumber *Holothuria sp*., the molusk *Flabellina affinis*, and the spirograph *Sabella spallanzanii*.

Figure 110. Dead matte of *Posidonia oceanica*. Source: AFR-IX Telecom, 2021.

At depths between 12 and 8 m, the Posidonia meadow appears in different discontinuous forms: in hill formations (from 0.7 to 1 m high) and on matte (meadow developed on significant heights of matte and forming drop-offs at interfaces with sandy bottoms). Dead matte of Posidonia have been found too. Sands alternated to dead matte and seagrass areas are coarse and shelly. The meadow seems to have good condition, with long leaves covered with epiphytes and a high rate of leave coverage. However, the state of health of the meadow has been assessed during the survey and the general result is that the meadow is qualified as normal with a certain stability, but with a lower limit showing sign of regression.

Figure 111. Posidonia meadow. Source: AFR-IX Telecom, 2021.

At depths between 8 and 5 m the biocenosis of well-calibrated fine sands has been found. This biocenosis extends to the coast.

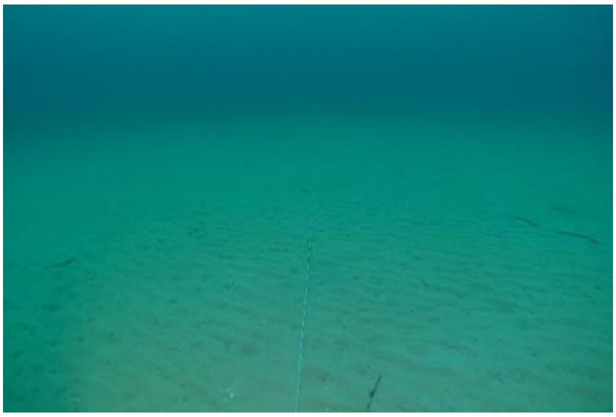

Figure 112. Biocenosis of well-calibrated fine sands. Source: AFR-IX Telecom, 2021.

Seabed habitat survey has confirmed the presence of coastal detrital biocenosis and offshore detrital biocenosis from about 25 m up to 94 m. The cable route does not cross any coralligenous zone in this area and remains on poor detrital bottoms.

The seabed habitat survey has showed that the route of Medusa cable will have a reduced influence on *Posidonia oceanica*, by crossing mainly dead matte zones.

ROV transects at depths between 60 and 94 m have shown the presence of individuals of sea pens such as *Funiculina quadrangularis* (Figure 113) and *Pennatula rubra* (Figure 114), corals (*Alcyonium palmatum*) (Figure 115), sponges (*Axinella damicornis*).

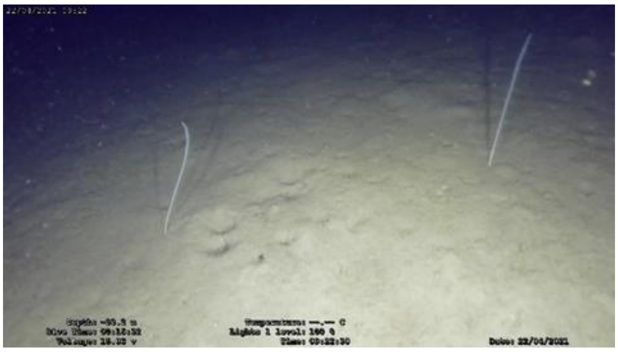

Figure 113. Individuals of *Funiculina quandrangularis*. Source: AFR-IX, 2021.

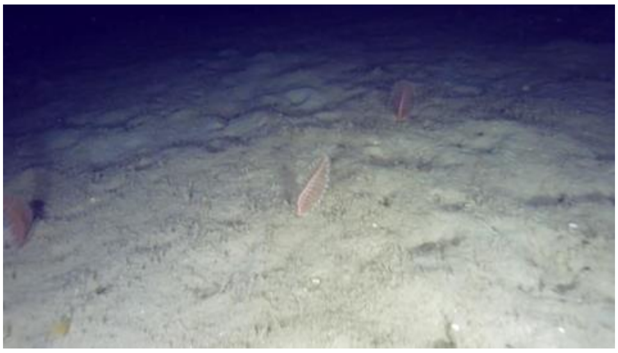

Figure 114. Individuals of *Pennatula rubra*. Source: AFR-IX, 2021.

Figure 115. Individual of *Alcyonium palmatum*. Source: AFR-IX, 2021.

1.5.2.3.5 Italy: Mazara landing

According to the Broad-Scale Predictive Habitat Map (EUSeaMap (2021)) based on the EUNIS 2019 classification, marine habitats in the proximity of Mazara landing are (from the coast seawards): Mediterranean infralittoral sand (MB55), biocenosis of *Posidonia oceanica* (MB252), Mediterranean circalittoral coarse sediments (MC35) and biocenosis of Mediterranean open-sea detritic bottoms on shelf-edge (MD451).

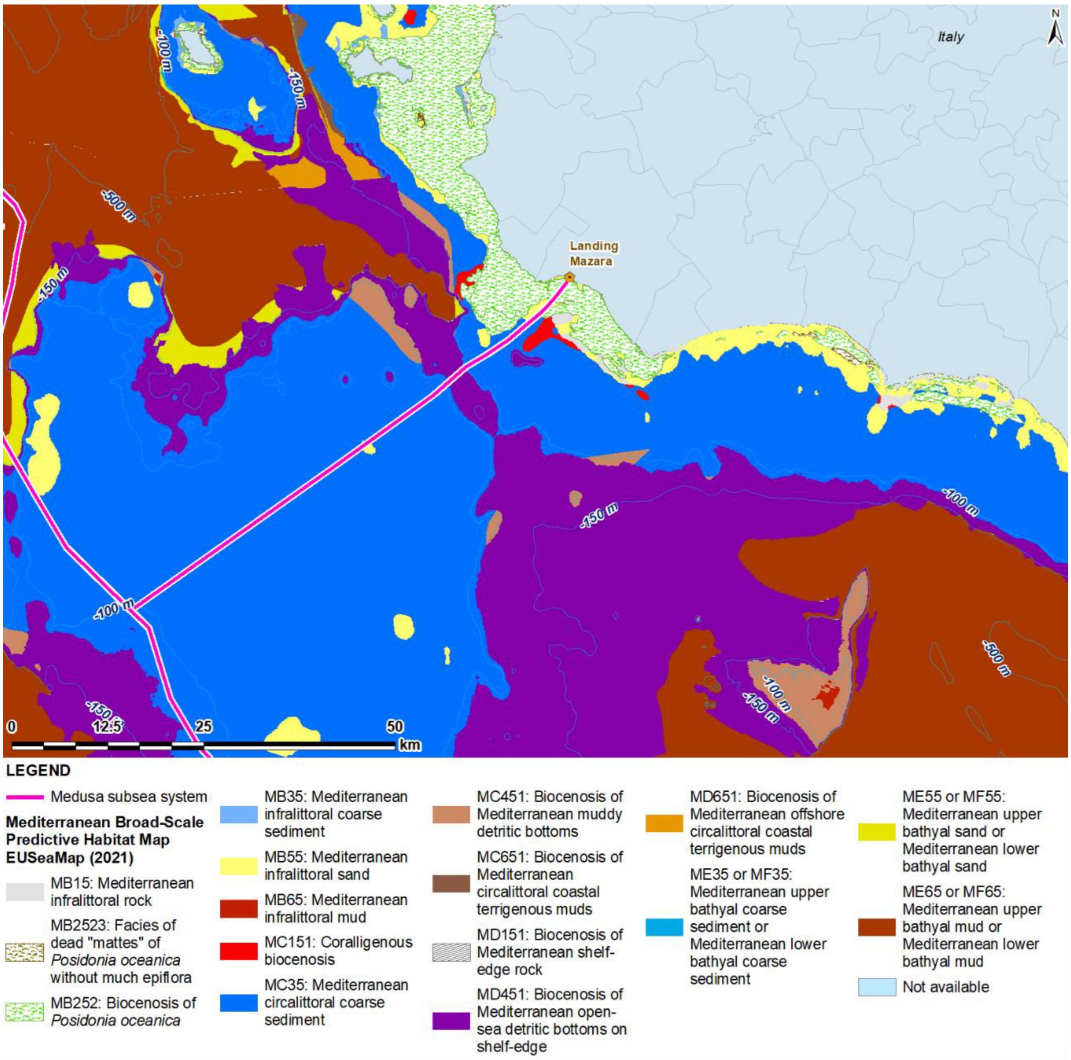

Figure 116. EUSeaMap (2021) Habitat types (EUNIS 2019) at Mazara landing. Source: Elaborated with data from EMODnet Seabed Habitats.

According to Calvo et al. (2010), only the seagrass *Posidonia oceanica* can be found in Mazara del Vallo zone. Other seagrass species, like *Cymodocea nodosa* or *Zostera marina* are not found in the area, although they are present in some coastal areas of Sicily.

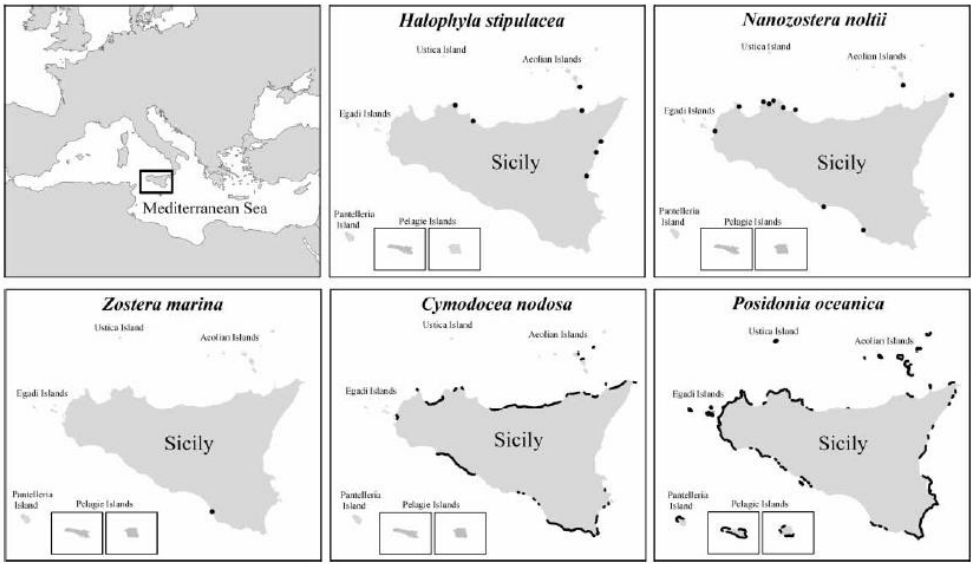

Figure 117. Seagrasses distribution in Sicily, Source: Calvo, S. et al. (2010).

1.5.2.4 Protected Areas

Study area: trunk of Medusa submarine system, branches and landing sites.

Data for protected areas have been mainly obtained from Nature 2000 network for European countries and from the website https://www.protectedplanet.net/, for North Africa countries.

The Natura 2000 has the aim to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive (79/409/CEE, currently substituted for 2009/147/CE) and the Habitats Directive (92/43/CEE). Thus, Natura 2000 network includes the Birds Directive Sites, that is Special Protection Areas (SPA) and the Habitats Directive Sites, that is Spaces of Community Interest (SCI). The Habitat Directive Sites can also be designed as Special Areas of Conservation (SAC) by a state of the European Commission through a regulatory administrative and/or contractual act, which oblige the responsible authority to develop special conservation measures to maintain or restore a favorable conservation state of habitats or species for which the SAC has been designated.

Considering the typology of the project (laying of submarine cable on seabed), it is expected to have almost no interaction with SPA areas, while larger influence is foreseen for SCIs and SACs, in relation to the protection of seabed habitats.

Other protected areas to be taken into account are: i) RAMSAR sites, designed by the Convention on Wetlands, an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and use of wetlands and their resources; (ii) OSPAR marine protected areas, instituted with the aim of protecting the NE Atlantic Marine Environment; (iii) Important Bird and Biodiversity Areas (IBAs), identified by criteria agreed by researchers and experts; although it is not an official protection feature, they are often taken into account both in judicial decisions and by the administrations when appointing new protected spaces; (iv) Specially Protected Areas of Mediterranean Importance (SPAMIs), which are protected with the aim of ensuring the persistence of biological resources in the Mediterranean Sea.

1.5.2.4.1 Main trunk

In the Atlantic Ocean, at the west of the southern point of Portugal, Medusa submarine system will lay at approximately 4.5 km of distance from the offshore SCI of Gorringe Ridge (PTCON0062), which is extended on an area of 2,288,039 ha, including a wide seamount that represents a hotspot of biodiversity. No interaction with this Nature 2000 site is expected, due to the distance.

In the Gulf of Cadiz, the SCI Mud Volcanoes of Cadiz Gulf is located (ESZZ12002), with an area of about 317,761 ha. This NATURA 2000 protected area is important for the marine biodiversity related to methane emissions and the consequent peculiar structures that are formed in relation to microbian activity. The route of Medusa submarine system has been planned avoiding the direct crossing of this area (minimum distance of 0.6 km).

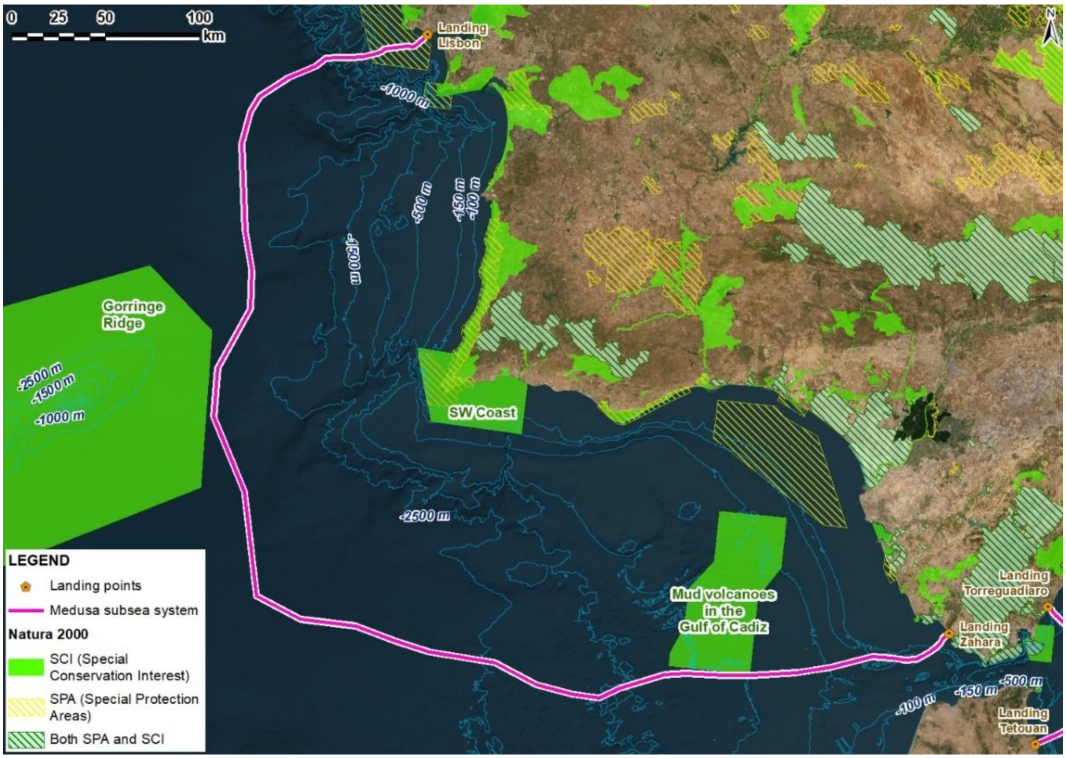

Figure 118. Nature 2000 network in the Atlantic Ocean and in Cadiz Gulf.

In the Alboran Sea, between the African and the Spanish Coast, three NATURA 2000 marine protected sites are located:

- SPA Marine Space of Alboran Island (ES0000505): area of 66,158.04 ha; it has been declared as protected site for the reproduction of *Larus audouinii*. Minimum distance of 3.9 km from Medusa cable.
- SCI Marine Space of Alboran (ESZZ16005); area of 10,896.24 ha; presence of rocky bottom with colonies of cnidarias such as for example *Corallium rubrum* and presence of maërl. Minimum distance of 9 km from Medusa cable.
- SCI and SAC Alboran (ES6110015): area of 26,391.20 ha; relevant for biodiversity and for migration of cetaceans and marine turtles that enter and exit the Mediterranean Sea. Minimum distance of 10.6 km from Medusa cable.

Due to the high distance of the cable route, no interaction with these Nature 2000 sites is expected.

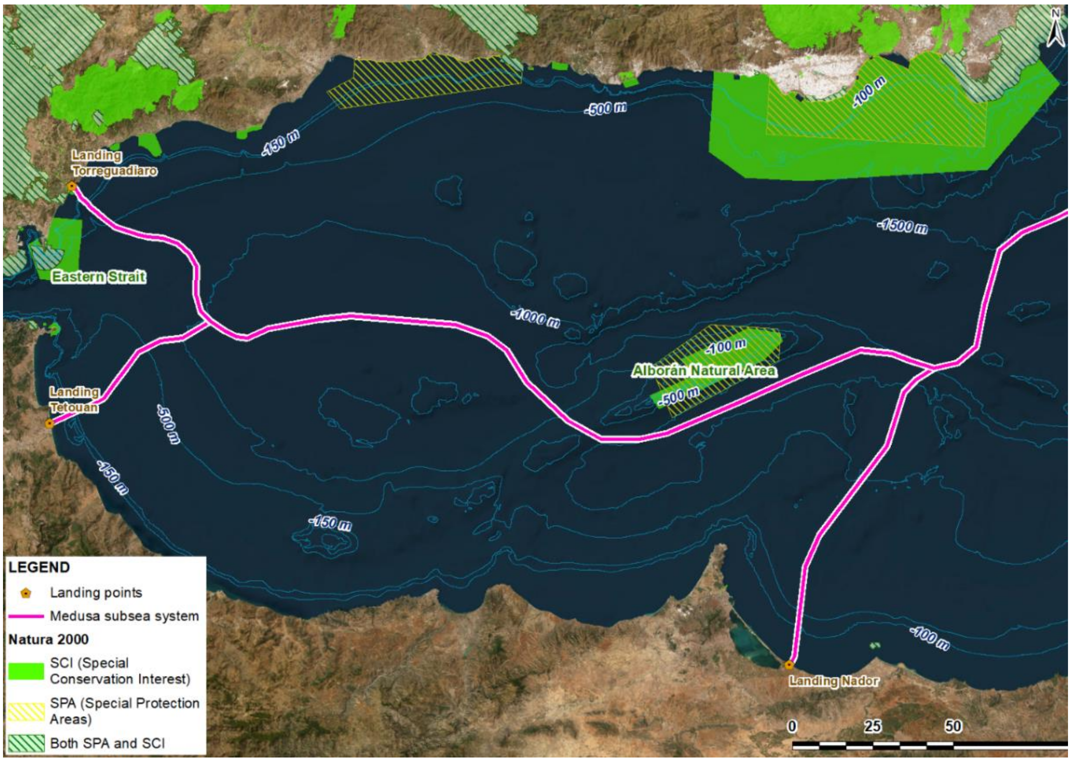

Figure 119. NATURA 2000 protected sites in the Alboran Sea.

In the Eastern Mediterranean (Pelagian Shelf), the trunk of the cable will cross the area near Malta where several Nature 2000 marine protected sites are recognized:

- SPA "Żona fil-Baħar fil-Majjistral" (MT0000114): area of 5589.76 ha; it has been declared as protected site for the breeding season of *Hydrobates pelagicus*. Minimum distance of 1.2 km from Medusa cable.
- SCI "Żona fil-Baħar fl-inħawi tal-Majjistral tal-Graben ta' Malta" (MT0000118): area of 10720.46 ha; it is characterized by caves and reef assemblages. Minimum distance of 2.5 km from Medusa cable.
- SCI "Żona fil-Baħar fl-inħawi tal-Punent tal-Graben ta' Malta" (MT0000117): area of 20127.74 ha; reef assemblages present are characterized by a variety of sessile cnidarians and sponges. Minimum distance of 1.0 km from Medusa cable.

- SCI "Żona fil-Baħar fil-Punent" (MT0000113): area of 46494.23 ha; the site hosts the highest population density of *Caretta caretta* (juveniles and sub-adults) and is also important for caves and reefs. Minimum distance of 1.2 km from Medusa cable.
- SCI " Żona fil-Baħar fl-inħawi tal-Graben ta' Medina" (MT0000116): area of 91192.67 ha; The site is significant for the presence of reef assemblages. It also hosts a concentration of *Caretta caretta* population. Minimum distance of 900 m from Medusa cable.
- SPA "Żona fil-Baħar fix-Xlokk" (MT0000109): area of 91192.67 ha; The site is significant for the presence of *Calonectris diomedea*. Minimum distance of 2.6 km from Medusa cable.

Medusa submarine cable system will not cross any of these Nature 2000 protected sites of Malta. However, possible interaction of the project with the presence of *Caretta caretta* during the installation phase should be taken into account. At the same time, the existence of reef assemblages in protected zones about 1 km far from the cable advises about the necessity of micro-routing after pre-installation survey to minimize crossing of rocky areas and therefore minimizing possible interference of the project with reef assemblages.

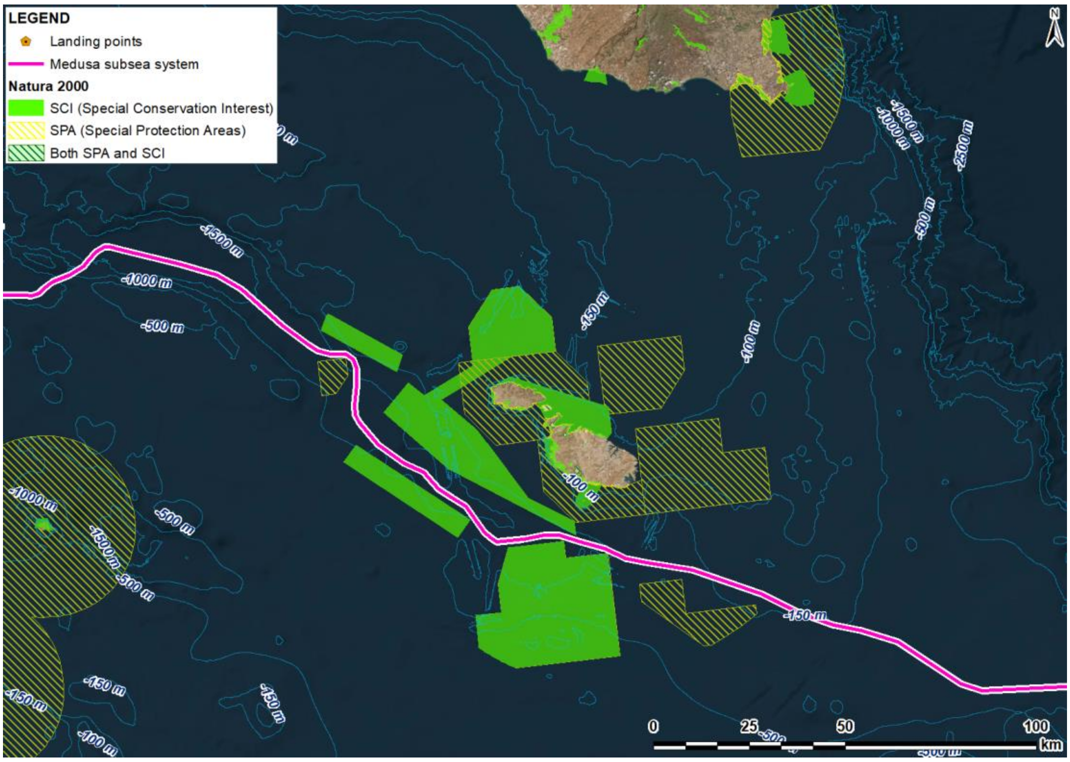

Figure 120. Nature 2000 sites in the proximity of Malta.

1.5.2.4.2 Portugal: Lisbon

Medusa submarine fiber optic cable system will cross the SPA Cabo Raso (PTZPE0061) in the proximity of Lisbon landing. This is a protected area of 133.486 ha, significant for the migration of several marine species and influenced by the proximity of Tagus estuary. This area is also recognized as IBA.

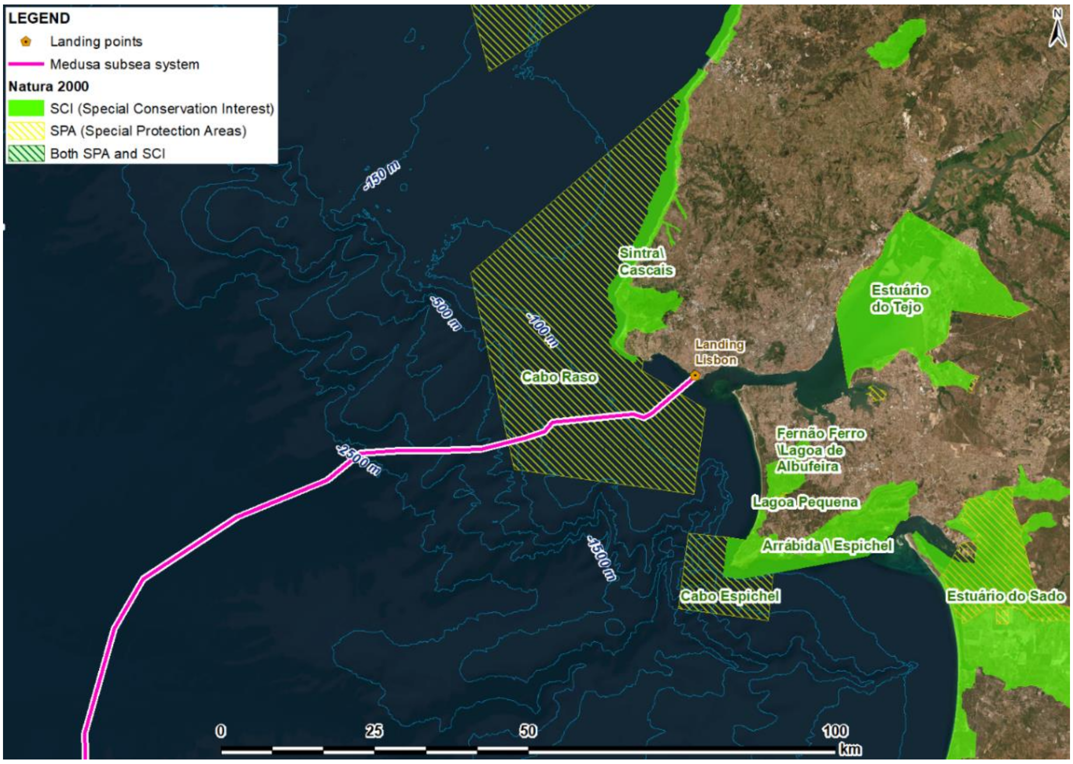

Figure 121. Nature 2000 network in the proximity of Lisbon.

1.5.2.4.3 Spain: Zahara, Torreguadiaro and Barcelona

In the area Zahara landing the following NATURA 2000 protected sites are recognized:

- SCI, SAC and SPA La Breña y Barbate wetlands (ES6120008): area of 5072 ha; only 22% of the site is marine area; the site is important for bird migrations and for sandwave and wetland habitats. Minimum distance of 9.4 km from Medusa system.
- SCI, SAC and SPA Estrecho (ES0000337): area of 19166 ha; 50% of marine area; key site for migration of birds. Minimum distance of 4.2 km from Medusa system.

Medusa submarine system will have no interaction with these natural protected areas.

The nearby of Torreguadiaro landing is characterized by the presence of the following Nature 2000 sites:

- SCI and SAC Seabed of Guadiaro river estuary (ES6120034): area of 107.43 ha; it is significant for the ecological connectivity between sea and river. The site is also relevant for the habitat “sandy banks permanently covered by shallow seawater”. Minimum distance of 1.0 km from Medusa system.
- SAC Eastern Strait (ES6120032): area of 23,636.24 ha; it is relevant for Tursiops truncates and *Caretta caretta* that use the zone as preparation area for the migration to the Atlantic Ocean; the site is also important for a peculiar marine habitat related to the complex submarine structures typical of the zone. Minimum distance of 4.6 km from Medusa system.

Medusa cable system will have no influence on these natural protected sites.

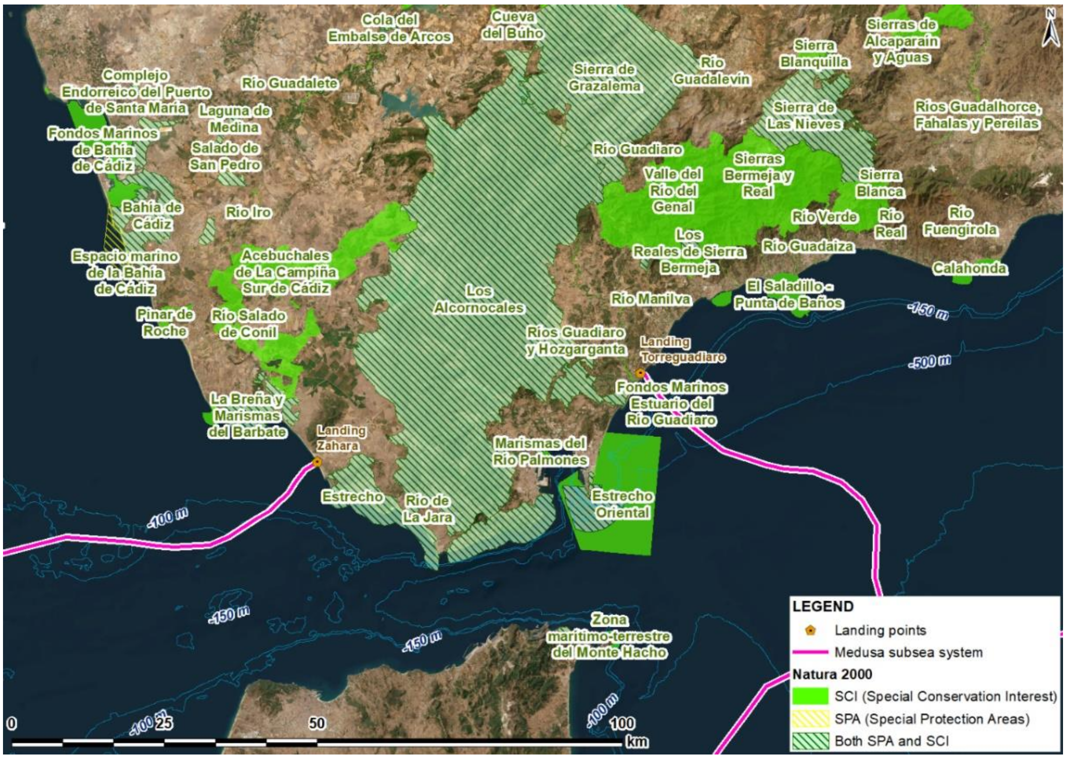

Figure 122. Nature 2000 network in the proximity of Zahara and Torreguadiaro landings.

Medusa system will cross the IBA “Gibraltar Strait” in both Zahara and Torreguadiaro landings. The IBA concept was created and developed over 30 years ago by BirdLife International. The spaces that are declared IBA are identified using criteria agreed upon by researchers and experts and, although it is not an official protection figure, they are often taken into account both in court rulings and by the administrations when designating new protected spaces. IBAs are those areas in which a significant part of the population of one or more bird species considered a priority by

BirdLife (http://www.birdlife.org/) is regularly present. Considering the typology of the project (submarine cable), almost no influence is expected on this IBA.

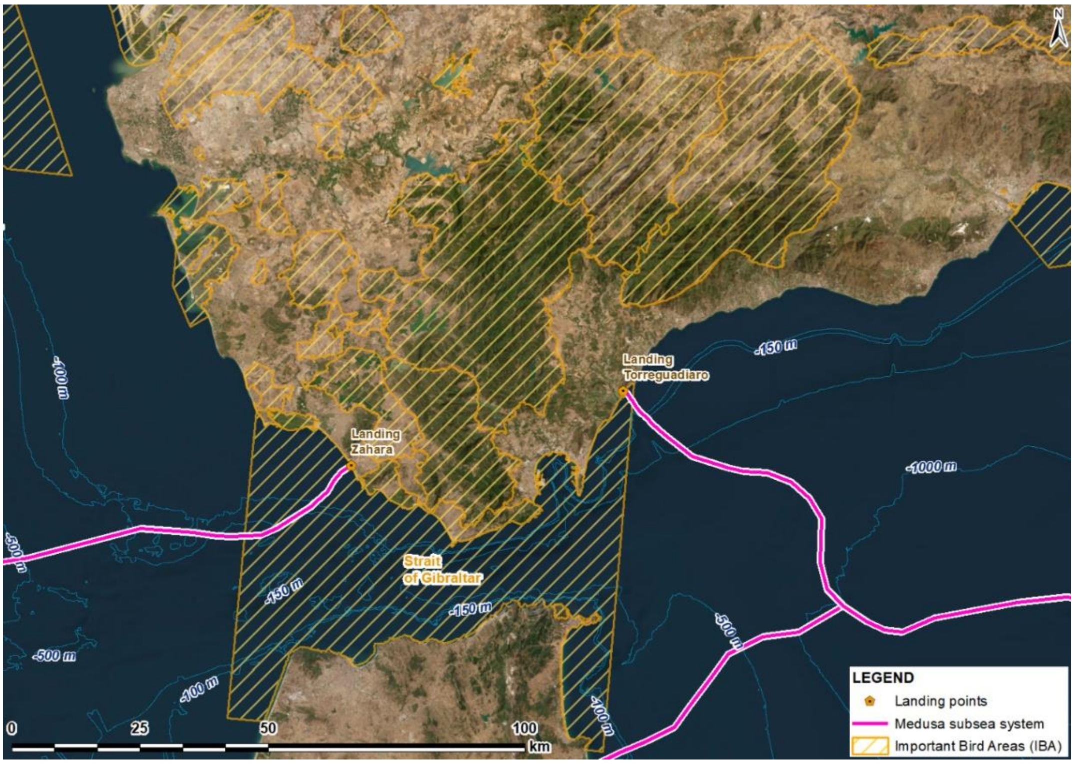

Figure 123. IBA in the proximity of Zahara and Torreguadiaro landings.

In the proximity of the Barcelona landing, we can find three different Natura 2000 areas:

- SCI and SAC Maresme coasts (ES5110017): area of about 2906 ha; it includes a relevant Posidonia oceanica meadow. This corresponds roughly also to the Maresme coasts Plan of Natural Interest Spaces of Catalonia (PEIN) (ES511010), which belong to the network of Natural Protected Spaces (ENP) in Catalonia. Minimum distance of 17.2 km from Medusa system.
- SPA Baix Llobregat-Garraf marine space (ES0000513): area of 3,866,100 ha; it is favorable to the development of small fishes that feed birds such as *Calonectris diomedea*, *Puffinusyelkouan*, *Puffinus mauretanicus* and *Larus audouinii* during the reproduction season. The area is also classified as AMP (marine protected area), a protection category created in 2007 (Ley 42/2007), and can be included in the Spanish protected marine areas network (EMPA), which was formally created in 2010 (Ley 41/2010). This SPA also partially coincides with the IBA "Water of Baix Llobregat-Garraf". Minimum distance of 16.8 km from Medusa system.

- SCI, SAC and SPA Llobregat delta (ES0000146): area of about 923 ha; it is a coastal wetland related to the second important delta system in Catalonia. This corresponds roughly also to the Llobregat delta PEIN (ES5101103). It is also recognized as RAMSAR site. Minimum distance of 16.3 km from Medusa system.

Medusa cable system will have no influence on these natural protected sites.

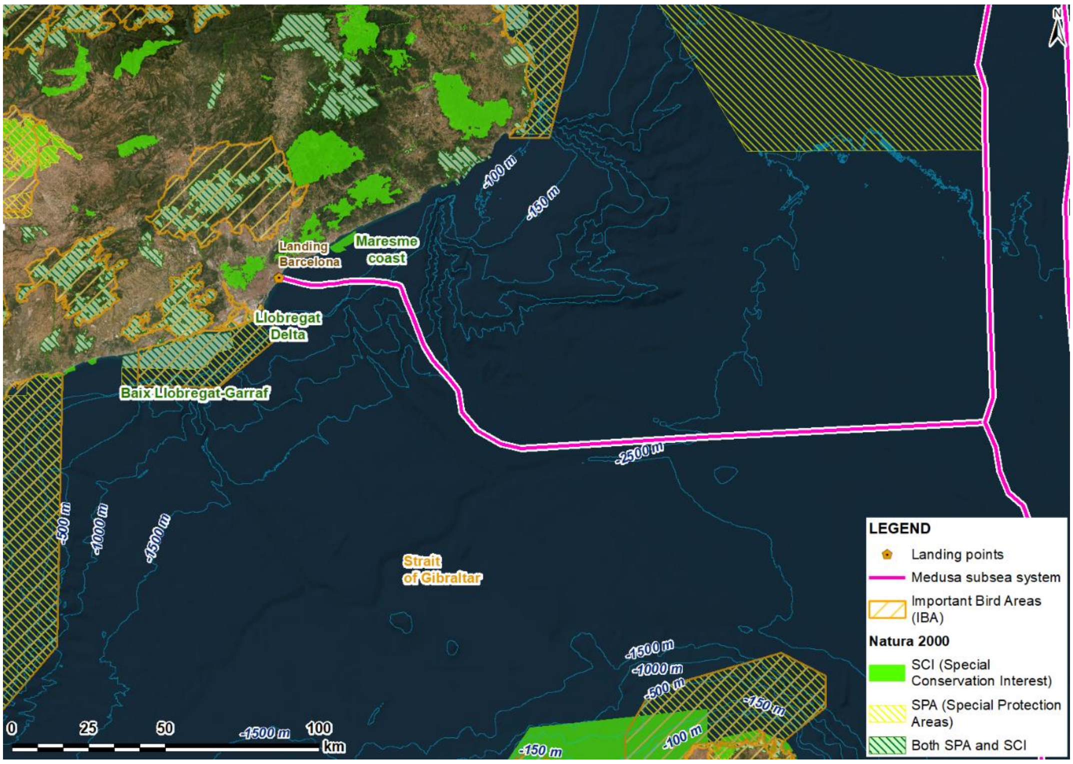

Figure 124. Protected areas in the proximity of Barcelona landing.

Barcelona branch of Medusa submarine cable will inevitably cross the SPAMI "Cetacean Migration Corridor (ES10)". This protected area occupies an area of 46,385 km^2 and was established in July 2018 with the aim of protecting the species of cetaceans that live or migrate in Spanish waters, half of which are endangered. Seven of these species are present in the area during the migration season: *Tursiops truncates*, *Delphinus delphis*, *Stenella coerueoalba*, *Grampus griseus*, *Globicephala melas*, *Balaenoptera physalus* and *Ziphius cavirostris.* In addition, *Physeter macrocephalus* have been seen sporadically. Interference of the Medusa project on this protected area would concern the installation phase, in relation to the generation of submarine noise and the possibility of collisions with cetaceans. These aspects are specifically analyzed in the Impact Assessment and Mitigation Measure section.

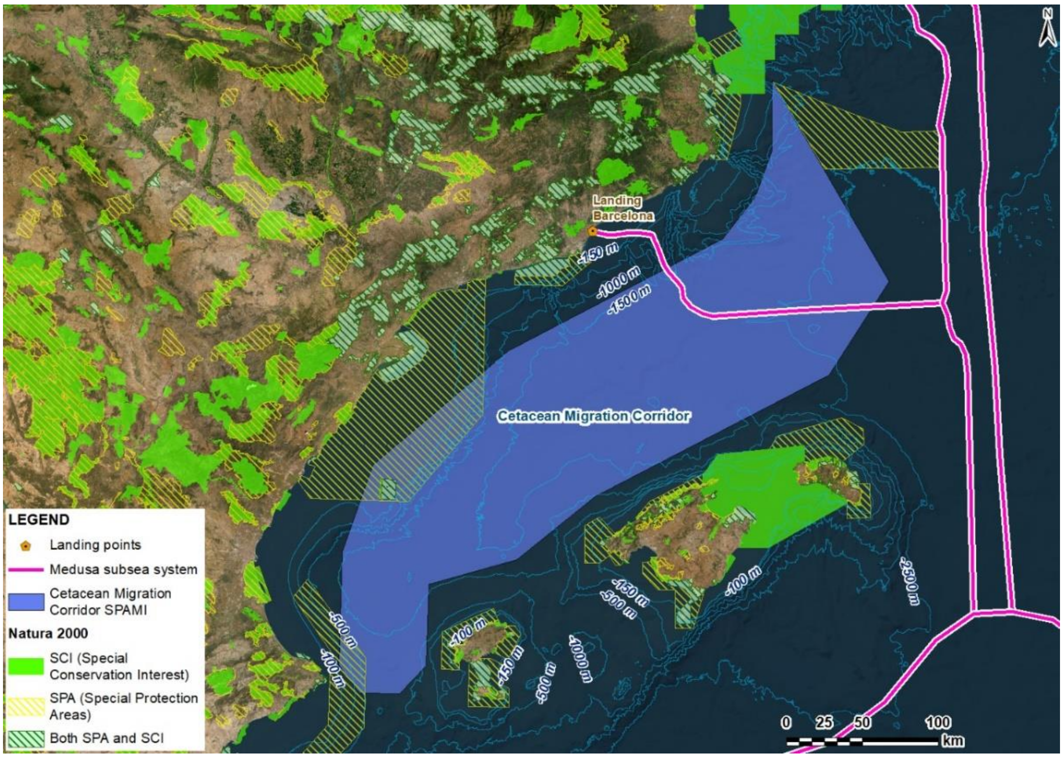

Figure 125. Cetacean Migration Corridor SPAMI.

1.5.2.4.4 France: Marseille

In the proximity of Marseille landing the following NATURA 2000 protected areas are found:

- SCI and SAC Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet (FR9301602): area of 50,015 ha; the marine environment of this site occupies 79% of the area. It is significant for the presence of *Posidonia oceanica,* coraligenous and karstic caves. Deep-water corals are also present in the proximity of Cassidaigne canyon. Marseille Segment 1 and Segment 2 of Medusa system will lay on this protected site for about 10.2 km and 16.7 km, respectively.
- SPA Iles Marseillaises-Cassidaigne (FR9312007): area of about 39,158 ha, particularly important for the conservation of *Puffinus puffinus mauretanicus*, *Puffinus yelkouan* and *Hydrobates pelagicus*. Marseille Segment 1 and Segment 2 of Medusa system will lay on this protected site for about 10.2 km and 16.7 km, respectively.
- SCI and SAC Côte Bleue Marine (FR9301999): area of 18,863.91 ha; particularly relevant for *Posidonia oceanica,* coraligenous, *Caretta caretta* and *Tursiops truncates*. The minimum distance of Medusa system from this site is 2.2 km for Segment 1 and 9.2 km for Segment 2.

In addition to these Nature 2000 protected sites, Calanques national park is present in the area, partially coinciding with the SCI and SAC Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet, but characterized also by a terrestrial part. This national park has the aim of protecting several habitats such as submarine canyons, *Posidonia oceanica* meadows, coralligenous, submarine caves, etc. Medusa system will lay on this national park area for about 10 and 17 km in the case of Segment 1 and Segment 2 of Marseille branch, respectively. The area is then surrounded by a wider zone classified as adjacent marine area.

Finally, in the area the IBA “Iles Marseillaises: Maire, Jarron, Jarre, Riou, Calseraigne, Congloue et Pomègues” is present.

Medusa system near Marseille landing can influence protected seabed habitats of SCI and SAC Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet, as well as of Calanques national park. For this reason, a benthic communities survey has been conducted by promoter in the framework of permitting process to identify the distribution and features of *Posidonia oceanica* meadows, as well as coraligenous and deep-water corals in the zone and select a cable route that minimize affections on these habitats.

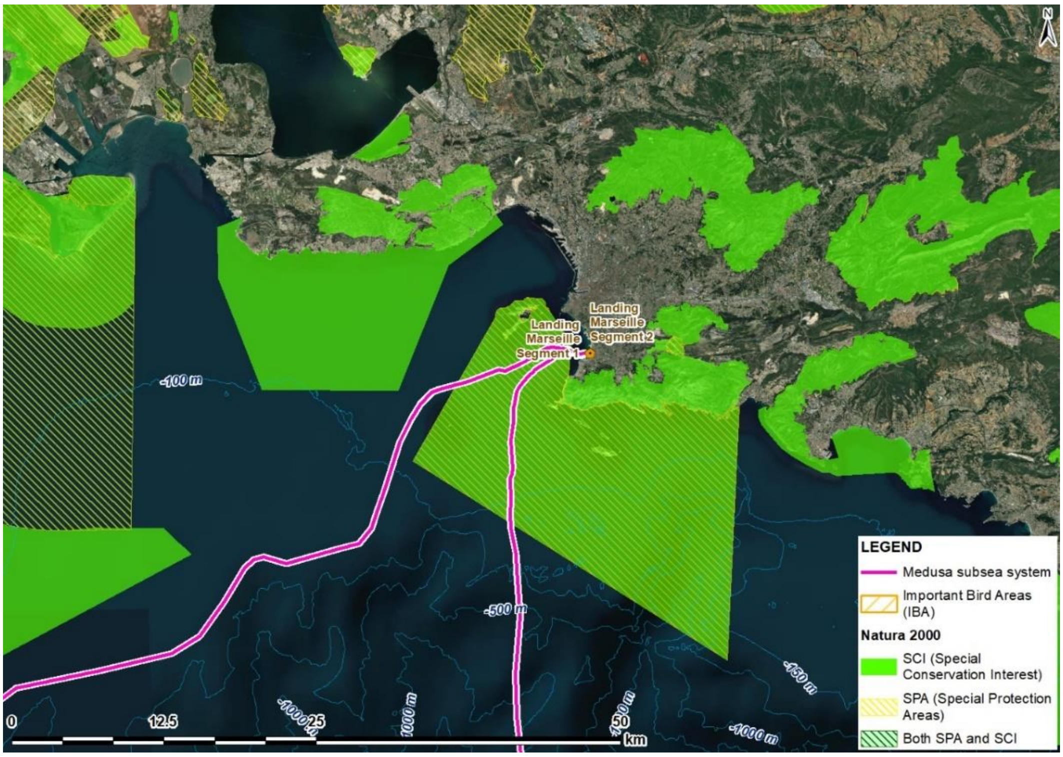

Figure 126. Protected area in the proximity of Marseille landing.

Segment 1 of Marseille branches will also cross the eastern limit of the SPA “Oiseaux marins sud golfe du Lion” (FR9112038). This nature 2000 site has an area of 308.559 ha in the marine domain and it has been established in 2019 in particular for (i) the presence of the storm petrel (*Hydrobates pelagicus*) in summer and much rarely in winter, and (ii) the presence of the little gull (*Larus minutus*), one of the most abundant species in the Mediterranean EEZ in winter. Aproximately 24 km of Medusa subsea system will cross this protected area.

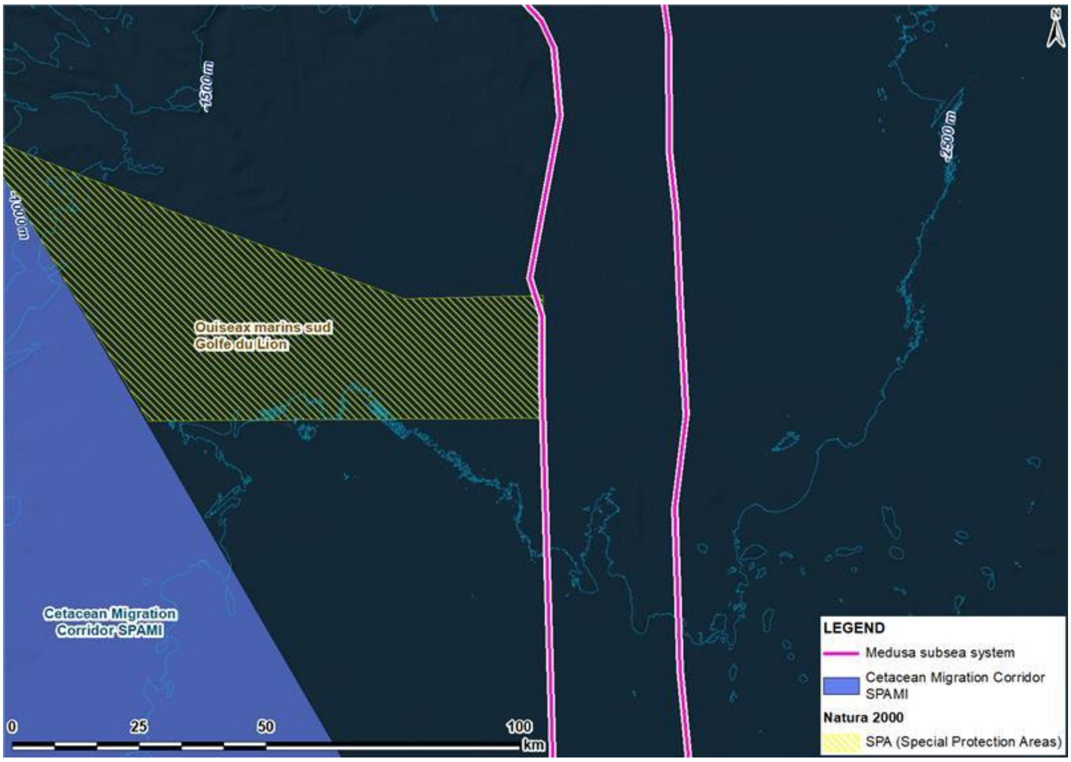

Figure 127. Nature 2000 site crossed by Segment 1 of Marseille branch.

1.5.2.4.5 Italy: Mazara

In the proximity of Mazara del Vallo landing the following NATURA 2000 sites are present:

- SCI, SAC and SPA Capo Feto and Margi Spanò wetlands (ITA010006): area of 349.86 ha; this protected area is entirely on the terrestrial domain and it is located just on the west coast with respect to the landing beach. Minimum distance of 2.4 km from Medusa system.
- SCI Seabed of Capo San Marco-Sciacca (ITA040012): area of 18,328.34 ha; the area is relevant for the presence of extended *Posidonia oceanica* meadows. Minimum distance of 14.3 km from Medusa system.

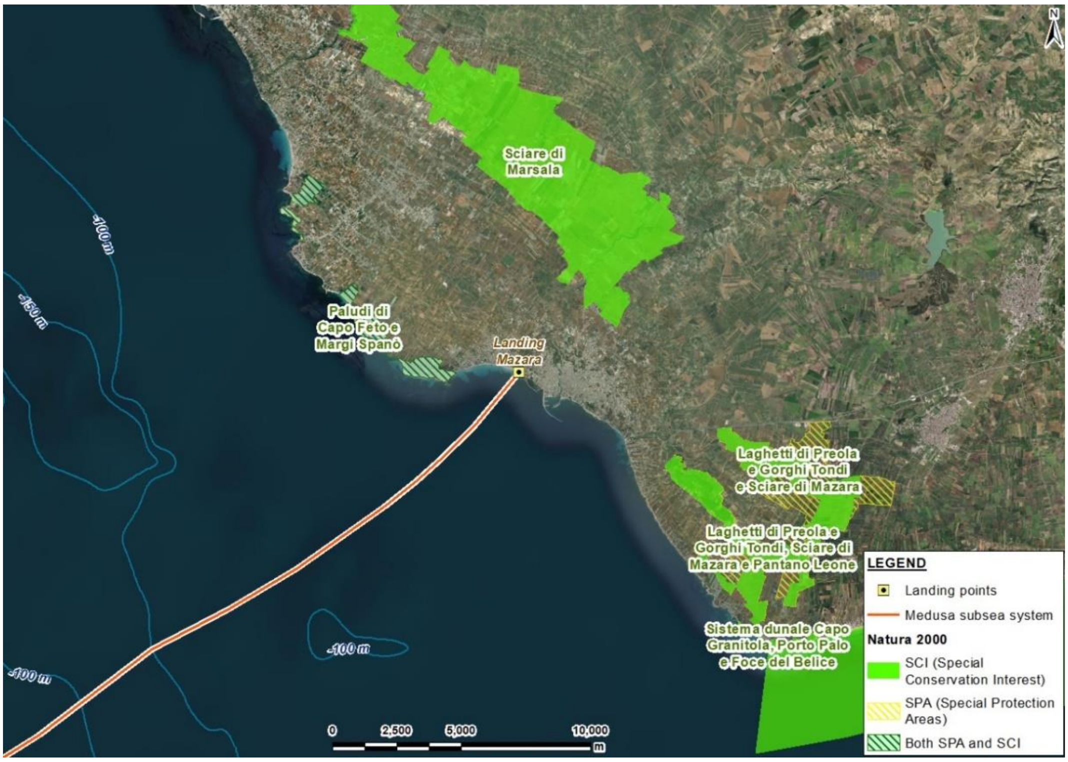

Figure 128. NATURA 2000 protected sites near Mazara del Vallo landing.

1.5.3 Socio-economic Aspects

1.5.3.1 Demographic conditions

Study area: landing sites.

In this section, a general analysis on the demographic characteristics of the population at landing countries and regions is presented, together with information about education, the role of the woman and households. Household insights can help to assess household appliance and digital readiness that is key for formulating market technology and internet strategies (https://www.euromonitor.com/). In addition, households are changing around the world in their size, location, general make-up, income and expenditure in relation to shifts in gender, ageing, migration and housing. This fact has several implications for governments and companies (https://www.euromonitor.com/).

Study area: countries and regions of Medusa submarine system landings.

1.5.3.1.1 Portugal: Lisbon landing

Data from the National Statistical Institute of Portugal show that the estimated population of Portugal in 2021 was 10,343,066 inhabitants, being that of the Metropolitan area of Lisbon 2,870,208 (27.9% of total country population). Females constitutes 52.9% of the population in this region and males constitutes 47.1%, being these values consistent with the national average. Life expectancy in the metropolitan area of Lisbon region is 78.3 years for males and 84.3 years for females. Median age of population is 44.7 years in the region.

At local level, considering the municipality involved in the project, the following data are highlighted:

- Cascais (metropolitan area of Lisbon) (source: ine.pt): data from 2021 indicate a total of 214,158 inhabitants, being 99,780 men (46.6%) and 114,378 women (53.51%).

In the metropolitan area of Lisbon, 27.8% of population aged 25-64 has a low level of education, 30.9% a medium level and 41.3% a high level[1].

Preliminary data for 2021 (ine.pt) indicate that the number of households in Portugal showed an increase of 2.7% in 2021 compared to 2011 reaching 4,156,017. The Metropolitan Area of Lisbon has shown the same country trend, with an increase of almost 4%. The average household size in Portugal in 2021 was 2.5 people, 0.1 less than in 2011. The most common households in 2021 were those made up of 3-5 individuals (40.2%). This was followed by two-people households (33.3%) and then by single-person households (24.8%). Meanwhile, households of six or more persons constituted 1.7% of the total.

The number of single-person households was 655,000 in 2021, being 446,900 the number of households with a person aged 65 and over.

According the European Institute for Gender equality, the Gender 2022 equality Index in Portugal has a score of 62.8 points of 100 (data from 2020), making Portugal 15th in EU Gender Equality Index ranking. This score is 5.8 points below the EU's score. Since 2010, Portugal's score has increased by 9.1 points, and its ranking has improved by four places. Since 2019, Portugal's score has improved only marginally and its ranking has remained the same. This is because the improvements in the domain of money have been balanced out with a setback in the domain of health and slow progress in the domains of power and knowledge. Since 2019, Portugal's ranking

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[1] Low level of education = no more than a primary or lower secondary education; medium level of education = upper secondary or post-secondary non-tertiary education; high level of education = tertiary education

has dropped from the 19th to the 22nd place in the domain of health. Portugal's lowest rankings are in the domain of time (24th among all EU Member States), in particular in the sub-domain of social activities.

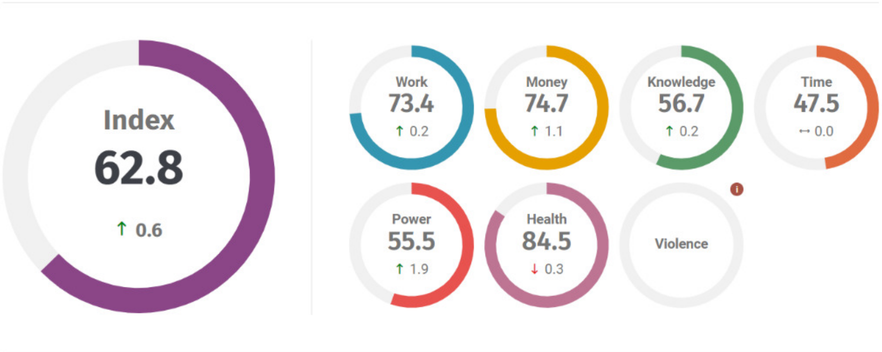


Figure 129. Gender equality 2022 indexes for Portugal (data from 2020). Source: European Institute for Gender Equality (EIGE).

1.5.3.1.2 Spain: Zahara, Torreguadiaro and Barcelona landings

The estimated population of Spain in 2021 was 47,326,687 inhabitants, being that of Catalonia 7,671,252 (16.2% of total country population) and of Andalusia 8,502,216 (17.9% of the total country population). Females constitutes 52.2% of the population in this region and males constitutes 47.8%, being these values consistent with the national average. Life expectancy in Catalonia region is 79.5 years for males and 85.0 years for females, while in Andalusia is 79.0 for males and 84.4 years for females. Median age of population is 43.8 years in Catalonia and 43.3 years in Andalusia.

At local level, considering the municipalities involved in the project, the following data are highlighted:

- Sant Adrià de Besòs (Barcelona province, Catalonia region) (source: ine.es): data from 2021 indicate a total of 37,283 inhabitants, being 18,357 men and 18,926 women.
- San Roque (Cadiz province, Andalusia region) (source: ine.es): data from 2021 indicate a total of 32,178 inhabitants, being 16,042 men and 16,136 women.
- Tarifa (Cadiz province, Andalusia region) (source: ine.es): data from 2021 indicate a total of 18,466 inhabitants, being 9,275 men and 9,191 women.

Immigration to Spain is neither predominantly male nor female. Currently, 47% of registered foreigners are women; and 51% of the inflow of new immigrants in 2018 were women (OECD, 2020).

In Catalonia, 34.3% of population aged 25-64 has a low level of education, 22.4% a medium level and 43.2% a high level[2]. In Andalusia, 44.8% of population aged 25-64 years has a low level of education, 21.1% a medium level and 34.1% a high level.

According to data from OECD (2020), the average number of households in Spain increased by 129,100 during 2020 reaching 18,754,800 (increase of 0.836% with respect to the previous year). The average household size stood at 2.50 people, the same as the previous year. 55.0% of young people aged 25 to 29 lived with their parents. The most common households in 2020 were once again those made up of two persons (30.4% of the total). This was followed by single-person households (26.1%, although the population included in these only accounted for 10.4% of the total). Meanwhile, households of five or more persons constituted 5.8% of the total.

The number of single-person households was 4,889,900 in 2020, being 2,639,800 the number of one-woman households (approximately 54%). With regard to marital status, the most frequent one-person households of men consisted of single persons (59.7% of the total) and those of women consisted of widows (45.5%). In the case of Andalusia, the number of single-person households was 789,700, being 412,800 the number of one-woman households (52%). Concerning Catalonia, the number of one-single person households in 2020 was 789,600, being 441,500 one-woman households (56%).

In 2020, single-parent households (formed by one single parent with children) were mostly comprised of a mother with children (81.4% of the total). The number of single-parent households increased by 3.0% compared with 2019. The number of mothers with children grew by 3.4%, while that of fathers with children did so by 1.6%. In 37.6% of households of mothers with children, the mother was a widow, in 40.2% separated or divorced, in 15.8% single, and in 6.4% married.

According to the European Institute for Gender Equality, Spain has seen relevant advancements in gender equality and gender mainstreaming (integration of a gender perspective into the preparation, design, implementation, monitoring and evaluation of policies, regulatory measures and spending programs) over the last 30 years. The Gender 2022 equality Index in Spain had a score of 74.6 points of 100 (data from 2020), making Spain 6th in EU Gender Equality Index ranking. This score is 6.0 points above the EU's score. Since 2010, Spain's score has increased by 8.2 points, and its ranking has improved by one place. Since 2019, Spain's score has increased by 0.9 points, mostly driven by improvements in the domain of power and health. The country's ranking has remained the same. Since 2019, Spain's score has improved in the domain of power

[2] Low level of education = no more than a primary or lower secondary education; medium level of education = upper secondary or post-secondary non-tertiary education; high level of education = tertiary education

(mainly economic and social power). One of the best categories for Spain is the domain of health, where the country has one of the highest scores in the EU. Spain's lowest rankings are in the domain of time (14th among all EU Member States), in particular in the sub-domain of social activities.

Figure 130. Gender equality 2022 indexes for Spain (data from 2020). Source: European Institute for Gender Equality (EIGE).

1.5.3.1.3 France: Marseille landing

The estimated population of France in 2021 was 67,499,343 inhabitants, being that of Provence-Alpes-Côte d'Azur region 5,116,360, representing 7.6% of the total population of the country. Females constitutes 52.2% of the population in this region and males constitutes 47.8%, being these values consistent with the national average. Life expectancy in Provence-Alpes-Côte d'Azur region is 80.0 years for males and 85.7 years for females. Median age of population in this area is 40.9 years.

At local level, data from 2019 indicate a total of 870,731 inhabitants for the city of Marseille (Source: insee.fr).

In Provence-Alpes-Côte d'Azur, 19.2% of population aged 25-64 has a low level of education, 40.0% a medium level and 40.8% a high level.

Data about immigration have been consulted on *Institut National d'Études Démographiques* (INED) website. The immigrant population of metropolitan France -that is, persons born non-French outside France- has been predominantly female for the last few years. However, degree of feminization varies by origin, being men slightly dominating in number for immigrants just from Turkey, Morocco and Tunisia (data from 2008). Immigrant population feminization is often attributed to family reunification, as, historically, persons immigrating to find work were initially men, later joined by their female partners and possibly their children. However, this is not the only explication, as it seems that newly arriving single persons are increasingly women, whereas persons arriving by the reunification process are increasingly men.

As in the case of immigration, data about households present in the following paragraphs have been consulted on INED website. The number of households reached 29,700,000 in France in 2020, increasing 0.412% with respect to the previous year. 37% of households are composed by just 1 person and 32.7% by 2 persons, while just 1.6% of households have more than 6 people.

The most common households in 2019 were couple family households (51.4% of the total). This was followed by single-person households (37.0%, although the population included in these only accounted for 17% of the total). Meanwhile, lone parent family households constituted 9.5% of the total.

The number of one-person households was 10,815,644 in 2019, being 4,416,074 the number of one-woman households (approximately 56.6%).

In 2018, single-parent households (formed by one single parent with children) were mostly comprised of a mother with children (82.5% of the total).

For several decades gender equality has been taken into account in policies aimed at reconciling work and family life in France. For this reason, France ranks high in terms of women's employment and benefits to reconcile work and family life. However, unequal access to services and subsidies continues to obstacle the achievement of equality in the division of paid and unpaid work more broadly across society (OECD, 2017).

According the European Institute for Gender equality, the Gender equality 2022 Index in France had a score of 75.1 points of 100 (data from 2020), making France 5th in EU Gender Equality Index ranking. This score is 6.5 points above the EU's score. The score has registered a high increase between 2010 and 2018 (8 points). From 2018 to 2019, France's score has increased by 0.4 points, mainly driven by improvements in the domain of power. Since 2019, France's score has decreased slightly by – 0.4 points, mainly due to setbacks in the domains of money and knowledge, thus dropping in ranking by one place. France's lowest rankings are in the domains of knowledge, segregation and work (8th, 12th and 15th, respectively, among all EU Member States).

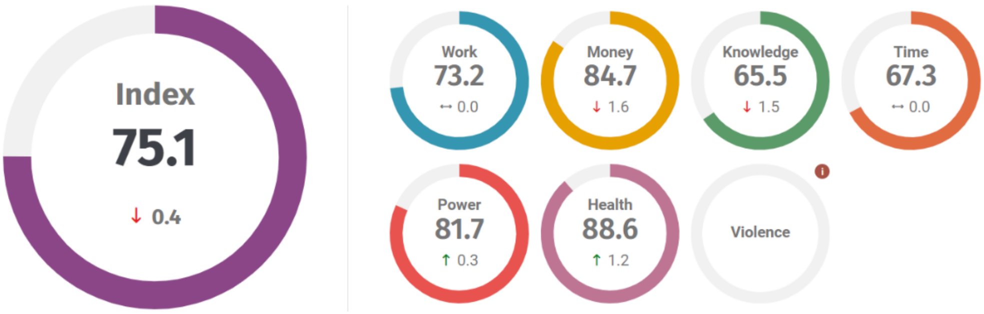


Figure 131. Gender equality 2022 indexes for France (data from 2020). Source: European Institute for Gender Equality (EIGE).

1.5.3.1.4 Italy: Mazara del Vallo landing

The estimated population of Italy in 2021 was 59,236,213 inhabitants, being in Sicily region up to 4,833,705, representing 8.2% of the total population of the country. Females constitutes 51.5% (2,486,946) of the population in this region and males constitutes 48.5% (2,346,759), being these values consistent with the national average (51.3% for females and 48.7% for males). Life expectancy in Sicily region is 79.7 years for males and 84 years for females. Median age of population in this area is 40.9 years, being the average in Italy between 44.4 and 51.6.

At local level, data from 2022/01/01 indicate a total of 50,129 inhabitants for the city of Mazara del Vallo (Source: citypopulation.de). With a total area of 274.7 km², the population density of this city is 182.5/km².

In Sicily, 47.6% of population aged 25-64 has a low level of education, 37.6% a medium level and 14.8% a high level. The employment rate in 2021 of the population aged between 20-64 years is 57.8% for males and 31.6% for females, one of the lowest rates in the UE for both females and males.

Data about immigration have been consulted on *Istituto Nazionale di Statistica* (Istat) website. The total immigrant population of Italy -that is, persons born non-Italy outside Italy- has been mainly male. In 2020 the total immigrants registered were 128,288 for males and 119,238 for females, with a total of 247,526. The main immigration comes from age group 18 to 39 years (52%), and the countries from which most immigration is received (in 2020) are Romania (10.5%), Albania (7%), United Kingdom (5.8%) and Morocco (5.1%).

As in the case of immigration, data about households in Italy have been consulted on Istat website. The number of households reached 25.7 million in 2020; this is 0.71% more than in the previous year. The projections about households show that in 2040 this number will increase by 3.5 percentage points, reaching 26.6 million of households. Also, the projection shows that households without a nucleus would increase consistently, from 9.2 in 2020 to 11 million in 2040 (+20%). Households with at least one nucleus, for example couples with or without children and one parent with children, follow an opposite trend, decreasing from 16.6 in 2020 to 15.6 million in 2040 (-6%).

In 2020, the most common households were households without a nucleus (single person, with 8410 households) and couples with children (with 8000 households). This was followed by couples without children (4,801 households) and one parent with children (with 2,509 households). Meanwhile, a nucleus with other persons only is found in 875 households.

According to the European Institute for Gender equality, the Gender 2022 equality Index in Italy has a score of 65.0 points of 100 (data from 2020), making Italy 14th in EU Gender Equality Index ranking. This score is 5.8 points below the EU's score. Since 2010, Italy's score has increased by 11.7 points, and its ranking has improved by seven places. Since 2019, Italy's score has improved by 1.2 points. However, its ranking has remained the same. Improvements are mainly due to the domain of power. One of the best scores for the country is that related to health, in particular in relation to access to health services. Italy's lowest rankings are in the domain of knowledge (13th among all EU Member States), in particular in the sub-domain of educational attainment and participation (25th place) and in the domain of work, in which it currently scores 63.2 points and consistently ranks last among all EU Member States.

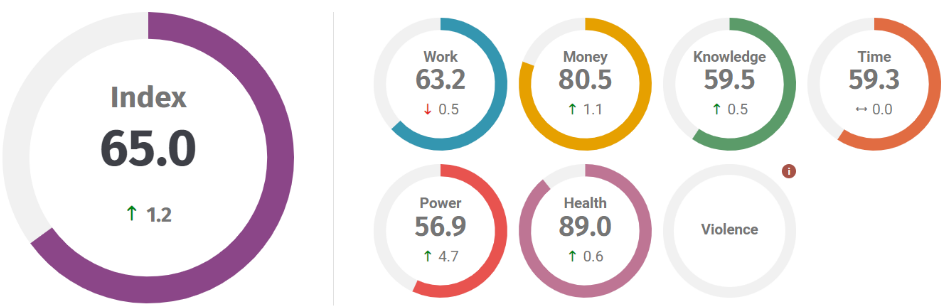


Figure 132. Gender equality 2022 indexes for Italy (data from 2020). Source: European Institute for Gender Equality (EIGE).

Figure 133.

1.5.3.2 Community Organizations and Institutions

1.5.3.2.1 Portugal: Lisbon landing

Cascais (metropolitan area of Lisbon) is a town and municipality in the Lisbon District of Portugal. Administratively, the municipality is divided into 4 civil parishes (*freguesias*), with municipal authority vested in the Câmara Municipal of Cascais: Alcabideche, Carcavelos e Parede, Cascais e Estoril, São Domingos de Rana.

Over the years Cascais has developed several art galleries and museums. These are concentrated in a relatively small area of the town, mainly in parkland. Combined, they are known as The Museum Quarter.

The following institutions will be involved in the project:

- Local authorities/entities (Lisbon District, the *freguesia* Carcavelos e Parede and the Cascais's municipality).
- Ministry of Environment and Climatic Action (main authority in charge of the environment).
- Portuguese Environment Agency (APA)
- Water and waste Regulatory Authority (ERSAR)
- General Inspection of the Environment, Spatial Planning, Agriculture and Sea (IGAMAOT).
- Institute for Nature Conservation and Forests (ICNF).
- Regional Spatial Planning Commissions (CCDR).
- Ministry of Economy and Sea.
- Ministry of Culture.
- Ministry of Infrastructure and Home.
- Ministry of Health.
- Ministry of Economic Affairs and Digital Transformation.
- Ministry of Agriculture, Fishing and Food.
- Ministry of Culture and Sports.
- Ministry of Health.

1.5.3.2.2 Spain: Zahara, Torreguadiaro and Barcelona landings

The zone where Zahara landing is located is part of Atlanterra, an urbanization belonging to the Spanish municipality of Tarifa, in the Campo de Gibraltar region (province of Cádiz, Andalusia, Spain). Atlanterra is an important tourist center of the area that is home to a large population during the summer months. The main population center of Tarifa is located in the so-called Punta de Tarifa Strait of Gibraltar. Due to the great extension of the municipality, in Tarifa there are other population centers or districts. One of these is Atlanterra, at 42 km from the main population center. The others are Facinas, (about 20 km from the main population nucleus), Tahivilla (at 26 km), La Zarzuela (at 39 km), El Almarchal (at 40 km) and Bolonia-Lentiscal (at 20 km from the main population nucleus).

Next to Zahara landing there is also Zahara de los Atunes, an autonomous entity (a public administrative unit, of a local and inframunicipal nature) belonging to the Spanish municipality of Barbate. The political administration of the entity is carried out through the Neighborhood Council and the autonomous entity's president.

In Zahara de los Atunes there are not museums and cultural centers. However, Barbate has the following cultural public centers: assembly hall (Lonja Vieja), exhibition hall (Casa de la Cultura), youth house, etc.

Torreguadiaro territory belong to San Roque, a municipality of Spain in the province of Cádiz. The municipality is divided into 4 districts: Bahía, Interior, Valle del Guadiaro y San Roque Centro. On the other hand, within each district there are several population nucleuses. The Medusa system's landing point is located in the population nucleus of Torreguadiaro, which is in the Valle del Guadiaro district.

In San Roque, the main museum is the Palacio de los Gobernadores and there are too some cultural centers (Centro Cultural San Roque, Centro Social San Roque, etc.).

Sant Adrià de Besòs (Barcelona's landing) is a city and a municipality within the *comarca* of Barcelonès in Catalonia. Sant Adrià is the smallest municipality of Barcelonès and has close ties with the neighbouring cities of Barcelona, Badalona and Santa Coloma de Gramenet, forming a uniform urban area within Barcelona metropolitan area.

The main museum of Sant Adrià de Besòs is the Museum of History of Immigration of Catalonia. There are also the Culture House (*Casal de Cultura*) and the Centre Cultural Besòs.

The following institutions will be involved in the project for the Spanish landings:

- Local authorities/entities (the autonomous communities of Andalucía and Catalonia, Provinces of Cádiz and Barcelona, *vegueria* of Àmbit metropolità de Barcelona, *comarques* of La Janda, Campo de Gibraltar and Barcelonés, and the councils of Tarifa, San Roque and Sant Adrià del Besòs).
- Ministry of Ecological Transition and Demographic Challenge (main authority in charge of the environment).
- Ministry of Social Rights and Agenda 2030.
- Ministry of Equality.

- Ministry of territorial policy.
- Department of Agriculture, Fisheries, Water and Rural Development, Autonomous Community of Andalusia.
- Department of Sustainability, Environment and Blue Economy, Autonomous Community of Andalusia.
- Department of Tourism, Culture and Sports, Autonomous Community of Andalusia.
- Department of Territory and Sustainability, Autonomous Community of Catalonia.
- Department of Climate Action, Food and Rural Agenda, Autonomous Community of Catalonia.
- Department of Culture, Autonomous community of Catalonia.

1.5.3.2.3 France: Marseille landing

Marseille is the prefecture of the French department of Bouches-du-Rhône and capital of the Provence-Alpes-Côte d'Azur region. Situated in the Camargue region of southern France. The city of Marseille is divided into 16 municipal arrondissements, which are themselves informally divided into 111 neighbourhoods. The arrondissements are regrouped in pairs, into 8 sectors, each with a mayor and council.

Marseille has twenty-six museums, in addition to the Préau des Accoules, the largest number of museums in the country after Paris (such as *Musée d'histoire de Marseille, Musée des Beaux-Arts, Muséum d'histoire Naturelle*, etc.). As a notable building, there is also the Marseille Opera.

The following institutions will be involved in the project:

- Local authorities/entities (the Region of Provence-Alpes-Côte d'Azur, the Bouches-du-Rhône's Departments, the Intercommunality of Aix-Marseille-Provence Metropolis and the *commune* of Marseille).
- Ministry of the Ecological Transition (main authority in charge of the environment).
- French Office of the Biodiversity (OFB).
- Ministry of Agriculture and Food.
- Ministry of Economy, Finance and the Recovery.
- Ministry of Health and Solidarities.
- Ministry of Labour, Employment and Economic Inclusion.
- Ministry of Culture.
- Ministry of Marine Affairs.
- Ministry Delegate for Gender Equality, Diversity and Equal Opportunities.
- Regional Directorates for the Environment, Planning and Housing (DREAL).
- Regional Health Agency (ARS).

1.5.3.2.4 Italy: Mazara del Vallo landing

Mazara del Vallo is a town and municipality in the province of Trapani and it is composed by the hamlets (*frazioni*) of Borgata Costiera and Mazara Due. Mazara has great monuments and museums, such as the *Museo della Satira Danzante* (where resides the statue of the Dance Satyr), the *Museo Diocesano di Mazara Del Vallo*, the Norman Arch, etc.

The following institutions will be involved in the project:

- Local authorities/entities (the Region of Sicily, the Province of Trapani and the municipality of Mazara do Vallo).
- Ministry of Ecological Transition (main authority in charge of the environment).
- Ministry of Infrastructures and sustainable mobility.
- Ministry of Health.
- Ministry of Economic Development.
- Ministry of Cultural and Landscape Heritage.
- Interministerial Committee for Ecological Transition.
- Superior Institute for Environmental Protection and Research (ISPRA).
- Superior Health Institute (ISS).
- Regulatory Authority for Energy, Networks and the Environment (ARERA).
- Region of Sicily; Province of Trapani, City Council of Mazara del Vallo.
- Integrate Hydric Service Ambit Authority (ATO 7 – Trapani).
- Regional Environmental Protection Agency (ARPA Sicilia).
- Local Health and Safety Agencies (ATS).

1.5.3.3 Economic Activities

Study area: landing sites.

In this section, a general analysis on economic activities of landing countries and regions is presented. Attention is given in particular to unemployment data and significance of the different economic sectors. Finally, information about internet use is also reported.

1.5.3.3.1 Portugal: Lisbon

Concerning the significance of the different economic activities, Portugal is a post-industrial society, mainly based on added value from services. In the Lisbon metropolitan area, services account for 87.0% of total gross value added in 2019, industry and construction for 12.6% and agriculture, forestry and fishing for 0.4%. Within the service sector the following categories can be differentiated:

- Wholesale and retail trade; transport; accommodation and food service activities; information and communication; account for 32.6% of total gross value added.
- Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities; account for 32.9% of total gross value added.
- Public administration and defense; compulsory social security; education; human health and social work activities; arts, entertainment and recreation, repair of household goods and other services; account for 21.5% of total gross value added.

Historically, Lisbon's economy has been based on the fishing industry, however since the 1990s services have become the dominant economic activity of Lisbon employing more than three-fourths of the active population. Heavy industry has become obsolete; however, plants were modernized to produce automotive parts, chemicals, electronics, tobacco, paper, and foodstuff. Since the 1990s, foreign-owned automotive assembly and food production plants have gained prominence, however, traditional industries such as cork and textiles have maintained their competitiveness through technological innovation.

Tourism and commerce have played a major part in Lisbon's modernization, and revenues from tourism have helped offset usually negative national trade balances. The 1998 World's Fair and the impressive waterfront renovation have contributed significantly to a new image of Lisbon and since Portugal's entrance into the European Economic Community in 1986, there has been an increase in the number of foreign financial institutions and corporations in Lisbon (Source: Encyclopedia Britannica website).

The unemployment population in Portugal (third trimester of 2022) increased by 2.3% from the previous quarter and decrease by 4.1% from a year earlier (ine.pt). The following picture shows unemployment population and unemployment rate in the period of time 2012-2022.

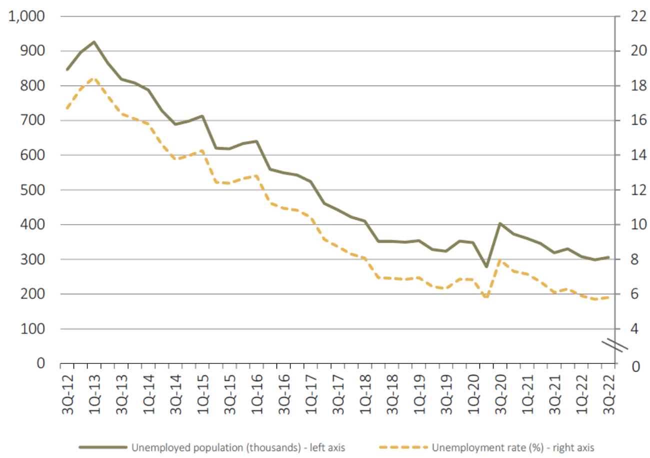


Figure 134. Unemployment in Portugal between 2012 and 2022. Source: Statistics Portugal, Labour Force Survey, 3rd quarter of 2022.

The decrease in unemployment was more significant for males as well as for population aged 16 to 24 and people with tertiary education. When considering long-term unemployment (more than 12 months), it can be noticed that this has increased with respect to previous year, in particular for population categories such as woman, people aged 16-24 years and those with tertiary education.

Concerning the Metropolitan Area of Lisbon, unemployment rate was above the national average in the 3rd quarter of 2022. When compared to the previous year, unemployment rate in this region was slightly higher.

In the following paragraphs more specified data from ec.europa.eu/Eurostat are reported.

Specifically, for the population aged 20-64 years, employment (2021) in the Metropolitan Area of Lisbon was 79.0% and 76.0% for male and females, respectively.

In 2021, for the population aged 15-74 years, unemployment rate (2021) was 6.8% in the region, being the youth unemployment rate 16.1%.

Median gross hourly earnings (all employees, excluding apprentices) was 5.4 euros in Portugal in 2018 (https://ec.europa.eu/eurostat). 4.0% of the employees were low-wage earners (employees earning two thirds or less the n median gross hourly earnings). Annual net earnings for single person without children (100% of average worker) was 14,828 euros in 2021 (ec.europa.eu/Eurostat).

The unadjusted gender pay gap (i.e., the difference between average gross hourly earnings of male and female as % of male gross earnings) was 11.4% in Portugal in 2020 (https://ec.europa.eu/eurostat).

Internet use affects people's everyday lives in many ways, both at work and at home. Daily internet users represent 83.0% of the population aged 16-74 years in the metropolitan area of Lisbon.

Concerning different internet uses, 59% of people aged 17-74 years use internet for purchasing goods or services, 61% for internet banking and 70% for social networks in the Lisbon metropolitan area.

Gross domestic product per inhabitant in purchasing power standards (PPS) in 2020 was 22,800 euros for Portugal, while, at regional level, it was 29,300 euros for the Lisbon metropolitan area.

1.5.3.3.2 Spain: Zahara, Torreguadiaro and Barcelona landings

Concerning the significance of the different economic activities, Spain is a post-industrial society, mainly based on added value from services. In Catalonia, services account for 74.5% of total gross value added in 2019, industry and construction for 24.4% and agriculture, forestry and fishing for 1.2%. Within the service sector the following categories can be differentiated:

- Wholesale and retail trade; transport; accommodation and food service activities; information and communication; account for 28.3% of total gross value added.
- Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities; account for 26.0% of total gross value added.
- Public administration and defense; compulsory social security; education; human health and social work activities; arts, entertainment and recreation, repair of household goods and other services; account for 20.1% of total gross value added.

In the case of Andalusia, services are again the main sector (75.1% of total gross value added in 2019), followed by industry and construction (18.6%) and agriculture, forestry and fishing (6.3%). The categories of the service sector have a similar proportion to Catalonia in relation to the total economic activities: transport, accommodation, food service, information and communication account for 25.1%; financial, insurance professional, scientific, technical, administrative, support and real estate activities account for 23.2%; and public administration, defense, compulsory social security, education, human health, social work, arts, entertainment and recreation account for 26.8%.

In 2019, gross domestic expenditure on Research and Development (R&D), a key sector for the improvement of the daily lives of millions of people, was 1.51% in Catalonia and 0.93% in Andalusia.

In Catalonia region, geography has played a favorable role regarding the economy. Its location in the Peninsula and the Mediterranean has made it a top rank strategic position as a port in the south of Europe, by road transport, motorways and rail transport; by sea, due to port that are constantly growing, and by air, taking advantage of the platform that constitutes the new Terminal in Barcelona airport. The industrial activity has grown particularly in the Barcelona conurbation, but it has also developed in many industrial estates that have grown all over the country. This set of circumstances has led to strong growth, and it has enabled Catalonia to historically become the industrial avant-garde of Spain. Industrial activity is very important for the overall economy of Catalonia, particularly in the chemical, food, energy, metal and transport material sectors.

In recent years, tourism has increased in such a way that it has become one of the most notable economic activities of Catalonia. This phenomenon has had a particular impact on the consolidation and expansion of commercial activity. The tourist demand has positioned Barcelona port as the leading one in Europe regarding cruises and over two million people have arrived in Catalonia by this mode. The financial activity is based on the savings banks, institutions with a long tradition in Catalonia which traditionally focused on small savings. In recent years, these banks have extended their activity to other sectors and they have a strong presence in the main Spanish companies (Source: Generalitat de Catalunya website).

On the other hand, Andalusia is particularly rich in natural resources, but despite this fact, Andalusia continues to have one of the lowest GDP per capita in Spain. The economic difficulties of the region are commonly attributed to poor soil conditions. Major agricultural products of the region include olive oil and wine, whose production levels are gradually increasing with increased mechanization. The natural wealth of the region is found in its mineral deposits, particularly copper, iron, zinc, and lead.

While the agricultural portions of the economy continue to struggle, the service sector is becoming a significant part of the national product of Andalusia. Manufacturing and service sectors are growing exponentially, with the growth rates in Andalusia exceeding those found elsewhere in Spain. High growth rates in the service sector are expected to continue, especially as tourism becomes more prominent in the area.

The following picture shows the unemployment rate (third trimester of 2022) in Spain, as well as in Andalusia and Catalonia, for males, females and total. Unemployment rate is higher in Andalusia and lower in Catalonia with respect to the data for the entire country. Female unemployment rate is higher than the value for males in each of the geographical contexts included in the graph.

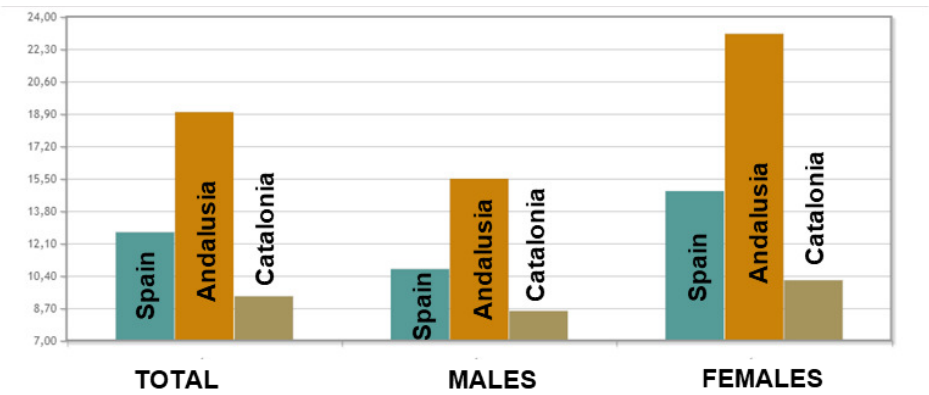


Figure 135. Unemployment rate for Spain, Andalusia and Catalonia in the third trimester of 2022. Source: ine.es.

In the following paragraphs more specified data from ec.europa.eu/Eurostat are reported.

Specifically, for the population aged 20-64 years, employment (2021) in Catalonia was 77.2% and 69.1% for male and females, respectively. In Andalusia employment rate (2021) was 67.2% for males and 51.7% for females.

In 2021, for the population aged 15-74 years, unemployment rate (2021) was 11.6% in Catalonia, being the youth unemployment rate 22.3%. In Andalusia unemployment rate (2021) was 21.7%, being the youth unemployment rate 35.5%.

At local level, considering the municipalities involved in the project, the following unemployment data are highlighted:

- Sant Adrià de Besòs (Barcelona province, Catalonia region) (source: datos.gob.es): data from October 2022 indicate a total of 2,556 unemployed people, being the number lower for men (1,122) than for women (1,434). When considering the different sectors, most of unemployed people are registered in services sector (1,899 people), in agreement with the post-industrial nature of the society in the zone.
- San Roque (Cadiz province, Andalusia region) (source: datos.gob.es): data from October 2022 indicate a total of 3,401 unemployed people, being the number lower for men (1,302) than for women (2,099). When considering the different sectors, most of unemployed people are registered in services sector (2,207 people), in agreement with the post-industrial nature of the society in the zone. The second unemployed sector is construction, with 486 unemployed people.
- Tarifa (Cadiz province, Andalusia region) (source: datos.gob.es): data from October 2022 indicate a total of 1,354 unemployed people, being the number lower for men (546) than for women (811). When considering the different sectors, most of unemployed people are registered in services sector (1,130 people), in agreement with the post-industrial nature of the society in the zone.

Median gross hourly earnings (all employees, excluding apprentices) was 10.1 euros in Spain in 2018. 14.3% of the employees were low-wage earners (employees earning two thirds or less then median gross hourly earnings). Annual net earnings for single person without children (100% of average worker) was 21,173 euros in 2021.

The unadjusted gender pay gap (i.e., the difference between average gross hourly earnings of male and female as % of male gross earnings) was 9.4% in Spain in 2020.

Internet use affects people's everyday lives in many ways, both at work and at home. Daily internet users represent 88.0% in Catalonia and 84.0% in Andalusia (population aged 16-74 years). Concerning different internet uses, in Catalonia 72% of people aged 17-74 years use internet for purchasing goods or services, 71% for internet banking and 68% for social networks. In Andalusia, internet is used for purchasing goods or services by 64% of people aged 17-74, for internet banking by 58% and for social networks by 66%.

Gross domestic product per inhabitant in purchasing power standards (PPS) in 2020 was 25,200 euros for Spain, while, at regional level, it was 29,600 euros for Catalonia and 18,900 for Andalusia.

1.5.3.3.3 France: Marseille landing

Concerning the significance of the different economic activities, France is a post-industrial society, mainly based on added value from services. In Provence-Alpes-Côte d'Azur, services account for 81.0% of total gross value added in 2019, industry and construction for 17.3% and agriculture, forestry and fishing for 1.7%. Within the service sector the following categories can be differentiated:

- Wholesale and retail trade; transport; accommodation and food service activities; information and communication; account for 36.7% of total gross value.
- Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities; account for 43.8% of total gross value.
- Public administration and defense; compulsory social security; education; human health and social work activities; arts, entertainment and recreation, repair of household goods and other services; account for 42.4% of total gross value.

In 2019, gross domestic expenditure on Research and Development (R&D), a key sector for the improvement of the daily lives of millions of people, was 2.19% in Provence-Alpes-Côte d'Azur.

The Provence-Alpes-Côte d'Azur region is the 3rd richest French region and ranks 19th at the European scale. It is going well mainly thanks to its attractivity in terms of tourism; it is indeed one of the favorite worldwide tourist destinations welcoming about 34 million tourists every year. If tourism is the driving force of Provence-Alpes-Côte d'Azur, the region is also in the lead when it comes to innovative sectors, such as high technology, biotechnology, microelectronics... Education for its part is well developed with various universities, international schools, engineering, business schools... All these institutes of higher learning help to contribute to the human capital needed on the region to meet current technological challenges. Although it is an indissociable activity in the region, tourism is not the only force at stake in the regional economy.

Indeed, this area bordered by the Mediterranean can also have a dynamic industrial fabric. Nice, Avignon, Toulon, Marseille and Aix-en-Provence are the real engines for the regional economy.

Historically, Marseille itself has never been a major industrial center, its importance has been much more in relation with trade and commerce. However, some industries developed, such as the manufacture of soap from olive oil (the oldest), and food processing (linked to both imported agricultural products and those originating from the surrounding region), shipbuilding and ship repair, metallurgy, clothing, chemicals, and precision engineering. At present, many of these industries have either disappeared or been reduced in importance through loss of markets or transfer to the city's periphery.

Heavy industry (oil refining and petrochemicals) grew up around the Berre Lagoon in the 1950s. Most of these installations use raw materials that enter through the port of Fos, and some of their finished products also leave by sea. The industrial zone is also directly linked to the national rail and highway networks and to the Rhône inland waterway. Within Marseille itself a number of new industrial and related service activities have become established in fields such as electronics, data processing, telecommunications, and biomedicine. The city's maritime location and traditions have also led to the growth of industries and services in offshore exploration and engineering (Source: Encyclopedia Britannica website).

The male unemployment rate in France was 8.1% in 2021, being similar to female unemployment rate (8.0%) (data.worldbank.org).

In the following paragraphs more specified data from ec.europa.eu/Eurostat are reported.

Concerning Provence-Alpes-Côte d'Azur region, for the population aged 20-64 years, employment rate (2021) was 74.9% and 69.4% for male and females, respectively. For the population aged 15-74 years, unemployment rate (2021) was 8.1%, coinciding with the total country data. Youth unemployment rate in the region was 14.7%.

At local level, unemployment was 16.9% of the population in the range of 15-64 years in 2019 for the municipality of Marseille (source: insee.fr).

Median gross hourly earnings (all employees, excluding apprentices) was 15.3 euros in France in 2018. 8.65 of the employees were low-wage earners. Annual net earnings for single person without children (100% of average worker) was 28,869 euros in 2021.

The unadjusted gender pay gap was 15.8% in France in 2020.

Internet use affects people's everyday lives in many ways, both at work and at home. Daily internet users represent 76.0% of the population aged 16-74 years in Provence-Alpes-Côte d'Azur region.

Concerning different internet uses, in Provence-Alpes-Côte d'Azur 78% of people aged 17-74 years use internet for purchasing goods or services, 73% for internet banking and 44% for social networks.

Gross domestic product per inhabitant in purchasing power standards (PPS) in 2020 was 31,200 euros for France, while, at regional level, it was 28,900 euros for Provence-Alpes-Côte d'Azur.

1.5.3.3.4 Italy: Mazara landing

Concerning the significance of the different economic activities, Italy is a post-industrial society, mainly based on added value from services. In Sicily, services account for 83.2% of total gross value added in 2019, industry and construction for 12.7% and agriculture, forestry and fishing for 4.1%. Within the service sector the following categories can be differentiated:

- Wholesale and retail trade; transport; accommodation and food service activities; information and communication; account for 24.7% of total gross value.
- Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities; account for 26.8% of total gross value.
- Public administration and defense; compulsory social security; education; human health and social work activities; arts, entertainment and recreation, repair of household goods and other services; account for 31.6% of total gross value.

In 2019, gross domestic expenditure on Research and Development (R&D), a key sector for the improvement of the daily lives of millions of people, was 0.84% in Sicily.

The Sicily's Island economy has remained relatively underdeveloped, but heavy industrial activity, based on the oil-refining and chemical industries, expanded markedly in the latter decades of the 20th century. Large quantities of natural gas and sulfur are produced, although the latter has been declining. Besides some oil, gas and salt, however, Sicily is relatively poor in terms of raw materials. The industries are focused mainly on the cities of Palermo, Catania, Milazzo, Syracuse and Gela. The focus is on shipbuilding and mechanical engineering as well as the petrochemical industry. Other industries include food processing, salt extraction, wine making, textiles, and shipbuilding. The region is mainly agricultural. Wheat, barley, corn (maize), olives, citrus fruit, almonds, wine grapes, and some cotton are produced, and cattle, mules, donkeys, and sheep are raised.

Most Sicilian companies with high added value are concentrated in Palermo and Catania. Catania has the largest scientific park of Sicily's region, the Etna Valley cluster, with companies specialized in ICT, biotechnology, pharmaceutical products, chemicals, etc). Other important industrial areas are located around Messina, Syracuse and Gela (petrochemical industry), Mazara del Vallo (province of Trapani and an important fishing port in Italy) and Trapani-Marsala at the western extremity (salt, tuna-fishing and wine).

Due to its natural and cultural heritage Sicily is a very attractive touristic destination and most of the hotels are situated in the regions of Messina, Palermo and Trapani.

The average unemployment rate (from 15 to 74 years) was 18.7% in the Sicily region in 2021, being 9.5% the average in Italy. For the same years, in Sicily this rate for males was 17.2% and for females 21.3%.

At local level, unemployment rate was 26.5% for Mazara municipality in 2011, being youth unemployment 52.4% (istat.it). Unemployment rate was higher for women (35%) than for men (21.9%).

Median gross hourly earnings (all employees, excluding apprentices) was 12.6 euros in Italy in 2018 (ec.europa.eu/eurostat). 8.5% of the employees were low-wage earners (employees earning two thirds or less the median gross hourly earnings). Annual net earnings for single person without children (100% of average worker) was 23,940 euros in 2021 (ec.europa.eu/Eurostat).

The unadjusted gender pay gap (i.e., the difference between average gross hourly earnings of male and female as % of male gross earnings) was 4.2% in Italy in 2020 (ec.europa.eu/eurostat).

Internet use affects people’s everyday lives in many ways, both at work and at home. Daily internet users represent 70.0% of the population aged 16-74 years in Sicily region.

Concerning different internet uses, 38% of people aged 17-74 years use internet for purchasing goods or services, 29% for internet banking and 45% for social networks in Sicily.

Gross domestic product per inhabitant in purchasing power standards (PPS) in 2020 was 28,000 euros for Italy, while, at regional level, it was 17,300 euros for Sicily.

1.5.3.4 Fishing

Study area: trunk of Medusa submarine system, branches and landing sites.

The following map shows some general information about fishing in the study area. Continental plateau up to 200 m is generally considered as a potential fishing zone. On the contrary, trawling is banned in waters deeper than 1,000 m.

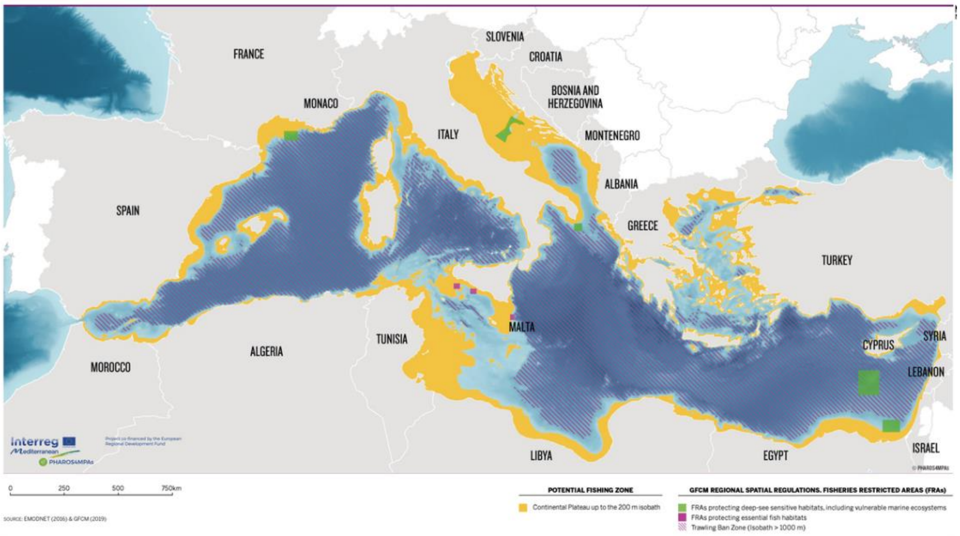


Figure 136. Distribution of fishing potential areas and trawl-banned zones in the Mediterranean Sea. Source: https://www.obs.planbleu.org/en/maps/fishing-areas-statistical-unit-practices-and-fishing-zone/.

Total capture by country in 2018 was higher for Italy, Algeria and Tunisia, medium for Spain and lower for Morocco and France (see figure below). Total capture by inhabitants was higher for Tunisia, followed by Algeria and Italy, medium for Spain and low for Morocco and France.

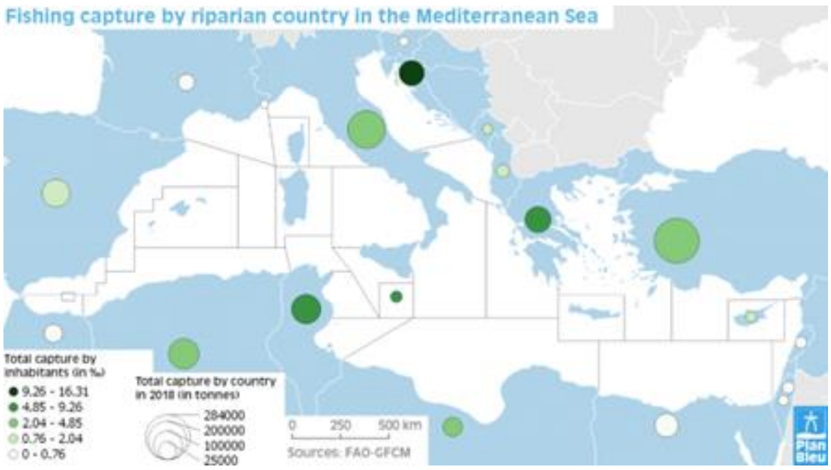


Figure 137. Fishing capture by riparian country in the Mediterranean Sea. Source: https://www.obs.planbleu.org/en/maps/fishing-areas-statistical-unit-practices-and-fishing-zone/.

Fishing pressure in the study area is higher in the coastal zone, in particular along the Spanish coast and the south coast of Sicily. The pressure is considered low in open sea areas.

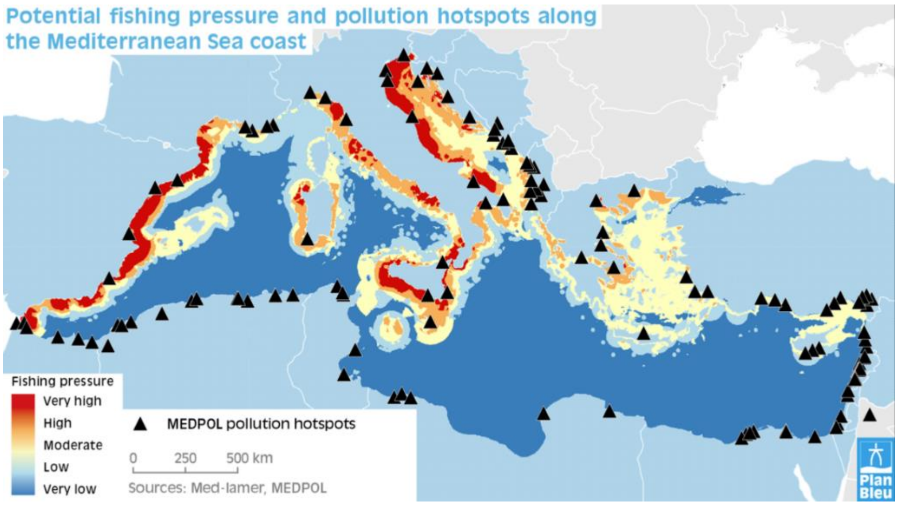


Figure 138. Distribution of fishing pressure in the Mediterranean area. Source: https://www.obs.planbleu.org/en/maps/fishing-areas-statistical-unit-practices-and-fishing-zone/.

Concerning the different fishing gear type, trawlers and dredgers are numerous are more than 25% of the entire fishing fleet for Spain, Italy and Egypt, while are significantly lower for France, Algeria, Tunisia, Greece and Libya. In the case of Morocco, the number of trawlers and dredgers working in the Mediterranean Sea seems to be extremely low. Small-scale artisanal boats represent the majority of fishing float for any of the Mediterranean countries.

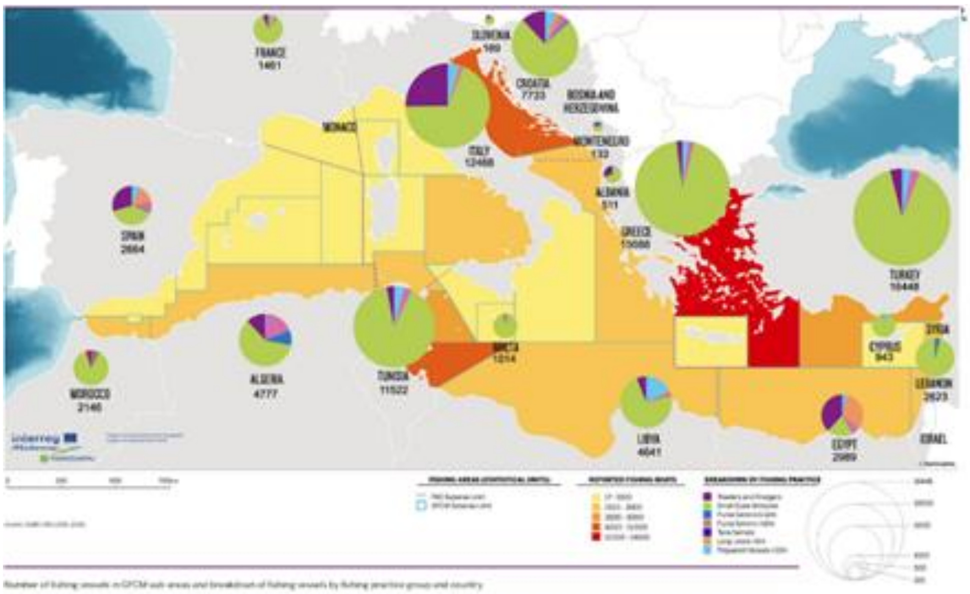


Figure 139. Fishing vessels in the Mediterranean Sea. Source: https://www.obs.planbleu.org/en/maps/fishing-areas-statistical-unit-practices-and-fishing-zone/.

In the following paragraphs some information about fishing is reported for the main trunk, as well as the branches of Medusa system. Information about fishing is more limited for North Africa landings at the current stage. In these cases, some general information about country fishing profile is reported.

1.5.3.4.1 Main trunk

The Global Fishing Watch map (https://globalfishingwatch.org/) shows how fishing effort in the study area is high near the European coast, as well as in the Alboran Sea, next to Alboran Island, and in the shelf zone near Sicily (Sicily Strait and platform between Sicily and Malta). Fishing effort seems to be much lower at the North African Coast.

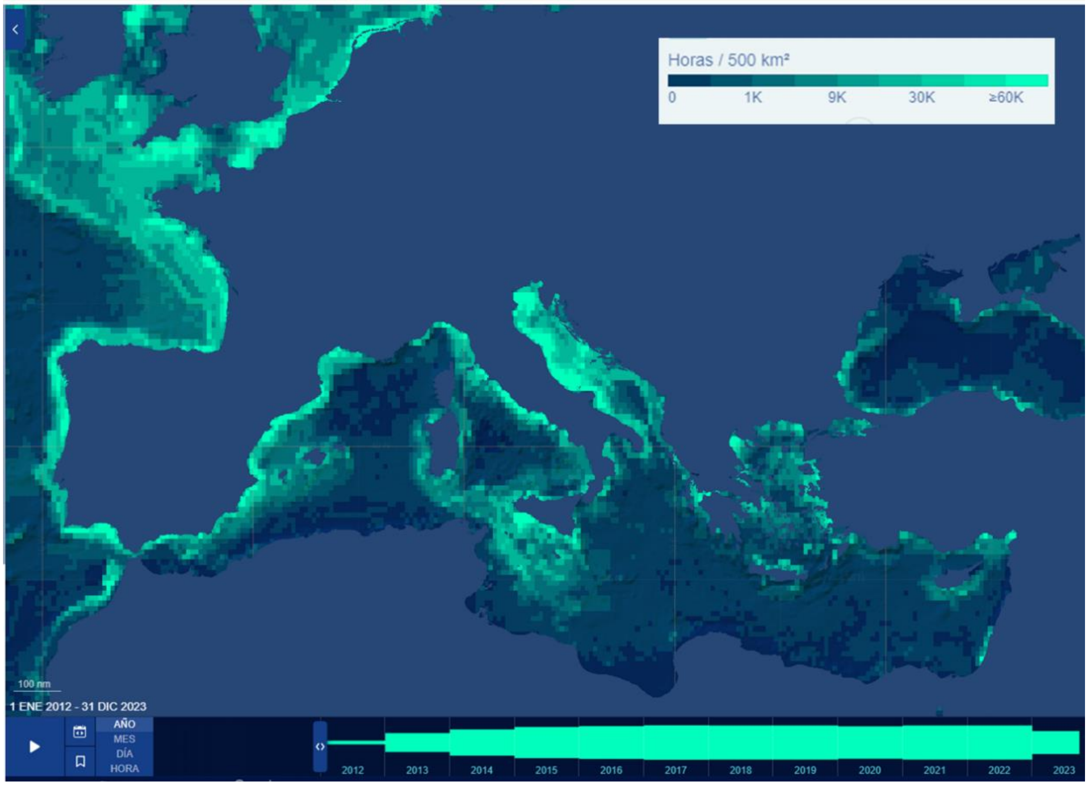


Figure 140. Fishing effort during the period 2012-2023 in the study area. Source: https://globalfishingwatch.org/.

At the Mediterranean Sea, trawl fishing is conducted from depths of 50 m (100 m in the Atlantic Sea) up to depths of 1,000 m. Therefore, considering the trunk of Medusa submarine system, the area characterized by higher trawling fishing activities is the platform between Sicily and North Africa.

Other important fishing areas next to the trunk of Medusa subsea system are those in the middle of the Alboran Sea, that is the *Banco de Djibouti* and *Terreira* fishing ground, where the Spanish fleet works mainly by trawling for catching demersal communities, in addition to bottom longline and gill nets. Fishing here is focused on deep-sea species such as hake, monkfish, sea bream, octopus, Norway lobster, red mullet, crab and, especially, the red shrimp.

1.5.3.4.2 Portugal: Lisbon and Sines landings

In the case of Portugal, the fishing data reported in this document were presented in the 2021 Fishery Statistics compendium that is elaborated by Statistics Portugal and the Directorate-General for Natural Resources, Safety and Maritime Services. The data are expressed globally for the whole country, but also presented for each territorial unit defined by Regulation (UE) nº 868/2014.

Lisbon landing includes the region defined as the metropolitan area of Lisboa. This area is made up of a total of 15 harbors: Cascais, Ericeira, Assenta, Vila Franca de Xira, Sesimbra, Costa da Caparica, Trafaria, Fonte da Telha, Barreiro, Montijo, Seixal, Alcochete, Setúbal, Faralhão and Gambia. Of all these harbors, the main ones would be Cascais, Sesimbra and Setúbal. Some data for this region are shown below.

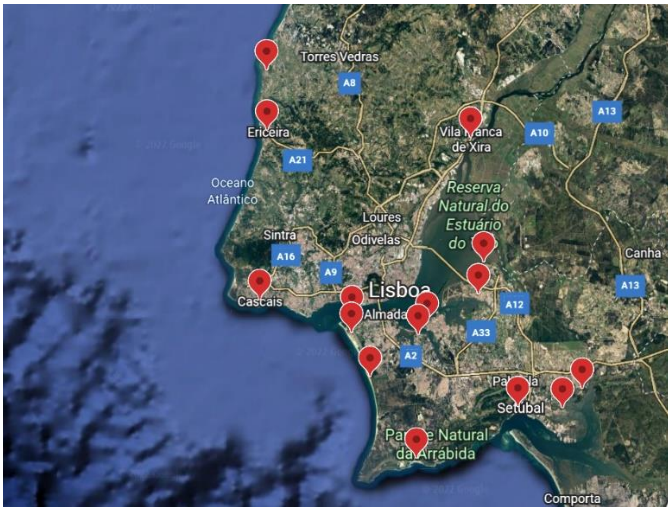


Figure 141. Harbours in the metropolitan area of Lisbon (red).

Particularly, in the metropolitan area of Lisbon, 46.1% of the registered fishermen are between 35 and 54 years old, while the youngest (16 to 34 years old) represent 18.1% and the oldest (over 55 years old) correspond to 35.8%. The number of total vessels for this region is 1575, of which the 30% are non-motorized vessels (Instituto Nacional de Estatística – Estatísticas da Pesca: 2021). The total number of catches for the year 2021 is 29277.5 T with an average value of 1.64 euro/kg. If analyze the catches and the price per fishing gear (dgrm.mm.gov.pt/), the results obtained are:

	Catches (T)	Price (euros/kg)

Trawler	838.2	1.46
Purse seine fishing	16306.2	0.55
Multipurpose	12177.5	3.34

Table 17. Catch and price for each fishing gear in the regions of metropolitan area of Lisbon in 2021.

In addition, it has been possible to analyze the principal fresh and refrigerated fish species landed (catches over 50 T) by the three fishing gear types mentioned above (dgrm.mm.gov.pt/). The caught species changed depending on the gear type, but Atlantic horse mackerel, blue jack mackerel and Atlantic makerel were caught for two of these fishing gear types. The most catches species was Atlantic mackerel, for both purse seine fishing and multipurpose. However, concerning the price, the most expensive species were caught by multipurpose fishing, highlighting the octopus and cuttlefish.

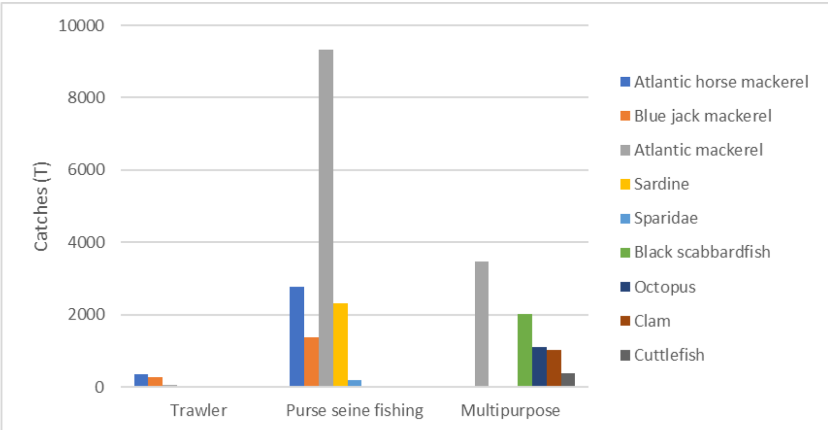


Figure 142. Catch by species for each fishing gear in the Metropolitan area of Lisbon in 2021.

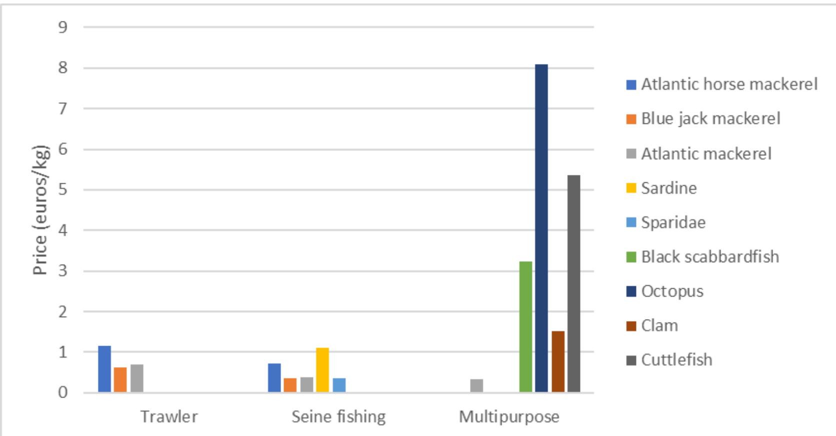


Figure 143. Price by species for each fishing gear in the metropolitan area of Lisbon in 2021.

Data from the fishing route density map (https://www.emodnet-humanactivities.eu/view-data.php) can be used to recognize the distribution of the most significant fishing grounds in the proximity of Lisbon landing. Medusa subsea system will cross a medium route density of fishing vessels in the first 42 km from the coast. The route density is higher in particular in the following 3 km, at the top of the continental slope, where a fishing ground is probably located.

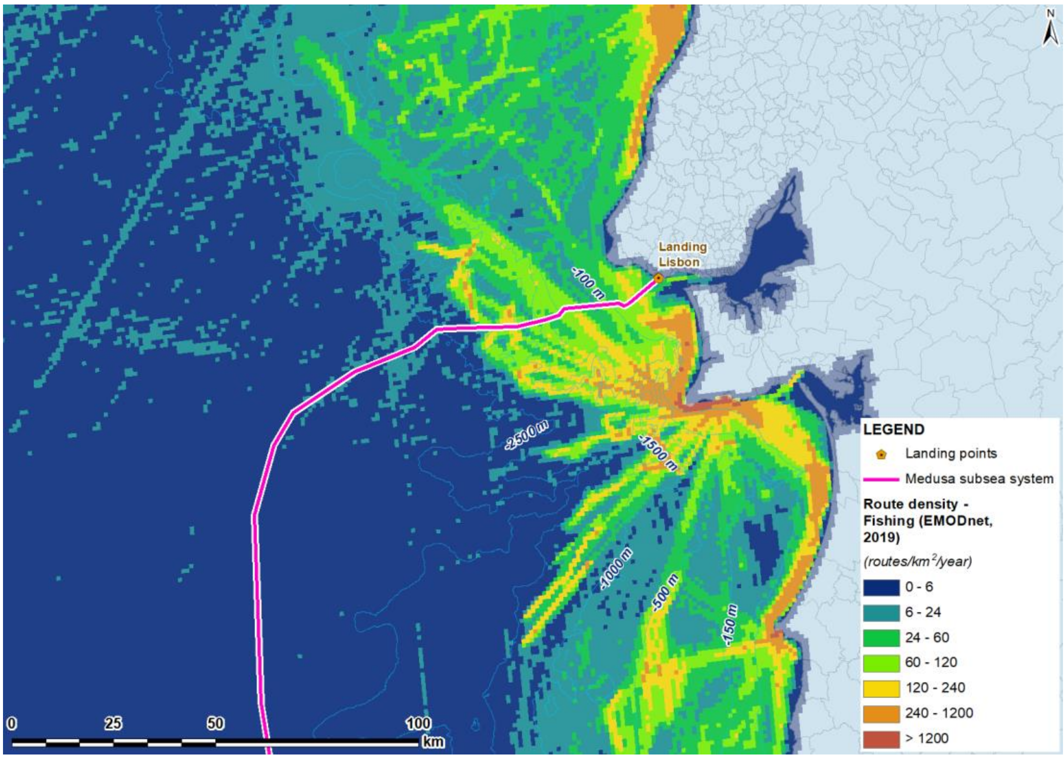


Figure 144. Fishing route density at Lisbon landing in 2019. Source: elaborated with data from EMODnet Human Activities.

The Global Fishing Watch map (https://globalfishingwatch.org/) confirms the presence of a trawling area crossed by Medusa subsea system near Lisbon landing.

1.5.3.4.3 Spain: Zahara, Torreguadiaro y Barcelona landings

Zahara

Medusa subsea system does not cross any fishing grounds at coastal zone in Zahara. The closest fishing ground to the route is *La Piojera*, which is at a minimum distance of 1.3 km from the cable. In this fishing ground sole, cuttlefish, spitfish and red mullet are caught. According to fishing effort maps (http://infomar.cedex.es/visor.html), in the coastal zone of Zahara landing, some purse seine fishing and trawling fishing seems to be conducted.

In addition, it is important to mention the presence of the Cabo Plata *almadraba* close to the landing site in Zahara. It is a specific fixed gear for the capture of bluefin tuna (*Thunnus thynnus*) that is usually set in clean places on the coast, where tuna end up on their way to the Mediterranean Sea. Time window for this fishing art is from the second half of April to the second half of June, when it begins to be dismounted, to finish definitively at the beginning of July. The species caught are those belonging to the tuna family.

The planned route of Medusa system does not cross the *almadraba* of Cabo Plata, being located at a minimum distance of 400 m. In any case, its presence must be taken into account when scheduling the works at Zahara landing: in order to avoid interferences, the bluefin tuna migration season to the Mediterranean (April-June) should be avoided. It must also be considered that the assembly and installation operations of the trap nets of the *almadraba* normally start about two months before, in February.

The harbour of Zahara showed a total of 365 T catches and turnover of 3 million euros in 2021. About the above, the most important species is Atlantic bluefin tuna (*Thunnus thynnus*), corresponding at 90% of the catches and turnover. Even so, 39 other species are caught, the second most important (with less than 5 %) is blackspot seabream (IDAPES).

No aquaculture facilities or shell fishing areas have been detected in the study area that could interfere with the route of the cable.

In the deep zone, the planned route of Medusa system will cross two fishing areas for the black-mouthed snapper. This species is not caught by trawling, but by bottom longlines (Tecnoambiente-Iberdrola, 2010). Therefore, once the cable is installed on the seabed, there would be no interference with these fishing areas.

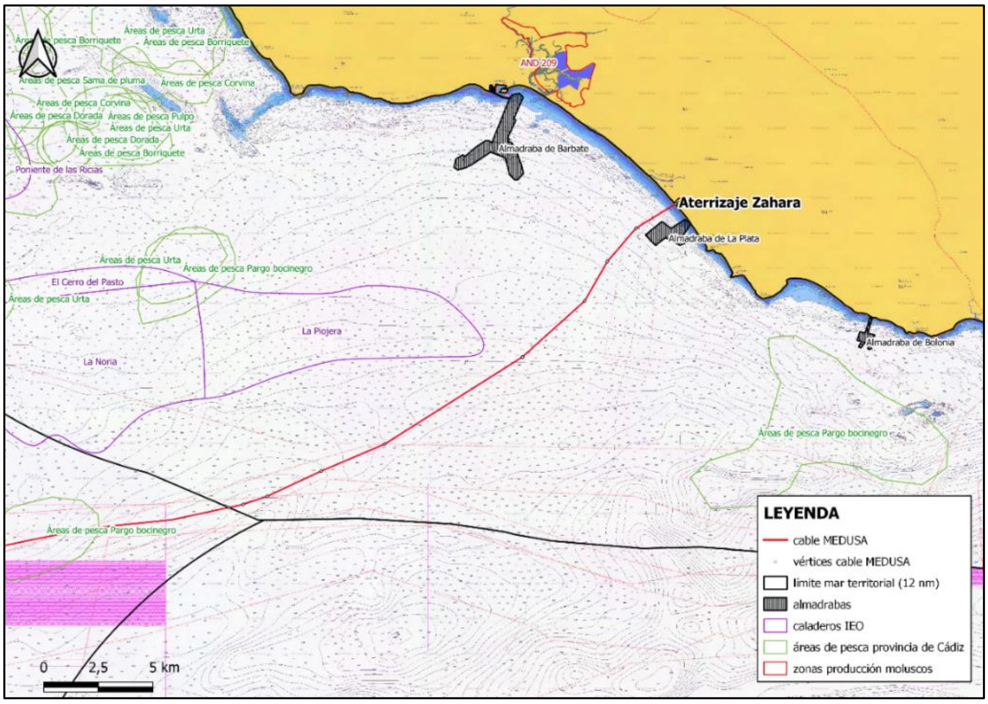


Figure 145. *Almadraba* of Cabo Plata and relevant fishing grounds in Zahara landing. Source: AFR-IX Telecom-Tecnoambiente, 2021.

Data from the fishing route density map (https://www.emodnet-humanactivities.eu/view-data.php) confirm the distribution of fishing area in the proximity of Zahara landing. Two high-density route areas of fishing vessels are recognized at the east and west of Zahara landing, highlighting that vessels usually start their routes from Barbate and Tarifa ports. Fishing activities are more limited in correspondence of Medusa subsea system. However, it is possible to recognize two medium route density zones about 38 and 50 km away from the landing point, corresponding to the two fishing areas for the black-mouthed snapper cited above.

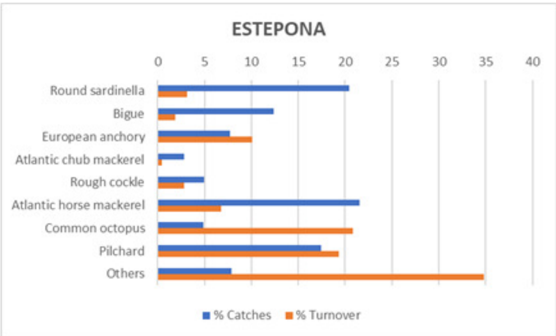
The Global Fishing Watch map (https://globalfishingwatch.org/) confirms the presence of trawl fishing at the east and the west of Medusa system, being absent at Zahara landing.

Torreguadiaro

Medusa subsea system will cross a fishing ground at Torreguadiaro landing zone, that is the *Guadiaro* fishing ground (source: ieo.es). The fleets of La Atunara and Estepona fish with trawls in this fishing ground. The species caught are *Chamelea gallina*, *Donax trunculus*, *Callista chione* and *Pecten jacobaeus*.

Other fishing grounds close to the route are *Cala Sardina-Chullera*, to the north, *Sotogrande* and *Carbonera*, to the south. The fleets of La Línea and Estepona fish in these fishing grounds. The species caught are the same as the *Guadiaro* fishing ground in the case of *Sotogrande*, while in the other two fishing grounds fish species such as horse mackerel and red mullet, among others, are also caught. The Medusa system would not interfere with these three fishing grounds.

The harbor of La Atunara and Estepona showed a total of 368 T and 3,298 T catches in 2021, respectively. Regarding turnover, La Atunara represents 992 thousand euros and Estepona 5.5 million euros in 2021. The species in the following figures have an individual percentage of more than 2% of the total catch and the species grouped in others include the species whose individual catch volume is less than 2% of the total. The most caught species in Estepona are fishes, while in La Atunara dominate the mollusks. In both harbors, concerning the turnover, species classified as other species account for a high percentage, around 30%. However, it must be borne in mind that the levels of catches and turnover in these two harbors are very different (IDAPES).



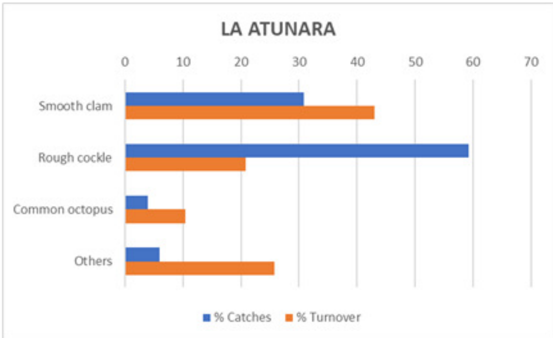


Figure 146. Relationship between catches and turnover for the main species landed in the harbours of Estepona and La Atunara. Source: IDAPES.

According to fishing effort maps (http://infomar.cedex.es/visor.html), trawl fishing is significant in the area, followed by purse seine fishing.

Considering data from the Autonomous Community of Andalusia (REDIAM viewer), there are two mussel farming to the south of the landing of the Medusa system in Torreguadiaro, close to the *Guadiaro* and *Sotogrande* fishing grounds. The route of Medusa cable does not cross these mussel farming areas.

The first 3.5 km of marine domain in front of Torreguadiaro landing are occupied by a bivalve production area, AND205 (Alcaidesa-Punta Chullera), which occupies an area of 29.2 km^2. Mollusks that are currently produced in this area are *Chamelea gallina*, *Glycymeris nummaria*, *Donax trunculus*, *Venus verrucosa*, *Callista chione* and *Acanthocardia tuberculate* (Source: BOE-A-2022-13833).

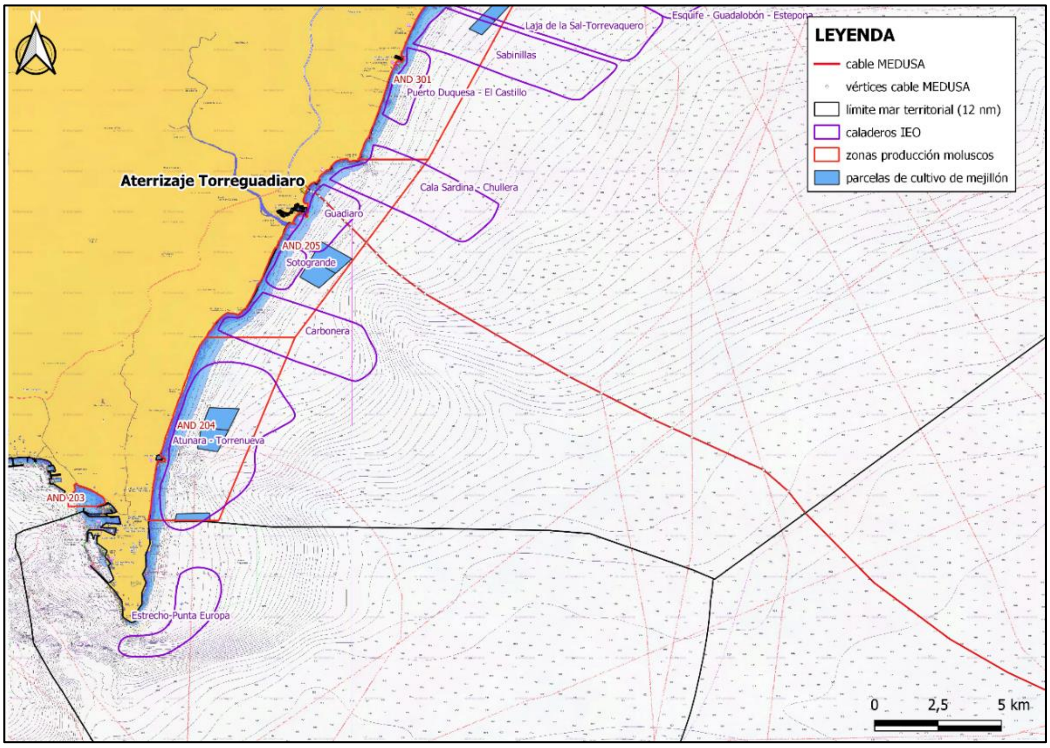


Figure 147. Relevant fishing grounds in Torreguadiaro landing. Source: AFR-IX Telecom-Tecnoambiente, 2021.

Data from the fishing route density map (https://www.emodnet-humanactivities.eu/view-data.php) confirm the distribution of fishing area in the proximity of Torreguadiaro landing. Fishing activities are quite significant from the coast up to the bottom of the continental slope in this zone, being the route density particularly high between 2 and 5 km from the coast and medium in the range of 5-7 km and 10-16 km of distance from the coast. This is confirmed also by data from the Global Fishing Watch map (https://globalfishingwatch.org/).

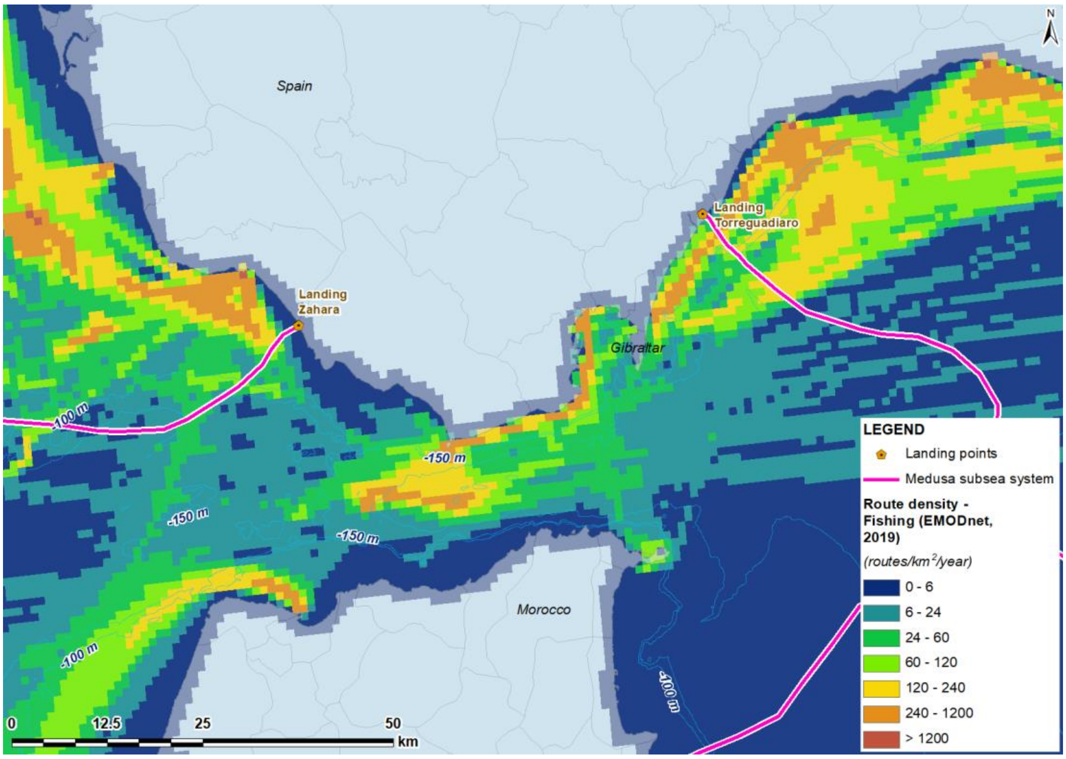


Figure 148. Fishing route density at Zahara and Torreguadiaro landings in 2019. Source: elaborated with data from EMODnet Human Activities.

<u>Barcelona</u>

At Barcelona landing zone, Medusa system will cross two fishing grounds, *Els Colls* and *La Barana*.

The first meters from the coast also belong to the mollusk production area CAT1-14, where currently echinoderms, gastropods and squirts and other tunicates can be caught (Source: BOE-A-2022-13833).

Barcelona and Arenys fleets are those working in these fishing grounds. Here, the most used fishing modalities are small gear and purse seine fishing, 40% and 24% respectively. Then trawling and fishing from other CCAA (vessels with the home harbour in other Autonomous Communities) each account for 16%. Finally, the surface longline and vessels from other countries (vessels with the home harbour abroad) not reach 3%.

Figure 149. Characteristics of the fishing fleet in the harbours of Barcelona and Arenys de Mar. Source: ICATMAR, 2021.

In 2021, the catches of the fishing fleet landed in the harbours of Barcelona and Arenys de Mar totalled 3,500 T (ICATMAR, 2021), with an associated turnover of 13 million euros.

Considering catches by fishing gear type, purse seine fishing for around 70% of the total, and the second is trawling, with approximately 16%. Regarding the economic part, trawling represents 49% of the total. Moreover, purse seine fishing is the second fishing gear type both in terms of catches and economics.

Figure 150. Catches and volume invoiced by fishing gear type of the fishing fleet of the harbours of Barcelona and Arenys de Mar. Source: ICATMAR, 2021.

As can be seen in the figure below, European pilchardus (*Sardina pilchardus*), round sardinella (*Sardinella aurita*) and European anchory (*Engraulis encrasicolus*), which are included in the category of small planktonic pelagic, represent 84% of the total catch of the fishing fleet operating in this fishing ground. These three species are mainly caught by purse seine fishing. The remaining species indicated have an individual percentage of more than 2% of the total catch and the species grouped in others include the species whose individual catch volume is less than 2% of the total.

In terms of turnover, the most important species are the blue and red shrimp (*Aristeus antennatus*) and the other species, which account for 55%. The other species with high turnover percentages are European pilchard (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*), representing a total percentage of 68%.

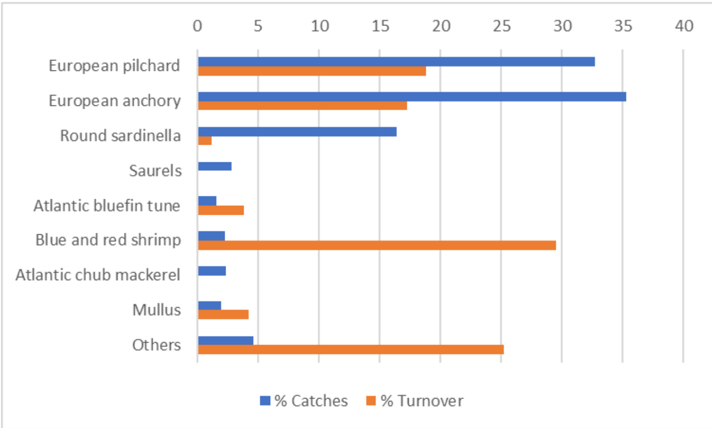


Figure 151. Relationship between catches and turnover for the main species landed in the harbours of Barcelona and Arenys de Mar. Source: ICATMAR, 2021.

At deeper depths, several fishing grounds exist in correspondence of the continental slopes, where submarine canyons are recognized. In these fishing grounds, red shrimp is mainly caught by trawling.

Fishing effort maps (http://infomar.cedex.es/visor.html), confirm the significance of trawl fishing in the area, followed by purse seine fishing and surface longlines.

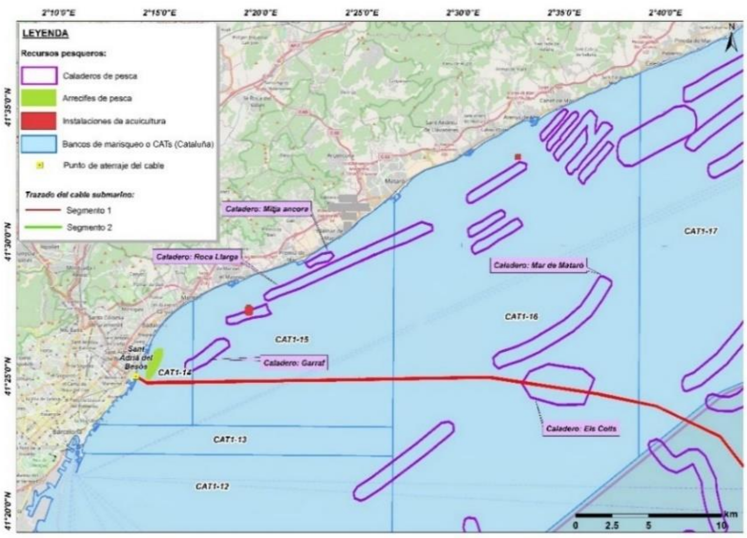


Figure 152. Relevant fishing grounds in Barcelona landing. Source: AFR-IX Telecom-Tecnoambiente, 2019.

Data from the fishing route density map (https://www.emodnet-humanactivities.eu/view-data.php) confirm the distribution of fishing area in the proximity of Barcelona landing. In this zone fishing activities are quite significant from the coast up to the top of the continental slope. This is showed also by data of the Global Fishing Watch map (https://globalfishingwatch.org/).

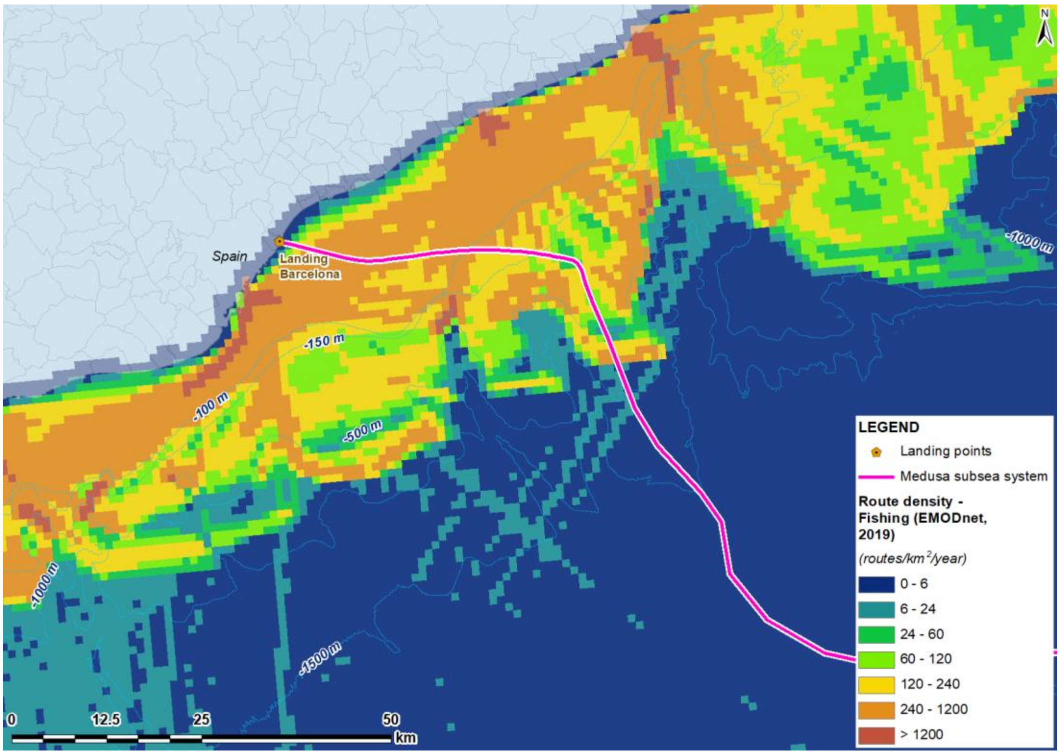


Figure 153. Fishing route density at Barcelona landing in 2019. Source: elaborated with data from EMODnet Human Activities.

Abandoned aquaculture facilities have been detected 5 km north of the route in Barcelona landing area. However, no interference is foreseen with Medusa subsea system.

1.5.3.4.4 France: Marseille landing

France is divided into different marine districts, the one corresponding to the Marseille landing being the district of Marseille. The data that are shown below come from the report “Activité des navieres de pêche: quartier maritime Marseille 2021” elaborated by “Système d’Informations Halieutiques (SIH) de l’Ifremer”.

This area is made up of a total of 5 principal harbours: La Madrague de Montredon, Vieux Port de Maseille, Saumaty, La Ciotat and Port-de-Bouc/Anse Aubran.

Figure 154. Harbours in the district of Marseilla (red).

The number of total vessels for this region that are listed in the "Flotte de Pêche Communautaire (FPC)" are 126, of which are active 111. The registered fishermen are around 230.

The most used fishing modalities are nets and longline fishing, 64% and 17% respectively. Then shore fishing and trawling each account for 7%. Finally, the purse seine fishing and traps and snares shows 3%.

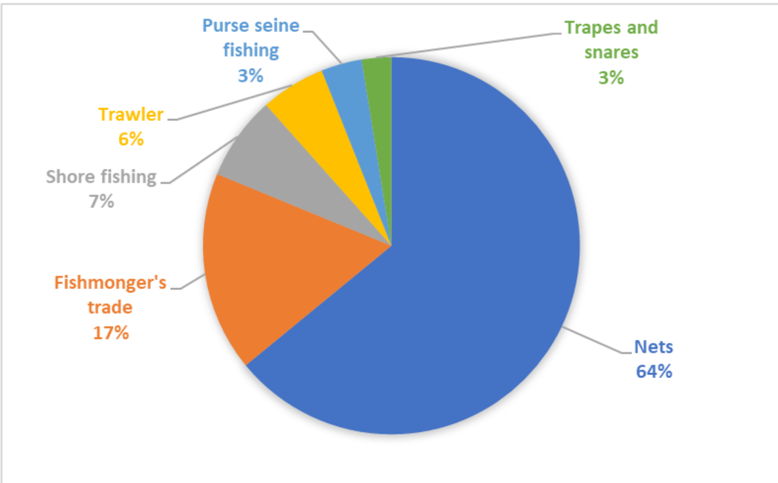


Figure 155. Characteristics of the fishing fleet in the harbours of Marseille district. Source: "Activité des navieres de pêche: quartier maritime Marseille 2021".

The following figure represents the 15 main species by value and the other species in this district. The most important species in relation to catches are anchovy, which represents 28% of the total catches. Then, the second is the other species, with 23% of the total. In terms of turnover, the other species are the most important, with 20%. Then, the species that have more than 10% are: gilt-head bream, European hake, bluefin tune.

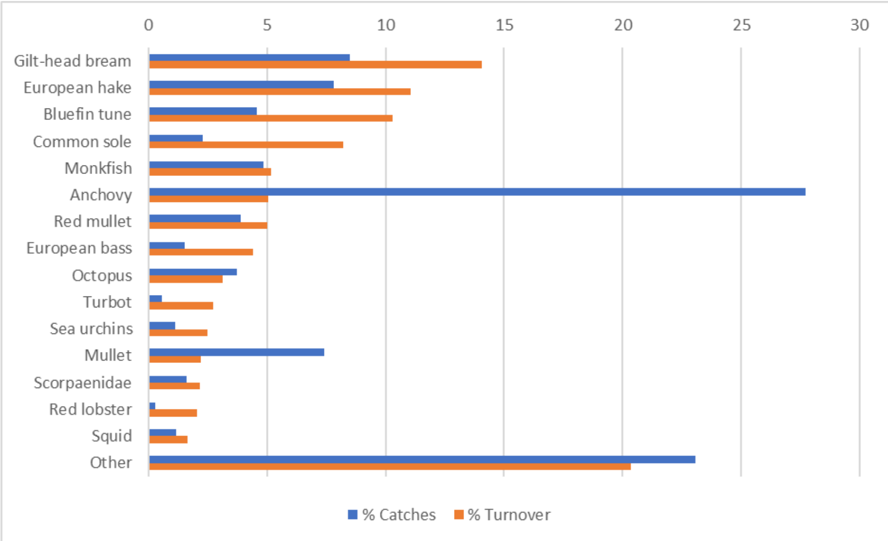


Figure 156. Relationship between catches and turnover for the main species landed in the harbours of Marseille district. Source: "Activité des navieres de pêche: quartier maritime Marseille 2021".

Data from the fishing route density map (https://www.emodnet-humanactivities.eu/view-data.php) can be used to recognize the distribution of the most significant fishing grounds in the proximity of Marseille landing. Medusa subsea system will not cross any fishing grounds in this area, being fishing activities focused in the continental platform at the east and the west of the cable landing. Route density of fishing vessels is lower in this area; the highest values are showed in the ranges of 7-11 km and 22-24 km from the landing point for Segment 1 and between 15 and 17 km for Segment 2.

The Global Fishing Watch map (https://globalfishingwatch.org/) confirm the presence of trawl fishing at the east and the west of Medusa system, being scarce along Medusa route at Marseille landing.

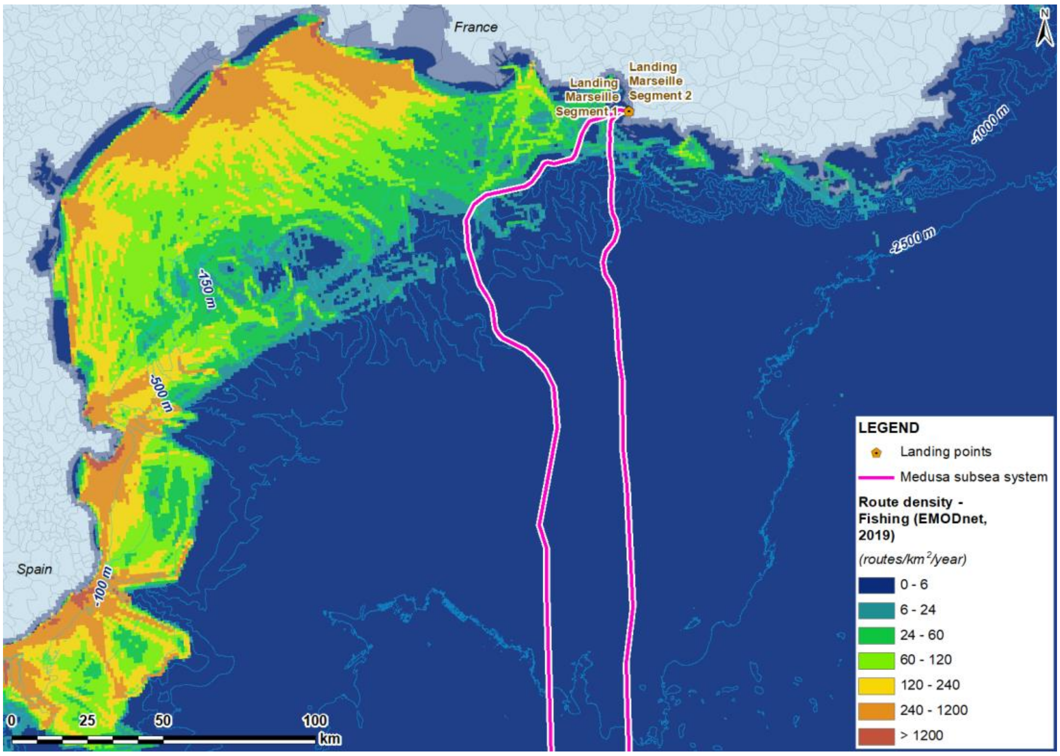


Figure 157. Fishing route density at Marseille landing in 2019. Source: elaborated with data from EMODnet Human Activities.

1.5.3.4.5 Italy: Mazara del Vallo landing

The Mazara del Vallo landing is situated on the southern coast of Sicily and in the northern part of the Strait of Sicily. In order to evaluate living resources and the monitoring of fisheries on the fleets that operate in the Mediterranean Sea, this sea has been subdivided into 30 sub-areas. In particular, the South of Sicily is named as GSA (Geographic Sub Areas) 16. The data for this region, detailed below, is extracted for the “Annual report on Italy’s efforts in 2020 to achieve a sustainable balance between fishing capacity and fishing opportunities”. The fleet on the south coast of Sicily is composed of 1,124 vessels, representing less than 10% of the total Italian fleet. However, the average size of vessels has a tonnage of 26 GT, more than double the average size of vessels operating in all of the Mediterranean (11.7 GT).

In the Strait of Sicily region, 12,782 tonnes of fish are landed in 2020, 10% of Italy’s total. However, thanks to shrimp fishing, as well as the high commercial value of the catches in the area, the total income amount to 100 million euros, or 16% of the national total.

Bottom trawling is the most important fishing activity along the Italian sector of the Strait of Sicily and it can be identified two main trawl fishing activities: coastal fishing and off-shore fishing (Cataudella & Spagnolo, 2011).

Coastal fishing	
Main target species	Incidental Species
Red and striped red mullet, European hake, Pandora spp., common star gazer, greater weever, horned octopus, common cuttlefish, greater forkbeard, white and black anglerfish, deep-water rose shrimp, broadtail shortfin squid, Norway lobster, john dory, Ray spp. (mixed fisheries)	
Off-shore fishing	
Main target species	Incidental Species
Red and striped red mullet (main striped red mullet)	European hake, pandora, common star gazer, Ray spp., greater weever, horned octopus, common cuttlefish, greater forkbeard, white and black anglerfish
Deep-water rose shrimp	Norway lobster, European hake, greater forkbeard, lesser flying squid, white and black anglerfish, red and striped red mullet, Pandora spp., john dory, Ray spp.
Giant red shrimp	Norway lobster, European hake, lesser flying squid, white and black anglerfish, blackbelly rosefish, forkbeard, Ray spp.

Table 18. Main target species of the trawl fisheries in the Strait of Sicily by different fishing type.

For some of these main target species in the GSA 16, are reported the distribution of the nursey area and the relation with the streams and the oceanographic process (Cataudella & Spagnolo, 2011).

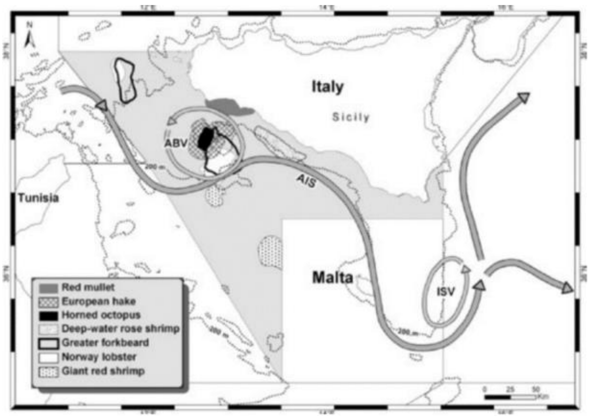


Figure 158. The main nursery area in GSA 16 of red mullet, European hake, deep-water rose shrimp, grater forkbeard, Norway lobster and giant red shrimp. Main hydrological features and morfobatimetric in the northern sector of the Strait of Sicily (AIS: Atlantic Ionian Stream; ABV: Adventure Bank Vortex; ISV: Ionian Shelf-break Vortex).

In particular, for the trawl fishery for the Mediterranean giant red shrimp (*Aristaemorpha foliacea*) and blue and red shrimp (*Aristeus antennatus*) in the Strait of Sicily, as provided for in Annex IV of Regulation (EU) 90/2021, a maximum number of fishing vessels has been set as a sustainable management measure for this fishery.

Data from the fishing route density map (https://www.emodnet-humanactivities.eu/view-data.php) can be used to recognize the distribution of the most significant fishing grounds in the proximity of Mazara landing. Starting from the locality of Mazara del Vallo to the east, the coastal zone of Southern Sicily is characterized by high fishing vessel density. Medusa subsea system route has been planned to avoid as far as possible this significant fishing area. Therefore, direct interference with the fishing area is minimized as far as possible and is seen in particular in the first 20 km from the coast.

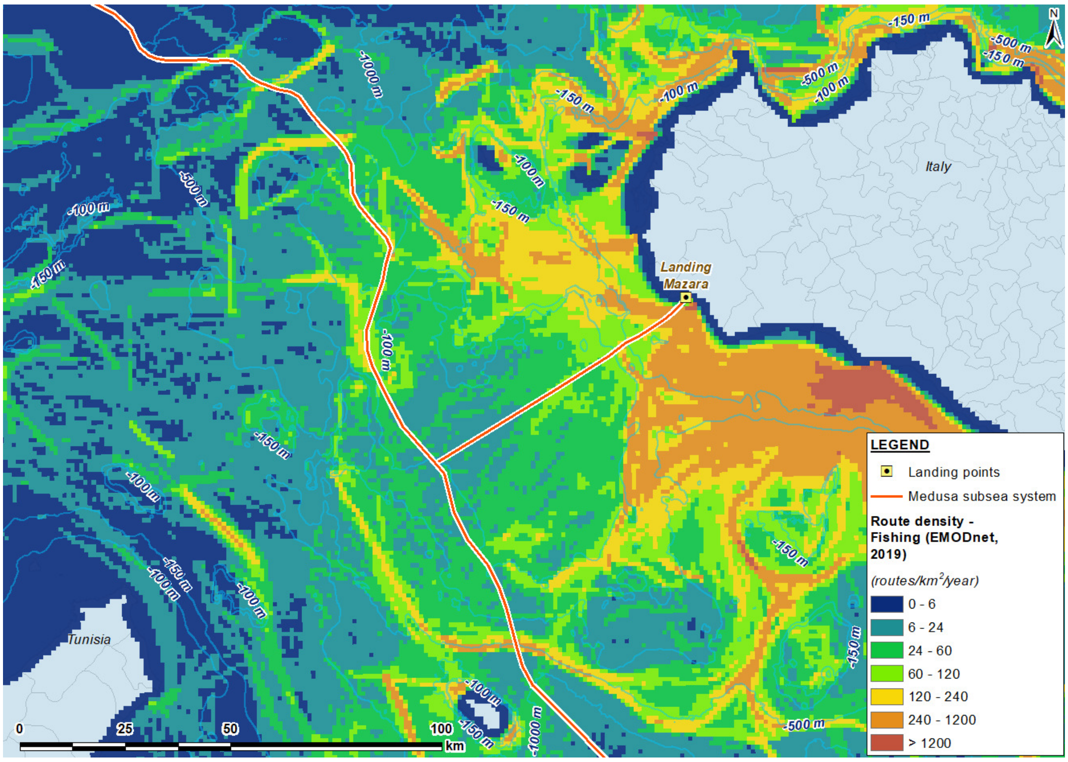


Figure 159. Fishing route density at Mazara branch in 2019. Source: elaborated with data from EMODnet Human Activities.

The Global Fishing Watch map (https://globalfishingwatch.org/) confirms the intense trawling activity at the platform between Sicily and North Africa, in particular at the east of Mazara landing.

Figure 160.

1.5.3.5 Infrastructures and Basic Services

Study area: trunk of Medusa submarine system, branches and landing sites.

1.5.3.5.1 Submarine infrastructures

1.5.3.5.1.1 Main trunk

In the marine environment, infrastructures that can be found at the sea bottom are firstly other submarine cables (telecommunication and power cables), which are abundant in the area of study. Telecommunication cables connect the Mediterranean countries each other but also with other countries of Europe and other continents (Asia, Africa and America). In the Atlantic section of the area of study, several cables link Spain and Portugal to Europe and Africa. In addition, both in the Mediterranean Sea and in the Atlantic Ocean, some cables (telecommunication and power type) connect the countries with their islands.

The following map shows submarine cables currently in use In the Mediterranean Sea, together with new planned cables. It is possible to notice that the study area is a very busy zone.

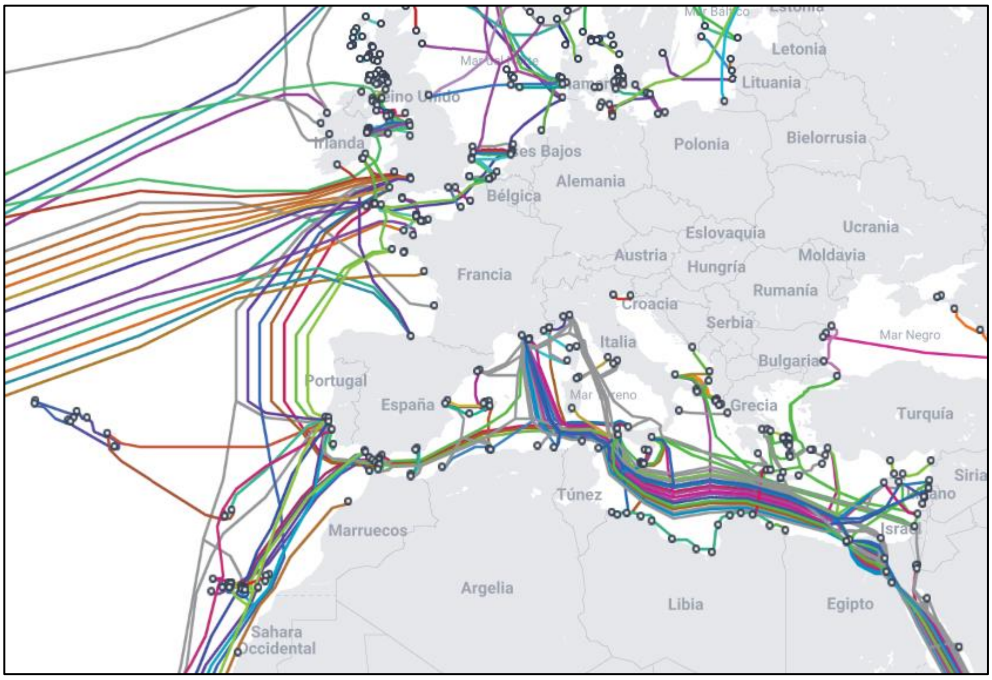


Figure 161. Schematic representation of submarine cables in the area of study. Source: https://www.submarinecablemap.com/.

It is out of the scope of this document to provide a full list of all the cables that will be crossed by Medusa system. Points of intersection will be investigated during surveys and are usually agreed with the cable owners. Some rules advised by the International Cable Protection Committee (ICPC) should been taken into account when planning the route of a new submarine cables: an ideal distance of three times the water depth (3WD) between cables or at least a minimum distance of two times (2WD) the water depth; crossing angles ideally engineered at 90º, discouraging in any case crossing angles lower than 35º. These rules are important to allow safe installation and repair of the cables when necessary.

The presence of cable crossings along a planned route prevents from the possibility to bury the new cable by plough, as the probability to damage the already present infrastructure is high.

In addition to in-use cables, the seabed can be also characterized by the presence of old cables, that are actually out of service. The removal of these cables is usually subjected to previous environmental studies that have the aim to determine the most environmentally favorable action among leave the cable at the bottom or remove it. At crossing points between Medusa system and these out-of-service cables, they may be cut, if previously agreed with the owners, in order to allow burial by plough.

Other submarine infrastructures that can interfere with Medusa system are out-of-service and in-use pipelines for the distribution of gas or crude oil. These infrastructures are not as common as telecommunication and power cables but are present in particular between North Africa and Mediterranean Countries. In the study area are recognized in particular the following: pipeline between Morocco and Spain; pipeline between Spain and Algeria; pipelines between Algeria and Italy; pipeline between Libya and Italy. Then, the EastMed natural gas pipeline is planned in the Eastern Mediterranean, directly connecting offshore resources of Israel to mainland Greece, via Cyprus and Crete.

Among these, the pipeline Tanger-Cordoba between Morocco and Spain is the one that can have more interference with the project, as it lands at the same beach of Medusa subsea system in Tarifa Municipality, Spain. The presence of this pipeline has carefully been taken into account when planning the fiber optic cable route: on the one hand, the cable will land at the NW of the pipeline, avoiding the crossing with this infrastructure at the sea, as well as on the beach; on the other hand, the landing beach for Medusa subsea system has been selected intentionally next to AXENT gas station, in order to take advantage of the infrastructures already existing, e.g., the tunnel of the land gas pipeline between Zahara and La Línea de la Concepción, at the Mediterranean side of Cadiz province. This tunnel will be used for running the terrestrial fiber optic system between Zahara and Torreguadiaro, with the aim of avoiding crossing the Gibraltar Strait by sea.

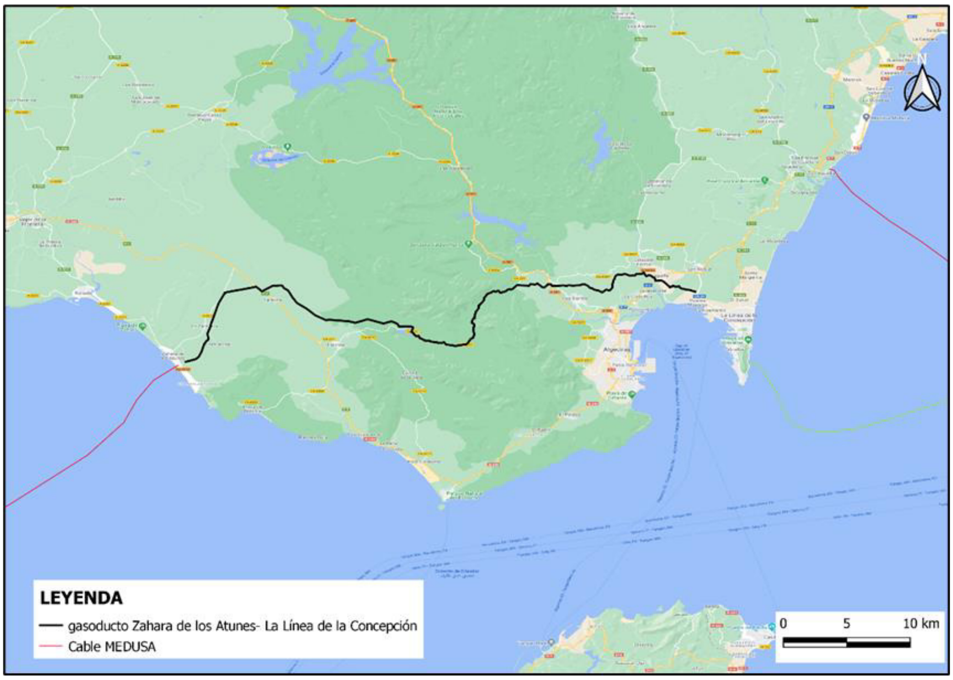


Figure 162. Gas pipeline (in black) between Zahara and Torreguadiaro, Spain. Source: AFR-IX Telecom-Tecnoambiente, 2021.

The gas pipeline connecting Italy with Algeria is landing near the SE limit of Capo Feto, several kilometers at the west of Mazara landing site. The Medusa route is planned in order to avoid the intersection with the gas pipeline nearshore. However, the crossing will be inevitable offshore.

1.5.3.5.1.2 Landing sites

Other submarine infrastructures that can be present at landing sites are artificial reefs. This happen in the case of Torreguadiaro landing, where Medusa cable will cross an area where artificial reefs could be found for approximately 1.5 km of its route. The sonar data obtained by Tecnoambiente in 2013 indicate a more precise location of these artificial reefs (concrete blocks) that have therefore been avoided in choosing the optimal route for the Medusa cable, as can be seen in the following figure. In any case, it cannot be excluded that concrete blocks may have undergone modifications in their location since 2013, for example due to trawling or that new artificial reefs have been placed in the polygon indicated as zone for artificial reefs. Therefore, the non-interference between the Medusa cable and the artificial reefs must be verified during the pre-installation survey.

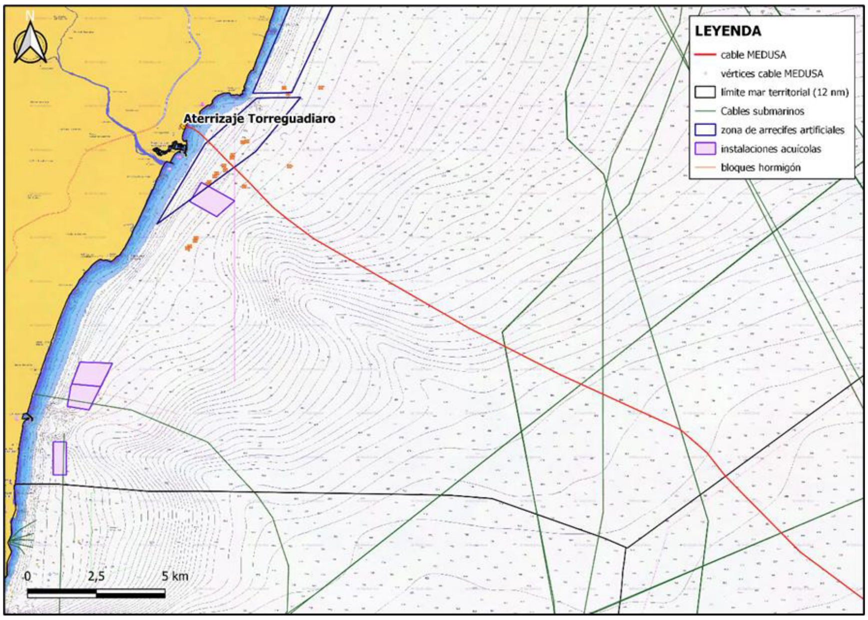


Figure 163. Artificial reefs at Torreguadiaro landing. Source: Tecnoambiente, 2021.

Artificial reefs are present also in the proximity of Barcelona landing site. Here is an old platform of the thermal power station for the water catchment. The platform has been kept as production reef.

Figure 164. Artificial reef located near Barcelona landing.

In addition to this isolated reef, several artificial reefs are located at the north of Barcelona. These artificial reefs will not interfere with the Medusa system.

1.5.3.5.2 Terrestrial Infrastructures and Basic Services

In the following paragraph a general baseline of terrestrial infrastructures and Basic Services in the landing zones is provided.

When analyzing terrestrial infrastructures and basic services, it has to be considered that the project does not provide for the connection of any service, beyond the one that is the object of the project itself (fiber optic telecommunications cables).

1.5.3.5.2.1 Portugal: Lisbon landing

From the Design Development Project presented to authorities in the frame of PIPs for Lisbon landing, no existing services have been identified in the area that will be effectively interested by installation works of Medusa system. Anyway, the correct identification of all services must be carried out by means of georadar and detailed visual inspection during the drafting phase of the executive project, prior to installation works.

Transport

The city of Lisbon is connected by rail and road to the interior of Portugal and to the rest of Europe. The 2.4 km long 25th of April Bridge, one of the longest suspension bridges in western Europe, has served as the main roadway into the city since it was built in the mid-1960s. A new subway line was added to the system whose first route opened in 1959, and the trolley system in the historic district that primarily served tourists was refurbished and expanded. Also expanded and modernized was the airport at Portela de Sacavém, some 10 km northeast of the city center.

In general, Portugal has a great network of roads (approximately 69,000 km), a railway system consisting of a big network of regional, inter-regional and suburban trains covering the whole of the country, a bus services in that include both regional and local buses as well international coaches, and a metro system in the Lisbon and Porto cities.

Lisbon and its metropolitan area are connected by several motorways. There are two circular motorways, the interior and the exterior. The main roads connecting the city to the rest of the country are the A1, the A8, the A5, the A2 and the A12. Additionally, Humberto Delgado Airport served 31 million passengers in 2019, being the busiest airport in Portugal, the third busiest in the Iberian Peninsula and the 20th busiest in Europe.

The municipality od Cascais can be reached by commuter train, by dual carriageway or by road along the coast from Lisbon. In addition, Cascais has a yacht port with more than 600 capacity seats.

Energy

In 2019, Portugal's electricity supply was split between renewables (53%, mostly wind and hydro) and fossil fuels (47%, mostly natural gas and coal). Portugal and Spain have a common wholesale electricity market (MIBEL). Portugal's energy policy places a strong focus on achieving economy-wide decarbonization through broad electrification combined with rapid expansion of renewable electricity generation. Portugal has goals for electricity to cover 32-33% total energy demand in 2030 and 66-68% in 2050 (electricity covered 25% of total final energy demand in 2019), and for renewables to cover 80% of electricity generation in 2030 and 100% in 2050 (renewables accounted for 53% of generation in 2019).

From 2009 to 2019, generation capacity in Portugal increased from 17.4 GW to 21.6 GW, driven mainly by growth in the capacity of hydropower with pumped storage and onshore wind. Hydropower represents by far the largest share of Portugal's installed capacity (34% in 2019). The majority of Portugal's installed capacity consists of large-scale (>100 MW) generation assets connected to the electricity transmission system. However, there is a growing capacity of generation connected to the electricity distribution system. The low-voltage distribution grid has also seen an increasing connection of small-scale (<250 KW) distributed generation and generation intended for self-consumption (both primarily solar PV). From 2015 to 2019, total installed capacity of small-scale distributed generation increased from 0.6 MW to 44.8 MW (0.2% of total generation capacity) and, in the same period, total installed capacity of self-consumption generation increased from 6.4 MW to 215.7 MW (1.0% of total generation capacity). From 2009 to 2019, Portugal's annual electricity generation increased from 49.5 TWh to 51.7 TWh, with notable annual variations driven by changing levels of hydro generation, economic activity and electricity trade. Natural gas and coal-fired power plants are the main assets used to compensate for the seasonal fluctuations in hydropower and increasing variable renewable energy generation. Consequently, the combined generation of natural gas and coal-fired power plants experiences strong variations, ranging from 18.8 TWh to 33.6 TWh between 2009 and 2019.

Portugal has also seen growing variable renewable energy generation, mainly onshore wind, but also solar photovoltaic. From 2004 to 2013, a feed-in tariff (FIT) for renewable generation drove a strong increase in wind generation, which expanded from 0.8 TWh to 12.0 TWh, however Portugal eliminated this FIT in November 2012, which results in wind project deployment slowdown. Generation from solar PV is relatively small (1.3 TWh in 2019) but is expected to grow rapidly starting in 2020 with the commissioning of solar PV projects.

Nuclear energy in Portugal is very limited and strictly non-commercial. Portugal has one 1 MW research reactor located in the National Nuclear Research Centre at Sacavém, which is in permanent shutdown state. Further nuclear energy activities are not planned soon.

The distribution network and the localization of power plants of Portugal in 2020 is shown in the next figure.

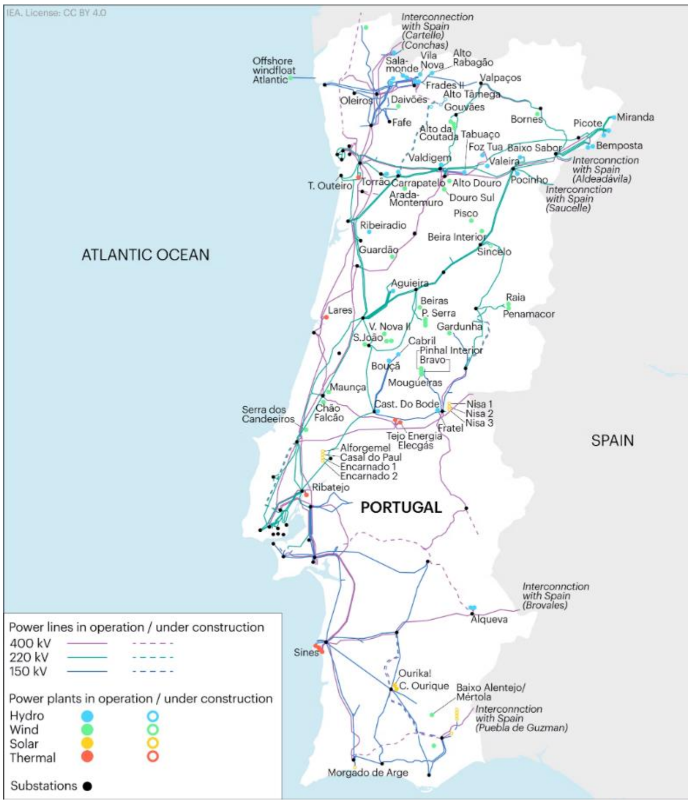


Figure 165. Portugal's electricity infrastructure in 2020. Source: Portugal 2021 Energy Policy Review, IEA.

Water and wastewater

In Portugal, water is provided and operated at local levels through municipal companies (public water supply). At Lisbon landing (Cascais municipality), the company providing water supply is *Águas de Cascais*, a company with a global capacity to store around 91,000 m^3 of water. The Cascais Water Supply System serves the entire municipality and has a length of around 1,411 km. To get the water to the highest levels, there are 24 pumping or overpressure stations, where 70 electric pump sets are installed. The system also comprises around 56 km of pipelines. The water supplied to the system has three origins: own collections, that is, water collected in the Municipality (around 9.1% in 2017), water acquired from EPAL, responsible for the supply of water in the city of Lisbon (around 90.6% in 2017) and water acquired from the SMAS of Sintra (about 0.3% in 2017).

The Wastewater Drainage System in the Municipality of Cascais ensures a population coverage rate of around 100%. Three categories of wastewater are recognized: Domestic, Industrial and meteoric. The domestic network consists of a set of gravity collectors with an extension of about 783 km. These collectors ensure the drainage of effluents, from the home branches to the outfalls located along the streams, which then deliver them to the general interceptor and wastewater treatment plant of Guia, under the management and ownership of Águas do Tejo Atlântico. Areas that cannot be gravity drained are served by wastewater pumping stations (EEARD), which lift wastewater to predefined locations. Currently there are 22 EEARDs in operation.

Wastewater network covers 100% of the Municipality of Cascais, with 99.96% of Customers being connected to the network and the remaining 0.04% of Customers being served using septic tanks.

Health

Health in Portugal is ensured by three different systems. The National Health Service (SNS), run by the State, special social health insurance schemes for certain professions and the private system.

Health centers are the basic units of the SNS for providing care and health care, which are used when dealing with non-urgent situations. The health center generally covers the area of a municipality. Health centers also attend some urgency calls. Hospitals primarily provide differentiated health care and are in charge of urgencies.

Considering Lisbon landing site, nearest pharmacy is at about 300 m distance from the landing area. Nearest health center is “Centro Medico Nossa Senhora dos Remedios” at a distance of about 1,200 m. Nearest public hospital is “Hospital de Cascais”, at less than 10 km of distance from the working area.

Education

In the metropolitan area of Lisbon 4 public and 8 private universities exist, as well as several research institutes.

1.5.3.5.2.2 Spain: Zahara, Torreguadiaro and Barcelona landings

From the Design Development Project presented to authorities in the frame of PIPs for Zahara landing, the following existing services have been identified in the area that will be effectively interested by installation works of Medusa system. At the sidewalk (seaside), Telefónica channeling, as well as street lighting are present, while at the mountain side, electricity channeling has been noticed. At the road, there is a Telefónica channel crossing and probably the presence of a sewerage. Then, drinking water pipeline crossing is present at the gas plant access located in the area. Finally, at the beach, according to information provided by municipal technicians, a drinking water pipe runs through the transit easement area. The technical services of the Tarifa City Council do not have a graphic inventory of existing urban services in the area. In any case, the presence of these services does not jeopardize the layout of the infrastructures necessary for Medusa subsea system detailed in this document, only specific adaptations will be required. The correct identification of all services must be carried out by means of georadar and detailed visual inspection during the drafting phase of the executive project, prior to installation works.

From the Design Development Project presented to authorities in the frame of PIPs for Torreguadiaro landing, the following existing services have been identified in the area that will be effectively interested by installation works of Medusa system. The beach is characterized by the presence of sewer network, while at the promenade and parking area rainwater network and lighting network are present. Finally, at the *Mar del Sur* Avenue, rainwater, lightening, telecommunications and drinking water network are recognized. Low and medium electricity tension networks are also present in this avenue. The technical services of the San Roque City Council do not have a graphic inventory of existing urban services in the area. In any case, the presence of these services does not jeopardize the layout of the infrastructures necessary for Medusa subsea system detailed in this document, only specific adaptations will be required. The correct identification of all services must be carried out by means of georadar and detailed visual inspection during the drafting phase of the executive project, prior to installation works.

From the Design Development Project presented to authorities in the frame of PIPs for Barcelona landing, it can be highlighted the presence of a sewer pipe at the beach, that will be crossed twice. The presence of this service does not jeopardize the layout of the infrastructures necessary for Medusa subsea system detailed in this document, only specific adaptations will be required. The correct identification of all services has been carried out by means of georadar and detailed visual inspection during the drafting phase of the executive project, prior to installation works of BMH and border pipe.

Transport

In 2019 Spain's road network consisted of 165,45 km. 26,466 km of this network were connection and state administration (collecting 52.4% of total traffic and 64.6% of heavy traffic), 71,205 km were managed by the Autonomous Communities (supporting 42.4% of the traffic), and 67,773 km by the Provincial Councils (representing 5.2% of the remaining traffic). Of the entire network, 17,377 km are large-capacity roads (tollways, freeways, motorways and multi-rail roads).

In Andalusia, in 2021 its Autonomous Road Network has a length of 10,554 km. However, at least until the beginning of the 21st century, Andalusia still had several shortcomings and imbalances arising from the territorial model, which it tried to remedy, in terms of road communication, the road A-92, but without resolving the fundamental problem of continuity between economic poles throughout Andalusia. With regard to isolation, it must be said that this is accentuated in those territories that are more remote from the main centers at the economic, demographic and Andalusian logistical level, as is the case for the province of Huelva, which has been relegated to a second place as regards its integration into the trans-European transport network, despite the strategic (transfrontier) position it occupies.

San Roque is the main road communications center of the Gibraltar Camp. Five of the six most important roads in the region pass through its municipality. The great longitudinal axis of San roque is the Mediterranean Highway (A-7).

Atlanterra urbanization is connected to Zahara de los Atunes via the CA-2216 road and to Tarifa via Zahara de los Atunes. Zahara is connected to Barbate (the municipal entity which it depends) via the A-2227 and E-5/N-340 roads and with a bus line.

On the other hand, southern Spain is one of the most touristic places on the peninsula, which has led to Andalusia currently having 6 airports. The airport Málaga-Costa del Sol is the main airport in Andalusia with more than 10 million passengers each year.

Catalonia is the main European region in terms of provision of road infrastructure of four or more lanes (48.7 km/1000 km^2), furthermore, it is the first Spanish region in both volume of intraregional and international road freight transport. An extensive rail network with almost 1,800 km connects the main cities in Catalonia with the rest of Spain and France, including 400 km of high-speed rail. The Josep Tarradellas Barcelona-El Prat airport is a world class infrastructure that serves 219 destinations with almost 90 airlines. In 2021, the airport accounted for 19 million passengers, a figure that is 48.2% higher than the year before.

The municipality of Sant Adrià del Besòs (where the cable flows) has public transport connecting it to Barcelona, Badalona and Santa Coloma de Gramenet. It also has a metro, tram, train and bus line. About roads, the municipality has access to the following: C-31, E-15, E-90, N-II, B10 and B20.

Energy

Total electricity generation in Spain was 271 TWh in 2019 and has gradually decreased since its peak in 2008 of 311 TWh. Spain has a nuclear fleet providing a constant base load of about 60 TWh/year since 1990, corresponding to 22% of total electricity generation in 2019. Fuel oil and diesel electricity generators are used mainly in the islands, and together accounted for 5% of total generation in Spain in 2019. Electricity generation from coal has decreased, especially in last years. In 2019, coal represented only 5% of total electricity generation, a significant decrease from 14% in the previous year.

Natural gas plays a major role in the country's electricity mix, accounting for almost one-third of electricity generation in 2019. The flexibility of natural gas power plants is used to balance the coal phase-out and variability of electricity generation from renewable energy sources such as wind and solar, but also the fluctuating annual generation from hydro power plants.

Renewables have become an increasingly important source of electricity generation in the country, amounting to 38% in 2019, including wind, hydro, solar, and bioenergy and waste. Within renewables, wind (20.5%) and hydro power (9.1%) had the largest shares in 2019, while solar power (both photovoltaic and concentrated solar power) experienced a quick rise between 2008 and 2014. Bioenergy sources consisted mainly of solid biomass, with some shares of renewable waste and biogas, and accounted for 2.4% of total generation in 2019.

In terms of installed capacity, in 2019, Spain relied on 25 GW of gas-fired power plants, 26 GW of wind capacity, 13 GW of hydro, 7.9 GW of coal-fired plants, 7.1 GW of nuclear and 8.9 GW of photovoltaic panels connected to the grid, in addition to 2.3 GW of concentrated solar power. Spain also has a small installed capacity of electricity generation using tidal energy, amounting to 4.8 MW in 2019. Relative to peak demand, Spain currently has an overcapacity of generation in its electricity system, even in a context of recent coal plant closures. Thanks to growth in both wind and solar generation since 2000 Spain falls slightly below the average in terms of the share of fossil fuels in its electricity mix, while it ranked 13th highest in terms of the share of renewables in 2019.

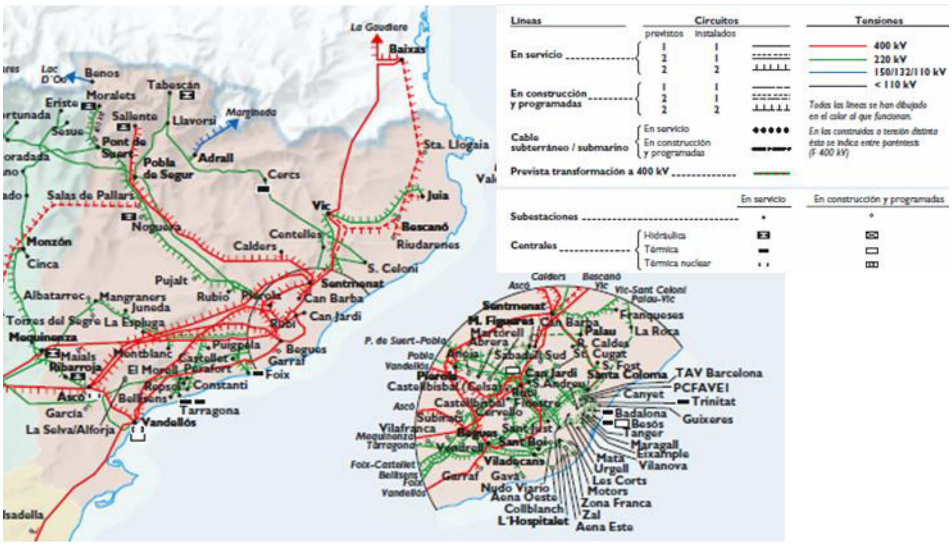


Figure 166. Electricity infrastructure in Catalonia 2005. Source: *Mapa del sistema eléctrico ibérico,* REE.

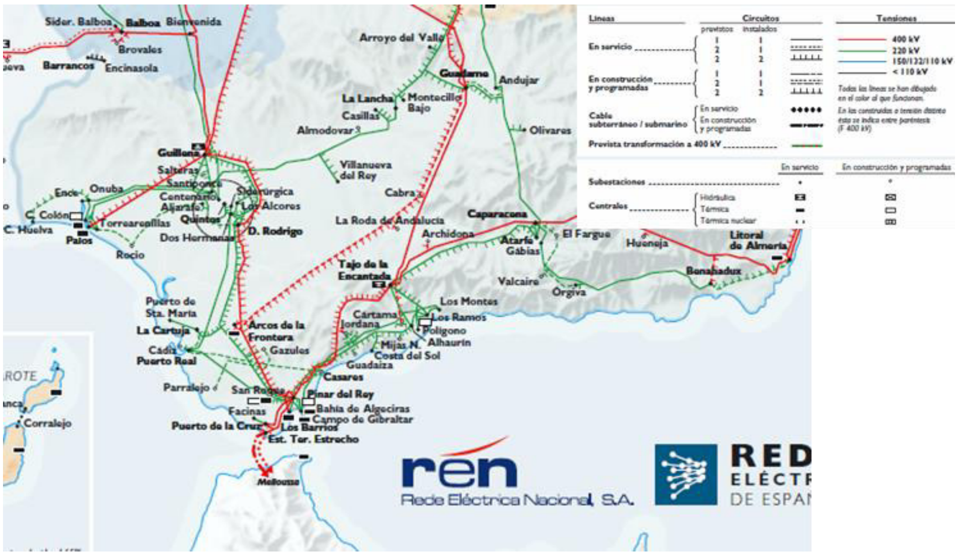


Figure 167. Electricity infrastructure in Andalucia 2005. Source: *Mapa del sistema eléctrico ibérico*, REE.

Water and wastewater

In Spain, approximately 50% of the water management is in the hands of local entities (municipalities) and another 50% of the water supply is privatized by agreements of the municipal governments or commonwealths.

In the case of Zahara landing, water supply in Atlanterra urbanization, just next to the landing point is currently a controversial matter in terms of efficiency. The company in charge of water supply in the Municipality is Aqualia, which manages each of the phases that make up the integral water cycle (collection, treatment and purification, distribution and collection of urban water, and its subsequent purification for its return to the natural environment in optimal conditions). Currently there is a plan to invest more than 9 million euros by *Aguas de la Zona Gaditana* Consortium in new infrastructures that will guarantee in the future the supply of water in the area of the landing point (Atlanterra, in the municipality of Tarifa). The action contemplates the removal of the current fiber cement branch and its replacement by a new ductile iron pipe for the supply of drinking water. Through this new pipeline, it is expected to supply the urban centers of Zahara de los Atunes, in Barbate, and Atlanterra, in Zahara, with a new tank located next to the current one, within the municipality of Tarifa. The layout of the projected pipeline is about 15 km long. The deposit will have a capacity of 4,500 m^3 of water. New pipes will depart from it to the centers of Zahara de los Atunes and Atlanterra, which will thus see their drinking water supplies reinforced. With respect to wastewater network, in the last 4 years some actions have been conducted: to improve the conduction of wastewater to the treatment plant for disinfection, a comprehensive reform of the Varadero pumping station has been carried out. In addition, wastewater treatment plant (EDAR), which treats dirty water to return it to the sea already clean, has also undergone several works to improve both the operation of the plant itself and the safety of the workers who operate this facility, vital for the preservation of the environment and the quality of bathing water.

In the case of Torreguadiaro landing, the water supply to the population of the Municipality is carried out by ARGISA from the resources of the *Confederación Hidrográfica del Sur* coming from regulated waters of the Guadarranque and Charco reservoirs. The supply system is quite complex with a framework of facilities, networks and contractual relationships. The northern part of San Roque territory has a water distribution that come from the drinking water treatment plant *Arenillas*. With respect to wastewater treatment, the municipality of San Roque carries out the evacuation of fecal water and rainwater separately by means of a double independent network. Wastewater from the Municipality finally discharging into the Mediterranean are purified in 6 different treatment plants, two of them at the left bank of Guadiaro River, being the nearest to the landing site (the Wastewater Treatment Plant of San Enrique and the treatment plant of Sotogrande Port).

Concerning Barcelona landing, the entire cycle of water is managed by AGBAR company. Tap water of the municipalities of the metropolitan area of Barcelona, which includes Sant Adrià de Besòs, is potable and complies with all the quality regulations established by legislation. In the zone, water comes mainly from surface sources in the Ter and Llobregat river basins. Some underground sources are also used, through the more than 60 wells distributed between the aquifers of the lower valley and the Llobregat delta, the Sant Andreu basin and the Barcelona plain, as well as the Besòs aquifer. Finally, a smaller part of the water for drinking is captured in the sea and desalinated. The variable climate of the area makes the provenance data change year after year. Once the catchment process is finished, the potabilization process begins. The water is treated, mainly, in the drinking water treatment stations (ETAP) of Abrera and Cardedeu (both outside the metropolitan area) and Sant Joan Despí. Although these are the main ETAPs, in the metropolitan area there are ten other smaller water treatment plants. The distribution of water is carried out by means of large canalizations that transport the water. Later, there is a network of smaller pipes that connect the large canalizations with the water use points. The 36 municipalities of the metropolitan area have a distribution network made up of about 6,000 km of pipes and 150 headwater tanks, where up to 540,000 m^3 of potable water can be stored.

In reference to wastewater, the metropolitan area is divided into five systems. Each one is made up of the sewer network, the collectors, the pumping stations, the sewage treatment plants and the underwater emissaries. In addition, in the Besòs system there is a mud line. The sewer system in the area of study is System 1, involving the NE part of the metropolitan Area of Barcelona. The sewer estuary is located at the other side of Besòs river, in Port Forum zone.

In the metropolitan area there are more than 3,000 km of collectors, which transport 900,000 m3 of wastewater daily. Of these 3,000 km, 300 correspond to the metropolitan management collectors and 2,700 km to the municipal management collectors.

From the water treatment plants, the water reaches (through a so-called transport network) the 150 headwater reservoirs that store the water before supplying it to the different metropolitan municipalities. Much of this process is what is known as “high supply”.

Health

Public Health System in Andalusia is named Andalucian health Service (SAS) and it is run by the regional government. Primary Care Centers – Centros de Atención Primaria (CAP) in Spanish – are located throughout big cities as well as towns and villages across Andalusia. CAP may attend some urgency calls. However, hospitals are structures in charge of urgencies.

Considering Zahara landing site, nearest pharmacy is within camping “Bahía de la Plata”, at less than 500 m distance from the landing area (SE direction); then there are 4 pharmacies in Zahara de Los Atunes village, at a range distance of 500-1,500 m from the working zone (NW direction). The nearest sanitary center belonging to SAS is in Zahara village, at a distance of 1 km, while nearest public hospital is “Hospital la Janda”, in Vejer de la Frontera, at about 20 km (NW direction).

Considering Torreguadiaro landing site, nearest pharmacy is at less than 150 m distance from the landing area. The nearest sanitary center belonging to SAS is in San Enrique, at a distance of 2 km (W direction), while nearest public hospitals are “Hospital Punta de Europa” in Algeciras, at about 30 km (SW direction), and “Hospital Costa del Sol”, in Marbella, at about 50 km (NE direction).

The Catalan Health Service (Servei Català de la Salut, SCS) is the public organization under the Ministry of Health of regional government of Catalonia; which is responsible for guaranteeing public, comprehensive and quality health care for residents in Catalonia. Primary Care Centers – Centros de Atención Primaria (CAP) in Spanish – are located throughout big cities as well as towns and villages across Catalonia. CAP may attend some urgency calls. However, hospitals are structures in charge of urgencies.

Considering Barcelona (Sant Adrià) landing site, nearest pharmacy is at less than 700 m distance from the landing area. The nearest sanitary centers (CAP) are in Barcelona (La Mina) at a distance of 1,300 m, in Sant Adrià, at a distance of 1600 m and in Badalona (Sant Roc), at a distance of about 1,600 m. Nearest public hospital is “Fundación Hospital del Espíritu Santo” in Santa Coloma de Gramenet, at about 2.5 km of distance from the working area.

Education

In Andalusia there are 11 universities, 23 national research centers that are part of the Superior Council of Scientific Investigations (CSIC) and several UNED associated centers (National University of On-line Education).

In Catalonia 8 public and 4 private universities exist, as well as 21 national research centers that are part of the Superior Council of Scientific Investigations (CSIC), and several UNED associated centers (National University of On-line Education).

1.5.3.5.2.3 France: Marseille landing

From the Design Development Project presented to authorities in the frame of PIPs for Marseille landing, according to the information and plans provided by the Town Hall of Marseille and by the INERIS networks and pipelines service, the following services have been located on site, which must be taken into account during the installation work: Watering system, sewage system and telephone infrastructures. The existence of these networks is compatible with the installation of the structures subject of Medusa system. The correct identification of all services has to be carried out by means of georadar and detailed visual inspection during the drafting phase of the executive project, prior to installation works.

Transport

Transportation in France relies on one of the densest networks in the world with 146 km of road and 6.2 km of rail lines per 100 km^2, and this dense network is built as a web with Paris at its center.

Provence-Alpes-Côte d'Azur is one of the most urbanized regions in France, with 5 huge urban poles where 62% of the population gather. Cars are the most used means of transport because is the easiest way to travel in that region, as only a few southern towns have developed their public transports. The quality of the road network is outstanding, even when it comes to secondary and departmental roads (Source: French-Property.com (IFP Ltd.)).

Marseille has good external connections: two highways provide access to the north; another highway reaches the city from the east and the high-speed train connects Marielle with the nearby major cities. To the north of the city, the Marseille-Provence Airport (France's third-ranking airport for passenger traffic) provides links to several destinations in France, Europe, and North Africa.

Within the city, road congestion is severe. However, public transportation has been improved with the introduction of two underground metro lines and a surface tramway serving part of the eastern suburbs.

Energy

Globally, France has the highest share of nuclear in its power generation (67% in 2020), which has allowed the country to benefit from a low-carbon electricity mix for decades. However, France's power sector is going to face major transformations in the context of the legislated target of decreasing the share of nuclear in electricity production from 70% (pre- COVID-19) to 50% and the ambition of boosting the share of renewables to 45% by 2035, alongside the phase-out of the remaining four coal-fired power plants by 2022. This will also entail major reforms in the French electricity market.

France's installed generating capacity amounted to 135 GW in 2019, up by 13% since 2009. Nuclear power accounted for 63.2 GW in 2019, while the second-highest capacity source was hydro, with 26 GW. Installed solar and wind capacity experienced noticeable increases between 2009 and 2019, with solar photovoltaic up from just 0.3 GW in 2009 to 9.4 GW in 2019 and wind from 4.6 GW to 16.5 GW over the decade. Gas-fired power plant capacity doubled over the same decade, to reach 12.2 GW in 2019. Coal power generation capacity has declined and in 2019 France had four remaining coal-fired power plants, with a total capacity of 3 GW. Coal-fired power plants account for one-third of the CO_2 emissions of the entire French power generation fleet, although they only contribute 1% to the country's electricity production.

France's electricity generation decreased by 7% between 2019 and 2020 to reach 528 TWh. In 2020, nuclear remained the main source of electricity, but at lower than usual levels (67%), following the closure of two reactors and lockdowns during the COVID-19 pandemic. The third source of electricity generation is hydro (12%), followed by natural gas (7%) and coal (1%). Coal decreased from 5% in 2010, while renewables (including hydro) increased their role in electricity generation, up from 80.4 TWh in 2010 to 116 TWh in 2020. Wind and bioenergy led this growth. Bioenergy almost doubled (up from 6 TWh in 2010 to 11 TWh in 2020). Wind power saw the highest growth (from 10 TWh in 2010 to 41 TWh in 2020). In 2020, solar and wind made up 11% of France's electricity mix.

France has been a net exporter of electricity for decades and is Europe's largest electricity exporter, although net exports decreased during 2009-2010, 2012-2013 and 2017-2018. In 2019, France recorded net exports of 57.7 TWh.

The distribution network of France is shown in the next figure.

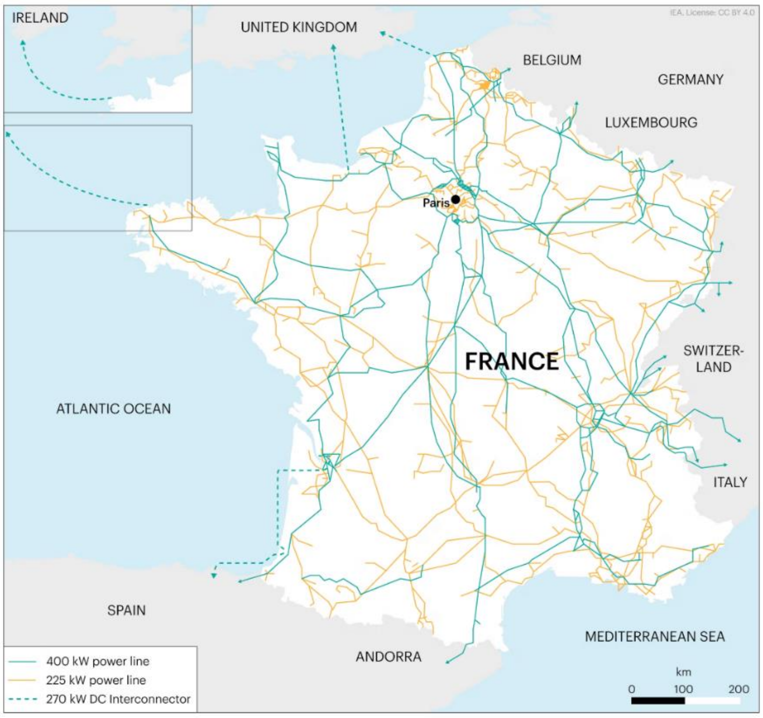


Figure 168. France's electricity infrastructure of France. Source: France 2021 Energy Policy Review, IEA.

Water and wastewater

The management of drinking water in France is mainly ensured by a plethora of local actors who deal with water purification, the distribution of drinking water and the treatment of domestic and industrial wastewater. Each prefect of a hydrographic basin establishes State policy at the local level and approves the Master Plan for Water Development and Management (SDAGE) drawn up by the basin committee. At the regional level, the prefect of the region will take care of the regional management organizing State policy at the technical level. The region and the department must ensure compliance with numerous local laws. The last link in the chain of water management in France concerns municipalities and intermunicipalities. These local actors will take care of drinking water management for individuals and professionals.

The hydrographic basis of Marseille landing site is the *Rhône-Méditerranée* basin. *Aix-Marseille-Provence Métropole* ensures the protection of the resource, the supply, the treatment and the distribution of drinking water on the territory. Regarding water purification in Marseille, three water treatment plants are in operation: Sainte-Marthe, Saint Barnabé and Vallon Dol. They alone produce an average of 260,000 m^3 of water. At the distribution level, the Marseille network is made up of feeders, reservoirs, pumping stations, meters and fountains. Marseille drinking water is one of the best in France. Thanks to the treatment of the stations and the sterilization with ozone, it exceeds the national recommendations concerning the quality of drinking water.

Concerning wastewater, *Aix-Marseille-Provence Métropole* provides individual or collective sanitation for drinking water. After use, the wastewater goes directly into the sewers and is sent to treatment plants. Since the end of the 19th century, the cove of Cortiou, in the area of the National Park of Calanques, has been the receptacle of the sewers of Marseille. Today, studies are carried out to create an outfall at sea to ensure a more secure discharge for the land and marine environment, taking into account health, ecological, landscape, technical and financial constraints.

Health

The French health system relies on multiple structures: outpatient clinics for so-called "city" care and hospitals. It is based on the patient's and resident's freedom of choice: each patient is free to choose their attending physician, a specialist with direct access, their health establishment, their accommodation structure, in both the public and private sectors. Regional health agencies coordinate prevention, care and support. They ensure consistent management of resources to allow equal access for all to continuous, quality and secure care.

Considering Marseille landing site, nearest pharmacy is at less than 100 m distance from the landing area. Nearest public hospital is "Hospital center Regional De Marseil", at about 3.2 km of distance from the working area.

Education

In Provence-Alpes-Côte d'Azur, 4 public universities exist, as well as 6 public establishments of scientific and technological nature (EPST) and 8 public establishments of industrial and commercial nature (EPIC).

1.5.3.5.2.4 Italy: Mazara landing

Transport

In 2020, there were above 23,300 kilometers of main or national roads in Italy. Overall, the Italian national motorway system counted almost 6,977 kilometers of length, whereas the secondary or regional road network accounted for approximately 137,300 kilometers. However, the current condition of the Sicilian transportation's system is critical. According to the *Istituto Tagliacarne*, the Italian Mezzogiorno and Sicily are characterized by an inferior level of infrastructures to the Italian average. The totality of the existing roads in the Sicily, amounts to 20,821 Km, 2.74% are highways that connect Palermo to Catania, to Messina and Mazara del Vallo, Alcamo, Trapani, Messina and Catania, 17.25% are from state roads and 80.01% from provincial roads.

Italy is a country famous for its train networks, it is possible to reach almost every point in Italy by train because Italy has an extensive network of both fast speed inter-city trains and regional services that connect the smaller cities and towns.

In Sicily there is too a good network of public transportation, composed mainly by train and bus. The main line of train runs east from Palermo to Messina and then south to Syracuse via Catania, and buses are the only form of public transportation serving many interior towns. Also, Sicily's offshore islands are served by ferries and hydrofoils. Services run from Milazzo and Messina to the Aeolian Islands, from Trapani and Marsala to the Egadi Islands, from Palermo to Ustica, and from Porto Empedocleto the Pelagic Islands.

Mazara del Vallo is connected to the rest of Sicily by a regional train service, a private bus service (only to Palermo), and by car, via the A29 highway. It is reachable from Trapani-Birgi Airport by an infrequent bus service and from Palermo by car. During the summer period, Mazara is also connected via ferry to the island of Pantelleria and Hammamet, in Tunisia.

Energy

Italy is relatively poor in conventional energy raw materials and has historically paid great attention to renewable sources, energy efficiency and energy saving as tools to reduce dependence and mitigate the environmental and climatic effects of the energy cycle.

Italy is heavily dependent on imported energy supplies. In 2019, the share of imported energy was 77.5%, but this is expected to decrease to 64% in 2030. Renewables are expected to play a key role in future strategy; renewables were already 18.2% of the total final energy consumption and 34.8% of the electricity consumption in 2019.

Electricity demand in Italy has been stable for around a decade but will inevitably rise in the long term as the government promotes electrification in transport, heating and industry. Demand will likely outpace growth in electricity generation, increasing Italy's reliance on electricity imports and as demand rises, Italy will need to install significant amounts of additional variable renewables capacity (estimated by the government at up to 70 GW by 2030). In the last decade, Italy has become one of the world's largest producers of renewable energy, ranking as the second largest producer in the European Union after Germany and the eighth in the world, as well as the world's sixth largest producer of energy from solar power in 2018.

Italy's total gross output capacity of electricity generating plants in 2019 amounted to 119.3 GW, however, from 2000 to 2019, the electricity production suffered a decreased (-0.52%) and coal, lignate and peat were the sources that suffered the most significant decline in production (-4.38%). Heat was the source with a major growth (17.38%), followed by bioenergy and waste with a growth of 9.29%. The total gross electricity production in 2019 was 293.85 TWh, including about 43.9 TWh from wind and photovoltaic sources. High voltage transmission lines, connecting power plants with the distribution system, are mainly based on 380 kV and 220 kV lines.

The Italian transmission network consists of power stations with voltages of 150 kV, 220 kV and 400 kV with a total line length of 74,711 km. The distribution network is shown in the next figure.

Figure 169. Italy's electricity infrastructure in 2022. Source: Italy Electricity Security Policy (2022), IEA.

<u>Water and wastewater</u>

In Italy 100% of the urban population and 97% of the rural population have access to water, with a capita water use for residential about 240 liter per day.

On the other hand, households and certain industries in 3034 urban areas of Italy generate 78 million p.e. of wastewater every day. For 3 million p.e. of urban wastewater, Italy applies individual systems (for example for domestic treatment plants or septic tanks), instead of centralized collecting systems and treatment plants. In addition, for 0.29 million p.e. of urban wastewater Italy does not need to apply biological treatment because this is wastewater discharged into coastal areas from smaller urban areas (Source: Freshwater Information System for Europe).

Water resources in Italy are distributed unevenly, with more abundant resources in the North and scarcer resources in the South. The total meteoric inflow is of about 300 billion m^3/year, the highest percentage of these precipitations (a little more than 40%) is concentrated in the northern regions, 22% in the central ones, 24% in the southern regions and just 12% in the two largest islands, Sicily and Sardinia.

However, the water resource availability is estimated to be only 58 billion m^3/year, 72% of which derivable from surface resources (springs, rivers, lakes), while 28% from underground resources (water tables close to the surface). Almost 53% of the utilizable surface resources are localized in northern Italy, 19% in central Italy, 21% in southern Italy, and 7% in the two largest islands. Most water withdrawals are for agriculture and industry, with only 18% of water withdrawals made for drinking water supply. Water supply is becoming a social and economic emergency in Apulia, Basilicata, Sicily and Sardinia, primarily because of increasing water demand and lack of management practices. Further associated decreases in mean precipitation could aggravate this situation.

Moreover, about 70% of the underground resources is localized in the large flood plains of northern Italy. Not many underground resources are utilizable in southern Italy, being confined in the short stretches of coastal plains and in a few inner areas. These data confirm the uneven distribution between northern and southern parts of the country and the reduction trend caused by the concurrent decrease in precipitation and increase in evapotranspiration and water utilization (Source: Land and Sea of Italy (2007) and WHO (2007)).

<u>Health</u>

Italy’s health system is a regionally based national health service that provides universal coverage largely free of charge at the point of delivery. In 2012, total health expenditure accounted for 9.2% of GDP. Public sources made up 78.2% of total health care spending. While the central government provides a stewardship role, setting the fundamental principles and goals of the health system and determining the core benefit package available to all citizens, the regions are responsible for organizing and delivering primary, secondary and tertiary health services as well as preventive and health promotion services (Source: Ferré et al., 2014).

Considering Mazara do Valle landing site, nearest pharmacy is around 800 m distance from the landing area and the nearest public hospital is “Ospedale Abele Ajello”, at about 2.8 km of distance from the working area.

Education

Italy continues to be at the bottom of the European rankings in the field of scientific research, where the ratio between investment in R&D and GDP is almost 2%. In particular, Sicily is the last in Europe in investments for innovation. However, there are several technological and research centres, such as universities, located in Sicily.

For example, in Etna Valley, there is the largest hi-tech cluster in South of Italy (in Catania province) where 1200 firms and more than 200 national companies are located. Most of Etna Valley's companies are specialized in ICT, but there are several prototypes which are growing in the field of Biotechnology, Pharmaceutics, Chemistry, Foods and Virtual Industry.

Regarding public universities, there are currently 4 in Sicily: Università degli Studi di Catania, Università degli Studi di Enna Kore, Università degli Studi di Messina and Università degli Studi di Palermo.

1.5.3.6 Land Use

Study area: landing sites

In the coastal zone, the area of influence of Medusa submarine fiber optic cable system includes internal waters (waters on the side of the baseline of a nation's territorial waters that is facing toward the land) and beach areas. In addition, usually BMH is located at the beach itself or on land, just behind the beach.

The following paragraphs summarize land use distribution in Medusa landings for which the location of BMH have been already established.

At Lisbon landing, the higher part of the beach corresponds to "uncovered spaces or with little vegetation". Behind the beach there are artificial territories, then bushes and forests (these last two not interested by the project) (https://smos.dgterritorio.gov.pt/coscid/). At this landing site, BMH is already existing and no land acquisition is therefore planned for the project object of study.

At Zahara and Torreguadiaro landings, the zone next to the working area is classified as urban soil and as single-family residential area. According to available information, the street where the installation of BMH is proposed in Zahara is private property. Therefore, land acquisition or agreements are necessary in this case for BMH. On the contrary, in Torreguadiaro, BMH will be built in public land, being subjected to construction permits to be released by San Roque municipality. Therefore, no land acquisition is planned in this case.

At Barcelona landing, the zone behind the beach is characterized by the presence of urban soil. Here, BMH is already built and no land acquisition is therefore planned for the project object of study.

At Marseille landing the area behind the beach is classified as "Discontinuous urban soil", according to Corine Land Cover Map (https://www.geoportail.gouv.fr/donnees/occupation-du-sol-zones-construites). At this site, BMH is already existing, so that no land acquisition is planned.

According to Corine Land Cover Map, at Mazara landing Psammophilous vegetation is recognized at the beach zone, where the landing point is planned. The zone just behind the beach is then characterized by "Residential areas with a compact and dense fabric". (https://www.sitr.regione.sicilia.it/geoportale/it/metadata/details/540). More details about the ubication of the BMH will be collected during PiPs process.

1.5.3.7 Heritage

The Mediterranean Sea has a unique cultural heritage, representing the roots of several ancient civilizations. The shores and seabed of the basin are generally characterized by the presence of traces of these civilizations, which must be preserved.

Underwater cultural heritage (UCH) is generally protected by the UNESCO 2001 Convention and articles 149 and 303 of the UNCLOS Convention. In addition, national and regional implementation laws can increase the legal protection of UCH. Indeed, local and regional authorities can play a key role in the protection and in the management of cultural heritage. All the countries that will be interested by phase 1 of Medusa project are state parties of the UNESCO 2001 Convention.

The UCH includes shipwrecks, sunken cities, submerged prehistoric landscapes with human traces and remains of ports and old fishing installations. Pipelines and cables (abandoned or active) as well as other seabed installations still in use are not considered part of UCH.

Wrecks and the other types of UCH represent a doble issue when founded in a zone selected for the laying of cables: on one hand they must be protected and on the other hand they are obstacles for the linear laying of cables.

In addition to UCH, the possible presence of archaeological heritage at beach sites should have to be considered, in order to avoid the influence of land works for the installation of BMH, as well as border pipe and conduits, on heritage elements.

Specific heritage studies are usually required by authorities, before granting permits for landing the cable in territorial waters. These studies start from deepest bibliographic research of available information on heritage and archaeological significant zones next to a landing site and are then usually followed by field survey, both at the beach and in shallow waters (boreholes and video survey) in order to identify the possible presence of archaeological remains. Geophysical data obtained from pre-installation survey are also usually interpretated by an archaeologist up to a certain depth.

In the following paragraphs, general considerations are presented for the main trunk of Medusa system,

Concerning landing sites, considering the different stage of permitting process in the landings for phase 1 of Medusa subsea system, detailed information on heritage in the study area is still lacking in most of the landing sites. Therefore, more detailed information is presented for some of European landings that have been already subjected to a part of this additional research, while for the African landings a general information about heritage in the zone is reported.

1.5.3.7.1 Main trunk

The main trunk of the Medusa cable route has been planned taking into account public databases on shipwrecks and other heritage features and avoiding the interference on these elements. Safe minimum distance has been considered for the route in case of presence of recognized heritage elements.

1.5.3.7.2 Spain: Zahara, Torreguadiaro and Barcelona landings

The following paragraphs collect the information that has been found on the archaeological characteristics of the study area in Spain.

Along the Andalusian coast, certain areas have been declared as archaeological easement zones by means of the Order of April 20, 2009, by which it is resolved to declare as Archaeological Easement Zones 42 spaces defined in the continental and inland waters of Andalusia, sea territory and continental shelf bordering the Andalusian territory (BOJA no. 101 of 05/28/09). This provision, in addition to defining the exact limits of the spaces of interest, describes their importance and their values.

In the case of Zahara landing, the archaeological easement area closest to the route of the Medusa subsea system is the “Ensenada de Bolonia” underwater space, where multiple occasional finds have been made and several ancient shipwrecks have been documented. This polygon frames the natural space of the Bolonia inlet, where the Roman site of Baelo Claudia is located. The area of Punta Camarinal, from the point of view of navigation, constitutes an area of difficult passage for boats that, as a consequence of the strong winds and prevailing currents, can be dragged against the rocks. The presence of ships from the Roman (high-imperial) and Byzantine eras has been confirmed in the zone.

This archaeological easement zone is located at a minimum distance of approximately 3 km from the route of Medusa system.

In addition to this archaeological easement zone, the nautical chart shows the presence of 3 shipwrecks near the coast, in front of the village of Zahara de los Atunes, just north of the Medusa cable landing. The closest to the cable route (more than 500 m of distance) is the ship Gibralfaro, which sank in 1902.

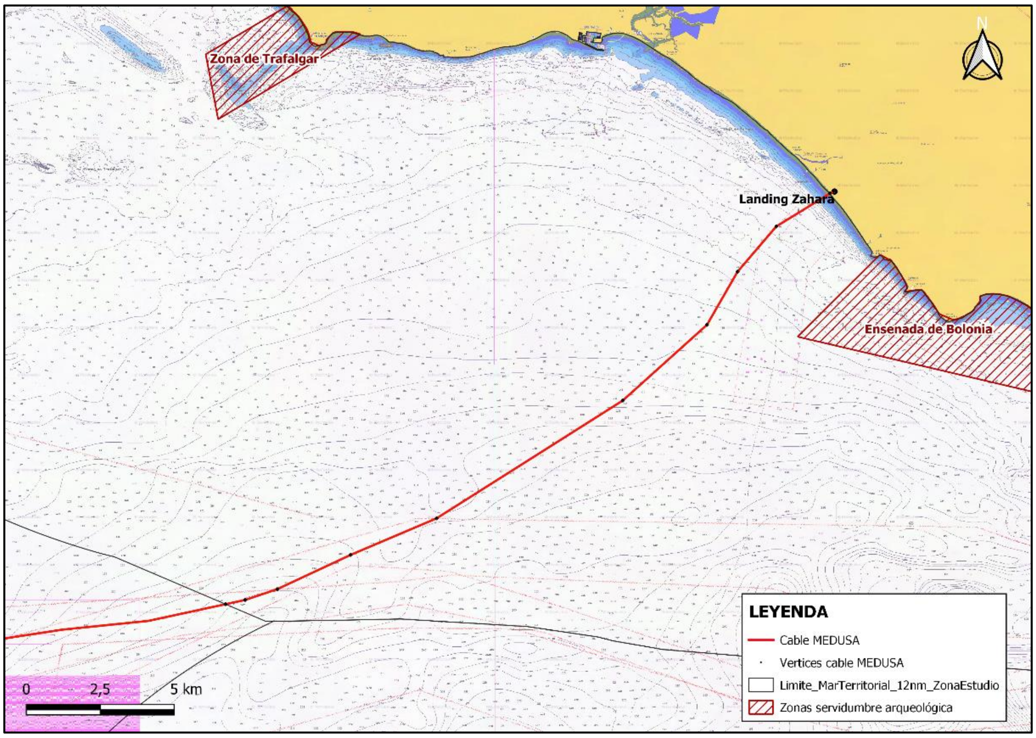


Figure 170. Archaeological easement zone in Zahara landing area. Source: AFR-IX Telecom-Tecnoambiente, 2021.

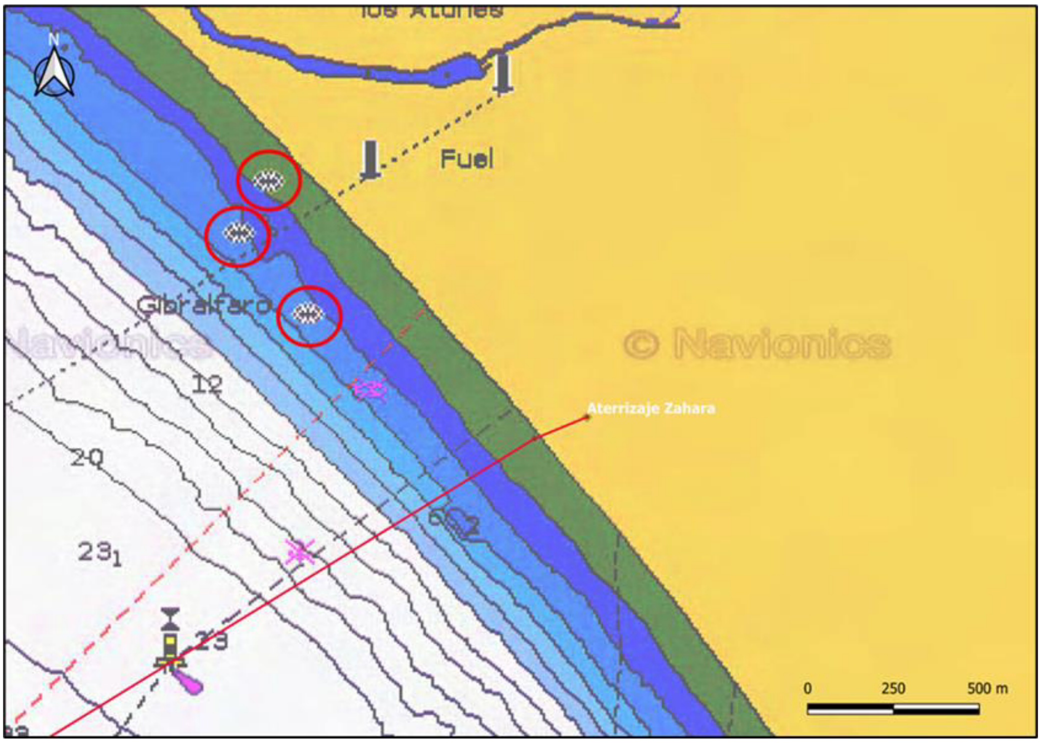


Figure 171. Shipwrecks next to Zahara landing site. Source: navionics.com.

Figure 172. Photo of Gibralfaro shipwreck in front of Zahara de los Atunes beach.

Concerning Torreguadiaro landing, the archaeological easement area closest to Medusa subsea system is the “Laja de Punta Chullera” underwater space, located in the province of Malaga, north of the cable landing. It is a dangerous area for coastal navigation, in which, through oral sources, the presence of amphoric remains and lead traps is known.

South of the route of Medusa system, the underwater space of “the Mouth of Borondo River” exists. This is located in front of the Rapalo area, and close to the Roman site of Borondo. Varied remains of material from various age appear in the water, located about 100 m from the coast. It has also been possible to document the presence of part of an iron cannon.

Another area of archaeological easement located further south is the “Bahía de Algeciras” underwater space, between Punta Carnero and Punta Europa. In this area there have been multiple occasional finds. The Punta Carnero area is one of the most dangerous in Gibraltar Strait, where the currents pull very strongly to the NE and NW, always tending to throw ships against the coast.

The history of the Bay of Algeciras and its archaeological remains include the prehistoric period, the Phoenician period, the Roman period and also the period of Arab occupation. The most important archaeological results obtained in this area are the finds in the Camping Zone, Ensenada del Tolmo and Punta Carnero, El Timoncillo area, western end of the Getares inlet, Isla Verde area, Punta de El Rodeo, Punta of El Rinconcillo with the wreck of El Tambor, dredging of the Port of Línea de la Concepción, San García wreck and Getares inlet.

Finally, the presence of possible wrecks has been detected with geophysical exploration by Tecnoambiente S.L. in the province of Cadiz in front of the area of the urbanization of Santa Margarita, T.M. La Línea de la Concepción, at depths between 40 and 60 m and in the province of Malaga, in front of San Diego urbanization, at depths between 65 and 75 m.

Regarding the terrestrial area, in the proximity of the study area there are two cataloged assets of cultural interest:

- Torre Guadiaro (01110330036): This is a coastal watchtower from the 16th century, built to replace the nearby Torre Caída. It is accessed by a path towards the sea, which starts at kilometer point 140 of the main road 340 from Cádiz to Málaga (old route). It is located 2,200 m southwest of Punta Chullera, on a sandy platform at a certain height above sea level. The plant is circular with a maximum diameter of 14 m and a height of 16 m. The construction is made of ashlar, relatively well ordered in horizontal courses, joined with mortar and with the holes filled with smaller stones. The tower served as a refuge for ranchers, passengers and loggers in the area, which was visually connected to the Chullera tower.
- Quebrada de Guadiaro Tower (01110330034): this other tower is located about 2 km southwest of the Chullera Tower, and was possibly built at the end of the XV or beginning

of the XVI. Today it is divided in two, with half of its construction material scattered in the vicinity. In 1985 its physiognomy was altered with the construction of a new enclosure.

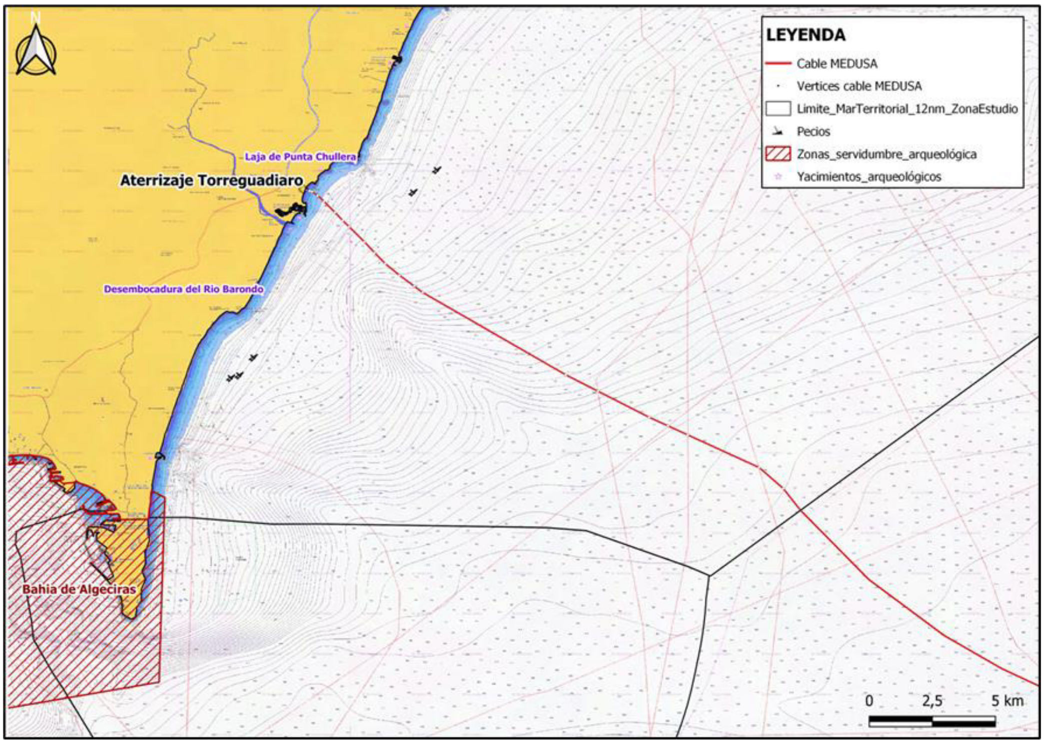


Figure 173. Archaeological features in Torreguadiaro study area. Source: AFR-IX Telecom-Tecnoambiente, 2021.

Concerning Barcelona landing, the databases of the Department of Culture of the Generalitat of Catalonia have been consulted, for the identification of the presence of known underwater archaeological sites in the area of study.

Several underwater remains have been registered for Barcelona municipality, while no remains have been identified in the municipality of Sant Adrià, where the landing of the cable is actually located.

Concerning the beach area, the zone does not show evidence of the presence of heritage elements. The beach has been regenerated in the face of storms, so that the surface material present is recent and lacking in archaeological elements.

Despite the Submarine Archaeological Chart of Catalonia does not include any archaeological remains in Sant Adrià, the possible existence of remains in the area cannot be excluded, in particular considering that the area is located at the end of the Besòs Estuary, and that different amphora production centers have been recognized in the proximity of the study area (Source: General Directorate of Cultural Heritage, Catalonia Government).

1.5.3.7.3 France: Marseille landing

During a marine biocenosis survey conducted in spring 2021 in the frame of PIPs for the landing of Medusa system in Marseille, ROV transects have shown the presence of the shipwreck *Miquelon* at a depth of 52 m, next to the preliminary planned route of the cable (90 m at NW of the cable). This is a 6.5-m high and 49-m long shipwreck of 1917.

Following the results of the ROV survey, Medusa cable route has been redefined in this area to increase the distance from the detected shipwreck and therefore avoid risks related to this element.

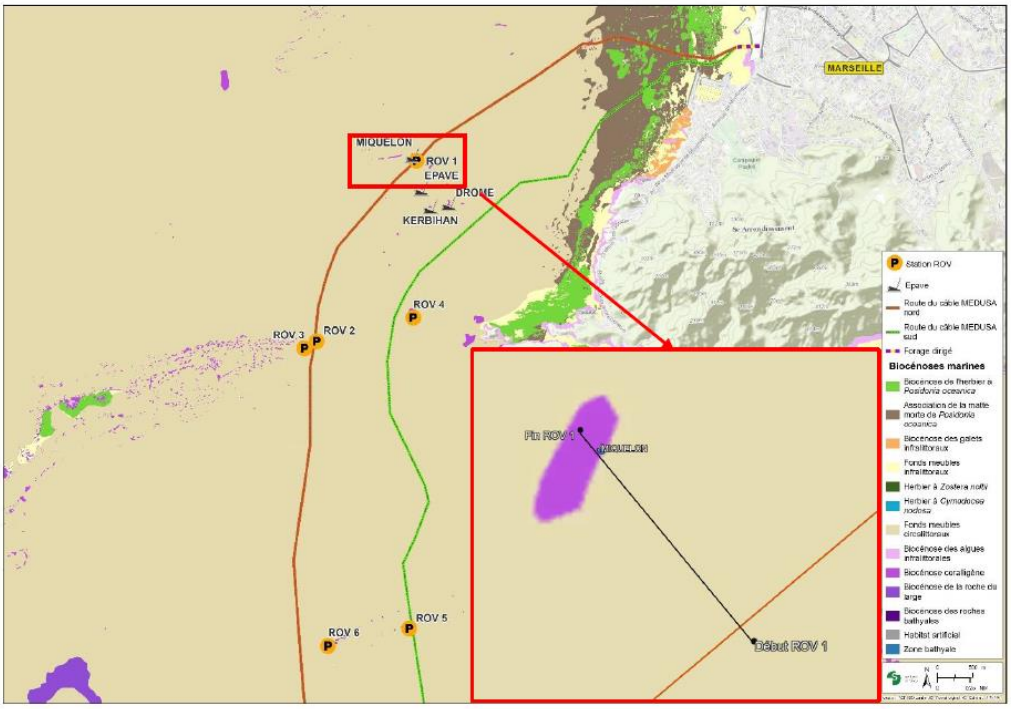


Figure 174. Localization of shipwreck *Miquelon* during ROV survey in spring 2021. The cable to be taken into account is the red one. Source: AFRIX, 2021.

Figure 175. Shipwreck *Miquelon* registered by ROV during a survey in 2021. Source: AFRIX, 2021.

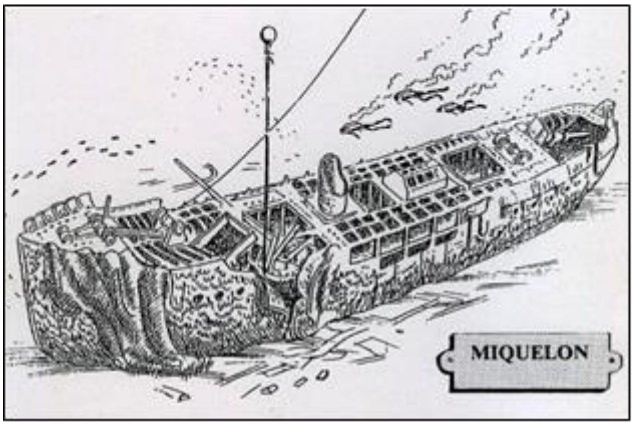


Figure 176. Representation of shipwreck *Miquelon* (Coulé, 1917).

1.5.3.8 Contamination

Pollution is the introduction of a contaminant into a natural environment, causing instability, disorder, damage or discomfort in an ecosystem. The main types of pollution are as follows: atmospheric, hydric, soil, acoustic, light, visual, thermal. Some of these types of contamination will be discussed in general terms below.

Air pollutants can have different origins, both natural and anthropogenic, including: industry, transport, agriculture, waste management, households, volcanic eruptions, windblown dust, sea-salt spray and emissions of volatile organic compounds from plants. In the 32 countries that form part of the European Economic Area (EEA) in 2010, was analyzed the most important pollutants (NO_x, SO_x, CO, NMVOC and suspended particles (PM_{10} and $PM_{2,5}$)) according to the origin, transport of other sources. For all the pollutants, transport represented around 20%, even for the case of NO_x the value was much higher, up to 58% (Sanchez Vicente et al., 2012). In particular, the emissions from the marine transport sector contribute significantly to air pollution globally. But it also has the potential to contribute to air quality degradation in coastal areas, because nearly 70% of ship emissions are estimated to occur within 400 km of land (Viana et al., 2014).

Concentrations of fine particulate matter ($PM_{2,5}$) exceed 100 µg/m^3 in certain areas in the Mediterranean basin (the global average stands at 39.6 µg/m^3).

For the characterization of air quality in the area of study, the data available on the 2021 World Air Quality Report and IQAir website (IQAir | First in Air Quality), have been used for all the landing sites for which this information was available. This report was generated exclusively from $PM_{2,5}$ (particulate matter consisting of fine aerosol particles measuring 2.5 microns or smaller in diameter), because is commonly accepted as the most harmful to human health due to its prevalence in the environment and broad range of health effects. This is expressed in micrograms per cubic meter (µg/m³) were selected as the standard metric for this report and the data was aggregated from regulatory monitoring stations operated by governments as well as privately-owned, non-regulatory stations operated by individuals, educational institutions, and non-profit organizations.

Quality of seawater is amongst the most important coastal resources, which is utilized as a primary resource by many coastal development sectors (fishing or tourism). Over the years, the coastal water quality has deteriorated due to the impact of numerous pollutants. Around 80% of the pollution of the marine environment comes from land-based sources. The rivers transported the pollutants or the pollutants can be discharged directly into coastal waters. El-Kholy et al. (2012) classified the pollutants as: eutrophication, petroleum, chemicals, coastal degradation, agricultural run-off, recycled solid wastes, solid wastes, treated industrial wastes, industrial wastes, treated urban wastes and untreated urban wastes. However, not all marine pollutants can have an anthropogenic origin, it can be natural too, such as the red tides.

The European Environment Agency (EEA, 2006) identifies the Mediterranean pollution hot spots and areas of major environmental concern based on UNEP/WHO data, country reports to UNEP/MAP and country National Action Plan. In particular, taking into account the area of interest of the Medusa system, in the following figure, will be detailed these data for each of the landing countries.

It is important to mention that in most of these countries the cities with higher populations are situated on the coastline, a fact that can increase the level of marine pollution.

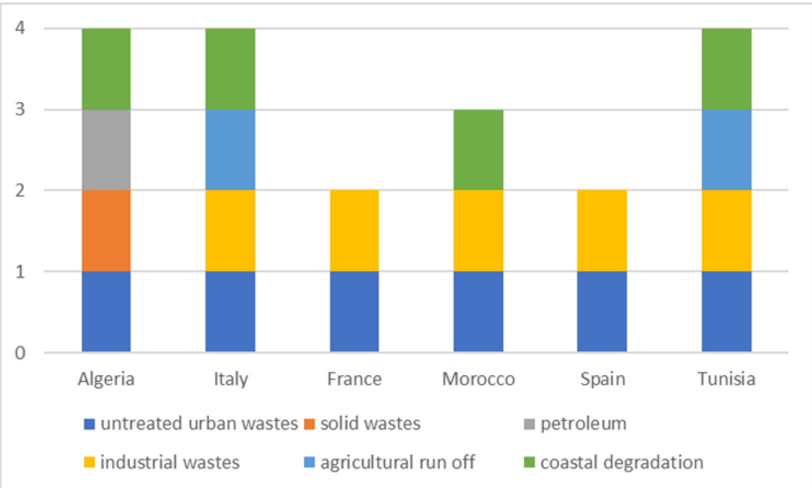


Figure 177. Distribution of the pollution sources by countries. Source: modified image from El-Kholy et al., (2012).

The most common source is untreated urban waste, although some countries have treatment plants, a large part of this water may be discharged directly to the sea. Some other facts that can be relevant in some countries are the presence of rivers that can increase the apport of urban and industrial wastewater (e.g., Muluya river in Nador or Lake of Bizerte in Bizerte), or the maritime traffic passing close to the coast. Moreover, the landings of this Medusa system run into the pollution hot spot areas on the Mediterranean Sea.

In the Atlantic Ocean, on the Portuguese coast, a study was carried out to analyze the quality of the waters of the Estoril coast, situated at west of Lisbon (Machado & Mourato, 1999). Machado & Mourato (1999) analyzed a total of 23 beaches in this area between 1994 and 1996. In 1996, 65% of the beaches in the area were found to be heavily polluted and only 4 beaches had a good standard of water quality. This pollution mainly sources from insufficiently treated urban wastewater that is discharged into the nearby sea. Another study of pollution developed in Portugal waters detected microplastics in the zooplankton. In particular, locations closest to the landings of Medusa system, Costa Vicentina and Lisboa, were the regions with the highest microplastic concentration. The origin of these plastics probably was related to the proximity of the industries, harbour and metropolitan area of the capital city (Frias et al., 2014).

1.5.3.8.1 Portugal: Lisbon and Sines landings

For Lisbon landing, the average annual $PM_{2,5}$ concentration for 2021 was 8.2 µg/m³ ([IQAir | First in Air Quality]). This value was expressed based on the 2021 WHO (World Health Organization) recommended annual air quality guideline levels and interim targets for $PM_{2,5}$. It was used colour band levels to provide easy identification, in this case the city of Lisbon was classified at the target 4 – green, this means that the values exceed WHO $PM_{2,5}$ guidelines by 1 to 2 times.

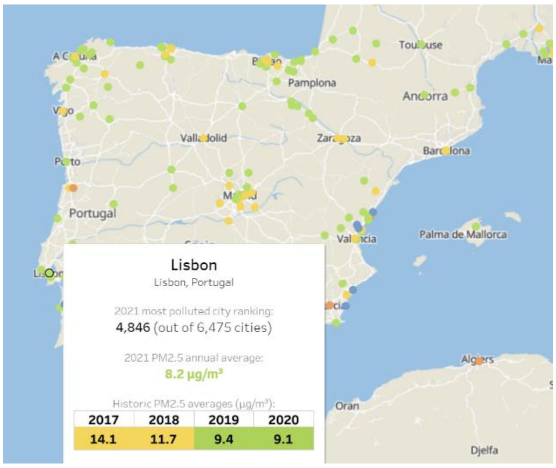
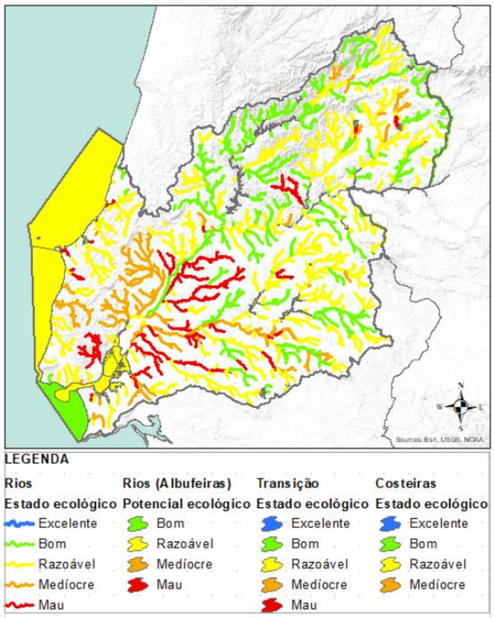


Figure 178. Data of $PM_{2,5}$ and colour set up by WHO for Lisbon landing.

The Portuguese Environment Agency produced a report to assess water quality (2014-2017). The map below shows the classification of the status of surface water bodies for the Lisbon landing area. Coastal waters show a good quality, although the water body coming from the Tajo River presents a lower level, reasonable status.



Classificação do estado ecológico/potencial da avaliação intercalar

Figure 179. Classification of the status of surface water bodies in the Lisbon landing area.

In relation to noise quality, the Portuguese Environment Agency has drawn up municipal noise maps ([(apambiente.pt)](apambiente.pt)). In particular, Lisbon shows the following map that represents the L_{den}, a noise indicator representing a weighted 24-hour measurement.

The noise analysis for this area shows that the main source of noise is associated with road traffic, even the noise associated with air traffic is masked by it. Although in the airport area (upper central part of the map) higher noise levels are denoted.

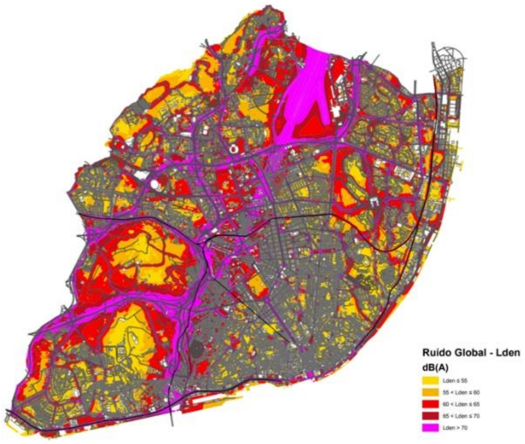


Figure 180. Map of global noise at the city of Lisbon in 2008.

1.5.3.8.2 Spain: Zahara, Torreguadiaro and Barcelona landings

For Zahara landing, no concrete air quality data have been found for this area. Concerning noise pollution, according to the Noise Pollution Information System (SICA) no significant noise from roads, railway lines, airports or agglomerations can be observed.

The "Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible" of the Andalusian Regional Government, on the basis of the provisions of the Water Framework Directive, carries out a physical-chemical and biological analysis on the Water Quality Control Network of the Intra-Community Hydrological Demarcation. Near the Zahara landing area, there are 3 sampling stations, two of them of coastal waters and the third continental.

Figure 181. Stations of the Water Quality Control Network that are near the Zahara landing. Source: Visor of the DNA network.

The physical-chemical analysis is only available for two of the stations. The following table shows the values of the analysed parameters for 2021. The continental station doesn't have values of transparency.

Code	Clorophyll A (mg/m3)	Phosphates (mg/L)	Nitrates (mg/L)	Transparency (m)
62C1125	0.87	0.02	<1*	9.18
GB0027	3.88	0.11	<1*	
* All the sampling days calculate < 1, except 3 sampling that have other values.				

Table 19. Analysis of the physical-chemical for the two near stations in 2021. Source: Visor of the DNA network.

With respect to Torreguadiaro landing, the average annual $PM_{2,5}$ concentration in San Roque for 2021 was 11,9 µg/m³ ([IQAir | First in Air Quality]). This value was expressed based on the 2021 WHO recommended annual air quality guideline levels and interim targets for $PM_{2,5}$. It was used colour band levels to provide easy identification, in this case the town of San Roque was classified at the target 3 – yellow, this means that the values exceed WHO $PM_{2,5}$ guidelines by 2 to 3 times.

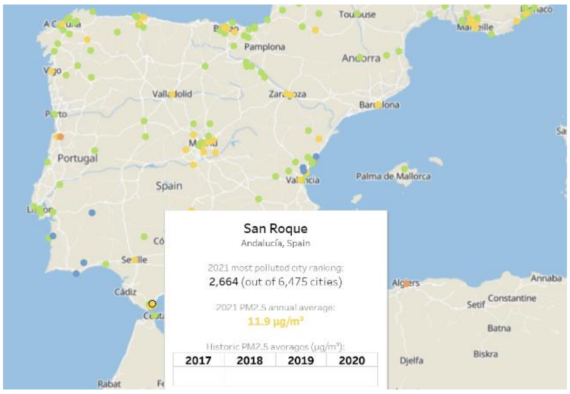


Figure 182. Data of $PM_{2,5}$ and colour set up by WHO for Torreguadiaro landing.

The "Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible" of the Andalusian Regional Government, on the basis of the provisions of the Water Framework Directive, carries out a physical-chemical and biological analysis on the Water Quality Control Network of the Intra-Community Hydrological Demarcation. Near the Torreguadiaro landing area, there are 3 sampling stations, two of them of transition waters and the third coastal.

Figure 183. Stations of the Water Quality Control Network that are near the Torreguadiaro landing. Source: Visor of the DNA network.

The physical-chemical analysis is only available for two of the stations. The following table shows the values of the analysed parameters for 2021. There are differences in chlorophyll A and transparency parameters.

Code	Clorophyll A (mg/m^3)	Phosphates (mg/L)	Nitrates (mg/L)	Transparency (m)
61C0050	1.58	0.02	<1	8.63
61T2010	5.87	<0.05	<1*	0.31
* All the sampling days calculate < 1, except 3 sampling that have value of around 3.				

Table 20. Analysis of the physical-chemical for the two near stations in 2021. **Source:** Visor of the DNA network.

In relation to noise, in Spain there is a Noise Pollution Information System (SICA), created on the basis of Royal Decree 1513/2005, developing Law 37/2003, on Noise. This system constitutes the necessary database on noise pollution. It elaborated 4 different noise maps, corresponding to: airports, agglomerations, roads and railway axis. The Torreguadiaro landing area is only affected by noise pollution generated by roads. There are two important roads that pass through San Roque territory, the A-7S and the AP-7.

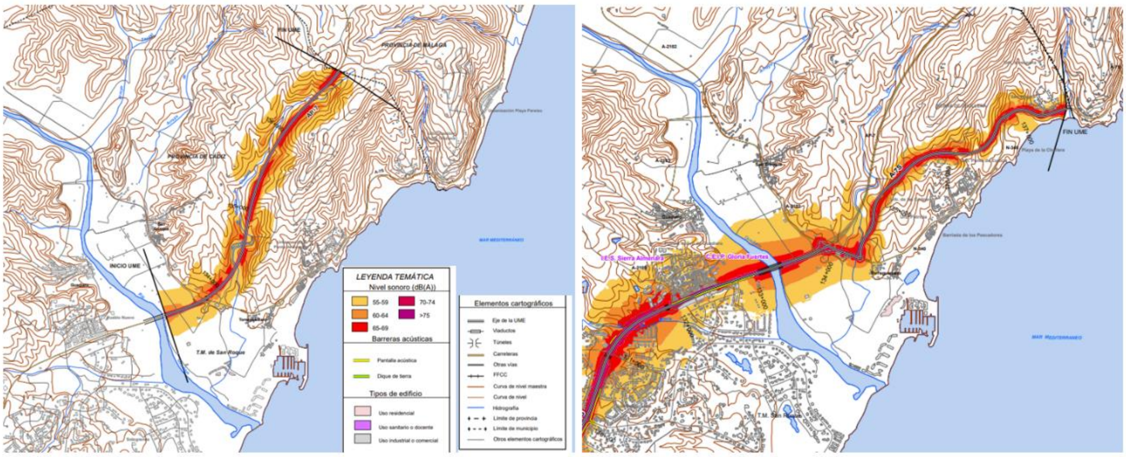


Figure 184. Map of noise near the Torreguadiaro landing in 2013. Sourde: sicaweb.cedex.es/.

For Barcelona landing, the average annual $PM_{2,5}$ concentration for 2021 was 13.2 µg/m³ ([IQAir | First in Air Quality]()). This value was expressed based on the 2021 WHO recommended annual air quality guideline levels and interim targets for $PM_{2,5}$. It was used colour band levels to provide easy identification, in this case the city of Barcelona was classified at the target 3 – yellow, this means that the values exceed WHO $PM_{2,5}$ guidelines by 2 to 3 times.

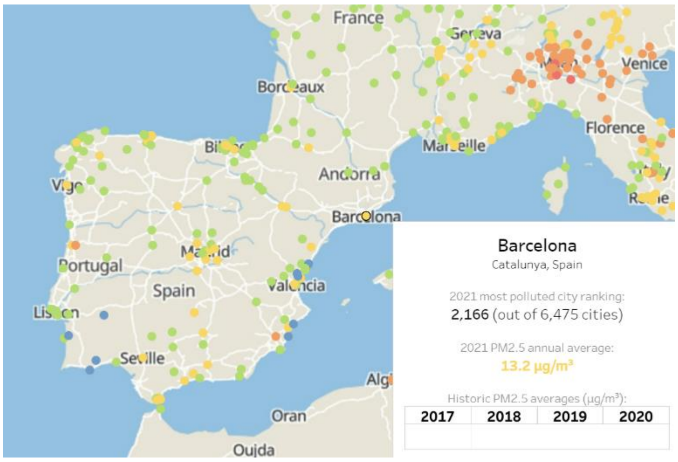


Figure 185. Data of $PM_{2,5}$ and colour set up by WHO for Barcelona landing.

The Catalan Water Agency (ACA) carries out a Control Monitoring Programme of the status of the water bodies of the river basin district of Catalonia. Barcelona's landing is located in coastal water C19, corresponding to Sant Adrià del Besòs – Barceloneta. According to the latest data published in 2018, the C-19 water body has an overall poor status with uncertainty, given that the ecological status is Deficient as a result of poor general physicochemical conditions. However, the quality elements assessed seems to fulfil the environmental objectives.

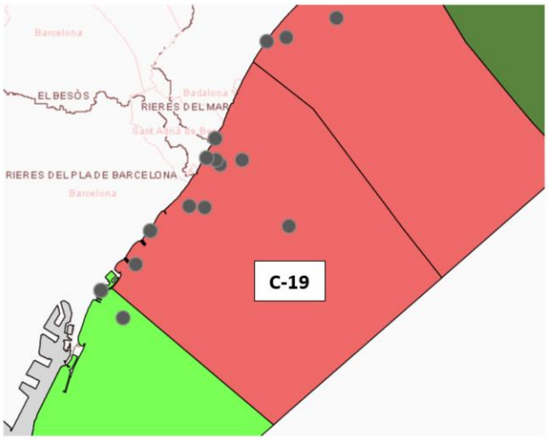


Figure 186. Overall status of water body C-19, according to latest published data (2018). Source: aca-web.gencat.cat/WDMA/wdma.jsp.

Moreover, Catalan Water Agency elaborate another document (IMPRESS 2019) where are analysed, among other things, the pressures on water bodies. Sant Adrià del Besòs-Barceloneta waters are affected by different antrophic pressures. This body is located in one of the most populated coastal sections of Catalonia and is influenced by the mouth of the Besòs river. It is also characterized by the discharge of treated wastewater from the wastewater treatment plant Besos, a treatment plant that treats 40% of the wastewater from the whole of Catalonia. For this reason, it is difficult to achieve a good state of quality.

ACA code	C-19
Industrial waste	3
Exotic species	0
Artificial coastline and confinement	3
Contribution and extraction of sand	0
Downloads unitary systems	3
Surface continental waters	3
Continental groundwater	2
Harbours	2

Table 21. Pressure in water body C19 (Sant Adrià del Besòs – Barceloneta).

With reference to Sant Adrià beach, it is important to highlight that the beach is closed to users since spring 2021, in relation to the presence of high concentration of heavy metals (Pb, Co, Cu, As, etc.) in sediments, which are considered to be carcinogenic if the exposure is extended in time. Indeed, contamination here is related to industrial activity of the past, which was responsible of contamination in Besòs river mouth and consequently in sediments accumulated at the beach. This contaminated material was buried at higher depths, but was moved and analyzed during the works of BMH and border pipe installation conducted by AFR-IX in 2021. The decontamination of this site depends on the Ministry of Ecological Transition, but no advances have been registered up to the moment.

In relation to noise pollution, the Generalitat of Catalonia has drawn up noise capacity maps of Catalonia, according to the criteria of Decree 245/2005 and 176/2009. Below is the noise capacity map for the area near Barcelona landing.

The right side of the Besòs river dominates the residential and industrial land. In particular, the territory near the river corresponds to residential land, while the other is industrial land. Moreover, in the area there are transport infrastructure noise zones, which correspond to road and rail transport (line R1: Molins de Rei – Maçanet/Massanes).

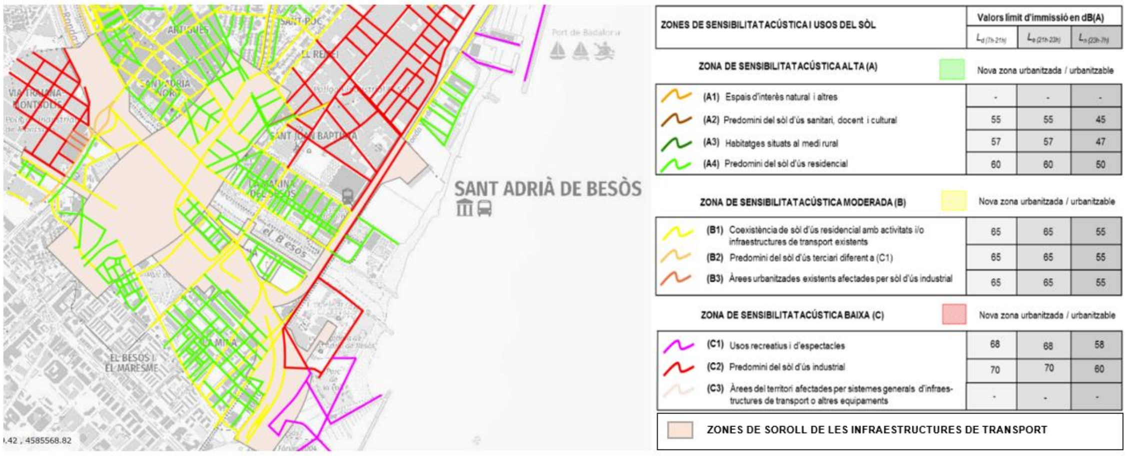


Figure 187. Map of acoustic capacity in the area surrounding the Barcelona landing. Source: sig.gencat.cat/visors/capacitat_acustica.

1.5.3.8.3 France: Marseille landing

For Marseille landing, the average annual $PM_{2.5}$ concentration for 2021 was 10.1 µg/m³ (IQAir | First in Air Quality). This value was expressed based on the 2021 WHO recommended annual air quality guideline levels and interim targets for $PM_{2.5}$. It was used colour band levels to provide easy identification, in this case the city of Marseille had a threshold value and was classified at the target 3 – yellow, this means that the values exceed WHO $PM_{2,5}$ guidelines by 2 to 3 times.

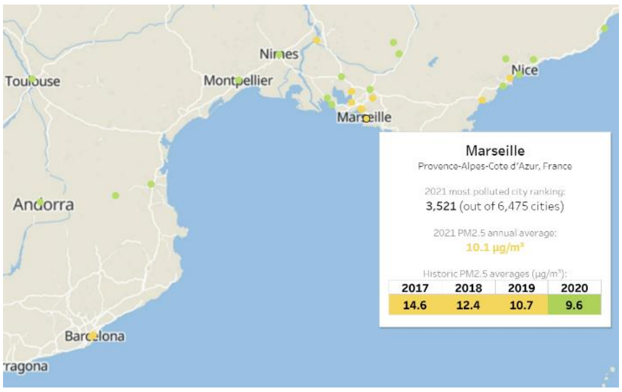


Figure 188. Data of $PM_{2.5}$ and colour set up by WHO for Marseille landing.

Regarding the quality of water, in France, the historical chemical control has improved over the last 40 years. In particular, the water in Marseille in 2019 was qualified with a medium level, this means that one or more concentrations exceed half the threshold, none exceed it (Pollution & contamination | Ifremer).

Furthermore, Bocquier et al. (2012) analyse, among others, the potential residential exposure to road traffic noise at a small-area level in Marseille. The map below shows the road potential noise exposure, which shows that the industrial harbour and northern outskirts are the areas most affected acoustically by the roads.

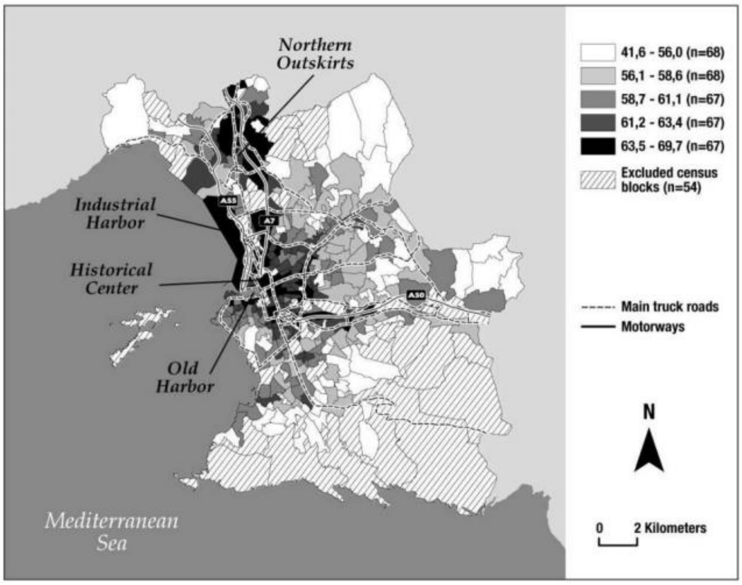


Figure 189. Spatial distribution of the road potential noise exposure indicator L_{den} in Marseille at a small-area level (n=338 census blocks). Source: Bocquier et al. (2012).

1.5.3.8.4 Italy: Mazara del Vallo landing

In the case of Mazara del Vallo landing, this site doesn't have monitoring station for the data of the 2021 World Air Quality Report and IQAir website (IQAir | First in Air Quality). For this reason, the data that are used in this report is from the closest town, Porto Empedocle. The average annual $PM_{2,5}$ concentration for 2021 was 13.1 μg/m³ (IQAir | First in Air Quality). This value was expressed based on the 2021 WHO recommended annual air quality guideline levels and interim targets for $PM_{2,5}$. It was used colour band levels to provide easy identification, in this case the town of Porto Empedocle was classified at the target 3 – yellow, this means that the values exceed WHO $PM_{2,5}$ guidelines by 2 to 3 times.

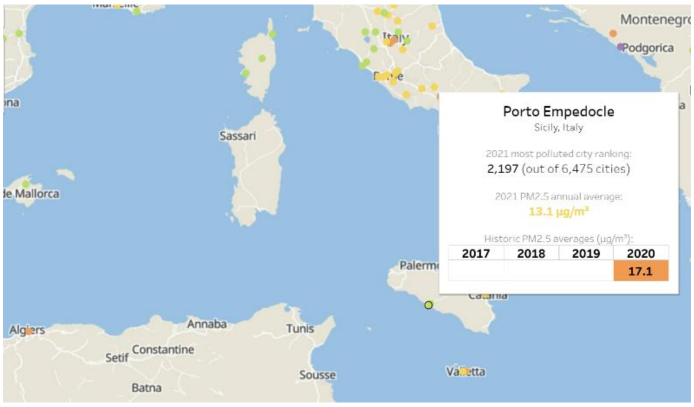


Figure 190. Data of $PM_{2.5}$ and colour set up by WHO for Porto Empedocle.

The Regional Agency for the Protection of the Environment (ARPA), carries out a monitoring of the coastal water quality in Sicily and published a final report. It analysed the ecological and chemical status of a total of 30 marine-coastal water bodies. In particular, the Mazara del Vallo landing corresponds to the Dragonara (Mazara del Vallo). The ecological status in 2018 show a good level, whereas the general chemical status was not so good (water not good and sediment good).

Concerning noise pollution, the European Environment Agency (EEA) summarise information on noise pollution for the country members. The available data show the number of people exposed to high levels of noise from various environmental noise sources such as road, rail, aviation and industry. The overall data for Italy show that the Mazara del Vallo landing area does not suffer a high noise impact. However, more specific noise maps have not been found for this area. It should be added that this year has been published the DDG n.250 of 31/05/2022 agreement for the activity of strategic noise mapping and plans of control and fight against noise between ARPA Sicilia and the Consortium for the Motorways of Sicily.

1.5.3.9 Offshore Risks and Easements

1.5.3.9.1 Main trunk

Marine traffic

Permits from Navigation Authority for each of the countries involved in the Medusa optic system should declare exclusion area (typically 500 m) around the cable-laying vessels, considering the International Regulations for Preventing Collisions at Sea 1972 (COLREGs).

Concerning maritime traffic, the Mediterrenean Sea is a very busy region in the world, hosting more than 20% of seaborne trade, 10% of world container throughput and over 200 million passengers (UN Environment 2017). Crude oil shipments (from Black Sea and Egypt or from the Persian Gulf) and container ships dominate the major traffic routes.

Hereafter we report pictures obtained using data from Emodnet human activities portal for total marine traffic in 2019. The maps highlight how vessels in general are concentrated in coastal zones. Moreover, it is clearly visible the route of vessels moving between Eastern and Western Mediterranean Sea, crossing at the Strait of Sicily and then at the Gibraltar Strait, where the route density reaches the highest values. In the Atlantic Ocean, main routes circumnavigate the southern and eastern coast of Iberian Peninsula, connecting then to the rest of Europe.

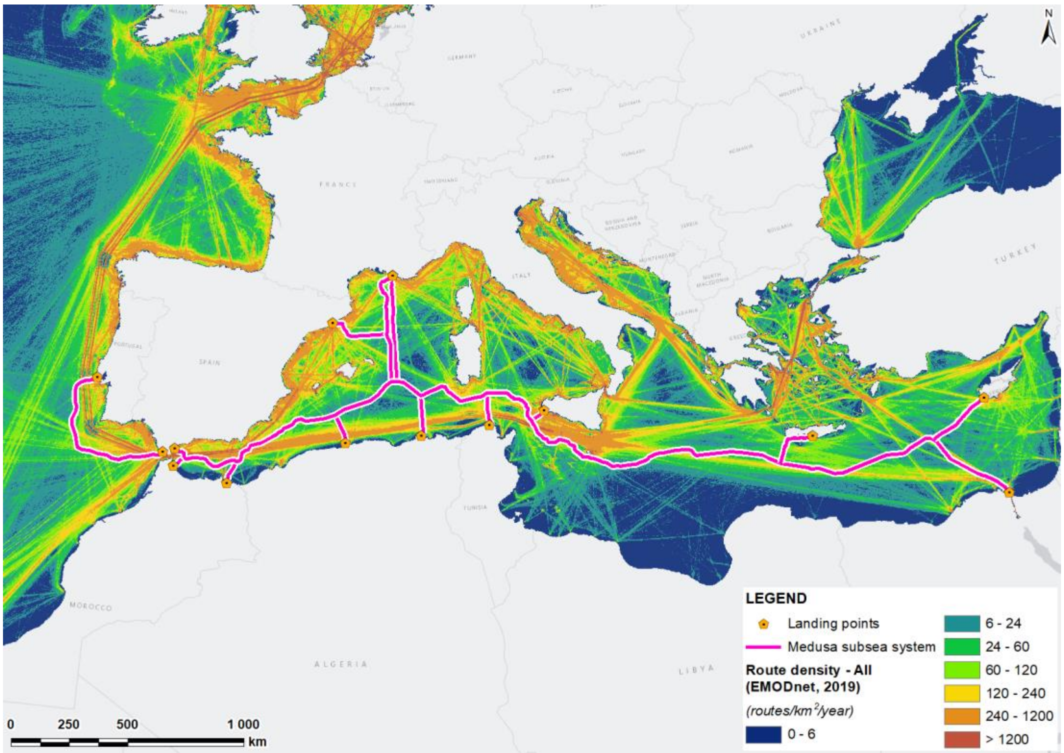


Figure 191. Density route map in the study area in 2019. Source: Elaborated with data from EMODnet Human Activities.

The following pictures show maritime traffic divided for different activities (cargo, fishing, passenger and pleasure vessel routes).

When considering only cargo vessels, the route density indicates clearly a pathway coming from the Northeast Atlantic Ocean, proceeding parallel to the Portugal coast, then entering the Mediterranean through the Strait of Gibraltar and splitting into two parts: one is going towards NW Mediterranean (ports of Valencia, Barcelona, Marseille and Genoa), the other is going parallel to the North African coast towards the Eastern Basin.

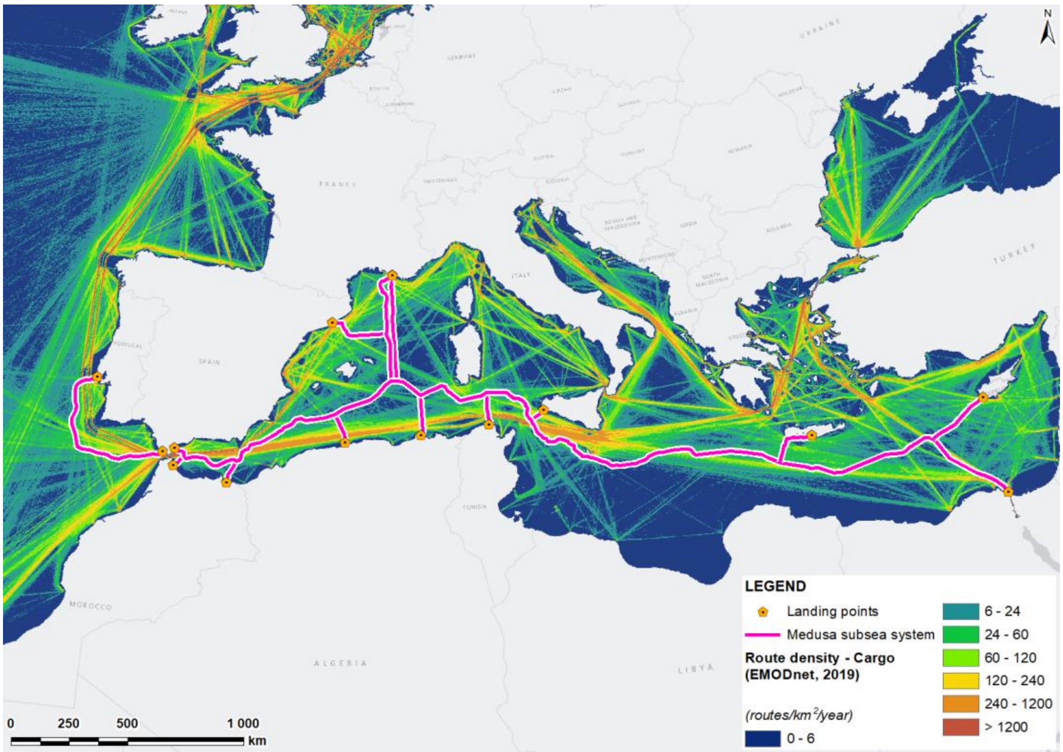


Figure 192. Density route map of cargo vessels in the study area in 2019. Source: Elaborated with data from EMODnet Human Activities.

In the area of study, the density of fishing routes is highest in coastal zones. However, in correspondence of the Spanish Eastern coast and the West and South coasts of Sicily (Pelagian Basin) the area of influence related to fishing seems to be larger than in other point of the basin, so that some interference with the main trunk of Medusa cable is expected.

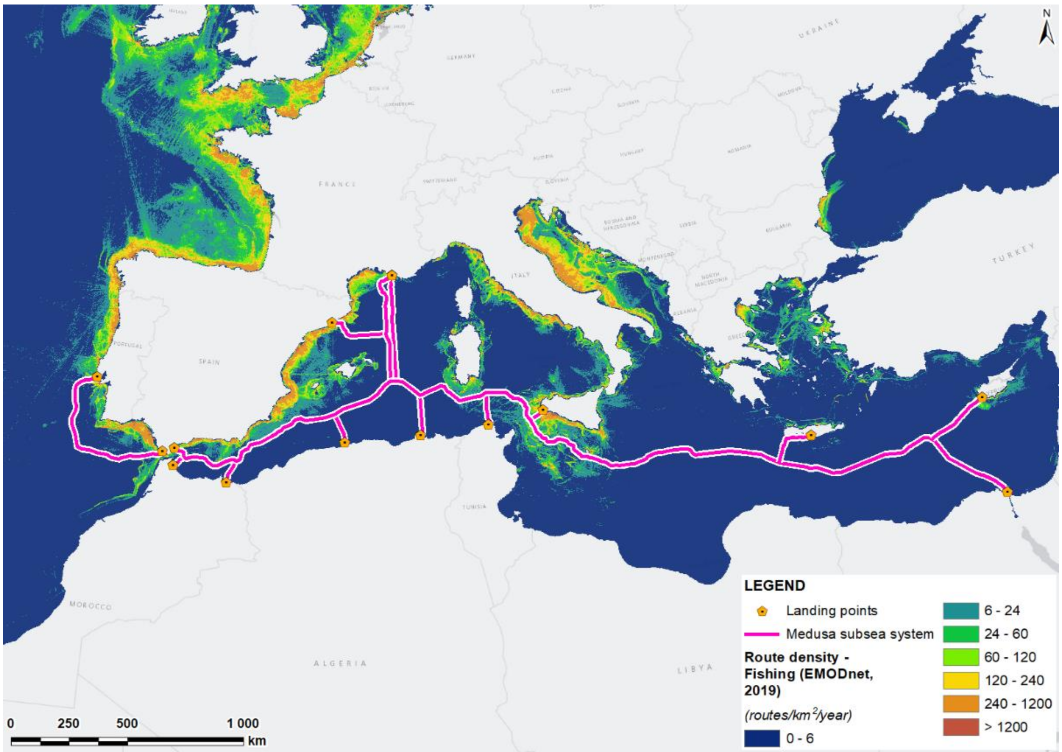


Figure 193. Density route map of fishing vessels in the study area in 2019. Source: Elaborated with data from EMODnet Human Activities.

The density of passenger routes is generally lower than for cargo and fishing vessels. The figures below show how it is possible to recognize the main routes of passenger vessels in the study area. These are mainly from Spanish territories in Morocco to South Spain in the case of the main trunk of the cable, as well as some routes connecting Euopean countries with North Africa.. The density of passenger routes is clearly higher during summer months than in winter.

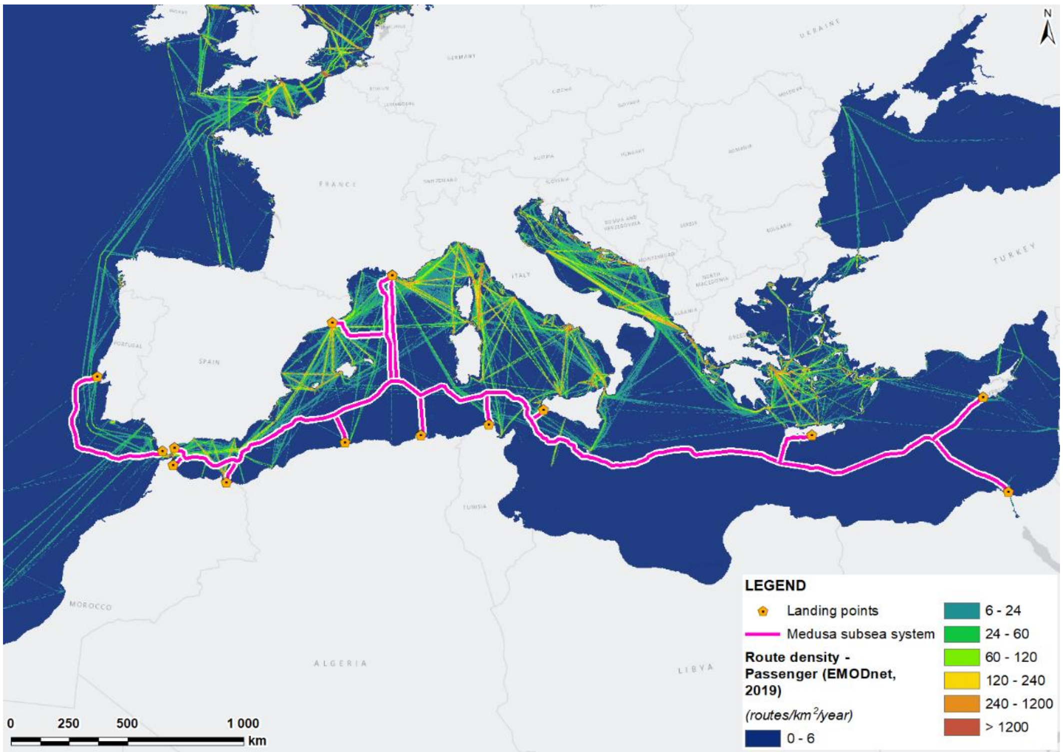


Figure 194. Density route map of passenger vessels in the study area in 2019. Source: Elaborated with data from EMODnet Human Activities.

Pleasure craft is concentrated in some strategic points such as the Spanish coast at the east of Gibraltar Strait, the Catalan coast, the coastline between Marseille and Monaco, the SW of Corsica and the SW of Sicily. Pleasure marine traffic in the area of study is generally limited to summer months.

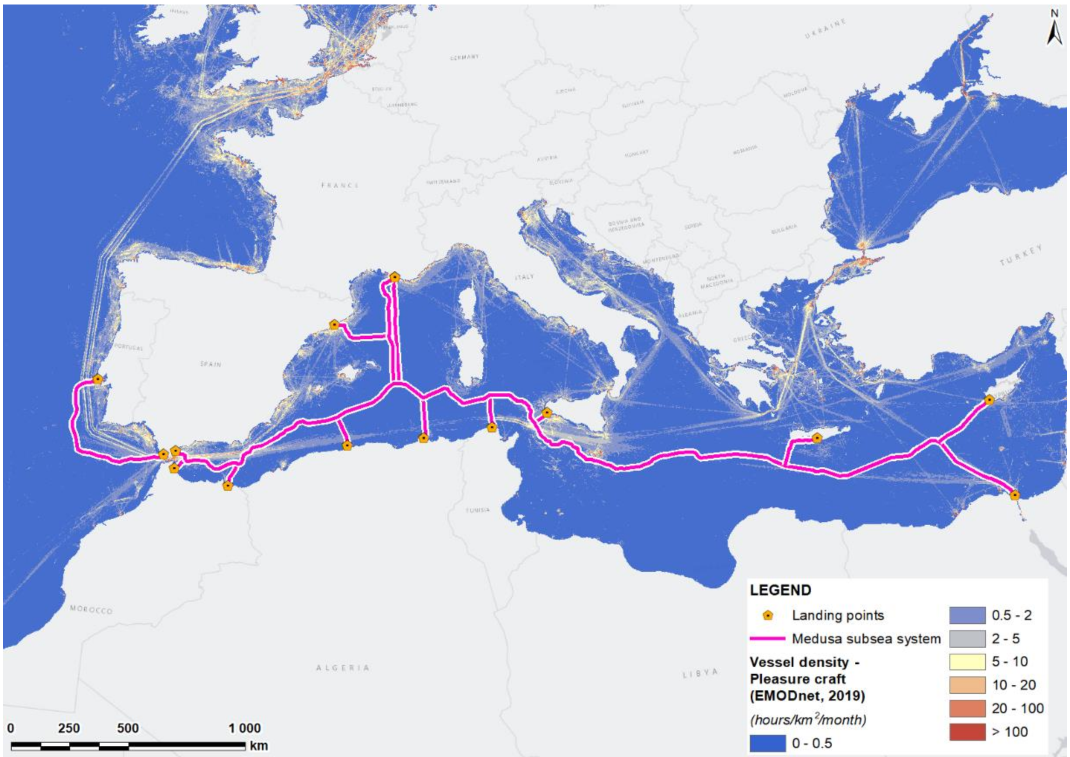


Figure 195. Density map of pleasure craft in the study area during summer 2019 (August). Source: Elaborated with data from EMODnet Human Activities.

<u>Military areas</u>

Some military areas can be found in correspondence of the Medusa system cable route.

According to data from the EMODnet Human activities viewer, the Portuguese EEZ is characterized by the presence of a National Defense Area of about 70,610 km^2, which will be inevitably crossed by Medusa system.

In Spanish EEZ, in correspondence of the Alboran Sea, Medusa system will cross an Air Force Exercise military area of about 15,327 km^2. This area has as secondary use “surface exercise”. Another Spanish Air Force Exercise military area of about 20,253 km^2 will be crossed at the SE of Ibiza Island.

No interference with other military areas is registered by EMODnet Human activities viewer for the main trunk of Medusa system.

Dumped munition areas

According to EMODnet Human Activities viewer, several dumped munition areas exist in the Mediterranean Sea. The ones located in the area of the main trunk of Medusa system are the following:

- Area at the W of the Strait of Gibraltar, 57 km offshore from Cadiz;
- Wide area in the Alboran Sea, at about 25 km offshore from Tetouan;
- Area offshore at the SE of Menorca, in deep waters;
-
- Wide area at the NW of Mazara del Vallo, including the Egadi Archipelago.
- Wide area offshore, between Malta and Libya.
- Wide area offshore, at the SE of Sicily.

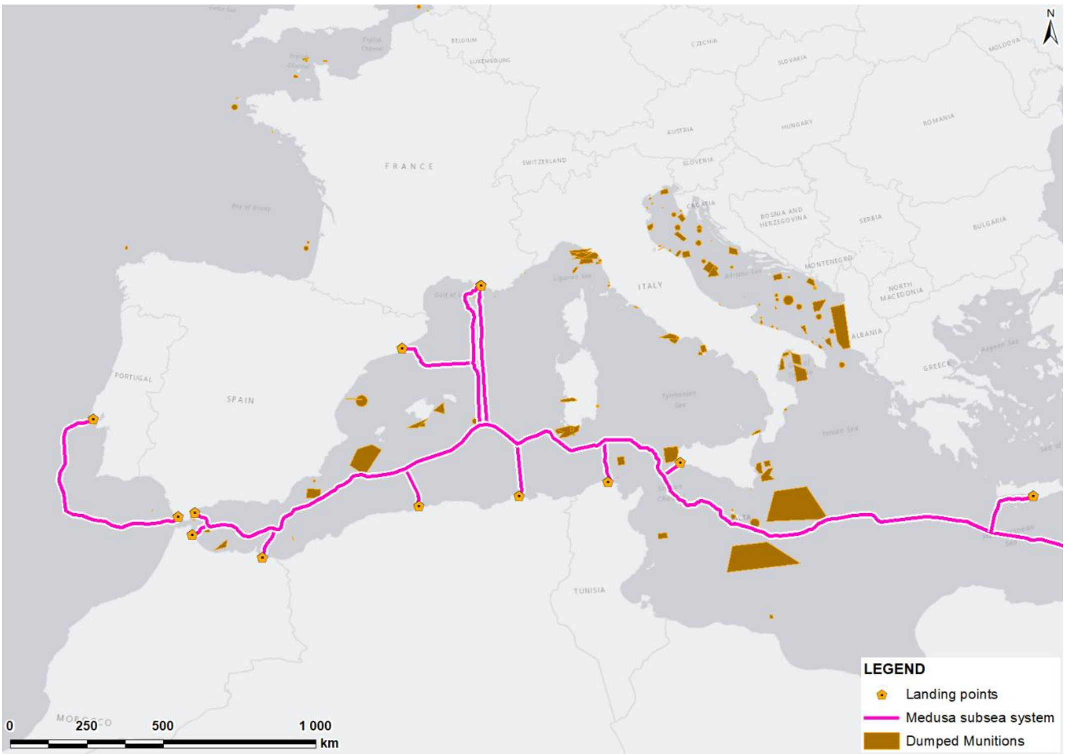


Figure 196. Dumped munition sites in the Mediterranean Sea. Source: elaborated with data from EMODnet Human Activities.

Location of deadly dumping grounds is often poorly documented, so that absence of data in a particular area does not really mean that there are none. This may be for example the case of the Levantine Basin, where dumped munition areas are not reported in the viewer, but data may be not available yet.

The risk of dumped munition areas is related to the possible presence of Unexploded Ordnances (UXOs), including chemical weapons that were dumped after World Wars I and II. UXOs represent a threat to the marine environment and human health, and are a real challenge to blue economic activities (fishing, navigation, aquaculture, tourism, offshore energy, etc.) and marine spatial planning.

The preliminary cable route of Medusa subsea system has been planned to take into account the presence of the known dumped munition areas and avoiding their crossing as far as possible. Out of these zones, the possibility of finding UXOs is low but cannot be totally excluded because of the role that the Mediterranean Sea has had during the Second World War with National Navies of the different alliances fighting for the control of supply lines.

In the proximity of these dumped munition areas, as well as in military areas and zone for which the information is limited but the probability of finding UXOs may be high (certain zones of the Levantine Basin), magnetometer data acquisition is recommended during pre-installation survey for UXO detection.

Dumping and dredging of sedimentary material

Dumping and dredging areas are usually related to coastal areas in the proximity of ports or used for the regeneration of beaches. Dredging and dumping zones should be avoided when planning the route of a submarine cable, as these activities can compromise the security of the project itself.

1.5.3.9.2 Portugal: Lisbon landing

Marine traffic

The landing is located at the north of Tagus River. The nearest port is the one of Lisbon, which is located between the river and the Atlantic Ocean. The port is particularly important for cargo and solid bulk agricultural food stuffs. Cargo vessels from the port of Lisbon have mainly two directions, that is or to the west and the to the north, parallel to the coast, or to the south, joining the route that is then crossing the Gibraltar Strait. The density of fishing vessels in correspondence of the port of Lisbon is not high, but it increases near the port of Cascais, to the west of the landing site, and along the coast south of the Tagus estuary. Fishing vessels are widespread also offshore, where submarine canyons start. Passenger traffic is high in the Tagus estuary, near the port of Lisbon, in relation to both fluvial transport and cruise tourism. Once at the Atlantic Ocean, it is possible to clearly recognized the route of cruise vessels coming and leaving Lisbon. Pleasure craft in the area is present at the Tagus estuary and along the coast north to the river.

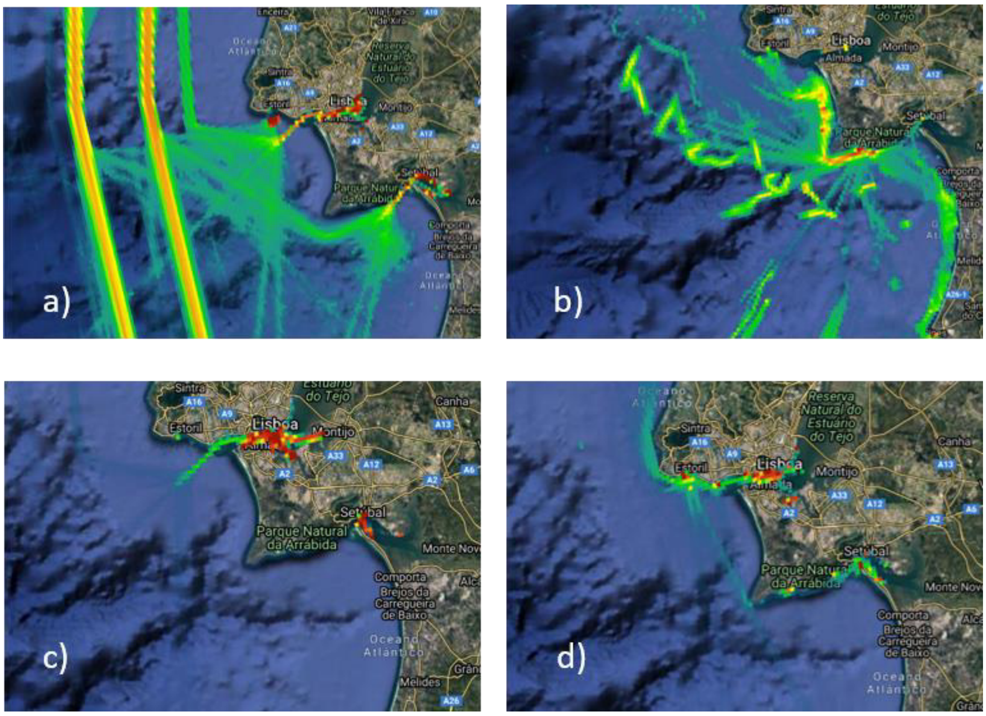


Figure 197. Vessel density map near Lisbon landing in 2019. (EMODnet Human Activities). A) Cargo vessels; b) Fishing vessels; c) Passenger vessels; d) Pleasure vessels.

Military areas

According to the nautical charter (www.navionics.com), in addition to what already said in Section 0 for Portuguese waters, at the east of the Medusa cable route, in the proximity of Lisbon landing, another military maneuver zone is present. However, it will not interfere with the project object of study.

1.5.3.9.3 Spain: Zahara, Torreguadiaro and Barcelona landing

Marine traffic

Concerning Zahara landing, the nearest port to the landing is Barbate, which is about 12 km north to the landing. The port is mainly dedicated to fishing, while cargo and pleasure traffic are very low and passenger vessels are not present. As it is possible to see in the following picture, fishing is widespread in the entire Barbate Bay.

Figure 198. Fishing vessel density map near Zahara landing in 2019. (EMODnet Human Activities).

Concerning Torreguadiaro landing, about 3 km south of the landing point of the cable system, a small port is present. Fishing and pleasure activities are common at the coast from Linea de Concepción to the north and also offshore. Cargo and passenger vessels are almost absent in this part of the coast, as are mainly related to the relevant ports of Algeciras and Gibraltar, which are located at the SW of the landing.

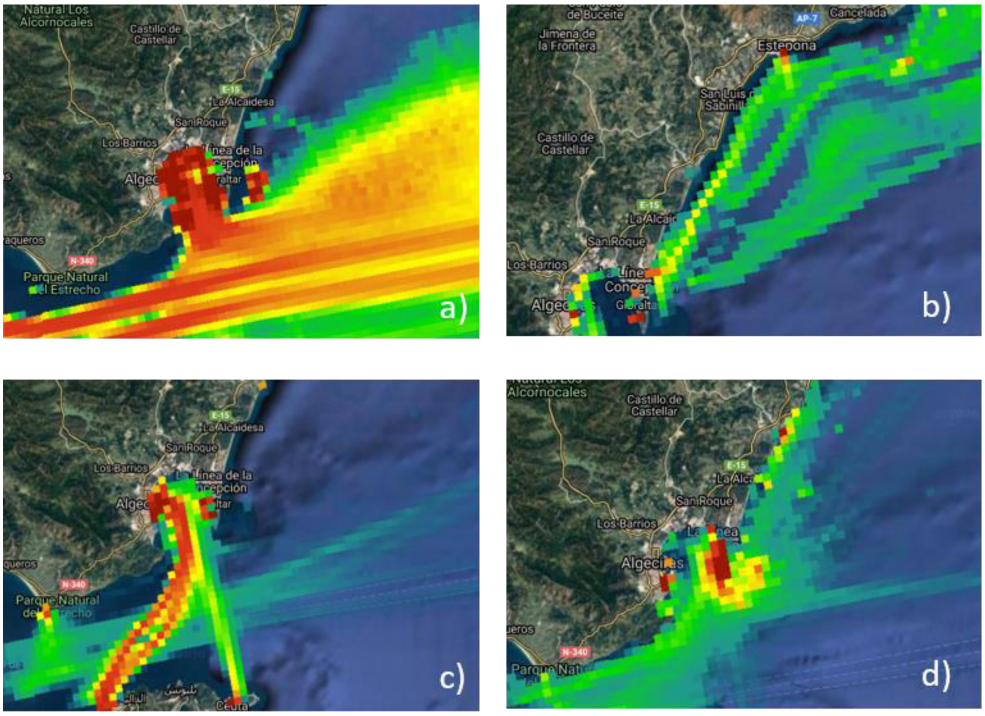


Figure 199. Vessel density map near Torreguadiaro landing in 2019. (EMODnet Human Activities). A) Cargo vessels; b) Fishing vessels; c) Passenger vessels; d) Pleasure vessels.

Concerning Barcelona landing, the nearest ports are the Sant Adrià de Besòs harbor (Port Forum) to the south and the Badalona harbor to the north. They are mainly marinas, while fishing activity is limited. Nevertheless, the most relevant port in the area is certainly the Barcelona port. The maritime traffic related to this port is huge and consist mainly of cargo vessels and passenger vessels. The highest number of routes are transversal to the planned cable and are related to the Transmediterranean transport. These routes are a connection among Catalonia, Valencia region and Balearics Islands. Then, parallel to the coast, we can observe the transport routes coming from Marseille and directing to North Africa. The port of Barcelona accommodates also passenger marine traffic, connecting the Iberian Peninsula with the Balearic Islands (Ibiza, Mallorca and Minorca), Italy (Genova, Civitavecchia, Porto Torres, Savona), Morocco (Tánger and Nador) and Algeria (Orán). Barcelona is also the most relevant port in Europe for cruise traffic and one of the most important in the world. Passenger maritime traffic is subjected to a relevant increase during summer (between June and September), mainly due to the higher frequency in the connection routes between Barcelona and the Balearic Islands.

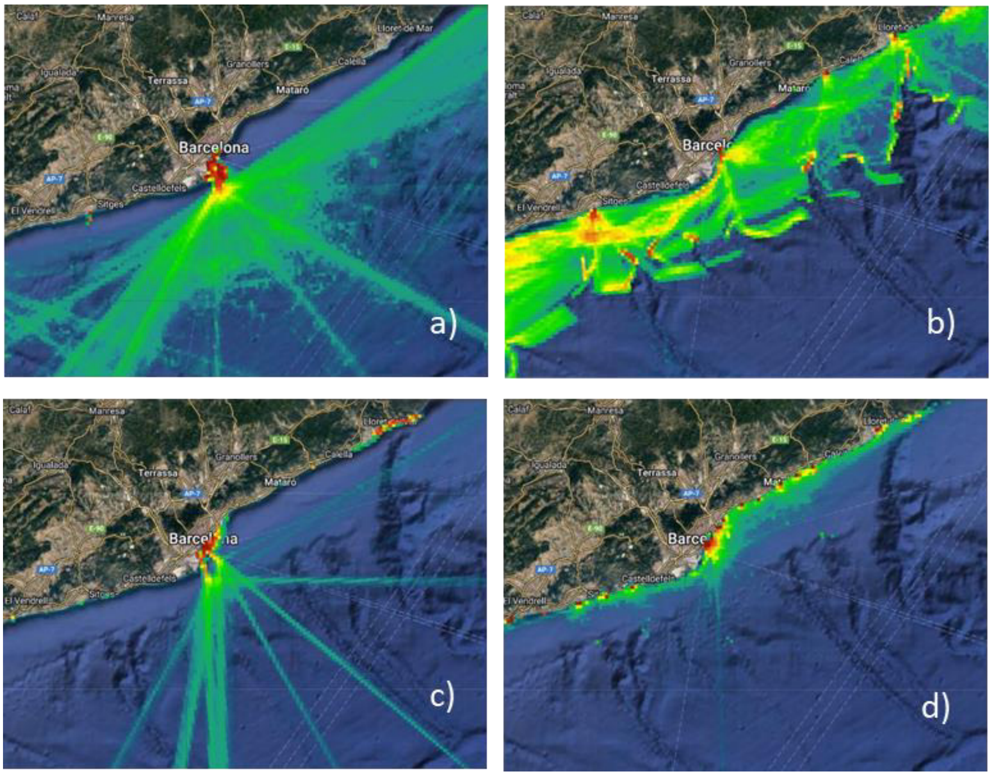


Figure 200. Vessel density map near Barcelona landing in 2019. (EMODnet Human Activities). a) Cargo vessels; b) Fishing vessels; c) Passenger vessels; d) Pleasure vessels.

<u>Military areas</u>

Next to Zahara landing there are areas reserved for national defense. In the coastal section of Barbate is the Sierra del Retín Training Camp, which constitutes a Zone of Interest for National

Defense. This zone does not include a close security zone, but it does include a remote security zone, which also coincides with a permanent zone for amphibian exercises. The delimitation and location in the study area of each of them is represented in the following figure.

The Medusa cable would pass through the remote security zone of the Sierra del Retín Training Camp, which coincides with an area for amphibian exercises, in the first 2.2 km of its route from landing in Zahara. The Sierra del Retín Training Field belongs to the facilities of the fifth group of RD 689/1978, of February 10, “Instruction and maneuver fields, and shooting ranges or bombing ranges”. According to article 27 of this Regulation, "the installations included in the fifth group... will, however, have a remote security zone in which the installation of industries or activities that, in accordance with the general (and local) Regulations, is prohibited where appropriate), in force in the matter, can be classified as "annoying, unhealthy, harmful or dangerous", in a strip of 2,000 meters wide around the military camp, from its outer perimeter".

Therefore, it is considered that the installation of the Medusa cable in this remote security military zone does not imply obtaining any prior authorization.

In addition, the cable will be buried at least one meter deep and will not constitute an obstacle to military activity.

In any case, the competent administration of the Ministry of Defense should be consulted about the frequency of activation of the amphibious activities area of the Sierra del Retín Training Camp in order to be able to schedule the works in this area avoiding interference with the military activities (Draft POEM 2020 Strait-Alborán Demarcation).

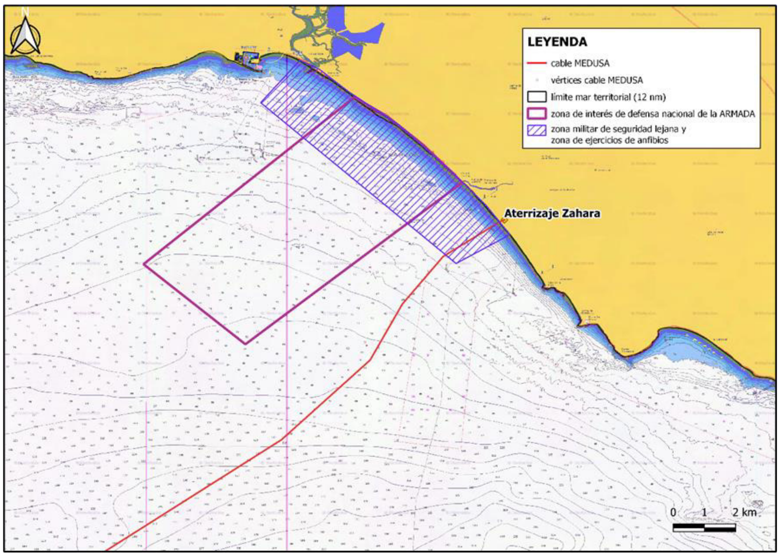


Figure 201. Military areas in the proximity of Zahara landing. Source: AFR-IX Telecom-Tecnoambiente, 2021.

With respect to Torreguadiaro landing, in the study zone there is an area of air military exercises of approximately 298 km^2. The cable will cross this military zone for 8.5 km. However, the typology of the project that is the object of this document means that there would also be no influence on the activity of this air military area.

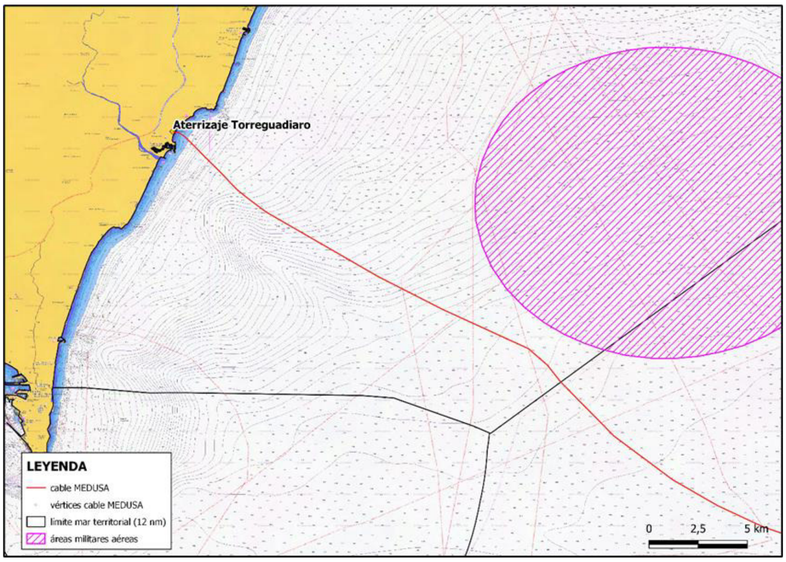


Figure 202. Military areas in the proximity of Torreguadiaro landing. Source: AFR-IX Telecom-Tecnoambiente, 2021.

<u>Dredging and dumping areas</u>

Dredging areas are present next to Barcelona landing in relation to the presence of ports and to the regeneration of beaches. Dredge spoil dumping areas are recognized near Zahara and Barcelona landing sites

1.5.3.9.4 France: Marseille landing

<u>Marine traffic</u>

The Marseille landing will be near the Port of Marseille, which is the most important trade seaport of France and has a key role in the Mediterranean Sea. The port handles hydrocarbons and bulk liquids, general cargo and bulk solids such as minerals and cereals. There are two different harbors, Eastern and Western: the first one is dedicated to the flow of goods to the Mediterranean and Africa, while the second hosts oil and chemical activities, and containers. The highest density of cargo vessels from/to the port of Marseille are on the routes connecting the city with Barcelona and with Genoa. Passenger traffic at the port of Marseille is also relevant, with ferries connections to North Africa, Sardinia, Corsica and other sites of the Mediterranean Sea. Fishing in coastal area is spread at the west of the port of Marseille, up to Montpellier zone, while it seems to be limited at the east. Pleasure vessels are present along the coast from the city of Marseille to the east and near Montpellier.

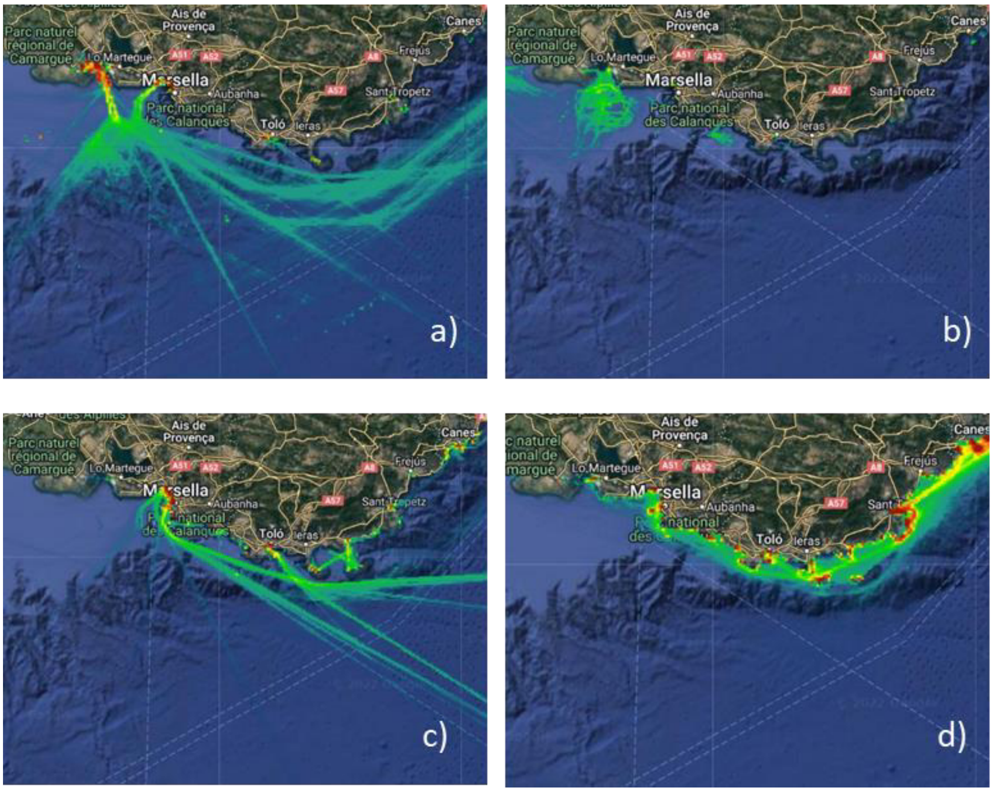


Figure 203. Vessel density map near Marseille landing in 2019. (EMODnet Human Activities). a) Cargo vessels; b) Fishing vessels; c) Passenger vessels; d) Pleasure vessels.

Dumped munition areas

A recognized dumped munition zone is present at the S of Marseille, in correspondence of the canyon area.

Dredging and dumping areas

Dredge spoil dumping areas are recognized near Mairseille landing.

1.5.3.9.5 Italy: Mazara landing

Marine traffic

The port of Mazara del Vallo, in Sicily, has been historically important for the marine traffic in the Mediterranean Sea. Currently it is particularly relevant for fishing vessels, providing shelter to the largest fishing fleet in Italy. Cargo, passenger and pleasure traffic is limited. Mazara del Vallo overlooks the Strait of Sicily, so that the density of cargo vessels in the offshore area of this landing is high, being the zone relevant for the connection between Western and Eastern Mediterranean Sea.

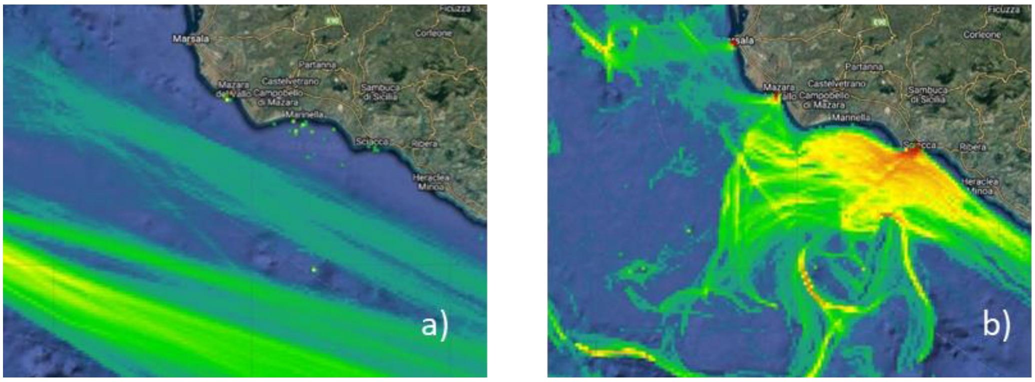


Figure 204. Vessel density map near Mazara del Vallo landing in 2019. (EMODnet Human Activities). A) Cargo vessels; b) Fishing vessels.

<u>Dredging and dumping areas</u>

Dredge spoil dumping areas are recognized near Mairseille landing.

1.5.3.10 Local Development Aid Structures

1.5.3.10.1 Portugal: Lisbon landings

With regards to territorial organization in Portugal, local development actors are broken down into three categories: local actors, private actors and other actors.

(i) Multilateral organizations, International NGOs: Portugal has been a member of the European Union since 1986 and the country is also a founding member of the North Atlantic Treaty Organization (NATO), the Organization for Economic Cooperation and Development (OECD), and also a founder of the International Renewable Energy Agency (IRENA). He also co-founded the Community of Portuguese Language Countries (CPLP). Portugal is also part of the Ibero-American Summit.

(ii) Local actors/authorities: the territorial organization of Portugal is based in districts and 2 Autonomous Regions. The districts are subdivided in metropolitan areas and intermunicipal communities. And the basic entity are the municipalities. Therefore, local actors/authorities in

Cascais (metropolitan area of Lisbon) are Lisbon District, the *freguesia* União das Freguesias de Carcavelos e Parede and the Cascais's municipality.

(iii) Amongst the private actors involved in local development, the metropolitan area of Lisbon is one of the major economic centers in Europe, with a growing financial sector and one of the largest container ports on Europe's Atlantic coast. The multiple forms of public–private partnerships which now exist reflect the increased liberalization and privatization of the Portuguese economy, the private sector is becoming much more directly involved in urban development. There is now a wide spectrum of private sector institutions dealing with substantive issues relevant to the governance of the Lisbon Metropolitan Area. These include companies operating in key sectors such as tourism promotion, transport, building and real estate, infrastructures and public services. Furthermore, the required liberalization of sectors such as water and telecommunications by European competition law has created powerful new private sector actors and indirectly speeded up the development of 'private management' at the municipal level, most notably in the water and urban waste sectors (Nunes Silva & Syrett, 2006).

1.5.3.10.2 Spain: Zahara, Torreguadiaro and Barcelona landings

With regards to territorial organization in Spain, local development actors are broken down into three categories: local actors, private actors and other actors.

(i) Multilateral organizations, International NGOs: Spain has been a member of the European Union since 1986 and the country is part of the following international organizations: the United Nations (UN), the North Atlantic Treaty Organization (NATO), the Organization for Economic Cooperation and Development (OECD), Organization for Security and Cooperation in Europe (OSCE), the Western European Union (WEU), the European Defence Agency (EDA), the Organization of Ibero-American States for Education, Science and Culture (OEI), the Latin Union, the Ibero-American Community of Nations (CIN) and the Association of Ibero-American States for the Development of the National Libraries of Iberoamerica (ABINIA).

(ii) Local actors/authorities: the territorial organization of Spain is based on an autonomous state, that is, a state made up of nationalities and regions, which have been constituted as autonomous communities. Catalonia and Andalusia are two of these autonomous communities that make up the country. The autonomous communities are made up of one or more provinces and, in these provinces, the basic entity are the municipalities. Some communities have also created supra-municipal entities with their own legal personality, such as the *comarcas* (similar to counties) and *vegueries*.

Therefore, local actors/authorities in Zahara and Torreguadiaro are the autonomous community of Andalucía, Cádiz's Province, *comarca* of Campo de Gibraltar (both for Zahara and

Torreguadiaro) and the council of Tarifa and San Roque. In Sant Adrià del Besòs (Barcelona's landing municipality), local actors/authorities are the autonomous community of Catalonia, Barcelona's Province, *vegueria* of Àmbit metropolità de Barcelona, *comarca* of Barcelonés, and the city's council of Sant Adrià del Besòs.

(iii) Amongst the private actors involved in local development, Tarifa is an important center for tourism, in relation both to the presence of hotel structures and to the touristic activities linked to sea and mountain, such as windsurf, kitesurf, cetacean observation, hiking and biking. With respect to industry, there is the presence of the Tarifa wind farm, managed by *Sociedad Eólica de Andalucía*, as well as the AXENT gas station, in the proximity of the landing site. Not much information has been found about the private actors performing in Zahara de los Atunes village, next to Zahara landing point. However, the economic engine of the area is tourism and the municipality has a large number of hotel establishments per head.

With respect to San Roque (Torreguadiaro landing), the town is home to the largest industrial center of Andalusia. Some of the private companies that influence the town are companies located in this industrial center, as Linde plc, Alstom, CEPSA, Endesa, Enel, E.ON, Repsol or Gas Natural Fenosa. The hotel/catering and tourism provide activity to the district of Valle del Guadiaro, highlighting the luxury residential area of Sotogrande, the Torreguadiaro Club resort and its golf courses.

In both Zahara and Torreguadiaro landings the following local NGO also exists: the *GDR* (rural development group) *del Litoral de la Janda y de Los Alcornocales*, a non-profit entity that works for the sustainable development of the municipalities included in its scope of action.

In Barcelona, some of the private actors involved in the city's public-private partnership are Barcelona Global and the IESE Public Center of Excellence of the IESE Business School. However, there are many more private companies that influence and collaborate with the city's development.

1.5.3.10.3 France: Marseille landing

With regards to territorial organization in France, local development actors are broken down into three categories: local actors, private actors and other actors.

(i) Multilateral organizations, International NGOs: France is a founding member of the United Nations. In 2015, it was qualified as "the best-connected state in the world" as being the one that integrates the most international institutions, including the G7, the World Trade Organization (WTO), the North Atlantic Treaty Organization (NATO), the Pacific Community (PC) and the

Indian Ocean Commission (COI). In addition, France is an associate member of the Association of Caribbean States (AEC) and the main member of the International Organization of Francophones (OIF). It also hosts the headquarters of several international organizations, including the Organization for Economic Cooperation and Development (OECD), the United Nations Educational, Scientific and Cultural Organization (UNESCO), Interpol, the International Bureau of Weights and Measures, and the OIF.

(ii) Local actors/authorities: the *communes* (analogous to city councils), the departments and the regions. A fourth intermediate level between the *commune* and the department is the inter-municipal cooperation structures. Therefore, local actors/authorities in Marseille are the Region of Provence-Alpes-Côte d'Azur, the Bouches-du-Rhône's Departments, the Intercommunality of Aix-Marseille-Provence Metropolis and the *commune* of Marseille.

(iii) Amongst the private actors involved in local development, co-operation efforts between public and private sector are numerous across the metropolitan area of Aix-Marseille. Higher education, R&D and innovation are among the sectors with the most intensive co-operation in the past several years. One of the very first co-operation initiatives was "Top 20", led by entrepreneurs, which strives to bring Aix-Marseille-Provence into the top 20 metropolitan areas in Europe (Source: OECD, 2013). For example, one of the main private actors in Marseille is Chamber of Commerce and Industry Aix Marseille Provence (CCIMP).

1.5.3.10.4 Italy: Mazara landing

With regards to territorial organization in Italy, local development actors are broken down into three categories: local actors, private actors and other actors.

(i) Multilateral organizations, International NGOs: Italy is a founding member of the European Economic Community (EEC), now the European Union (EU), and of NATO. In addition, Italy is a member of the Organization for Economic Co-operation and Development (OECD), the General Agreement on Tariffs and Trade/World Trade Organization (GATT/WTO), the Organization for Security and Co-operation in Europe (OSCE), the Council of Europe, and the Central European Initiative.

(ii) Local actors/authorities: the *comuni* (analogous to city councils), the provinces and the regions. *Comuni* are divided into *circoscrizioni* or *frazioni* (to which the *comune* delegates administrative functions like the running of schools, social services and waste collection). Therefore, local actors/authorities in Mazara del Vallo are the Region of Sicily, the Province of Trapani and the city council of Mazara del Vallo. This *comune* is subdivided into two *frazioni*: Borgata Costiera and Mazara Due.

(iii) Amongst the private actors involved in local development, not much information has been found about the main private actors acting on the development of the city of Mazara del Vallo. However, the city's economy is driven by the fishing industry, including fish processing and conservation, and the city's naval construction is one of the most important and well-known fishing ports in the Mediterranean. Tourism also plays an important role in the city's economy and development.

1.5.4 Climate Change Aspects

Climate change is referring to long-term shifts in temperature and weather patterns due to burning fossil fuels. Human activities have been the main driver in the last centuries.

The Mediterranean region is warming 20% faster than the global average. Water temperature is expected to rise by between 1.8 and 3.5 ºC by 2100 with hotspots in Spain and the Eastern Mediterranean (unep.org/; un.org/).

The foreseeable effects of Climate Change on the project are analyzed below. The consequences of Climate Change, derived from the reports of the Intergovernmental Panel on Climate Change (IPCC) that contemplate various scenarios for the future, may influence projects that do not take into account these scenarios in their analyses. The future consequences of Climate Change that may affect the project of study are mainly the following:

- Sea level rise
- Acidification of seas and oceans
- Increase in the temperature of the atmosphere
- Greater exposure to adverse climatic agents (floods, marine storms...).

The main effects on the terrestrial elements of the project are the flooding derived from the rise in sea level and the higher exposure to adverse climatic agents. A specific analysis on these conditions might be conducted for any of the landing sites, in the frame of PIPs.

However, a projection of the expected sea level rise for coastal line areas under the high-end sea-level rise scenario in 2100 is featured below.

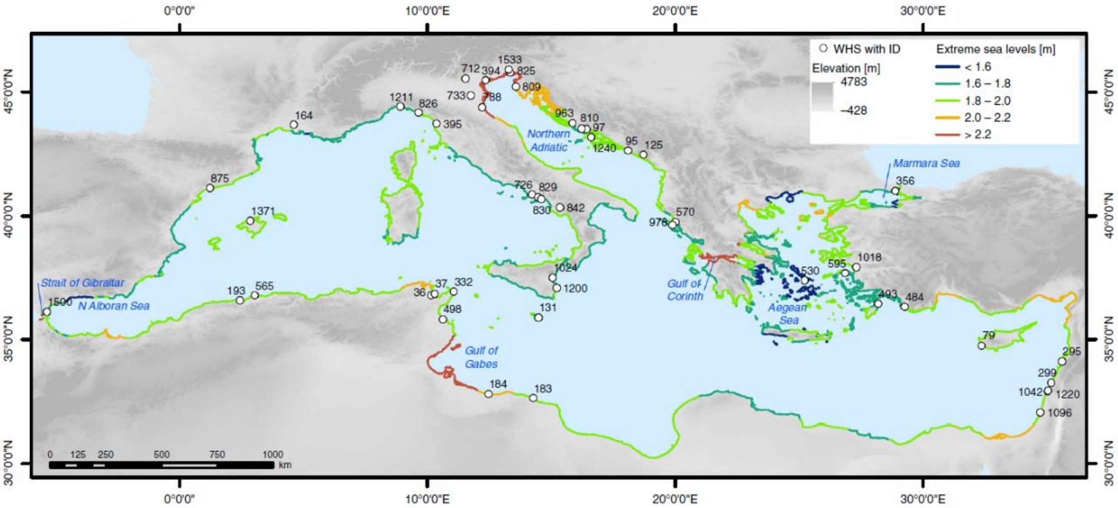


Figure 205. Mediterranean Low Elevation Coastal Zone (LECZ). The map also shows extreme sea levels per coastal segment based on the Mediterranean Coastal Database108 under the high-end sea-level rise scenario in 2100. Source: Reimann et al., 2018.

This projection has been obtained from the scientific study "Mediterranean UNESCO World Heritage at risk from coastal flooding and erosion due to sea-level rise" which, among others, shows the maximum sea level rise levels expected for the year 2100 along the entire Mediterranean coast.

In general, the sea-level rise is expected to be between 1.6 and 2 meters, lower than most of other coast areas in the world as the Mediterranean Sea is a semi-closed sea. Observing the map, the Mediterranean areas that will be most affected by the sea flood are the Melilla Bay (where Nador City is located), the northern coast of Adriatic Sea, the Gulf of Gabes, the coast of Bizerte, the Gulf of Corinth and the Nile Delta (where the Medusa system cable ends). However, it should be taken into account that the useful life of Medusa project is contemplated to be just 25 years, being this far from the 2100 scenario predicted above.

Most conservative values of sea level rise are obtained by the IPCC (Intergovernmental Panel on Climate Change). The Representative Concentration Pathways (RCP) are the greenhouse gas concentration pathways (not emissions) adopted by the IPCC. The IPCC, for its Fifth Assessment Report in 2014, used four pathways for climate modeling and research. The different trajectories contemplate different climate futures, all of them considered possible, depending on the volume of greenhouse gases (GHG) emitted in the coming years. The denominations of the different RCPs (RCP 2.6, RCP 4.5, RCP 6 and RCP 8.5) correspond to the value of radiative forcing in the year 2100 (2.6, 4.5, 6 and 8.5 W/m_2, respectively). The following graph shows the concentration of CO_2 Equivalent in the atmosphere until the year 2100, for each of the projections.

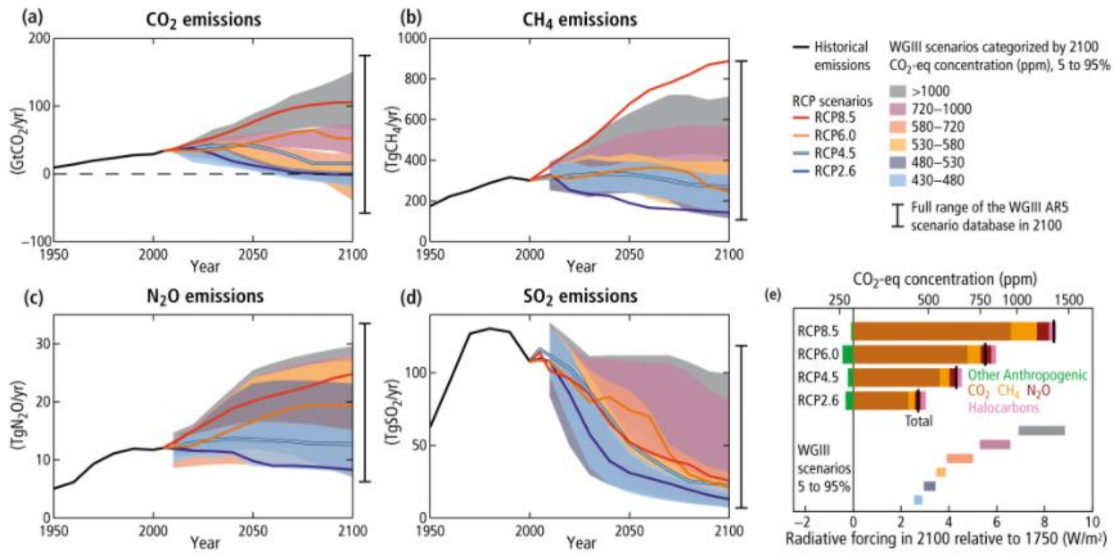


Figure 206. Resulting emissions and radiative forcing scenarios for the representative trajectories of each RCP from 2000 to 2100 (source: IPCC, 2014)

As can be seen in the previous figure, the higher the RCP number, the greater the emissions and CO_2 Equivalent concentrations in the atmosphere.

At the global level, the IPCC provides the most reliable sea level rise projections for the different emission scenarios. Specifically for 5 scenarios, the 4 RCP already mentioned and a scenario obtained from semi-empirical simulations): RCP2.6, RCP4.5, RCP6.0, RCP8.5, and Me by A1B.

As shown in Table 1, until the year 2050 the sea level increases with a similar rate in the five scenarios, with an increase around 0.17-0.38 m above the reference level in the period 1980-2000. Considering that the useful life Medusa subsea system is estimated to be 25 years, these data are those of interest in the case of Medusa subsea system. Then, by the end of the 21st century, the choice of one scenario or another implies clear differences in sea level, a variant of 0.28 to 0.98 m of ascent.

It should also be noted that there are authors who consider that these values could fall short and that the total ascent could become about +2 m.

	SRES A1B	RCP2.6	RCP4.5	RCP6.0	RCP8.5
Thermal expansion	0.21 [0.16 to 0.26]	0.14 [0.10 to 0.18]	0.19 [0.14 to 0.23]	0.19 [0.15 to 0.24]	0.27 [0.21 to 0.33]
Glaciers[a]	0.14 [0.08 to 0.21]	0.10 [0.04 to 0.16]	0.12 [0.06 to 0.19]	0.12 [0.06 to 0.19]	0.16 [0.09 to 0.23]
Greenland ice-sheet SMB[b]	0.05 [0.02 to 0.12]	0.03 [0.01 to 0.07]	0.04 [0.01 to 0.09]	0.04 [0.01 to 0.09]	0.07 [0.03 to 0.16]
Antarctic ice-sheet SMB[c]	–0.03 [–0.06 to –0.01]	–0.02 [–0.04 to –0.00]	–0.02 [–0.05 to –0.01]	–0.02 [–0.05 to –0.01]	–0.04 [–0.07 to –0.01]
Greenland ice-sheet rapid dynamics	0.04 [0.01 to 0.06]	0.04 [0.01 to 0.06]	0.04 [0.01 to 0.06]	0.04 [0.01 to 0.06]	0.05 [0.02 to 0.07]
Antarctic ice-sheet rapid dynamics	0.07 [–0.01 to 0.16]	0.07 [–0.01 to 0.16]	0.07 [–0.01 to 0.16]	0.07 [–0.01 to 0.16]	0.07 [–0.01 to 0.16]
Land water storage	0.04 [–0.01 to 0.09]	0.04 [–0.01 to 0.09]	0.04 [–0.01 to 0.09]	0.04 [–0.01 to 0.09]	0.04 [–0.01 to 0.09]
Global mean sea level rise in 2081–2100	0.52 [0.37 to 0.69]	0.40 [0.26 to 0.55]	0.47 [0.32 to 0.63]	0.48 [0.33 to 0.63]	0.63 [0.45 to 0.82]
Greenland ice sheet	0.09 [0.05 to 0.15]	0.06 [0.04 to 0.10]	0.08 [0.04 to 0.13]	0.08 [0.04 to 0.13]	0.12 [0.07 to 0.21]
Antarctic ice sheet	0.04 [–0.05 to 0.13]	0.05 [–0.03 to 0.14]	0.05 [–0.04 to 0.13]	0.05 [–0.04 to 0.13]	0.04 [–0.06 to 0.12]
Ice-sheet rapid dynamics	0.10 [0.03 to 0.19]	0.10 [0.03 to 0.19]	0.10 [0.03 to 0.19]	0.10 [0.03 to 0.19]	0.12 [0.03 to 0.20]
Rate of global mean sea level rise	8.1 [5.1 to 11.4]	4.4 [2.0 to 6.8]	6.1 [3.5 to 8.8]	7.4 [4.7 to 10.3]	11.2 [7.5 to 15.7]
Global mean sea level rise in 2046–2065	0.27 [0.19 to 0.34]	0.24 [0.17 to 0.32]	0.26 [0.19 to 0.33]	0.25 [0.18 to 0.32]	0.30 [0.22 to 0.38]
Global mean sea level rise in 2100	0.60 [0.42 to 0.80]	0.44 [0.28 to 0.61]	0.53 [0.36 to 0.71]	0.55 [0.38 to 0.73]	0.74 [0.52 to 0.98]
Only the collapse of the marine-based sectors of the Antarctic ice sheet, if initiated, could cause GMSL to rise substantially above the *likely* range during the 21st century. This potential additional contribution cannot be precisely quantified but there is *medium confidence* that it would not exceed several tenths of a meter of sea level rise.					

Notes:

[a] Excluding glaciers on Antarctica but including glaciers peripheral to the Greenland ice sheet.

[b] Including the height–SMB feedback.

[c] Including the interaction between SMB change and outflow.

Figure 207. Predictions of sea level rise for different scenarios (fuente: IPCC, 2014)

Sea level rise may affect terrestrial infrastructures of Medusa project. Starting from these scenarios and employing specific projection for inundation in coastal areas of the different landings, the probability of inundation of the area were BMH infrastructures are planned can be deduced. As already mentioned, this can be evaluated in the frame of PiPs for each of the landing sites. For examples, calculations for Zahara and Torreguadiaro landings brought to the results that marine inundation derived by climate change will not reach BMH zone, at least for the useful life of the project.

In the marine environment, the variables that may have the strongest effect on the project are the acidification of seawater and the occurrence of extreme weather events.

The acidification of seas and oceans is caused by the absorption of atmospheric CO2 by these in the form of carbonic acid, which will reduce the global pH. This phenomenon can enhance corrosion and alter the functionality of metallic structures in the sea, given the more aggressive environment in which they are located. In the project of study, the cable is already protected against these effects, considered in its design, so it is assumed that the effect on the cable will be minimal.

In the marine environment, more extreme weather events could cause cable failures (e.g., cable mismatch and movement of the cable due to waves). This has to be taken into account in landing areas of Medusa system and the planning of terrestrial infrastructures should consider this possibility in order to minimize the risk related to extreme weather events. For this reason, cable and conducts should be buried in the landing area at depth that guarantee the security of the cable in case these events occur.

1.6 Impact Assessment and Mitigation Measures

1.6.1 Environmental and Social impacts

The identification of potential impacts of the project object of study is based on the following steps:

- Detection of project activities likely to cause an impact.
- Identification of the environmental and social factors that receive any of the actions.
- Identification of potential impacts.

Any interaction between the actions that generate disturbance and the environmental and social variables present a potential impact, although in most cases it is irrelevant. Therefore, once potential impacts have been identified, the impact assessment analysis proceeds with the determination of significant impacts, which have an influence on the most sensitive elements of the complex.

The methodology for the evaluation of the significance of environmental and social impacts is explained in Chapter 4.3.

The following table shows the project activities that may cause an impact in the project context (generators of impacts), considering installation works, as well as operational phase.

Phase	Activity
Installation	Installation of BMH and border pipe
	Navigation
	Route Clearance / Pre-Lay Grapnel Run
	Shore-End and Post Shore-End Operation
	Plough Burial Operation

	Surface Lay Operation
	Post-Lay Inspection and Burial Operation
	Waste Generation
Operation	Presence of subsea system in the marine seabed
	Presence of terrestrial infrastructures
	Subsea system breakdown
	Navigation
	Maintenance or restoration works
	Fiber optic connectivity (or Medusa system exploitation)

Table 22. Project activities that may cause and impact in the project context.

Regarding the dismantling of the Medusa subsea system after its useful life (25 years), the possibility of leaving the cable on the seabed should be evaluated, since, when they are not buried, submarine cables constitute a hard substrate that could be colonized by species of interest, increasing biodiversity values in the area. The eventual removal of the cable will have effects similar to those described for the cable laying. As for the beach infrastructures, they will be removed and the affected area reconditioned at the end of the useful life of Medusa system. The effects expected in relation to the removal of the infrastructures are similar to the effects analyzed in relation to the phase of works in the landing area of the cable. The removed material will be managed correctly according to laws existing at the time of removal.

Considering the environmental and social baseline of the project context, the factors that might be affected by Medusa subsea system are the following:

- Physical Aspects:
  - **Lithology and sediments:** geomorphology and quality of seabed and beach sediments.
  - **Water resources:** seawater quality.

- Biological Aspects:
    - **Vegetation:** coastal vegetation and phanerogam seagrasses.
    - **Fauna:** marine mammals, chelonians and birds.
    - **Marine Habitats:** sensitive habitats.
    - **Protected Areas**
- Socio-economic Aspects:
    - **Population:** human health and safety**,** quality of life and education.
    - **Economic activities:** employment and internet use.
    - **Fishing.**
    - **Infrastructures:** other marine and terrestrial infrastructures.
    - **Land Use:** land property
    - **Heritage**.
    - **Contamination:** Air quality, terrestrial noise quality and submarine noise quality.
    - **Industrial Risks and Easements:** marine traffic.

The interaction between the elements that generate effects and the receiving vectors give rise to a series of potential effects that must be assessed. The matrixes for the identification of potential effects during installation and operational phases are showed below.

ENVIRONMENTAL and SOCIAL FACTORS / ACTIVITIES			Installation of BMH and border pipe	Navigation	Route Clearance/Pre-Lay Grapnel Run	Shore-end and Post Shore-End Operation	Plough Burial Operation	Surface Lay Operation	Post-Lay Inspection and Burial Operation	Waste generation
Physical Aspects	Lithology and Sediments	Seabed geomorphology				•	•		•	
		Beach geomorphology and soil alteration	•			•				
Biological Aspects	Vegetation	Coastal vegetation	•			•				
		Phanerogam seagrasses				•	•	•	•	
	Fauna	Marine mammals		•			•		•	•
		Chelonians	•	•		•	•		•	•
		Birds	•	•		•				•
	Marine Habitats	Sensitive Marine Habitats			•	•	•	•	•	
	Protected Areas			•		•	•	•	•	•
Socio-economic Aspects	Population	Human health and safety	•	•		•				
		Quality of life								
		Education								
	Economic activities	Employment	•							
		Internet Use								
	Fishing			•		•	•	•	•	
	Infrastructures	Other marine infrastructures			•	•	•	•	•	
		Other terrestrial infrastructures	•			•				
	Land Use	Land property	•			•				
	Heritage	Heritage	•		•	•	•		•	
	Visual landscape		•			•				
	Contamination	Seawater quality		•	•	•	•		•	•
		Air quality	•	•		•				
		Terrestrial noise quality	•			•				

		Submarine noise quality		•		•	•	•	•	
	Industrial Risk and Easements	Marine traffic		•	•	•	•	•	•	

Table 23. Matrix of potential effects of Medusa project on environmental and social factors during the installation phase.

ENVIRONMENTAL And SOCIAL FACTORS / ACTIVITIES			Occupation marine seabed	Repair works	Fiber optic connectivity
Physical Aspects	Lithology and Sediments	Seabed geomorphology	•	•	
		Beach geomorphology and soil alteration		•	
	Vegetation	Phanerogam seagrasses	•	•	
	Fauna	Marine mammals		•	
		Chelonians		•	
		Birds			
Biological Aspects	Marine Habitats	Sensitive Marine Habitats	•	•	
Socio-economic Aspects	Population	Human health and safety		•	
		Quality of life			•
		Education			•
	Economic activities	Employment			•
		Internet Use			•
	Fishing			•	
	Infrastructures	Other marine infrastructures		•	
		Other terrestrial infrastructures		•	
	Land Use	Land property			

	Heritage	Heritage			
	Visual landscape				
	Contamination	Seawater quality		•	
		Phanerogam seagrasses		•	
		Terrestrial noise quality		•	
		Submarine noise quality		•	
	Industrial Risk and Easements	Marine traffic		•	

Table 24. Matrix of potential effects of Medusa project on environmental and social factors during the operational phase.

1.6.1.1 During Installation phase

1.6.1.1.1 Seabed geomorphology

The activities that may potentially affect this environmental factor are the following:

- Shore-end and Post Shore-End Operation
- Plough Burial Operation
- Post-Lay Inspection and Burial Operation

<u>Impacts</u>

Seabed geomorphology can be potentially affected by the burial of Medusa subsea system. The system will be generally buried from the coast up to 1000 m, in areas where the nature of the bottom will allow it, and with the exclusion of Marseille branches, where the authorities forbid the burial.

The burial of the cable by means of ploughing forms an artificial depression in the bottom. This depression will be corrected in the short term by natural fill, since the excavation takes place in an extraordinarily dynamic environment. The displacement and transport capacity of the sediment is inversely proportional to the grain size and directly proportional to the energy of the current, so it is likely that the sediments with the largest granulometry are stored right at the edge of the trench, as they are not so easily transportable by current. The width of the depression created by the plough depends on the characteristics of the instrument used, being usually around 700-750 mm.

In the area closest to the coast, the technique mainly used will be jetting, which consists of injecting pressurized water to bury and protect the cable. This causes a movement in the detrital bottom and the cable falls under its own weight to a previously defined minimum depth. Subsequently, the sediments fall back on it, leaving the cable covered and protected.

The affection of seabed is limited in the space, as it is related only to a very narrow area from the coast up to only 1000 m of depth.

The impact is of negative nature, direct and reversible. It is characterized by low magnitude, local influence, short-scale duration and high probability of occurrence. The impact is **not significant**, being compatible with this environmental factor.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Seabed geomorphology								
Assessed Impact	-	D	L	L	S	R	H	C

Mitigation

The impact is compatible and does not need preventive or corrective measures. However, in order to minimize the affection on seabed, the burial of Medusa system will be done by using modern technique such as plough and jetting, which reduce the width of seabed affection. The plough, as well as the ROV used for post-lay inspection and burial, are ones of the most competitive instruments currently existing in the market.

1.6.1.1.2 Beach geomorphology and soil alteration

The activities that may potentially affect this environmental factor are the following:

- Installation of BMH and border pipe
- Shore-end and Post Shore-End Operation

Impacts

The installation of BMH and border pipe will require the excavation of urban soil and beach area. At the same time, at the landing beaches, an open trench will be opened between BMH and border pipe using a backhoe, in order to install conducts. The heavy machinery that needs to be moved on the beach also causes a temporary disturbance of the beach area.

The impact is direct and of negative nature, with a local influence and high probability of occurrence.

The effects of these activities on beach geomorphology and soil alteration strongly depend on the value of the landing zone.

In most of the cases, the morphological alteration of the beach will be of a temporary nature, as cable and conducts will be buried at an approximative depth of at least 2 m and they will be successively covered by the material extracted from the same trench. BMH is also usually buried and not visible once the cable installation has been completed, except for the access manhole.

Therefore, the impact on beach geomorphology and soil alteration will be mainly **not significant**, being compatible with this factor. It is characterized by short-term duration, low magnitude and reversibility.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Beach geomorphology and soil alteration								
Assessed Impact	-	D	L	L	S	R	H	C

However, at beaches with high geological value, being for example characterized by the presence of dunes, as it is the case of Zahara landing, the morphological alteration of the beach may have higher negative impact, as it would not be possible to recover the dunes. For this reason, in these cases, preventive measures are necessary.

The following table resumes the impacts (assessed and residual) considering the case of landings characterized by geological high value, as for example Zahara landing. This is the most pessimistic case, while in the majority of the landings the impact is compatible without the necessity to introduce preventive measures. In Zahara landing the potential impact on beach geomorphology would be irreversible and of long-term duration, being, therefore, of **serious significance**. The application of the constructive measure described below will make the residual impact compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Beach geomorphology and soil alteration at Zahara landing								
Assessed Impact	-	D	M	L	L	I	H	S
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

The impact need mitigation measures in landings characterized by high geological value. This is for example the case of Zahara, where the opening of a trench trough backhoe will be substituted by HDD, avoiding affecting the surface of the beach and therefore the dunes. The use of heavy machinery necessary for installation works will also be strictly controlled, and a pathway will be established in order minimize geomorphological effects on the beach.

1.6.1.1.3 Coastal vegetation

The activities that may potentially affect this environmental factor are the following:

- Installation of BMH and border pipe
- Shore-end and Post Shore-End Operation

Impacts

The installation of BMH and border pipe will require the excavation of urban soil and beach area. At the same time, at the landing beaches, an open trench will be opened between BMH and border pipe using a backhoe, in order to install conducts. The heavy machinery that needs to be moved on the beach can damage vegetation present at the beach area.

The impact is negative, direct, of local influence and reversible. The probability of occurrence is high.

The significance of the effects of these activities on coastal vegetation strongly depend on the value of the landing zone.

In most of the cases, vegetation present at the beaches of landings for which PIPs are already being in process, lacks of high ecological value, having an annual character and being absent protected species. Therefore, the impact on coastal vegetation is in these cases **not significant** and compatible, being the magnitude low and the duration short-term.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Coastal vegetation								
Assessed Impact	-	D	L	L	M	R	H	C

In the case of Zahara landing, two different zone of coastal vegetation are recognized: one is of more interested, being located in the dunar zone, even if protected species have not been seen, the second one is in the area just behind the beach and is of anthropic origin and low ecological value. The negative impact would be then higher on the first type vegetation. In this case the potential impact is both of direct and indirect type, being related in the second case to the potential destruction of the dune zone.

The following table resumes the impacts (assessed and residual) considering the case of landings characterized by higher value for coastal vegetation, as it is for example partially the case of Zahara landing. This is the most pessimistic case, while in the majority of the landings the impact is compatible without the necessity to introduce preventive measures. In the case of Zahara landing the potential impact on coastal vegetation would be of moderate magnitude and long-term duration, being, therefore, characterized by **moderate significance**. The application of the constructive measure described below will make the residual impact compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Coastal vegetation at Zahara landing								
Assessed Impact	-	D/I	M	L	M	R	H	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

The impact need mitigation measures in landings characterized by higher value of the vegetation. This is for example the case of Zahara, where the opening of a trench trough backhoe will be substituted by HDD, avoiding affecting the vegetation of the dunes. The use of heavy machinery necessary for installation works will also be strictly controlled, and a pathway will be established in order minimize effects on vegetation.

1.6.1.1.4 Marine mammals

The activities that may potentially affect this environmental factor are the following:

- Navigation

- Plough Burial Operation
- Post-Lay Inspection and Burial Operation
- Waste generation

Impacts

The presence of large vessels in shallow areas can produce, for a short period of time, a decrease in the quality of the acoustic environment, with the potential to affect the ability of marine mammals to locate prey and/or or communicate.

The noise generated by cable ships is typically in the order of 155-170 dB re 1 µPa, at 1 m from the source, while for example the noise generated by large commercial ships at normal speed is approximately 180 dB re 1 µPa m (Hale, 2018). Ploughing operations for the laying of submarine cables can give a noise of 178 dB re 1µPa m, of the same order as the use of jetting, whose frequencies are between 1 kHz and 15 kHZ (Hale, 2018). The emitted frequencies can affect both low-frequency cetacean species (whales, which have a maximum acoustic sensitivity between 0.5 and 5 kHz) and high-frequency species (dolphins, which have a maximum acoustic sensitivity between 20 and 50kHz). According to data from the National Oceanographic and Atmospheric Organization of the USA (NOAA), temporary negative physiological effects occur from 153 dB re 1uPa (NOAA, 2018). If these results are compared with the tables published by NOAA, the existing risk of direct effects is limited to animals located in the immediate vicinity of the noise source. In any case, the negative effects would be temporary.

The noise related to the installation of the cable in the marine domain can be considered comparable to the noise emitted by normal navigation activity in the study area.

Another possible impact on marine mammals in relation to the presence of ships involved in the project is the collision risk.

Most lethal damage observed in marine mammals is caused by vessels over 80 m in length, sailing at speeds greater than 14 knots (Laist et al., 2001). Regarding Medusa subsea system project, the speed of the cable ship during the installation is very low (1-2 knots), as it works in dynamic positioning, which reduces the risk of collision. Species such as dolphins rarely collide with boats due to their high swimming capacity, even more if the low speed of the cable ship is taken into account. It is estimated that in the Mediterranean area a good general measure to reduce the risk of collision with cetaceans is the reduction of the maximum navigation speed to 10 knots, in the case of areas with an abundance of cetaceans, (WWF-France, 2019).

Other potential impacts of laying the cable on marine mammals are related to contamination by drifting solids (dead dolphins or whales with plastic in their stomachs are some of cases that can be found) and accidental spills into the sea of hydrocarbons that remain on the surface affecting marine mammals swimming in upper layers.

The degradation of marine habitat can also have a negative impact on marine mammals.

The impact on the project on marine mammals can be direct and/or indirect, the magnitude is moderate, the influence is local, the duration from short-time to long-time. The impact can be reversible or irreversible, depending on the typology of damage. The probability of occurrence can be considered high for the Cetacean Migration Corridor and moderate in the other cases. The **significance** is considered **moderate**.

The most sensitive area for the interaction of Medusa project with marine mammals is the Cetacean Migration Corridor, crossed by the subsea system in correspondence of the Barcelona branch. Here, seven species are present during the migration season: *Tursiops truncates*, *Delphinus delphis*, *Stenella coerueoalba*, *Grampus griseus*, *Globicephala melas*, *Balaenoptera physalus* and *Ziphius cavirostris.* In addition, *Physeter macrocephalus* have been seen sporadically.

The application of preventive measures, some of them specifically required by authorities within the Cetacean Migration Corridor, will reduce the magnitude of the impact, as well as duration and probability of occurrence, making the residual impact compatible.

The following table resumes the impacts (assessed and residual) on marine mammals.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Marine mammals								
Assessed Impact	-	D/I	M	L	S to L	R/I	M to H	M
Residual Impact	-	D/I	L	L	S	R	L	C

<u>Mitigation</u>

The impact needs preventive measures in correspondence of the Cetacean Migration Corridor. The measures to be adopted in this area have been established by authorities in the frame of PIPs for Barcelona landing and are as following:

- Reduce the speed of cable ship and support vessels that participate in cable installation tasks, to avoid collisions with cetaceans and minimize the noise generated.
- Respect distances and norms established in Spanish Royal Decree 1727/2007, which establishes protection measures for cetaceans in order to avoid collisions or any another negative impact on them and have marine mammal observers (MMO) on the bridge in order to avoid collisions with them.
- Carry out the installation of the cable in the period of minimum presence of cetaceans.
- Establish an action protocol if the presence of cetaceans is detected during the installation of the cable, taking extreme precautions.
- Collect cetacean observation data in a database and send it to the General Sub-directorate for the Protection of the Sea.
- Respect provisions of article 2, point 1, section a) of Spanish Royal Decree 699/2018, which establishes that "The use of active systems intended for underground geological research will not be allowed.".

Some preventive measures to reduce impacts on marine mammals are proposed also out of the Cetaceans Migration Corridor:

- the works will be carried out in the shortest possible time, thus reducing the temporary duration of the pressure.
- the crew will be trained regarding cetacean sightings.
- an action protocol and good navigation practices will be prepared, in case of proximity of cetaceans on the route.

In addition, impacts on marine mammals related to micro-discharges or solid wastes can be easily minimized with a series of preventive measures:

- All ships involved in the project will strictly comply with the regulations for dumping waste into the sea (MARPOL annex I (prevention of hydrocarbon and hydrocarbonated water discharges), annex IV (wastewater discharge from ships) and annex V (garbage contamination).
- Prior to the authorization of marine works by the competent authority, vessels are required to submit updated MARPOL documentation, which obliges vessels to carry out proper waste management.
- During all phases of the project, the dumping of any type of waste into the sea is expressly prohibited.
- The cable ship will have an emergency plan in which the organizational means (definition of tasks, staff training, drills, etc.), human resources (intervention teams) and materials (anti-spill kits) will be defined for the containment of accidental discharges into the sea.

- The Emergency Plan will be prepared based on the environmental risk assessment and will include at least: List of possible emergency scenarios and risks; Actions to be taken in each of the emergencies, according to what is indicated in chapter 3 of part a of the SOLAS Convention (Muster list); List of equipment to contain possible spills of dangerous substances and prevent them from reaching the sea: absorbents, anti-pollution barriers, etc; List and details of the authorities to report in case the spill cannot be controlled.

1.6.1.1.5 Chelonians

The activities that may potentially affect this environmental factor are the following:

- Installation of BMH and border pipe
- Navigation
- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Post-Lay Inspection and Burial Operation
- Waste generation

<u>Impacts</u>

As in the case of marine mammals, the presence of vessels associated with laying operations can also lead to changes in the behavior of sea turtles.

The effect of noise pollution has been little studied for sea turtles. It is known that they can react with startle movements to low-frequency noises (Piniak, 2012). Likewise, in the case of prolonged exposure to noise, they could suffer physical damage to the auditory cells, causing disorientation (Francis and Barber, 2013).

Another possible impact in relation to the presence of boats is the potential collisions between the boats involved in the project with sea turtles, in particular in relation to their low swimming speed and relatively little reaction capacity with respect to most of marine mammals. It is estimated that in the Mediterranean area a good general measure to reduce the risk of collision with turtles is the reduction of the maximum navigation speed to 2 knots in the case of presence of chelonians (WWF-France, 2019). The cable ship works at a speed of 1-2 knots during cable installation, so that the risk of collision with sea turtles is considered almost zero in this case. The risk may be higher in case of auxiliary boats that with higher navigation speed. However, Work (2010) demonstrated that decreasing speed below 7.5 knots decreased fatal injuries on *Caretta caretta*, the most common sea turtle in the Mediterranean Sea.

Other potential impacts of the installation phase on sea turtles are related to contamination by drifting solids. One of the greatest dangers, as far as marine litter is concerned, is plastic because turtles confuse it with prey, such as jellyfish, and ingest or try to ingest it. This is associated with two types of problems. On the one hand, it causes entrapment of marine fauna, especially in relation to plastic lines, nets and bags. Entrapments can cause death by drowning if they prevent turtles from coming to the surface due to their inability to breathe underwater. Trappings can also cause injuries or malformations if they are not removed in time. On the other hand, the ingestion of plastic causes health problems in marine fauna since it can cause a tear in tissues or internal organs.

Accidental spills into the sea of hydrocarbons that remain on the surface can affect turtles when they swim in upper layers. At the same time, the degradation of marine habitat can also have an indirect impact on chelonians.

Works to be conducted in landing areas (installation of BMH and border pipe, shore-end and post shore-end operations) can also have affection on sea turtles in case of beaches that are selected from these animals for nesting. To our knowledge, beaches selected as landing sites have not been the location of sea turtle nests in the past (at least in the case of those landing for which PIPs have been started and therefore a higher level of information is available). In case of detecting a potential for sea turtles nesting in landing areas during PIP process, preventive measures need to be applied, for example avoiding nesting season for the installation of BMH and border pipe and for shore-end and post shore-end operations.

Therefore, the impact on sea turtles can be both direct and indirect be and of moderate magnitude. The influence is local, the duration from short-time to long-time. The impact can be reversible or irreversible, depending on the typology of damage. The probability of occurrence can be considered moderate and the **significance** of the impact before the application of preventive measures is **moderate**.

The application of preventive measures specified below, will make the residual impact compatible.

The following table shows the evaluation of the impacts during the installation phase on chelonians, considering the current state of knowledge (no nesting areas in correspondence with landing sites).

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Chelonians								
Assessed Impact	-	D/I	M	L	S to L	R/I	M	M
Residual Impact	-	D/I	L	L	S	R	L	C

Mitigation

Preventive measures to reduce impacts on chelonians are as following:

- the works will be carried out in the shortest possible time, thus reducing the temporary duration of the pressure.
- the crew will be trained regarding chelonians sightings.
- an action protocol and good navigation practices will be prepared, in case of proximity of chelonians on the route.
- All ships involved in the project will strictly comply with the regulations for dumping waste into the sea (MARPOL annex I (prevention of hydrocarbon and hydrocarbonated water discharges), annex IV (wastewater discharge from ships) and annex V (garbage contamination).
- Prior to the authorization of marine works by the competent authority, vessels are required to submit updated MARPOL documentation, which obliges vessels to carry out proper waste management.
- During all phases of the project, the dumping of any type of waste into the sea is expressly prohibited.
- The cable ship will have an emergency plan in which the organizational means (definition of tasks, staff training, drills, etc.), human resources (intervention teams) and materials (anti-spill kits) will be defined for the containment of accidental discharges into the sea. The Emergency Plan will be prepared based on the environmental risk assessment and will include at least: List of possible emergency scenarios and risks; Actions to be taken in each of the emergencies, according to what is indicated in chapter 3 of part a of the SOLAS Convention (Muster list); List of equipment to contain possible spills of dangerous substances and prevent them from reaching the sea: absorbents, anti-pollution barriers, etc; List and details of the authorities to report in case the spill cannot be controlled.

1.6.1.1.6 Birds

The activities that may potentially affect this environmental factor are the following:

- Installation of BMH and border pipe
- Navigation
- Shore-end and Post-Shore-End Operation
- Waste generation

Impacts

The installation phase in the landing zone can have impacts on birds in relation to noise generation and occupation of the beach area. This is a temporally affection (some days) and the impact depends on the ecological value of the area selected for the landing of Medusa system. Most of the landings for which PIP process has been started are located in beaches characterized by anthropic features, where birds are used to annoyance related to human activities. This is the case of Lisbon, Barcelona and Marseille landings. The impact may be higher in the case of Torreguadiaro landing, because of the presence of the Torreguadiaro Lagoon, located about 400 m south of the landing point, which is an important point for migratory species. This is in any case very limited in time in relation to the temporary nature of the works and migratory nature of birds visiting the lagoon. The highest impact on birds related to landing installation works may occur at Zahara landing. Indeed, in this beach the Kentish plover (*Charadrius alexandrines*) reproduces and nest in the dune area. The reproduction occurs between April and August and two periods of nesting are recognized, the first between April and early May and the second between end-May and early June. The Kentish plover is protected by the Spanish legislation and preventive measures are necessary at Zahara landing in order to minimize the affection of installation works on this species.

As for marine mammals and chelonians, other potential impacts of cable installation on birds are related to contamination by drifting solids, in particular plastic that can be confused by sea birds as a potential prey, and accidental spills into the sea of hydrocarbons that remain on the surface, which can affect especially seabirds when they swim or rest on the sea surface.

The presence of vessels associated with laying operations can also lead to some changes in the behavior of birds, in particular during landing cable operations.

The impact of the project activities on birds is of negative nature and can be direct or indirect. The magnitude is generally low, the duration is short and the probability of occurrence is moderate. The reversibility of the impact depends on the type of harm/disturbance generated.

In most of the landing sites the impact is considered **not significant** and compatible, without the necessity to introduce preventive measures.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Birds								
Assessed Impact	-	D/I	L	L	S	R	M	C

In the case of Zahara landing, the magnitude of the impact is considered moderate and the duration can be long-term in relation to the possible destruction of nests of *Charadrius alexandrines*. The potential **significance** is then considered **moderate** in this area.

The following table resumes the impacts (assessed and residual) considering the case of landings characterized by high value for birds, as it is for example the case of Zahara landing. This is the most pessimistic case at the current state-of-the-knowledge.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Birds at Zahara landing								
Assessed Impact	-	D	M	L	L	R/I	M	M
Residual Impact	-	D	L	L	S	R	L	C

<u>Mitigation</u>

The impact need mitigation measures in case of landing characterized by high ecological value in terms of birds. This is the case of Zahara landing, where reproduction and nesting season of *Charadrius alexandrines* (from April to August) must be avoid for BMH and border pipe installation, as well as for shore-end and post shore-end works.

In case of the other landings, no preventive measures are required. However, preventive measures to reduce risks of solid waste throw or micro-discharges from ships will be applied, as already described for marine mammals and chelonians.

1.6.1.1.7 Phanerogam seagrasses

The activities that may potentially affect this environmental factor are the following:

- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation

Impacts

The burial of the cable will have direct impact on phanerogam seagrasses for destruction of meadows and the hosted communities, as well as an indirect impact on nearby meadows because of the increasing in turbidity during ploughing and jetting operations. The increase in turbidity can alter the behavior of fauna associated with these phanerogam seagrasses.

In case of surface laying, the project will have anyway a direct impact on phanerogam seagrasses, but this would be limited just to a physic occupation of a very straight area, as the maximum diameter of Medusa subsea cable is 53 mm.

According to available data, the most critical point of Medusa system for the impact on phanerogam seagrasses is Marseille landing, because of the presence of *Posidonia oceanica* meadow. In the context of permitting process for Marseille landing, a marine biocenoses survey has been conducted in the zone between 0 and 90 m during spring 2021. During this survey, dead matte of Posidonia and different discontinuous forms of the meadow had been found. The state of health of the meadow has been assessed during the survey and the general result is that the meadow is qualified as normal with a certain stability, but with a lower limit showing sign of regression.

The presence of *Posidonia oceanica* is also noted at Mazara landingin relation to the indication of EUSeaMap 2021. The presence of phanerogam seagrasses need to be verified through surveys in the frame of PIPs. In addition, the presence of other seagrasses such as *Cymodocea nodosa* cannot be excluded in this landing.

The following table resumes the impacts (assessed and residual) considering the case of landings characterized by the presence of *Posidonia oceanica* or other phanerogams, as it is for example the case of Marseille landing. The impact is characterized by high magnitude, local influence, long-term duration and high probability of occurrence. The **significance** before the application of preventive measures is **serious**. The impact will be compatible only if mitigation described below is applied.

This is a pessimistic case, while in the majority of the landings the impact is compatible without the necessity to introduce preventive measures, because of the absence of phanerogam seagrasses in the landing areas.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Phanerogam seagrasses at Marseille landing								
Assessed Impact	-	D/I	H	L	L	I	H	S
Residual Impact	-	D	L	L	S	R	H	C

Mitigation

Preventive measures are necessary at landing sites characterized by the presence of *Posidonia oceanica* and other phanerogams (if they have been found through benthic surveys along the landing's areas). The following measures are proposed at these landings:

- Avoid the crossing of phanerogam seagrass meadows as far as possible.
- Prefer crossing of dead matte with respect to *Posidonia oceanica* meadows.
- Avoid burial of the cable in correspondence of *Posidonia oceanica* meadows.
- Avoid the burial of submarine cable in presence of *Posidonia oceanica* meadows.
- At Marseille landing an anti-MES (Suspended Matter) barrier will be installed around the area concerned by the burial operation (out of the phanerogam) to limit the deposit of fine particles within the Posidonia meadow. This anti-SS dam will also be set up at the outlet of the directional drilling in which the pipe will be installed, in order to prevent the transfer of fine particles generated by the drilling in the surrounding rock towards the Posidonia meadow.
- Within the Posidonia meadow, the cables will be fixed to the bottom at regular intervals by anchors specially profiled for this purpose (depending on the nature of the substrate: loose or matte), in order to avoid chafing phenomena on the background. The operations will be carried out carefully by specialized divers, gently separating the Posidonia leaves so as not to damage them. "Fuse" anchors will be placed at the ends of the seagrass field in order to keep the cables well fixed at the limits of the area.

1.6.1.1.8 Other Sensitive Marine Habitats

The activities that may potentially affect this environmental factor are the following:

- Route Clearance/Pre-Lay Grapnel Run
- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation

Impacts

With reference to sensitive marine habitats, it is indicated that: (i) the cable ship is a vessel with dynamic positioning, which does not require anchoring to carry out its activity, reducing the risk of affecting seabed habitats; (ii) the anchoring of the boats that operate in the shallow area is not foreseen, except when necessary for the safety of the boat itself; (iii) the fiber optic cable has a maximum diameter of about 53 mm (considering the DA cable with the most protection to be used). Therefore, the direct occupation of the seabed by the project is very limited.

The burial of the cable will affect the benthic communities present. The direct impact is greater in benthic sessile/buried communities, which cannot be displaced and will be uprooted or displaced. As for the free-living benthic fauna, their behavior could be affected, but in general they avoid direct impact. Indeed, several studies that compare the situation of benthic communities before and after cable installation, as well as in areas near and far from a cable, show that fiber optic cables have no or minimal impact on resident biota (Carter et al., 2009). At the marine level, the increase in turbidity can alter the behavior of fauna associated with the sediment, such as crustaceans or bottom fish, and affect the food system of sessile filter-feeding animals that have no option of moving (sponges, corals, and filter-feeding worms).

In areas where the cable will not be buried, direct damage may be caused to sessile fauna, which may be significant.

With respect to Route Clearance/Pre-Lay Grapnel Run, this activity can imply the remotion of hard substrate from seabed, that could have been colonized by species of interest.

The more sensitive habitats that can be present in the area of study and can be affected during installation phase are the following:

- Phanerogam seagrass habitats
- Reefs
- Coral gardens

- Communities dominated by pennatulacean individuals
- Deep-sea sponge habitats

With respect to reefs, this sensitive marine habitat is present in Torreguadiaro landing zone. Reefs are marine habitats originated on hard substrata, formed by biogenic concretions and/or biological communities developed on rocky substrata and are characterized by high ecological value. They can be found both in the infralittoral and circalittoral environment. In presence of rocky bottoms, Medusa system cannot be buried neither with ploughing nor with jetting and will be just subjected to surface laying. Therefore, the affection on this habitat is basically related to the physical occupation of seabed. It has to be taken into account that the maximum diameter of submarine fiber optic cable of Medusa project is 53 mm. Consequently, the affection of the project of reef communities is limited. In addition, the cable is a very stable infrastructure due to its technical characteristics and, therefore, in general, it will not impact the environment once laid, although in the rocky area it is impossible to completely prevent the cable from not being suspended in some sections. In any case, the detailed geophysical campaigns to be carry out in the pre-installation phase will make possible to optimize the route, reducing the sections of crossing reef areas, as well as reducing suspended cable to a minimum.

Even if rocky areas are not directly crossed by the subsea system, turbidity related to burial of the cable by ploughing or jetting in nearby soft bottom areas can implies an indirect effect on the sessile fauna of the reef habitat.

With reference to communities dominated by pennatulacean individuals, these are widely distributed in the study area and can be found in circalittoral soft bottoms and deep bottoms, sometimes associated with structures produced by gas escape. The most common species are *Pennatula rubra* and *Funiculina quadrangularis*. These species have been for example registered by ROV transects at depths between 60 and 94 m at Segment 2 of Marseille branch, during the survey conducted in the frame of PIPs. Although a direct interaction is to be expected for some individuals when laying the cable, the sensitivity of the biocenosis can be described as low to medium, given the small diameter of the cable and its immediate stability on these bottoms. The functionalities of the habitat will not be questioned.

Citation about deep-sea sponge habitat has been found for the Nature 2000 Site “Mud Volcanoes of Gulf of Cadiz”, which is located in the proximity of Medusa trunk in the Atlantic Ocean. However, according to the bibliography, the distribution of this habitat in the cited protected site is in zones located far from Medusa route. The presence of the deep-sea sponge habitat in other zones along the Medusa system route cannot be excluded. However, even if a direct interaction is to be expected for some individuals, the functionality of the habitat will not be questioned thanks to the small diameter.

The potential impact on sensitive marine habitats is negative, direct/indirect, of moderate magnitude, local influence, medium to large-term duration and the probability of occurrence is high. The reversibility of the impact depends on the typology of sensitive habitat. The **significance** before the application of preventive measures is considered **serious**, while the following of mitigation proposed below makes the residual impact compatible, reducing the magnitude, the duration and the probability of occurrence.

The following table resumes the impacts (assessed and residual) for sensitive marine habitats.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Sensitive Marine Habitats								
Assessed Impact	-	D/I	M	L	M to L	R/I	H	S
Residual Impact	-	D/I	L	L	S	R	L	C

Mitigation:

The preventive/mitigating measures of impact on sensitive marine habitats that will be applied are:

- The crossing of protected natural spaces significant for the conservation of seabed habitats is avoided as far as possible.
- The crossing of submarine canyons and seamounts, hotspots of biodiversity, has been avoided as far as possible.
- Different detailed geophysical and geotechnical campaigns will be carried out along the route of the cable up to about 1000 m of depth. These pre-installation survey will allow to improve and plan the route Medusa system in detail, minimizing the effects that could be generated on sensitive habitats.
- Medusa system preliminary route has been planned maximizing passage through detrital areas and minimizing the influence on rocky areas, which are generally characterized by a greater presence of sessile organisms.

1.6.1.1.9 Protected Areas

The activities that may potentially affect this environmental factor are the following:

- Navigation
- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation
- Waste generation

Impacts

The impact of installation phase on protected area is related to the elements whose conservation has been the base for the declaration of the protection site itself.

Therefore, navigation can have effect on those protected sites where marine mammals and chelonians are considered key elements (as for example the SPAMI "Cetacean Migration Corridor" in NW Spanish waters). Waste generation may interfere with the same areas, as well as with site protected following the Birds Directive, in particular when they represent a feeding zone for seabirds.

On the contrary, the impact of Shore-end and Post-Shore-End Operation, Plough Burial Operation, Surface Lay Operation and Post-Lay Inspection and Burial Operation is mostly related to the presence of sensitive marine habits whose conservation is a key factor for the protected site, as it is the case of the Nature 2000 site Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet, in the proximity of Marseille landing.

The only protected sites crossed by Medusa subsea system are:

- SPA "Cabo Raso" (PTZPE0061), near Lisbon landing: the area is significative for marine migratory bird species.
- SPAMI "Cetacean Migration Corridor" in NW Spanish waters: the zone is of primary importance for the presence of cetaceans.
- SCI and SAC "Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet" (FR9301602), near Marseille landing: it is significant for the presence of *Posidonia oceanica*, coraligenous and karstic caves. Deep-water corals are also present in the proximity of Cassidaigne canyon.
- "Calanques" national park near Marseille landing: this area coincides partially with Nature 2000 site indicated above, but it extends up to higher depths. This national park has the

aim of protecting several habitats such as submarine canyons, Posidonia oceanica meadows, coralligenous, submarine caves, etc.

- SPA “Oiseaux marins sud golfe du Lion” (FR9112038): the area is significative in particular for the presence of *Hydrobates pelagicus* and *Larus minutus*.

While the installation of Medusa system at the SPA “Cabo Raso” and the SPA “Oiseaux marins sud golfe du Lion” does not have almost any impact on key elements, the situation is different for both the Cetacean Migration Corridor and the French Nature 2000 site cited above, for which some impacts are expected, in particular in the second case.

The following table resumes the impacts (assessed and residual) for these two protected sites. No impacts on protected areas are considered at other zones of Medusa subsea system.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
SPAMI “Cetacean Migration Corridor”								
Assessed Impact	-	D/I	M	L	S to L	R/I	H	M
Residual Impact	-	D/I	L	L	S	R	L	C
Nature 2000 site “Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet” and Calanques national Park								
Assessed Impact	-	D/I	H	L	H	I	H	S
Residual Impact	-	D	L	L	S	R	H	C

Mitigation

The impact needs preventive measures in correspondence of the Cetacean Migration Corridor. The measures to be adopted in this area has been established by authorities in the frame of PIPs for Barcelona landing and are as following:

- Reduce the speed of cable ship and support vessels that participate in cable installation tasks, to avoid collisions with cetaceans and minimize the noise generated.
- Respect distances and norms established in Spanish Royal Decree 1727/2007, which establishes protection measures for cetaceans in order to avoid collisions or any another negative impact on them and have MMO on the bridge in order to avoid collisions with them.
- Carry out the installation of the cable in the period of minimum presence of cetaceans.
- Establish an action protocol if the presence of cetaceans is detected during the installation of the cable, taking extreme precautions.
- Collect cetacean observation data in a database and send it to the General Sub-directorate for the Protection of the Sea.
- Respect provisions of article 2, point 1, section a) of Spanish Royal Decree 699/2018, which establishes that "The use of active systems intended for underground geological research will not be allowed.".

In case of the Nature 2000 site "Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet", the following measures are proposed:

- Avoid the crossing of phanerogam seagrass meadows as far as possible.
- Prefer crossing of dead matte with respect to *Posidonia oceanica* meadows.
- Avoid burial of the cable in correspondence of *Posidonia oceanica* meadows.
- At Marseille landing an anti-MES (Suspended Matter) barrier will be installed around the area concerned by the burial operation (out of the phanerogam) to limit the deposit of fine particles within the Posidonia meadow. This anti-SS dam will also be set up at the outlet of the directional drilling in which the pipe will be installed, in order to prevent the transfer of fine particles generated by the drilling in the surrounding rock towards the Posidonia meadow.
- Within the Posidonia meadow, the cables will be fixed to the bottom at regular intervals by anchors specially profiled for this purpose (depending on the nature of the substrate: loose or matte), in order to avoid chafing phenomena on the background. The operations will be carried out carefully by specialized divers, gently separating the Posidonia leaves so as not to damage them. "Fuse" anchors will be placed at the ends of the seagrass field in order to keep the cables well fixed at the limits of the area.
- Avoid crossing of other significative elements, whose conservation has determined the declaration of the protected site, such as submarine caves and coraligenous.

With the application of these preventive measures, the protected areas crossed by Medusa subsea system will not be compromised by the installation of the cable.

1.6.1.1.10 Human Health and Safety

The activities that may potentially affect this environmental factor are the following:

- Navigation
- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation

Impacts

Impacts on human health and safety may occur as a result of accidents and unplanned events that may occur during the Project installation activities in various sites. At particular risk is artisanal fishermen who may move at night-time or in reduced visibility conditions when the Project activities are taking place. Collision of Project vessels with fishing boat and nets or other vessels could result in damage of vessels and equipment, injury or loss of life.

In onshore environment, human health and safety could be impacted through road traffic accidents involving construction vehicles. The risk of other injury associated with the installation activities at the landing sites will be limited to the work force only (as the site will be secured to avoid public incursion into the active development area).

The project activities may potentially result in a direct and indirect negative impact on human health and safety within the development area and surroundings. Extend of the impact is limited to on-site and local. The duration will range from short term to long term as some impacts will last only a short while (minor injury) and some may cause a permanent change mortality related to vehicle or vessel strike.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Human health and safety								
Assessed Impact	-	D	M	L	M	R	M	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

- All active construction areas will be marked with high-visibility tape to reduce risk accidents
- All open trenches and excavated areas will be backfilled as soon as possible after the construction has been completed. Access to open tranches and excavated areas will be secured to prevent pedestrians or vehicle from failing in.
- The project will require all contractors to implement an environmental, health and safety plan which will outline procedures for avoiding health and safety incidents and for emergency medical treatment.
- Workers will be required to wear suitable personnel protective equipment (hard hats, high-visibility vests, safety boots and gloves and life vests).
- All construction and cable repair workers will be sufficiently trained in the safe methods of working with optical fiber cables to avoid injury associated with laser lights and fibers.
- While a ship is laying its maneuverability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.

1.6.1.1.11 Employment

The activities that may potentially affect this environmental factor are the following:

- Installation of BMH and border pipe

Impacts

Employment opportunities may be available during the phases of the terrestrial infrastructure installation for local businesses and, as a result, residents. On the contrary, the laying of the cable will be managed by ASN with no impact on local business.

This is a positive direct impact. Its magnitude, duration and extent are low, short Term and local, respectively.

The following table summarizes the impact.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Employment								
Assessed Impact	+	D	L	L	S	R	H	C

Mitigation

No mitigation is necessary as the impact is compatible and with a positive nature.

1.6.1.1.12 Fishing

The activities that may potentially affect this factor are the following:

- Navigation
- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation

Impacts

The requirement that fishermen avoid conduct likely to break subsea cables is established in the United Nations Convention on the Law of the Sea.

During installation phase fishing will be affected by a temporal exclusion for this activity limited to the time necessary for the cable installation.

With reference to European landings, the areas that seems to be more interested by fishing and that therefore will receive a higher impact are Lisbon, Zahara, Torreguadiaro, Barcelona and Mazara. On the contrary, the affection near Marseille is lower, as artisanal and industrial fishing are very limited along the selected cable route, being concentrated at the west and the east of the study area.

In the case of the other landings, the most important potential impact in fishing is related to the presence of the Cabo Plata *almadraba* close to the landing site in Zahara. It is a specific fixed gear for the capture of bluefin tuna (*Thunnus thynnus*) that is usually set in clean places on the coast, where tuna end up on their way to the Mediterranean Sea. Mitigation measures are necessary at this landing in order to reduce the possible impact on this fishing art.

Then, other types of fishing present here and in other European landings that can be affected by installation of Medusa subsea system are trawling, bottom longlines, purse seine, etc.

Considering European landings, the magnitude of the potential impact is considered high, the probability of occurrence medium and the **significance moderate**.

In North Africa landings, sectors that could be affected during a temporary exclusion to fishing ground during the installation phase of the Project include the traditional line fish sector, which operates in the nearshore vicinity of the area of influence.

The following table summarizes the impacts (assessed and residual) on fishing. The residual impact obtained after the application of preventive measures described below is compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
				Fishing				
Assessed Impact	-	D	M	L	S	R	H	M
Residual Impact	-	D	L	L	S	R	M	C

Mitigation

The following mitigation measures have been considered in order to minimize the impact on fishing during installation phase:

- For Zahara landing, avoid doing installation works in the time window when fishing at Cabo Plata *almadraba* is active, that is from the second half of April to the second half of June, when it begins to be dismounted, to finish definitively at the beginning of July. Period between February and April should also be avoided as there is the preparation of the fishing art of *almadraba*.
- Distribute a Notice to Mariners prior to the commencement of the subsea cable installation. The Notice to Mariners should give notice of an indication of the proposed timeframes for subsea installation and an indication of safety zone around the subsea cable lay. This notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.
- The subsea vessel contractors must adhere to the ISO 9000 and ISO 9001 and the International Cable Protection Committee (ICPC) recommendations.
- Economic compensation for fishing days lost during installation works would also be discussed with fishing association in the frame of PIPs and offered by the promoter of Medusa project.

1.6.1.1.13 Infrastructures

Other marine infrastructures

The activities that may potentially affect this factor are the following:

- Route Clearance/Pre-Lay Grapnel Run
- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation

Impacts

The installation of Medusa subsea system can have potentially an impact on other submarine infrastructures present on the seabed as for example other electric or telecommunication cables, as well as artificial reefs.

The presence of other submarine cables needs to be known before starting with the installation, in order to avoid their possible damages during laying and in particular burial operations. Crossing of Medusa subsea system with other in-use cables will be agreed with cables owners in all those section with depth lower than 1000 m, where burial is usually advised.

With reference to artificial reefs, they are intentionally placed benthic structures built of natural or man-made materials, which are designed to protect, enhance, or restore components of marine ecosystems. The crossing of these infrastructures by Medusa system may have an impact on the marine communities that are growing on them.

Submarine cables are present in many points of Medusa subsea system being then particularly numerous in some areas such as in correspondence of Marseille landing.

Artificial reefs are certainly present in the area of Torreguadiaro and Barcelona, but their presence cannot be excluded in other landing zones that have not been investigated in detail yet.

The following table summarizes the impact of the project on this aspect. The impact is negative, direct, of moderate magnitude, local influence, long-term duration and of medium probability. The potential **significance** is **moderate**, but the application of preventive measures will make the impact compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Other marine infrastructures								
Assessed Impact	-	D	M	L	L	R	M	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

The presence of submarine infrastructures must be taken into account when planning the cable route, as they can affect the installation stage of the project and may condition the cable burial. In the case of other submarine cables present at the seabed, ICPC guidelines recommends an ideal distance of three times the water depth (3WD) between cables or at least a minimum distance of two times (2WD) the water depth to allow safe cable repairs if necessary. At the same time, crossing angles between cables are ideally engineered at 90º, discouraging in any case crossing angles lower than 35º.

Direct crossing of artificial reefs should also be minimized both for maintain the ecological value of it and to reduce risk for the stability of Medusa system.

The most efficient preventive measure is to identify the route of other submarine cables and the position of artificial reefs through geophysical pre-installation surveys. Then, ICPC recommendations should be followed in case of presence and crossing with other submarine cables. Burial by plough must be avoided in presence of crossing with in-use cables as it can damage the cables already present at the sea bottom.

Other terrestrial infrastructures

The activities that may potentially affect this factor are the following:

- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation

Impacts

When analyzing terrestrial infrastructures and basic services, it has to be considered that the project does not provide for the connection of any service, beyond the one that is the object of the project itself (fiber optic telecommunications cables).

However, existing services in the landing areas may be affected by installation works of Medusa system in some landing. A preliminary identification of the impact on these services can be done by consulting City Councils in the frame of PIPs for each of the landings. Anyway, the correct identification of all services must be carried out by means of georadar and detailed visual inspection during the drafting phase of the executive project, prior to installation works.

The degree of knowledge about terrestrial infrastructures that may be affected by Medusa project is not the same at any of the landings included in phase 1, depending on the different development stage of PIPs. Therefore, no specific information is known for the landing of Mazara, while some more information exists from the Design Development Project presented to authorities for Lisbon, Zahara, Torreguadiaro, Barcelona and Marseille landings.

At Lisbon and Marseille, no significant interference between Medusa system and terrestrial infrastructures have been noticed. At Zahara, Torreguadiaro and Barcelona, influence on some terrestrial infrastructures have been recognized. In any case, the presence of these services does not jeopardize the layout of the infrastructures necessary for Medusa subsea system and only specific adaptations will be required.

The following table summarizes the impact of the project on this aspect considering Zahara, Torreguadiaro and Barcelona landings, which are, up to the moment, the most affected ones with respect to terrestrial infrastructures. The **significance** of the impact is **moderate**, but the residual impact is considered compatible after the application of preventive measures.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Other terrestrial infrastructures								
Assessed Impact	-	D	M	L	L	R	H	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

Preventive measures are necessary in case of impacts of Medusa system on terrestrial infrastructures already present in correspondence of some landing sites. However, these preventive measures cannot be detailed in this stage of the project. They will mainly consist in some constructive adaptations to be included in executive projects, after the identification of these elements by means of georadar and detailed visual inspection and prior to installation works. These constructive adaptations will minimize the affection of existing terrestrial infrastructures, so that the residual impact of the project is considered compatible.

1.6.1.1.14 Land Property

The activities that may potentially affect this factor are the following:

- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation

Impacts

The clearing of the right-of-way for the installation of the onshore infrastructures including access road can generate risks of loss of agricultural land but also risks of degradation of private and public property in the landings where BMH and border pipe are not yet built. Fields investigations will give more details concerning this impact.

Given the surface of the onshore infrastructures, the people and property impacted are minimal.

This is a negative direct impact. Its magnitude, duration and extent are low and the impact is considered in general **not significant**.

The following table summarizes the impact.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Land Property								
Assessed Impact	-	D	L	L	S	R	M	C

Mitigation

The agricultural lands and private property impacted will be taken into account by the project according to local legislation.

1.6.1.1.15 Heritage

The activities that may potentially affect this social factor are:

- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation
- Route Clearance / Pre-Lay Grapnel Run
- Plough Burial Operation
- Post-Lay Inspection and Burial Operation

Impacts

The risks to heritage sites associated with installation activities are a result of physical penetration of the surface during excavation on land or burial of the subsea cable offshore.

The impact on heritage can be classified as direct and negative. The extent will be localized and the duration will be short-term, for the duration of subsea cable laying activities. The scale of the impact would potentially be large if cultural heritage resources were disturbed or damaged by Project activities. The magnitude of the impact is Small, and the sensitivity is Low considering the lack of known heritage resources along the subsea cable in various sites. The **significance** of this impact is potentially **moderate**, while residual impact after the application of preventive measures is assessed as compatible.

The following table summarizes the impacts (assessed and residual).

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Heritage								
Assessed Impact	-	D	Not determined now	L	S to L	R/I	Not determined now	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

Prior to installation, an archaeological survey and testing of the route should be carried out to identify any sites that will be affected by the installation of the cable. The results of this survey and testing program will be used to inform decisions about further mitigation that may be required.

1.6.1.1.16 Visual landscape

The activities that may potentially affect this factor are:

- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation

Impacts

Visual landscape will be affected during installation in the beach area of the landing, as well as in the section where BMH should be built. In the case of Zahara landing the opening of a trench trough backhoe will be substituted by HDD, avoiding affecting the surface of the beach and therefore the dunes. Therefore, it will be no visual affection in the landscape of Zahara landing or destruction and modification of the dunes and other high-value beaches in the area.

After installation, the onshore facilities will be buried in the case of beach manhole and border pipe and therefore little visual impact is envisaged.

This is a negative direct impact. Its magnitude, duration and extent are low. The impact is considered **not significant**.

The following table summarizes the impact.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance

Visual-landscape								
Assessed Impact	-	D	L	L	S	R	H	C

Mitigation

Efforts will be made to minimize visual impacts; land disturbed by cable laying will be contoured to its original form as part of overall reinstatement. The condition of beach area will be brought again to initial baseline. In the case of new BMH, only a hole to guarantee the access in case of maintenance and reparation works will be visible.

1.6.1.1.17 Contamination

Seawater quality

The activities that may potentially affect this environmental factor are the following:

- Navigation
- Route Clearance/Pre-Lay Grapnel Run
- Shore-end and Post Shore-End Operation
- Plough Burial Operation
- Post-Lay Inspection and Burial Operation
- Waste generation

Impacts

Installation works may affect both physical and chemical quality of seawater.

Ploughing removes certain amounts of sediments, which remain in suspension until it settles again. The increase in turbidity can alter the behavior of fauna associated with the sediment, such as crustaceans or bottom fish, and affect the food system of sessile filter-feeding animals that have no option of moving (sponges, corals, and filter-feeding worms). Turbidity also implies an indirect effect on the sessile fauna of the rocky areas located next to the soft bottoms directly affected by burying with ploughing.

In the beach area, the burial of the cable will be done by means of jetting, which cause a plume of suspended sediments. In coastal areas, the landscape effect is important, since this increase in turbidity will be negatively valued by users.

Some bottom sediment mobilization can occur also during pre-lay grapnel run (removal of objects from the seabed) and the post-lay inspection and burial operation done by ROV.

The worsening of seawater chemical quality can be related to two different factors: on the one hand the sediment mobilization during installation activities may cause mobilization of contaminants and nutrients present in the seabed; on the other hand, cable ship and auxiliary vessels, as well as the machinery used on the beach, might be interested by micro-discharges. These elements will finally affect filtering sessile fauna, such as corals, sponges or worms that can filter and assimilate pollutants and nutrients. At the same time, micro-discharges in the coastal zone will be negatively evaluated by beach users.

Other types of contamination are not contemplated, since fiber optic cables do not contain polluting substances (internal fluids). Indeed, the structure of the cable is based on a small steel cylinder containing the optical fibers, sealed against the ingress of water by a water-blocking gel. A series of resistance members (fine steel wires) surrounds this core which, in turn, is encased in a seam-soldered copper conductive tape. For insulation and protection, the cable is then sheathed with medium-density polyethylene. Depending on the need for more or less protection for the cable, there may also be a steel tape, a high-density polyethylene layer, some galvanized steel wires, and a portion of propylene wire sealed with bitumen.

The impact on seawater physical quality is negative, direct, of low magnitude, local influence, short-duration and reversible. The probability is high due to the turbidity generated. However, the impact is **not significant**, being compatible with this factor.

In the case of effects on seawater chemical quality, the potential impact is negative, of low magnitude, local influence and medium duration, with medium probability of occurrence. The impact is direct in the case of micro-discharges and indirect in the case of remobilization of contaminated sediments. The potential impact is of **moderate significance**, but the application of preventive and corrective measures makes the residual impact compatible, as the probability of occurrence and the magnitude will be low. The chemical affection will be higher in sites with contaminated baseline sediment conditions, because of the remobilization of sediments. However, at the current state of the knowledge, specific information about presence of areas characterized by contaminated baseline sediment conditions is currently absent.

The following table resumes the impacts on physical and chemical seawater quality.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Seawater physical quality								

Assessed Impact	-	D	L	L	S	R	H	C
Seawater chemical quality								
Assessed Impact	-	D/I	L	L	M	R	M	M
Residual Impact	-	D/I	L	L	S	R	L	C

Mitigation

Concerning physical seawater quality, given the characteristics of the study project, the increase in turbidity will be limited and temporary, and therefore, no measures are foreseen in reference to the control of turbidity on the seabed.

With respect to chemical seawater quality, some preventive measures are included in order to make the impact compatible: vessels involved in the project will strictly comply with the MARPOL regulations for the prevention of discharges into the sea, especially in its annexes I (prevention of hydrocarbon and hydrocarbonated water discharges) and its annex IV (wastewater discharge from ships). Prior to the authorization of marine works by the competent authority, vessels are required to present updated MARPOL documentation, which obliges vessels to carry out proper waste management. The cable will have an environmental risk assessment. Based on this risk assessment, an Emergency Plan will have been drawn up, which will include at least:

- List of possible emergency scenarios and risks.
- Actions to be taken in each of the emergencies, according to what is indicated in chapter 3 of part a of the SOLAS Convention (Muster list).
- List of equipment to contain possible spills of dangerous substances and prevent them from reaching the sea: absorbents, anti-pollution barriers, etc.
- List and details of the authorities to report in case the spill cannot be controlled.

With the application of these preventive measures, the impact on chemical seawater quality is considered compatible.

Air quality

The activities that may potentially affect this factor are:

- Navigation
- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation

Impacts

The only source of air pollution will be that caused by the cable ship and auxiliary vessels, as well as by the machinery used on the beach, derived from the operation of their combustion engines.

Emissions from ship's combustion engines are particles (PM10), NOx and SO2. The vast majority of emissions in EU maritime areas come from cargo ships of more than 500 GT. Approximately 20% of the emissions are emitted within the 12 miles limit of the territorial seas. According to the EMEP/EEA air pollutant emission inventory guidebook 2019, emissions from the stack of a ship with the characteristics of a cable ship are 79.3 kg/t of fuel for NOx and 20 kg/t for SOx.

In October 2008, the International Maritime Organization (IMO) adopted a set of amendments to MARPOL Annex VI that, among other things, strengthened the requirements for allowable levels of sulfur in bunker fuels.

Taking into account the distance of the cable ship from the main receivers and the reception capacity of the territory, as long as the MARPOL agreement is complied with, the effects of air pollution can be considered not significant.

The following table summarizes the impact of the project on this aspect. The impact is negative, of low-magnitude, local or regional influence and of short-term duration. The impact is **not significant** and compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Air Quality								
Assessed Impact	-	D	L	L/R	S	R	M	C

Mitigation

No mitigation measures are necessary, apart from the compliance of the ANNEX VI of MARPOL Convention, which addresses air pollution from ocean-going ships.

Terrestrial noise quality

The activities that may potentially affect this factor are:

- Installation of BMH and border pipe
- Shore-end and Post-Shore-End Operation

<u>Impacts</u>

The installation phase in the landing zone will generate noise that could have a negative effect on beach users, as well as on the fauna, especially bird species in the nearby areas.

This is a temporally affection (some days for each landing) and the impact depends on the ecological value of the area selected for the landing of Medusa system, as well as on the season selected for the installation works.

Most of the landings for which PIP process has been started are located in beaches characterized by anthropic features, where birds are used to annoyance related to human activities. This is the case of Lisbon, Barcelona and Marseille landings. The impact may be higher in the case of Torreguadiaro landing, because of the presence of the Torreguadiaro Lagoon, located about 400 m south of the landing point, which is an important point for migratory species. This is in any case very limited in time in relation to the temporary nature of the works and migratory nature of birds visiting the lagoon. The highest impact on birds related to landing installation works may occur at Zahara landing. Indeed, in this beach the Kentish plover (*Charadrius alexandrines*) reproduces and nest in the dune area. The reproduction occurs between April and August and two periods of nesting are recognized, the first between April and early May and the second between end-May and early June. The Kentish plover is protected by the Spanish legislation and preventive measures are necessary at Zahara landing in order to minimize the affection of installation works on this species.

Concerning negative effect on beach users, it has to be considered that bath season should be avoided as far as possible for landing installation works. This is also usually imposed by local authorities in the frame of PIPs to be obtained for landing points.

The following table resumes the impacts (assessed and residual). The **significance** of the potential impact is **moderate**, considering the possible presence of beach users and fauna. The residual impact obtained after the application of preventive measures described below is compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance

Terrestrial Noise Quality								
Assessed Impact	-	D	M	L	S	R	M	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

- Avoid period from April to August for terrestrial installation works and shore-end works in the case of Zahara landing (reproduction and nesting season of *Charadrius alexandrines*).
- Avoid bath seasons in all the landings for terrestrial installation works and shore-end works.

Submarine noise quality

The activities that may potentially affect this factor are the following:

- Navigation
- Shore-end and Post-Shore-End Operation
- Route Clearance/Pre-Lay Grapnel Run
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation

Impacts

The operation of the cable ship as well as laying and burial works generate underwater noise. In the case of marine mammals, underwater noise can alter their ability to communicate, detect prey, and avoid dangers, such as collisions with ships.

The noise generated by cable ships is typically in the order of 155-170 dB re 1 μPa, at 1 m from the source, while for example the noise generated by large commercial ships at normal speed is approximately 180 dB re 1 μPa m (Hale, 2018). Ploughing operations for the laying of submarine cables can give a noise of 178 dB re 1μPa m, of the same order as the use of jetting, whose frequencies are between 1 kHz and 15 kHZ (Hale, 2018). The emitted frequencies can affect both low-frequency cetacean species (whales, which have a maximum acoustic sensitivity between

0.5 and 5 kHz) and high-frequency species (dolphins, which have a maximum acoustic sensitivity between 20 and 50kHz). According to data from the National Oceanographic and Atmospheric Organization of the USA (NOAA), temporary negative physiological effects occur from 153 dB re 1uPa (NOAA, 2018). If these results are compared with the tables published by NOAA, the existing risk of direct effects is limited to animals located in the immediate vicinity of the noise source; in any case, the negative effects would be temporary.

The noise impact related to the installation of the cable in the marine domain is considered low and comparable to the noise emitted by normal navigation activity in the study area. It is also a temporary effect, related to the total duration of the works.

The impact is negative, characterized by low magnitude, local influence, short duration, reversibility and low probability. The impact is **not significant** and compatible without the necessity of applying preventive measures. In any case, the works will be carried out in the shortest possible time, thus reducing the temporary duration of the pressure.

The following table resumes the impact on submarine noise quality, considering the comparation of emitted underwater noise with normal navigation activity.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Submarine noise quality								
Assessed Impact	-	I	L	L	S	R	L	C

Mitigation

The impact does not need preventive measures.

Light pollution

At the installation phase, night-time work will be carried out only offshore (navigation, route clearance/pre-Lay Grapnel Run, Plough Burial Operation, Post-lay Inspection and Burial Operation), while work in landing areas will only take place during sunlight.

Impacts

No impacts are predicted as this generation of artificial light will only be given offshore, in relation to the presence of the cable ship, without affecting the population.

Mitigation

No mitigation measures are necessary.

1.6.1.1.18 Marine traffic

The activities that may potentially affect this factor are the following:

- Navigation
- Shore-end and Post-Shore-End Operation
- Plough Burial Operation
- Surface Lay Operation
- Post-Lay Inspection and Burial Operation

Impacts

The presence of the cable ship, as well as auxiliary boats, will entail an obstruction to the navigation of other vessels, whether commercial, fishing or recreational. It must be considered that this effect is temporary, limited only to the cable laying period.

The following table shows impacts on this aspect: the impact is negative and direct, the magnitude is considered moderate, the influence is local and the duration short-term. The impact is **not significant** and compatible but coordination with the Maritime Captaincy is necessary.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Marine Traffic								
Assessed Impact	-	D	M	L	S	R	H	C

Mitigation

In order to minimize this impact, Medusa subsea system cable route has been planned avoiding main navigation routes as far as possible. Coordination with the Maritime Captaincy to restrict navigation in the areas of action (radio warnings and publication in bulletins) is necessary as corrective measure.

1.6.1.2 During Operational phase

1.6.1.2.1 Seabed geomorphology

The activities that may potentially affect seabed geomorphology during the operational phase of Medusa project are on the one hand the occupation of the seabed because of the presence of the cable itself and on the other hand possible reparation works related to some cable breaks, which will imply the presence of the cable ship for a certain time frame and the substitution of some cable sections.

Impacts

During operational phase, the cable will not cause morphological alteration of seabed, since the depression caused by the plough during the burial of the cable will be recovered in a short period of time due to the sedimentary transport generated by the currents. In areas where the cable cannot be buried due to the presence of a rocky bottom or other infrastructure, the cable itself will constitute a new hard substrate that can be colonized by benthic communities, as several studies lasting several years carried out by the Montrey Bay Aquarium Research Institute have shown. (Kogan et al., 2006). In this case the duration of the effect is long term.

Some affections on seabed geomorphology may be caused by reparation works in case of cable breakdown, as part of the cable might need to be recovered and substituted, causing some movements of sediments constituting the seabed. The alteration caused will be recovered soon due to the sedimentary transport generated by currents.

The following table summarizes the impact related to reparation works. The impact is considered **not significant** and compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Seabed geomorphology								
Assessed Impact	-	D	L	L	S	R	L	C

Mitigation

The impact is compatible and does not need preventive or corrective measures. Anyway, in case reparation works will be necessary, they will be done by using the most modern techniques available in order to reduce the seabed affection.

1.6.1.2.2 Beach geomorphology and soil alteration

The activities that may potentially affect beach geomorphology and soil alteration during the operational phase of Medusa project are reparation and maintenance works that may be conducted on terrestrial infrastructures.

Impacts

BMH and border pipe has an access hole that limits affection on the beach in case of required actions. Anyway, possible alterations of the beach zone will be limited and temporary. Total restoration will be conducted at the end of the works.

The following table summarizes the impact related to reparation works. The impact is considered **not significant** and compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Beach geomorphology and soil alteration								
Assessed Impact	-	D	L	L	S	R	L	C

Mitigation

The impact does not need any mitigation measure.

1.6.1.2.3 Marine mammals

The activities that may potentially affect marine mammals during the operational phase of Medusa project are just the possible reparation works related to some cable breaks, which will imply the presence of the cable ship and/or ancillary vessels for a certain time frame.

Impacts

Fiber optic cables are considered non-polluting, with a very low electromagnetic field and a zero thermal footprint. In addition, during the operating phase the cable does not emit submarine noise.

Therefore, no affection on marine mammals is expected in relation to the presence and functioning of Medusa subsea system.

The only affections on marine mammals during operational phase can be related to the risk of collision with ships, as well as contamination by drifting solids and accidental spills into the sea of hydrocarbons. At the same it has to be considered the noise that may be produced by the ROV circulating on the bottom during inspections or any repairs, as well as the noise of the navigation of the ship from which repair operations are monitored. However, these are localized and temporally limited situations, with low probability of occurrence.

More detailed information concerning the effects on marine mammals in relation to navigation can be found at Section 1.6.1.1.4.

As in the case of installation phase, the most sensitive area is the Cetacean Migration Corridor, crossed by the Medusa subsea system in correspondence of the Barcelona branch.

The following table resumes the impacts (assessed and residual) on marine mammals. They are both considered **not significant** and compatible, although the magnitude and reversibility of the impact can be improved by applying preventive measures during navigation related to reparation works.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Marine mammals								
Assessed Impact	-	D/I	M	L	S to L	R/I	L	C

Mitigation

The impact on marine mammals during operational phase can be reduced and made negligible with the application of preventive measures detailed in Section 1.6.1.1.4. Some of these measures have been established by authorities in the frame of PIPs for Barcelona landing because of the crossing of the Cetacean Migration Corridor and must be fulfilled. Some other measures should be applied for the navigation also outside of this natural protected area.

1.6.1.2.4 Chelonians

The activities that may potentially affect chelonians during the operational phase of Medusa project are just the possible reparation works related to some cable breaks, which will imply the presence of the cable ship and/or ancillary vessels for a certain time frame.

Impacts

As in the case of marine mammals, possible impacts on chelonians during operational phase are related to the risk of collision, the risk of drifting solids and accidental oil spills and the noise emitted during navigation and reparation works, which can alter the behavior of marine turtles.

The probability of occurrence of these risks is low and the impact is considered compatible, after following some preventive measures during navigation of cable ships or ancillary vessels.

The following table resumes the impacts (assessed and residual) on chelonians. They are both considered **not significant** and compatible, although the magnitude and reversibility of the impact can be improved by applying preventive measures during navigation related to reparation works.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Chelonians								
Assessed Impact	-	D/I	M	L	S to L	R/I	L	C

Mitigation

The preventive measures to be followed in order to minimize the impact are those already described in Section 1.6.1.1.5.

1.6.1.2.5 Phanerogam seagrasses

The activities that may potentially affect phanerogam seagrasses during the operational phase of Medusa project are on the one hand the occupation of the seabed because of the presence of the cable itself and on the other hand possible reparation works related to possible cable breaks.

Impacts

According to available data, the most critical point of Medusa system for the presence of phanerogam seagrasses is Marseille landing, because of the presence of *Posidonia oceanica* meadow. The presence of *Posidonia oceanica* and other phanerogams, as for example *Cymodocea nodosa*, cannot be totally excluded at Mazara because of the scarcity of data collected in these areas up to the moment in the frame of the project. The eventual presence of phanerogam seagrasses need to be verified through surveys in the frame of PIPs.

The impact on phanerogam seagrasses caused by the occupation of seabed is limited just to a physic occupation of a very straight area, as the maximum diameter of Medusa subsea cable is 53 mm.

During operational phase, the cable will not cause an increase in turbidity in the areas where it will be buried. In areas where the cable will be laid directly on the seabed, the increase in turbidity is considered low, since the cable is a very stable element due to its technical characteristics and structure. Movements caused by bottom currents or, for example, an anchor that hooks the cable could cause a local and punctual increase in turbidity.

Reparation works may also cause temporary disturbance to phanerogam seagrasses and punctual increase in turbidity. However, the probability of occurrence in this case is low and the impact is temporary.

The following table summarizes the impacts related to operational phase of Medusa system (assessed and residual). The **significance** of the potential impact is considered **moderate**, while the residual impact after the application of preventive measures will be compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Phanerogam seagrasses								
Assessed Impact	-	D	M	L	H	R	L	M
Residual Impact	-	D	L	L	S	R	L	C

Mitigation

Within the Posidonia meadow, the cables will be fixed as close as possible to the rhizomes at regular intervals by anchors adapted to the nature of the substrate (matte or sediment), in order to avoid chafing phenomena on the bottom. Thus, the lateral movements of the cables on the bottom will be eliminated and will not cause damage to the meadow and the associated sessile (fixed) species.

The optimization of the routes of the cables with regard to the most sensitive areas, their small diameters and their immobility should make it possible to avoid any significant and measurable impact on the phanerogam seagrasses during their period of exploitation and an integration of the cables in the environment is to be expected.

1.6.1.2.6 Other Sensitive marine habitats

The activities that may potentially affect sensitive marine habitats during the operational phase of Medusa project are on the one hand the occupation of the seabed because of the presence of the cable itself and on the other hand possible reparation works related to possible cable breaks.

Impacts

According to available data, the most critical points for other sensitive habitats is Torreguadiaro landing for the presence of reefs.

The impact on sensitive marine habitats caused by the occupation of seabed is limited just to a physic occupation of a very straight area, as the maximum diameter of Medusa subsea cable is 53 mm. In addition, the cable is a very stable infrastructure due to its technical characteristics and, therefore, in general, it will not impact the environment once laid, although in the rocky areas it is impossible to completely prevent the cable from not being suspended in some sections.

In areas where the cable is buried, the only impact on fauna is the occupation of the space by animals that live buried (polychaetes and bivalves).

In areas where the cable is laid directly on the surface of the seabed, colonization by sessile organisms basically occurs, as has been shown by studies lasting several years carried out by the Montrey Bay Aquarium Research Institute (Kogan et al., 2006).

Reparation works may also cause temporary disturbance to sensitive marine habitats. However, the probability of occurrence in this case is low and the impact is temporary.

The following table summarizes the impact related to operational phase of Medusa system. With the exclusion of seagrasses meadows, the impact is considered **not significant** and compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Sensitive Marine Habitats								
Assessed Impact	-	D/I	L	L	S	R	L	C

Mitigation

The optimization of the routes of the cables with regard to the most sensitive areas, their small diameters and their immobility should make it possible to avoid any significant and measurable impact on the benthic populations during their period of exploitation and an integration of the cables in the environment is to be expected.

1.6.1.2.7 Human health and safety

The reparation works during operating period may potentially affect this social factor.

Impacts

Impacts on human health and safety may occur as a result of accidents and unplanned events that may occur during the operating period. For offshore interventions, collision of operating vessels with fishing boat and nets or other vessels could result in damage of vessels and equipment, injury or loss of life.

The project activities may potentially result in a direct and indirect negative impact on human health and safety within the cable route in case of reparation works. Extend of the impact is limited to on-site and local. The duration will range from short term to long term as some impacts will last only a short while (minor injury) and some may cause a permanent change mortality related to vehicle or vessel strike.

The following table summarizes the impact, which is **not significant** and compatible.

Parameter	**Nature**	**Type**	**Magnitude**	**Influence**	**Duration**	**Reversibility**	**Probability**	**Significance**
Human health and safety								
Assessed Impact	-	D	M	L	S to L	R/I	L	C

Mitigation

- All active reparation areas will be marked with high-visibility tape with a temporary exclusion zone to reduce risk accidents
- The project will require all contractors to implement an environmental, health and safety plan which will outline procedures for avoiding health and safety incidents and for emergency medical treatment.
- Workers will be required to wear suitable personnel protective equipment (hard hats, high-visibility vests, safety boots and gloves and life vests).
- All construction and cable repair workers will be sufficiently trained in the safe methods of working with optical fibre cables to avoid injury associated with laser lights and fibers.
- While a ship is laying its maneuverability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.

1.6.1.2.8 Quality of Life and Education

The fiber optic connectivity (or Medusa system exploitation) may potentially affect this social factor.

Impacts

In the operational phase the fiber optic connectivity will result in an increase in the transmission networks capacity, and, consequently, will enable a faster digital transformation in North African countries across different sectors, stimulating innovation-related business activities by increasing collaboration opportunities among research centers on both sides of the Mediterranean.

These improvements in internet connectivity will indirectly bring to a positive impact on the quality of life and education in particular in North African countries, where the digital transformation is still limited at the present stage.

The following table summarizes the impact, which has a **positive** nature.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Quality of life and education								
Assessed Impact	+	I	M	R	L	R	H	I

Mitigation

No mitigation measures are necessary as this is a positive impact.

1.6.1.2.9 Employment

The fiber optic connectivity (or Medusa system exploitation) may potentially affect this social factor.

Impacts

In the operating phase, the project will contribute to the creation of stable jobs. The operation of the stations and technical centers will be an opportunity to recruit a workforce (for guarding, cleaning activities, etc.). The creation of new ICT-related jobs du high-speed internet will be also observed. These jobs will not only reduce the number of unemployed but will also provide stable incomes for these employees.

This is a positive direct impact. Its magnitude, duration and extent are Low, Long Term and Regional, respectively.

The following table summarizes the impact, which has a **positive** nature.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Employment								
Assessed Impact	+	D	L	R	L	R	H	M

Mitigation

The impact does not need mitigation measures as it is positive and compatible. However, the following measures are considered in order to maximize the benefits of the impact:

- Ensure transparency in the recruitment procedures
- Encourage direct recruitment without intermediaries;
- Encourage female candidature.

1.6.1.2.10 Internet use

The fiber optic connectivity (or Medusa system exploitation) may potentially affect this social factor.

Impacts

The implementation of the project will provide a high-speed internet connection that will significantly improve Internet access conditions with potential positive consequences below:

- Internet access for schools: the project will provide new opportunities for equipping educational and research institutions with multimedia centers having high-speed connection.
- Internet access for higher education and research: the higher education and scientific research sectors, data sharing and publication of results will be strongly linked to the availability and accessibility of a very high-speed connection.
- In the health sector, the emergence of telemedicine will be seen as a new opportunity to improve medical coverage with the availability and accessibility of a very high-speed internet connection.
- Implementation of a digital administration: the improvement of services at the level of public administration could be impacted with access to an improved internet connection.

This is a positive direct impact. Its magnitude, duration and extent are high, long term and regional, respectively.

The following table summarizes the impact, which has a **positive** nature.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Internet use								
Assessed Impact	+	D	H	R	L	R	H	I

Mitigation

No mitigation measures are necessary as this is a positive impact.

1.6.1.2.11 Fishing

During operation of Medusa subsea system, maintenance and restoration works may potentially affect this social factor.

Impacts

The impact on fishing during operating period is probably related to navigation of cable ship in case reparation works are necessary. Thus, the sensitive receptors during the operating phase of the project would be those fishing sectors that would be temporary excluded from anchoring or trawling within the protection corridor surrounding the intervention zone in case of reparation works.

The impact of a temporary exclusion zone from the demersal fisheries during operational phase i.e., trawling, bottom longlines and purse seine in European landings is localized and punctual.

Another possible affection on fishing during operational phase is related to the fact that, when a gear fouls a cable, the gear may be damaged or lost completely and catches contained in nets will be lost (Carter et al., 2009).

The overall impact is considered **not significant** and compatible in relation to the low probability of occurrence, low magnitude, local influence and reversibility feature of the impact.

The following table summarizes the impact on fisheries.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Fishing								
Assessed Impact	-	D	L	L	S	R	L	C

Mitigation

Although the impact on fishing during operational phase of Medusa subsea system is not significant, the following mitigation measures should be taken into account to minimize effects on fisheries:

- A notice to mariners and a navigational warning will be issued to mariners, to communicate the location and the duration of the temporary exclusion zone for reparation works;

- Undertaking all maritime operations in line with International Maritime Law and safe practice guidelines.
- Publication of cable route in official notices to mariners and nautical charts, which are distributed by hydrographic and other authorities in various countries.

1.6.1.2.12 Infrastructures

No interaction with existing infrastructures is considered once the Medusa cable is installed.

However, the presence of other infrastructures on the seabed, as well as at the landing site, should be taken into account in case reparation works for Medusa system are necessary in order to avoid any damage to those infrastructures.

Therefore, the impact of the project on other infrastructures during operational phase is considered **negligible**.

1.6.1.2.13 Contamination

The activities that may potentially affect contamination during the operational phase of Medusa project are just the possible reparation works related to some cable breaks, which will imply the presence of the cable ship and/or ancillary vessels for a certain time frame. Then, movements caused by bottom currents or, for example, an anchor that hooks the cable could cause a local and punctual increase in turbidity and therefore affect seawater quality.

Impacts

The fiber optic cable does not carry inside any product that can be spilled after a break. Regarding the degradation of the cable, it must be considered that fiber optic cables have an outer layer of polyethylene, whose total conversion of polyethylene into carbon dioxide in water would occur in hundreds of years. Likewise, it is considered that degradation processes such as oxidation, hydrolysis, and mineralization of these cables are very slow and not significant when considering that the useful life of a cable is normally about 25 years (OSPAR 2009). Therefore, the contamination in relation to the degradation of fiber optic cables is considered insignificant.

Air quality, as well as terrestrial and underwater noise, may be affected in relation to possible reparation works, but these are localized and temporally limited situations.

The possible affection on physical quality of seawater can be related to an increase in turbidity in relation to bottom currents or to incidents such as an anchor that hooks the cable. This impact is considered negligible in relation to the low magnitude, the local influence and the short-term duration.

The possible affection on chemical seawater quality during operational phase can be related to possible contamination by drifting solids and accidental spills into the sea of hydrocarbons. However, these are limited situations, with low probability of occurrence. Therefore, the impact is considered **not significant** and compatible.

The overall impact is considered **not significant** and compatible, as it can be seen in the following table.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Contamination								
Assessed Impact	-	D	L	L	S	R	L	C

Mitigation

Preventive measures described for chemical quality of seawater during installation phase will be applied also in case of reparation works during the operational phase.

1.6.1.2.14 Marine traffic

The activities that may potentially affect marine traffic during the operational phase of Medusa project are just the possible reparation works related to some cable breaks, which will imply the presence of the cable ship and/or ancillary vessels for a certain time frame.

Impacts

In the case of maintenance and repair of the cable itself navigation activities could be temporarily affected, as occurs in the cable installation phase. In any case, these are localized situations limited in time.

Given the low probability of occurrence and the temporary nature that it would eventually have, the impact is considered **not significant** and compatible.

Parameter	Nature	Type	Magnitude	Influence	Duration	Reversibility	Probability	Significance
Marine Traffic								
Assessed Impact	-	D	L	L	S	R	L	C

Mitigation

Coordination with the Maritime Captaincy to restrict navigation in the areas of action (radio warnings and publication in bulletins) is necessary as corrective measure.

1.6.1.3 During Decommissioning

The international obligations to the disused installations decommissioning were defined by the first time in the United Nations Convention on the Law of the Sea (UNCLOS) in 1982. It determines that abandoned or disused cable installations must be removed to ensure navigation safety, according to international standards. In addition, the International Maritime Organization standards determine that any infrastructure placed in the marine environment must include a decommissioning plan in its design and workplan. The IMO establishes that the cable removal should be the default action unless some exception, as for example in the case of designation of conservation areas after the cable installation.

In order to understand if Medusa cable may represent one of these exceptions, after the useful life of Medusa project the possibility of leaving the cable on the seabed should be evaluated, since, when they are not buried, submarine cables constitute a hard substrate that could be colonized by species of interest, increasing biodiversity values in the area.

The eventual removal of the cable will have effects similar to those described for the phase of works for the laying of the cable itself. In the case of terrestrial infrastructures, in several landings these have been planned to host more than just 1 cable, so that their decommissioning will not be possible until the end-of-life of the more recent installed cable. One this occurs, the beach infrastructures will be removed and the area reconditioned. The effects expected in relation to the removal of the infrastructures are similar to the effects analyzed in relation to the phase of works in the landing area of the cable. The removed material will be managed correctly according to laws and regulations in force at the time of decommissioning.

A full decommissioning plan will be developed at the end of the cable's useful life and best practices at that time will be considered. The plan will take into account the potential environmental and social impacts for the decommissioning alternatives.

1.6.1.4 Summary of environmental and social impacts

The analyses of environmental and social impacts of Medusa project during installation and operational phases done according to the current state-of-the-knowledge highlights the following conclusions:

- **During installation phase:**
  - Few impacts are considered **serious** and there are limited to some specific areas of the project, characterized by high environmental value. This is the case of impact on sensitive marine habitats, impact on beach geomorphology for Zahara landing and impact on phanerogam seagrasses and protected natural areas for Marseille landing. The application of specific preventive measures makes the residual impacts compatible.
  - Several impacts are considered potentially **moderate**, and they are subjected to recuperation after a short period of time. Preventive and corrective intensive measures are not necessary but are applied in order to reduce the impact. This is the case of impact on seawater chemistry, marine mammals, chelonians, sensitive marine habitats, human health and safety, fishing, marine and terrestrial infrastructures, heritage, generally considering the entire route of the cable. Then, impact on coastal vegetation is moderate in Zahara landing, as well as impact on terrestrial noise. The application of specific preventive measures makes all these residual impacts compatible.
  - Several impacts are directly considered as **compatible**. This is the case of impacts on seabed geomorphology, seawater turbidity, land property, visual landscape, air quality, underwater noise and marine traffic. The application of preventive measures is not required in this case, although is advised in some case in order to make the impacts completely negligible.
  - Impact on employment has a **positive** nature.
- **During operational phase:**
  - Most of the impacts are directly considered as **compatible,** being mainly related to works of cable repair that may occur in relation to cable breakdowns (low probability and temporary character). This is the case of impacts on seabed geomorphology, beach geomorphology, marine mammals, chelonians, sensitive marine habitats (with the exclusion of *Posidonia oceanica* meadows), human health and safety, fishing, contamination and marine traffic.

- The only impact that is considered **moderate** is the one on phanerogam seagrasses (*Posidonia oceanica* meadow) at Marseille landing, in relation to the presence of the cable itself on the seabed. The proposed measure is to fix the cable to the bottom at regular intervals by anchors specially profiled for this purpose (depending on the nature of the substrate: loose or matte), in order to avoid chafing phenomena on the background. The residual impact obtained after the application of this measure is considered compatible.
- Some of the social impacts are **positive** for the socio-economic baseline. This is the case of impacts on quality of life and education, employment and internet use. The significance of these positive impacts is particularly high for quality of life and education, as well as internet use.

The following table summarizes the significant negative environmental and social impacts that have been assessed during the impact assessment for the installation and the operational phase, as indicated above. All the other negative impacts on different factors are considered compatible with the baseline conditions and the application of preventive measures is not necessary, although some measures are always applied as best practices for the project or because they are imposed by the legislation.

Environmental and Social Factors	Location	Significance of the Assessed Impact	Significance of the Residual Impact
During installation			
Beach geomorphology and soil alteration	Zahara landing	Serious	Compatible
Coastal vegetation	Zahara landing	Moderate	Compatible
Marine mammals	General	Moderate	Compatible
Chelonians	General	Moderate	Compatible
Birds	Zahara landing	Moderate	Compatible
Phanerogam seagrasses	Marseille landing and probably Mazara landing	Serious	Compatible

Other Sensitive Marine Habitats	Zones where they are present	Serious	Compatible
Protected areas	Cetacean Migration Corridor	Moderate	Compatible
	Nature 2000 site and national park at Marseille landing	Serious	Compatible
Human health and safety	General	Moderate	Compatible
Fishing	General	Moderate	Compatible
Marine infrastructures	General	Moderate	Compatible
Terrestrial infrastructures	General	Moderate	Compatible
Heritage	General	Moderate	Compatible
Chemical quality of seawater	General	Moderate	Compatible
Terrestrial noise quality	General	Moderate	Compatible
During operation			
Phanerogam seagrasses	General	Moderate	Compatible

Table 25. Summary of significant negative impacts during installation and operational phases for Medusa subsea system.

The table below shows the summary of positive impacts that have been assessed during the ESIA. All the positive impacts are social impacts and do not need any measures, due to their positive value.

Environmental and Social Factors	Location	Significance of the Assessed Impact
During installation		
Employment	All the landing sites	Compatible

During operation		
Quality of life and education	General	Important
Employment	General	Moderate
Internet use	General	Important

Table 26. Summary of positive impacts during installation and operational phases for Medusa subsea system.

1.6.2 Proposed Mitigation Measures

The detailed design of mitigation measures will be developed by the project promoter in the frame of PIPs for each of the landing sites. Along with the design development, the promoter will update the Environmental and Social Management Plan (ESAP).

The mitigation measures to be applied to reduce the impacts generated by the Medusa subsea system are described in the previous section. However, below are attached all the measures proposed, grouped according to the phase (constructive or operational phase) and the receiver of the impact. Additionally, more specific measures are described for those landings that are at a more advanced state of the permitting process.

1.6.2.1 During Installation phase

1.6.2.1.1 General measures

The general measures that will be applied for the installation of the cable along the entire route in order to minimize the impacts generated by the Medusa project are the following, grouped according to the receiver of the impact:

Seabed geomorphology

The burial of Medusa system (generally from the coast up to a depth of 1000 m) will be done by using modern competitive plough and jetting systems, which reduce the width of seabed affection. The ROV used for post-lay inspection and burial will be ones of the most competitive currently existing in the market.

Beach geomorphology and soil alteration

The use of heavy machinery necessary for installation works will be strictly controlled, and a pathway will be established in order to minimize geomorphological effects on the beach. After the installation of the cable, the initial state of beach areas will be restored.

Coastal vegetation

The use of heavy machinery necessary for installation works will be strictly controlled, and a pathway will be established in order to minimize effects on vegetation.

Marine mammals

The works will be carried out in the shortest possible time, thus reducing the temporary duration of the pressure. In addition, the crew will be trained regarding cetacean sightings and an action protocol and good navigation practices will be prepared, in case of proximity of cetaceans on the route.

Finally, all the ships involved in the project will strictly comply with the MARPOL regulations, while the cable ship will also have an emergency plan (see section on contamination for more details).

Chelonians

The works will be carried out in the shortest possible time, thus reducing the temporary duration of the pressure. In addition, the crew will be trained regarding chelonian sightings and an action protocol and good navigation practices will be prepared, in case of proximity of chelonians on the route.

Finally, all the ships involved in the project will strictly comply with the MARPOL regulations, while the cable ship will also have an emergency plan (see section on seawater quality for more details).

Birds

Some measures to reduce risks of solid waste throw or micro-discharges from ships will be applied, as already described for marine mammals and chelonians.

Phanerogam seagrasses

In those landing sites characterized by the presence of *Posidonia oceanica* and other phanerogams, the following measures are proposed:

- Avoid the crossing of phanerogam seagrass meadows as far as possible.
- Prefer crossing of dead matte with respect to *Posidonia oceanica* meadows.
- Avoid burial of the cable in correspondence of *Posidonia oceanica* meadows.

Other Sensitive Marine Habitats

During the planning of the preliminary Medusa cable route, the crossing of protected natural spaces significant for the conservation of seabed habitats has been avoided as far as possible, as well as the crossing of submarine canyons and seamounts, which are considered hotspots of biodiversity. At the same time, the passage through detrital areas has been maximized, while the influence on rocky areas has been minimized. Indeed, rocky areas are generally characterized by a greater presence of sessile organisms.

Geophysical and geotechnical background recognition campaigns (side-scan sonar, multibeam echosounder, sub bottom profiler, etc.) will be conducted on the theoretical route of the Medusa system generally up to 1000 m of depth. These field surveys will allow the optimization of the cable routing to avoid any habitat potentially sensitive to the operations performed within the project framework.

Protected Areas

During the planning of the preliminary Medusa cable route, the crossing of protected natural spaces has been avoided as far as possible.

In the different protected areas crossed, those measures that are aimed at protecting and conserving the final objective of the protected area in question will be applied.

Human Health and Safety

The project will require all contractors to implement a health and safety plan which will outline procedures for avoiding health and safety incidents and for emergency medical treatment. All construction workers will be sufficiently trained in the safe methods of working with optical fiber cables to avoid injury associated with laser lights and fibers.

During beach and terrestrial works at landing points, all active construction areas will be marked with high-visibility tape to reduce risk accidents and all open trenches and excavated areas will be backfilled as soon as possible after the construction has been completed. Access to open tranches and excavated areas will be secured to prevent pedestrians or vehicle from failing in.

Concerning marine works, while a ship is laying a cable its maneuverability is restricted, therefore it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.

Fishing

During the determination of the cable route fishing areas have been taken into account. The route should be designed in a way that prevent the attachment of authorized fishing gear in the seabed.

Before starting the installation of the cable, a Notice to Mariners should be given, also indicating the proposed timeframes for subsea installation and the safety zone around the subsea cable lay. This notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible. Indeed, the fisheries sector must be informed with a minimum of 48 hours in advance about the area of the project, the working area and deadlines so that they can adapt their professional activity.

The subsea vessel contractors must adhere to the ISO 9000 and ISO 9001 and the International Cable Protection Committee (ICPC) recommendations.

Economic compensation for fishing days lost during installation works would also be discussed with fishing association in the frame of PIPs and offered by the promoter of Medusa project if necessary.

Infrastructures

Pre-installation geophysical surveys will identify the ubication of other submarine cables, as well as artificial reefs and other submarine infrastructures.

In the case of presence of other submarine cables at the seabed, the planification of Medusa route should comply with ICPC guidelines, considering an ideal distance of three times the water depth (3WD) between cables or at least a minimum distance of two times the water depth (2WD) At the same time, crossing angles between cables are ideally engineered at 90º, discouraging in any case crossing angles lower than 35º.

Burial by plough must be avoided in presence of crossing with in-use cables as it can damage the cables already present at the sea bottom.

Crossing agreements with owners of submarine cables must be discussed by the responsible of cable installation (ASN) before the starting of the works.

Direct crossing of artificial reefs should be minimized both for maintain the ecological value of it and to reduce risk for the stability of Medusa system.

Concerning beach and terrestrial works, the identification of terrestrial infrastructures at landing site must be done by means of georadar and detailed visual inspection prior to installation works.

Some constructive adaptations must be included in executive projects, after the identification of these elements to minimize the affection on existing infrastructures.

Land Property

The agricultural lands and private property impacted will be taken into account by the project according to local legislation.

Heritage

Prior to installation, an archaeological survey and testing of the route should be carried out to identify any sites that will be affected by the installation of the cable. The survey should be conducted on beach and terrestrial zone, as well as at the shallow marine area. An archeologist will also assist geophysical survey in particular in shallow waters. The results of these surveys and testing program will be used to inform decisions about further mitigation that may be required.

Visual landscape

Efforts will be made to minimize visual impacts; land disturbed by cable laying will be contoured to its original form as part of overall reinstatement. The condition of beach area will be brought again to initial baseline. In the case of new BMH, only a hole to guarantee the access in case of maintenance and reparation works will be visible.

Contamination

With respect to seawater quality, vessels involved in the project will strictly comply with the MARPOL regulations for the prevention of discharges into the sea, especially in its annexes I (prevention of hydrocarbon and hydrocarbonated water discharges) and its annex IV (wastewater discharge from ships). Prior to the authorization of marine works by the competent authority, vessels are required to present updated MARPOL documentation, which obliges vessels to carry out proper waste management. The cable installation will have an environmental risk assessment. Based on this risk assessment, an Emergency Plan will have been drawn up for the cable vessel, which will include at least:

- List of possible emergency scenarios and risks.
- Actions to be taken in each of the emergencies, according to what is indicated in chapter 3 of part a of the SOLAS Convention (Muster list).
- List of equipment to contain possible spills of dangerous substances and prevent them from reaching the sea: absorbents, anti-pollution barriers, etc.
- List and details of the authorities to report in case the spill cannot be controlled.

The main measure for air quality is the compliance of the ANNEX VI of MARPOL Convention for ships and vessels involved in the project. This annex addresses air pollution from ocean-going ships.

The works (terrestrial and marine) will be carried out in the shortest possible time, thus reducing the temporary duration of the noise (terrestrial and underwater) pressure.

Finally, bath season will be avoided for terrestrial installation works and shore-end works in all the landing sites, in order to minimize the effect that noise and deterioration of seawater quality can have on human population.

Marine traffic

In order to minimize the obstruction to the navigation generated via the presence of the cable ship and the auxiliary boats, Medusa subsea system cable route has been planned avoiding main navigation routes as far as possible.

Cable ship, as well as auxiliary vessels, must be properly registered and the necessary permissions for the work to be carried out will be obtained. The corresponding lights and navigation marks will also be displayed in accordance with the International Regulations for Preventing Collisions at Sea and will keep a permanent hearing in the VHF media.

Coordination with the Maritime Captaincy to restrict navigation in the areas of action (radio warnings and publication in bulletins) is necessary.

1.6.2.1.2 Portugal: Lisbon landing measures

In the frame of PIPs for Lisbon landing, the following measures have been proposed by the promoter to authorities:

- Installation of the submarine cable in the shallow zone carried out outside the bathing season and avoiding weekends.
- Safety signs and fencing of the beach area affected by the cable installation work.
- Maritime signaling of the works.
- Maintenance of access between the west and east areas of Carcavelos beach ensured through the sidewalk parallel to the EN6 (Avenida Marginal).
- Placement of a plastic warning band 20 cm from the upper limit of beach conducts.
- Replacement of the sand removed for opening the trench.
- Replacement of existing equipment on the playing fields.
- Adequate management of construction waste.

1.6.2.1.3 Spain: Zahara, Torreguadiaro and Barcelona landings measures

In the frame of PIPs for Spanish landings, the following specific measures have been indicated:

Planning, management and administrative processing

- The project will have to be compatible with other planning converging in its area of action and will also have to follow the procedures laid down in the Coastal Law (Ley de Costas) and its regulation of development.
- Boats and vessels used during the operations, as well as auxiliary vessels, must be properly registered and the necessary permissions will be requested to Maritime Captaincy for the work to be carried out. The corresponding lights and navigation marks (appropriate to the work to be done) will also be displayed in accordance with the International Regulations for Preventing Collisions at Sea and will keep a permanent hearing in the VHF media.
- If professional underwater work were necessary for any activity related to the work, the corresponding authorization of this administrative organ must be obtained, without prejudice to those corresponding to other administrations.
- Once the work has been adjudicated, and before it begins, the contracting company will have to provide to Maritime Captaincy the precise information of the tools used for the completion of the installation work of submarine cables and will indicate, via a justifying memory, the technical and operational details of these tools, as well as the person responsible for the works in question. In addition, there will be a coordination meeting in the respective Maritime Captaincy, convened by Maritime Captaincy once it is informed by the contracting company.
- In relation to the previous point, if the contracting company is in charge of the installation of the underwater cables in the Exclusive Economic Zone, information about the resources and tools to be used and the planning of the work will be included in the justifying memory.

Beach geomorphology and soil alteration

In the case of Zahara landing, the opening of a trench trough backhoe at the beach will be substituted by PHD, avoiding affecting the surface of the beach and therefore the dunes. The use of heavy machinery necessary for installation works will also be strictly controlled, and a pathway will be established in order minimize geomorphological effects on the beach.

Coastal vegetation

In the case of Zahara landing, the opening of a trench trough backhoe at the beach will be substituted by PHD, avoiding affecting the vegetation of the dunes. The use of heavy machinery necessary for installation works will also be strictly controlled, and a pathway will be established in order minimize effects on vegetation.

Birds

In the case of Zahara landing, reproduction and nesting season of *Charadrius alexandrines* (from April to August) will be avoid for coastal and terrestrial works.

Marine mammals

In the case of Barcelona landing, in the frame of PIPs the following measures have been established by authorities and must be observed in correspondence of the Cetacean Migration Corridor:

- Reduce the speed of cable ship and support vessels that participate in cable installation tasks.
- Respect distances and norms established in Spanish Royal Decree 1727/2007, which establishes protection measures for cetaceans and have marine mammal observers (MMO) on the bridge in order to avoid collisions with them.
- Carry out the installation of the cable in the period of minimum presence of cetaceans.
- Establish an action protocol if the presence of cetaceans is detected during the installation of the cable, taking extreme precautions.
- Measure the noise generated during the installation of the cable in the Cetacean Migration Corridor. This data will be submitted to the *Subdirección General para la Protección del Mar* (Subdirectorate General for the Protection of the Sea).
- Collect cetacean observation data in a database and send it to the General Sub-directorate for the Protection of the Sea.
- Respect provisions of article 2, point 1, section a) of Spanish Royal Decree 699/2018, which establishes that "The use of active systems intended for underground geological research will not be allowed".

Fishing

In the case of Barcelona landing, in the frame of PIPs authorities have established that a detailed assessment of the impacts of the implementation of the project on the fishing grounds ultimately affected will be made, as well as on the commercial fishing and shellfish species present, in a coordinated manner with the General Directorate of Fishing and Maritime Affairs (Generalitat de Catalunya) and the fisheries sector in the area.

In addition, the granting of concession must not lead to any limitation of professional fishing activity or of navigation in the area.

Concerning Zahara landing, the installation works will avoid the time window when fishing at Cabo Plata *almadraba* is active, that is from the second half of April to the second half of June, when it begins to be dismounted, to finish definitively at the beginning of July. Period between February and April should also be avoided as there is the preparation of the *almadraba* fishing art.

Seawater quality

In the case of Barcelona landing, the Barcelona Rescue Coordination Centre (*Centre de Coordinació de Salvament de Barcelona*) (CCS), must be informed of any accidents or incidents that occur during the completion of the installation works, including the possible turbidity or pollution of the waters in the area.

Navigation

The responsible companies will inform the Marine Hydrographic Institute (*Instituto Hidrográfico de la Marina*) of the beginning and completion of the work, as well as beacons associated for its dissemination and warning in navigation.

1.6.2.1.4 France: Marseille landing measures

In the frame of PIPs for Marseille landing, the following specific measures have been indicated up to now:

Phanerogam seagrasses

- Carry out a survey of the benthic biocenoses with recognition of the *Posidonia meadows* and of the stations with hard substrate identified.
- Characterize the meadow according to standardized descriptors. This will enable to assess its vitality and coverage, but above all to define its spatial limits with a view to optimizing the cable routes locally.
- Describe the species associated to *Posidonia oceanica* meadow and georeferenced those protected ones. A specific search for large nacres (*Pinna nobilis*) will be made. Any individual observed will be taken into account in the optimized route of the cable.
- Install an anti-MES (Suspended Matter) barrier around the area concerned by the burial operation (out of the phanerogam) to limit the deposit of fine particles within the Posidonia meadow. This anti-SS dam will also be set up at the outlet of the directional drilling in which the pipe will be installed, in order to prevent the transfer of fine particles generated by the drilling in the surrounding rock towards the Posidonia meadow.

- Bury the cable only between the bottom of the beach and the upper limit of the seagrass bed, depending on soil conditions. Beyond the lower limit of the seagrass bed, the cables will be laid on the bottom of the water where they will be stabilized by their weight and their calculated tension.
- Fix the cables within the Posidonia meadow to the bottom at regular intervals by anchors specially shaped for this purpose (depending on the nature of the substrate: soft or matte), in order to avoid scraping phenomena on the bottom. The operations will be carried out carefully by specialized divers, gently separating the Posidonia leaves in order not to damage them. Fusible anchors will be placed at the ends of the seagrass field in order to maintain the cables well fixed to the limits of the zone.

Other Sensitive Marine Habitats

- Carry out a geophysical and geotechnical background recognition campaign (side-scan sonar, multibeam echosounder, sub bottom profiler, etc.) on a 500 m corridor centered on the theoretical route of the cables. This field survey will allow the optimization of the cable routing to avoid any habitat potentially sensitive to the cable installation.
- Do inspections of the bottom with a benthic camera beyond the phanerogam meadows to validate the nature of the bottom and optimize the routes of the cables by using preferentially sandy areas or give preference to areas of low sensitivity.
- Carry out ROV survey in correspondence of submarine canyons (among 90 and 1000 m of depth of the preliminary route) to recognize sensitive habitats and protective species and conduct a micro-routing of the cable.

Protected Areas

In case of the Nature 2000 site "Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet", the same measures applied for seagrass meadows are proposed. are proposed. In addition, the crossing of other significative elements, whose conservation has determined the declaration of the protected site, such as submarine caves and coraligenous, will be avoid as far as possible.

1.6.2.2 During Operational phase

1.6.2.2.1 General measures

Seabed geomorphology

In case reparation works will be necessary, they will be done by using the most modern techniques available in order to reduce the seabed affection.

Marine mammals

In case of reparation works measures described for marine mammals during the installation phase should be applied.

Chelonians

In case of reparation works measures described for chelonians during the installation phase should be applied.

Phanerogam seagrasses

The optimization of cable routes, the small cable diameter and the cable stability should make it possible to avoid any significant and measurable impact on the Phanerogam seagrasses during the period of exploitation.

Other sensitive marine habitats

The optimization of the cable routes with regard to the most sensitive areas, the small cable diameter and the cable stability should make it possible to avoid any significant and measurable impact on the benthic populations during the period of exploitation and an integration of the cables in the environment is to be expected.

Human health and safety

In case of reparation works measures described for human health and safety during the installation phase should be applied.

Employment

The following measures are considered in order to maximize the benefits of the impact:

- Ensure transparency in the recruitment procedures.
- Encourage direct recruitment without intermediaries.
- Encourage female candidature.

Fishing

In case of reparation works, the following measures will be applied:

- Issue a notice to mariners and a navigational warning to fisheries sector, to communicate the location and the duration of the temporary exclusion zone for reparation works.

- Undertake all maritime operations in line with International Maritime Law and safe practice guidelines.

Contamination

In case of reparation works measures described for chemical quality of seawater during the installation phase should be applied.

Marine traffic

In the case of maintenance and repair works, the same measure contemplated for the installation phase will be applied.

1.6.2.3 During Decommissioning

The same mitigation measures considered during installation (1.6.2.1) will be applied during the decommissioning phase.

2 Development of Management Plans

2.1 Environmental and Social Management Plan

This section details the environmental and social management plan to be implemented during the installation and operating phases of the project. The aim is to provide a set of guidelines and actions/indicators aimed at addressing potential environmental and social impacts associated with the installation and operating of the subsea submarine cable systems.

The description of impacts and mitigation measures have been presented in Section 1.6.

2.1.1 During Installation phase

The following table presents the summary of environmental and social management plan during installation period.

Ref. N°	Potential Impact	Objective	Mitigation/Management and Enhancement Commitments	Responsibility	Monitoring and Indicators
1	General	Ensure legal compliance	- Procure and appoint an appropriately qualified Environmental Supervisor to oversee management of environmental issues of the project activities.	- Director of Medusa Project - Environmental and Social Supervisor	- Proof documents (authorisation, notification, signed commitment)

			- Ensure that the Environmental authorizations are available prior to commencement of the activity. - Ensure that environmental exigencies are part of the contract with the contractors appointed to install the cable. - Notify relevant authorities of location and timing of project activities prior to commencement of the activity		
2	Impact on seabed geomorphology	Minimize the affection on seabed	- Employ ones of the most competitive instruments currently existing in the market for the burial and inspection of the cable (ploughing, jetting and ROV)	- Director of Medusa Project - Responsible of cable installation (ASN) - Environmental Supervisor	- Documents specifying technical features of employed instruments - Trench width created by ploughing - ROV trace
3	Impact on beach geomorphology and soil alteration	Minimize the impact on beach geomorphology	- Employ PHD instead of open trench in zones characterized by high geological value, as it is the case of the dune system at Zahara landing. - Restore initial conditions once installation works are finished.	- Director of Medusa Project - Environmental Supervisor	- Comparison between initial and final conditions
4	Impact on coastal vegetation	Minimize coastal vegetation destruction	- Employ PHD instead of open trench in zones characterized by higher vegetation value, as it is the case of the dune system at Zahara landing. - Control the use of heavy machinery necessary for installation works and establish a determined pathway	- Director of Medusa Project - Responsible of cable installation (ASN) - Environmental Supervisor	- Time necessary for the new growth of coastal vegetation in case of destruction
5	Impact on marine mammals	Avoid the affection on marine mammals	- Respect distances and norms established in Spanish RD 1727/2007 (Cetacean Migration Corridor)	- Director of Medusa Project - Responsible of cable	-Number of cetacean sightings

			- Presence of MMO on cable ship (Cetacean Migration Corridor) - Avoid period of high presence of cetaceans (Cetacean Migration Corridor) - Preparation of an Emergency Plan for the cable ship - Preparation of Action Protocol and Good Navigation Practices - Comply with MARPOL regulations - Train the crew about cetacean sightings - Collect cetacean observation data in a database	installation (ASN) - Environmental Supervisor - MMO (Cetacean Migration Corredor)	-Number of collision incidents -measure of underwater noise in correspondence of the Cetacean Migration Corridor
6	Impact on chelonians	Avoid the affection on chelonians	- Preparation of an Emergency Plan for the cable ship - Preparation of Action Protocol and Good Navigation Practices - Comply with MARPOL regulations - Train the crew about chelonians sightings	- Director of Medusa Project - Responsible of cable installation (ASN) - Environmental Supervisor	-Number of chelonian sightings -Number of collision incidents
7	Impact on birds	Minimize affection on birds	- Comply with MARPOL regulations - Avoid reproduction and nesting season of *Charadrius alexandrines* (from April to August) in Zahara landing	- Director of Medusa Project - Responsible of cable installation (ASN) - Environmental Supervisor	
8	Impact on phanerogam seagrasses	Minimize affection on phanerogam seagrasses	- Benthic survey in zone where the presence of phanerogam seagrasses is present to characterize their distribution. - Avoid the burial of the cable in presence of meadows.	- Director of Medusa Project -Responsible of benthic survey - Responsible of cable	- percentage of phanerogam seagrass meadow affected by the installation of the cable with respect to the

			- Planning the crossing of dead matte instead of meadows - Planning the use of barriers for suspended matter - Considering fixing the cable where meadows are present	installation (ASN) - Environmental Supervisor	meadow extension - current state of the meadow - state of the meadow after cable installation
9	Impact on Sensitive Marine Habitats	Minimize affection on sensitive marine habitats	- Geophysical pre-installation survey through SSS, SBP and MBES up to 1000 m depth - Benthic survey in zone where the presence of sensitive marine habitats is probable (phanerogam seagrasses, reefs, etc.). - Planning the crossing of detrital areas instead of rocky area when possible - Avoid the crossing of hot spot biodiversity zones	- Director of Medusa Project -Responsible of benthic survey - Responsible of cable installation (ASN) - Environmental Supervisor	- percentage of sensitive marine habitats affected by the installation of the cable with respect to their extension -state of the sensitive habitats crossed after cable installation
10	Impact on Protected Areas	Minimize the crossing of protected areas	- Reduce the crossing of natural protected areas. - Apply measures to prevent the affection on key elements inside natural protected areas	- Director of Medusa Project -Responsible of benthic survey - Responsible of cable installation (ASN) - Environmental Supervisor - MMO (Cetacean Migration Corridor)	-cetacean indicators for the “Cetacean Migration Corridor” -phanerogam seagrass indicators and sensitive habitat indicators for “Calanques et îles Marseillaises-Cap Canaille et Massif du Grand Caunet”
11	Impact on Human health and safety	Avoidance of public health and safety incidents.	- All active construction areas will be marked with high-visibility tape to reduce risk accidents - All open trenches and excavated areas will be backfilled as soon as possible after the construction has been completed. Access to open tranches and excavated areas will be secured to prevent	- Director of Medusa Project - Social Supervisor	- Reporting of serious incidents to structure in charge of Labour. - Site Inspection Reports by Social Supervisor

			pedestrians or vehicle from failing in. - The project will require all contractors to implement an environmental, health and safety plan which will outline procedures for avoiding health and safety incidents and for emergency medical treatment. - Workers will be required to wear suitable personnel protective equipment (hard hats, high-visibility vests, safety boots and gloves and life vests). - All construction and cable repair workers will sufficiently be trained in the safe methods of working with optical fibre cables to avoid injury associated with laser lights and fibers. - While a ship is laying its maneuverability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.		
12	Impact on employment	Reduce the risk of gender-based discrimination and social conflict	- Respect the labor legislation - Ensure transparency in the recruitment procedures - Encourage direct recruitment without intermediaries; - Encourage female candidature	- Director of Medusa Project - Social and Environmental Supervisors	- Number of requests recorded -Number of employees hired - Number of female employees hired
13	Disturbance to fishing and fisheries	Minimize impact on fisheries and fishing activities.	- Distribute a Notice to Mariners prior to the commencement of the subsea cable installation. The Notice to Mariners should give notice of an indication of the proposed timeframes for subsea installation and an indication of safety zone around the subsea cable lay. This notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible; - The subsea vessel contractors must adhere to the ISO 9000 and ISO	- Local competent administration - Director of Medusa Project - Social and Environmental Supervisors	-Record of communications with Fisheries and authorities Copy of notice sent to the Navy

			9001 and the International Cable Protection Committee (ICPC) recommendations. - Compensatory measures will be offered if necessary (incomes lost by fishers during installation period)		
14	Impact on infrastructures	Have under control interference with other infrastructures	- Pre-installation geophysical survey - Follow ICPC guidelines - Contact cable owners to make agreements - identification of terrestrial infrastructures by means of georadar	- Director of Medusa Project - Responsible of cable installation (ASN)	-number of active submarine cables crossed -number of constructive adaptations to be made
15	Impact on Land Property	Avoid loss of agricultural land or degradation of private and public property	- The choice of the infrastructure sites will avoid loss of agricultural land or degradation of private and public property. - The compensations will be made according to local legislation, in the case of loss of agricultural land or degradation of private and public property.	- Director of Medusa Project - Social Supervisor - Local administration	- Number of impacted people - Number of people having benefited from compensation measures due to the loss of their property
16	Impact on heritage	Minimize chance of damage to any archaeological sites and maximize benefits associated with finds.	- Prior to installation, an archaeological terrestrial and shallow survey and testing of the route should be carried out to identify any sites that will be affected by the installation of the cable - Alternatively, an archaeologist must be commissioned to monitor vegetation clearance and installation work; - An archaeologist will be present during geophysical pre-installation survey in shallow waters	- Director of Medusa Project - Social and Environmental Supervisors - Local administration in charge of heritage	- Report on archaeological survey or signed contract with an archaeologist. - Number of notifications of the authorities in charge of Heritage Resources. - Site Inspection Reports
17	Impact on visual-landscape	Minimize impact on visual-landscape	- Land disturbed by cable laying have to be contoured to its original form as part of overall reinstatement	- Director of Medusa Project - Social and Environmental Supervisors	End of works environmental and social audit report

18	Impact on contamination	Minimize contamination related to installation phase Minimize turbidity and avoid seawater contamination	- Comply with ANNEX VI of MARPOL Convention - Avoid bath season in landing areas - Avoid period of high presence of cetaceans (Cetacean Migration Corridor) - Employ ones of the most competitive instruments currently existing in the market for the burial and inspection of the cable (ploughing, jetting and ROV) - Comply with MARPOL regulations - Fill a list of possible emergency scenarios and risks - Fill a list of Actions to be taken in each of the emergencies, according to SOLAS Convention (Muster list). - Fill a list of equipment to contain possible spills of dangerous substances and prevent them from reaching the sea - Fill a list of the authorities to report in case the spill cannot be controlled.	- Director of Medusa Project - Social and Environmental Supervisors - Responsible of cable installation (ASN)	-measure of underwater noise in correspondence of the Cetacean Migration Corridor - Documents specifying lists of emergency scenarios, actions, equipment and authorities - Documents specifying technical features of employed instruments
19	Impact on marine traffic	Minimize affection on marine traffic	- Reduce the crossing of main marine traffic routes - Coordination with the Maritime Captaincy	- Director of Medusa Project - Responsible of cable installation (ASN)	-Record of communications with Maritime Captaincies.

Table 27. Environmental and Social Management Plan for the installation phase.

2.1.2 During Operational phase

With respect to operational phase, the environmental and social management plan is presented in the following table.

Ref. N°	Potential Impact	Objective	Mitigation/Management and Enhancement Commitments	Responsibility	Monitoring and Indicators
1	Impact on seabed geomorphology	Minimize the affection on seabed during repair works	- Employ competitive instruments existing in the market at the time of cable repair	- Director of Medusa Project -Responsible of cable repair - Environmental Supervisor	- Documents specifying technical features of employed instruments
2	Impact on marine mammals	Avoid the affection on marine mammals during repair works	In case of cable repair works: - Respect distances and norms established in Spanish RD 1727/2007 (Cetacean Migration Corridor) - Preparation of an Emergency Plan for the cable ship - Comply with MARPOL regulations - Train the crew about cetacean sightings - Collect cetacean observation data in a database	- Director of Medusa Project - Responsible of cable repair - Environmental Supervisor	-Number of cetacean sightings -Number of collision incidents
3	Impact on chelonians	Avoid the affection on chelonians during repair works	In case of cable repair works: - Preparation of an Emergency Plan for the cable ship - Comply with MARPOL regulations - Train the crew about chelonians sightings	- Director of Medusa Project - Responsible of cable repair - Environmental Supervisor	-Number of chelonian sightings -Number of collision incidents
4	Impact on phanerogam seagrasses	Minimize the affection on phanerogam seagrasses	- Fixation of the cable in seagrasses meadows to avoid cable movements	- Director of Medusa Project - Responsible of cable installation (ASN) - Environmental Supervisor	- state of the meadow during cable operation
5	Impact on Sensitive Marine Habitats	Minimize affection on sensitive marine habitats	- Fixation of the cable in seagrasses meadows to avoid cable movements	- Director of Medusa Project - Responsible of cable	-state of the sensitive habitats crossed

			- Avoid fixation with concrete matrix in rocky areas	installation (ASN) - Environmental Supervisor	after cable installation
6	Impact on Human health and safety	Avoidance of public health and safety incidents.	- All active reparation areas will be marked with high-visibility tape with a temporary exclusion zone to reduce risk accidents - The project will require the operating structure to implement an environmental, health and safety plan which will outline procedures for avoiding health and safety incidents and for emergency medical treatment. - Workers will be required to wear suitable personnel protective equipment (hard hats, high-visibility vests, safety boots and gloves and life vests). - All cable repair workers will sufficiently be trained in the safe methods of working with optical fibre cables to avoid injury associated with laser lights and fibers. - While a ship is laying its maneuverability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.	- Director of Medusa Project - Social Supervisor	- Reporting of serious incidents to structure in charge of Labor. - Site Inspection Reports by Social Supervisor
7	Quality of life and education	Enhance quality of life and education opportunities	- Enable a faster digital transformation in North African countries - Increase collaboration opportunities among research centers	-Local and central administrations	-Number of new collaboration opportunities
8	Impact on employment	Reduce the risk of gender-based discrimination and social conflict	- Respect the labor legislation - Ensure transparency in the recruitment procedures - Encourage direct recruitment without intermediaries; - Encourage female candidature	- Director of Medusa Project - Local and central administration	- Number of requests recorded -Number of employees hired - Number of female employees hired

9	Impact on internet use	Increase internet use in particular in African countries	- Enhance internet access for schools, higher education and research - Enhance the use of internet in the health sector - Go towards a digital administration transformation	-Local and central administrations	-Number of schools, higher education and research centers taking advantage from the new internet connection -Monitoring of administrative digital transformation
10	Disturbance to fishing and fisheries	Minimize impact on fisheries and fishing activities during reparation works.	- A notice to mariners and a navigational warning will be issued to mariners, to communicate the location and the duration of the temporary exclusion zone for reparation works; - Undertaking all maritime operations in line with International Maritime Law and safe practice guidelines. - Cable route will be inserted in nautical charts.	- Director of Medusa Project - Social and Environmental Supervisors -Responsible of cable repair	-Record of communications with Fisheries and authorities -Copy of notice sent to the Navy
11	Impact on contamination	Minimize contamination related to reparation works Avoid seawater contamination	In case of cable repair works: - Comply with ANNEX VI of MARPOL Convention - Comply with MARPOL regulations - Fill a list of possible emergency scenarios and risks - Fill a list of Actions to be taken in each of the emergencies, according to SOLAS Convention (Muster list). - Fill a list of equipment to contain possible spills of dangerous substances and prevent them from reaching the sea	- Director of Medusa Project - Responsible of cable repair - Social and Environmental supervisors	-number of navigation days related with cable repair -number of cable breakdowns -Documents specifying lists of emergency scenarios, actions, equipment and authorities
12	Impact on marine traffic	Minimize affection on marine traffic during repair works	- Coordination with the Maritime Captaincy	- Director of Medusa Project -Responsible of cable repair	-number of cable breakdowns

Table 28. Environmental and Social Management Plan for the operational phase.

2.2 Specific Plans

In addition to the environmental and social management plan, the project will require the development of specific plans such as Health & Safety Plan, Waste Management Plan and Emergency Preparedness and Response Plan. These plans are also required in the frame of PIPs for any of the landing sites.

The following paragraphs present a description of a H&S Plan and Waste Management Plan, on the base of those that have been included by promoter of Medusa project in the Design Development Projects presented to authorities in the case of European landings for which the permitting process has already started.

Health & Safety Plan

At European Union level, directives have established general criteria for safety and health measures at certain workplaces, as well as specific criteria for measures to protect against accidents and risk situations. In particular, Directive 92/57/EEC of 24 June 92/57/EEC lays down minimum safety and health requirements to be applied on temporary or mobile construction sites. The H&S plan will incorporate these criteria and measures established in the European legislation as well as the specific legislation of each landing.

Therefore, the H&S plan will include a Health and Safety Study in those construction works where the duration is longer than 30 working days or if there are underground works, and will also include the basic guidelines for the construction company to carry out its obligations in the field of occupational risk prevention.

The contractor will take the necessary measures to ensure the hygiene of the site facilities for the personnel as well as all measures to ensure order and safety on the construction site in order to prevent accidents to third parties as well as to his own personnel. It shall provide lighting, surveillance, interior and exterior signage and physical barriers for its location. All these measures are the contractor's responsibility.

In the event of non-compliance by the contractor with the above requirements and without prejudice to the powers of the competent authorities, the project owner may take the necessary measures at the contractor's expense after the formal notice has lapsed. In case of emergency or danger, these measures shall be taken without prior notice.

In general terms, the main risks to human health and safety that may occur during the construction phases of the project are the following:

Occupational risks

a) Soil moving

- Caught by machines and vehicles.
- Vehicle accidents due to excess load.
- Vehicle falls and overturning.
- Personnel falling at level.
- Personnel falling to different levels.
- Material falls.
- Projection of particles in the eyes.
- Entrapment due to slides and landslides.
- Unforeseen explosions.
- Fires.
- Electrocutions.
- Breakage of pipelines of water, gas, electricity, etc.
- Dust.
- Noise.

b) Construction work

- Personnel falling to different levels.
- Material falls.
- Tools falls.
- Load balancing.
- Contusions and sprains to feet and hands.
- Puncture wounds to feet and hands.
- Cutting machine injuries.
- Erosions and contusions due to material handling.
- Entrapment by machines and vehicles.
- Projection of particles into the eyes.
- Dermatitis.
- Burns.
- Electrocutions.
- Noise.

c) Sanitation

- Entrapment by machines and vehicles.
- Personnel falling at level.
- Personnel falling from different levels.
- Material falls.
- Tools falls.
- Projections of particles in the eyes.
- Entrapment due to slides and landslides.
- Erosions and contusions due to material handling.
- Contusions and sprains in feet and hands.
- Electrocutions.
- Breakage of pipelines of water, gas, electricity, etc.
- Dust.
- Noise.

d) In removal of debris, loading, transporting and dumping

- Entrapment.
- Personnel falling to the same or different levels.
- Blows from or against objects.
- Run over and collisions.
- Material falls.
- Dust.

e) Electrical

- Interference in underground high voltage lines.
- Derived from deficiencies in machines or installations.

g) Fires

- In warehouses, installations, etc.

Risks of damage to third parties

The risks of damage to third parties in the execution of the work may be caused mainly by the circulation of third parties from outside the work site once the work has begun.

To prevent the risks to damage third parties, the access to third parties from outside the work will be blocked by barriers throughout the area accessible to third parties and will be suitably signposted.

Possible interactions and incompatibilities with any other type of work or activity carried out on or near the site will also be foreseen.

Once the occupational risks that may occur during the development of the works have been identified, the main safety and protection measures that must be adopted are detailed:

Prevention of occupational risks

The organization of the work will be done in such a way that safety is maximized at all times. Working conditions must be hygienic and, as far as possible, comfortable.

Individual protections

The individual protections will be, as a minimum, the following:

- Helmets for all persons participating in the work, including visitors.
- Safety boots, class III, for all personnel handling heavy loads.
- General use leather and anti-cut gloves for handling materials and objects.
- Overalls or coveralls, bright yellow, taking into account the replacements throughout the work.
- Waterproof overalls, especially for work that cannot be suspended in adverse weather conditions, bright yellow in color.
- Homologated waterproof boots in the same conditions as waterproof clothing, when working on muddy or wet ground.
- Anti-impact and anti-dust goggles in all operations where particles may be detached.
- Safety belts.
- Anti-vibration belts.
- Dust mask.
- Filters for masks.
- Hearing protectors.
- Reflective vests for protection personnel.
- Wrist straps.
- Self-contained breathing apparatus.

Collective protections

a) General signaling

- STOP sign at vehicle exits.
- Mandatory use of helmets, safety belts, falls to different levels, heavy machinery in motion, suspended loads, fire and explosions.
- Entrance and exit of vehicles.
- Prohibition of the passage of any person from outside the work site, prohibition of fire lighting, smoking and parking.
- Information sign indicating the location of the first aid kit and fire extinguisher.
- Marking tape.
- Construction site warning disc, speed limit.

b) Electrical installation

- Protection conductor and grounding spike or grounding plate.
- Differential switches of 30 mA sensitivity for lighting and 300 mA for power.
- Emergency lighting.

c) Cable laying and levelling of land:

- For personnel access to the cut will use stairs independent of vehicle access.
- Containment barriers on the edge of excavation areas. To prevent vehicles from falling, prefabricated concrete barriers of the New Jersey type will be placed.
- Closing and protection barriers. Movable metal barriers with border piping of at least two meters in height will be used.
- It will be signaled with reflective beacon tape and signs indicating risks.

d) Fire and explosion protection:

- Portable homologated ABC powder fire extinguishers will be used.
- Explosion meters shall be used to detect the possible risk of explosion.

Training

All personnel must receive, at the start of their work on site, a briefing on the working methods and the risks they may be exposed to, together with the safety measures they must use.

Choosing the most qualified personnel, first aid and assistance courses shall be given, so that all cuts have a lifeguard available.

Contractors and subcontractors shall ensure that workers are adequately informed of all health and safety measures to be taken on the site.

<u>Preventive medicine and first aid</u>

a) First-aid kit

There shall be a first-aid kit containing basic first aid material as well as the specific material required by the legislation of each country.

b) Assistance to injured persons

The worksite shall be informed of the location of the different Medical Centers in the area (own services, Employer's Mutual Insurance Companies, Labour Mutual Insurance Companies, Outpatients, etc.) to which the injured should be taken for their quickest and most effective treatment.

A list of telephone numbers and addresses of the centers assigned for emergencies, ambulances, taxis, etc., shall be available on the site and in a visible place, in order to guarantee a rapid and adequate transport of possible injured parties to the Assistance Centers.

c) Medical examination

All personnel starting work on site shall undergo a medical examination prior to work.

<u>Prevention of risks of damage to third parties</u>

The connection with the streets will be analyzed, taking the appropriate safety measures required in each case.

The natural accesses to the site will be analyzed, prohibiting the passage of any person outside the work, and the necessary closures will be put in place if necessary.

<u>Waste Management Plan</u>

The waste management plan will be carried out considering the legal framework and applying the waste legislation of each country (of each landing).

As a waste producer, the project owner is responsible for the legal and regulatory framework applicable to construction site waste in case of mismanagement of such waste. Therefore, a diagnosis of the waste to be generated will be carried out before starting work on each landing, as it will allow an analysis and action plan to be made in terms of waste prevention and management. The plan to be followed is as follows:

- Waste diagnosis prior to the works

- Reduction of waste production
- Reduction of waste harmfulness
- Waste characterization
- Selective removal and sorting of waste
- Waste logistics
- Preferred treatment methods
- Waste recovery
- Requirements to be met by waste suppliers
- Waste traceability
- Waste prevention and management

In addition, the producer of the waste (developer or licensee) shall comply with the following obligations:

- Include in the working project a study of construction and demolition waste management and an inventory of hazardous waste.
- Have the documentation that proves that the construction waste has been managed during the execution of the work.

Below is a list of the waste that may be produced during the construction work and its classification according to the European Waste Catalogue (EWC), which has been in force since January 1, 2002. With the new catalog, by means of a single list system, it establishes which wastes must be considered hazardous (special).

The main wastes according to the EWC from the demolition and/or urbanization process that are expected to be generated in this project are the following:

- Soil
- Rock
- Concrete (pavements, walls, ...)
- Bituminous mixtures
- Others: wood, glass, plastic, paper and cardboard.

According to the European Waste Catalogue, these wastes are included in the following groups:

<u>NON-SPECIAL WASTES</u>

(17) Construction and demolition wastes

RUBBLE:

- 17 01 01 Concrete
- 17 01 02 Bricks

- 17 01 03 Tiles and ceramics
- 17 02 02 Glass
- 17 05 04 Soil and stones other than those specified under code 17 05 03

WOOD:

- 17 02 01 Wood

PLASTIC:

- 17 02 03 Plastic

AGGLOMERATE:

- 17 03 02 Non-special asphalt agglomerate

SCRAP METAL:

- 17 04 Metals (including their alloys).
- 17 04 01 Copper, bronze, brass
- 17 04 02 Aluminum
- 17 04 04 Zinc
- 17 04 05 Iron and steel
- 17 04 11 Cables other than those mentioned in 17 04 10

SPECIAL WASTES:

(17) Construction and demolition wastes.

- 17 09 01 Construction and demolition wastes containing mercury.
- 17 09 02 Construction and demolition wastes containing PCBs (e.g., PCB-containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors).
- 17 09 03 Other construction and demolition wastes (including mixed wastes) containing hazardous substances.
- 17 02 04 Glass, plastic and wood containing or contaminated by dangerous substances.
- 17 08 01 Gypsum-based building materials contaminated with hazardous substances.
- 17 06 01 Insulation materials containing asbestos.
- 17 06 03 Other insulation materials consisting of or containing hazardous substances.
- 17 06 05 Construction materials containing asbestos.
- 17 05 03 Soil and stones containing hazardous substances.
- 17 05 05 Dredging spoil containing hazardous substances.

- 17 05 07 Track ballast containing hazardous substances.
- 17 04 09 Metallic wastes contaminated with hazardous substances.
- 17 04 10 Cables containing oil, coal tar and other dangerous substances.
- 17 03 01 Bituminous mixtures containing coal tar.
- 17 03 03 Coal tar and tarred products.

In addition to the mentioned wastes, other wastes may be generated in small quantities: paper and cardboard; and packaging, cleaning rags and work clothes.

According to the European Waste Catalogue, these wastes are included in the following groups:

- (15) Packaging waste, absorbents, cleaning rags, filter materials and protective clothing not specified.

Other special wastes generated during construction works not included in Chapter 17 of the EWC. In addition, waste may be generated during construction work:

- (13) Waste oils and liquid fuels (except edible oils and those of chapters 05, 12 and 19). They are treated as SPECIAL WASTE, and as such shall have a specific treatment.

3 Stakeholders Engagement Plan

3.1 Objectives

The Stakeholder Engagement Plan (SEP) aims to describe a method to engage and disclose that is both technically sound and culturally suitable. This SEP aims to enhance and facilitate decision-making and establish a channel for communication that actively involves, fosters quickly, and ensures that all project stakeholders have a common understanding. It also ensures that all groups have enough opportunities to express their opinions and concerns, which may have an impact on project decisions. The SEP is an effective tool for coordinating communications among the project promoter, project funders, project beneficiaries, and project affected parties.

The Key specific objectives of the SEP can be summarized as follows:

- Understand the stakeholder engagement requirements of Portugal, Spain, France and Italy legislation.
- Provide guidance for stakeholder engagement such that it meets the standards of European Investment Bank.
- Identify key stakeholders that are affected, and/or able to influence the Proposed Project and its activities.

- Identify the most effective methods and structures through which to disseminate project information, and to ensure regular, accessible, transparent and appropriate consultations;
- Guide the promoter to build mutually respectful, beneficial and lasting relationships with stakeholders.
- Develop a stakeholders' engagement process that provides stakeholders with an opportunity to influence project planning and design.
- Establish formal grievance/resolution mechanisms.
- Define roles and responsibilities for the implementation of the SEP.
- Define reporting and monitoring measures to ensure the effectiveness of the SEP and periodical reviews of the SEP based on findings.
- Assist the promoter with securing and maintaining a social license to operate throughout the life of the Proposed Project.

3.2 Legal framework related to stakeholder engagement

3.2.1 Legal framework related to stakeholder engagement in Portugal: Lisbon

The requirements related to public consultation and information for the installation of Medusa subsea system in Portugal are specified in the Sea Management and Planning Law (Law nº 17/2014) and the Decree-Law that develops this Law (Decree-Law nº 38/2015).

According to Article 23 of the Law nº 17/2014, the uses or activities not provided in the instruments of planning of the national maritime space will need to address to the competent entity a request for prior information on the possibility of using the national marine space.

According to of the Article 60 and Article 61 of the Decree-Law nº 38/2015, the entities identified in Annex II of this Decree-Law shall be consulted. These entities must give their opinion within 20 days of the process being made available and the deadline for consultation will have a maximum period of 30 days.

The entities consulted will give their opinion exclusively under the terms of their respective attributions and competences and if they verify that there are omissions or irregularities in the instructional elements, the consulted entities may request that the applicant is invited, within a maximum of 10 days, to complete or correct them.

The opinions of the consulted entities will be only binding when resulting from the law and provided that they are based on legal or regulatory constraints and received within the legal timeframe.

According to Annex II of Decree-Law no. 38/2015, the entities to be consulted for infrastructure-related activities are Autoridade Marítima Nacional (AMN), Guarda Nacional Republicana (GNR), Agência Portuguesa do Ambiente (APA I. P.) and Instituto da Conservação da Natureza e Florestas (ICNF).

On the other hand, it should be noted that the Portuguese law regulating installation and operation of electronic communications network (which includes fiber optics) is the Law No. 5/2004 of 10 February (Electronic Communications). According to the article 19 of this law, the instalment and functioning of the infrastructure of undertakings providing publicly available electronic communications networks shall be subject to the procedure established in articles 35 and 36 of Decree-Law no 555/99, as amended by Decree-Law no 177/2001.

According to these articles 35 and 36, the works can be performed after 30 days from the presentation of the prior communication addressed to the mayor and, within 20 days from the delivery of the communication, the mayor shall determine the submission of the work to licensing or authorization.

3.2.2 Legal framework related to stakeholder engagement in Spain: Zahara, Torreguadiaro and Barcelona

The requirements related to public consultation and information for the installation of Medusa subsea system in Spain are specified in General Coast Regulations (RD 876/2014), as the project is not actually subjected to environmental impact assessment in this country (see Chapter 1.3.3).

According to Article 86 of RD 876/2014, projects involving the occupation or use of maritime domain are subjected to public information process, unless they are related to national defense or security questions. The public information will have a duration of 20 days.

Projects involving the occupation or use of maritime domain should also be submitted to other Departments and Organisms, whose selection depend on the nature of the project and the impacts involved. City Council where the works will be conducted, General Directorate of the Coast and the Sea (Ministry of Ecological Transition and Demographic Challenge), Ministry of Defense, Autonomous Community and Maritime Captaincies are some of these authorities. Departments and Organisms consulted might send corresponding reports, once they have analyzed the project.

The public information process and the consultation to other authorities and organisms will be parallel.

If the project will finally undergo significant modifications in relation to opinions obtained during the consultation project, it must be submitted again to information process (Article 98).

No actions are required to the promoter of the project for the public information process once the documents for permitting are officially presented to Atlantic Andalusia (Cadiz) Coast Demarcation and Cataluña Coast Demarcation. These authorities will be directly in charge of submitting reports to public information.

3.2.3 Legal framework related to stakeholder engagement in France: Marseille

In this country several public domain regimes coexist. The General Code of Property of Public Persons (CG3P or CGPPP) provides general principles for the occupation of the public domain (II.1.1) but specific rules introduced by the Postal and Electronic Communications Code (CPCE) clarify the regime applicable to fiber optic networks. Thus, the deployment of fiber optic networks will follow different regimes when their implementation concerns the maritime public domain (II.1.2), the road public domain (II.1.3) or the non-road public domain (II.1.4). Similarly, the sole installation of a fiber optic cable on pre-existing infrastructures will lead to a different procedure (II.1.5).

Fiber optic networks wishing to occupy part of the maritime public domain will have to be the subject of a concession of use and this the concession request must be addressed to the prefect, which is the local representant of the Ministry of Ecology, Sustainable Development, Transport and Housing (MEDDTL). The request will specify the technical conditions of the future occupation, its location, the initial environmental inventory and the monitoring of the project.

Concessions to use the maritime public domain are provided for in article L.2124-3 of the General Code of Property of Public Persons. The system of these concessions of use is defined in articles R.2124-1 and following of the CG3P. The proposed occupation must not harm the environment, otherwise it will be refused. Article R.2124-2 of the same code provides that the operator must carry out an initial inventory when applying for a concession. He must then determine the possible impact of his installations on the natural environment and, if necessary, provide for reversibility and restoration measures for the natural environment at the end of use.

The prefect will design a sub-prefect for the project coordination, who will have to consult several people. Indeed, according to the General Code of Property of Public Persons, the process for the concession to use the maritime public domain includes a consultation phase, where the maritime public domain management service consult, as a minimum, to the following:

- Service in charge of maritime affairs.
- Interested military authorities.

- Other civil services: DREAL (nature, site inspector), *Architecte des bâtiments de France*, DDTM (water police, Nature 2000), AFB (PNM) for assent, Commune(s) concerned, EPCI concerned, DDFIP (articles R.2125 and R.2124-26 of CG3P), local nautical commission and CNDPS if the site is classified as Natura 2000.

The Maritime Prefect must give his prior consent to any installation on the part of the natural DPM covered permanently or intermittently by water. The Prefect is the authority that locally regulates the use of the DPM, allows private or non-private occupations and ensures the defense of its integrity by prosecuting the perpetrators of attacks on this area.

The sub-prefect will then send the file with answers sent by consulted authorities to the prefect with his observations, or with a draft agreement if he approves the project.

A public inquiry of the Environmental Code type is then carried out before approval by the prefect. Conditions of this public inquiry are included in TITLE II “Information and participation of citizens” (Articles L121-1 to L126-1). The public enquiry mentioned in Article L. 123-1 is conducted, according to the nature and scale of the operations, by a *commissaire enquêteur* or an enquiry commission appointed by the President of the administrative tribunal or by the tribunal member delegated by the President for this purpose. At least fifteen days before the enquiry is opened and throughout its duration, the competent authority informs the public by all appropriate means, notably in the places concerned by the enquiry and, according to the scale and nature of the project, via the written press or by audiovisual communication, of the purpose of the enquiry, the names and capacities of the *commissaire enquêteur* or the members of the enquiry commission, the date on which the enquiry is opened, the place of the enquiry and its duration. The duration of the enquiry must not be less than one month. By a reasoned decision, the *commissaire enquêteur* or the President of the enquiry commission may prolong the enquiry for a maximum period of fifteen days. The *commissaire enquêteur* or the enquiry commission is available to meet people or representatives of associations who request to be heard.

3.2.4 Legal framework related to stakeholder engagement in Italy: Mazara

In Italy, issues concerning the request for concession of marine public domain is contained in the Navigation Code, but indications about the process are very general and no reference is done to public inquiry before obtaining this permit.

Following the entry into force of Legislative Decree no. 112/1998, the Regions and local bodies are responsible for the functions and responsibilities regarding the issue of concessions of maritime state property and territorial sea areas and consequently falls within the competence of the municipal administration and not of the Ministry of Infrastructure and Transport, the adoption of the relative acts. In particular, as the concession will be for a period of time higher than 15 years, the competency lies with the Department of the Territory and the Environment of Sicily.

According to Environmental Code (D.Lgs. 152/2006), once the administration in charge of analyzing the submitted documentation has verified the presented documents, this administration should publish in its web site the project documentation in order to make it accessible to the public. Meanwhile, the administration must officially communicate the occurrence of this publication to all the other authorities and local bodies involved in the evaluation process. The municipality involved in the project must also publish the documents on its own website. Starting from this date, involved administrations, as well as anyone of the public that want to present observations about the project can do it in a maximum time window of 60 days. However, it should be taken into account that this procedure is valid for EIA, while Medusa subsea system is not subjected to EIA according to Italian legislation, but only to the request of concession of marine public domain. Therefore, it is possible that the described process is subjected to some variations with respect to stakeholder engagement procedure.

More specific information about legal framework related to stakeholder engagement for Mazara landing will be obtained during the permitting process.

3.2.5 EIB standard related to stakeholder engagement

The Standard n°2 of EIB recognizes the importance of stakeholder engagement, as a means to ensure respect for the rights to: (i) access to information; (ii) public participation in decision-making processes; and (iii) access to justice.

The EIB standard for stakeholder participation has particular requirements depending on the project's location. For projects located in the European Union and in the European Free Trade Area the promoter shall comply with the applicable national and EU legislation. For projects located in the rest on the world, the promoter shall carry out a stakeholder engagement process that is proportionate to the nature and scale of the project and its potential impacts and risks, involving, at a minimum: (i) the identification and analysis of the stakeholders; and (ii) the establishment and/or maintenance of a grievance mechanism; as well as some or all of the following elements to varying degrees as deemed necessary by the EIB; (iii) engagement planning; (iv) disclosure of information; (v) meaningful consultation; and (vi) monitoring and reporting.

3.3 Identification of Stakeholders

3.3.1 Stakeholders for the main trunk

Categories	Stakeholder	Relationship to the project	Tasks
Institutional	Environmental Portuguese Agency. (APA) (**PORTUGAL**)	Concerned	Agreement to the Utilisation of Maritime Public Domain, which includes the seafloor of the continental shelf including the EEZ
	General Directorate of Natural Resources and Security Maritime Services (DGRM) (**PORTUGAL**)	Concerned	Issuance of TUPEM (Title of Private Use of Maritime Space) and concession contract.
	Protection of the Sea Department - Coast Direction General – MITERD (**SPAIN**)	Concerned	Approval of Compatibility Report with the Marine Strategy & Maritime areas planning
	Maritime Public Domain Department - Coast Direction General – MITERD (**SPAIN**)	Concerned	Agreement to the occupancy of the affected area by the project within the EEZ
	Ministry of Infrastructures and sustainable mobility (**ITALY**)	Concerned	Responsible about Marine Spatial Planification
	Continental Shelf Department (**MALTA**)	Concerned	Licensing of submarine cables in territorial waters and EEZ

	Ministry of Environment and Energy (**GREECE**)	Concerned	Competent authority about Marine Spatial Planification
	National Telecommunication Regulatory Authority (**EGYPT**)	Concerned	Issue of licence for constructing telecommunication infrastructures
	Egyptian Environmental Affairs Agency (EEAA) (**EGYPT**)	Concerned	Approval of EIA
Decentralized local authorities and their representatives	Territorial Delegation of Sustainable Development in Cádiz – Coast Department - Ministry of Agriculture, Livestock, Fisheries and Sustainable Development (Junta de Andalucía) **(SPAIN)**	Concerned	Issue of concession for the occupation of maritime public domain
Legal entities affected by the project	Fishing business	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment. Can slow down or suspend the project
Funding partner	European Investment Bank (EIB)	Concerned	Financing Develops and monitors that the projects comply with its Environmental and Social standards

Media	Radio/Newspapers, Television, website	Concerned	Information, communication Promotion of the project

3.3.2 Stakeholders in Portugal: Lisbon

The table below presents a non-exhaustive list of stakeholders for Lisbon landing. It also summarizes their relationship to the project (stakeholder concerned and/or affected) and their specific issues.

Categories	Stakeholder	Relationship to the project	Tasks
Institutional	General Direction of Natural Resources, Security and Maritime Services (DGRM)	Concerned	Manage the concession request for the occupation of maritime public domain issuance of TUPEM (Title of Private Use of Maritime Space) and concession contract.
	Environmental Portuguese Agency. (APA) I.P./Administration of the Hydrographic Region of Tejo and West	Concerned	issuance of the TURH (Title for the Use of Water Resources). Participates in the instruction of the PIPs
	National Maritime Authority (Porto de Lisboa Captaincy)	Concerned	Participates in the instruction of the PIPs
	Republican National Guard (GNR)	Concerned	Participates in the instruction of the PIPs
	General Direction of Cultural heritage (DGPC)	Concerned	Participates in the instruction of the PIPs

	Institute for the Conservation of Nature and Forests (ICNF)	Concerned	Participates in the instruction of the PIPs management of Protected Areas and State managed national, municipal and communal forests of mainland Portugal
	General Direction of Energy and Geology (DGEG)	Concerned	Participates in the instruction of the PIPs
	General Direction of Resources for National Defense and Civil Aviation National Authority	Concerned	Participates in the instruction of the PIPs
	Infraestruturas de Portugal, S.A. -	Concerned	Participates in the instruction of the PIPs
Decentralized local authorities and their representatives	Câmara Municipal de Lisboa (CMS) -	Concerned	use of municipal public domain Local development Planning and land use Granting of building permits
	Commission for the Coordination and Regional Development of the Alentejo	Concerned	Instruction of the relevant public interest application under the terms of article 21 of the National Ecological Reserve regime
	Regional Directorate of Culture of Alentejo (DRAC)	Concerned	Participates in the instruction of the PIPs
	Cascais Captaincy	Concerned	Authorize maritime works

Physical persons affected by the project	Local population	Concerned and affected	May be consulted in the development of environmental and social management plans Contribute to economic and social development Can slow down or suspend projects
Legal entities affected by the project	Local businesses especially the fishing business	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment. Can slow down or suspend the project
	Organizations and associations representing the population	Concerned and affected	Defends the interests and allows the knowledge of the problems of the population of a region
	Community-based organizations (CBOs)	Concerned	Actions in favor of women and youth Representatives of the populations of the project's intervention zone
Funding partner	European Investment Bank (EIB)	Concerned	Financing Develops and monitors that the projects comply with its Environmental and Social standards
Media	Radio/Newspapers, Television, website	Concerned	Information, communication Promotion of the project

Table 29. List of stakeholders identify for Lisbon landing and their relationship with the project.

3.3.3 Stakeholders in Spain: Zahara, Torreguadiaro and Barcelona

The table below presents a non-exhaustive list of stakeholders for Zahara, Torreguadiaro and Barcelona landing. It also summarizes their relationship to the project (stakeholder concerned and/or affected) and their specific issues.

Categories	Stakeholder	Relationship to the project	Tasks
Institutional	Protection of the Sea Department - Coast Direction General - MITERD	Concerned	Issue of report of compatibilities with marine strategy Authorization of installation trough EEZ
	General Secretary of Fisheries. - Ministry of Agriculture, Fishing and Food	Concerned	Participates in the instruction of the PIPs
	Sub-Directorate General of Heritage (Ministry of Defense)	Concerned	Participates in the instruction of the PIPs
	Coast demarcation of Atlantic Andalusia (MITERD)	Concerned	Point of contact with the Coast Direction General, MITERD
	Coast Demarcation of Catalunya (MITERD)	Concerned	Point of contact with the Coast Direction General, MITERD
Decentralized local authorities	Territorial Delegation of Sustainable Development in Cádiz – Coast Department - Ministry of Agriculture, Livestock, Fisheries and Sustainable	Concerned	Manage the concession request for the occupation of maritime public domain Issue of concession for the occupation of maritime public domain

	Development (**Junta de Andalucía**)		
	Coastal Service, General Directorate of Mountain and Coastal Policies, Territory and Sustainable Department (**Generalitat de Catalunya**)	Concerned	Manage the concession request for the occupation of maritime public domain Issue of concession for the occupation of maritime public domain
	Tarifa municipality	Concerned	Local development Planning and land use Granting of building permits
	San Roque municipality	Concerned	Local development Planning and land use Granting of building permits
	Sant Adrià del Besòs municipality	Concerned	Local development Planning and land use Granting of building permits
	Environmental Protection Service – Department of Environmental Prevention and Protection (**Junta de Andalucía**)	Concerned	Participates in the instruction of the PIPs
	Barcelona Territorial Office for	Concerned	Participates in the instruction of the PIPs

	Environmental Action and Assessment		
	Fisheries and Aquaculture Development Department - Ministry of Agriculture, Livestock, Fisheries and Sustainable Development (**Junta de Andalucía**)	Concerned	Participates in the instruction of the PIPs
	Maritime Action and Control Service of the General Directorate of Fisheries and Maritime Afers (**Generalitat de Catalunya**)	Concerned	Participates in the instruction of the PIPs
	Algeciras-La Línea Marine Captaincy	Concerned	Participates in the instruction of the PIPs Authorize marine works
	Barcelona Marine Captaincy	Concerned	Participates in the instruction of the PIPs Authorize marine works
	Àrea Metropolitana de Barcelona (AMB)	Concerned	Participates in the instruction of the PIPs
	Department of Culture and Historical Heritage	Concerned	Participates in the instruction of the PIPs

	(**Junta de Andalucía**)		
	Heritage Protection and Diffusion Section - Archeology and Paleontology Service - Department of Culture (**Generalitat de Catalunya**)	Concerned	Participates in the instruction of the PIPs
	Andalusian Environment and Water Agency	Concerned	Participates in the instruction of the PIPs
	Catalan Water Agency (ACA)	Concerned	Participates in the instruction of the PIPs
	Autoridad Portuaria Bahía de Algeciras (APBA)	Concerned	Probably consulted in the frame of PIPs
Physical persons affected by the project	Local population	Concerned and Affected	May be consulted in the development of environmental and social management plans Contribute to economic and social development Can slow down or suspend projects
Legal entities affected by the project	Local businesses	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment. Can slow down or suspend the project
	Almadraba CABO PLATA	Concerned and affected	Are subject to the decisions of the project in the foreground

			Contributes to economic and social development and employment. Can slow down or suspend the project
	Tarifa and Barbate Fishing associations and “Organización Productores Pesqueros la Atunara OPP79”	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment. Can slow down or suspend the project
	Estepona and la Línea Fishing Associations	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment. Can slow down or suspend the project
	Organizations and associations representing the population	Concerned and affected	Defends the interests and allows the knowledge of the problems of the population of a region
	Community-based organizations (CBOs)	Concerned	Actions in favor of women and youth Representatives of the populations of the project's intervention zone
Funding partner	European Investment Bank (EIB)	Concerned	Financing Develops and monitors that the projects comply with its Environmental and Social standards
Media	Radio/Newspapers, Television, website	Concerned	Information, communication Promotion of the project

Table 30. List of stakeholders identify for Zahara, Torreguadiaro and Barcelona landings and their relationship with the project.

3.3.4 Stakeholders in France: Marseille

The table below presents a non-exhaustive list of stakeholders for Marseille landing. It also summarizes their relationship to the project (stakeholder concerned and/or affected) and their specific issues.

Categories	Stakeholder	Relationship to the project	Tasks
Institutional	Ministry of Ecology, Sustainable Development, Transport and Housing (MEDDTL)	Concerned	Ensure compliance with the conditions of implementation of public domain management and conservation policies
	Prefect of, Provence-Alpes-Côte d'Azur, Bouches-du-Rhône Department (MEDDTL)	Concerned	Main regulatory authority Represents the MEDDTL at territorial scale Design a sub-director for the project coordination Issue of concession for the occupation of maritime public domain
	Maritime Prefect of Mediterranean Sea (MEDDTL)	Concerned	must give his prior consent to any installation on the part of the natural public domain covered permanently or intermittently by water. Participates in the instruction of the PIPs
	General Directorate for Planning, Housing and Nature (DGALN)	Concerned	Ensure compliance with the conditions of implementation of public domain management and conservation policies
	General Directorate of Strategies (DGE)	Concerned	National referent about telecommunication cables.

	(Ministry of economy and Finances)		Support to territorial services Support to sub-prefect
	Architectes des Bâtiments de France (APF)	Concerned	Heritage conservation Participates in the instruction of the PIPs
	French Agency for the Biodiversity (AFB)	Concerned	Participates in the instruction of the PIPs Must give conformity for natural maritime parcs (PNM)
	Ministry of Army	Concerned	Participates in the instruction of the PIPs if military areas are interested
Decentralized local authorities	Direction Départementale des Territoires et de la Mer des Bouches-du-Rhône (DDTM 13)	Concerned	administrative examination of management acts and for missions related to the conservation of the public domain and instruction of the occupation requests. Water policy; Nature 2000 sites. Support the prefect
	Service de la Mer et du Littoral (SML) of DDTM	Concerned	administrative examination of management acts and for missions related to the conservation of the public domain and instruction of the occupation requests. Support the prefect
	Regional Directorate for the Environment, Planning and Housing of Provence-Alpes-Côte d'Azur (DREAL)	Concerned	Nature and site inspection Support the prefect Participates in the instruction of the PIPs

	Regional Directorate of Public Finances (DDFIP)	Concerned	Determine and collect the State fees Support the prefect
	Marseille municipality	Concerned	Local development Planning and land use Granting of building permits
	Other territorial entities (EPCI)	Concerned	Participates in the instruction of the PIPs
	Nautic Commission of *Bouches du Rhône*	Concerned	Participates in the instruction of the PIPs
	Department Commission of Nature Landscapes Sites (CDNPS)	Concerned	Participates in the instruction of the PIPs if the project concerns Nature 2000 sites
	Comandament de zone maritime	Concerned	Participates in the instruction of the PIPs Authorize marine works
Physical persons affected by the project	Local population	Concerned and affected	May be consulted in the development of environmental and social management plans Contribute to economic and social development Can slow down or suspend projects
Legal entities affected by the project	Local businesses especially the fishing business	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment.

			Can slow down or suspend the project
	Organizations and associations representing the population	Concerned and affected	Defends the interests and allows the knowledge of the problems of the population of a region
	Community-based organizations (CBOs)	Concerned	Actions in favor of women and youth Representatives of the populations of the project's intervention zone
Funding partner	European Investment Bank (EIB)	Concerned	Financing Develops and monitors that the projects comply with its Environmental and Social standards
Media	Radio/Newspapers, Television, website	Concerned	Information, communication Promotion of the project

Table 31. List of stakeholders identify for Marseille landing and their relationship with the project.

3.3.5 Stakeholders in Italy: Mazara

The table below presents a non-exhaustive list of stakeholders for Mazara landing. It also summarizes their relationship to the project (stakeholder concerned and/or affected) and their specific issues.

Categories	Stakeholder	Relationship to the project	Tasks
Institutional	Ministry of Ecological Transition	Concerned	Participates in the instruction of the PIPs
	Ministry of Cultural and Landscape Heritage.	Concerned	Participates in the instruction of the PIPs

	Interministerial Committee for Ecological Transition.	Concerned	Participates in the instruction of the PIPs
	Superior Institute for Environmental Protection and Research (ISPRA).	Concerned	Participates in the instruction of the PIPs
	Ministry of Infrastructures and sustainable mobility.	Concerned	Participates in the instruction of the PIPs
	Ministry of Army	Concerned	Participates in the instruction of the PIPs if military areas are interested
Decentralized local authorities	Department of the Territory and the environment, Autonomous Region of Sicily	Concerned	Manage the concession request for the occupation of maritime public domain Issue of concession for the occupation of maritime public domain
	Regional Environmental Protection Agency (ARPA Sicilia).	Concerned	Participates in the instruction of the PIPs
	Integrate Hydric Service Ambit Authority (ATO 7 – Trapani)	Concerned	Participates in the instruction of the PIPs
	Trapani province	Concerned	Participates in the instruction of the PIPs
	Mazara del Vallo municipality	Concerned	Local development Planning and land use Granting of building permits

Physical persons affected by the project	Local population	Concerned and affected	May be consulted in the development of environmental and social management plans Contribute to economic and social development Can slow down or suspend projects
Legal entities affected by the project	Local businesses especially the fishing business	Concerned and affected	Are subject to the decisions of the project in the foreground Contributes to economic and social development and employment. Can slow down or suspend the project
	Organizations and associations representing the population	Concerned and affected	Defends the interests and allows the knowledge of the problems of the population of a region
	Community-based organizations (CBOs)	Concerned	Actions in favor of women and youth Representatives of the populations of the project's intervention zone
Funding partner	European Investment Bank (EIB)	Concerned	Financing Develops and monitors that the projects comply with its Environmental and Social standards
Media	Radio/Newspapers, Television, website	Concerned	Information, communication Promotion of the project

Table 32. List of stakeholders identify for Mazara landing and their relationship with the project.

3.4 Consultation methodology and communication methods, planning dissemination of information

The following table presents the communication methods, planning, dissemination of the information within the different phases of the Project.

Nº	Phase and process	Consultation activity	Stakeholder	Means of communication
A1	Preparation of final stakeholder database	The preliminary database compiled during desktop activity will be update at the time of field investigations	Institutional, decentralized authorities, NGO, Media	Individual contact meeting with decentralized administrations and concerned structures
A2	Preparation of the Social Impact Assessment	Face-to-face and consultations for additional data collection for the social baseline	Institutional, decentralized authorities, NGO, physical persons affected by the project	Individual contact meeting with decentralized administrations and concerned structures
A3	Preparation of the Environmental Impact Assessment	- Submission of the EIA to the relevant administrative departments as part of the review process - Public inquiry as required by the law on impact studies - Public meetings to present the EIA to be scheduled as public meetings or open houses	Commission in charge of public inquiry, Institutional, decentralized authorities, NGO, physical persons affected by the project, Media	Public meetings, Media Advertisement of planning of public inquiry in local media
A4	Installation	Vulgarisation of Grievance Redressal Mechanism (GRM)	Institutional, decentralized authorities, NGO, physical persons	Public meetings, Media

			affected by the project, Media	Advertisement of GRM in local media

Table 33. Communication methods, planning and dissemination of the information within the different phases of Medusa subsea system project.

3.5 Fishermen stakeholders plan

The fishery sector is one of the most significant stakeholders to be taken into account before, during and after the cable installation: on the one hand fishing activity will be restricted in the proximity of the cable route during installation and reparation works, causing a decrease in captures (although this is just for a very limited period of time); on the other hand, once the cable is installed, fishing with mobile gear, such as bottom trawls, beam trawls and dredges can damage the cable, also in relation to the use of large anchors and grapnels used to recover lost gear.

Therefore, as already explained in this document, fishing areas have been taken into account during the determination of the cable route, in order to minimize the interaction with the fishing grounds. However, it is not possible to completely eliminate the risk related to commercial fishing.

A general consultation and communication plan have been drafted for Medusa submarine system project, being conscious of the importance of a positive and productive relationship between the cable owner and commercial fishermen.

Hereafter, the fishing stakeholder plan is detailed.

Pre installation phase

1. Preliminary consultation with the fishery sector:
   - Designation of the person in charge of communicating with the fishery sector. This can be the consultant in charge of permitting in case of good knowledge and relationship with the sector.
   - Organization of a meeting with fishing authorities (or written communication in case it is not granted) of each country/landing involved in the project. During the meeting, a summary of Medusa project is exposed, together with the identified possible areas of conflict with commercial fishing. The potential gap of knowledge about fishing grounds and activities in the area is filled by authorities in this phase, and their concerns about the project arise.
   - Organization of a meeting with commercial fishermen and their unions (or written communication in case it is not granted). During the meeting, a summary of

Medusa project is exposed, together with the identified possible areas of conflict with fishermen. Aspects about concrete interaction between cables and fishing are highlighted and discussed in this phase: prohibition of fishing near the cable route during installation phase, possible damage caused by trawl fishing once the cable is installed, danger of recovering a gear hooked with the cable, etc. The potential gap of knowledge about fishing grounds and activities in the area is filled by fishermen in this phase, and their concerns about the project arise.

2. Analyses of concerns and additional information received by fishing authorities and fishermen unions. Possible changes of cable route are contemplated at this stage.
3. Discussion of economic compensation for fishing days lost during installation works with fishing unions.

Installation phase

1. Distribution of a Notice to Mariners prior to the commencement of the subsea cable installation. The Notice to Mariners should give an indication of the proposed timeframes for subsea installation and an indication of safety zone around the subsea cable lay. This Notice to Mariners should be distributed timeously to fishing companies (no later than 48 hours before the installation) and directly onto vessels where possible. The level of detail set out in these notices shall allow fishermen to identify the timing and location of activities to avoid adverse interaction with the cable installation.
2. Granting of economic compensation for lost days, if necessary, as previously discussed with fishermen unions.

Commissioning phase

1. Publication of the subsea cable routing in nautical charts, which are distributed by the navy hydrographic office.
2. Designation of a Fishery Liaison Manager for the project, to liaise between the cable operator and the fishing industry during the operation of the cable in relation to possible accidents with trawl nets or maintenance and repair periods.
3. Announcement to fishermen of any maintenance, survey or repair activities in advance.
4. Minimization of duration of maintenance and repair activities to reduce the duration of any exclusion for fishing.
5. Notification of new hazards or changes to the cable route after maintenance and repair works.

3.6 Grievance Redressal Mechanism

A Grievance Redress Mechanism (GRM) is a locally based, formalized way to accept, assess, and resolve community feedback or complaints about a project.

The present GRM has the purpose to outline the approach that the promoter of Medusa project will use to accept, assess, resolve and monitor grievances and complaints from the affected stakeholders.

Hereafter, the steps of the GRM planned for Medusa project are briefly described.

The first step of the GRM is the receipt and registration of complaints/grievances, which can be submitted by stakeholders directly during *face to face* meeting with the promoter of Medusa project or a person designed as representative, as well as by sending an email to MEDUSA SLU. A grievance manager will be established by the company and contact details for sending complaints, as well as a grievance form, will be provided at a later stage of the project.

Once the grievance form filled by stakeholders will be received by the grievance manager, the grievance will be added to the database created for the management of grievances. This step of receipt and registration will take a maximum of 2 days.

After the registration of the grievance form, an acknowledgement email will be sent by grievance manager to involved stakeholders to inform that the communication has reached the promoter and it has been taken in charge. The time frame for this operation it is estimated to be a maximum of 4 days.

Then, the investigation phase will start: the complaint will be analyzed more in details by promoter and its significance will be assessed. The stakeholder that has sent the complaint may be contacted by grievance manager in order to clarify possible doubts. Additional stakeholders can be involved in the process to better assess and try to solve the complaint. This step can have a different duration depending on the clarity and the seriousness of the grievance. It is estimated to have a general duration between 10 and 15 days.

Once the complaint is correctly assessed, the promoter will look for a solution to the grievance: mitigation measures will be proposed to the stakeholders, when possible. If the grievance is considered to be invalid by promoter, a full explanation for this will be included in the grievance registration database and will be discussed with the concerned stakeholder. The resolution of the grievance will provisionally take a maximum of 40 days, but this also depends on the gravity of the complaint, so that it cannot be guarantee and can vary case by case.

When an agreement with the stakeholder that has presented the complaint is reached, the grievance can be declared closed. If the agreement is not reached the promoter should go back to the investigation phase and involve additional stakeholders that can clarify the situation.

The following scheme shows the main steps of the GRM described above.

Figure 208. Scheme of the proposed Grievance Redressal Mechanism.

4 Methods Used

4.1 Defining the area of influence

According to the EIB, the area of influence of the project is defined as *"Areas, individuals and communities impacted beyond the footprint of the project or activity by cumulative impacts from further planned development of the project or other sources of similar impacts in the geographical area, any existing project or condition, and other project-related developments that can realistically be expected at the time due diligence is undertaken. In addition to the area of geographical or spatial influence, temporal influence should also be determined."*

For Medusa subsea system the area of influence is composed by: (i) the marine space occupied by the trunk of the cable as well as the different branches, including maritime users of that domain that may be affected by the project; (ii) the terrestrial zone of landing sites, where terrestrial infrastructures such as BMH, border pipe and conduits between them will be placed. As in the case of marine space, the area of influence on landing sites includes also users of these areas.

4.2 Establishing Environmental and Social Baseline

Environmental and social baseline has been established firstly on the base of available bibliographic data from different sources: scientific publications; international, national and regional reports; global, regional and country GIS viewers; etc.

More specific bibliographic data and field data have been presented for those landings for which permitting process has already been started and therefore a higher number of information is currently available on the base of surveys, meetings with stakeholders and documentations already produced in the frame of PIPs. This is the case of Lisbon, Zahara, Torreguadiaro, Barcelona and Marseille landings. The degree of detail in the information presented depend in these cases on the available documents already produced for permitting. Indeed, depending on the country or regional area, documentation required by authorities may vary, in particular in Europe, where submarine fiber optic cables are not subjected to EIA.

4.3 Evaluation of Impact Significance

Submarine cables are linear infrastructures with relatively high deployment speed and small local footprint. The analysis of potential impacts of Medusa submarine cable system has been conducted in this document both for environmental (physical and biological) aspects and for socio-economic aspects.

The impact classification and ranking include:

- The identification of project-related activities during installation, operation and decommissioning phases.
- The identification of the environmental and socio-economic aspects that should be taken into account.
- The determination of potential impacts that the project can have on the identified environmental and socio-economic aspects.
- The assessment and the evaluation of potential impacts (qualitative level) on the base of the following criteria:

Nature	+	Positive: Impacts are considered to improve the baseline condition or introduces new positive factors.

	-	Negative: Impacts result in a negative change of the baseline conditions or introduce new adverse factors
Type	D	Direct: Impacts result from a direct interaction between project activities and baseline conditions
	I	Indirect: Impacts are generated as a result of subsequent interactions with baseline conditions
	C	Cumulative: impacts acting together with others that arise from other projects
Magnitude	L	Low: low degree of incidence of the action on the factor in the affected area.
	M	Moderate: moderate degree of incidence of the action on the factor in the affected area.
	H	High: high degree of incidence of the action on the factor in the affected area.
Influence	L	Local
	R	Regional
	G	Global
Duration	S	Short-term
	M	Medium-term
	L	Long-term
Reversibility	R	Reversible
	I	Irreversible
Probability	L	Low: not occurring under normal conditions
	M	Medium: possibly occurring
	H	High: likely to occur under normal conditions

Table 34. Methodology for the assessment of the project impacts on the environmental and social baseline of the study area.

The evaluation of potential negative impacts on the base of criteria cited above will bring to the assessment of the impact significance, following this classification:

Significance	C	Compatible: immediate recuperation after the activity. Preventive and corrective measures are not necessary
	M	Moderate: recuperation after a short period of time. Preventive and corrective intensive measures are not necessary
	S	Serious: preventive and corrective measures are necessary for the recuperation of initial conditions. The recuperation will take anyway a large period of time
	C	Critic: Permanent loose of the quality of baseline conditions, without any possibility of recuperation, even with preventive and corrective measures.

Table 35. Classification of the significance of environmental and social impacts.

In the case of positive impacts, the significance is evaluated as compatible, moderate, important and very important.

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